DO NOT SCALE

FOR CONTINUATION SEE SHEET 13730:500

PROPOSED SURFACE WATER TO DISCHARGE INTO EXISTING SURFACE WATER DRAINAGE NETWORK VIA CONSTRUCTION OF A NEW MANHOLE.

PROPOSED FOUL WATER DRAINAGE TO DISCHARGE INTO EXISTING FOUL DRAINAGE NETWORK VIA CONSTRUCTION OF A NEW MANHOLE

CONTRACTOR SHALL ENSURE EXCAVATIONS INTO EXISTING BANK ARE ADEQUATELY SHORED AND BATTERED BACK TO SAFE ANGLE FROM BASE OF EXCAVATION. CONTRACTOR'S CONSTRUCTION HEALTH & SAFETY PLAN TO INCLUDE METHOD STATEMENT OUTLINING SAFE METHOD OF WORKING.

15.0x10.0x1.5m ATTENUATION TANK TO STORE AND ATTENUATE EXCESS SURFACE WATER FLOWS FOR ALL STORM RETURN PERIODS UP TO AND INCLUDING A 1 IN 100 YEAR DESIGN EVENT WITH AN ADDITIONAL ALLOWANCE FOR 40% FUTURE CLIMATE CHANGE.

DRAINAGE AREA	0.23Ha
TOP OF TANK LEVEL	50.950
BOTTOM OF TANK LEVEL	49.450
100YR +40% STORAGE VOL	201.4m³
100YR +40% WATER LEVEL	50.843
100YR +40% WATER DEPTH	1.393m

MANHOLE TO BE EQUIPPED WITH A HYDROBRAKE FLOW CONTROL DEVICE TO RESTRICT FLOWS TO A MAXIMUM DISCHARGE RATE OF;

100YR +40%	1.4l/s
100YR	1.1l/s
30YR	1.0l/s
1YR	0.9l/s

CONTRACTOR SHALL ENSURE EXCAVATIONS INTO EXISTING BANK ARE ADEQUATELY SHORED AND BATTERED BACK TO SAFE ANGLE FROM BASE OF EXCAVATION. CONTRACTOR'S CONSTRUCTION HEALTH & SAFETY PLAN TO INCLUDE METHOD STATEMENT OUTLINING SAFE METHOD OF WORKING.

CONSTRUCTION WORKS IN CLOSE PROXIMITY TO EXISTING POND. CONTRACTOR'S CONSTRUCTION HEALTH & SAFETY PLAN TO INCLUDE METHOD STATEMENT OUTLINING SAFE METHOD OF WORKING.

POND C

BALANCING POND
TO STORE AND ATTENUATE EXCESS SURFACE WATER FLOWS FOR ALL STORM RETURN PERIODS UP TO AND INCLUDING A 1 IN 100 YEAR DESIGN EVENT WITH AN ADDITIONAL ALLOWANCE FOR 40% FUTURE CLIMATE CHANGE.

DRAINAGE AREA	0.06Ha
TOP OF POND LEVEL	55.800
BOTTOM OF POND LEVEL	54.300
STANDING WATER LEVEL	55.400
100YR +40% STORAGE VOL	16.2m³
100YR +40% WATER LEVEL	55.447
100YR +40% WATER DEPTH	0.047m

MANHOLE TO BE EQUIPPED WITH A HYDROBRAKE FLOW CONTROL DEVICE TO RESTRICT FLOWS TO A MAXIMUM DISCHARGE RATE OF;

100YR +40%	4.0l/s
100YR	3.9l/s
30YR	3.9l/s
1YR	3.8l/s

FILTER DRAIN 78.0 x 0.45 x 0.9m DEEP 150mm DIA. PERFORATED PIPE

FILTER DRAIN 53.8 x 0.45m x 0.9m DEEP 150mm DIA. PERFORATED PIPE

LION ROCK

HOLIDAY INN

DESIGNERS RESIDUAL RISK SCHEDULE

CONSTRUCTION

1. EXISTING SEWERS / DRAINAGE / SERVICES:
   a. Refer to existing services layout (ref: 13730:03) / topographical survey (ref: 6546BW/6) / statutory undertaker's records for location of existing drainage / services & overhead cables.
   b. Works in close proximity to existing sewers / services. Contractor's Construction Health & Safety Plan should include method statement outlining safe method of working agreed with relevant statutory undertaker where necessary.
   c. Works affected by existing services. Contractor should arrange for diversion / lowering / protection by statutory undertaker where necessary prior to commencement of works.

2. EXCAVATIONS & EARTHWORKS
   a. Refer to ground investigation report (ref: RML 5949) for details of underlying soils. Where ground conditions are found to deviate from those reported in the site investigation report, the engineer should be contacted immediately for advice on how to proceed.
   b. Excavations where access is required should be temporary supported with slopes battered well back and maintained at a safe angle.
   c. Contractor's Construction Health & Safety Plan should include method statement outlining safe method of working in or adjacent to deep excavations adjacent to boundaries / structures / embankments / bulk earthworks.
   d. Groundwater may be encountered in excavations. contractor's Construction Health & Safety Plan should include method statement outlining safe method for dewatering excavations during groundworks.

3. WORKS ON OR ADJACENT TO EXISTING CAR PARK
   a. Contractor should ensure site personnel have appropriate training & use appropriate PPE when carrying out works adjacent to the car park and the Construction Health & Safety Plan should include method statement that adopts best practice health and safety policies for all site personnel throughout the duration of the works on / adjacent to existing vehicular routes.

5. CONNECTING TO EXISTING DRAINAGE
   a. Contractor's Construction Health & Safety Plan should include method statement that adopts best practice health and safety policies for all site personnel throughout the duration of such works.
   b. Contractor should ensure site personnel have appropriate training & use appropriate PPE when making connections to existing drainage.

DRAINAGE STRATEGY LEGEND

- Surface water drain
- Foul water drain
- Surface water above ground pipe.
- Surface water inspection chamber
- Foul water inspection chamber
- Surface water catchpit manhole
- Surface water manhole
- Foul water manhole
- Bagwork headwall.
- +57.0 — Spot level taken from NBW planning drawings
- Overland Flow Route

ENGINEERING NOTES

1. This drawing to be read in conjunction with all relevant Architects, Engineers and Subcontractors drawings and details.
2. This drawing is based on topographical survey by On Centre Surveys:
   Drawing Number 6546BW/6
   Dated June 2016
3. All levels relate to levels given on survey drawing.
4. Refer to Architects drawings for details of all soft landscaping, fences, gates & bollards.
5. For lighting, service supplies & ducting requirements, refer to M&E drawings.
6. All works to be carried out in accordance with BS EN 752 "Drain and sewer systems outside buildings" and the current edition of The Building Regulations "Approved document H".
7. New drainage connections are to be made with appropriate lengths of rocker pipes & couplings.
8. All manhole chamber covers to be installed parallel to final kerbs, edgings, paving joints or building lines as appropriate.
9. This drawing details all below ground drainage up to finished floor level. For details of drainage above finished floor level, refer to Architects drawings.
10. All stack connections under buildings to be minimum 100mm diameter solid PVC-U to BS EN 1401-1/BS4660 & laid at a minimum gradient of 1 in 80 unless otherwise noted. If the stack is greater than 100mm then the diameter of the connection is to be increased to match it
11. All RWP connections to be minimum 100mm diameter solid PVC-U to BS EN 1401-1/BS4660 & laid at a minimum gradient of 1 in 80 unless otherwise noted. If the RWP is greater than 100mm then the diameter of the connection is to be increased to match it.
12. All private foul water pipework up to 150mm in diameter to be PVC-U to BS EN 1401-1/BS4660.
13. All private surface water pipework up to 150mm in diameter to be solid PVC-U to BS EN 1401-1/BS4660. All private surface water pipework 225mm and above to be structured wall plastic sewer pipe complying with clause 518 of the specification for highway works.
14. Concrete manholes shall comply with BS EN 1917 and BS 5911-3.
15. Plastic chambers shall comply with BS 7158.
16. On completion of development all drainage shall be jet cleaned and CCTV surveyed.
17. Redundant drainage & services marked to be removed are to be dug out with chambers demolished & void filled with Type 1 material to clause 803 & 806.
18. All existing services shown are based on topographical survey by On Centre Surveys. Location of all services in close proximity to works should be confirmed by means of trial pits under supervision of statutory undertaker & in accordance with HSE document "Avoiding Danger from Underground Services"

P1	FIRST ISSUE	BCT	22.10.21
MK	REVISION	BY	DATE

DRAWING STATUS

FINAL

DRAWING TITLE

DRAINAGE LAYOUT
SHEET 2 OF 2

PROJECT — Project Number 13730

CHESSINGTON WORLD OF ADVENTURES LODGES

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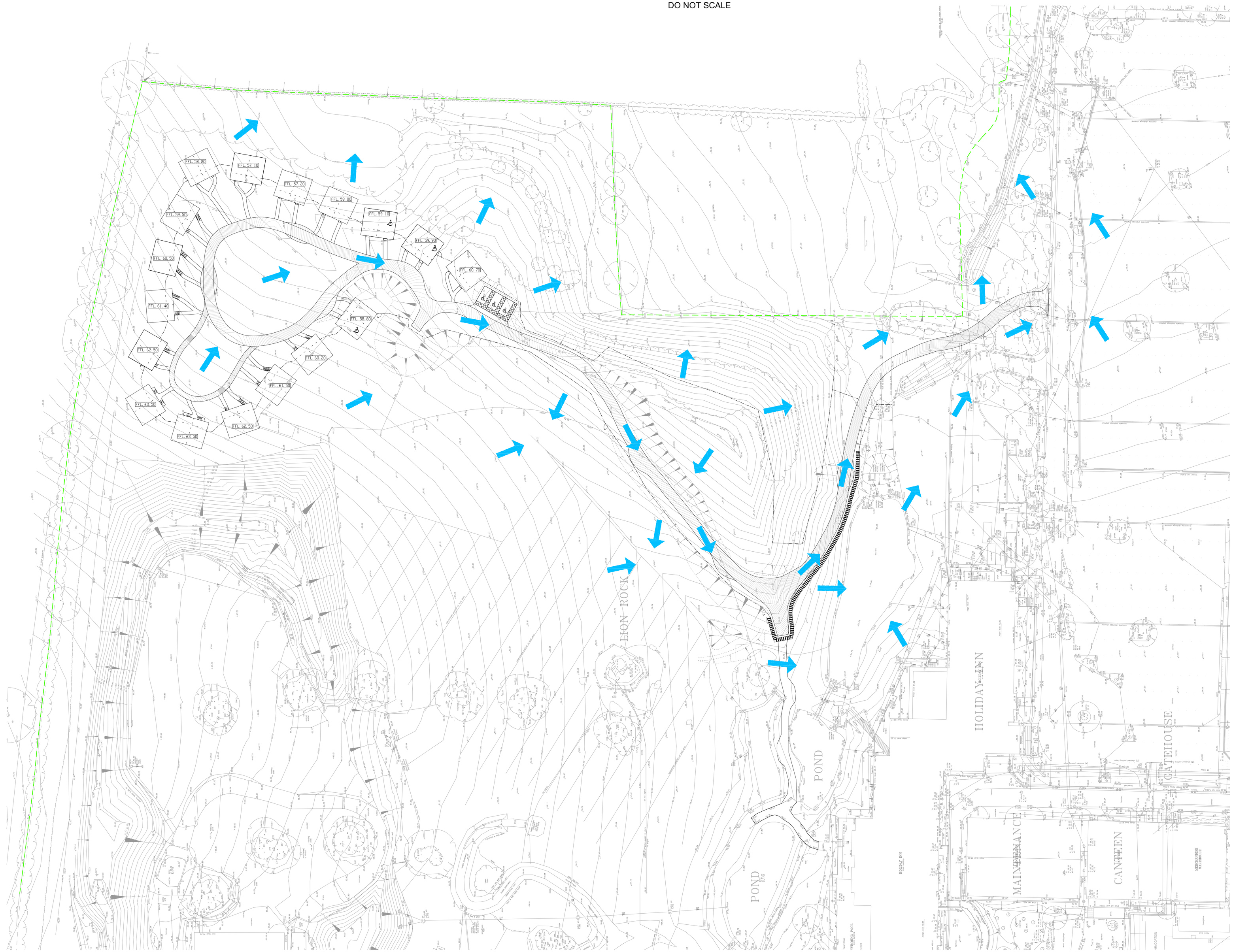
Drawn	Ch'kd	Scales	Date
BCT	MC	1:250 @ A1	OCT '21

Purpose of Issue
DISCHARGE OF CONDITIONS

Drawing Number 13730 : 501 — Revision P1

A1

DO NOT SCALE



LEGEND

Overland Flow Route

P1	FIRST ISSUE	BCT	22.10.21
MK	REVISION	BY	DATE

DRAWING STATUS

FINAL

DRAWING TITLE

OVERLAND EXCEEDANCE FLOW ROUTES

PROJECT

Project Number 13730

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BCT	MC	1:500 @ A1	OCT '21

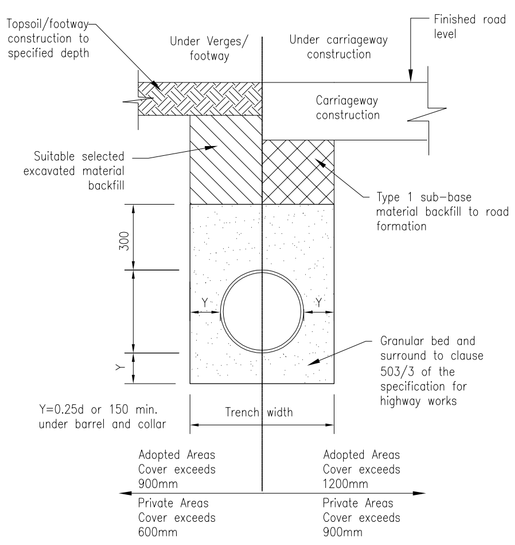
Purpose of Issue

DISCHARGE OF CONDITIONS

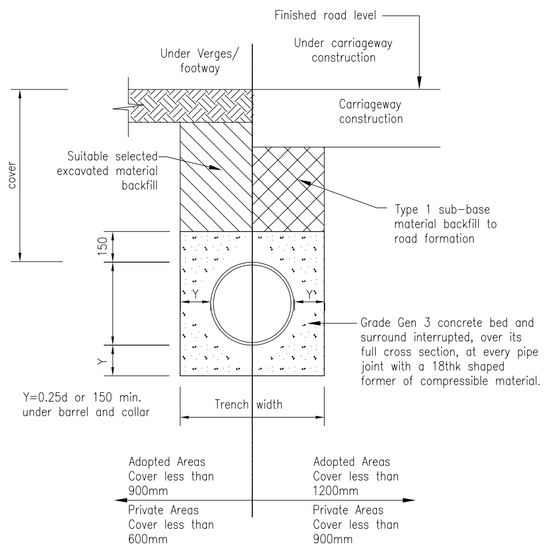
Drawing Number	Revision
13730 : 504	P1

A1

DO NOT SCALE

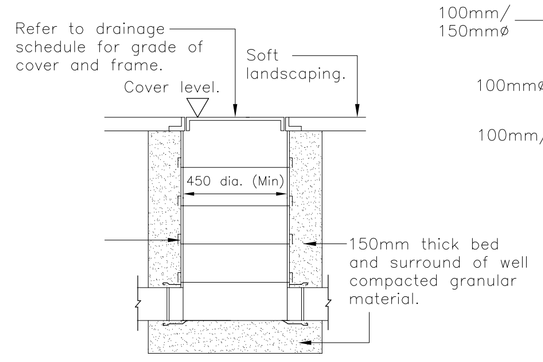


Class S Granular Surround

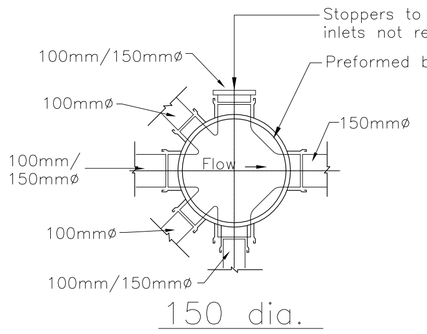


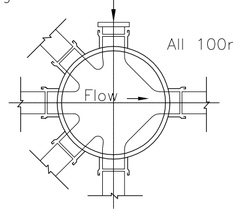
Class Z Concrete surround

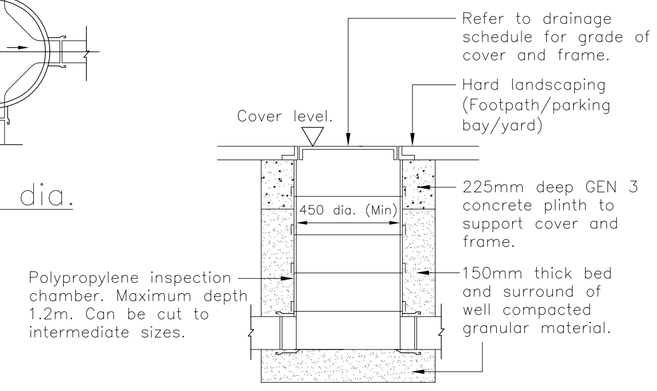
PIPE BEDDING DETAILS



UIC SITED IN SOFT LANDSCAPING





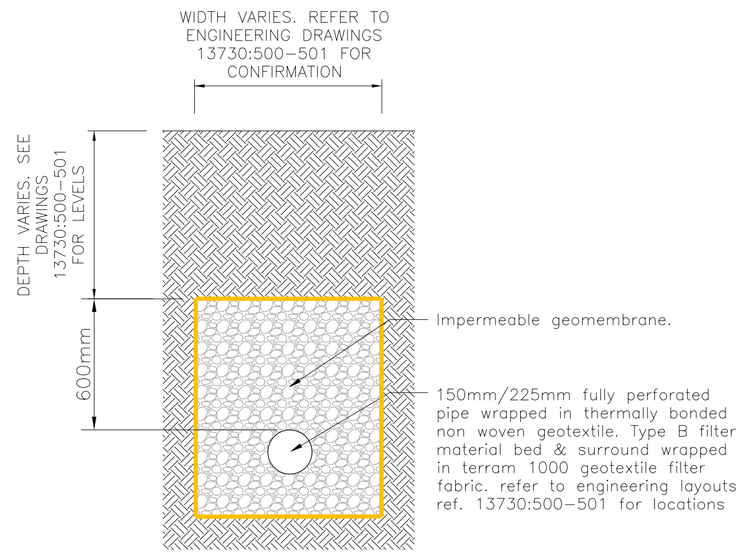


UIC SITED IN HARD LANDSCAPING

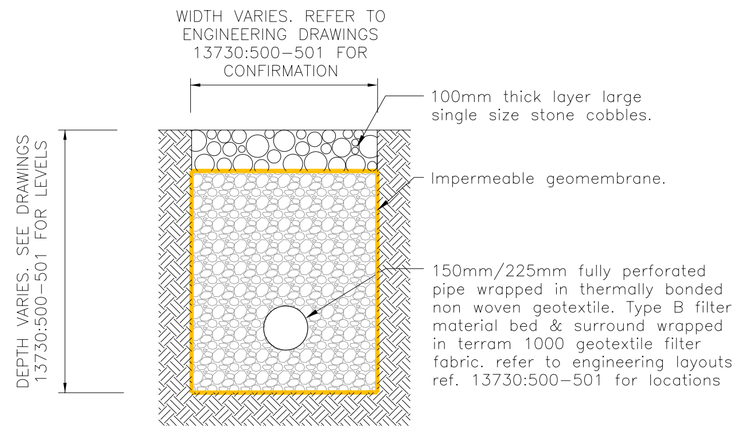
UNIVERSAL INSPECTION CHAMBER (UIC) – POLYPROPYLENE

Max. Depth from cover level to invert of pipe 1.2m

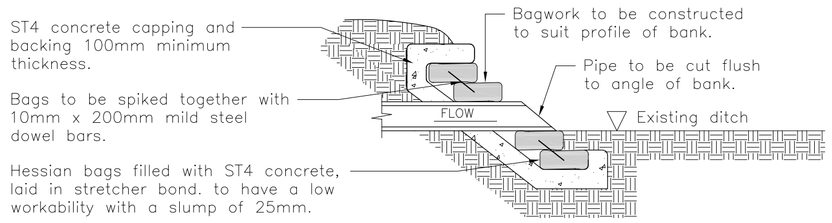
Manhole Diameters	
Diameter of largest pipe in manhole (mm)	Internal diameter of manhole (mm)
Less than 375	1200
375 – 700	1500
750 – 900	1800
Greater than 900	Consult Undertaker



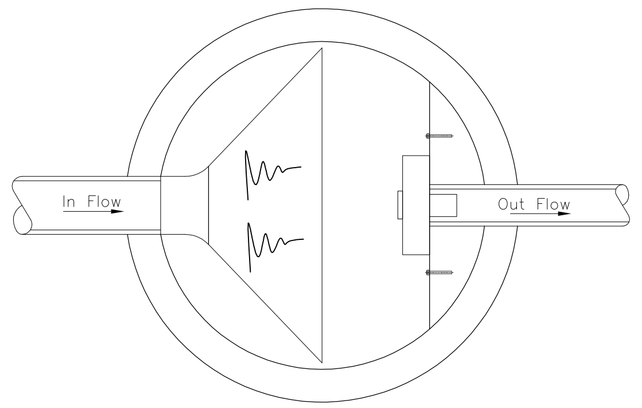
TYPICAL BELOW GROUND FILTER DRAIN DETAIL



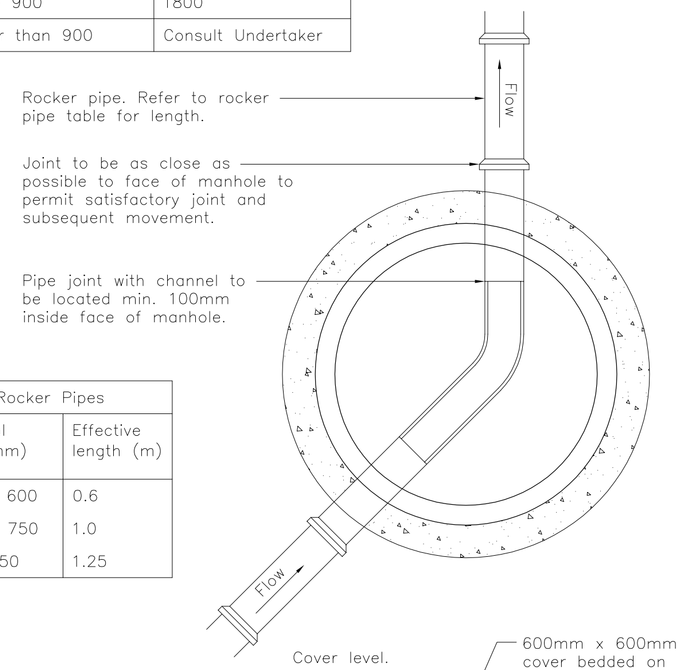
TYPICAL FILTER DRAIN DETAIL



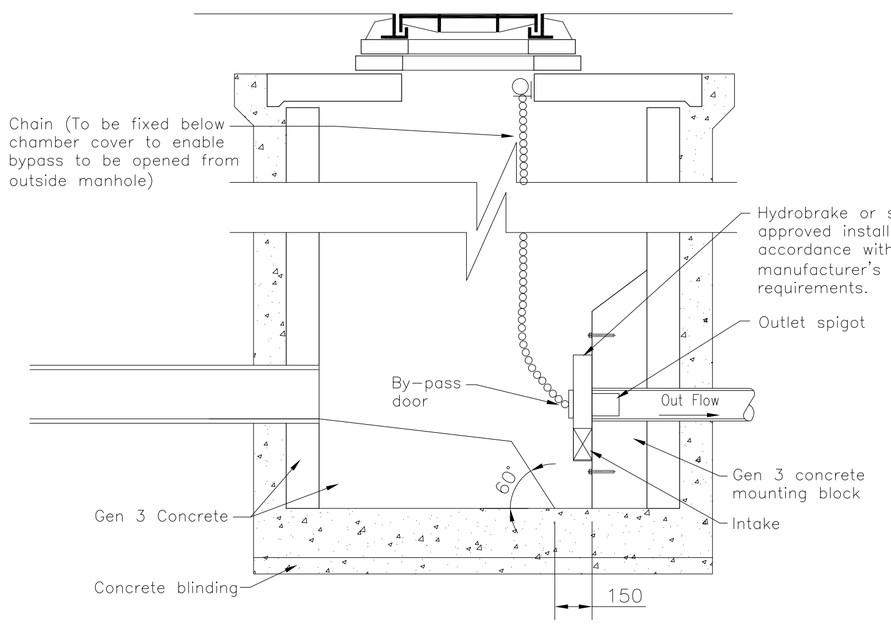
TYPICAL CONCRETE BAG HEADWALL



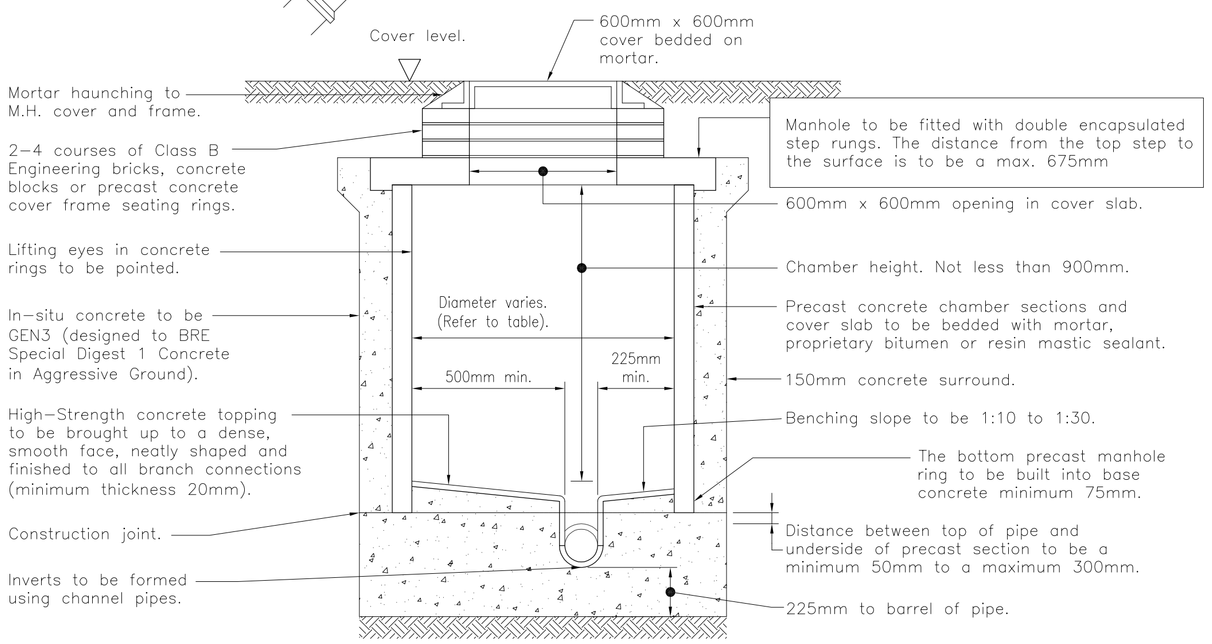
Hydro–Brake Chamber (Plan)



Rocker Pipes	
Nominal dia. (mm)	Effective length (m)
150 – 600	0.6
601 – 750	1.0
Over 750	1.25

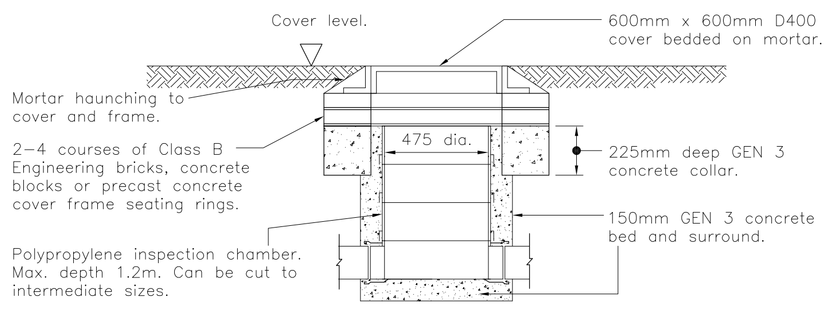


Hydro–Brake Chamber (Section)



MANHOLE – TYPE B

Max. depth from cover level to soffit of pipe 3.0m



POLYPROPYLENE INSPECTION CHAMBER WITH A HEAVY DUTY COVER

Notes:

1. Chamber cover to be positioned directly above by–pass door.
2. Dimensions are indicative only and are dependant on type of control device used. Refer to manufacturer's specifications for details.
3. Refer to Engineering Layouts 13730: 500–501 for details of Hydro–Brakes.
4. For chamber construction details refer to surface water catchpit manhole construction details.

DRAINAGE NOTES

1. This drawing is to be read in conjunction with all relevant architect's, engineers and subcontractors drawings and details.
2. Dimensions not to be scaled.
4. Refer to Architects drawings for details of all paving types & patterns, soft landscaping, fences & gates.
5. All works to be carried out in accordance BS EN 752 "Drain and sewer systems outside buildings" and the current edition of The Building Regulations "Approved document H".
6. New drainage connections are to be made with appropriate lengths of rocker pipes & couplings.
7. All manhole chamber covers to be installed parallel to final kerbs, edgings, paving joints or building lines as appropriate.
9. All stack connections under buildings to be minimum 100mm diameter solid PVC–U to BS EN 1401–1/BS4660 & laid at a minimum gradient of 1 in 80 unless otherwise noted. If the stack is greater than 100mm then the diameter of the connection is to be increased to match it
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13. Plastic chambers shall comply with BS EN 1917 and BS 5911–3.

P1	ISSUED FOR DISCHARGE OF CONDITION 10	BCT	22.10.21
MK	REVISION	BY	DATE

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SUDS DETAILS SHEET 1 OF 2

PROJECT Project Number 13730

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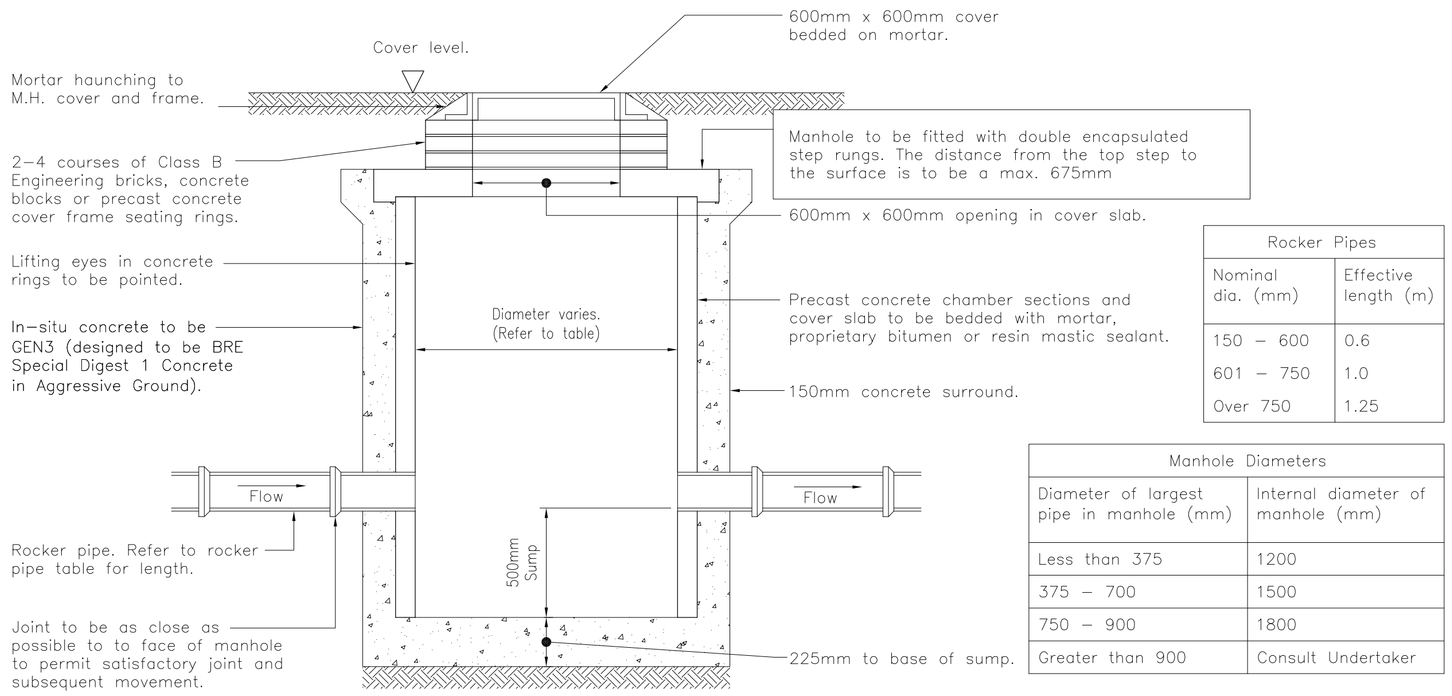
Drawn	Ch'kd	Scales	Date
BCT	MC	SHOWN	OCT '21

Purpose of Issue: DISCHARGE OF CONDITIONS

Drawing Number 13730:505 Revision P1

A1

DO NOT SCALE



Rocker Pipes	
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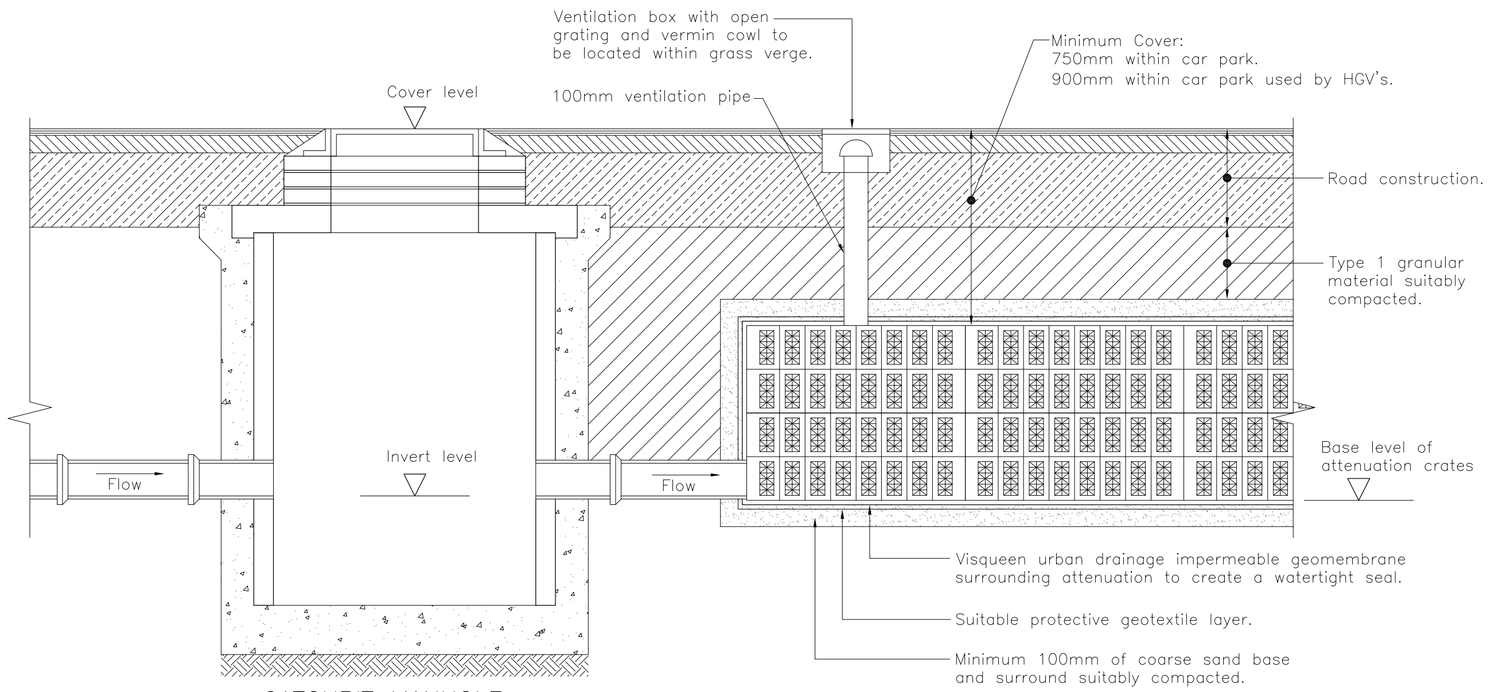
601 – 750	1.0
Over 750	1.25

Manhole Diameters	
Diameter of largest pipe in manhole (mm)	Internal diameter of manhole (mm)
Less than 375	1200
375 – 700	1500
750 – 900	1800
Greater than 900	Consult Undertaker

CATCHPIT MANHOLE



CATCHPIT MANHOLE

GEOCELLULAR ATTENUATION DETAIL

DRAINAGE NOTES

1. This drawing is to be read in conjunction with all relevant architect's, engineers and subcontractors drawings and details.
2. Dimensions not to be scaled.
4. Refer to Architects drawings for details of all paving types & patterns, soft landscaping, fences & gates.
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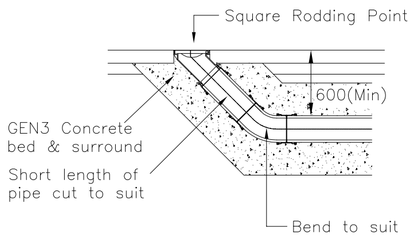
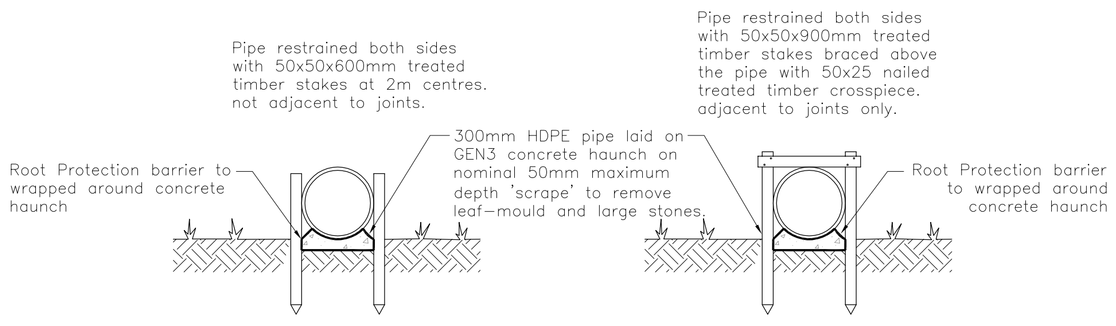
13. Plastic chambers shall comply with BS EN 1917 and BS 5911–3.



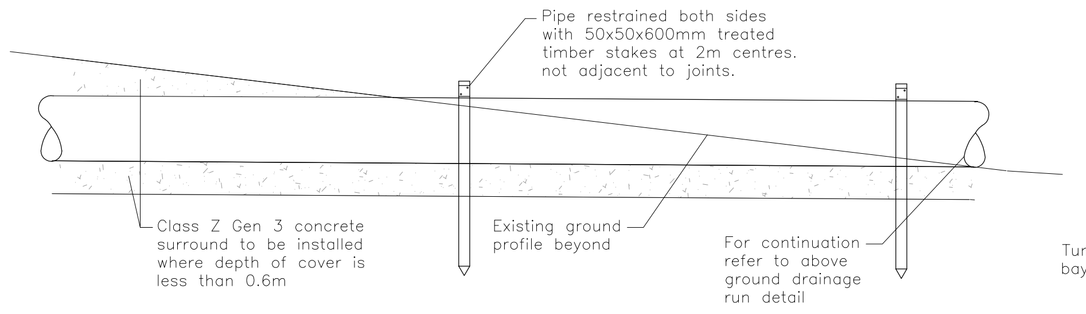
RODDING POINT INSTALLATION DETAILS



ON PIPE RUN AT JOINTS

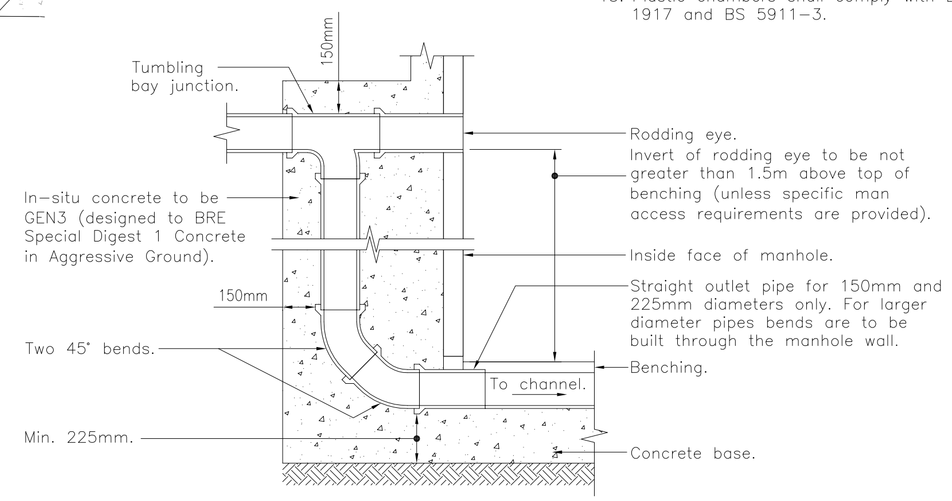
ABOVE GROUND DRAINAGE RUN

SCALE 1:20

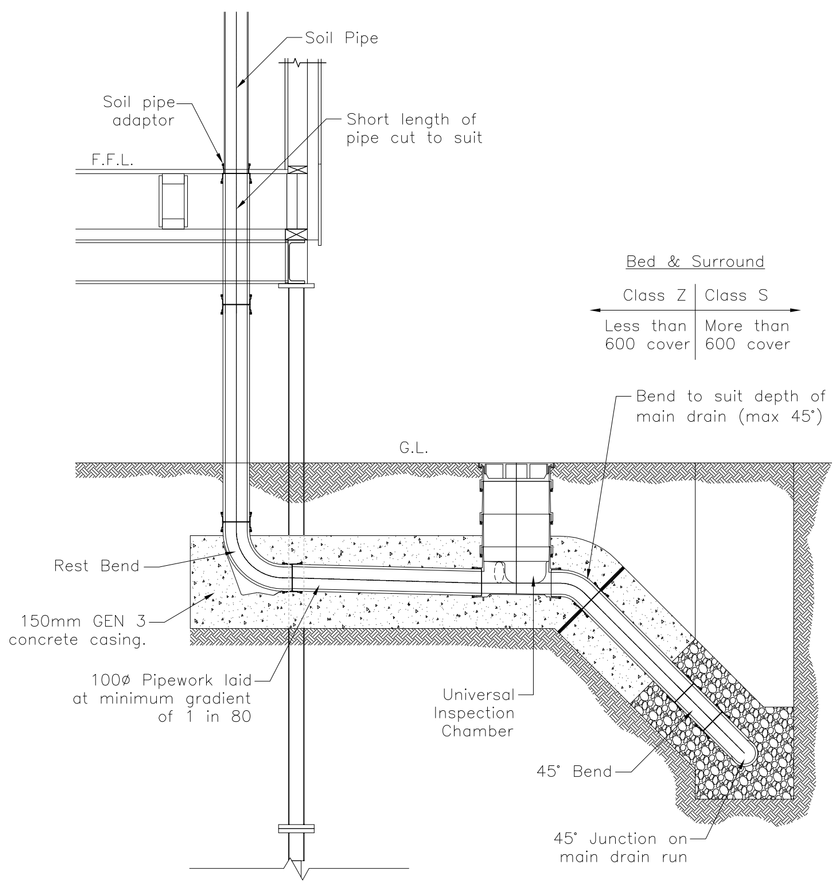


TYPICAL TRANSITION DETAIL BETWEEN BELOW & ABOVE GROUND PIPEWORK

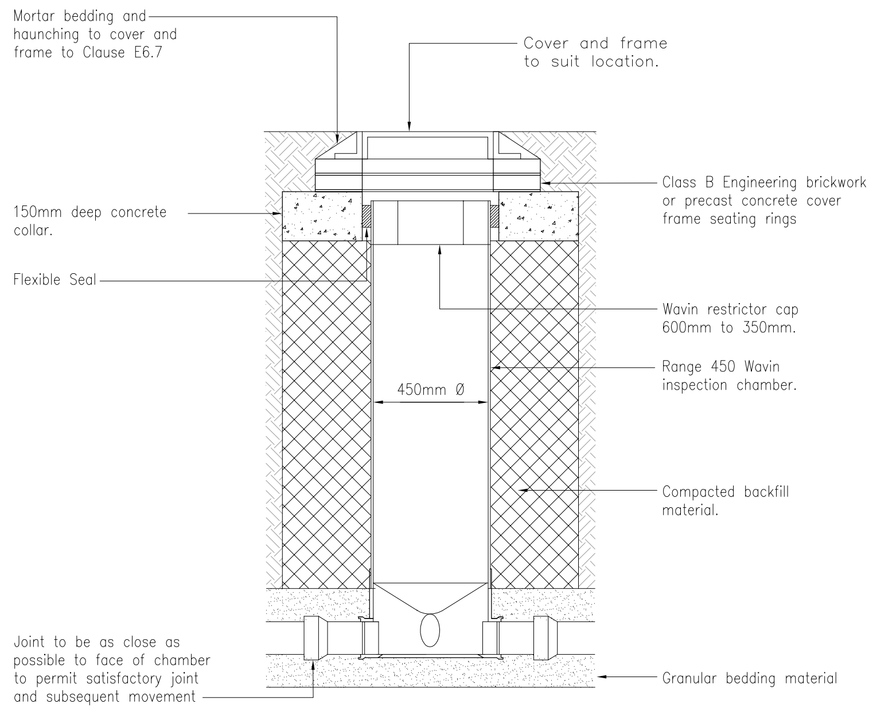
SCALE 1:20



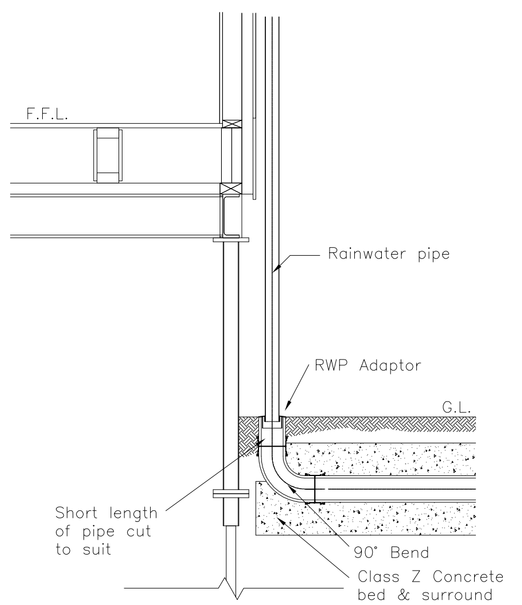
EXTERNAL VERTICAL BACKDROP



TYPICAL SOIL VENT PIPE & SHALLOW ACCESS CHAMBER DETAIL



TYPICAL WAVIN RANGE 450 INSPECTION CHAMBER DETAIL (R450)



TYPICAL EXTERNAL RAINWATER PIPE CONNECTION DETAIL

P1	ISSUED FOR DISCHARGE OF CONDITION 10	BCT	22.10.21
MK	REVISION	BY	DATE

DRAWING STATUS

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SUDS DETAILS SHEET 2 OF 2

PROJECT Project Number 13730

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BCT	MC	SHOWN	OCT '21

Purpose of Issue

DISCHARGE OF CONDITIONS

Drawing Number 13730:506 Revision P1

A1

APPENDIX F
SURFACE WATER DESIGN 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	0.400	Minimum Backdrop Height (m)	0.200
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

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	24.900	0.250	99.6	0.028	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	24.900	0.250	99.6	0.028	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	56.700	2.150	26.4	0.088	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	17.400	0.870	20.0	0.015	4.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	9.400	0.118	79.7	0.015	4.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	53.410	2.100	25.4	0.035	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.600	0.100	96.0	0.000	0.00	0.0	0.600	o	300	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	4.41	59.400	0.028	0.0	0.0	0.0	1.01	17.8	3.8
2.000	50.00	4.41	59.400	0.028	0.0	0.0	0.0	1.01	17.8	3.8
1.001	50.00	4.78	59.100	0.144	0.0	0.0	0.0	2.56	101.7	19.5
3.000	50.00	4.13	59.300	0.015	0.0	0.0	0.0	2.26	40.0	2.0
4.000	50.00	4.14	56.970	0.015	0.0	0.0	0.0	1.13	19.9	2.0
5.000	50.00	4.44	59.100	0.035	0.0	0.0	0.0	2.00	35.4	4.7
1.002	50.00	4.88	56.700	0.209	0.0	0.0	0.0	1.60	113.4	28.3

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
1.003	143.000	2.400	59.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	29.860	2.600	11.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	23.480	2.110	11.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	57.200	2.860	20.0	0.032	4.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	51.230	0.171	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	51.230	0.171	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.003	10.000	0.033	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	78.100	3.800	20.6	0.022	4.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	14.260	1.120	12.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.004	1.085	0.002	500.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.005	16.460	0.206	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.006	53.770	2.920	18.4	0.038	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.007	8.120	2.610	3.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	11.980	0.040	299.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	11.020	0.010	1081.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	14.600	0.290	50.3	0.000	0.00	0.0	0.600	o	375	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)
1.003	50.00	6.05	56.600	0.209	0.0	0.0	0.0	2.04	144.2	28.3
1.004	49.76	6.16	54.200	0.209	0.0	0.0	0.0	4.66	329.7	28.3
1.005	49.44	6.24	51.600	0.209	0.0	0.0	0.0	4.74	335.0	28.3
6.000	50.00	4.27	60.320	0.032	0.0	0.0	0.0	3.53	249.6	4.3
6.001	50.00	5.22	55.870	0.032	0.0	0.0	0.0	0.90	63.8	4.3
6.002	49.73	6.16	55.699	0.032	0.0	0.0	0.0	0.90	63.8	4.3
6.003	49.04	6.35	55.528	0.032	0.0	0.0	0.0	0.90	63.8	4.3
7.000	50.00	4.58	60.320	0.022	0.0	0.0	0.0	2.23	39.4	3.0
7.001	50.00	4.67	56.520	0.022	0.0	0.0	0.0	2.84	50.2	3.0
6.004	48.88	6.39	55.400	0.054	0.0	0.0	0.0	0.44	7.8	7.1
6.005	48.00	6.63	55.380	0.054	0.0	0.0	0.0	1.12	19.9	7.1
6.006	46.70	7.01	55.170	0.092	0.0	0.0	0.0	2.36	41.7	11.6
6.007	46.62	7.03	52.250	0.092	0.0	0.0	0.0	5.76	101.7	11.6
1.006	45.90	7.26	49.490	0.301	0.0	0.0	0.0	0.90	63.8	37.4
1.007	44.85	7.59	49.375	0.301	0.0	0.0	0.0	0.54	59.9	37.4
1.008	44.56	7.69	49.365	0.301	0.0	0.0	0.0	2.56	282.6	37.4

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)
1.008		51.100	49.075	49.150	525	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	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	0.400		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 17, DS/PN: 6.005, Volume (m³): 0.9

Unit Reference	MD-SHE-0103-4000-0400-4000
Design Head (m)	0.400
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	55.380
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.0
Flush-Flo™	0.156	4.0
Kick-Flo®	0.306	3.5
Mean Flow over Head Range	-	3.2

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)
0.100	3.5	1.200	6.7	3.000	10.3	7.000	15.5
0.200	4.0	1.400	7.2	3.500	11.1	7.500	16.1
0.300	3.6	1.600	7.6	4.000	11.8	8.000	16.6
0.400	4.0	1.800	8.1	4.500	12.4	8.500	17.1
0.500	4.4	2.000	8.5	5.000	13.1	9.000	17.6
0.600	4.8	2.200	8.9	5.500	13.7	9.500	18.1
0.800	5.5	2.400	9.2	6.000	14.4		
1.000	6.1	2.600	9.6	6.500	15.0		

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.008, Volume (m³): 5.0

Unit Reference	MD-SHE-0050-1400-1585-1400
Design Head (m)	1.585
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	50
Invert Level (m)	49.365
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.008, Volume (m³): 5.0

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.585	1.4
Flush-Flo™	0.219	1.0
Kick-Flo®	0.446	0.8
Mean Flow over Head Range	-	1.0

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)
0.100	0.9	1.200	1.2	3.000	1.9	7.000	2.8
0.200	1.0	1.400	1.3	3.500	2.0	7.500	2.9
0.300	1.0	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.9	1.800	1.5	4.500	2.3	8.500	3.0
0.500	0.8	2.000	1.6	5.000	2.4	9.000	3.1
0.600	0.9	2.200	1.6	5.500	2.5	9.500	3.2
0.800	1.0	2.400	1.7	6.000	2.6		
1.000	1.1	2.600	1.7	6.500	2.7		

Storage Structures for Storm

Tank or Pond Manhole: 16, DS/PN: 6.004

Invert Level (m) 55.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	60.0	0.200	98.0

Cellular Storage Manhole: 22, DS/PN: 1.008

Invert Level (m) 49.440 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)
0.000	150.0	150.0	1.501	0.0	225.0
1.500	150.0	225.0			

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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					59.450
2.000	2	15 Winter	1	+0%					59.450
1.001	3	15 Winter	1	+0%					59.167
3.000	4	15 Summer	1	+0%					59.324
4.000	5	15 Summer	1	+0%					57.005
5.000	6	15 Winter	1	+0%					59.139
1.002	6	15 Winter	1	+0%	100/15 Summer				56.824
1.003	7	15 Winter	1	+0%					56.691
1.004	8	15 Winter	1	+0%					54.260
1.005	9	15 Winter	1	+0%					51.660
6.000	10	15 Winter	1	+0%					60.349
6.001	11	15 Winter	1	+0%					55.926
6.002	12	15 Winter	1	+0%					55.753
6.003	13	15 Winter	1	+0%					55.587
7.000	14	15 Winter	1	+0%					60.349
7.001	15	15 Winter	1	+0%					56.546
6.004	16	60 Winter	1	+0%					55.447
6.005	17	60 Winter	1	+0%	100/30 Winter				55.445
6.006	18	15 Winter	1	+0%					55.204

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.100	0.000	0.25		4.2	OK	
2.000	2	-0.100	0.000	0.25		4.2	OK	
1.001	3	-0.158	0.000	0.19		18.6	OK	
3.000	4	-0.126	0.000	0.06		2.2	OK	
4.000	5	-0.115	0.000	0.13		2.2	OK	
5.000	6	-0.111	0.000	0.15		5.2	OK	
1.002	6	-0.176	0.000	0.35		28.0	OK	
1.003	7	-0.209	0.000	0.19		26.4	OK	
1.004	8	-0.240	0.000	0.09		26.5	OK	
1.005	9	-0.240	0.000	0.09		26.5	OK	
6.000	10	-0.271	0.000	0.02		4.8	OK	
6.001	11	-0.244	0.000	0.08		4.5	OK	
6.002	12	-0.246	0.000	0.07		4.3	OK	
6.003	13	-0.241	0.000	0.09		4.2	OK	
7.000	14	-0.121	0.000	0.08		3.2	OK	
7.001	15	-0.124	0.000	0.07		3.2	OK	
6.004	16	-0.103	0.000	0.18		1.9	OK	
6.005	17	-0.085	0.000	0.10		1.9	OK	
6.006	18	-0.116	0.000	0.11		4.6	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.007	19	15 Winter	1	+0%					52.272
1.006	20	240 Winter	1	+0%	30/15 Summer				49.672
1.007	21	240 Winter	1	+0%	30/15 Summer				49.671
1.008	22	240 Winter	1	+0%	30/30 Summer				49.671

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.007	19	-0.128	0.000	0.05		4.6	OK	
1.006	20	-0.118	0.000	0.16		8.2	OK	
1.007	21	-0.079	0.000	0.17		8.1	OK	
1.008	22	-0.069	0.000	0.00		0.9	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%					59.484
2.000	2	15 Winter	30	+0%					59.484
1.001	3	15 Winter	30	+0%					59.217
3.000	4	15 Winter	30	+0%					59.338
4.000	5	15 Summer	30	+0%					57.027
5.000	6	15 Winter	30	+0%					59.163
1.002	6	15 Winter	30	+0%	100/15 Summer				56.934
1.003	7	15 Winter	30	+0%					56.757
1.004	8	15 Winter	30	+0%					54.299
1.005	9	15 Winter	30	+0%					51.700
6.000	10	15 Winter	30	+0%					60.363
6.001	11	15 Winter	30	+0%					55.959
6.002	12	15 Winter	30	+0%					55.785
6.003	13	15 Winter	30	+0%					55.622
7.000	14	15 Winter	30	+0%					60.366
7.001	15	15 Winter	30	+0%					56.562
6.004	16	60 Winter	30	+0%					55.506
6.005	17	120 Winter	30	+0%	100/30 Winter				55.513
6.006	18	15 Winter	30	+0%					55.233

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.066	0.000	0.60		10.2	OK	
2.000	2	-0.066	0.000	0.60		10.2	OK	
1.001	3	-0.108	0.000	0.53		52.1	OK	
3.000	4	-0.112	0.000	0.15		5.5	OK	
4.000	5	-0.093	0.000	0.31		5.5	OK	
5.000	6	-0.087	0.000	0.37		12.8	OK	
1.002	6	-0.066	0.000	0.95		75.5	OK	
1.003	7	-0.143	0.000	0.50		70.3	OK	
1.004	8	-0.201	0.000	0.24		70.3	OK	
1.005	9	-0.200	0.000	0.24		70.8	OK	
6.000	10	-0.257	0.000	0.05		11.7	OK	
6.001	11	-0.211	0.000	0.18		11.1	OK	
6.002	12	-0.214	0.000	0.18		10.6	OK	
6.003	13	-0.207	0.000	0.21		10.4	OK	
7.000	14	-0.104	0.000	0.20		7.9	OK	
7.001	15	-0.108	0.000	0.17		7.9	OK	
6.004	16	-0.044	0.000	0.37		4.0	OK	
6.005	17	-0.017	0.000	0.18		3.4	OK	
6.006	18	-0.087	0.000	0.35		14.3	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.007	19	15 Winter	30	+0%					52.291
1.006	20	480 Winter	30	+0%	30/15 Summer				50.127
1.007	21	480 Winter	30	+0%	30/15 Summer				50.126
1.008	22	480 Winter	30	+0%	30/30 Summer				50.126

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.007	19	-0.109	0.000	0.16		14.2	OK	
1.006	20	0.337	0.000	0.21		11.0	SURCHARGED	
1.007	21	0.376	0.000	0.23		10.8	SURCHARGED	
1.008	22	0.386	0.000	0.00		1.0	SURCHARGED	

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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+0%					59.501
2.000	2	15 Winter	100	+0%					59.501
1.001	3	15 Winter	100	+0%					59.239
3.000	4	15 Winter	100	+0%					59.344
4.000	5	15 Summer	100	+0%					57.070
5.000	6	15 Winter	100	+0%					59.173
1.002	6	15 Summer	100	+0%	100/15 Summer				57.046
1.003	7	15 Summer	100	+0%					56.786
1.004	8	15 Winter	100	+0%					54.314
1.005	9	15 Winter	100	+0%					51.714
6.000	10	15 Winter	100	+0%					60.369
6.001	11	15 Winter	100	+0%					55.972
6.002	12	15 Winter	100	+0%					55.798
6.003	13	15 Winter	100	+0%					55.635
7.000	14	15 Winter	100	+0%					60.373
7.001	15	15 Winter	100	+0%					56.568
6.004	16	60 Winter	100	+0%					55.543
6.005	17	120 Winter	100	+0%	100/30 Winter				55.570
6.006	18	15 Winter	100	+0%					55.244

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.049	0.000	0.78		13.2	OK	
2.000	2	-0.049	0.000	0.78		13.2	OK	
1.001	3	-0.086	0.000	0.69		67.1	OK	
3.000	4	-0.106	0.000	0.19		7.1	OK	
4.000	5	-0.050	0.000	0.40		7.0	OK	
5.000	6	-0.077	0.000	0.48		16.6	OK	
1.002	6	0.046	0.000	1.23		97.1	SURCHARGED	
1.003	7	-0.114	0.000	0.63		88.7	OK	
1.004	8	-0.186	0.000	0.30		91.2	OK	
1.005	9	-0.186	0.000	0.31		91.7	OK	
6.000	10	-0.251	0.000	0.06		15.2	OK	
6.001	11	-0.198	0.000	0.24		14.4	OK	
6.002	12	-0.201	0.000	0.23		13.7	OK	
6.003	13	-0.194	0.000	0.27		13.5	OK	
7.000	14	-0.097	0.000	0.27		10.3	OK	
7.001	15	-0.102	0.000	0.22		10.2	OK	
6.004	16	-0.007	0.000	0.39		4.2	OK	
6.005	17	0.040	0.000	0.20		3.8	SURCHARGED	
6.006	18	-0.076	0.000	0.46		18.9	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.007	19	15 Winter	100	+0%					52.297
1.006	20	600 Winter	100	+0%	30/15 Summer				50.377
1.007	21	600 Winter	100	+0%	30/15 Summer				50.377
1.008	22	600 Winter	100	+0%	30/30 Summer				50.376

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.007	19	-0.103	0.000	0.21		18.7	OK	
1.006	20	0.587	0.000	0.23		11.8	SURCHARGED	
1.007	21	0.627	0.000	0.25		11.7	SURCHARGED	
1.008	22	0.636	0.000	0.01		1.1	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

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	24.900	0.250	99.6	0.028	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	24.900	0.250	99.6	0.028	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	56.700	2.150	26.4	0.088	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	17.400	0.870	20.0	0.015	4.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	9.400	0.118	79.7	0.015	4.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	53.410	2.100	25.4	0.035	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.600	0.100	96.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	143.000	2.400	59.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	29.860	2.600	11.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	23.480	2.110	11.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	57.200	2.860	20.0	0.032	4.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	51.230	0.171	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	51.230	0.171	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.003	10.000	0.033	300.0	0.000	0.00	0.0	0.600	o	300	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	4.41	59.400	0.028	0.0	0.0	0.0	1.01	17.8	3.8
2.000	50.00	4.41	59.400	0.028	0.0	0.0	0.0	1.01	17.8	3.8
1.001	50.00	4.78	59.100	0.144	0.0	0.0	0.0	2.56	101.7	19.5
3.000	50.00	4.13	59.300	0.015	0.0	0.0	0.0	2.26	40.0	2.0
4.000	50.00	4.14	56.970	0.015	0.0	0.0	0.0	1.13	19.9	2.0
5.000	50.00	4.44	59.100	0.035	0.0	0.0	0.0	2.00	35.4	4.7
1.002	50.00	4.88	56.700	0.209	0.0	0.0	0.0	1.60	113.4	28.3
1.003	50.00	6.05	56.600	0.209	0.0	0.0	0.0	2.04	144.2	28.3
1.004	49.76	6.16	54.200	0.209	0.0	0.0	0.0	4.66	329.7	28.3
1.005	49.44	6.24	51.600	0.209	0.0	0.0	0.0	4.74	335.0	28.3
6.000	50.00	4.27	60.320	0.032	0.0	0.0	0.0	3.53	249.6	4.3
6.001	50.00	5.22	55.870	0.032	0.0	0.0	0.0	0.90	63.8	4.3
6.002	49.73	6.16	55.699	0.032	0.0	0.0	0.0	0.90	63.8	4.3
6.003	49.04	6.35	55.528	0.032	0.0	0.0	0.0	0.90	63.8	4.3

STORM SEWER DESIGN by the Modified Rational Method

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
7.000	78.100	3.800	20.6	0.022	4.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	14.260	1.120	12.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.004	1.085	0.002	500.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.005	16.460	0.206	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.006	53.770	2.920	18.4	0.038	0.00	0.0	0.600	o	150	Pipe/Conduit	
6.007	8.120	2.610	3.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	11.980	0.040	299.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	11.020	0.010	1081.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	14.600	0.290	50.3	0.000	0.00	0.0	0.600	o	375	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)
7.000	50.00	4.58	60.320	0.022	0.0	0.0	0.0	2.23	39.4	3.0
7.001	50.00	4.67	56.520	0.022	0.0	0.0	0.0	2.84	50.2	3.0
6.004	48.88	6.39	55.400	0.054	0.0	0.0	0.0	0.44	7.8	7.1
6.005	48.00	6.63	55.380	0.054	0.0	0.0	0.0	1.12	19.9	7.1
6.006	46.70	7.01	55.170	0.092	0.0	0.0	0.0	2.36	41.7	11.6
6.007	46.62	7.03	52.250	0.092	0.0	0.0	0.0	5.76	101.7	11.6
1.006	45.90	7.26	49.490	0.301	0.0	0.0	0.0	0.90	63.8	37.4
1.007	44.85	7.59	49.375	0.301	0.0	0.0	0.0	0.54	59.9	37.4
1.008	44.56	7.69	49.365	0.301	0.0	0.0	0.0	2.56	282.6	37.4

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)
1.008		51.100	49.075	49.150	525	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	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	0.400		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 17, DS/PN: 6.005, Volume (m³): 0.9

Unit Reference	MD-SHE-0103-4000-0400-4000
Design Head (m)	0.400
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	55.380
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	4.0
Flush-Flo™	0.156	4.0
Kick-Flo®	0.306	3.5
Mean Flow over Head Range	-	3.2

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)
0.100	3.5	1.200	6.7	3.000	10.3	7.000	15.5
0.200	4.0	1.400	7.2	3.500	11.1	7.500	16.1
0.300	3.6	1.600	7.6	4.000	11.8	8.000	16.6
0.400	4.0	1.800	8.1	4.500	12.4	8.500	17.1
0.500	4.4	2.000	8.5	5.000	13.1	9.000	17.6
0.600	4.8	2.200	8.9	5.500	13.7	9.500	18.1
0.800	5.5	2.400	9.2	6.000	14.4		
1.000	6.1	2.600	9.6	6.500	15.0		

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.008, Volume (m³): 5.0

Unit Reference	MD-SHE-0050-1400-1585-1400
Design Head (m)	1.585
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	50
Invert Level (m)	49.365
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.008, Volume (m³): 5.0

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.585	1.4
Flush-Flo™	0.219	1.0
Kick-Flo®	0.446	0.8
Mean Flow over Head Range	-	1.0

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)
0.100	0.9	1.200	1.2	3.000	1.9	7.000	2.8
0.200	1.0	1.400	1.3	3.500	2.0	7.500	2.9
0.300	1.0	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.9	1.800	1.5	4.500	2.3	8.500	3.0
0.500	0.8	2.000	1.6	5.000	2.4	9.000	3.1
0.600	0.9	2.200	1.6	5.500	2.5	9.500	3.2
0.800	1.0	2.400	1.7	6.000	2.6		
1.000	1.1	2.600	1.7	6.500	2.7		

Storage Structures for Storm

Tank or Pond Manhole: 16, DS/PN: 6.004

Invert Level (m) 55.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	60.0	0.200	98.0

Cellular Storage Manhole: 22, DS/PN: 1.008

Invert Level (m) 49.440 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)
0.000	150.0	150.0	1.501	0.0	225.0
1.500	150.0	225.0			

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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%	100/15 Summer				59.584
2.000	2	15 Winter	100	+40%	100/15 Summer				59.585
1.001	3	15 Winter	100	+40%					59.275
3.000	4	15 Winter	100	+40%					59.353
4.000	5	15 Winter	100	+40%	100/15 Summer				57.221
5.000	6	15 Winter	100	+40%					59.190
1.002	6	15 Winter	100	+40%	100/15 Summer				57.184
1.003	7	15 Winter	100	+40%					56.833
1.004	8	15 Winter	100	+40%					54.337
1.005	9	15 Winter	100	+40%					51.737
6.000	10	15 Winter	100	+40%					60.380
6.001	11	15 Winter	100	+40%					55.993
6.002	12	15 Winter	100	+40%					55.818
6.003	13	15 Winter	100	+40%					55.655
7.000	14	15 Winter	100	+40%					60.384
7.001	15	15 Winter	100	+40%					56.578
6.004	16	60 Winter	100	+40%	100/15 Winter				55.602
6.005	17	120 Summer	100	+40%	100/15 Summer				55.623
6.006	18	15 Winter	100	+40%					55.262

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.034	0.000	1.05		17.8	SURCHARGED	
2.000	2	0.035	0.000	1.05		17.8	SURCHARGED	
1.001	3	-0.050	0.000	0.94		92.1	OK	
3.000	4	-0.097	0.000	0.27		10.0	OK	
4.000	5	0.101	0.000	0.56		9.8	SURCHARGED	
5.000	6	-0.060	0.000	0.67		23.1	OK	
1.002	6	0.184	0.000	1.69		133.6	SURCHARGED	
1.003	7	-0.067	0.000	0.90		126.4	OK	
1.004	8	-0.163	0.000	0.42		127.1	OK	
1.005	9	-0.163	0.000	0.43		127.2	OK	
6.000	10	-0.240	0.000	0.09		21.3	OK	
6.001	11	-0.177	0.000	0.34		20.2	OK	
6.002	12	-0.181	0.000	0.32		19.0	OK	
6.003	13	-0.173	0.000	0.37		18.7	OK	
7.000	14	-0.086	0.000	0.37		14.4	OK	
7.001	15	-0.092	0.000	0.31		14.3	OK	
6.004	16	0.052	0.000	0.40		4.3	SURCHARGED	
6.005	17	0.093	0.000	0.21		3.8	SURCHARGED	
6.006	18	-0.058	0.000	0.66		27.0	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.007	19	15 Winter	100	+40%					52.307
1.006	20	960 Winter	100	+40%	100/15 Summer				50.844
1.007	21	960 Winter	100	+40%	100/15 Summer				50.843
1.008	22	960 Winter	100	+40%	100/15 Summer				50.842

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.007	19	-0.093	0.000	0.30		26.7	OK	
1.006	20	1.054	0.000	0.22		11.6	SURCHARGED	
1.007	21	1.093	0.000	0.24		11.4	SURCHARGED	
1.008	22	1.103	0.000	0.01		1.4	SURCHARGED	

APPENDIX G
SUDS IMPLEMENTATION PLAN

SUDS IMPLEMENTATION PLAN

CHESSINGTON WORLD OF ADVENTURES RESORT

LODGE ACCOMMODATION SCHEME

1.1 This SUDS Implementation Plan sets out measures to be implemented during construction of the surface water drainage system for the scheme to ensure the site and areas downstream are protected from runoff during construction of the development. It is recommended that the plan is incorporated into the Contractor's Construction Health and Safety Plan with the development carried out in accordance with the measures proposed.

1.2 To assist in managing construction runoff and help settle out the high volumes of sediments created during construction, the following additional measures should be implemented to ensure construction runoff is appropriately managed:

- Protective coverings should be used to help prevent runoff stripping material stockpiles.

- Plant and wheel washing should take place in a designated location. The area should be tanked and not allowed to discharge into the drainage system or infiltrate into the ground. Effluent should be treated as contaminated waste and disposed off site by a licensed waste management operator.

- Surfaces used as access roads and storage areas during construction should be swept regularly to prevent the accumulation of dust and mud.

- Should groundwater be encountered in excavations such water should not be discharged to the drainage system until the amount of suspended solids has been reduced though the controlled use of skips or tanks, which will act as stilling basins.

- To prevent contamination associated with the use of oils and hydrocarbons during construction, the Contractor should ensure that the following precautionary measures are employed during construction:

    - Regular maintenance of machinery and plant.

    - Use of drip trays.

    - Regular checking of machinery and plant for oil leaks.

    - Use of correct storage facilities.

    - Regular checks for signs of wear and tear on tanks.

    - Specific procedures are followed when refuelling.

    - Use of a designated area for refuelling.

    - Emergency spill kit to be located near refuelling area.

    - Regular emptying of bunds.

    - Tanks should be located in secure areas to stop vandalism.

1.3 The above measures would help to ensure that untreated construction runoff would not be discharged to the surface water drainage system.

1.4 During construction all components of the drainage system should be constructed in accordance with relevant drawings, specifications and manufacturer's guidelines. Further to this Building Control should visit site on a regular basis to inspect completed works and ensure that the drainage system is installed correctly.

APPENDIX H
SUDS MAINTENANCE PLAN

SUDS MAINTENANCE & MANAGEMENT PLAN

CHESSINGTON WORLD OF ADVENTURES RESORT

LODGE ACCOMMODATION SCHEME

On occupation of the development, this maintenance and management plan should be incorporated into the sites Operation and Maintenance Manual with the as-built drainage system operated and maintained in accordance with the regime set out in the tables below.

The Site Manager should ensure that the Maintenance Contractor tasked with carrying out any maintenance works provides a risk assessment and method statement that adopts best practice health and safety policies for maintenance personnel throughout the duration of any maintenance works. Measures may include:

- Ensure the use of safe systems of work and procedures are followed.
- Certificated operatives only to be used for all confined space entry.
- Ensure appropriate PPE is worn at all times including the use of safety goggles, ear defenders and other relevant equipment when using high pressure jetting.
- Do not work in weather conditions where flooding or surging is likely.
- Erect barriers where appropriate and provide adequate lighting.
- No operations to be carried out by operatives working alone.
- Time maintenance to not conflict with other on-site activities.
- Method statement to be prepared and approved prior to entry into confined space.

Table 1: Below Ground Drainage System - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Remove all litter and debris from external hard landscaped areas and adjacent landscaping, which may pose a risk to the performance of the system.	Monthly.
	Remove build-up of sediment / silt in catch-pits and dispose of oils / petrol residues using safe standard practices.	As required.
	Stabilise and mow adjacent landscaped areas and remove weeds.	
Remedial actions	Repair or rehabilitate inlet and outlets to ensure they are in good condition and operating as designed.	
	Remediate any landscaping, which has raised to within 50mm of the level of adjacent hard landscaping.	
Monitoring	Check of all inlets / outlets for blockages or evidence of physical damage with any necessary remedial action or clearance carried out if required.	On a monthly basis for the first 3 months of operation, thereafter every 6 months & following severe rainfall events.
	Inspect all surfaces for ponding, or silt accumulation. Record areas where water is ponding for more than 48 hours and carry out any remedial work deemed necessary.	After severe storms.

Table 2: Gravel Filter Drains - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal from trench surface, access chambers and pre-treatment devices.	Monthly (or as required).
	Removal and washing of exposed stones on the trench surface.	Annual (bi-annual the first year) or when silt is evident on the surface.
	Trimming of any roots that may be causing blockages.	Annually (semi-annual the first year).
	Remove weeds on the trench surface.	Monthly (at start, then as required)
Occasional Maintenance	Removal of sediment from pre-treatment devices.	Every 6 months.
	Remove tree roots or trees that grow close to the trench.	As required.
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace filter media.	Every 5 years.
Remedial actions	Clear perforated pipework of blockages.	As required.
	Rehabilitate infiltration or filtration surfaces.	
	Excavate trench walls to expose clean soils if infiltration performance reduces to unacceptable levels.	
	Replace geotextiles and clean and replace filter media, if clogging occurs.	
	Inspect inlets, outlets and inspection points for blockages, clogging, standing water and structural damage.	Monthly
Monitoring	Inspect pre-treatment systems, inlets, trench surfaces and perforated pipework for silt accumulation. Establish appropriate silt removal frequencies.	Every 6 months.

Table 3: Geocellular Storage Tanks - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for first 3 months of operation, then every 6 months.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly.
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly / after severe storms.
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial actions	Repair/rehabilitation of inlets, outlet, 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 and after large storms.

Table 4: Detention Basin- Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly.
	Grass cutting for landscaped areas.	Monthly (during growing season), or as required.
	Grass cutting of meadow grass in and around basin.	Every 6 months (spring - before nesting season, and autumn).
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from inlets, outlet.	Annually or as required.
Occasional Maintenance	Re-seed areas of poor vegetation growth.	Annually or as required.
	Prune and trim trees and remove cuttings.	Every 2 years or as required.
	Remove sediment from inlets, outlet and main basin.	3 – 10 years (or as required).
Remedial actions	Repair of erosion or other damage by re-seeding or re-turfing.	As required.
	Repair / rehabilitation of inlets and outlets	
	Re-level uneven surfaces and reinstate design levels.	
Monitoring	Inspect inlets and outlets for blockages, and clear if required.	Monthly (for first year) / then annually or as required.
	Inspect banksides, structures, pipework, etc for evidence of physical damage.	
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Every 6 months.

Table 5: Flow Control Chamber / Non-Return Valves - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Cleaning off the flow control device of any debris/ sediment	As required
Remedial Actions	Flow control device repairs.	As required
	Repair of erosion damage, or damage to chamber.	
Monitoring	Inspection of the chamber for debris and sediment build up.	Monthly for first 3 months, thereafter, every 6 months and following severe storm events.