ONN POINT
CIVIL ENGINEERING

DRAINAGE STRATEGY

Sustainable Urban Drainage Systems

Prepared by

Rees Wedderburn

Civil Engineer

April 2025

Kemple View, 115 Kemple View, Clitheroe

Project ref: 25-OP-1472	Prepared by: Rees Wedderburn	Client: Wajid Mahmood
Note ref: 100	Date: 30.04.25	

1. Introduction

1.1. Onn Point was commissioned by the client to develop a proposed drainage strategy for the site known as Kemple View, located in Clitheroe.

1.2. This technical note should be read in conjunction with:

a) Proposed Drainage Strategy Layout – 25-OP-1472-A1-100_P01
b) Drainage Construction Details – 25-OP-1472-A1-200_P01
c) Hydraulic Simulation Analysis
d) Maintenance Strategy

2. Development Proposal

2.1. The development proposal comprises of two dwellings along with associated access road and parking.

3. Surface Water Discharge point

3.1. Generally the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable.

a) Into the ground via infiltration techniques
b) To a surface watercourse
c) To a surface water sewer, highway drain, or other drainage systems
d) To a combined sewer

3.2. Infiltration

Due to site constraints, it is not feasible to position a soakaway on the premises. The site is traversed by two existing public sewers, and as such, soakaways cannot be situated within the designated easements.

3.3. Watercourse.

There are no watercourses located in the vicinity of the site; consequently, discharge to any watercourse has been excluded from the design considerations.

3.4. Public Sewer

United Utilities has confirmed their acceptance of a connection to the existing combined sewer that runs through the site, contingent upon S106 compliance.

4. SuDS Assessment

4.1. As part of the surface water drainage strategy for the site a number of Sustainable Drainage Systems (SuDS) have been considered. Below provides a list of the options considered and a justification for the inclusion or omission.

Table 1. SuDS Assessment

SuDS System	Used	Justification
Rainwater Harvesting	No	The use of rainwater harvesting is not considered economically viable on this site considering installation and operational costs.
Green Roofs	No	Green roofs have not been proposed for this site as there is insufficient access to roof areas for maintenance and as such the system could not be effectively maintained to ensure long term performance.
Infiltration Systems	Yes	It is proposed that permeable surfacing be implemented to enable surface water run-off to discharge into the ground at greenfield rates. The use of soakaways have been discounted from the design due to the existing sewer easements running across the site.
Proprietary Treatment Systems	No	The use of proprietary treatment systems is not considered economically viable or required on this site considering installation and operational costs.
Filter Strips	No	Filter strips have not been considered the most effective proposal for this site due to the proposed site layout.
Filter Drains	No	Filter Drains have not been considered the most effective proposal for this site due to the proposed site layout.
Swales	No	Swales are not suitable for this scheme due to available space and proposed land use.
Bioretention Systems	No	Bioretention Systems have not been considered the most effective proposal for this site due to the lack of available landscape areas.
Porous Pavements	Yes	Porous paving should be considered to ensure the site meets necessary SuDS requirements.
Attenuation Storage	No	Due to the lack of impermeable area there is no sufficient need for attenuation.
Detention Basin	No	There is sufficient space for a detention basin on this site
Ponds & Wetlands	No	There is insufficient space for ponds and wetlands on this site.

5. Runoff Rate

5.1. Brownfield sites should seek to discharge surface water from the redeveloped site at Greenfield rates wherever possible. As a minimum, betterment should be offered (in terms of reduced runoff) for all redeveloped sites.

5.2. The site is classed as Brownfield. The Brownfield run-off values have been calculated using the FSR analysis with the aid of a hydraulic modelling software Site3D.

5.3. The calculated runoff rates can be found below in Table 2.

Table 2. Runoff rates

Return Period	Qbar	1-Year	30-Year	100-Year
Existing Brownfield runoff rate	N.A	8.1l/s	19.2l/s	24.4l/s
Proposed runoff rate	l/s	1.451l/s	1.458l/s	1.975l/s

6. Climate Change

6.1. The Flood Risk Assessments: Climate Change Allowances guidance (Published Feb 2016 and last updated May 2022) says that climate change allowances should be used to help minimise vulnerability and provide resilience to flooding.

The proposed development is located within the Ribble Management catchment area and the peak rainfall allowances are outlined in the below table.

Table 3. Climate Change Allowances

Return Period	Climate Change Allowance
30 Year	35%
100 Year	40%

7. Drainage Strategy

7.1. The proposed drainage system will comprise of pipes, rainwater pipes, manholes, porous paving and a flow control chamber

7.2. In accordance with the CIRIA SuDS Manual and the LLFA guidance the proposed drainage system will be discharging via a flow control chamber to an adopted network on an adjacent site. The flow will be restricted to 2 l/s.

7.3. To demonstrate the compliance of the proposed drainage strategy a Hydraulic simulation analysis for the drainage system has been carried out using Site3d.

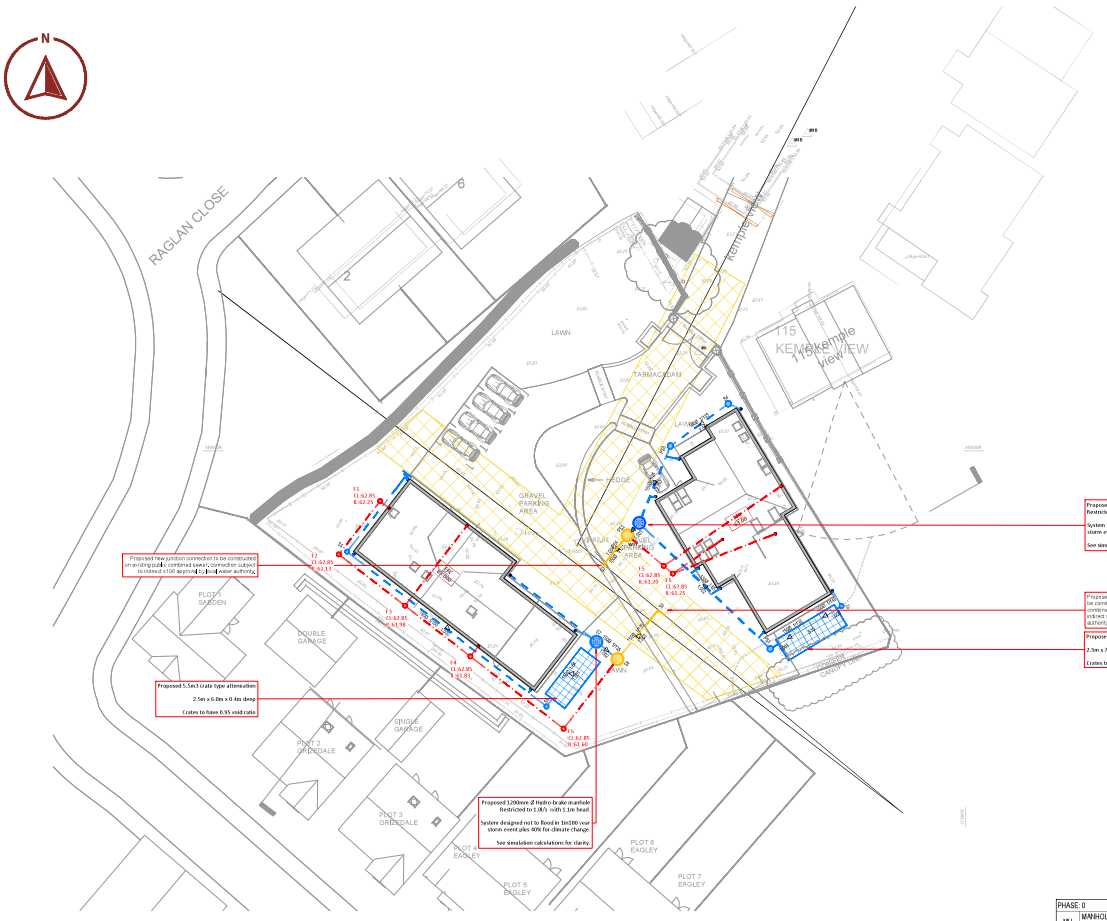
7.4. The proposed drainage strategy layout has been appended within this technical note.

7.5. The drainage construction details have been appended within this technical note.

7.6. The hydraulic simulation analysis results have been appended within this technical note.

7.7. The maintenance strategy has been appended within this technical note.

APPENDIX A – Proposed Drainage Strategy



KEY:

- 450mm (DIA M/H) PRIVATE SURFACE WATER PIPE
- ROOF PIPE
- 1200mm (DIA RPW) SEE SIMULATION CALCULATIONS FOR CLARITY
- 1200mm (DIA RPS) PRIVATE FOUL SEWER. PIPE TO BE 160mm IN DIAMETER AND MANHOLE TO BE POLYTHENE 450mm IN DIAMETER UP TO 1m DEPTH AND 1200mm DIAMETER CONCRETE RINGS GREATER THAN 1m DEPTH OR WITHIN ROAD
- 450mm (DIA MH)

NOTES

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6. ALL ADOPTABLE DRAINAGE TO COMPLY WITH THE REQUIREMENTS OF SFA.
7. ALL MATERIALS, UNLESS SPECIFIED OTHERWISE, SHALL COMPLY WITH THE RELEVANT BRITISH STANDARD. SOURCES OF MATERIALS ARE TO BE AGREED WITH THE EMPLOYER'S TECHNICAL REPRESENTATIVE/ENGINEER IN ADVANCE OF THE WORKS.
8. ANY DISCREPANCIES IN THE DETAILS SHOWN TO BE REPORTED TO THE EMPLOYER'S REPRESENTATIVE/ENGINEER PRIOR TO CONSTRUCTION.
9. LOCATION AND LEVELS OF EXISTING DRAINAGE RUNS ARE BASED UPON SEWER RECORD PLANS AND MUST BE CHECKED ON SITE PRIOR TO THE COMMENCEMENT OF ANY DRAINAGE WORKS.
10. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO THE COMMENCEMENT OF ANY DRAINAGE WORKS WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORKS.
11. ALL ADOPTABLE DRAINAGE AND FITTINGS TO BE F1 JOINTED CLAY WARE TO BS EN295 OR CONCRETE TO BS5911 PART 100. FLEXIBLY JOINTED UPVC PIPES AND FITTINGS TO WIS No. 4-13-05 MAY BE USED FOR PRIVATE BUILDING DRAINAGE SYSTEMS ONLY.
12. TYPICAL PIPE BEDDING TO DRAINAGE WHERE DEPTH TO SOFFIT IS GREATER THAN 600mm IN LANDSCAPED AREAS AND GREATER THAN 1100mm IN ADOPTABLE HIGHWAYS AND 900mm IN OTHER TRAFFICKED AREAS IS TO BE CLASS S BE. 10-14mm GRADED IMPORTED GRANULAR BED AND SURROUND FOR PIPES UP TO 525 Dia AND 20 - 40mm GRADED IMPORTED GRANULAR BED AND SURROUND FOR PIPES GREATER THAN 525 Dia
13. BACKFILL TO DRAINAGE TRENCHES UNDER CARRIAGEWAYS TO BE TYPE 1 SUB-BASE MATERIAL (CLEAN WELL GRADED FILL TO BE FREE DRAINING READILY COMPATIBLE MATERIAL, FREE FROM RUBBISH AND ORGANIC MATTER, FROM N SOIL OR CLAYS AND SILTS, STONES NOT EXCEEDING 75mm IN ANY DIMENSION AND EXCEEDING 150mm THICK.
14. ALL MANHOLE COVERS LOCATED IN TRAFFICKED AREAS ARE DESIGNATED AS HEAVY DUTY AND TO BS EN 124.
15. BACKGROUND PLAN BASED ON TOPOGRAPHIC SURVEY DATA ENCLOSED BY OTHERS AND SUPPLIED FOR THE PURPOSE OF CARRYING OUR ENGINEERING WORKS. WE CANNOT BE HELD RESPONSIBLE FOR THE CONTENT, COMPLETENESS AND ACCURACY PROVIDED TO US BY OTHERS.
16. PROPOSED HOUSING LAYOUT PROVIDED BY CLIENT. LOCATION OF RWP'S AND SVP'S ARE INDICATIVE ONLY AND SHOULD BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION.

PHASE: 0

MH No.	MANHOLE DIMENSION (mm)	COVER LEVEL (m)	INVERT LEVEL (m)	DEPTH TO SOFFIT (m)	EASTING (m)	NORTHING (m)
PS1	600ø	62,774	61,289	1,335	1474,650	1707,988
PS2	1200ø	62,790	61,000	1,640	1481,142	1720,640
PS4	1200ø	62,780	58,130	4,501	1458,738	1719,060
PS5	450ø	62,783	61,365	1,278	1464,271	1728,821
S1	600ø	62,700	61,350	1,200	1481,996	1712,082
S3	1200ø	62,780	58,104	4,526	1457,768	1716,708
S4	450ø	62,880	61,422	1,108	1470,813	1732,865
S5	900ø	62,750	61,847	0,753	1431,028	1717,894
S6	450ø	62,750	61,586	1,014	1451,802	1701,870
S7	1200ø	62,750	61,488	1,112	1456,744	1708,457
S8	1200ø	62,849	57,999	4,500	1458,900	1706,607
S9	1200ø	62,810	57,951	4,510	1465,338	1711,481
S10	450ø	62,379	61,322	0,909	1478,525	1708,985

P01	Initial Issue - Planning	RAW	30.04.25
Rev	Description	By	Date

Status: **FOR PLANNING**

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CLIENT: **WAJID MAHMOOD**

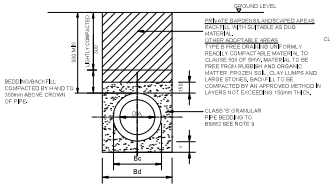
PROJECT: **KEMPLE VIEW, 115 KEMPLE VIEW, CLITHEROE**

DRAWING: **PROPOSED DRAINAGE STRATEGY**

SCALE @ A1	DATE	DRAWN BY	CHECKED BY
1:200	APRIL 25	RAW	RJS

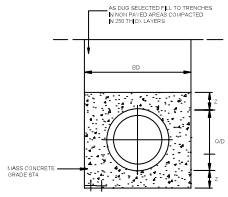
PROJECT NO	DWG NO	REV
25-OP-1472	100	P01

APPENDIX B – Drainage Construction Details



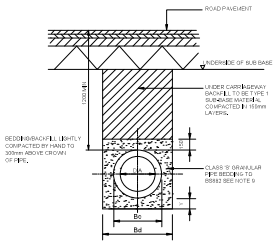
TYPICAL CROSS SECTION THROUGH DRAINAGE TRENCH IN OTHER AREAS

SCALE 1:20



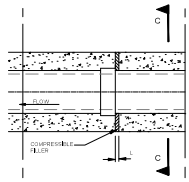
TYPE Z
SECTION C -C

SCALE 1:25



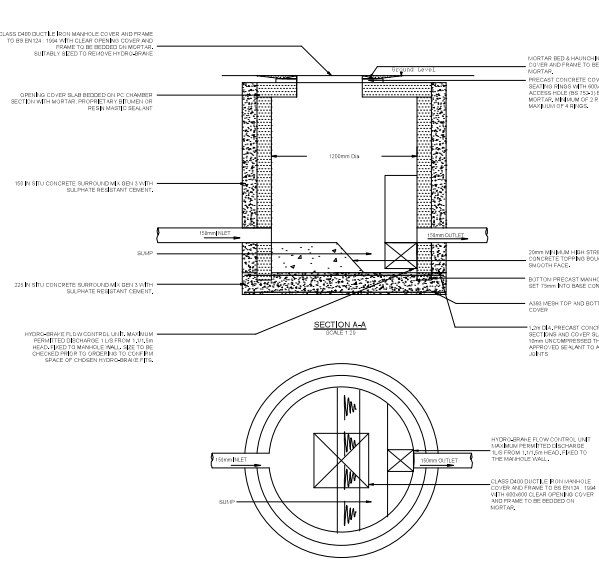
TYPICAL CROSS SECTION THROUGH DRAINAGE TRENCH UNDER CARRIAGEWAY/ADOPTABLE AREAS

SCALE 1:20



TYPE Z -FLEXIBLE JOINT DETAIL CONCRETE BED AND SURROUND

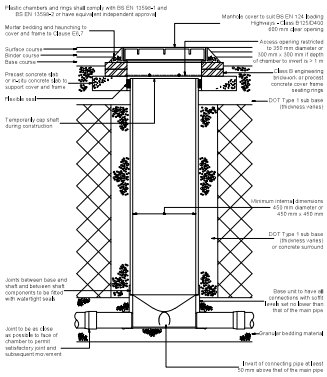
N.T.S



SECTION A-A

SCALE 1:25

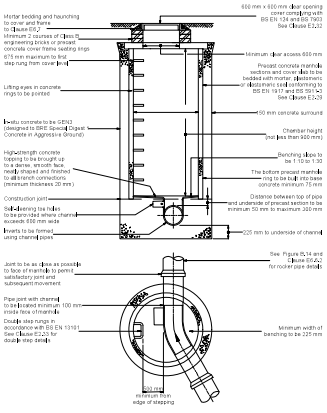
FIGURE B.16
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Flexible material detail)
Maximum depth from cover level to soffit of pipe
in areas subject to vehicle loading 3 m, non-entry



Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE B.2.5
TYPICAL MANHOLE DETAIL - TYPE B
Maximum depth from cover level to soffit of pipe 3.0 m



Not to scale

TABLE A2.1 FOR TRENCHES UNDER CARRIAGEWAY AND IN LANDSCAPED AREAS			
PIPE DIAM. PIPE	TRENCH WIDTH Bd	APPROX. EXT. PIPE DIA. Dc	BEDDING THICKNESS Y
150	550	190	100
225	700	260	100
300	850	340	100
450	1150	575	100
525	1200	670	125
600	1350	770	150
900	1900	1100	185

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9. BACKFILL TO DRAINAGE TRENCHES UNDER CARRIAGEWAYS TO BE TYPE 1 SUB-BASE MATERIAL (SHW804). BACKFILL TO BE FREE DRAINING HEADED, COMPACTED MATERIAL FREE FROM RUBBISH AND ORGANIC MATTER, FROZEN SOIL, CLAY LUMPS AND LARGE STONES. TO BE COMPACTED IN LAYERS NOT EXCEEDING 150mm THICK.
10. A FLEXIBLE JOINT SHALL BE PROVIDED AS CLOSE AS IS PRACTICABLE TO OUTSIDE FACE OF ANY STRUCTURE INTO WHICH A PIPE IS BUILT, COMPATIBLE WITH THE SATISFACTORY COMPLETION AND SUBSEQUENT MOVEMENT OF THE JOINT. THE LENGTH OF THE NEXT PIPE (EXCEPT PIPE AWAY FROM THE STRUCTURE SHALL BE AS SHOWN IN THE TABLE BELOW:

NOMINAL DIAMETER (mm)	EFFECTIVE LENGTH (m)
Up to 450	1.0
515-700	1.2
823 AND OVER	1.25

11. WHERE COVER TO PIPE WORKS IS LESS THAN 600mm IN PRIVATE AREAS CONCRETE BED AND SURROUND IS TO BE USED.
12. PRECAST CONCRETE MANHOLE RINGS MUST NOT BE CUT UNDER ANY CIRCUMSTANCES
13. IN AREAS OF LESS THAU 1.2m COVER, PIPEWORK IS TO HAVE CONCRETE BED AND SURROUND

P01	Initial Issue - Planning	RAW	30.05.25
Rev	Description	By	Date

Status
FOR PLANNING

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CLIENT
WAJID MAHMOOD

PROJECT
KEMPLE VIEW, 115 KEMPLE VIEW, CLITHEROE

DRAWING
DRAINAGE CONSTRUCTION DETAILS

SCALE @ A1	DATE	DRAWN BY	CHECKED BY
NTS	APR 25	RAW	RJS

PROJECT NO.	DWG NO.	REV.
25-OP-1472	200	P01

APPENDIX C – Hydraulic Simulation Analysis

Network Details

Manhole Schedule

Manhole	Catchment Area (ha)	Diameter (m)	Type	CL (m)	IL (m)	Depth To Soffit (m)	Easting (m)	Northing (m)
S5	0.012	0.900	Unknown	62.750	61.847	0.753	1431.028	1717.684
S6	0.008	0.450	Unknown	62.750	61.586	1.014	1451.802	1701.870
S7	0.000	1.200	Unknown	62.750	61.488	1.112	1456.744	1708.457
S8	0.000	1.200	Type A	62.649	57.999	4.500	1458.900	1706.607
S9	0.000	1.200	Type A	62.610	57.951	4.510	1463.336	1711.481

Pipe Schedule

Pipe Number	US Manhole	US IL (m)	DS Manhole	DS IL (m)	Shape	Dimension (m)	Length (m)	Gradient (1:x)	Roughness (mm)	US Depth To Soffit (m)	DS Depth To Soffit (m)
1.000	S5	61.847	S6	61.586	Circ	0.15mØ	26.108	100.0	0.600	0.753	1.014
1.001	S6	61.586	S7	61.488	Circ	0.15mØ	8.234	84.3	0.600	1.014	1.112
1.002	S7	61.488	S8	61.467	Circ	0.15mØ	2.840	135.0	0.600	1.112	1.032
1.003	S8	57.999	S9	57.951	Circ	0.15mØ	6.590	135.0	0.600	4.500	4.510

Outfall Details

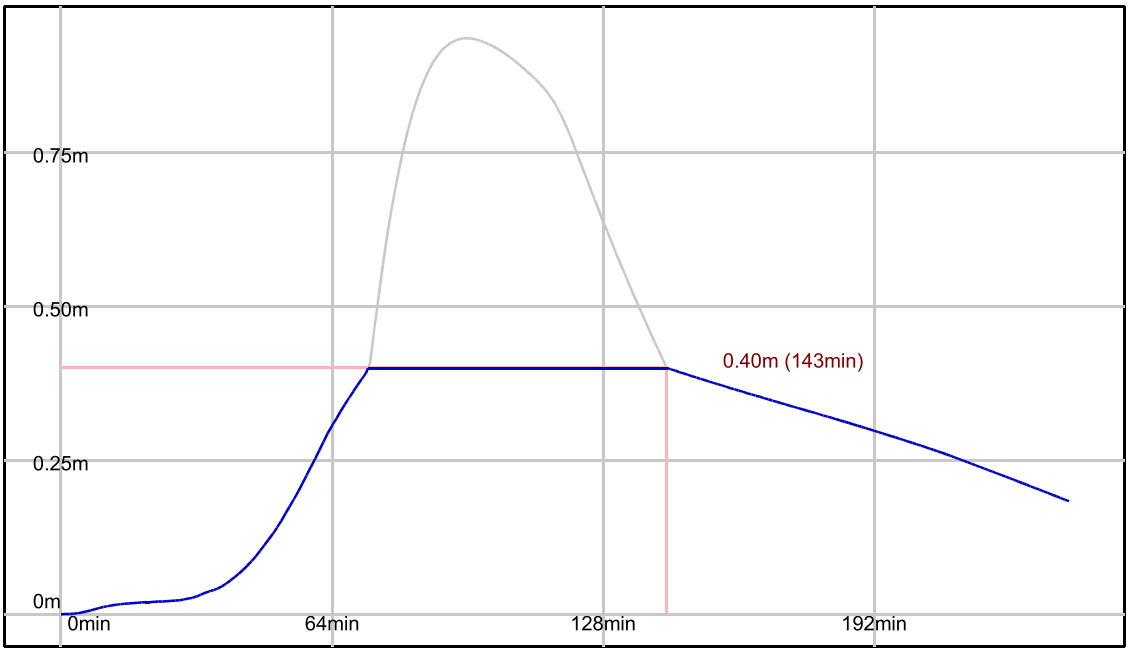
Outfall Manhole S9 : Free Discharge

Flow Control Details

Tank Structure at Manhole S6

Tank Invert (m)	Tank Height (m)	Porosity Ratio (%)	Area (m2)	Effective Area (m2) Area x Porosity Ratio	Max Storage (m3) Effective Area x Height	Infil Base (m/hr)	Infil Side (m/hr)	Safety Factor
61.586	0.400	95.00	15.000	14.250	5.700	0.00000000	0.00000000	2.00

Tank at S6 (100Yr+40% 120Min Winter)

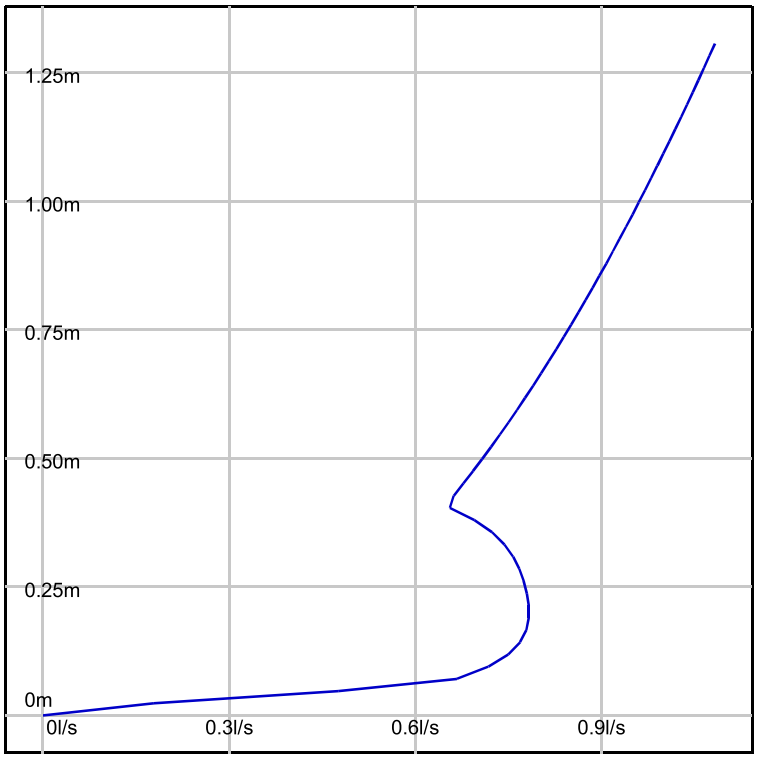


Controls within Manhole S7

Hydro-Brake® Optimum Control at Manhole S7

Model Ref	Design Depth (m)	Design Flow (l/s)	Depth Above Invert (m)	FF Head (m)	FF Flow (l/s)	KF Head (m)	KF Flow (l/s)
SHE-0046-1000-1100-1000	1.100	1.000	0.000	0.200	0.783	0.407	0.648

Hydro-Brake® Optimum Control at S7



Simulation Settings

FSR: M5-60=19.10, R=0.26, Locale=England and Wales

Summer (Cv: 1.00), Winter (Cv: 1.00)

Global Time of Entry: 5.0 mins

Durations (mins): 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160

Return Periods (yrs) + Climate Change: (1, +0%), (10, +0%), (30, +0%), (100, +40%)

Simulated Rainfall Events

Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %	Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %
1Yr 15Min Winter	30.567	0.00	0.00	30Yr 15Min Summer	62.602	0.00	0.00
1Yr 15Min Summer	30.567	0.00	0.00	30Yr 15Min Winter	62.602	0.00	0.00
1Yr 30Min Winter	20.667	0.00	0.00	30Yr 30Min Summer	43.749	0.00	0.00
1Yr 30Min Summer	20.667	0.00	0.00	30Yr 30Min Winter	43.749	0.00	0.00
1Yr 60Min Winter	13.593	0.00	0.00	30Yr 60Min Summer	29.395	0.00	0.00
1Yr 60Min Summer	13.593	0.00	0.00	30Yr 60Min Winter	29.395	0.00	0.00
1Yr 120Min Winter	8.863	0.00	0.00	30Yr 120Min Summer	19.139	0.00	0.00
1Yr 120Min Summer	8.863	0.00	0.00	30Yr 120Min Winter	19.139	0.00	0.00
1Yr 180Min Winter	6.923	0.00	0.00	30Yr 180Min Summer	14.665	0.00	0.00
1Yr 180Min Summer	6.923	0.00	0.00	30Yr 180Min Winter	14.665	0.00	0.00
1Yr 240Min Winter	5.811	0.00	0.00	30Yr 240Min Summer	12.097	0.00	0.00
1Yr 240Min Summer	5.811	0.00	0.00	30Yr 240Min Winter	12.097	0.00	0.00
1Yr 360Min Winter	4.533	0.00	0.00	30Yr 360Min Summer	9.212	0.00	0.00
1Yr 360Min Summer	4.533	0.00	0.00	30Yr 360Min Winter	9.212	0.00	0.00
1Yr 480Min Winter	3.801	0.00	0.00	30Yr 480Min Summer	7.579	0.00	0.00
1Yr 480Min Summer	3.801	0.00	0.00	30Yr 480Min Winter	7.579	0.00	0.00
1Yr 600Min Winter	3.316	0.00	0.00	30Yr 600Min Summer	6.509	0.00	0.00
1Yr 600Min Summer	3.316	0.00	0.00	30Yr 600Min Winter	6.509	0.00	0.00
1Yr 720Min Summer	2.966	0.00	0.00	30Yr 720Min Summer	5.745	0.00	0.00
1Yr 720Min Winter	2.966	0.00	0.00	30Yr 720Min Winter	5.745	0.00	0.00
1Yr 960Min Winter	2.489	0.00	0.00	30Yr 960Min Summer	4.712	0.00	0.00
1Yr 960Min Summer	2.489	0.00	0.00	30Yr 960Min Winter	4.712	0.00	0.00
1Yr 1440Min Summer	1.946	0.00	0.00	30Yr 1440Min Summer	3.557	0.00	0.00
1Yr 1440Min Winter	1.946	0.00	0.00	30Yr 1440Min Winter	3.557	0.00	0.00
1Yr 2160Min Winter	1.523	0.00	0.00	30Yr 2160Min Summer	2.679	0.00	0.00
1Yr 2160Min Summer	1.523	0.00	0.00	30Yr 2160Min Winter	2.679	0.00	0.00
10Yr 15Min Summer	49.662	0.00	0.00	100Yr+40% 15Min Summer	112.960	0.00	0.00
10Yr 15Min Winter	49.662	0.00	0.00	100Yr+40% 15Min Winter	112.960	0.00	0.00
10Yr 30Min Summer	34.337	0.00	0.00	100Yr+40% 30Min Summer	79.869	0.00	2.36
10Yr 30Min Winter	34.337	0.00	0.00	100Yr+40% 30Min Winter	79.869	0.00	2.41
10Yr 60Min Summer	22.913	0.00	0.00	100Yr+40% 60Min Summer	54.074	0.00	3.27
10Yr 60Min Winter	22.913	0.00	0.00	100Yr+40% 60Min Winter	54.074	0.00	3.34
10Yr 120Min Summer	14.925	0.00	0.00	100Yr+40% 120Min Summer	35.187	0.00	0.65
10Yr 120Min Winter	14.925	0.00	0.00	100Yr+40% 120Min Winter	35.187	0.00	0.73
10Yr 180Min Winter	11.507	0.00	0.00	100Yr+40% 180Min Summer	26.781	0.00	0.00
10Yr 180Min Summer	11.507	0.00	0.00	100Yr+40% 180Min Winter	26.781	0.00	0.00
10Yr 240Min Summer	9.546	0.00	0.00	100Yr+40% 240Min Summer	21.955	0.00	0.00
10Yr 240Min Winter	9.546	0.00	0.00	100Yr+40% 240Min Winter	21.955	0.00	0.00
10Yr 360Min Summer	7.326	0.00	0.00	100Yr+40% 360Min Summer	16.576	0.00	0.00
10Yr 360Min Winter	7.326	0.00	0.00	100Yr+40% 360Min Winter	16.576	0.00	0.00
10Yr 480Min Summer	6.065	0.00	0.00	100Yr+40% 480Min Summer	13.547	0.00	0.00
10Yr 480Min Winter	6.065	0.00	0.00	100Yr+40% 480Min Winter	13.547	0.00	0.00
10Yr 600Min Summer	5.235	0.00	0.00	100Yr+40% 600Min Summer	11.570	0.00	0.00
10Yr 600Min Winter	5.235	0.00	0.00	100Yr+40% 600Min Winter	11.570	0.00	0.00
10Yr 720Min Winter	4.640	0.00	0.00	100Yr+40% 720Min Summer	10.162	0.00	0.00
10Yr 720Min Summer	4.640	0.00	0.00	100Yr+40% 720Min Winter	10.162	0.00	0.00
10Yr 960Min Summer	3.834	0.00	0.00	100Yr+40% 960Min Summer	8.269	0.00	0.00
10Yr 960Min Winter	3.834	0.00	0.00	100Yr+40% 960Min Winter	8.269	0.00	0.00
10Yr 1440Min Winter	2.927	0.00	0.00	100Yr+40% 1440Min Summer	6.165	0.00	0.00
10Yr 1440Min Summer	2.927	0.00	0.00	100Yr+40% 1440Min Winter	6.165	0.00	0.00
10Yr 2160Min Summer	2.232	0.00	0.00	100Yr+40% 2160Min Winter	4.580	0.00	0.00
10Yr 2160Min Winter	2.232	0.00	0.00	100Yr+40% 2160Min Summer	4.580	0.00	0.00

Simulation Results

Return Period Yrs: 1.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S5	15 min Summer	9	61.881	0.034	2.003		OK
S6	60 min Summer	39	61.652	0.066	0.850		OK
S7	60 min Summer	42	61.661	0.173	1.815		Surcharged
S8	30 min Summer	23	58.022	0.023	0.770		OK
S9	30 min Winter	24	57.973	0.023	0.767		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	60 min Summer	36	S5	S6	0.043	0.560	1.480	0.083	OK
1.001	60 min Summer	39	S6	S7	0.108	0.309	3.710	0.192	OK
1.002	30 min Summer	22	S7	S8	0.023	0.456	0.770	0.051	OK
1.003	30 min Winter	24	S8	S9	0.023	0.455	0.767	0.050	OK

Return Period Yrs: 10.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S5	15 min Summer	8	61.891	0.044	3.389		OK
S6	120 min Summer	79	61.725	0.139	0.776		OK
S7	60 min Summer	43	61.726	0.238	0.857		Surcharged
S8	120 min Winter	101	58.022	0.023	0.783		OK
S9	120 min Winter	101	57.973	0.023	0.783		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	60 min Summer	40	S5	S6	0.079	0.547	2.498	0.141	OK
1.001	120 min Summer	79	S6	S7	0.145	0.311	1.840	0.095	OK
1.002	240 min Summer	153	S7	S8	0.023	0.458	0.783	0.051	OK
1.003	120 min Winter	101	S8	S9	0.023	0.458	0.783	0.051	OK

Return Period Yrs: 30.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S5	15 min Summer	8	61.896	0.050	4.272		OK
S6	120 min Summer	83	61.792	0.206	0.764		Surcharged
S7	120 min Summer	83	61.792	0.304	0.773		Surcharged
S8	480 min Summer	306	58.022	0.023	0.783		OK
S9	480 min Summer	306	57.973	0.023	0.783		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	60 min Summer	34	S5	S6	0.094	0.507	3.205	0.181	OK
1.001	180 min Winter	105	S6	S7	0.150	0.294	3.005	0.155	Surcharged
1.002	180 min Winter	176	S7	S8	0.023	0.458	0.783	0.051	OK
1.003	480 min Summer	306	S8	S9	0.023	0.458	0.783	0.051	OK

Return Period Yrs: 100.0

Climate Change %: 40

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S5	120 min Winter	96	62.522	0.675	0.566		Flood Risk
S6	120 min Winter	96	62.521	0.936	0.960		Surcharged
S7	120 min Winter	96	62.521	1.033	0.961		Flood Risk
S8	120 min Winter	96	58.025	0.025	0.964		OK
S9	120 min Winter	96	57.976	0.025	0.964		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	60 min Winter	42	S5	S6	0.150	0.498	4.196	0.237	Surcharged
1.001	60 min Winter	27	S6	S7	0.150	0.421	3.984	0.206	Surcharged
1.002	120 min Winter	96	S7	S8	0.025	0.487	0.964	0.063	OK
1.003	120 min Winter	96	S8	S9	0.025	0.487	0.964	0.063	OK

Network Details

Manhole Schedule

Manhole	Catchment Area (ha)	Diameter (m)	Type	CL (m)	IL (m)	Depth To Soffit (m)	Easting (m)	Northing (m)
S1	0.000	0.600	Unknown	62.700	61.350	1.200	1481.996	1712.082
S10	0.000	0.450	Unknown	62.379	61.322	0.906	1478.525	1709.985
PS1	0.011	0.600	Unknown	62.774	61.289	1.335	1474.650	1707.668
S4	0.000	0.450	Unknown	62.680	61.422	1.108	1470.813	1732.885
PS5	0.009	0.450	Unknown	62.793	61.365	1.278	1464.271	1728.821
PS2	0.000	1.200	Type B	62.790	61.000	1.640	1461.142	1720.648
PS4	0.000	1.200	Type A	62.780	58.130	4.501	1459.738	1719.090
S3	0.000	1.200	Type A	62.780	58.104	4.526	1457.768	1716.708

Pipe Schedule

Pipe Number	US Manhole	US IL (m)	DS Manhole	DS IL (m)	Shape	Dimension (m)	Length (m)	Gradient (1:x)	Roughness (mm)	US Depth To Soffit (m)	DS Depth To Soffit (m)
1.000	S1	61.350	S10	61.322	Circ	0.15mØ	4.055	146.3	0.600	1.200	0.906
1.001	S10	61.322	PS1	61.289	Circ	0.15mØ	4.514	135.1	0.600	0.906	1.335
1.002	PS1	61.289	PS2	61.000	Circ	0.15mØ	18.733	64.8	0.600	1.335	1.640
2.000	S4	61.422	PS5	61.365	Circ	0.15mØ	7.701	135.0	0.600	1.108	1.278
2.001	PS5	61.365	PS2	61.000	Circ	0.15mØ	8.751	24.0	0.600	1.278	1.640
1.003	PS2	61.000	PS4	60.984	Circ	0.15mØ	2.098	135.0	0.600	1.640	1.646
1.004	PS4	58.130	S3	58.104	Circ	0.15mØ	3.091	121.4	0.600	4.501	4.526

Outfall Details

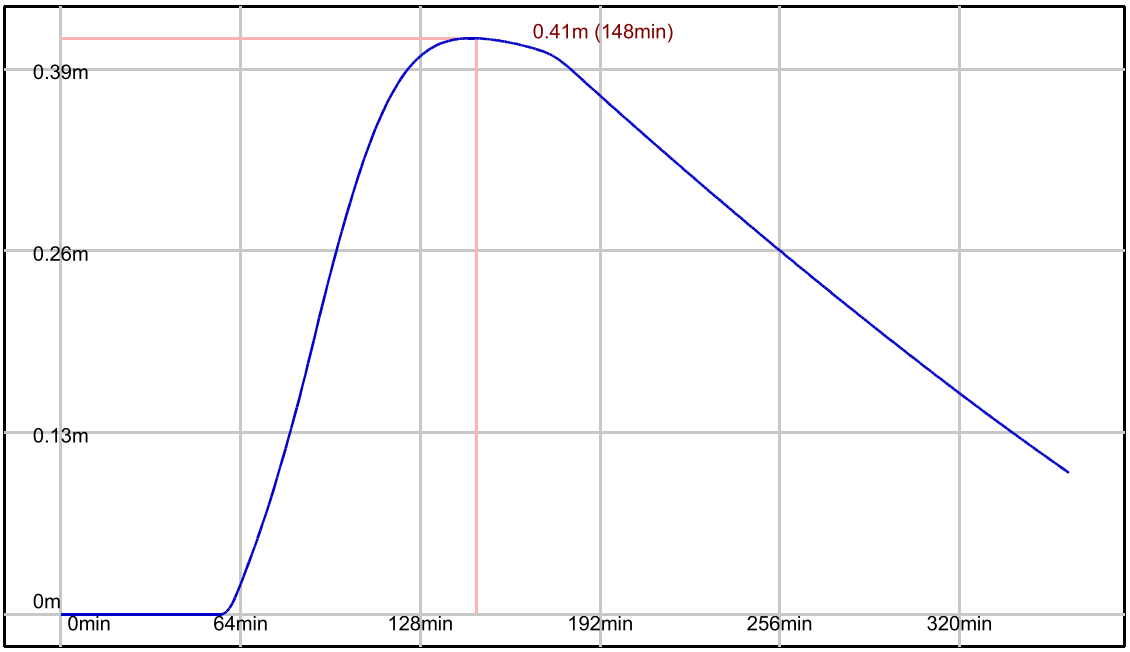
Outfall Manhole S3 : Free Discharge

Flow Control Details

Tank Structure at Manhole S10

Tank Invert (m)	Tank Height (m)	Porosity Ratio (%)	Area (m2)	Effective Area (m2) Area x Porosity Ratio	Max Storage (m3) Effective Area x Height	Infil Base (m/hr)	Infil Side (m/hr)	Safety Factor
61.322	0.800	95.00	17.395	16.526	13.221	0.00000000	0.00000000	2.00

Tank at S10 (100Yr+40% 180Min Winter)

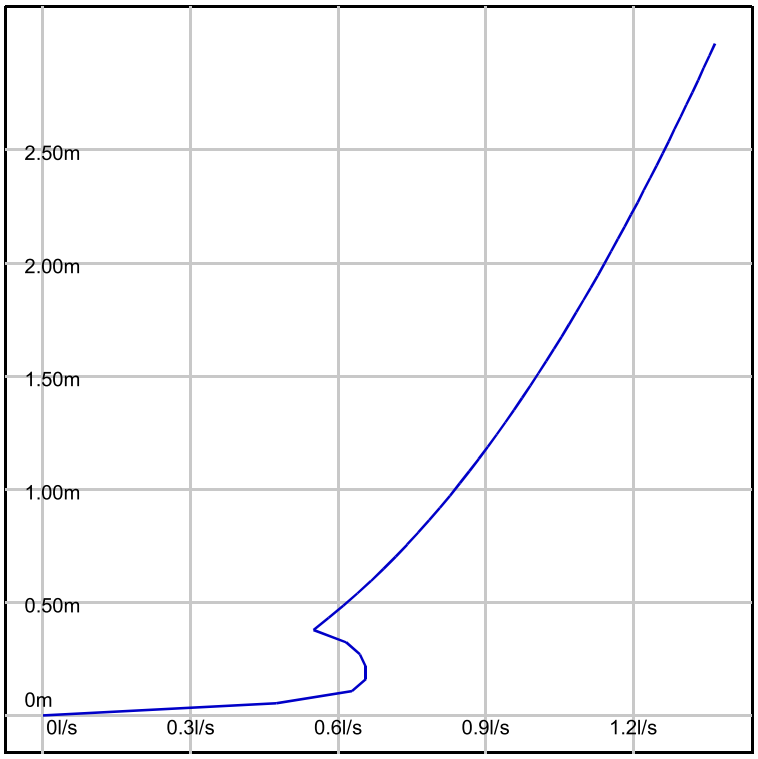


Controls within Manhole PS2

Hydro-Brake® Optimum Control at Manhole PS2

Model Ref	Design Depth (m)	Design Flow (l/s)	Depth Above Invert (m)	FF Head (m)	FF Flow (l/s)	KF Head (m)	KF Flow (l/s)
SHE-0042-1000-1500-1000	1.500	1.000	0.000	0.186	0.659	0.378	0.548

Hydro-Brake® Optimum Control at PS2



Simulation Settings

FSR: M5-60=19.10, R=0.26, Locale=England and Wales

Summer (Cv: 1.00), Winter (Cv: 1.00)

Global Time of Entry: 5.0 mins

Durations (mins): 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160

Return Periods (yrs) + Climate Change: (1, +0%), (10, +0%), (30, +0%), (100, +40%)

Simulated Rainfall Events

Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %	Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %
1Yr 15Min Winter	30.567	0.00	0.00	30Yr 15Min Summer	62.602	0.00	4.09
1Yr 15Min Summer	30.567	0.00	0.00	30Yr 15Min Winter	62.602	0.00	3.16
1Yr 30Min Winter	20.667	0.00	0.00	30Yr 30Min Summer	43.749	0.00	7.26
1Yr 30Min Summer	20.667	0.00	0.00	30Yr 30Min Winter	43.749	0.00	7.28
1Yr 60Min Winter	13.593	0.00	0.00	30Yr 60Min Summer	29.395	0.00	6.31
1Yr 60Min Summer	13.593	0.00	0.00	30Yr 60Min Winter	29.395	0.00	6.36
1Yr 120Min Winter	8.863	0.00	0.00	30Yr 120Min Summer	19.139	0.00	0.00
1Yr 120Min Summer	8.863	0.00	0.00	30Yr 120Min Winter	19.139	0.00	0.00
1Yr 180Min Winter	6.923	0.00	0.00	30Yr 180Min Summer	14.665	0.00	0.00
1Yr 180Min Summer	6.923	0.00	0.00	30Yr 180Min Winter	14.665	0.00	0.00
1Yr 240Min Winter	5.811	0.00	0.00	30Yr 240Min Summer	12.097	0.00	0.00
1Yr 240Min Summer	5.811	0.00	0.00	30Yr 240Min Winter	12.097	0.00	0.00
1Yr 360Min Winter	4.533	0.00	0.00	30Yr 360Min Summer	9.212	0.00	0.00
1Yr 360Min Summer	4.533	0.00	0.00	30Yr 360Min Winter	9.212	0.00	0.00
1Yr 480Min Winter	3.801	0.00	0.00	30Yr 480Min Summer	7.579	0.00	0.00
1Yr 480Min Summer	3.801	0.00	0.00	30Yr 480Min Winter	7.579	0.00	0.00
1Yr 600Min Winter	3.316	0.00	0.00	30Yr 600Min Summer	6.509	0.00	0.00
1Yr 600Min Summer	3.316	0.00	0.00	30Yr 600Min Winter	6.509	0.00	0.00
1Yr 720Min Summer	2.966	0.00	0.00	30Yr 720Min Summer	5.745	0.00	0.00
1Yr 720Min Winter	2.966	0.00	0.00	30Yr 720Min Winter	5.745	0.00	0.00
1Yr 960Min Winter	2.489	0.00	0.00	30Yr 960Min Summer	4.712	0.00	0.00
1Yr 960Min Summer	2.489	0.00	0.00	30Yr 960Min Winter	4.712	0.00	0.00
1Yr 1440Min Summer	1.946	0.00	0.00	30Yr 1440Min Summer	3.557	0.00	0.00
1Yr 1440Min Winter	1.946	0.00	0.00	30Yr 1440Min Winter	3.557	0.00	0.00
1Yr 2160Min Winter	1.523	0.00	0.00	30Yr 2160Min Summer	2.679	0.00	0.00
1Yr 2160Min Summer	1.523	0.00	0.00	30Yr 2160Min Winter	2.679	0.00	0.00
10Yr 15Min Summer	49.662	0.00	0.00	100Yr+40% 15Min Summer	112.960	0.00	7.98
10Yr 15Min Winter	49.662	0.00	0.00	100Yr+40% 15Min Winter	112.960	0.00	7.97
10Yr 30Min Summer	34.337	0.00	0.81	100Yr+40% 30Min Summer	79.869	0.00	8.18
10Yr 30Min Winter	34.337	0.00	0.99	100Yr+40% 30Min Winter	79.869	0.00	8.23
10Yr 60Min Summer	22.913	0.00	4.35	100Yr+40% 60Min Summer	54.074	0.00	8.75
10Yr 60Min Winter	22.913	0.00	4.37	100Yr+40% 60Min Winter	54.074	0.00	8.82
10Yr 120Min Summer	14.925	0.00	0.00	100Yr+40% 120Min Summer	35.187	0.00	5.04
10Yr 120Min Winter	14.925	0.00	0.00	100Yr+40% 120Min Winter	35.187	0.00	5.14
10Yr 180Min Winter	11.507	0.00	0.00	100Yr+40% 180Min Summer	26.781	0.00	2.72
10Yr 180Min Summer	11.507	0.00	0.00	100Yr+40% 180Min Winter	26.781	0.00	2.77
10Yr 240Min Summer	9.546	0.00	0.00	100Yr+40% 240Min Summer	21.955	0.00	0.27
10Yr 240Min Winter	9.546	0.00	0.00	100Yr+40% 240Min Winter	21.955	0.00	0.55
10Yr 360Min Summer	7.326	0.00	0.00	100Yr+40% 360Min Summer	16.576	0.00	0.00
10Yr 360Min Winter	7.326	0.00	0.00	100Yr+40% 360Min Winter	16.576	0.00	0.00
10Yr 480Min Summer	6.065	0.00	0.00	100Yr+40% 480Min Summer	13.547	0.00	0.00
10Yr 480Min Winter	6.065	0.00	0.00	100Yr+40% 480Min Winter	13.547	0.00	0.00
10Yr 600Min Summer	5.235	0.00	0.00	100Yr+40% 600Min Summer	11.570	0.00	0.00
10Yr 600Min Winter	5.235	0.00	0.00	100Yr+40% 600Min Winter	11.570	0.00	0.00
10Yr 720Min Winter	4.640	0.00	0.00	100Yr+40% 720Min Summer	10.162	0.00	0.00
10Yr 720Min Summer	4.640	0.00	0.00	100Yr+40% 720Min Winter	10.162	0.00	0.00
10Yr 960Min Summer	3.834	0.00	0.00	100Yr+40% 960Min Summer	8.269	0.00	0.00
10Yr 960Min Winter	3.834	0.00	0.00	100Yr+40% 960Min Winter	8.269	0.00	0.00
10Yr 1440Min Winter	2.927	0.00	0.00	100Yr+40% 1440Min Summer	6.165	0.00	0.00
10Yr 1440Min Summer	2.927	0.00	0.00	100Yr+40% 1440Min Winter	6.165	0.00	0.00
10Yr 2160Min Summer	2.232	0.00	0.00	100Yr+40% 2160Min Winter	4.580	0.00	0.00
10Yr 2160Min Winter	2.232	0.00	0.00	100Yr+40% 2160Min Summer	4.580	0.00	0.00

Simulation Results

Return Period Yrs: 1.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	-	0	61.350	0.000	0.000		OK
S10	60 min Summer	41	61.346	0.024	0.001		OK
PS1	30 min Winter	19	61.358	0.069	1.325		OK
S4	-	0	61.422	0.000	0.000		OK
PS5	15 min Summer	8	61.387	0.022	1.688		OK
PS2	30 min Summer	18	61.360	0.360	1.488		Surcharged
PS4	480 min Summer	268	58.150	0.021	0.657		OK
S3	480 min Summer	268	58.125	0.021	0.657		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	60 min Summer	41	S1	S10	0.012	0.000	0.000	0.000	OK
1.001	60 min Summer	52	S10	PS1	0.041	0.250	0.332	0.022	OK
1.002	30 min Winter	19	PS1	PS2	0.110	0.399	1.494	0.068	OK
2.000	15 min Summer	8	S4	PS5	0.011	0.000	0.000	0.000	OK
2.001	15 min Summer	8	PS5	PS2	0.086	0.571	1.679	0.046	OK
1.003	480 min Summer	268	PS2	PS4	0.021	0.435	0.657	0.043	OK
1.004	480 min Summer	268	PS4	S3	0.021	0.451	0.657	0.041	OK

Return Period Yrs: 10.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	120 min Summer	85	61.421	0.071	0.000		OK
S10	120 min Summer	85	61.420	0.098	0.007		OK
PS1	120 min Summer	84	61.420	0.132	0.322		OK
S4	-	0	61.422	0.000	0.000		OK
PS5	120 min Summer	85	61.420	0.055	0.251		OK
PS2	120 min Summer	86	61.420	0.420	0.583		Surcharged
PS4	600 min Winter	369	58.150	0.021	0.657		OK
S3	600 min Winter	369	58.125	0.021	0.657		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	120 min Summer	124	S1	S10	0.084	0.025	0.064	0.004	OK
1.001	120 min Summer	158	S10	PS1	0.115	0.283	0.595	0.039	OK
1.002	120 min Summer	84	PS1	PS2	0.141	0.375	1.170	0.053	OK
2.000	120 min Summer	85	S4	PS5	0.028	0.000	0.000	0.000	OK
2.001	120 min Summer	85	PS5	PS2	0.103	0.462	1.438	0.039	OK
1.003	960 min Summer	564	PS2	PS4	0.021	0.435	0.657	0.043	OK
1.004	600 min Winter	369	PS4	S3	0.021	0.451	0.657	0.041	OK

Return Period Yrs: 30.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	120 min Winter	94	61.479	0.129	0.000		OK
S10	120 min Winter	94	61.479	0.157	0.015		Surcharged
PS1	120 min Winter	94	61.479	0.190	0.334		Surcharged
S4	120 min Winter	95	61.479	0.057	0.000		OK
PS5	120 min Winter	95	61.479	0.114	0.265		OK
PS2	120 min Winter	95	61.479	0.479	0.589		Surcharged
PS4	1440 min Summer	813	58.150	0.021	0.657		OK
S3	1440 min Summer	813	58.125	0.021	0.657		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	120 min Winter	123	S1	S10	0.140	0.023	0.043	0.003	OK
1.001	180 min Summer	250	S10	PS1	0.150	0.281	0.579	0.038	Surcharged
1.002	60 min Summer	37	PS1	PS2	0.150	0.436	1.595	0.072	Surcharged
2.000	120 min Winter	119	S4	PS5	0.086	0.010	0.037	0.002	OK
2.001	120 min Winter	95	PS5	PS2	0.132	0.417	1.216	0.033	OK
1.003	1440 min Summer	813	PS2	PS4	0.021	0.435	0.657	0.043	OK
1.004	1440 min Summer	813	PS4	S3	0.021	0.451	0.657	0.041	OK

Return Period Yrs: 100.0

Climate Change %: 40

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	180 min Winter	146	61.734	0.384	0.000		Surcharged
S10	180 min Winter	146	61.734	0.412	0.000		Surcharged
PS1	180 min Winter	146	61.734	0.445	0.397		Surcharged
S4	180 min Winter	146	61.734	0.312	0.000		Surcharged
PS5	180 min Winter	146	61.734	0.369	0.325		Surcharged
PS2	180 min Winter	146	61.734	0.734	0.722		Surcharged
PS4	180 min Winter	147	58.151	0.021	0.721		OK
S3	180 min Winter	147	58.126	0.021	0.721		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Winter	18	S1	S10	0.150	0.011	0.198	0.014	Surcharged
1.001	360 min Winter	548	S10	PS1	0.150	0.281	0.581	0.038	Surcharged
1.002	15 min Winter	9	PS1	PS2	0.150	0.545	3.634	0.165	Surcharged
2.000	60 min Summer	64	S4	PS5	0.150	0.004	0.073	0.005	Surcharged
2.001	30 min Winter	19	PS5	PS2	0.150	0.612	4.097	0.112	Surcharged
1.003	180 min Winter	146	PS2	PS4	0.022	0.447	0.721	0.047	OK
1.004	180 min Winter	147	PS4	S3	0.021	0.464	0.721	0.045	OK

APPENDIX D – Maintenance Strategy

SuDS Maintenance Strategy

KEMPLE VIEW, 115 KEMPLE VIEW, CLITHEROE

1. Responsibility

1.1. The land owner of the proposed development shall be responsible for the maintenance and operation of the drainage system, including any attenuation and flow control devices.

2. Maintenance of Pipe Networks

2.1. Maintenance and management of main storm sewers and chambers inclusive of pipework from paved areas and buildings (but excluding internal building drainage) should be visually inspected and jetted/cleaned as required. As a minimum, this should be carried out every 5 years. Methods of inspection to give indications of blockages may include:

a) CCTV Drainage survey;

b) Flushing/jetting;

c) Measurement of water depths in pipe entries, catchpits or interceptors along a drain run;

d) Pulling a mandrel through the pipe to identify physical faults (e.g. disjointed pipes);

2.2. Gully gratings, manhole gratings and channel gratings shall be visually inspected at least once every year and replaced or re-set if damaged or dislodged. Gullies should be inspected at least once every year, ideally during springtime as the autumn and winter seasons produce the most detritus build up in the form of leaves, litter, and silt. This material should be removed from the channels and disposed of at a licensed tip. This material should not be tipped in other areas of the development as it may pose a pollution threat to the surrounding drainage system.

2.3. Jetting should only be carried out after removal of the silt and debris, as jetting alone will simply wash the debris further downstream without removing the problem.

3. Maintenance of SuDS features

3.1. The regular and correct maintenance of the SuDS features is essential to the continued performance. The SuDS Manual C753 provides advice on the management of the system.

3.2. It should be noted that maintenance regimes detailed below are initial recommendations and the actual maintenance work undertaken should be adapted to suit the system performance by the maintenance provider.

3.3. The recommended maintenance regimes for the surface water drainage, as highlighted in the below table, is given in the SuDS Manual C753 respectively, which will form the basis of the strategy for the provided development.

4. Attenuation Storage Tanks

Table 1. Operation and maintenance requirements for attenuation storage tanks (CIRIA SuDS Manual 2015 Table 21.3)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae, or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and or internal forebays	Annually
Remedial actions	Repair/rehabilitate inlets, outlets, overflows, and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

5. Pervious Pavement

Table 1. Operation and maintenance requirements for pervious pavements (CIRIA SuDS Manual 2015 Table 20.15)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (Standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious

Maintenance schedule	Required action	Typical frequency
		surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually