

 Joule Consulting Engineers Timber Wharf, 40 Worsley Street Manchester M15 4LD	Project New Islington Phase 3				Job no. 284/05	
	Calcs for Existing M1-5				Start page no./Revision 1	
	Calcs by SW	Calcs date 13/09/2018	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedd's calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Manchester
Storm duration	D = 5 min
Return period	Period = 1 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.360
5-year return period rainfall of 60 minutes duration	M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.36
Rainfall for 5min storm with 5 year return period	M5_5min _i = Z1 × M5_60min = 6.5 mm
Factor Z2 (Wallingford procedure)	Z2 = 0.62
Rainfall for 5min storm with 1 year return period	M1_5min = Z2 × M5_5min _i = 4.0 mm
Design rainfall intensity	I _{max} = M1_5min / D = 48.0 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 8900 m ²
Percentage of area that is impermeable	p = 70 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 83.0 l/s

SURFACE 04

 Joule Consulting Engineers Timber Wharf, 40 Worsley Street Manchester M15 4LD	Project New Islington Phase 3				Job no. 284/04	
	Calcs for Existing M2-5				Start page no./Revision 1	
	Calcs by SW	Calcs date 13/09/2018	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Manchester
Storm duration	D = 5 min
Return period	Period = 2 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.360
5-year return period rainfall of 60 minutes duration	M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.36
Rainfall for 5min storm with 5 year return period	M5_5min _i = Z1 × M5_60min = 6.5 mm
Factor Z2 (Wallingford procedure)	Z2 = 0.79
Rainfall for 5min storm with 2 year return period	M2_5min = Z2 × M5_5min _i = 5.1 mm
Design rainfall intensity	I _{max} = M2_5min / D = 61.4 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 8900 m ²
Percentage of area that is impermeable	p = 70 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 106.3 l/s

SURFACE 05

 Joule Consulting Engineers Timber Wharf, 40 Worsley Street Manchester M15 4LD	Project New Islington Phase 3				Job no. 284/04	
	Calcs for Existing M5-5				Start page no./Revision 1	
	Calcs by SW	Calcs date 13/09/2018	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedd's calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Manchester
Storm duration	D = 5 min
Return period	Period = 5 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.360
5-year return period rainfall of 60 minutes duration	M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.36
Rainfall for 5min storm with 5 year return period	M5_5min _i = Z1 × M5_60min = 6.5 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.02
Rainfall for 5min storm with 5 year return period	M5_5min = Z2 × M5_5min _i = 6.6 mm
Design rainfall intensity	I _{max} = M5_5min / D = 79.5 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 8900 m ²
Percentage of area that is impermeable	p = 70 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 137.7 l/s

 Joule Consulting Engineers Timber Wharf, 40 Worsley Street Manchester M15 4LD	Project				Job no.	
	New Islington Phase 3				284/04	
	Calcs for				Start page no./Revision	
	Existing M30-5				1	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	SW	13/09/2018				

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Manchester
Storm duration	D = 5 min
Return period	Period = 30 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.360
5-year return period rainfall of 60 minutes duration	M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.36
Rainfall for 5min storm with 5 year return period	M5_5min _i = Z1 × M5_60min = 6.5 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.45
Rainfall for 5min storm with 30 year return period	M30_5min = Z2 × M5_5min _i = 9.4 mm
Design rainfall intensity	I _{max} = M30_5min / D = 112.4 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 8900 m ²
Percentage of area that is impermeable	p = 70 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 194.5 l/s

SURFACE 07

 Joule Consulting Engineers Timber Wharf, 40 Worsley Street Manchester M15 4LD	Project New Islington Phase 3				Job no. 284/04	
	Calcs for Existing M100-5				Start page no./Revision 1	
	Calcs by SW	Calcs date 13/09/2018	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Manchester
Storm duration	D = 5 min
Return period	Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.360
5-year return period rainfall of 60 minutes duration	M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.36
Rainfall for 5min storm with 5 year return period	M5_5min _i = Z1 × M5_60min = 6.5 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.83
Rainfall for 5min storm with 100 year return period	M100_5min = Z2 × M5_5min _i = 11.8 mm
Design rainfall intensity	I _{max} = M100_5min / D = 142.0 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 8900 m ²
Percentage of area that is impermeable	p = 70 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 245.7 l/s

Job No	Z86-05	Sheet No	Surface 04		
Project	N13	Engineer	NR	Date	13/03/20
Element	SURFACE WATER DRAINAGE	Checked by		Date	

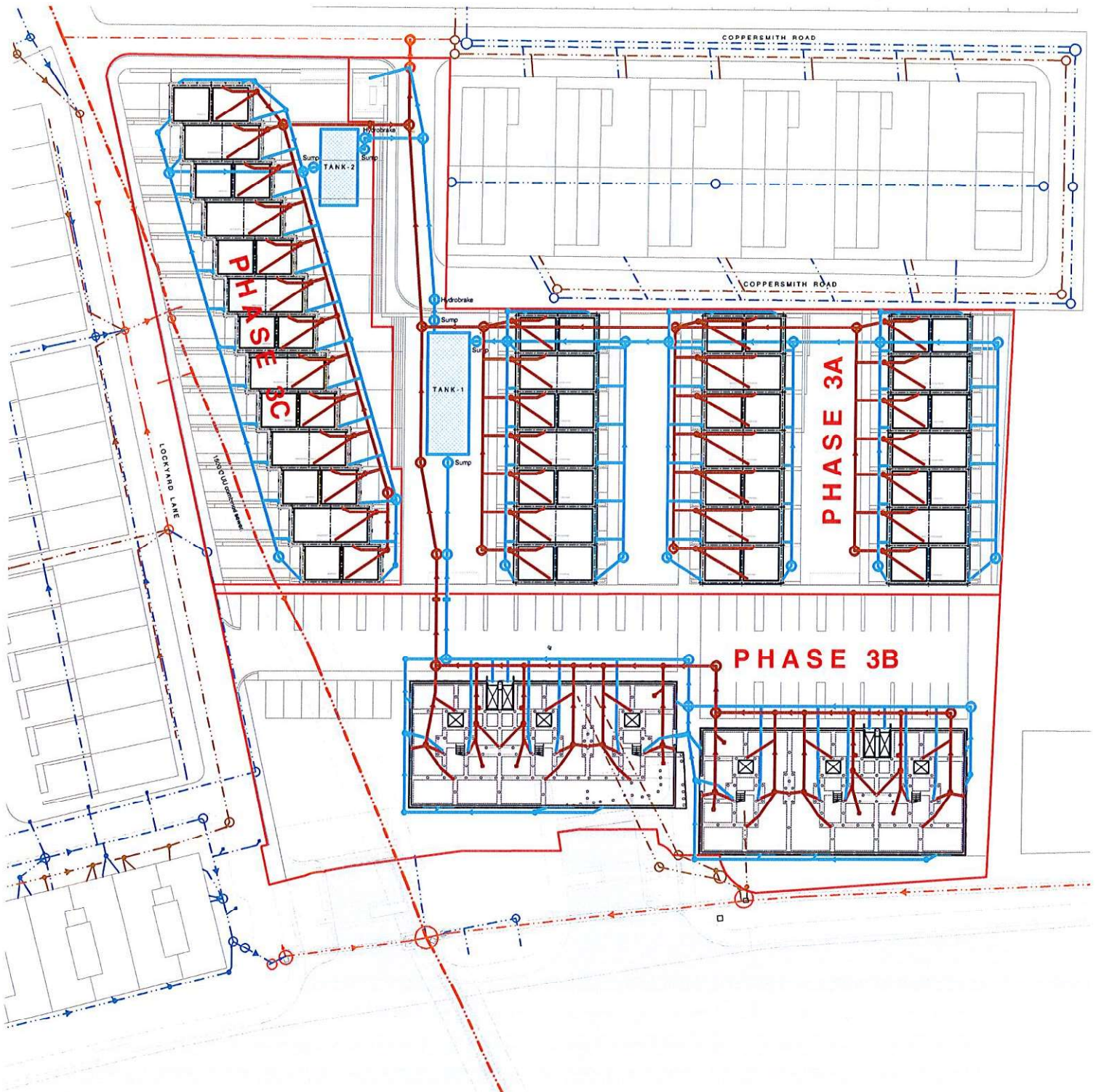
ALLOWABLE DISCHARGE

Surface water discharge into the combined public sewer is to provide a 50% reduction in flow.

Existing flow = 83.0 l/s

Proposed flow = $\frac{83.0}{2} = 41.5$ l/s

Attenuation tank within site 3A serves sites 3A & 3B. As part of construction of phase 3A site, pipes for Phase 3B & Phase 3C will be installed & so are sized based on the impermeable areas for each respective site.

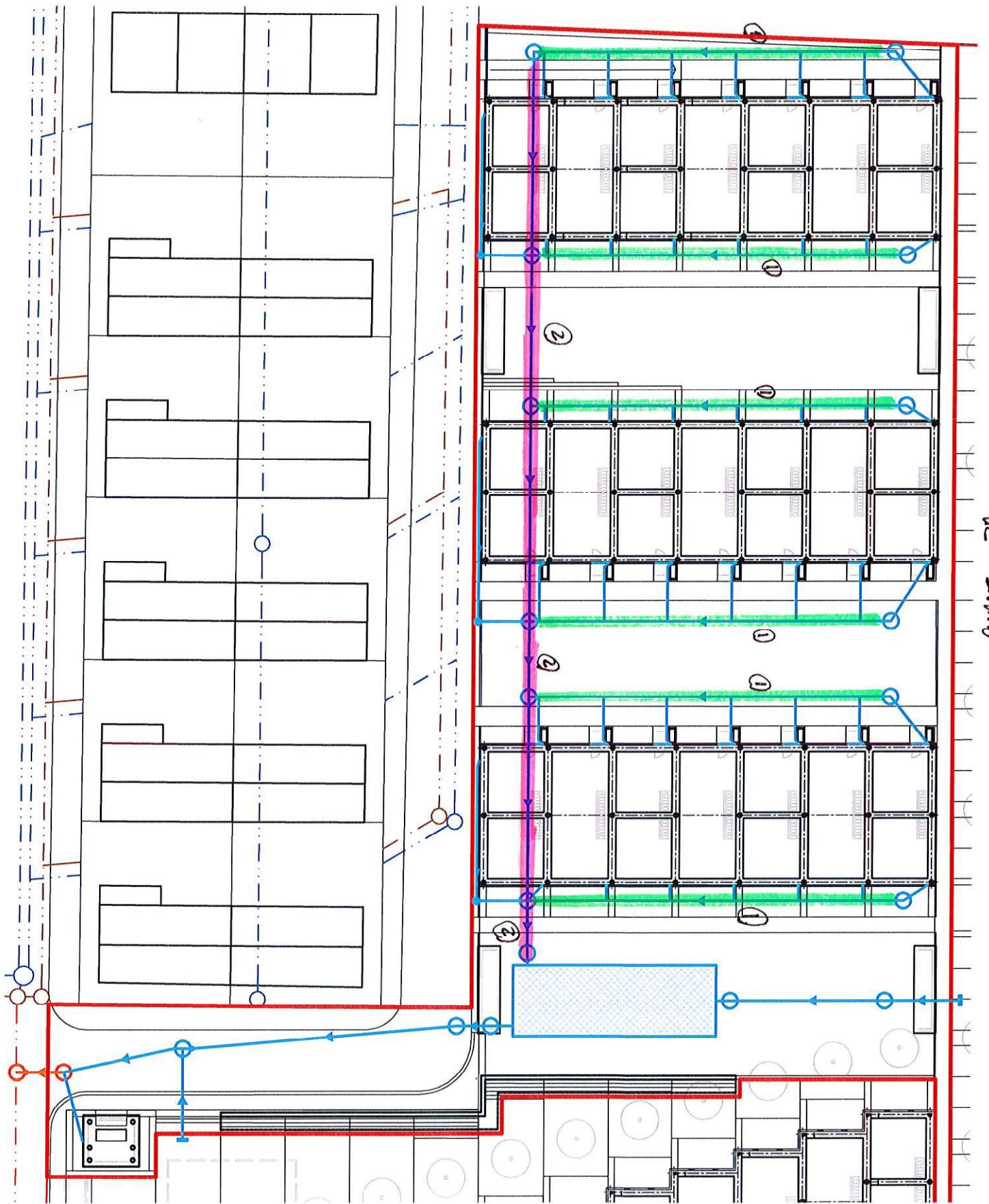


Impermeable Areas

Phase 3A = 1639m^2 (Excluding unattenuated area of 31m^2)

Phase 3B = 3590m^2

Phase 3C = 1476m^2



PHASE 3A

Job No	244-05	Sheet No	surface 11
Project	N13	Engineer	NR
		Date	13/03/20
Element	SURFACE WATER DRAINAGE	Checked by	Date

PHASE 3A SURFACE WATER DRAINAGE.

- ① Half of 1No terrace block plus associated handstanding.

Area per run (maximum) = 315m^2

Runoff = 0.014 l/s/m^2 (From Part H Building Regs)

Flow rate = 4.4 l/s

Use 100mm ϕ @ 1 in 80 $\Rightarrow$ capacity = 6.5 l/s $\geq 4.4\text{ l/s} \therefore \text{OK}$.
(from Part H)

- ② Full attenuated area of Phase 3A side.

Total area = 1639m^2

Runoff = 0.014 l/s/m^2

Flow rate = $0.014 \times 1639 = 23.0\text{ l/s}$

Capacity of 150mm ϕ at 1:80 = 19.8 l/s (Treda calc)

Capacity of 225mm ϕ at 1:80 = 54.0 l/s (Treda calc)

- Use 150mm ϕ at 1:80 up to penultimate chamber.

$\hookrightarrow$ flow = $23.0 - 4.4 = 18.6\text{ l/s} \leq 19.8\text{ l/s} \therefore \text{OK}$.

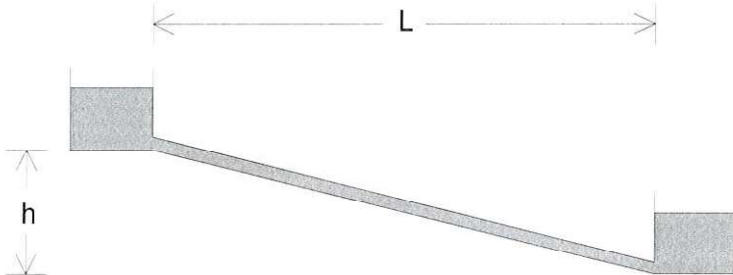
- Use 225mm ϕ at 1:80 between penultimate chamber and last chamber tank.

$\hookrightarrow$ flow = $23.0\text{ l/s} \leq 54.0\text{ l/s} \therefore \text{OK}$

joule Joule Consulting Engineers Ltd Timber Wharf 40 Worsley Street Manchester, M15 4LD	Project New Islington - Phase 3A			Job no. 384-05	
	Calcs for 150mm Pipe at 1 in 80			Start page no./Revision 1 17	
	Calcs by NR	Calcs date 13/03/2020	Checked by	Checked date	Approved by Approved date

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate $Q_{\text{design}} = 10.0 \times 10^{-3} \text{ m}^3/\text{s}$
Length of the drain $L = 80.0 \text{ m}$
Fall along length of drain $h = 1.000 \text{ m}$
Gradient of drain $i = h / L = 0.013 \text{ (1 in 80)}$

(Library item Drain design details)

Minimum pipe diameter $D_{\text{min}} = 150 \text{ mm}$
Surface roughness $k_s = 0.6 \text{ mm}$
Mean hydraulic depth factor $m = 0.25$
Kinematic viscosity of fluid $\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$

Using the Chezy equation

Constant $c = 56$
Diameter of pipe required $D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 111 \text{ mm}$
Nearest pipe diameter $D_{\text{chezy}} = 150 \text{ mm}$
Flow velocity using Chezy $V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.212 \text{ m/s}$

Using the Eschritt equation

Diameter of pipe required $D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 116 \text{ mm}$
Nearest pipe diameter $D_{\text{eschritt}} = 150 \text{ mm}$
Flow velocity using Eschritt $V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) = 1.113 \text{ m/s}$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter $D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 150 \text{ mm}$
Constant $Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.192$
Flow velocity $V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s}))) \times 1 \text{ m/s}$
 $V_{\text{full}} = 1.121 \text{ m/s}$
Flow rate running full $Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 19.8 \times 10^{-3} \text{ m}^3/\text{s}$

PASS - Maximum flow rate is greater than design flow rate

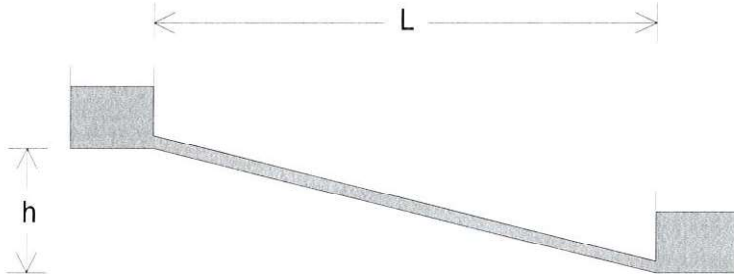
From Hydraulics Research Tables 35 and 36

Depth as proportion of D $x = 0.503$
Flow velocity at design flow rate $V_{\text{design}} = 1.123 \text{ m/s}$

joule Joule Consulting Engineers Ltd Timber Wharf 40 Worsley Street Manchester, M15 4LD	Project		New Islington - Phase 3A		Job no.		384-05
	Calcs for		225mm Pipe at 1 in 80		Start page no./Revision		1 13
	Calcs by	NR	Calcs date	13/03/2020	Checked by	Checked date	Approved by Approved date

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate $Q_{\text{design}} = 10.0 \times 10^{-3} \text{ m}^3/\text{s}$
Length of the drain $L = 80.0 \text{ m}$
Fall along length of drain $h = 1.000 \text{ m}$
Gradient of drain $i = h / L = 0.013 \text{ (1 in 80)}$

(Library item Drain design details)

Minimum pipe diameter $D_{\text{min}} = 225 \text{ mm}$
Surface roughness $k_s = 0.6 \text{ mm}$
Mean hydraulic depth factor $m = 0.25$
Kinematic viscosity of fluid $\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$

Using the Chezy equation

Constant $c = 56$
Diameter of pipe required $D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 111 \text{ mm}$
Nearest pipe diameter $D_{\text{chezy}} = 225 \text{ mm}$
Flow velocity using Chezy $V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.485 \text{ m/s}$

Using the Eschritt equation

Diameter of pipe required $D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 116 \text{ mm}$
Nearest pipe diameter $D_{\text{eschritt}} = 225 \text{ mm}$
Flow velocity using Eschritt $V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) = 1.431 \text{ m/s}$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter $D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 225 \text{ mm}$
Constant $Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.235$
Flow velocity $V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s}))) \times 1 \text{ m/s}$
 $V_{\text{full}} = 1.459 \text{ m/s}$
Flow rate running full $Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 58.0 \times 10^{-3} \text{ m}^3/\text{s}$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D $x = 0.280$
Flow velocity at design flow rate $V_{\text{design}} = 1.095 \text{ m/s}$

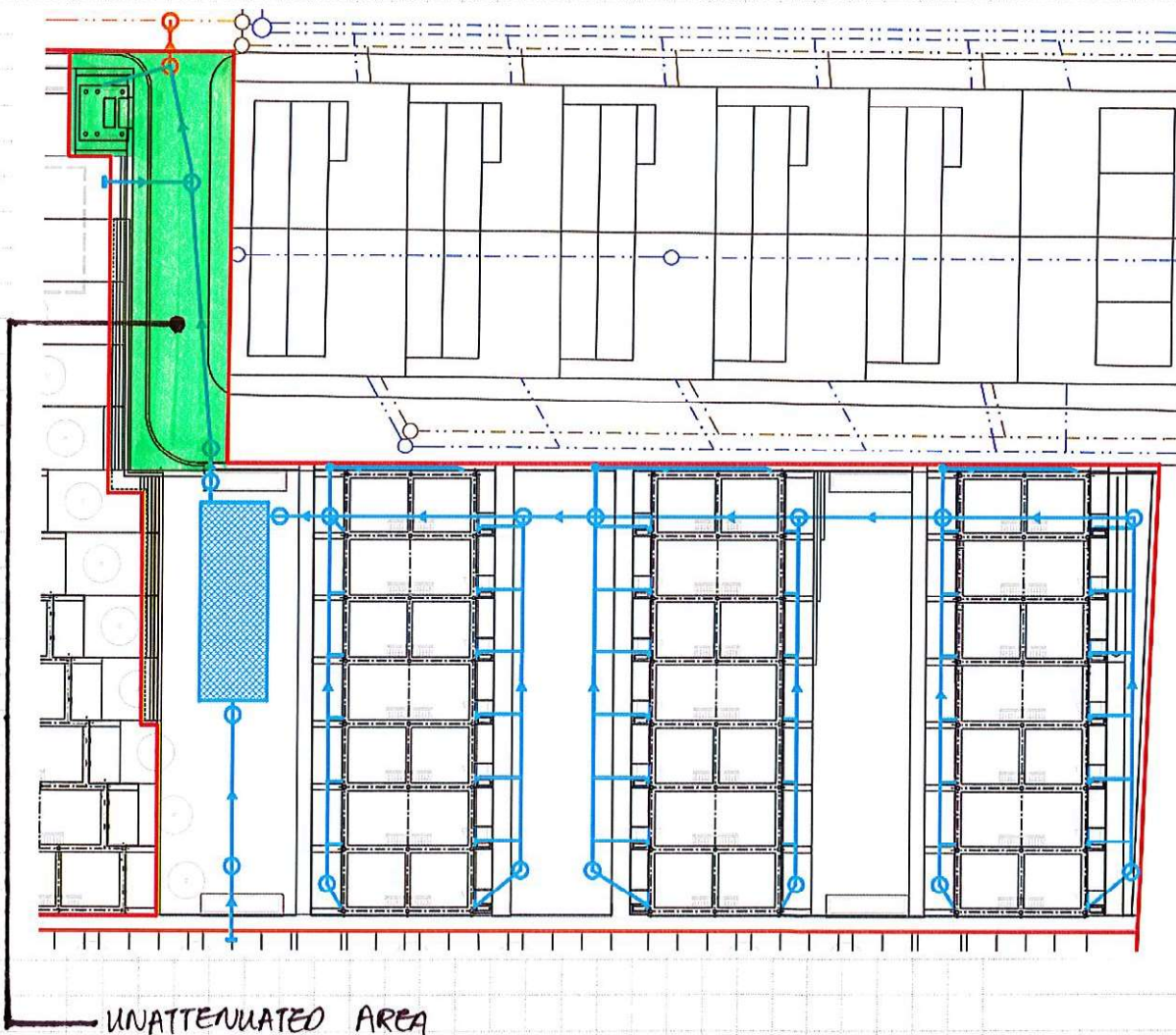
Job No	246-05	Sheet No	surface 14
Project	N13	Engineer	NR
Element	SURFACE WATER DRAINAGE	Checked by	Date 13/03/20

PHASE 3A - UNATTENUATED RUNOFF

$$\text{Area} = 282 \text{ m}^2 \quad ; \quad \text{Runoff} = 0.014 \text{ l/s/m}^2 \quad ; \quad \text{Flow} = 0.014 \times 282 = 4.4 \text{ l/s}$$

$$\text{Allowable flow into combined sewer} = 41.5 \text{ l/s}$$

$$\text{Allowable flow remaining from storage tanks} = 41.5 - 4.4 = 37.1 \text{ l/s}$$



Job No	284-05	Sheet No	Surface 15		
Project	N13	Engineer	NR	Date	13/03/20
Element	SURFACE WATER DRAINAGE		Checked by	Date	

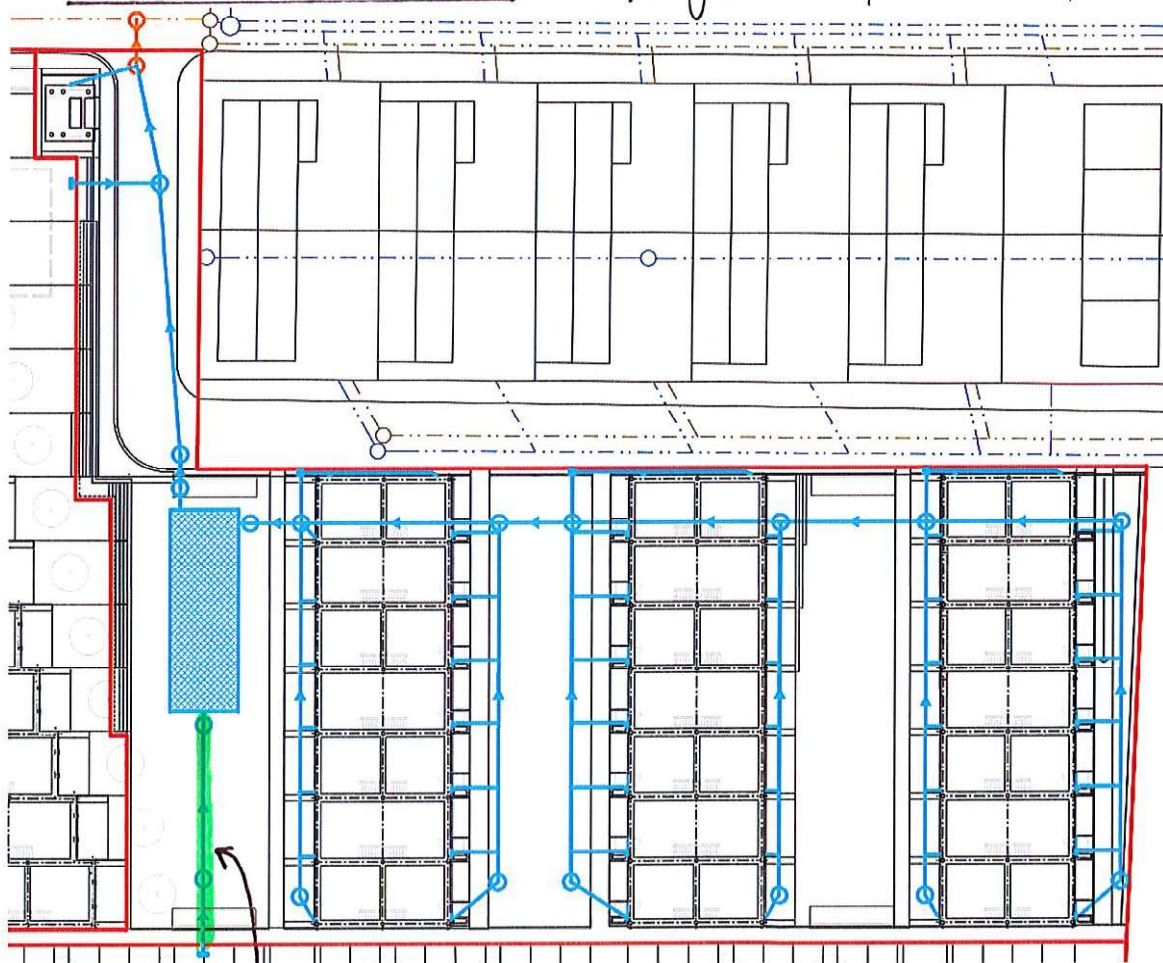
SURFACE WATER FLOW FROM SITE 3B

$$\text{Site area} = 3590 \text{ m}^2$$

$$\text{Runoff} = 0.014 \text{ l/s/m}^2 \text{ (from Part H)}$$

$$\text{Flow rate} = 3590 \times 0.014 = 50.3 \text{ l/s}$$

$$\text{Use } 225 \text{ mm } \phi @ 1:80 \Rightarrow \text{capacity} = 58.0 \text{ l/s} \gg 50.3 \text{ l/s}$$



225 mm ϕ at 1:80

Job No	244-04	Sheet No	Surface 16
Project	N13	Engineer	NR
		Date	13/03/20
Element	SURFACE WATER DRAINAGE.	Checked by	Date

ATTENUATION TANK SIZING

- Total allowable outfall from Phase 3 site (see Drainage Statement) is 41.5 l/s.
- Part of Phase 3A site is not attenuated due to difficulty of directing the flow into storage tank. Unattenuated flow = 4.4 l/s.
Remaining allowable flow from attenuation tanks = 37.1 l/s.
- See attached tank size calculation for full site.
Total impermeable site area = 1639 + 3590 + 1476 = 6705 m²
60% climate change + 1 in 100 year storm.
Total storage area required = 169.1 m³
- Apportion tank sizes + flow control rate between each site relative to the relevant area.

Phase 3A tank serves site 3A + 3B ;

$$\text{Tank size} = \frac{3590 + 1639}{6705} \times 169.1 = 131.9 \text{ m}^3$$

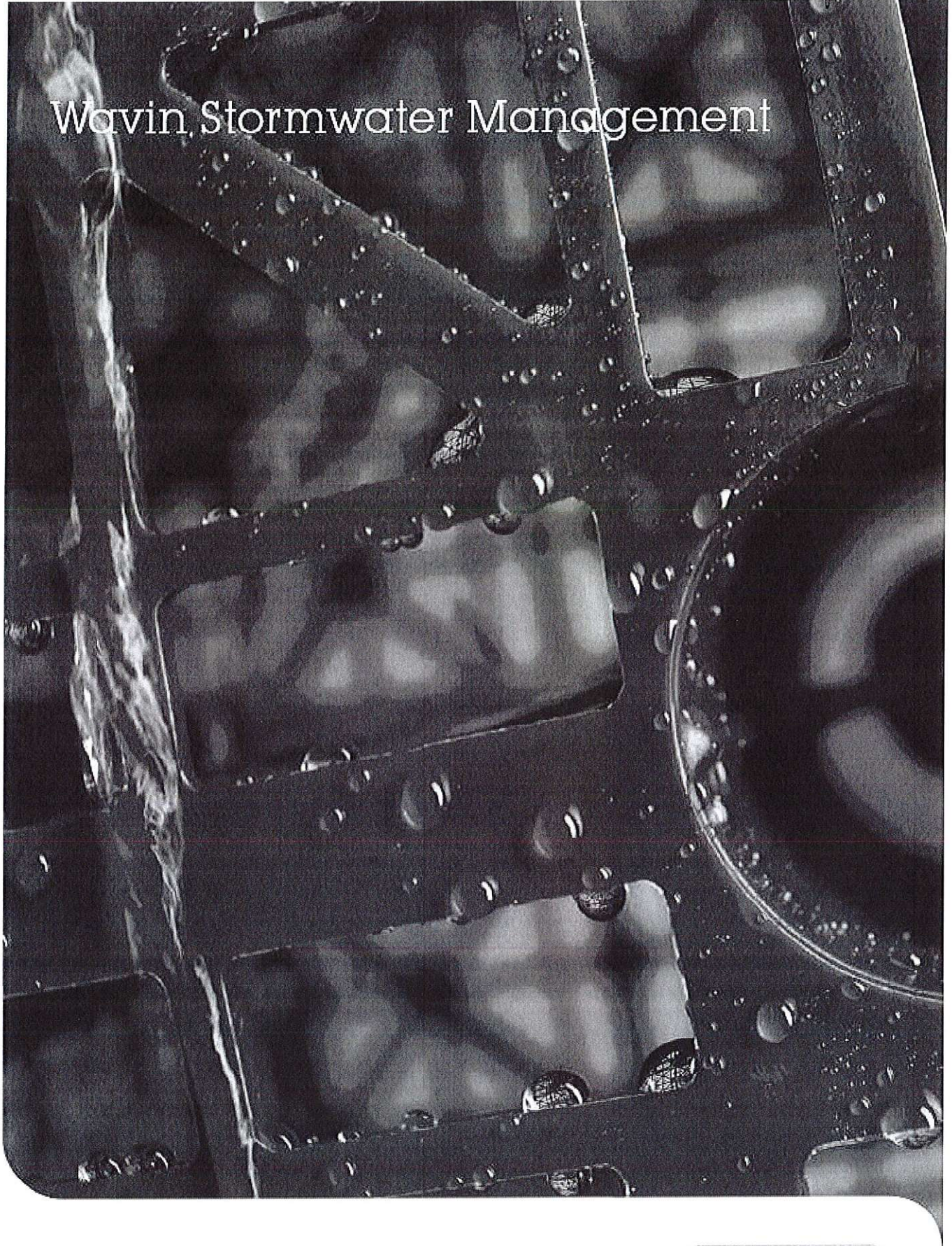
$$\text{Flow control} = \frac{3590 + 1639}{6705} \times 37.1 = 28.9 \text{ l/s}$$

Phase 3C tank serves site 3C only ;

$$\text{Tank size} = \frac{1476}{6705} \times 169.1 = 37.2 \text{ m}^3$$

$$\text{Flow control} = \frac{1476}{6705} \times 37.1 = 8.2 \text{ l/s}$$

Wavin Stormwater Management



CONNECT TO BETTER

Wavin Stormwater Management

Project Details

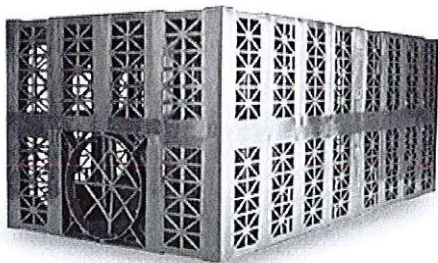
Project Name	New Islington Phase 3	Produced By	Nick Rule
Client Name	Urban Splash		
Site Address	, M4 6AS	Date	13/03/2020

Modular Units and Tank Details - Storage Size - Full Phase 3 site

Length	20m	20 units	Void	95%
Width	8m	16 units	Cover Depth	0.7m
Depth	1.2m	3 units	Installation Depth	1.9m
Total Number of Units	960 units			

Recommended Unit

Wavin recommend using the following unit for your installation.



AquaCell Core R

Product Number: 6LB100
AquaCell Core has been designed for use in deep applications, subject to both regular and heavy traffic loadings, such as cars and HGV's (for vehicles up to 44 tonnes).

Drainage Details

Area	6705m ²	Allowable Discharge	37.1 ltr/sec
Catchment Type	Roof + Hardstanding	Climate Change	40%
Area Reduction Factor	0.9	Effective Area	8448.3m ²
Soil Type	Silty sandy clay	Factor of Safety	1

Rainfall Data

R Value	0.33	Storm Return Period	1 in 100 years
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M5-60

18 County

Greater Manchester

Time	Z1 Value	y mm	Z2 Value	p mm	Inflow	Outflow	Storage Volume
5min	0.35	6.3	1.81	11.4	96.34	11.13	85.21
10min	0.5	9	1.89	17.01	143.71	22.26	121.45
15min	0.61	10.98	1.91	20.97	177.18	33.39	143.79
30min	0.78	14.04	1.91	26.82	226.55	66.78	159.77
1hr	1	18	1.99	35.82	302.62	133.56	169.06
2hr	1.22	21.96	2.03	44.58	376.62	267.12	109.5
4hr	1.56	28.08	2.01	56.44	476.83	534.24	-57.41
6hr	1.72	30.96	1.97	60.99	515.27	801.36	-286.09
10hr	2	36	1.97	70.92	599.15	1335.6	-736.45
24hr	2.6	46.8	1.89	88.45	747.27	3205.44	-2458.17
48hr	3.25	58.5	1.81	105.89	894.55	6410.88	-5516.33

Critical storm duration (hrs) 1hr

Required Storage Height 169.06m

Volume from Dimensions 182.4m³

Surfex 20

Area Sales Manager

If you would like to find out how to purchase, please contact your Area Sales Manager

Name	Michael Rose
Phone Number	07966 333620

Aquacell Disclaimer

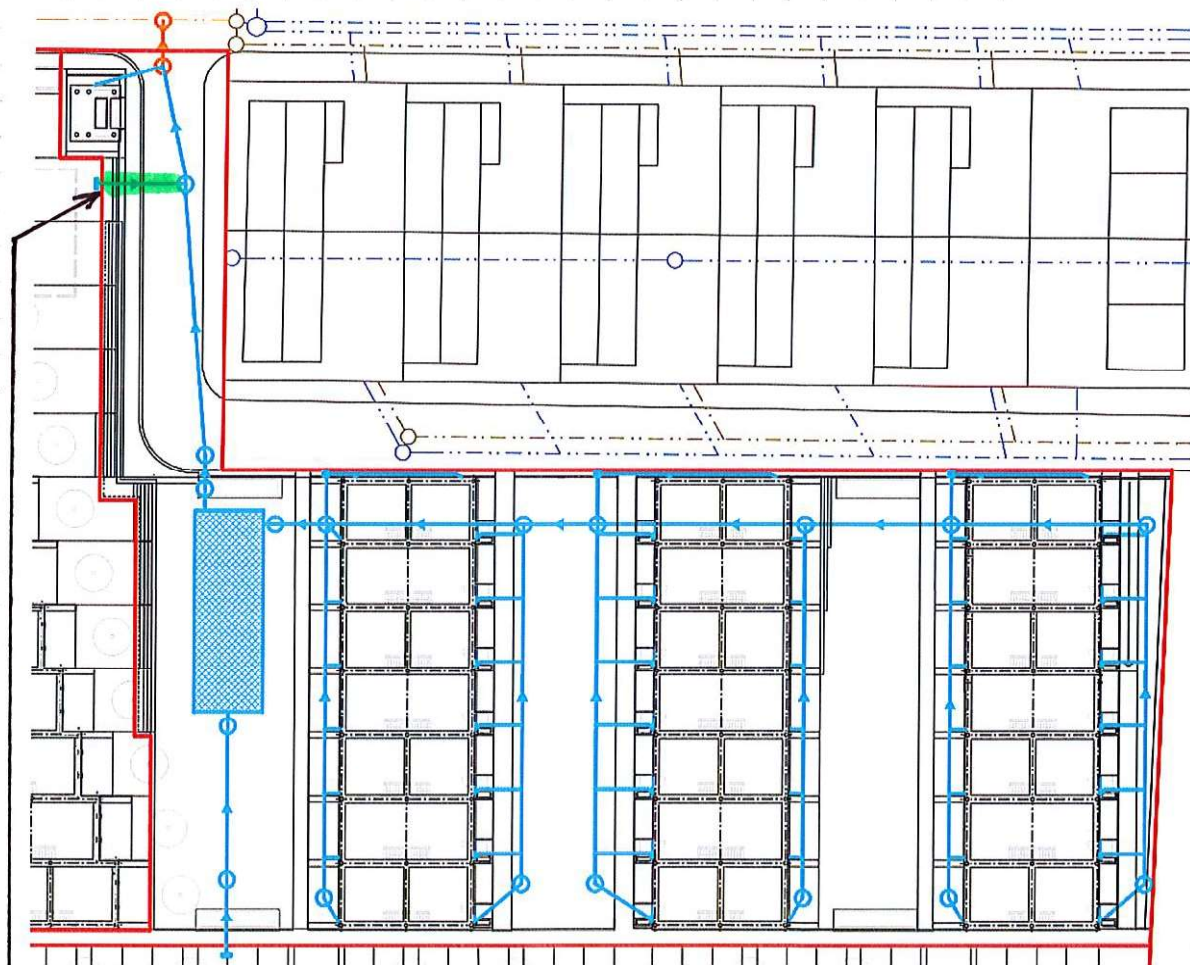
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- Wavin offers a program of continuous improvement and reserves the right to modify the specification of products without notice.
- All information in this publication is believed to be correct at time of preparation. However, no responsibility can be accepted for any errors or omissions. Final determination of the suitability of information or material for the use contemplated and the manner of the use is the sole responsibility of the user
- Calculations are based upon relevant industry standards in accordance with the Wallingford Procedure, and should be verified by a qualified engineer.

Job No	244-05	Sheet No	Surface 21
Project	N13	Engineer	NR
Element	SURFACE WATER DRAINAGE.	Checked by	Date 13/03/20
			Date

SURFACE WATER FROM PHASE 3C

From attenuation Tank size, surface water from 3C restricted to 8.2 l/s.

Use 150mm ϕ pipe @ 1:40 $\Rightarrow$ capacity = 11 l/s $\gg$ 8.2 l/s
(from PART H)



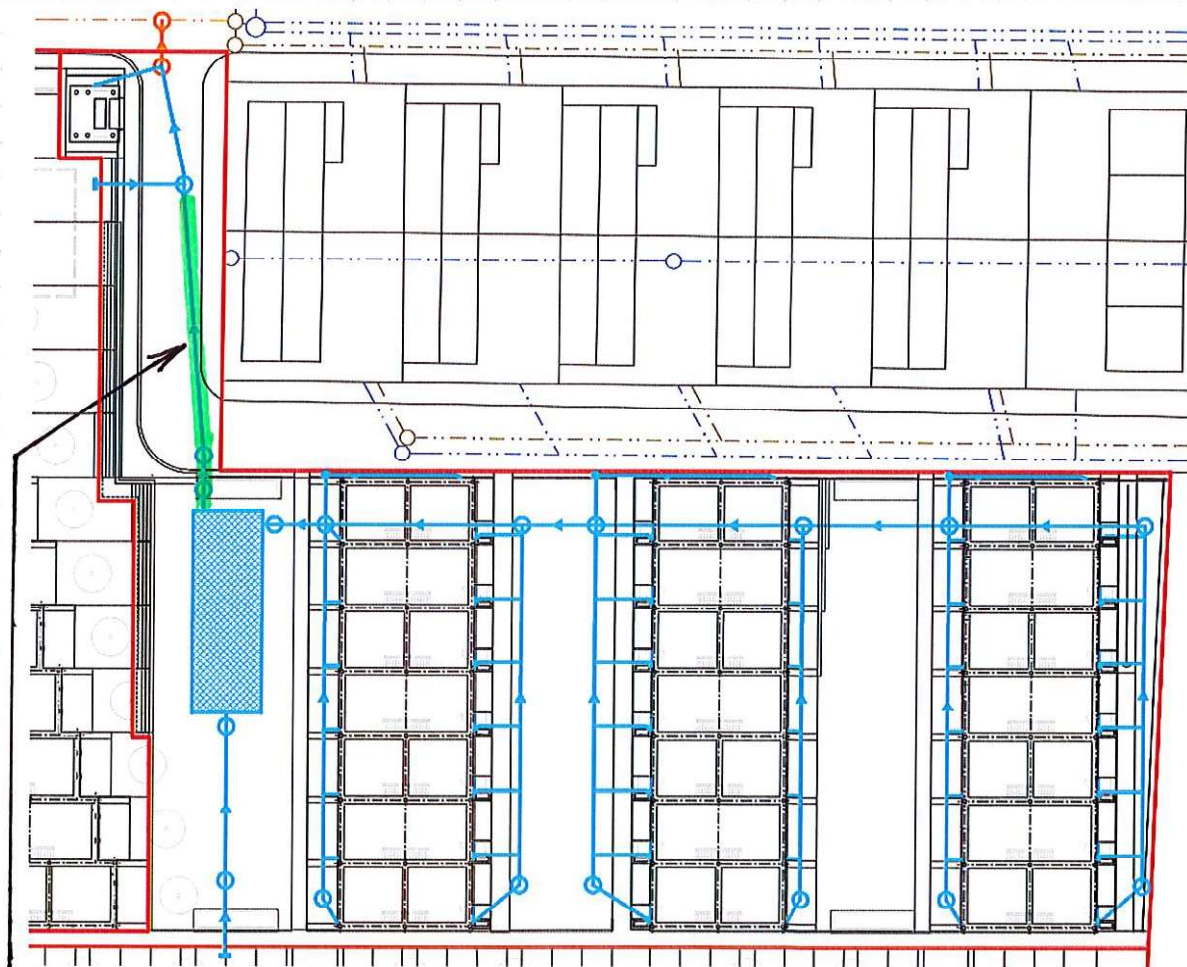
150mm ϕ @ 1:40

Job No	284-05	Sheet No	Surface 22
Project	N13	Engineer	NR
Element	SURFACE WATER DRAINAGE.	Checked by	Date 13/03/20

ATTENUATED SURFACE WATER FROM 3A + 3B

From tank calc, discharge from tank = 24.9 l/s

use 225mm ϕ pipe at 1 in 80 $\Rightarrow$ capacity = 54.0 l/s



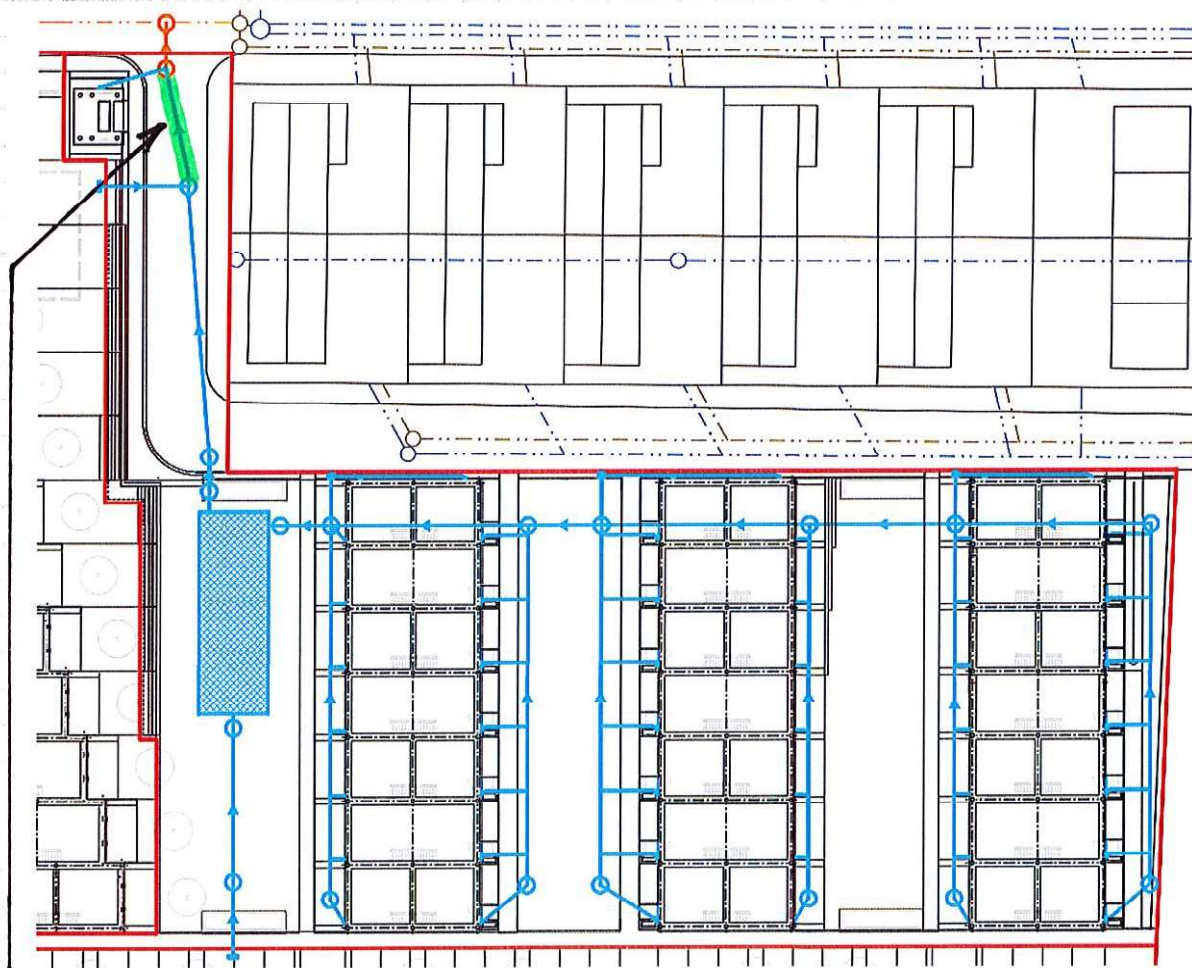
225mm ϕ at 1 in 80

Job No	284-05	Sheet No	Surface 23
Project	NIS	Engineer	NR
Element	SURFACE WATER DRAINAGE	Checked by	Date

SURFACE WATER FROM 3A, 3B & 3C

Total discharge of surface water = 41.5 l/s in accordance with Joule Drainage Statement.

Use 225mm ϕ pipe at 1 in 80 $\Rightarrow$ capacity 58.0 l/s (from previous Teddo calc.).



225mm ϕ @ 1 in 80.