BURO HAPPOLD

Planning Amendment

*Project	Project North Stand
Subject	Drainage Strategy Planning Amendment
Project no	053810
Date	7 February 2025

Revision	Description	Issued by	Date	Approved (signature)
P01	For Non-Material Amendment to Planning Permission	CRM	07.02.2025	NJH
P02	For Non-Material Amendment to Planning Permission	CRM	21.05.2025	NJH
P03	For Non-Material Amendment to Planning Permission	CRM	13.06.2025	NJH

1 Introduction

An expansion to the Project North Stand Manchester was approved as part of planning permission 135764/FO/2022 dated 06 June 2023. Buro Happold have now been instructed by Manchester City Football Club to prepare a stormwater drainage strategy in support of a non-material amendment to this planning application.

The site is located within the Etihad Campus in the east of Manchester. It is approximately 3.5ha and is bordered by the Etihad Stadium to the south, the National Squash Centre to the west, the Metrolink Tram Line to the north and Alan Turing Way to the east.

The change from the original strategy consists of the inclusion of a ramp and seating area within the northwest of the site boundary which in the previous planning application was considered to remain as greenfield land. This area is approximately 200m^2 in area and from herein will be referred to as the site amendment area.

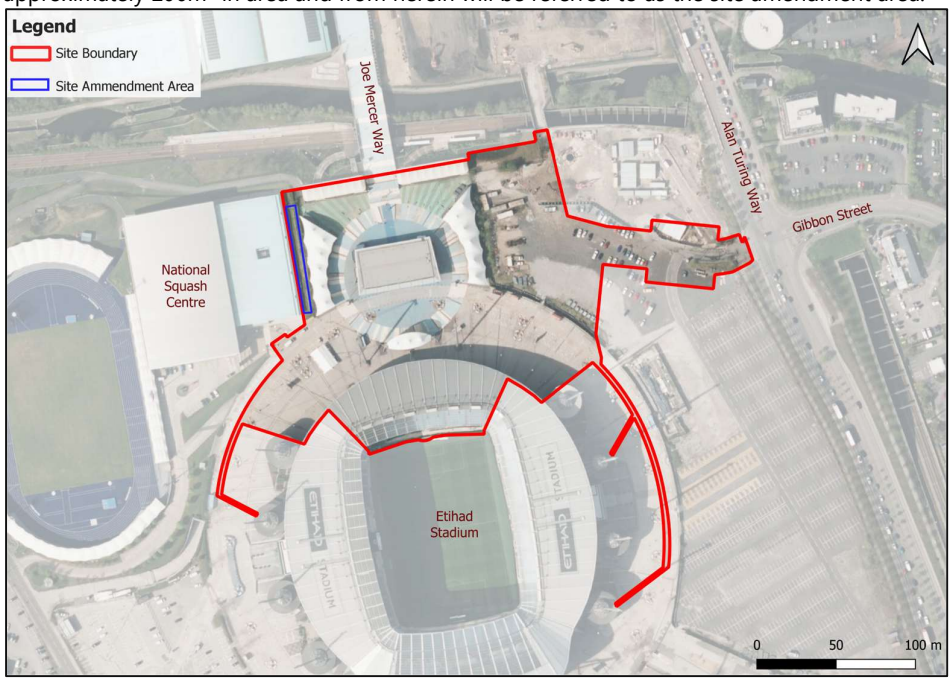


Figure 1-1 Site Location Plan

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2 Existing Site Conditions

The existing site conditions were established within the original planning application, the below section refers only to the conditions within the site amendment area. For further details of the wider site please refer to the original planning application, 135764/FO/2022 dated 06 June 2023

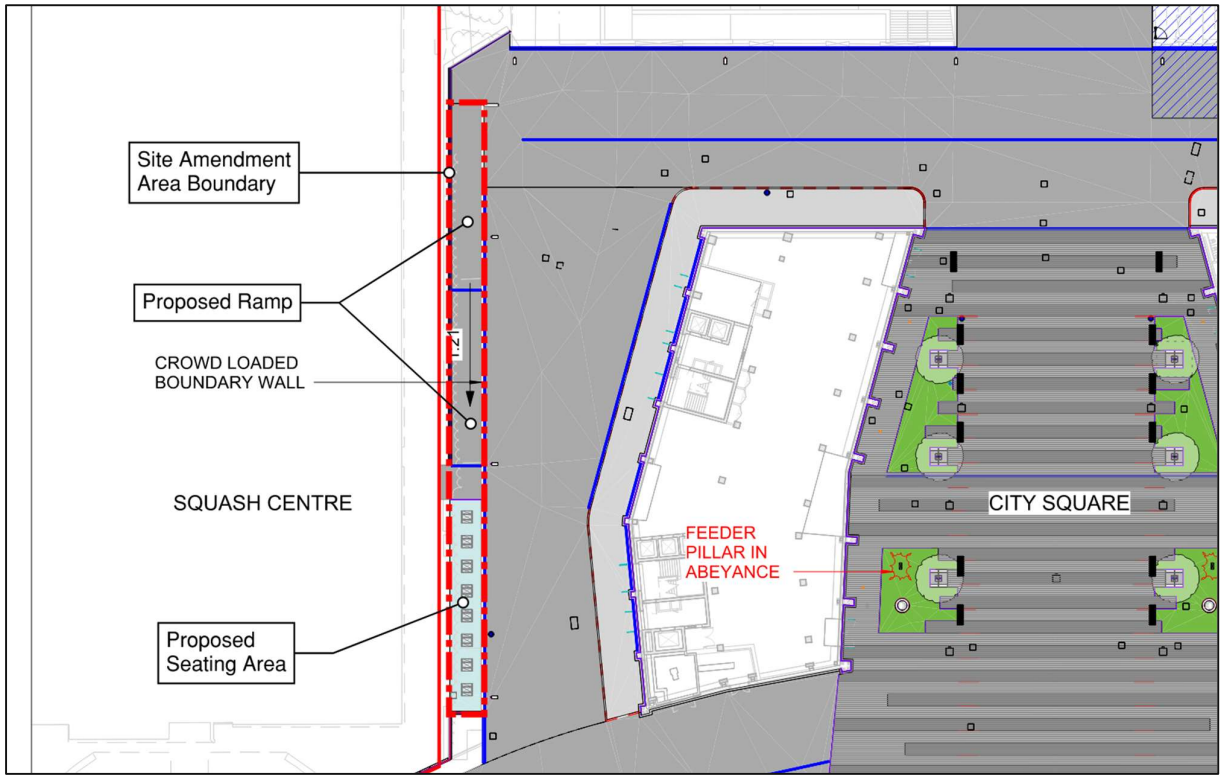
The site amendment area is located on an existing vegetated embankment. The high point is located at the northeast corner of the embankment, 60.83mAOD, the embankment then slopes down towards the west at a gradient of 1:4 until it reaches a level of 59.08mAOD adjacent to an existing footway that runs along the side of the national squash centre. The site levels are generally consistent along the length of the embankment with levels of 60.71mAOD within the southeast corner and 59.05 at the southwest corner. Refer to **Appendix A** for Topographical survey.

As established within the drainage strategy developed for the original planning permissions, 135764/FO/2022, the site is located within flood zone 1 and is considered at low risk from flooding.

British Geological Survey (BGS) England and Wales (Sheet No. 085 - Manchester, 1:50 000, 2011) and the BGS online geology (1:50,000) indicate the site is underlain by Made Ground over till deposits and the Pennine Upper Coal Measures Formation (mudstone, siltstone and sandstone). Boreholes, undertaken as part of the ground investigation, shows that the ground make up within the site consists of approximately 4.40m of made ground on top of clay.

3 Proposed Development

The proposed change from the original strategy consists of the inclusion of a ramp and seating area within the northwest of the site boundary, as shown in the figure below, it has a total area of 200m^3. Within the previous planning application this land was considered as remaining as greenfield land and therefore was not included within the drainage calculations.



4 Proposed Surface Water Strategy

4.1 Existing Site Discharge Rate

The area of change measures 0.021ha, this area was previously considered greenfield and did not positively drain.

The greenfield runoff rate for this area has been calculated as 6.5l/s/ha (Q_{bar}). The greenfield rate for the area of change is therefore calculated as 0.13l/s. This was prorated using the greenfield rates for a 1ha site via the HR Wallingford Greenfield Runoff Rate Estimation tool. Please refer to **Appendix B** for the results.

As it is impractical to discharge surface water flows via gravity at 0.13l/s due to the risk of blockage of the flow control units it is proposed to discharge from the site at 2l/s. This rate has been agreed in principle with United Utilities. Please see **Appendix C** for correspondence.

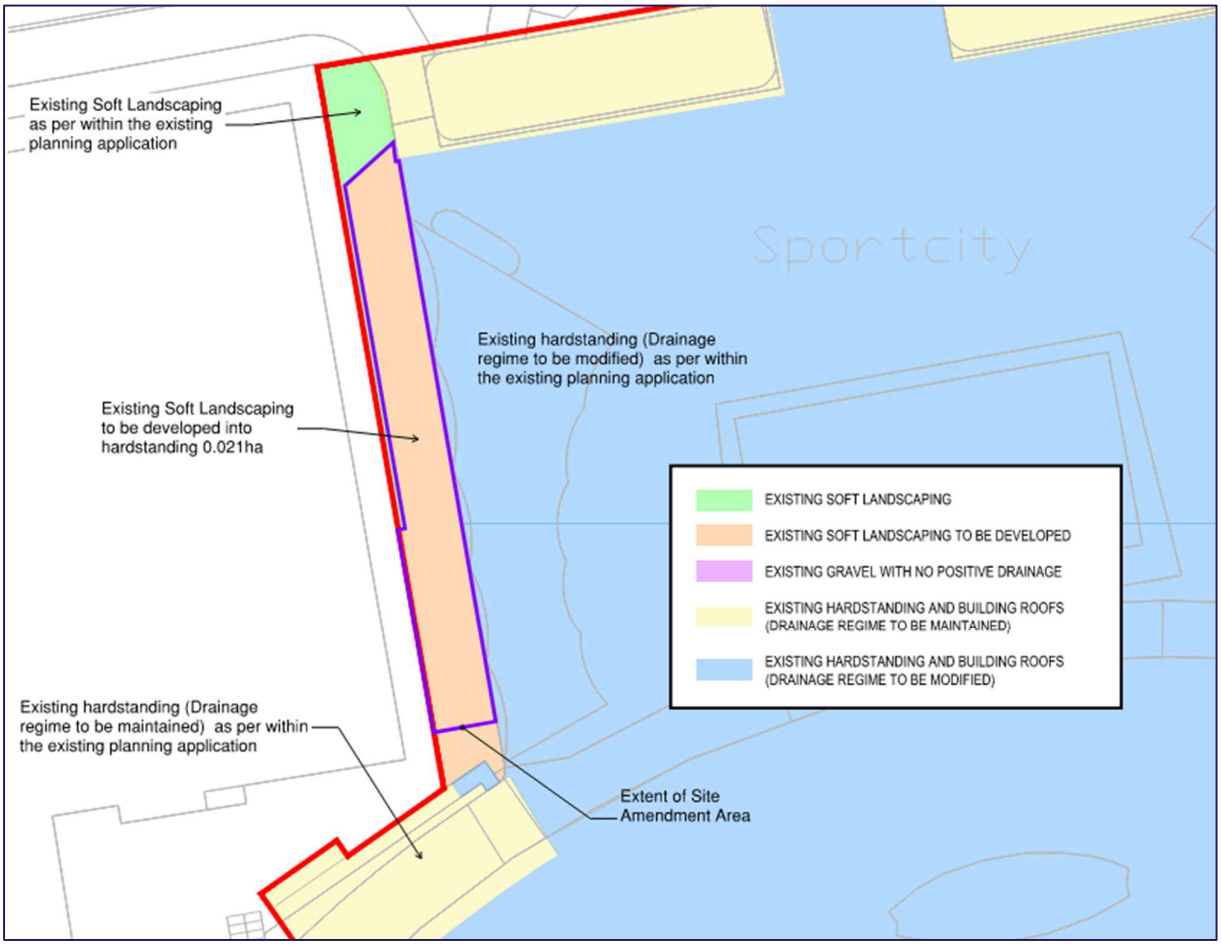


Figure 4-1 Existing Surface Water Catchment Areas

4.2 Drainage Hierarchy

Planning guidance requires drainage strategies for new developments to discharge surface water in line with the following hierarchy:

1. Infiltration
2. Existing Watercourse
3. Existing sewer

Infiltration is not considered suitable on site due to the ground conditions identified within the ground investigation. Boreholes, undertaken as part of the ground investigation, shows that the ground make up consists of approximately 4.40m of made ground on top of clay. This strategy has been agreed with United Utilities.

There are no existing watercourses onsite to receive flows from the development. It is therefore proposed to utilise the existing private surface water connection adjacent to the proposed seating area which later connects to the public UU overflow sewer, which in turn discharges into the River Medlock.

4.3 Climate Change

The stormwater network will ensure no flooding in the 1 in 100 year rainfall event. The site is modelled using FEH13 rainfall data.

In accordance with the Irwell Management Catchment peak rainfall allowance, for a 1% annual exceedance event, an uplift in rainfall intensity of 45% is proposed to account for the future effects of climate change across the lifespan of the development.

4.4 SuDS selection

The following Sustainable Drainage Systems (SuDS) are considered appropriate for the development.

Permeable Paving

Permeable paving provides a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainfall to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before being discharged downstream. As part of the development, permeable paving will be included to provide collection, conveyance, attenuation and water treatment within the proposed seating area.

4.5 Surface Water Drainage Network

As there will be an increase in positively drained impermeable area within the site, there will be an increase in the likelihood and magnitude of standing water and surface water runoff occurring. The surface water strategy below has been devised to mitigate this. Refer to drawing NSE-BHE-XX-XX-DP-C-003110 in **Appendix D** for more details.

The anticipated impermeable area of the catchment is based upon all redeveloped areas being utilised as hardstanding. With limited possibility of further hardstanding being implemented no allowance has been made for urban creep.

The proposed piped drainage system should be designed such that there is no surcharging in the 1 in 2 year probability event, and no flooding in the 1 in 30 year probability event. The piped system should be designed to Building Regulations Part H standards.

The surface water drainage strategy will comprise of 2 ACO Monodrain linear channels which will collect flows on the ramp, traditional gravity drainage pipework sized to convey flows from the channels to permeable paving located at the bottom of the ramp. Flows will then be attenuated within the permeable paving subbase prior to being discharged offsite at 2l/s. Pipe gradients are set to achieve the self-cleansing velocity of 1m/s.

The flow is controlled by a 35mm orifice located within the inspection chamber. Based on the 35mm sizing, and the stormwater source, either via a channel drain sump unit or via permeable paving this is not considered a blockage risk.

The permeable paving subbase is sized based on 30% porosity and is designed to accommodate rainfall events up to and including the critical 1 in 100 year plus 45% allowance for climate change rainfall event (see Table 4—1 for required attenuation volumes). Hydraulic Calculations are available in **Appendix E**.. Typical details of permeable paving and the orifice are available in Appendix F.

Table 4—1 Attenuation Volumes

Catchment	Catchment Area (ha)	Proposed Discharge Rate (l/s)	Approximate Total Volume (m^3)	Void Ratio
Site Amendment Area	0.02	2	6	0.3

4.6 Pollution Control

Due to the nature of the proposed development, being a ramp and seating area, there are no expected vehicle movements onsite and therefore no expected pollutants. In the unexpected scenario that pollutants do enter this area, all flows are directed through the permeable paving which will provide a level of treatment and filtration.

4.7 Designing for Exceedance

The proposed site levels are designed to allow exceedance flow paths to safely convey overland surface water. Levels are designed to direct flows towards the south west of the proposed site amendment area as occurs within the existing scenario.

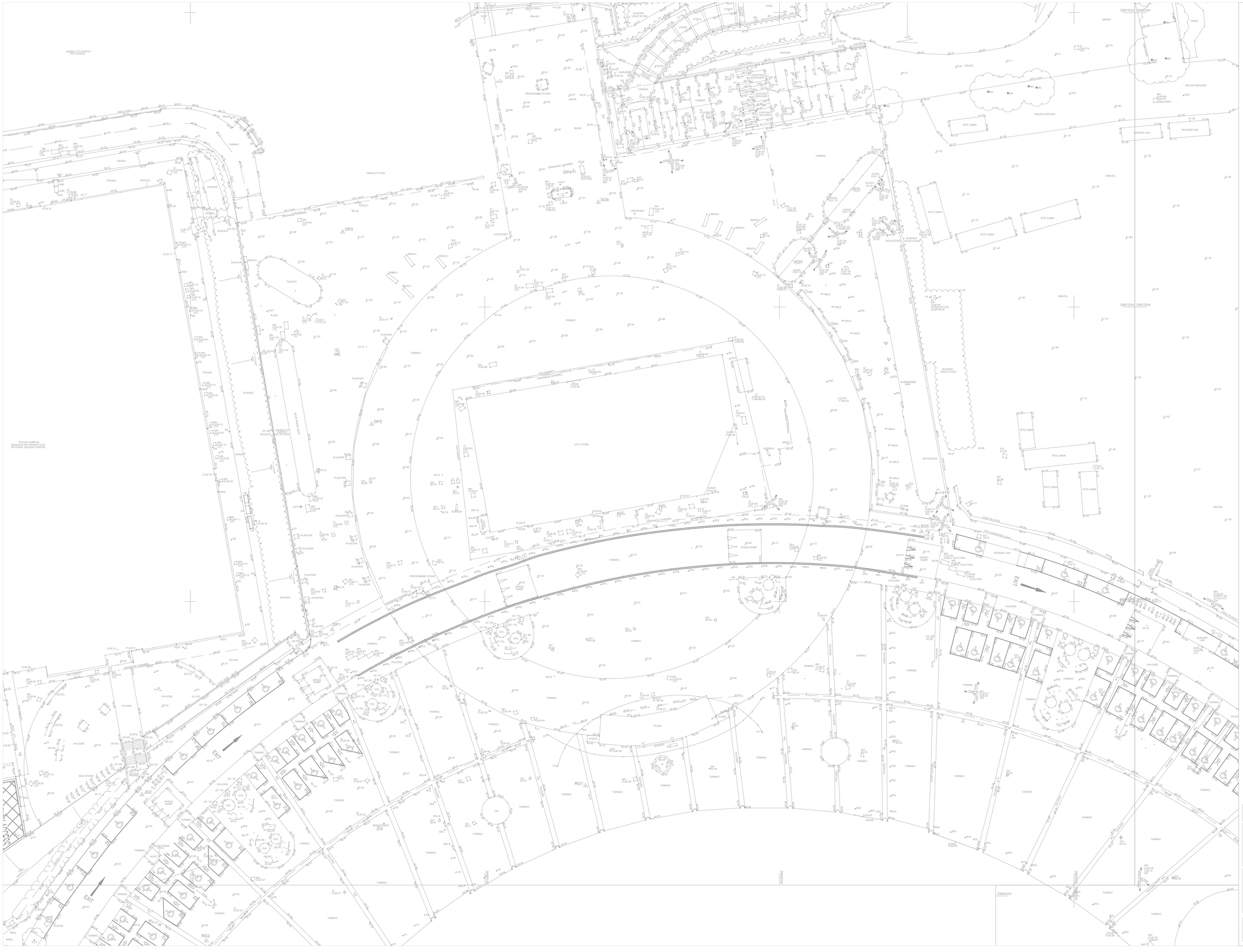
4.8 SuDs Operation and Maintenance Manual

Regular maintenance of the sustainable drainage system is essential to maintain its performance. An Operation and Maintenance Manual will be prepared in accordance with the CIRIA guidance C753 section 32. This manual will be collated during the detailed design stage and will be included as part of the H&S File and Building Manual for the development. Maintenance will be in accordance with the specific requirements of each feature and the chosen attenuation supplier.

The Operation and Maintenance Manual will set out the location of all SuDS components on-site as well as a brief summary of their design intent, how the SuDS components work, their purpose and performance risks. It will also include a maintenance plan and record pro forma, an explanation of the objectives of the maintenance proposed and the potential implications of not meeting those objectives.

It is currently understood that all drainage, including SuDS features, will remain within the ownership of the developer.

Appendix A – Topographical Survey



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Note:
Orientation to existing site grid.
All levels relate to existing site datum.
Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.
Drainage information must be verified with local authority records before use
Levels in parenthesis indicate top of walls.
A - 07/06/19 - Additional drainage infomation added.

SURVEY STATIONS

Name	Eastting	Northing	Height
SO1	386721.67	398820.01	57.14
SO2	386617.56	398918.87	57.02
SO3	386741.20	398815.98	61.42
SO4	386769.25	398717.79	60.96
SO5	386813.52	398697.57	60.62
SO6	386913.44	398610.20	60.65
SO7	386937.57	398522.46	60.62
SO8	386827.35	398447.36	60.62
SO9	387008.05	398411.30	61.97
SO10	387137.75	398352.69	63.16
SO11	387124.73	398459.14	61.97
SO12	387010.82	398552.83	61.01
SO13	387019.92	398602.57	62.01
SO14	386978.40	398798.85	63.81
SO15	386898.51	398956.39	56.75
SO16	386798.10	398952.83	56.10
TBM1	386721.76	399070.17	58.65
MF1	386761.83	398781.31	61.20
MF2	386761.83	398781.31	61.20
MF3	386802.60	398787.06	56.87
MF4	386831.82	398790.90	56.93
MF5	386869.50	398795.96	57.67
MF6	386891.26	398800.37	60.27
MF7	386835.55	398858.06	60.61
MF8	386934.83	398843.43	61.96
PA1	386864.49	398900.89	58.63
PA2	386864.49	398900.89	58.63
PA3	386806.40	398900.16	57.70
PA4	386771.87	398799.10	60.85
MF9	386832.46	399075.21	52.23
SO4	386449.28	398988.75	56.27
SO5	386546.44	398718.60	59.69

STANDARD REFERENCE & ABBREVIATIONS

(AS).....Assumed Route	I1.....Invert Level
AB.....Air Brick	IP.....Inset Pipe
AV.....Air Valve	KO.....Kerb Outlet
B/W.....Barbed Wire	LB.....Letter Box
BAR.....Barrier	LP.....Lamp Post
BB.....Bellaha Beacon	MG.....Multi Girth
BH.....Borehole	MH.....Manhole
BL.....Bed Level	MKR.....Marker
BOL.....Bollard	MP.....Mooring Point
BS.....Bus Stop	NP.....Street Name Plate
BT Box.....British Telecom Box	O/H.....Overhead
BT.....British Telecom St	O/P.....Open Paling
BWTW.....Brick Retaining Wall	OH.....Overhead Electric Wire
BW.....Brick Wall	OP.....Outfall Pipe
C/H.....Close Boarded	OSBM.....Ordnance Survey Bench Mark
C/I.....Corrugated Iron	OT.....Overhead Telecom Wire
C/P.....Chestnut Paling	P/C.....Post & Chain
CB.....Control Box	P/R.....Post & Rail
CBW.....Concrete Block Wall	P/W.....Post & Wire
CCTV.....Closed Circuit TV	PAV.....Paving
CO.....Cable Duct	PB.....Pillar Box
CR.....Cellar Light	PC.....Pedestrian Crossing
CWJ.....Chain Link	PP.....Petrol Pump
CHY.....Chimney	PT.....Post or Pillar
CL.....Cover Level	RD.....Rodding Eye
CM.....Cable Marker	RS.....Road Sign
COL.....Column	RTW.....Retaining Wall
CONC.....Concrete	RWP.....Rain Water Pipe
CP.....Catch Pit	SAP.....Sapling
CRTW.....Concrete Retaining Wall	SL.....Sump Level
CTV.....Cable Television	SoL.....Soffit Level
CUL.....Culvert	SP.....Sign Post
CW.....Concrete Block Wall	SPL.....Springing Level
DC.....Drainage Channel	SRTW.....Stone Retaining Wall
DPO.....Deep Proof Course	SV.....Stop Valve (unspecified)
DR.....Drain	SVP.....Soil Vent Pipe
DSW.....Dry Stone Wall	SW.....Stone Wall
ESP.....Electricity Cable Pit	TC.....Tactile Paving
ESS.....Electricity Inspection Cover	TB.....Traffic Bollard
EJ.....Expansion Joint	TBM.....Temporary Bench Mark
EJB.....Electricity Junction Box	TCB.....Telephone Call Box
EL SUB STN..Electricity Sub Station	TPR.....Taken From Records
EL.....Trans Level	TSC.....Anchor Point (Back/Pole)
ELB.....Electricity Box	TL.....Traffic Light
EP.....Electricity Pole	TLB.....Traffic Light Control Box
ER.....Earth Rod	TM.....Ticket Machine
ETL.....Electricity Transmission Line	TWC.....Tarmac
FB.....Flower Bed	TP.....Telecommunications Pole
FH.....Fire Hydrant	TPIT.....Trial Pit
FL.....Floor Level	TS.....Trash Screen
FP.....Flagpole	U/C.....Under Construction
GP.*.....Girth (# tree)	U/G.....Underground
H.....Holly	UTL.....Unable to Life (BM,St etc)
HWL.....Hedge	UTS.....Unable to Survey
GIP.....Gas Inlet Pipe	VIP.....Vehicle Detector Pad
GMKR.....Gas Marker	VP.....Vent Pipe
GOT.....Gas Stop Tap (Domestic)	W/W.....Wire Mesh
GPV.....Gas Stop Valve (Mains)	WL.....Water Level
HSE.....Housing	WM.....Water Meter
Ht.....Height	WO.....Wash Out
HV.....High Voltage	WP.....Waste Pipe
I/W.....Iron Railing	WST.....Water Stop Tap (domestic)
IC.....Inspection Cover	WSV.....Water Stop Valve (mains)

Client

Drawing Title
Topographical Survey of Land at:
Etihad Campus
Manchester

Scale(s) 1:200	Surveyor
Date June 19	Drawn
Job Number	Checked

Sheet Size & Drg Number & Revision

Appendix B – Greenfield Runoff Rate Calculation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Chris Moore
Site name:	Site Amendment Area
Site location:	Etihad Stadium

Site Details

Latitude:	53.48478° N
Longitude:	2.20149° W
Reference:	1088456840
Date:	Feb 06 2025 17:13

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	902	902
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	6.5	6.5
1 in 1 year (l/s):	5.65	5.65
1 in 30 years (l/s):	11.04	11.04
1 in 100 year (l/s):	13.51	13.51
1 in 200 years (l/s):	15.39	15.39

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix C – United Utilities Correspondence

Christopher Moore

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 02 October 2024 10:39
To: Christopher Moore
Subject: RE: 03884294 S116 CA28, MANCHESTER CITY FOOTBALL CLUB LTD

External Email. This email originated from outside Buro Happold.

Hi Chris,

I can confirm in principal that we have no objections subject to a Section 106 application review.

Regards

Anthony

---------- Original Message ----------
From: Christopher Moore [christopher.moore@burohappold.com]
Sent: 27/09/2024 07:26
To: wastewaterdeveloperservices@uuplc.co.uk
Cc: nick.hall@burohappold.com
Subject: RE: 03884294 S116 CA28, MANCHESTER CITY FOOTBALL CLUB LTD

Hi Anthony,

Yes we did. Please see attached.

Kind regards

Chris

Chris Moore
Principal Engineer

Mob: 07912163893
BuroHappold Engineering | Cities - Infrastructure
www.burohappold.com

From: wastewaterdeveloperservices@uuplc.co.uk <wastewaterdeveloperservices@uuplc.co.uk>
Sent: Thursday, September 26, 2024 2:59 PM
To: Christopher Moore <christopher.moore@burohappold.com>
Cc: Nick Hall <nick.hall@burohappold.com>
Subject: RE: 03884294 S116 CA28, MANCHESTER CITY FOOTBALL CLUB LTD

External Email. This email originated from outside Buro Happold.

Hi Chris,

Thank you for your email.

I can see you have responded to the abandonment case, this query should be for the WW PDE, however before commenting on the additional area did you receive formal S106 acceptance for the surface water drainage that communicates with the CSO for the wider site? If so can you please send me the acceptance document.

Regards

Anthony

United Utilities
Water for the North West

Anthony Laithwaite
Ww Engineer
Developer Services & Metering
Customer Services

T: 01925 429090
unitedutilities.com

---------- Original Message ----------
From: wastewaterdeveloperservices@uuplc.co.uk [wastewaterdeveloperservices@uuplc.co.uk]
Sent: 26/09/2024 11:52
To: christopher.moore@burohappold.com
Cc: nick.hall@burohappold.com
Subject: 03884294 S116 CA28, MANCHESTER CITY FOOTBALL CLUB LTD

Good Afternoon

Thank you for your email.

I can confirm that your email has been sent over to Anthony Laithwaite and will be responded to on or before 03/10/2024

Many Thanks

Kelly

Kelly Cook
Developer, SLP & NAV
Developer Services & Metering
unitedutilities.com

If you have received a great service today why not tell us?
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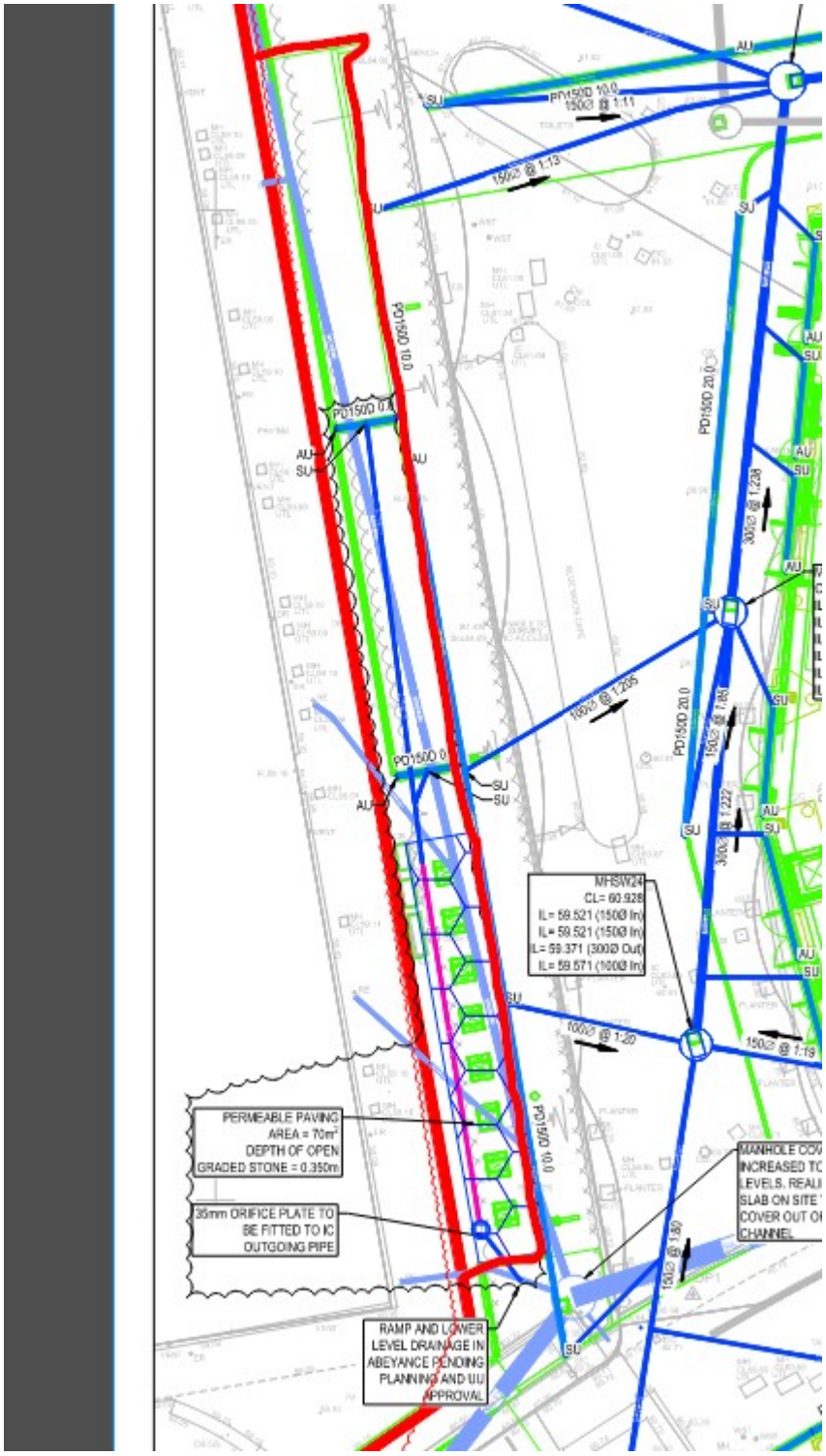
---------- Original Message ----------
From: Christopher Moore [christopher.moore@burohappold.com]
Sent: 25/09/2024 10:24
To: wastewaterdeveloperservices@uuplc.co.uk
Cc: nick.hall@burohappold.com
Subject: RE: 03884294 S116 CA28, MANCHESTER CITY FOOTBALL CLUB LTD

Hi Anthony,

A small additional area consisting of a ramp and seating area, approx. 200m^2 has been added to the Etihad Stadium development. Please see image below, new area circled in red. This area is at a lower level to the rest of the site and therefore cannot utilise attenuation and outfall for the main development. We are proposing to attenuate within permeable paving at the bottom of the ramp before discharging to an existing private drain at 2l/s. The existing private drain eventually discharges to the UU overflow sewer.

Proposed area: 200m^2

Discharge rate 2l/s



Please confirm if you have any objections to this or require any additional information.

Kind regards

Chris

Chris Moore
Principal Engineer

Mob: 07912163893
BuroHappold Engineering | Cities - Infrastructure
www.burohappold.com

Appendix D – Surface Water Strategy

LEGEND

- SITE BOUNDARY

EXISTING

- PRIVATE SURFACE WATER DRAIN TO BE RETAINED
- PRIVATE SURFACE WATER TO BE ABANDONED

PROPOSED

- SURFACE WATER SEWER
- ATTENUATION TANK
- SURFACE WATER CHANNEL CONNECTING TO FOUL DRAINAGE
- PERFORATED PIPE
- CHANNEL DRAIN
- SU SUMP UNIT / OG OVERFLOW GULLY / RE RODDING EYE / ROAD GULLY
- PERMEABLE PAVING (APPROX EXTENTS)
- PROPOSED FOUL WATER (SEE FOUL WATER DRAWINGS PACKAGE)
- TREE ROOT CELLS

NOTE
SISK ACCEPT PIPE IL OF 60.36mAOD ON PILE CAPS WHERE LOCATED ON THICKENING. ON SITE SOLUTION TO BE PUT IN PLACE AS PER AGREEMENT WITH SISK.

SHEET LOCATION PLAN

C04 - REVISION NOTE
COVER LEVELS UPDATED WHERE CLOUDED.

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DO NOT SCALE THIS DRAWING.

HEALTH AND SAFETY INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING

CONSTRUCTION
1. CONSTRUCTION ACTIVITIES IN CLOSE PROXIMITY TO MEDIUM PRESSURE AND LOW PRESSURE GAS MAINS
2. CONNECTION INTO UNUSUALLY DEEP AND LARGE DIAMETER SEWER
3. EXCAVATIONS IN MADE GROUND
4. WORKING ADJACENT TO LIVE SERVICES
5. WORKING ADJACENT TO LIVE HIGHWAY

MAINTENANCE/CLEANING/OPERATION
NO UNUSUAL RISKS IDENTIFIED

DECOMMISSIONING/DEMOLITION
NO UNUSUAL RISKS IDENTIFIED

NOTES
1. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE.
2. ALL LEVEL ARE TO ORDNANCE SURVEY DATUM UNLESS STATED OTHERWISE
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, SPECIFICATIONS AND REPORTS.
4. FOR LONG SECTIONS REFER TO DRAWINGS NSE-BHE-XX-XX-DS-C-003431 TO 003439.
5. FOR STANDARD DETAILS REFER TO DRAWINGS NSE-BHE-XX-XX-DD-C-003501 TO 3515.
6. FOR MANHOLE SCHEDULE REFER TO DRAWINGS NSE-BHE-XX-XX-LS-C-003301.
7. FOR BELOW GROUND DRAINAGE SPECIFICATION PLEASE REFER TO NSE-BHE-XX-XX-TS-C-000001 R12 BELOW GROUND DRAINAGE SPECIFICATION.
8. TOPOGRAPHIC SURVEY DATA TAKEN FROM JUNE 2019 SURVEY 19D065 UNDERTAKEN BY SURVEY OPERATIONS.
9. FOR KNOWN EXISTING UTILITIES IDENTIFIED WITHIN GPR SURVEY PLEASE REFER TO SUBSCAN DRAWING GR48864-UU-DR.
10. ADDITIONAL LIVE BURIED SERVICES MAY BE PRESENT ONSITE.
11. DRAINAGE RECORDS DATA TAKEN FROM 137954-25-11-2019-02-54-50.PDF RECEIVED FROM UNITED UTILITIES 26/11/2019.
12. REFER TO ONSITE MANHOLE SURVEY REPORT OSCC2310257_OSCJ2310749 FOR DEEP DRAINAGE SURVEY DETAILS.
13. REFER TO CADENT GAS MAIN RECORD DATA FOR MEDIUM PRESSURE AND LOW PRESSURE GAS MAIN ROUTING.
14. ALL MANHOLES INTERFACING WITH PIPEWORK TO BE INSTALLED AT A LATER DATE TO BE PROVIDED WITH STUB PIPE PROTRUDING OUT OF MANHOLE AND CAPPED TO PROVIDE A WATERTIGHT SEAL.
15. COVERS INSTALLED DURING SITE IMPROVEMENT WORKS PHASE TO BE RESET TO PROPOSED LEVELS DURING MAIN PHASE WORKS. MANHOLE COVER SLABS HAVE BEEN CONSTRUCTED TO ALLOW READJUSTMENT OF COVERS AND FRAMES TO FINAL LEVELS BY ADDITION OR REMOVAL OF BRICK COURSES ABOVE COVER SLAB.
16. REFER TO LONG SECTIONS FOR BACKDROPS AND PIPE CROSSING INFORMATION.
17. ALL STORM WATER LATERAL PIPES ARE 150mmØ UNLESS STATED OTHERWISE.
18. ALL HOTEL 150mmØ INTERNAL LATERAL INVERT LEVELS ARE SET AT 60.360mAOD UNLESS STATED OTHERWISE.
19. ALL HOTEL 100mmØ INTERNAL LATERAL INVERT LEVELS ARE SET AT 60.475mAOD UNLESS STATED OTHERWISE.
20. ALL COMMERCIAL BUILDING LATERAL INVERT LEVELS ARE SET AT 60.415mAOD UNLESS STATED OTHERWISE.
21. ALL NORTH STAND BUILDING LATERAL INVERT LEVELS ARE SET AT 60.040mAOD UNLESS STATED OTHERWISE.
22. POP UP CONNECTION POINTS AND SIZES FROM MEE MODEL Hotel L0 Drain Points.dwg DATED 11.03.2024. POP UP SETTING OUT BY OTHERS.
23. ALL BUILDING THRESHOLD CHANNEL DRAINS ARE ACO MONODRAIN PD100D 0.0 UNLESS OTHERWISE STATED
24. STRUCTURAL THICKENING IS PROPOSED AROUND THE EXTERNAL EDGE OF THE HOTEL AND COMMERCIAL BUILDING GROUND FLOOR SLABS. THE THICKENING HAS AN IL OF 60.400mAOD. THE CROWN OF THE DRAINAGE PIPES PASSING THE THICKENING SHOULD BE CONSTRUCTED TO PASS BENEATH THE THICKENING. ANY INSTANCES OF THIS NOT OCCURRING SHOULD BE RAISED IMMEDIATELY TO THE CONSULTANT.
25. ALL THRESHOLD DRAINS ARE PROPOSED TO BE ACO MONODRAIN PD100D SHALLOW

Rev	Description	Date	Iss'd	Rev'd	App'd
C05	A5 - AUTHORISATION	21.05.2025	TB	CM	NH
C04	A5 - AUTHORISATION	20.09.2024	TB	CM	NH
C03	A5 - AUTHORISATION	23.08.2024	FR	CM	NH
C02	A5 - AUTHORISATION	02.08.2024	TB	CM	NH
C01	A5 - AUTHORISATION	26.06.2024	TB	CM	NH
P02	S4 - FOR REVIEW & AUTHORISATION	31.01.2024	TB	CM	NH
P01	S3 - FOR REVIEW & COMMENT	25.08.2023	TB	CM	NH

STAGE 5
Project Stage

A5 AUTHORISATION
Status of Drawing

BURO HAPPOLD
3 Wellington Place
Leeds
LS1 4AP
UK
Tel: +44 (0)113 204 2200
Fax: +44 (0)870 787 4144
Email: 0053810@burohappold.com
Web: www.burohappold.com

Client: MANCHESTER CITY FOOTBALL CLUB
Architect: POPULOUS
Project: MCFC NORTH STAND
Drg Title: BELOW GROUND DRAINAGE SURFACE WATER GENERAL ARRANGEMENT SHEET 1

Job No.	Scale@A1
053810	1:200

Drawn/Designed By.	Checked By.	Approved By.
AM	CM	NH

Drawing No. NSE-BHE-XX-XX-DP-C-003110 Revision C05

FOR CONTINUATION SEE SHEET NSE-BHE-XX-XX-DP-C-003113

FOR CONTINUATION SEE SHEET NSE-BHE-XX-XX-DP-C-003112

Christopher Moore \\Srv-bath\Projects\053810 MCFC North Stand\08 Cities - Infrastr...Sheet\NSE-BHE-XX-XX-DP-C-003110.dwg

Appendix E – Surface Water Hydraulic Calculation

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Ramp Drainage

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386840 398863 SJ 86840 98863
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	60
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Ramp Drainage

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.011	4-8	0.004	8-12	0.003	12-16	0.003

Total Area Contributing (ha) = 0.021

Total Pipe Volume (m^3) = 0.247

Network Design Table for Ramp Drainage

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

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)

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Network Design Table for Ramp Drainage

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
SW2.000	26.934	0.287	93.8	0.012	15.00	0.0	0.600	o	100	Pipe/Conduit	
SW2.001	4.539	0.045	100.9	0.009	0.00	0.0	0.600	o	100	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)
SW2.000	50.00	15.57	58.450	0.012	0.0	0.0	0.0	0.79	6.2	1.7
SW2.001	50.00	15.66	58.163	0.021	0.0	0.0	0.0	0.77	6.0	2.8

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Manhole Schedules for Ramp Drainage

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diame (mm
SWChannel Connection	59.100	0.650	Junction		SW2.000	58.450	100			
SW57	59.050	0.887	Open Manhole	1200	SW2.001	58.163	100	SW2.000	58.163	
SW	60.703	2.585	Open Manhole	0		OUTFALL		SW2.001	58.118	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWChannel Connection	386710.836	398670.366			No Entry	
SW57	386715.777	398643.889	386715.777	398643.889	Required	
SW	386718.787	398640.492			No Entry	



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PIPELINE SCHEDULES for Ramp Drainage

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SW2.000	o	100	SWChannel Connection	59.100	58.450	0.550	Junction	
SW2.001	o	100	SW57	59.050	58.163	0.787	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SW2.000	26.934	93.8	SW57	59.050	58.163	0.787	Open Manhole	1200
SW2.001	4.539	100.9	SW	60.703	58.118	2.485	Open Manhole	0

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Area Summary for Ramp Drainage

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	User	-	100	0.012	0.012	0.012
2.001	User	-	100	0.009	0.009	0.009
				Total	Total	Total
				0.021	0.021	0.021

Free Flowing Outfall Details for Ramp Drainage

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SW2.001	SW	60.703	58.118	0.000	0	0

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Online Controls for Ramp Drainage

Orifice Manhole: SW57, DS/PN: SW2.001, Volume (m³): 1.2

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 58.163

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Storage Structures for Ramp Drainage

Porous Car Park Manhole: SW57, DS/PN: SW2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	3.2
Membrane Percolation (mm/hr)	1000	Length (m)	21.5
Max Percolation (l/s)	19.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	58.600	Cap Volume Depth (m)	0.350

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Ramp Drainage

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 386840 398863 SJ 86840 98863
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
SW2.000	SWChannel Connection	30 Winter	2	+0%			
SW2.001	SW57	30 Winter	2	+0%	2/15 Winter		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SW2.000	SWChannel Connection		58.477	-0.073	0.000	0.16		
SW2.001	SW57		58.397	0.134	0.000	0.23		10

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Ramp Drainage

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SW2.000	SWChannel Connection	1.0	OK*	
SW2.001	SW57	1.2	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 386840 398863 SJ 86840 98863
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
SW2.000	SWChannel Connection	15 Winter	30	+0%			
SW2.001	SW57	30 Winter	30	+0%	2/15 Winter		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SW2.000	SWChannel Connection		58.550	0.000	0.000	0.34		
SW2.001	SW57		58.638	0.375	0.000	0.33		14

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

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SW2.000	SWChannel Connection	2.1	SURCHARGED*	
SW2.001	SW57	1.7	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 386840 398863 SJ 86840 98863
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

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

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
SW2.000	SWChannel Connection	15 Winter	100	+45%			
SW2.001	SW57	60 Winter	100	+45%	2/15 Winter		

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SW2.000	SWChannel Connection		58.550	0.000	0.000	0.65		
SW2.001	SW57		58.813	0.550	0.000	0.39		34

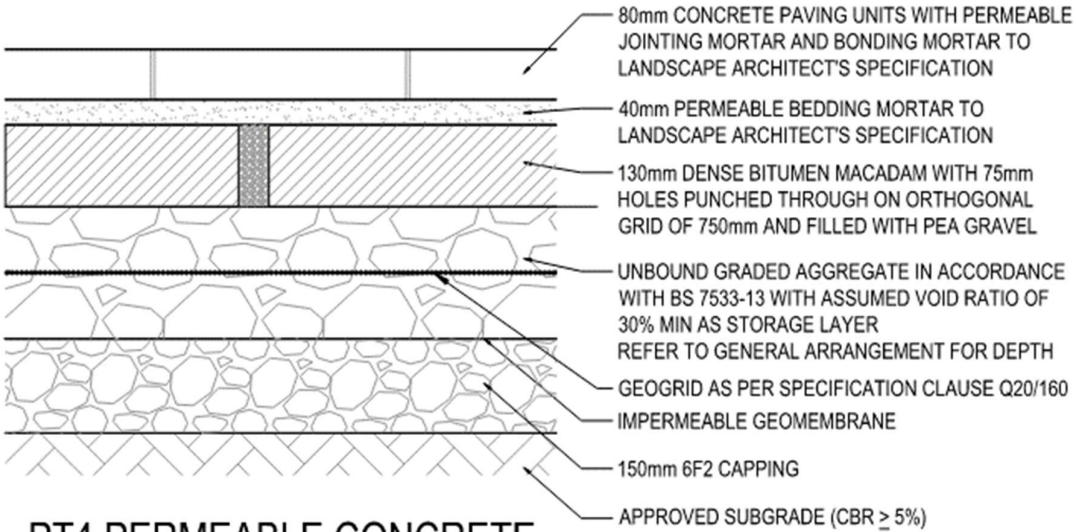
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Ramp Drainage

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SW2.000	SWChannel Connection	4.0	SURCHARGED*	
SW2.001	SW57	2.0	FLOOD RISK	

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Appendix F – Construction Details

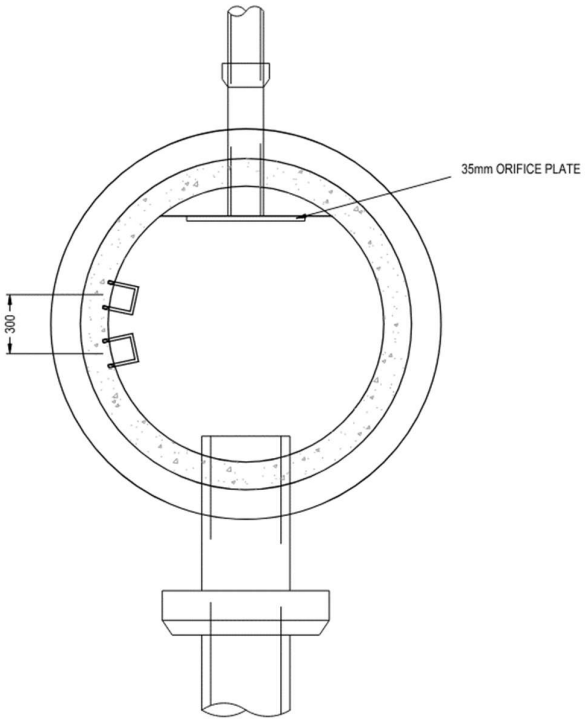


PT4 PERMEABLE CONCRETE BLOCKS FOR OCCASIONAL OVERRUN

SCALE 1:10

ALL PIPES ENTERING MANHOLE SHALL HAVE A FLEXIBLE JOINT WITHIN 600mm OF THE INSIDE FACE OF THE MANHOLE JOINING WITH A ROCKER PIPE.

ROCKER PIPE LENGTHS:- UP TO 450mmØ - 750mmØ MAX OVER 450mmØ - 1000mmØ MAX



PLAN