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BeEV – Reliance Street, Manchester

**Drainage Statement in Support of
Condition 5 Pursuant to Planning
Permission 136359/FO/2023**

Ref: 220698-CON-XX-XX-RP-C-0003

Author: A.Smith

Approved By: A.Marshall

Date: 08 July 2024

Status: S2 – Suitable for Information

Version: 1.1



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1.0 INTRODUCTION

1.1 This statement has been prepared to inform the Local Planning Authority (LPA) and the Lead Local Flood Authority (LLFA) on the design development of the surface water drainage for the development of the proposed Be.EV electric car charging station at Reliance Street, Manchester, M40 3AG

1.2 The site has received planning permission (Ref: 136359/FO/2023) for:

“Change of use of site and creation of an electric forecourt comprising 16 no. electric vehicle charging points (Sui Generis use), with associated canopy/bio-diverse roof structure, erection of single storey retail unit (Use Class E), hard and soft landscaping, access arrangement and other associated infrastructure”.

1.3 A subsequent planning application (Ref: 139860/JO/2024) has been submitted for:

“Variation of Conditions 2 (specified plans), 3 (construction management), 4 (contaminated land), 7 (external plant), 8 (plant verification), 9 (acoustics) and 11 (waste) and removal of condition 16 (green roof) attached to planning permission 136359/FO/2023 to allow for omission of the biodiverse canopy and replacement with individual canopies, reduction in retail/commercial space, reduction in trees, reduction in cycle parking, increased spacing between car parking spaces, new servicing and loading bay, reduction of green space and inclusion of roof-mounted PV arrays”.

1.4 At the time of writing, the subsequent planning application has not been decided.

1.5

2.0 SUMMARY OF PLANNING CONDITION

2.1 Condition 5 of the planning permission for the development states:

Prior to the installation of any drainage associated with the development details of a surface water drainage scheme in accordance with Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards shall be submitted to and approved in writing by the City Council as Local Planning Authority.

The submitted scheme shall include:

- 1. A finalised drainage layout showing all components, discharge rates, outfalls, levels and connectivity;*
- 2. Maximised integration of green SuDS components (utilising infiltration or attenuation) if practicable;*
- 3. An existing and proposed impermeable areas drawing to accompany all discharge rate calculations;*
- 4. Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e. at least a 50% reduction in runoff rate compared to the existing rates with the aim of reducing to the Greenfield runoff rates, as the site is located within Conurbation Core Critical Drainage Area;*
- 5. Evidence that the drainage system has been designed (unless an area is designated to hold and/or convey water as part of the design) so that flooding does not occur during a 1 in 100 year rainfall event with allowance for 45% climate change in any part of a building;*
- 6. Progression through the drainage hierarchy shall be evidence based and supported by site investigation. Results of ground investigation carried out under Building Research Establishment Digest 365. Site investigations should be undertaken in locations and at proposed depths of the proposed infiltration devices. Proposal of the attenuation that is achieving half emptying time within 24 hours. If no ground investigations are possible or infiltration is not feasible on site, evidence of alternative surface water disposal routes (as follows) is required.*
- 7. Where surface water is connected to the public sewer, evidence of an agreement in principle from the Water utilities provider (United Utilities) is required that there is adequate spare capacity in the existing system taking future development requirements into account;*
- 8. Hydraulic calculation of the proposed drainage system;*
- 9. Construction details of flow control and SuDS elements.*
- 10. Management and maintenance plan for the lifetime of the development.*

The development shall subsequently incorporate the approved drainage scheme.

3.0 RESPONSE TO DRAINAGE CONDITION

The following section of this report provides a summary of responses to the planning condition.

3.1 Condition 5 Item 1:

1. *A finalised drainage layout showing all components, discharge rates, outfalls, levels and connectivity;*

3.1.1 A finalised drainage layout for the development is included in Appendix A of this report.

3.2 Condition 5 Item 2

2. *Maximised integration of green SuDS components (utilising infiltration or attenuation) if practicable;*

3.2.1 The site is underlain by Made Ground and Clay subsoils which are not suitable for using infiltration systems.

3.2.2 Therefore, runoff from the site will be attenuated to a restricted rate of 1.0 l/s.

3.2.3 Attenuation storage will be provided within the porous subbase of the site.

3.3 Condition 5 Item 3

3. *An existing and proposed impermeable areas drawing to accompany all discharge rate calculations;*

3.3.1 Existing impermeable area details are summarised below:

- Total Site Area 1369 m²
- Total Existing Impermeable Area 1061 m²
- Percentage Impermeable (PIMP) 77.50 %

3.3.2 Proposed impermeable area plans are included in Appendix B of this report.

3.4 Condition 5 Item 4

4. Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e. at least a 50% reduction in runoff rate compared to the existing rates with the aim of reducing to the Greenfield runoff rates, as the site is located within Conurbation Core Critical Drainage Area;

3.4.1 The figure below shows the calculated brownfield discharge rates for the site

Pre-development discharge

Site Makeup	Brownfield	OK
Brownfield Method	MRM	Cancel
Contributing Area (ha)	0.137	
PIMP (%)	78	
CV	1.000	
Time of Concentration (mins)	5.00	
Betterment (%)	0	
		Calc

Note: FEH point descriptors can be downloaded from fehweb.ceh.ac.uk

Only XML file format can be used

FEH-22 is the current FEH data and this should be used for new development

ReFH2 legacy – Doesn't contain the new BFIHOST19 descriptor
ReFH2 – Contains the new BFIHOST19 descriptor

Return Period (years)	Q (l/s)
1	21.1
10	40.2
30	49.9
100	63.3

Figure 1 - Brownfield discharge rates

3.4.2 The proposed drainage strategy involves restricting the discharge from the site to 1.0 l/s.

3.5 Condition 5 Item 5

5. Evidence that the drainage system has been designed (unless an area is designated to hold and/or convey water as part of the design) so that flooding does not occur during a 1 in 100 year rainfall event with allowance for 45% climate change in any part of a building;

3.5.1 Refer to hydraulic calculations included in Appendix D of this report.

3.6 Condition 5 Item 6

6. *Progression through the drainage hierarchy shall be evidence based and supported by site investigation. Results of ground investigation carried out under Building Research Establishment Digest 365. Site investigations should be undertaken in locations and at proposed depths of the proposed infiltration devices. Proposal of the attenuation that is achieving half emptying time within 24 hours. If no ground investigations are possible or infiltration is not feasible on site, evidence of alternative surface water disposal routes (as follows) is required.*

3.6.1 The Building Regulations (H3) and the NPPG set out the following hierarchy for discharging surface water runoff from a development in order of preference:

- Collection for reuse in the development;
- Infiltration into the ground;
- Discharge into a watercourse;
- Discharge into a surface water sewer;
- Discharge into a combined water sewer

3.6.2 The proposed development intends to integrate a rainwater harvesting system into the development and reuse some of the captured runoff within the site. The rainwater harvesting will not capture all runoff from all storm scenarios and therefore an outfall for surface water will still be required.

3.6.3 As described previously, the site is underlain by Made Ground and Clay subsoils which are not suitable for using infiltration systems. Therefore, this method of disposal is not suitable.

3.6.4 There are no watercourses within the vicinity of the site. Therefore, this method of disposal is not suitable.

3.6.5 There are no surface water sewers within the vicinity of the site. Therefore, this method of disposal is not suitable.

3.6.6 There are combined water sewers within the vicinity of the site. This will be the targeted form of disposing runoff from the development.

3.7 Condition 5 Item 7

- 7. Where surface water is connected to the public sewer, evidence of an agreement in principle from the Water utilities provider (United Utilities) is required that there is adequate spare capacity in the existing system taking future development requirements into account;*

- 3.7.1 Discharge to the existing sewer network to be approved under Section 106 Agreement with United Utilities. Application to be submitted by contractor.

3.8 Condition 5 Item 8

- 8. Hydraulic calculation of the proposed drainage system;*

- 3.8.1 Refer to hydraulic calculations included in Appendix D of this report.

3.9 Condition 5 Item 9

- 9. Construction details of flow control and SuDS elements.*

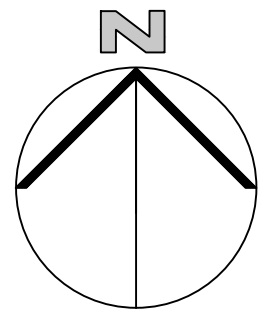
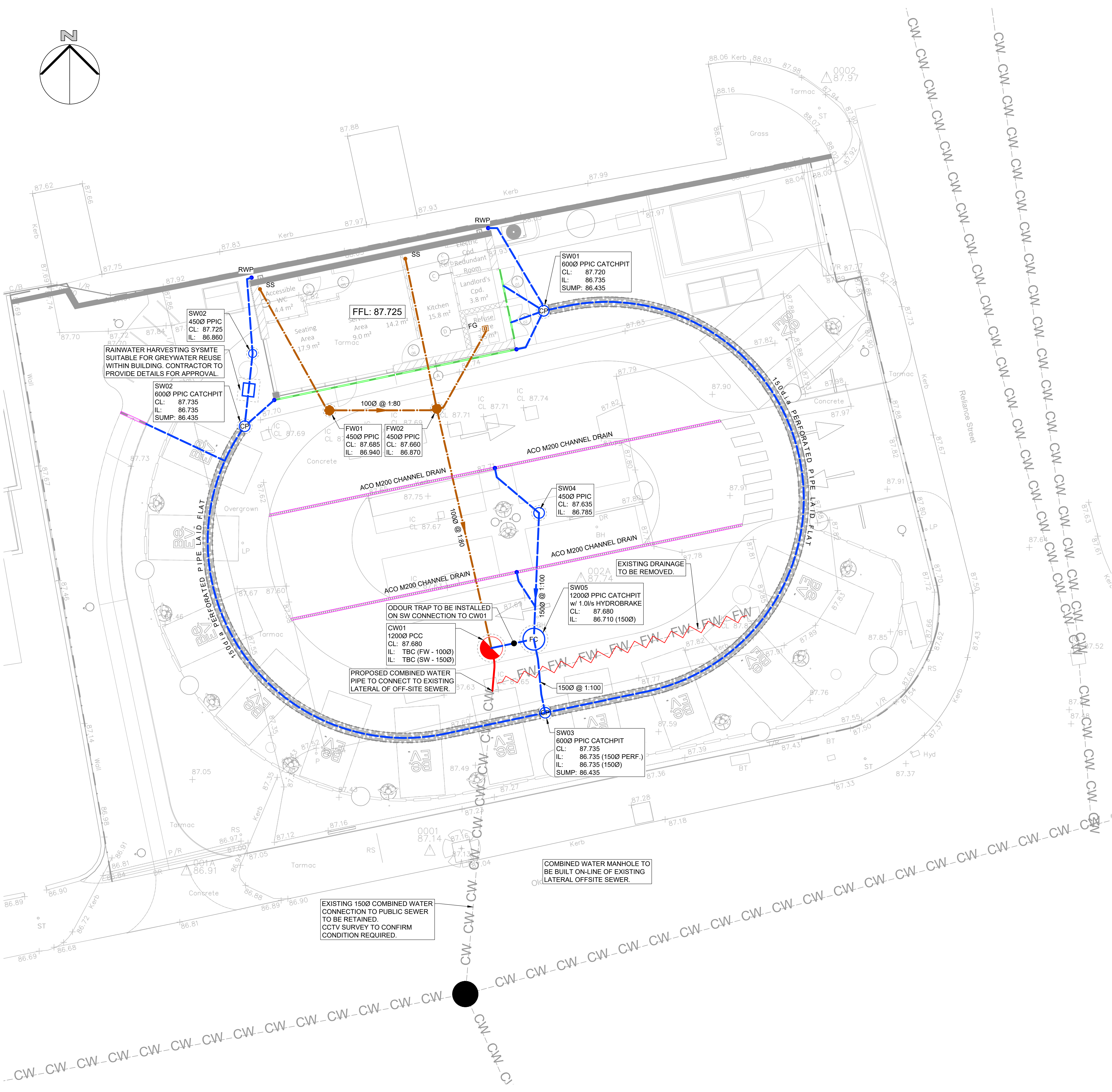
- 3.9.1 Refer to the drainage construction details included in Appendix C of this report.

3.10 Condition 5 Item 10

- 10. Management and maintenance plan for the lifetime of the development.*

- 3.10.1 Management & maintenance to be carried out in accordance with document 220698-CON-ZZ-XX-RP-C-0002 approved as part of the planning application.

APPENDIX A – DRAINAGE GENERAL ARRANGEMENT



- LEGEND**
- SW --- SW --- EXISTING SURFACE SEWER
 - CW --- CW --- EXISTING COMBINED SEWER
 - FW --- FW --- EXISTING FOUL SEWER
 - EXISTING SEWER TO BE ABANDONED
 - PROPOSED PERFORATED PIPE
 - PROPOSED SURFACE WATER SEWER
 - PROPOSED FOUL WATER SEWER
 - PROPOSED SURFACE WATER MANHOLES
 - PROPOSED CATCHPIT MANHOLE
 - PROPOSED COMBINED WATER MANHOLE
 - PROPOSED FOUL WATER MANHOLES
 - EXISTING ADOPTED MANHOLE
 - RWP --- PROPOSED RAINWATER DOWNPIPE
 - RG --- PROPOSED ROAD GULLY
 - SVP --- PROPOSED SOIL VENT PIPE / STUB STACK
 - FG --- PROPOSED FLOOR GULLY
 - PROPOSED CHANNEL DRAIN
 - PROPOSED THRESHOLD DRAIN
 - FFL + 12.00 --- PROPOSED FINISHED FLOOR LEVEL

- GENERAL DRAINAGE NOTES**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
 - DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.
 - INVERT LEVELS AND POSITIONS OF EXISTING DRAINS / CHAMBERS / SEWERS WHERE NEW CONNECTIONS ARE TO BE MADE MUST BE CHECKED AND CONFIRMED TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF ANY WORKS.
 - ALL DRAINAGE SHALL COMPLY WITH THE TYPICAL DETAILS AND THE REQUIREMENTS OF BS EN 752 AND PART H OF THE BUILDING REGULATIONS.
 - ANY PART OF THE EXISTING DRAINAGE SYSTEM TO BE RETAINED AS PART OF THE NEW SCHEME SHALL BE CLEANED AND INSPECTED. ANY STRUCTURAL DEFECTS SHALL BE REPAIRED USING APPROPRIATE AND APPROVED MEANS
 - FOR SETTING-OUT DIMENSIONS OF SVP'S, RWP'S ETC., REFER TO ARCHITECT'S OR MECHANICAL ENGINEER'S DRAWINGS. POSITIONS SHOWN ARE INDICATIVE AND SUBJECT TO FINAL DESIGN.
 - ALL FOUL AND RWP CONNECTIONS SHALL BE 100MM DIAMETER UNLESS OTHERWISE SPECIFIED.
 - ALL PRECAST CONCRETE UNITS USED IN THE DRAINAGE WORKS SHALL BE MANUFACTURED USING SULPHATE RESISTING CEMENT.
 - MANHOLE COVERS AND FRAMES SHALL BE TO BS EN 124 AND SHALL BE KITEMARKED. COVERS AND FRAMES SHALL BE HEAVY DUTY D400 IN CARRIAGEWAYS AND VEHICULAR AREAS AND MEDIUM DUTY B125 IN FOOTWAYS AND SOFT LANDSCAPING. IN BLOCKED/CONCRETE PAVED AREAS COVERS SHALL BE RECESSED FABRICATED STEEL. ALL RECESSED COVERS SHALL IN ACCORDANCE WITH THE FACTA ASSOCIATION GRADINGS.
 - COVER LEVELS ARE TO BE ADJUSTED LOCALLY TO SUIT FINISHED GROUND LEVELS.
 - AT LEAST ONE SOIL PIPE AT THE HEAD OF EACH FOUL RUN SHALL VENT TO THE ATMOSPHERE.
 - EXISTING DRAINAGE TO BE REMOVED IS TO BE BROKEN OUT TO BED LEVEL AND VOID BACKFILLED WITH GRANULAR MATERIAL, COMPACTED IN LAYERS NOT EXCEEDING 250MM.
 - ALL DRAIN RUNS FROM SVP'S, STUB STACKS OR FW GULLIES TO BE LAID AT 1:40 GRADIENT UNLESS OTHERWISE STATED. ALL RWP'S TO BE LAID 1:80 MIN UNLESS OTHERWISE STATED.
 - ALL PRIVATE DRAINAGE TO BE LAID TO LEVELS SHOWN USING FLEXIBLY JOINTED PIPES, EITHER UPVC TO BS 4660 AND BS 5481 OR VITRIFIED CLAYWARE TO BS EN 295.
 - ALL PROPOSED TREES TO HAVE APPROPRIATE TREE BARRIER DETAILS LINKING PITS TO ENSURE ROOTS ARE DIRECTED AWAY FROM DRAINAGE.
 - WHERE NEW SEWERS ARE CONSTRUCTED WITHIN 5M OF A NEW OR EXISTING TREE THE SEWER SHALL BE CONCRETE ENCASED AGAINST ROOT INTRUSION. REFER TO DRAINAGE DETAILS.
 - ALL NEW DRAINAGE TO BE JETTED AND CCTV SURVEYED ON COMPLETION. CONTRACTOR TO MAKE SURE THAT THE DRAINAGE IS FULLY OPERATIONAL. REFER TO DRAINAGE MAINTENANCE MANUAL FOR MAINTENANCE DETAILS.
 - ALL RUNS CONNECTING INTO THE PUBLIC DRAINAGE NETWORK TO BE VITRIFIED CLAY, EXTRA LENGTH TO BS EN 295 OR BS65 WITH PLAIN SLEEVED OR SOCKETED FLEXIBLE JOINTS.

NOT FOR CONSTRUCTION

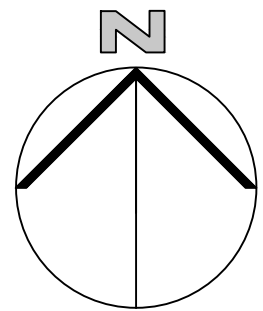
P07	11.07.24	CW01 & SW05 ADJUSTED	AS	-
P06	10.07.24	SITE LAYOUT UPDATED	AS	-
P05	08.07.24	CHANNEL DRAINS UPDATED	AS	-
P04	24.05.24	RWP POSITIONS AMENDED, HARVESTING ADDED	JT	AS
P03	18.04.24	AMENDED TO MATCH UPDATED SITE LAYOUT	JT	AS
P02	26.10.23	PERFORATED PIPE AMENDED, TREE PITS ADDED	JT	AS
P01	22.09.23	FIRST ISSUE	JT	AS
Rev	Date	Description	Drawn	Check

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Drawing Status	
S3 - SUITABLE FOR REVIEW & COMMENT	
Project	Date SEPT 2023
Be.EV RELIANCE STREET MANCHESTER	Scale 1:100
	Drawn JT
Title	Engineer AS
DRAINAGE LAYOUT	Project No 220698
Drawing No 220698-CON-XX-00-DR-C-1000	Revision P07

1. DRAWING BASED ON TOPOGRAPHIC SURVEY BY SURVEY SOLUTIONS, REF. 42087MCLS-01-200-1:1:TOPO, DATED 18/07/22.
2. PROPOSED LAYOUT BASED ON ARCHITECT THAT DRAWING 612-AT-ZZ-R-DR-A-3.1.001, REV P11, DATED 08.04.2024.
3. POSITION OF EXISTING UNITED UTILITIES FOUL AND SURFACE WATER SEWERS BASED ON RECORD INFORMATION.
4. RWP / SVP / SS POSITIONS ARE SHOWN INDICATIVELY AND SUBJECT TO FINAL DESIGN.



- LEGEND**
- EXTENT OF WORKS BOUNDARY
 - [FFL + 12.00] PROPOSED FINISHED FLOOR LEVEL
 - +12.35 PROPOSED LEVELS
 - 1 in 58 FALL/GRAIENT ARROW
 - PROPOSED RETAINING WALL

- GENERAL DRAINAGE NOTES**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
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Meters 1:100

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P05	10.07.24	SITE LAYOUT UPDATED	AS	-
P04	08.07.24	SPOT LEVELS UPDATED TO SUIT NEW DRAINAGE	JT	AS
P03	18.04.24	AMENDED TO MATCH UPDATED SITE LAYOUT	JT	AS
P02	26.10.23	SCHEME AMENDED	JT	AS
P01	22.09.23	FIRST ISSUE	JT	AS
Rev	Date	Description	Drawn	Check

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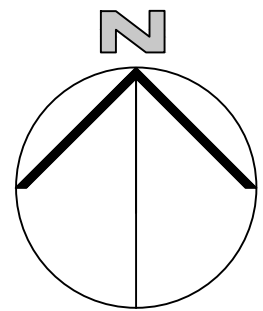
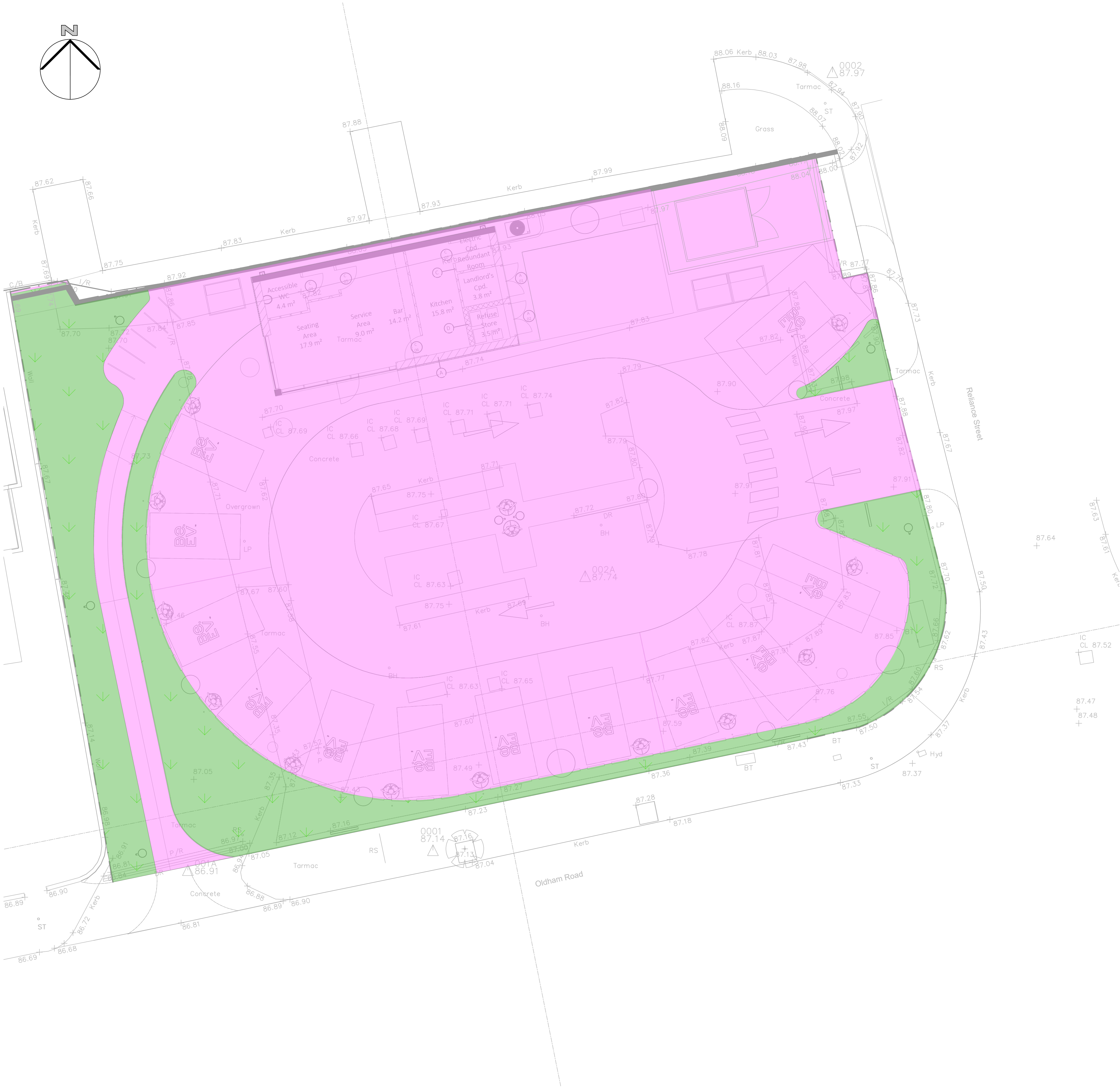
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Drawing Status	
S3 - SUITABLE FOR REVIEW & COMMENT	
Project	Date SEPT 2023
Be.EV RELIANCE STREET MANCHESTER	Scale 1:100
	Drawn JT
Title	Engineer AS
EXTERNAL LEVELS LAYOUT	Project No 220698
Drawing No 220698-CON-XX-00-DR-C-2000	Revision P05

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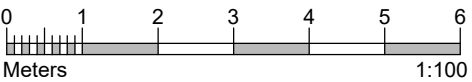
APPENDIX B – IMPERMEABLE AREAS PLAN



- LEGEND**
- EXTENT OF WORKS BOUNDARY
 - PROPOSED SOFT LANDSCAPING
 - IMPERMEABLE AREA

IMPERMEABLE AREA TABLE	
Total Site Area	1,367 m²
Total Existing Impermeable Area	338 m²
Total Proposed Impermeable Area	1,124 m²
Total Impermeable Area created by the development	786 m²
Total Proposed Impermeable Area as a percentage of Total Site Area	82.2 %

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P02 10.07.24 SITE LAYOUT UPDATED	AS	-
P01 24.05.24 FIRST ISSUE	JT	AS
Rev	Date	Description
Drawn		Check

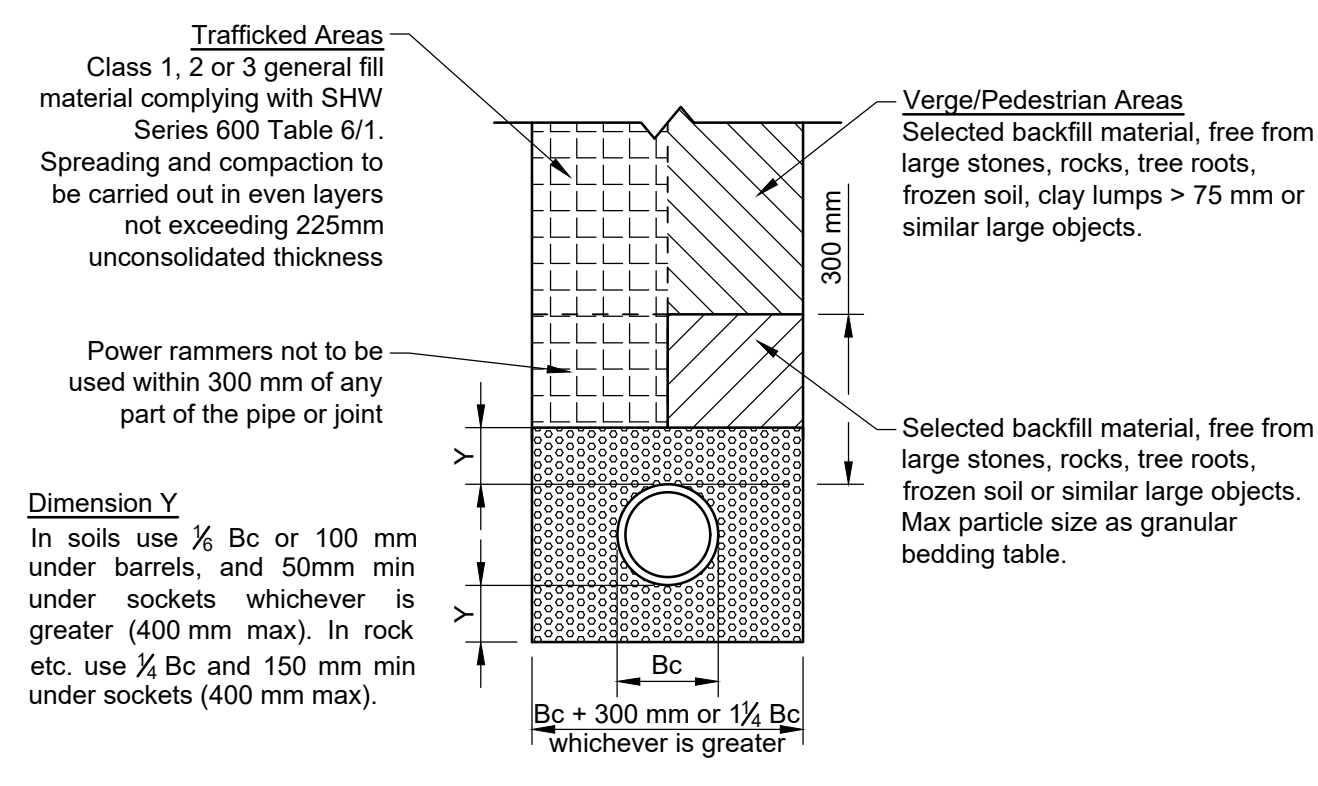
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Drawing Status	
S3 - SUITABLE FOR REVIEW & COMMENT	
Project	Date MAY 2024
Be.EV RELIANCE STREET MANCHESTER	Scale 1:100
	Drawn JT
Title	Engineer AS
IMPERMEABLE AREA PLAN	Project No 220698
Drawing No 220698-CON-XX-00-DR-C-1050	Revision P02

- DRAWING BASED ON TOPOGRAPHIC SURVEY BY SURVEY SOLUTIONS, REF. 42087MCLS-01.200.1:1:TOPO, DATED 18/07/22.
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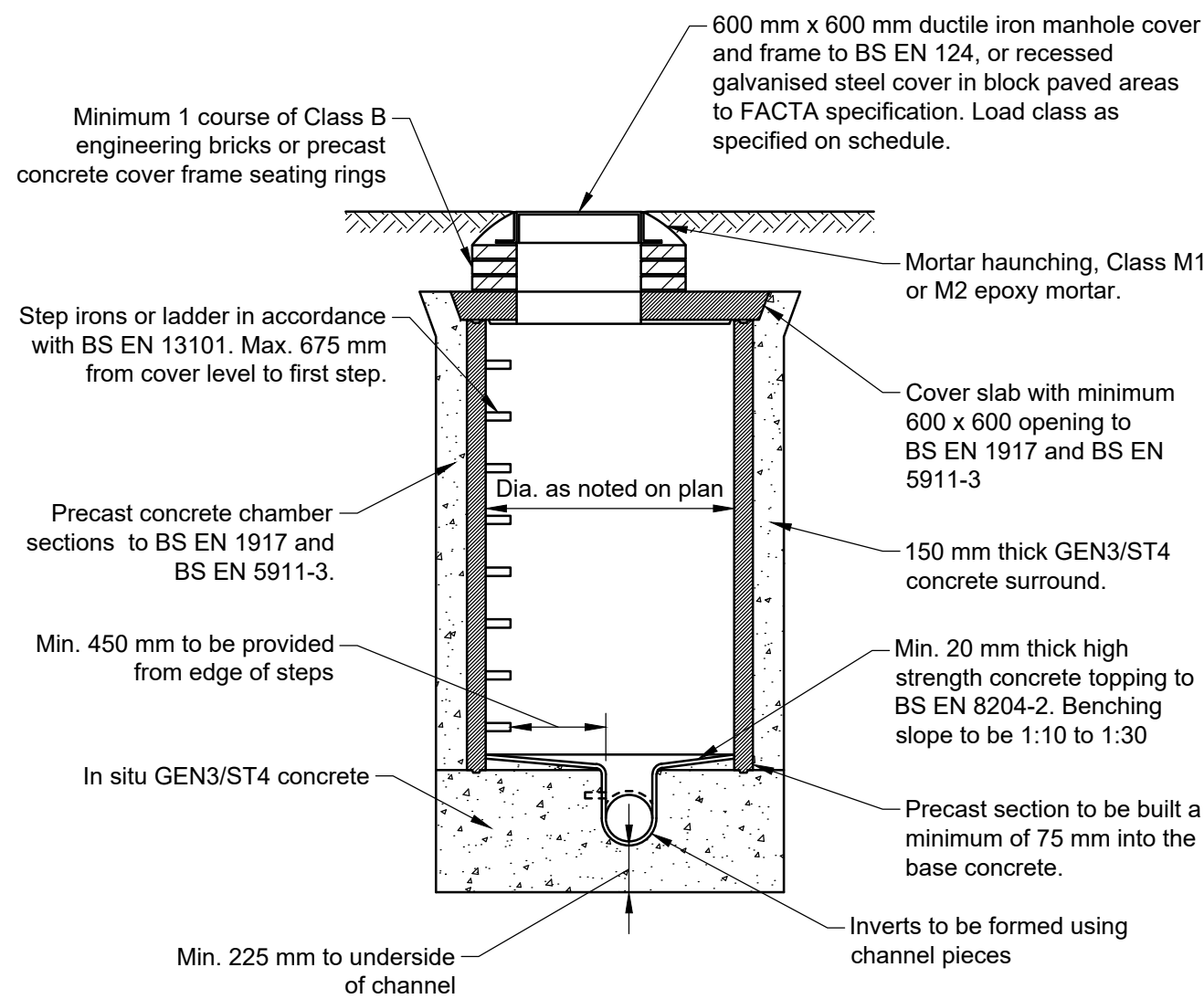
APPENDIX C – DRAINAGE CONSTRUCTION DETAILS



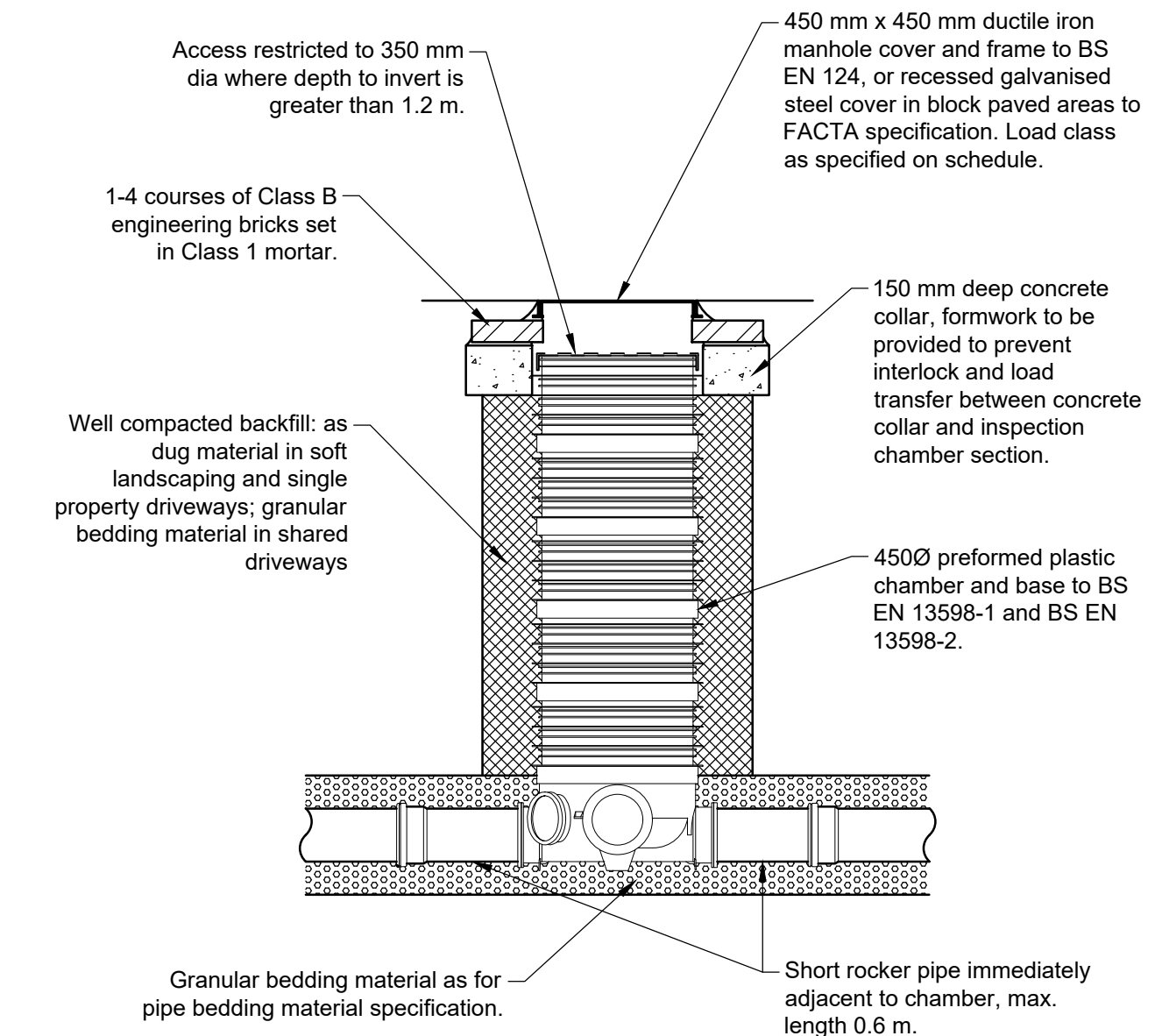
PROCESSED AND AS-DUG GRANULAR BEDDING FOR PIPES		
Pipe nominal size (mm)	Nominal maximum particle size (mm)	Suitable Materials
100	10	10 mm nominal single size
Over 100 to 150	16	10 or 14mm nominal single-size or 14mm to 5mm graded
Over 150 to 300	20	10, 14 or 20mm nominal single-size or 14mm to 5mm graded or 20mm to 5mm graded
Over 300 to 550	20	14 or 20mm nominal single-size or 14 to 5mm graded or 20 to 5mm graded
Over 550	40	14, 20 or 40mm nominal single sized crushed rock or 14mm to 5mm graded or 20mm to 5mm graded or 40mm to 5mm graded

Maximum Compaction Fraction value for all granular bedding: 0.15

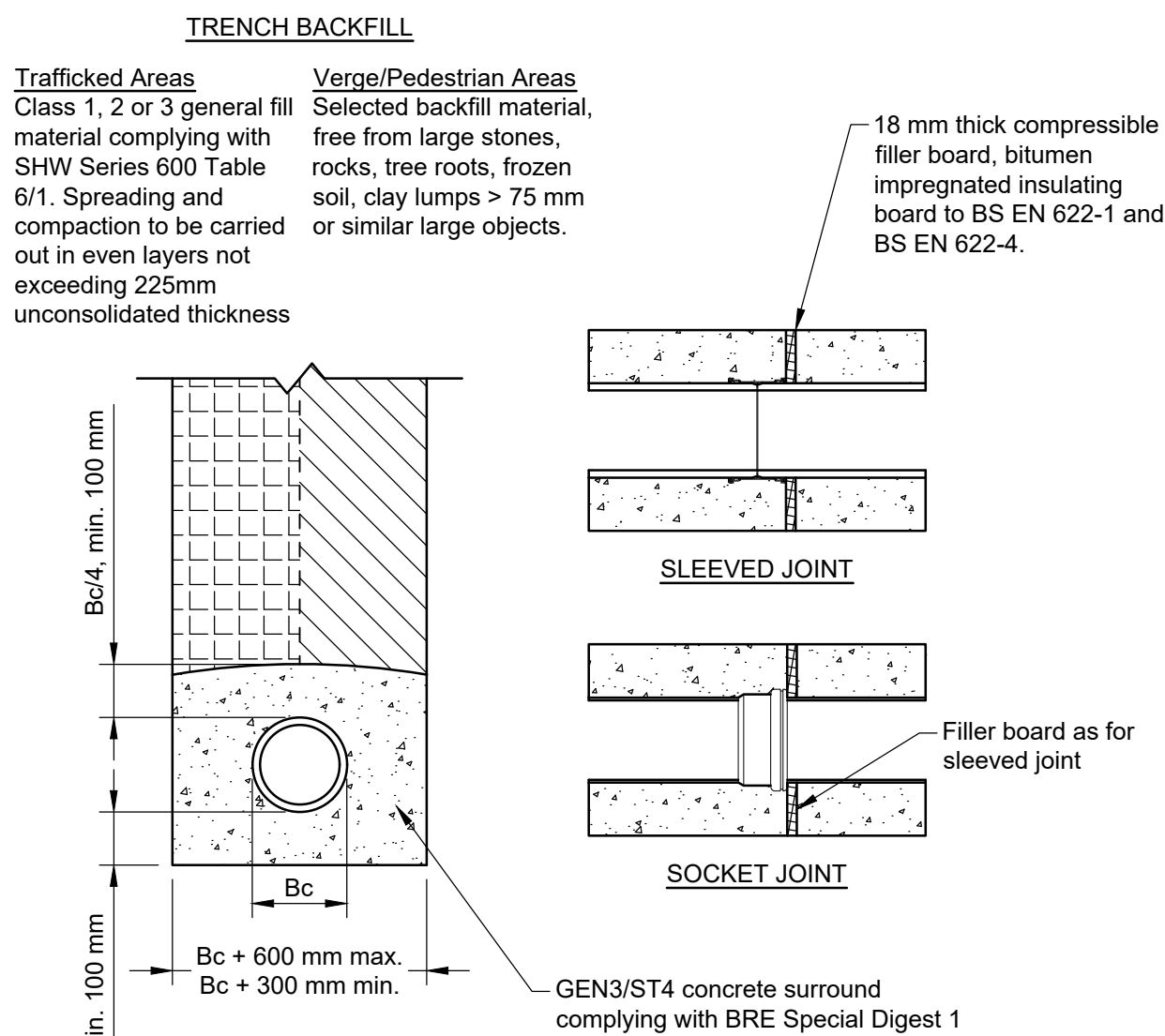
CLASS S BEDDING FOR RIGID AND FLEXIBLE PIPES



PRECAST CONCRETE MANHOLE

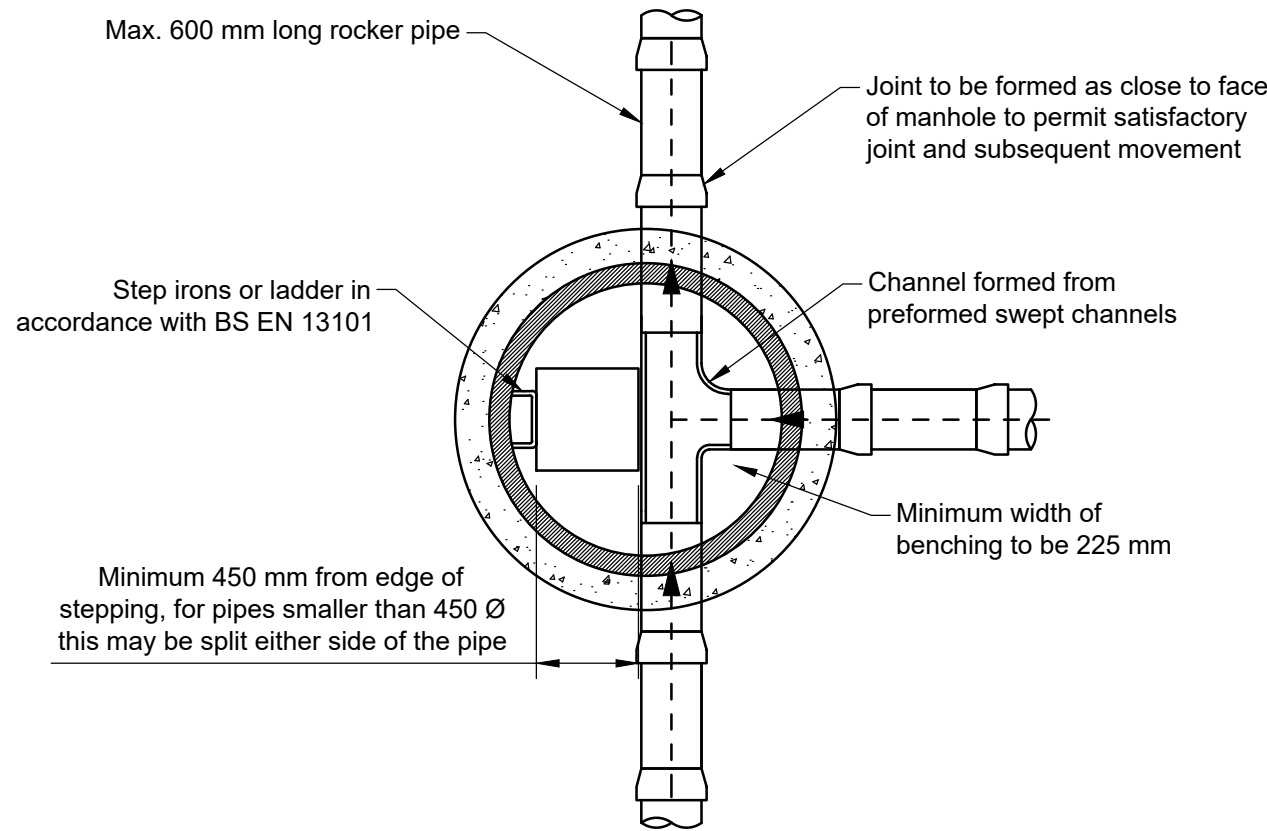


450 Ø INSPECTION CHAMBER

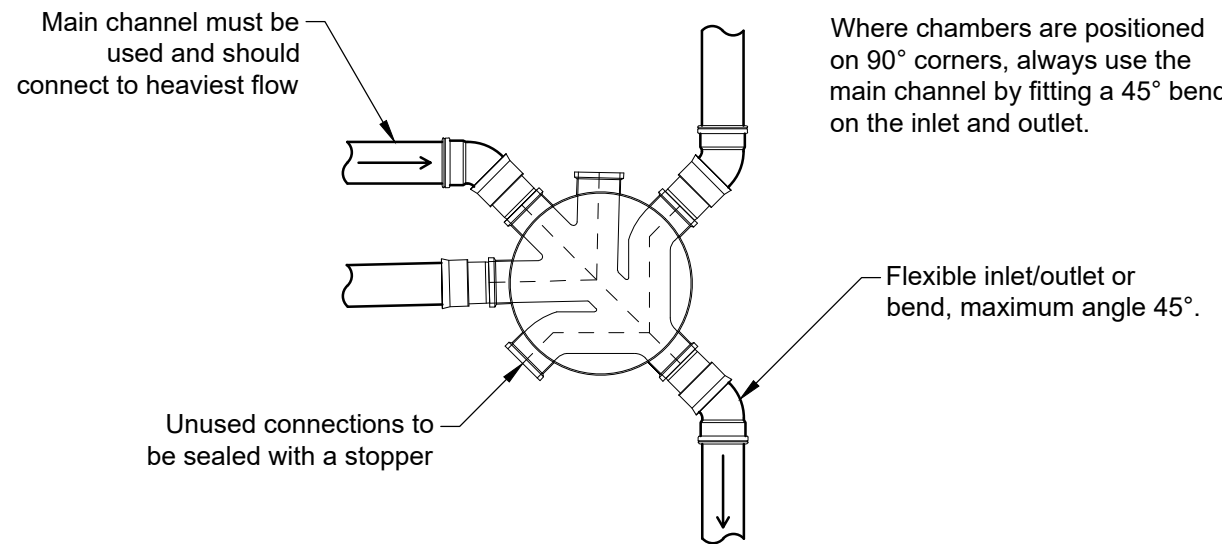


CLASS Z PIPE BEDDING

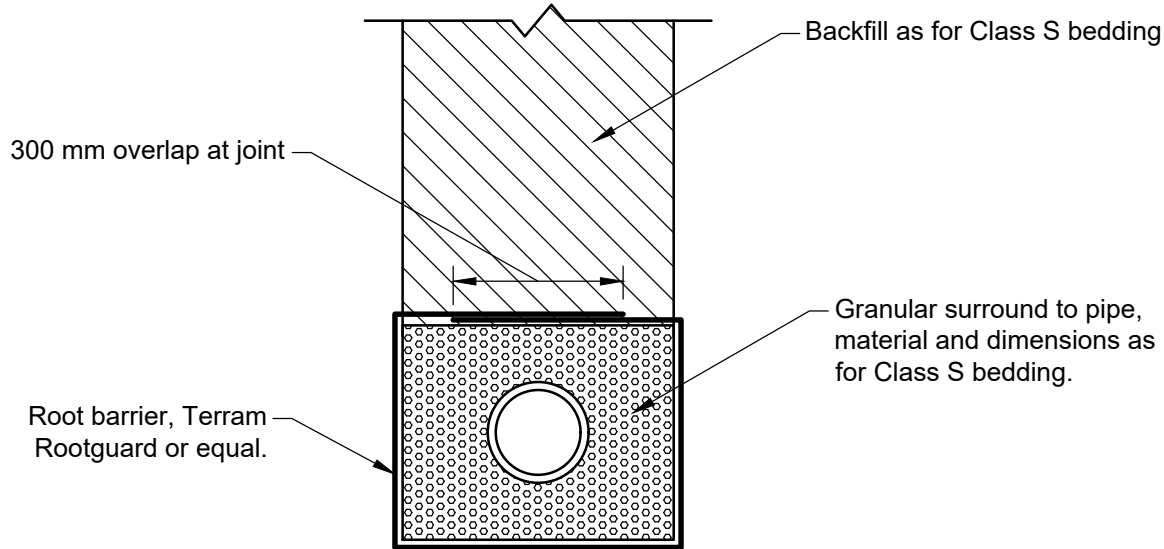
Concrete surround, rigid and flexible pipes



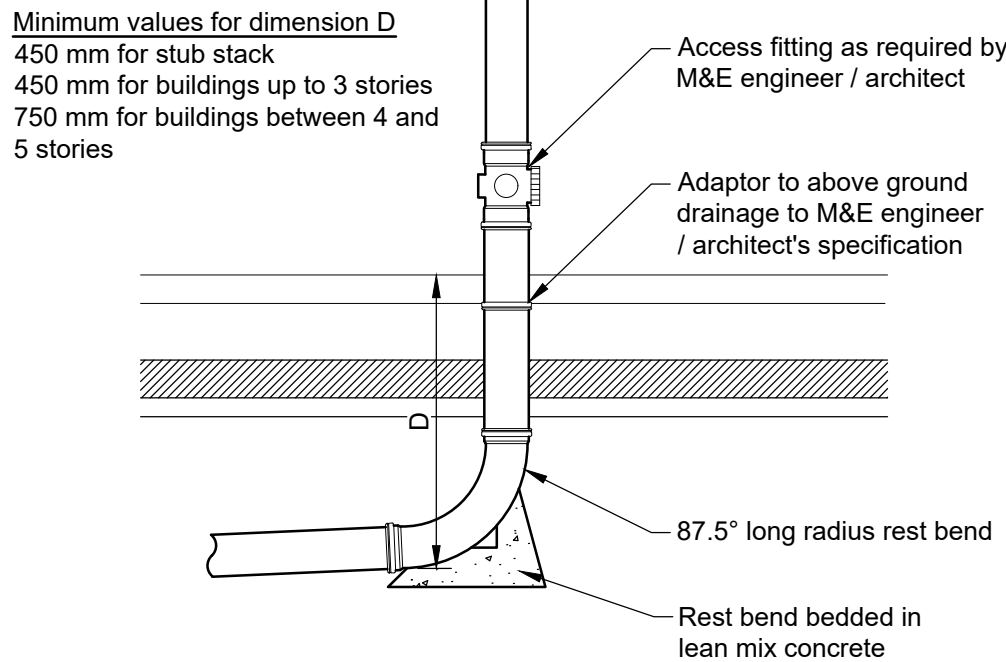
PRECAST CONCRETE MANHOLE TYPICAL BASE ARRANGEMENT



INSPECTION CHAMBER TYPICAL BASE ARRANGEMENT

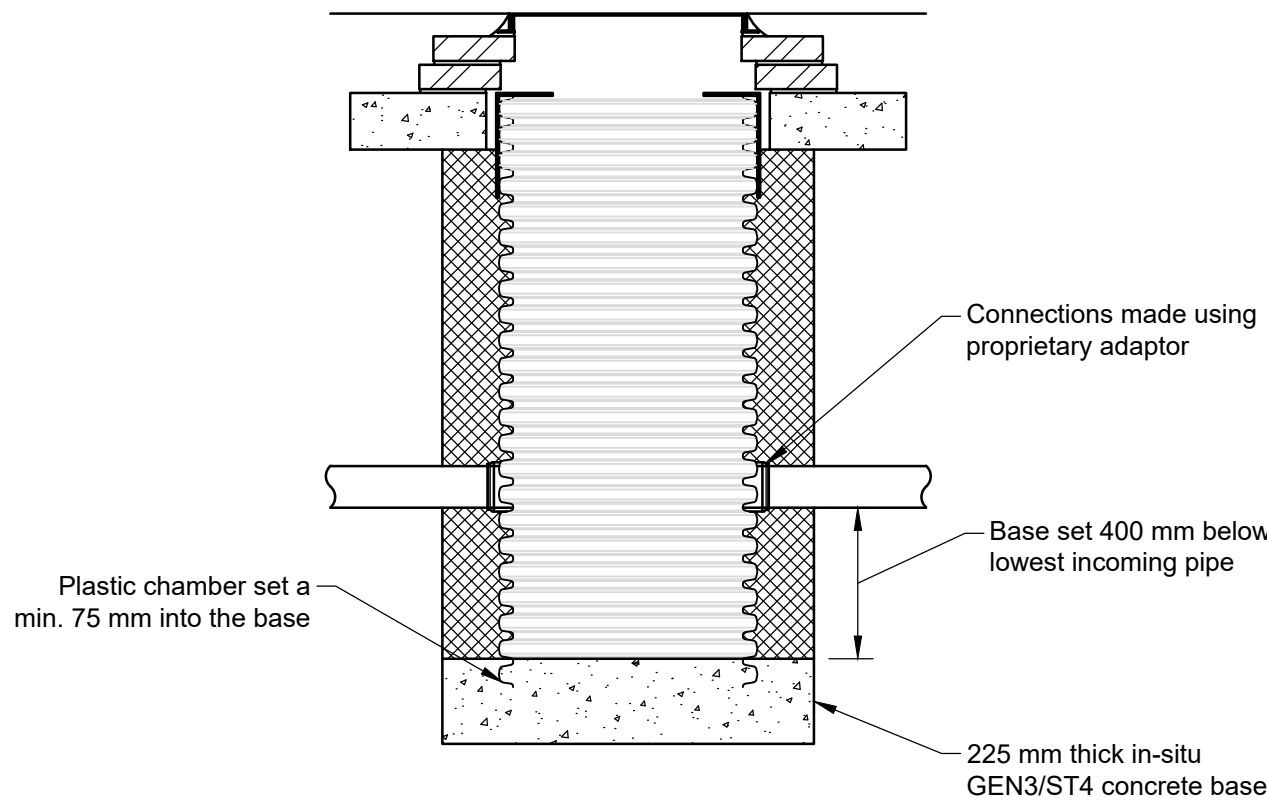


ROOT PROTECTION BARRIER TO PIPES



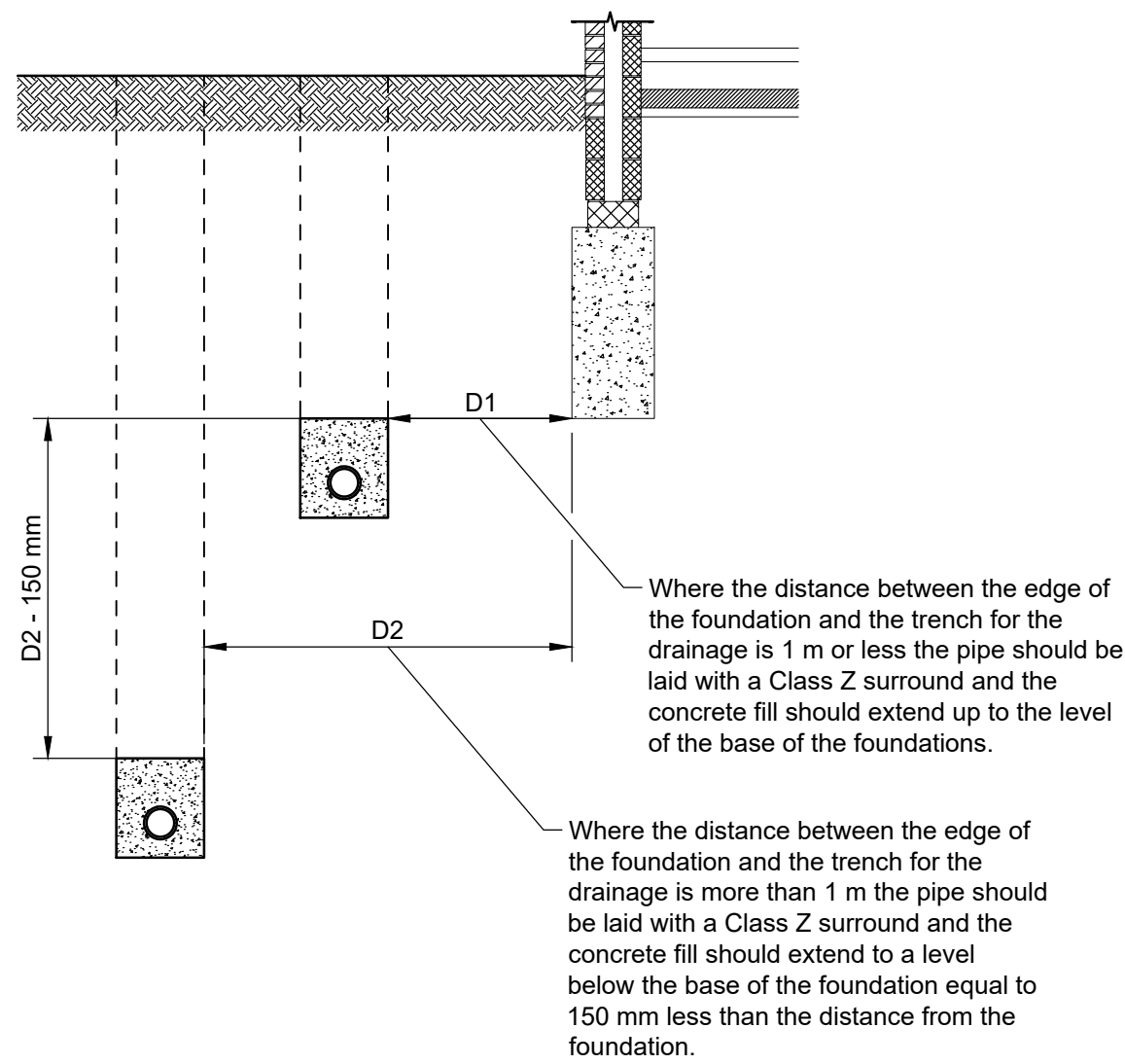
SOIL VENT PIPE OR STUB STACK TO DRAIN

Unless noted otherwise all details are to be in accordance with those for a 600Ø inspection chamber



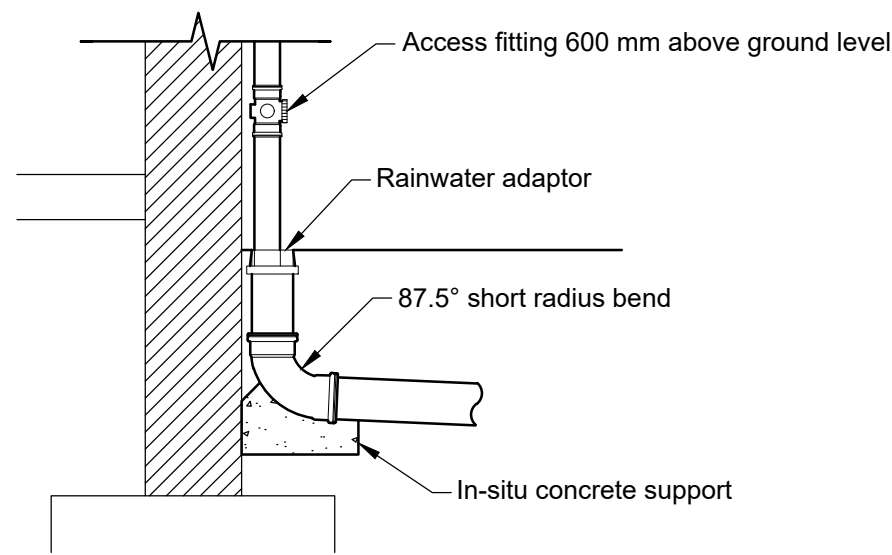
600 Ø CATCHPIT

No more than 2 connections



TRENCH FILL NEAR BUILDINGS

Strip, pad and raft foundations



EXTERNAL RAINWATER PIPE DIRECT TO BELOW GROUND DRAINAGE

DRAINAGE DETAIL NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
- DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.
- CDM NOTE: ALL PIPEWORK, SILT TRAPS, CATCHPITS, TRAPPED GULLIES, ATTENUATION TANKS AND PUMP CHAMBERS TO BE REGULARLY INSPECTED EVERY THREE MONTHS AND CLEARED OUT ON A REGULAR FREQUENCY FOR THE FIRST NINE MONTHS. AFTER THIS PERIOD THE FREQUENCY CAN BE REDUCED TO EVERY SIX MONTHS. PUMP SETS TO BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE MANUFACTURER/PUMP PROVIDER. POROUS SURFACE TO BE REGULARLY SWEEPED THREE TIMES A YEAR TO REMOVE THE SILT. GREASE TRAPS/INTERCEPTORS ARE TO BE INSTECTED/EMPTIED AT LEAST ONCE A MONTH AND, PREFERABLY, EVERY TWO WEEKS.
- HEALTH AND SAFETY: THE WORKS SHALL BE CARRIED OUT BY SPECIALIST COMPETENT AND EXPERIENCED CONTRACTORS WHO ARE MEMBERS OF A RECOGNISED NATIONAL ORGANISATION OPERATIVES SHALL HAVE RECEIVED FULL AND APPROPRIATE TRAINING FOR THE OPERATIONS THEY ARE TO UNDERTAKE. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH ALL PERTINENT HEALTH AND SAFETY REGULATIONS.
- REFER TO THE MANUFACTURER'S INSTALLATION GUIDANCE FOR ALL SPECIFIED PRODUCTS.

NOT FOR CONSTRUCTION

P01 22.09.23	FIRST ISSUE	JT	AS	
Rev	Date	Description	Drawn	Check

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Drawing Status	
S3 - SUITABLE FOR REVIEW & COMMENT	
Project	Date SEPT 2023
Be.EV RELIANCE STREET MANCHESTER	Scale 1:20
	Drawn JT
Title	Engineer AS
DRAINAGE DETAILS SHEET 1	Project No 220698
Drawing No 220698-CON-XX-00-DR-C-1300	Revision P01



- ## TYPICAL VORTEX FLOW CONTROL



1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.
3. CDM NOTE: ALL PIPEWORK, SILT TRAPS, CATCHPITS, TRAPPED GULLIES, ATTENUATION TANKS AND PUMP CHAMBERS TO BE REGULARLY INSPECTED EVERY THREE MONTHS AND CLEARED OUT ON A REGULAR FREQUENCY FOR THE FIRST NINE MONTHS. AFTER THIS PERIOD THE FREQUENCY CAN BE REDUCED TO EVERY SIX MONTHS. PUMP SETS TO BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE MANUFACTURER/PUMP PROVIDER. POROUS SURFACE TO BE REGULARLY SWEEP THREE TIMES A YEAR TO REMOVE THE SILT. GREASE TRAPS/INTERCEPTORS ARE TO BE INSPECTED/EMPTIED AT LEAST ONCE A MONTH AND, PREFERABLY, EVERY TWO WEEKS.
4. HEALTH AND SAFETY: THE WORKS SHALL BE CARRIED OUT BY SPECIALIST COMPETENT AND EXPERIENCED CONTRACTORS WHO ARE MEMBERS OF A RECOGNISED NATIONAL ORGANISATION. OPERATIVES SHALL HAVE RECEIVED FULL AND APPROPRIATE TRAINING FOR THE OPERATIONS THEY ARE TO UNDERTAKE. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH ALL PERTINENT HEALTH AND SAFETY REGULATIONS.
5. REFER TO THE MANUFACTURER'S INSTALLATION GUIDANCE FOR ALL SPECIFIED PRODUCTS.

220698-CON-XX-00-DR-C-1301 P01

APPENDIX D – HYDRAULIC CALCUALTIONS

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW01	0.004	5.00	87.720	600	388071.190	400741.428	0.984
SW02	0.004	5.00	87.735	600	388055.243	400735.271	0.999
SW03			87.735	600	388071.272	400719.991	1.000
SW04	0.045	5.00	87.635	450	388070.948	400730.646	0.850
SW05	0.045	5.00	87.680	1200	388070.634	400723.075	0.970
CW01			87.680	1200	388068.586	400722.647	0.991

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW01	SW03	39.531	0.600	86.736	86.735	0.001	39531.0	150	20.16	50.0
2.000	SW02	SW03	30.392	0.600	86.736	86.735	0.001	30392.0	150	15.08	50.0
1.001	SW03	SW05	3.149	0.600	86.735	86.710	0.025	126.0	150	20.22	50.0
3.000	SW04	SW05	7.578	0.600	86.785	86.710	0.075	101.0	150	5.13	50.0
1.002	SW05	CW01	2.092	0.600	86.710	86.689	0.021	100.0	150	20.25	25.9

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.043	0.8	0.5	0.834	0.850	0.004	0.0	92	0.047
2.000	0.050	0.9	0.5	0.849	0.850	0.004	0.0	85	0.053
1.001	0.894	15.8	1.1	0.850	0.820	0.008	0.0	27	0.512
3.000	0.999	17.7	6.1	0.700	0.820	0.045	0.0	61	0.908
1.002	1.005	17.8	6.9	0.820	0.841	0.098	0.0	65	0.941

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	39.531	39531.0	150	Circular	87.720	86.736	0.834	87.735	86.735	0.850
2.000	30.392	30392.0	150	Circular	87.735	86.736	0.849	87.735	86.735	0.850
1.001	3.149	126.0	150	Circular	87.735	86.735	0.850	87.680	86.710	0.820
3.000	7.578	101.0	150	Circular	87.635	86.785	0.700	87.680	86.710	0.820

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW01	600	Manhole	Adoptable	SW03	600	Manhole	Adoptable
2.000	SW02	600	Manhole	Adoptable	SW03	600	Manhole	Adoptable
1.001	SW03	600	Manhole	Adoptable	SW05	1200	Manhole	Adoptable
3.000	SW04	450	Manhole	Adoptable	SW05	1200	Manhole	Adoptable



Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.002	2.092	100.0	150	Circular	87.680	86.710	0.820	87.680	86.689	0.841

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.002	SW05	1200	Manhole	Adoptable	CW01	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Link	IL (m)	Dia (mm)
SW01	388071.190	400741.428	87.720	0.984	600			
						1.000	86.736	150
SW02	388055.243	400735.271	87.735	0.999	600			
						2.000	86.736	150
SW03	388071.272	400719.991	87.735	1.000	600	2.000	86.735	150
						1.000	86.735	150
						1.001	86.735	150
SW04	388070.948	400730.646	87.635	0.850	450			
						3.000	86.785	150
SW05	388070.634	400723.075	87.680	0.970	1200	3.000	86.710	150
						1.001	86.710	150
						1.002	86.710	150
CW01	388068.586	400722.647	87.680	0.991	1200	1.002	86.689	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
10	0	0	0
30	0	0	0
100	45	0	0

Node SW05 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.710	Product Number	CTL-SHE-0052-1000-0600-1000
Design Depth (m)	0.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node SW03 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	87.285
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	900.0	0.0	0.300	900.0	0.0	0.301	0.0	0.0



Results for 1 year Critical Storm Duration. Lowest mass balance: 76.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	SW01	22	87.301	0.565	1.8	0.2057	0.0000	SURCHARGED
30 minute winter	SW02	26	87.297	0.561	1.7	0.2038	0.0000	SURCHARGED
60 minute winter	SW03	58	87.294	0.559	5.7	2.8517	0.0000	SURCHARGED
30 minute winter	SW04	21	87.296	0.511	4.9	0.6224	0.0000	SURCHARGED
60 minute winter	SW05	58	87.294	0.584	5.9	1.2034	0.0000	SURCHARGED
15 minute summer	CW01	1	86.689	0.000	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	SW01	1.000	SW03	-1.4	-0.128	-1.797	0.6959	
30 minute winter	SW02	2.000	SW03	-1.3	-0.124	-1.519	0.5350	
60 minute winter	SW03	1.001	SW05	-4.7	-0.266	-0.297	0.0554	
30 minute winter	SW04	3.000	SW05	3.5	0.327	0.200	0.1334	
60 minute winter	SW05	Hydro-Brake®	CW01	1.0				10.6

Results for 10 year Critical Storm Duration. Lowest mass balance: 76.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	87.336	0.600	4.0	0.2185	0.0000	SURCHARGED
120 minute winter	SW02	118	87.331	0.595	0.9	0.2160	0.0000	SURCHARGED
120 minute winter	SW03	116	87.331	0.596	7.2	12.6937	0.0000	SURCHARGED
15 minute winter	SW04	11	87.431	0.646	12.3	0.7869	0.0000	FLOOD RISK
15 minute winter	SW05	11	87.385	0.675	23.2	1.3900	0.0000	FLOOD RISK
15 minute summer	CW01	1	86.689	0.000	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	1.000	SW03	-3.4	-0.268	-4.411	0.6959	
120 minute winter	SW02	2.000	SW03	0.7	-0.100	0.761	0.5350	
120 minute winter	SW03	1.001	SW05	-6.5	-0.370	-0.413	0.0554	
15 minute winter	SW04	3.000	SW05	11.6	0.662	0.660	0.1334	
15 minute winter	SW05	Hydro-Brake®	CW01	1.1				12.3



Results for 30 year Critical Storm Duration. Lowest mass balance: 76.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	SW01	118	87.355	0.619	0.8	0.2252	0.0000	SURCHARGED
120 minute winter	SW02	122	87.354	0.618	0.8	0.2245	0.0000	SURCHARGED
120 minute winter	SW03	120	87.355	0.620	9.4	19.0826	0.0000	SURCHARGED
15 minute winter	SW04	11	87.535	0.750	15.6	0.9132	0.0000	FLOOD RISK
15 minute winter	SW05	11	87.460	0.750	30.1	1.5447	0.0000	FLOOD RISK
15 minute summer	CW01	1	86.689	0.000	1.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	SW01	1.000	SW03	0.8	-0.087	0.996	0.6959	
120 minute winter	SW02	2.000	SW03	0.9	-0.088	1.045	0.5350	
120 minute winter	SW03	1.001	SW05	-8.7	-0.493	-0.549	0.0554	
15 minute winter	SW04	3.000	SW05	14.8	0.843	0.840	0.1334	
15 minute winter	SW05	Hydro-Brake®	CW01	1.1				14.9



Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 76.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	SW01	236	87.465	0.729	0.5	0.2653	0.0000	FLOOD RISK
240 minute winter	SW02	236	87.465	0.729	0.5	0.2646	0.0000	FLOOD RISK
240 minute winter	SW03	236	87.465	0.730	10.7	48.9538	0.0000	FLOOD RISK
15 minute winter	SW04	9	87.635	0.850	29.2	1.0353	3.8133	FLOOD
15 minute winter	SW05	10	87.594	0.884	40.8	1.8211	0.0000	FLOOD RISK
15 minute summer	CW01	1	86.689	0.000	1.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	SW01	1.000	SW03	0.5	-0.105	0.604	0.6959	
240 minute winter	SW02	2.000	SW03	0.5	-0.112	0.524	0.5350	
240 minute winter	SW03	1.001	SW05	-9.8	-0.557	-0.621	0.0554	
15 minute winter	SW04	3.000	SW05	17.9	1.017	1.014	0.1334	
15 minute winter	SW05	Hydro-Brake®	CW01	1.2				15.4