### APPENDIX E

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Preliminary Drainage Layout & Site Proposals





Due Chalter

		N	OTES				
Site Boundary     W     Existing Combined Sew	er	1.	Invert leve where nev confirmed	ls and positions of a connections are to the engineer price to the	existing drains / cha b be made must be or to the commence	ambers / sew checked and ment of any	ers works.
Proposed Foul Water Se	ewer	2.	All drainag	e works shall be ca	arried out in accord	ance with the	o o ol i o
Proposed Storm Water	Sewer		conjunctio	nts of the Local Aut n with all relevant B r Adoption' 7th Edit	nority, the Environr British Standards, C ion and any adden	nent Agency odes of Pract dums as	and in ice and
Proposed Combined Wa	ater Sewer		appropriat	e.			
Proposed Private Surfac	e Water Manholes:	3.	All drainaç requireme	e shall comply with nts of BS EN 752 a	the typical details nd Part H of the Bu	and the iilding Regula	tions.
- 450mm dia PPIC - 750 x 675mm RC Ins	situ Manhole	4.	Any part o new scher shall be re	f the existing draina ne shall be cleaned paired using appro	age system to be re and inspected. An priate and approve	tained as par y structural d d means.	t of the efects
Proposed Private Foul W	/ater Manholes	5.	For setting or Mechar	-out dimensions of ical Engineer's dra	SVP's, RWP's etc, wings. Positions sh	refer to Archi own are indic	tect's ative
- 450mm dia PPIC		6.	All foul and otherwise	d RWP connections specified.	s shall be 100mm d	iameter unles	S
- 1200 x 900mm RC Ir	nsitu Manhole	7.	All precast manufactu	concrete units use red using sulphate	d in the drainage wresisting cement.	orks shall be	
- 900mm dia PCC Ma Proposed Combined Wa	nhole ter Manhole	8.	Manhole c Kitemarke carriagewa footways a covers sha in accorda	overs and frames s d. Covers and fram ays and vehicular a and soft landscaping Ill be recessed fabr nce with the FACT	hall be to BS EN 12 es shall be heavy c reas and medium d g. In blocked/conci icated steel. All rec A association gradii	24 and shall b luty D400 in luty B125 in rete paved an essed covers ngs.	eas shall
1200 x 900mm RC Insitu	I Manhole	9.	All interna screw dow	inspection chambern covers.	ers to be recessed,	double seale	d with
Soil Vent Pipe/stub Stac	k	10.	Cover leve	ls are to be adjuste	ed locally to suit fini	shed ground	levels.
Proposed Rainwater Pipe	e	11.	At least or atmosphered	e soil pipe at the he	ead of each foul rur	n shall vent to	the
Proposed Floor Gully		12.	Existing dr void backf exceeding	ainage to be remov illed with granular n 250mm.	ved is to be broken naterial, compacted	out to bed lev I in layers not	vel and
Proposed Yard Gully		13.	All drain ru gradient u unless oth	ins from SVP's, stu nless otherwise sta erwise stated.	b stacks or FW gul ted. All RWP's to b	lies to be laid e laid 1:80 mi	at 1:40 n
Private Pumping station		14.	All manho recessed o orientated	es / inspection cha covers. MH covers i 'square' with pavir	mbers in block pav in paved areas to h ig to minimise cut s	ed areas, to h ave cover & f labs or blocks	nave rame s.
Manhole with hydro-brak dia PCC)	xe (1200mm	15.	All private pipes, eith BS EN 299 be Cast Ire	drainage to be laid er uPVC to BS 466 5. Pipes below struc on to BS 437.	to levels shown us 0 and BS 5481 or v ctural building slabs	ing flexibly jo vitrified claywa s or basemen	inted are to ts shall
<ul> <li>Attenuation Tank with Person Distributor Pipe</li> </ul>	erforated	16.	Rodding e and depth	yes, etc are to be la to allow adequate f	aid to manufacturer fall from adjoining u	s minimum co Init.	over
		17.	All propos to ensure	ed trees to have ap roots are directed a	propriate tree barrie way from drainage	er details link	ing pits
C101		18.	Where new tree the se Refer to di	v sewers are const wer shall be concre ainage details.	ructed within 5m of ete encased agains	a new or exis t root intrusio	sting n.
		19.	All new dra Contractor to Drainag	ainage to be jetted to make sure that e maintenance mai	and CCTV surveye the drainage is fully nual for maintenand	d on complet operational. ce details.	ion. Refer
		20.	All runs co clay, extra socketed f	nnecting into the p length to BS EN 29 lexible joints.	ublic drainage netw 95 or BS65 with pla	ork to be vitri in sleeved or	fied
		21.	CDM note attenuation cleared ou period the surface to	All pipework, silt tr n tanks to be regula t on a regular frequ frequency can be r be regularly swept	aps, catchpits, trap arly inspected every lency for the first ni educed to every siv three times a year	ped gullies a three month ne months. A months. Por to remove the	nd s and fter this ous e silt.
		22.	This drawi drawings.	ng is to be read in o	conjunction with all	relevant Con	isbee
nt = ent = event = ble Area:	1.9 l/s 3.9 l/s 4.5 l/s 2.2 l/s 2,070 m <sup>2</sup> 2,070 m <sup>2</sup>	23.	HEALTH A competent recognised and appro work shall Safety Reg	ND SAFETY: The and experienced of I national organisat priate training for the be carried out in ac gulations.	works shall be carr contractors who are ion.Operatives sha ie operations they a ccordance with all p	ied out by spo members of Il have receiv are to underta pertinent Heal	ecialist a ed full ke. All th and
able Area: from Impermeable	2,070m <sup>2</sup>		NC	I FUR C	UNSIRU	CHON	I
ace Water discharge rate	14.0 l/s		P4 10.05.1	6 Architect's Layo	ut Updated	JC	TG
00YS + 30%CC:	70 <u>m³</u>	-	P3 25.04.1	6 Tank size revise	d	AW	TG
	T.B.C. I/s.		Rev Date	Description		Drawn	Check
tenuation Notes         Roof Area = 54m²         Max. water depth = 0         Total =3m³         Roof Area = 20m²	).08m	(	COD Consulting S Consulting C	tructural Engineers ivil Engineers	see	1-5 Offord St London N1 1D Tel 020 7700 Fax 020 7700 design@conis www.conisbee	H ) 6666 ) 6686 bee.co.uk .co.uk

Drawing	Status
Diaming	Olulus

PRELIMINARY

## Project

5-17 Haverstock Hill London NW3 2I

## Title

DRAINAGE LAYOUT **GROUND FLOOR** SHEET 1 OF 2

Date	March 2016			
Scale	1:100 @A1			
Drawn	AW			
Engineer AW				
Project No				

140870 Drawing No

C100

Revision **P4** 

Max. water depth = 0.10m

70m³

Total =20m<sup>3</sup>

Total = 47m<sup>3</sup>

63m<sup>2</sup> x 0.80m deep



	N	OTES			
Site Boundary	1.	Invert levels and where new con	d positions of existing drains / nections are to be made mus	chambers / sev t be checked ar	wers nd
Proposed Foul Water Sewer	2.	All drainage wo	rks shall be carried out in acc	cordance with th	y works. Ie
Proposed Storm Water Sewer		requirements of conjunction with	the Local Authority, the Envi an all relevant British Standard	ronment Agenc s, Codes of Pra	y and in ctice and
Proposed Combined Water Sewer		'Sewers for Add appropriate.	option' 7th Edition and any add	dendums as	
Proposed Private Surface Water Ma	nholes: <sup>3.</sup>	All drainage shared and the second se	all comply with the typical deta f BS EN 752 and Part H of the	ails and the e Building Regu	lations.
- 450mm dia PPIC - 750 x 675mm RC Insitu Manhole	4. e	Any part of the new scheme sh shall be repaire	existing drainage system to b all be cleaned and inspected.	e retained as pa . Any structural oved means	art of the defects
	5.	For setting-out or Mechanical E	dimensions of SVP's, RWP's Engineer's drawings. Positions	etc, refer to Arc s shown are ind	hitect's licative
Proposed Private Foul Water Manho - 450mm dia PPIC	oles 6.	and subject to f All foul and RW	inal design. ′P connections shall be 100m	m diameter unle	ess
- 1200 v 900mm BC Insitu Manho	Je 7.	otherwise speci	ified. crete units used in the drainad	ge works shall b	e
- 1200 x 900mm RC Insitu Manno	ne r.	manufactured u	ising sulphate resisting cemer	nt.	
- 900mm dia PCC Manhole Proposed Combined Water Manhole	8.	Manhole covers Kitemarked. Co carriageways a footways and s covers shall be in accordance v	s and frames shall be to BS E vers and frames shall be hea nd vehicular areas and mediu oft landscaping. In blocked/co recessed fabricated steel. All with the FACTA association g	N 124 and shall vy duty D400 in im duty B125 in oncrete paved a recessed cove radings.	l be areas rs shall
1200 x 900mm RC Insitu Mannole	9.	All internal insp screw down cov	ection chambers to be recess vers.	sed, double sea	led with
Soil Vent Pipe/stub Stack	10.	Cover levels are	e to be adjusted locally to suit	finished ground	d levels.
Proposed Rainwater Pipe	11.	At least one soi atmosphere.	I pipe at the head of each fou	I run shall vent	to the
Proposed Floor Gully	12.	Existing drainag void backfilled v exceeding 250r	ge to be removed is to be brol with granular material, compa nm.	ken out to bed le cted in layers ne	evel and ot
Proposed Yard Gully	13.	All drain runs fr gradient unless unless otherwis	om SVP's, stub stacks or FW otherwise stated. All RWP's t e stated.	gullies to be lai to be laid 1:80 r	d at 1:40 nin
Private Pumping station	14.	All manholes / i recessed cover orientated 'squa	nspection chambers in block s. MH covers in paved areas are' with paving to minimise c	paved areas, to to have cover & cut slabs or bloc	have frame ks.
Manhole with hydro-brake (1200mm dia PCC)	15.	All private drain pipes, either uP BS EN 295. Pip be Cast Iron to	age to be laid to levels shown VC to BS 4660 and BS 5481 ses below structural building s BS 437.	n using flexibly j or vitrified clayv labs or baseme	ointed ware to nts shall
<ul> <li>Attenuation Tank with Perforated</li> <li>Distributor Pipe</li> </ul>	16.	Rodding eyes, o and depth to all	etc are to be laid to manufactu ow adequate fall from adjoinir	urers minimum o ng unit.	cover
	17.	All proposed tre to ensure roots	ees to have appropriate tree b are directed away from drain	arrier details lin age.	king pits
C101	18.	Where new sev tree the sewer s Refer to drainag	vers are constructed within 5r shall be concrete encased ag ge details.	n of a new or e» ainst root intrus	kisting ion.
	19.	All new drainag Contractor to m to Drainage ma	e to be jetted and CCTV surv ake sure that the drainage is intenance manual for mainter	reyed on comple fully operationa nance details.	etion. I. Refer
	20.	All runs connec clay, extra leng socketed flexibl	ting into the public drainage r th to BS EN 295 or BS65 with e joints.	network to be vit a plain sleeved o	trified or
	21.	CDM note: All p attenuation tanl cleared out on a period the frequ surface to be re	pipework, silt traps, catchpits, ks to be regularly inspected en a regular frequency for the firs lency can be reduced to every egularly swept three times a ye	trapped gullies very three mont st nine months. y six months. Pe ear to remove th	and hs and After this orous he silt.
	22.	This drawing is drawings.	to be read in conjunction with	n all relevant Co	nisbee
nt = 1.9 l/s ent = 3.9 l/s event = 4.5 l/s 2.2 l/s 2,070 2,070	23. m² m²	HEALTH AND S competent and recognised nati and appropriate work shall be ca Safety Regulati	SAFETY: The works shall be experienced contractors who onal organisation.Operatives e training for the operations th arried out in accordance with ons.	carried out by s are members c shall have rece ey are to under all pertinent He	pecialist of a ived full take. All alth and
able Area: 2,070 f from Impermeable	m²	NOT	FOR CONSTR		N
ace Water discharge rate 14.0 1/s	s   -	P4 10.05.16 Ar	chitect's Layout Updated	JC	TG
00YS + 30%CC: 70 <u>m<sup>3</sup></u>	F	23 25.04.16 Ta	ank size revised	AW	TG
T.B.C. I	/s.	Rev Date De	escription	Drawn	Check
tenuation Notes Roof Area = 54m <sup>2</sup> Max. water depth = 0.08m Total =3m <sup>3</sup> Roof Area = 20m <sup>2</sup>		COT Consulting Structs	ural Engineers ngineers	1-5 Offord S London N1 1 Tel 020 77 Fax 020 77 design@con www.conisbe	t IDH 00 6666 00 6686 isbee.co.uk ee.co.uk

Drawing Status

PRELIMINARY

Project

5-17 Haverstock Hill London NW3 2I

Title

**GROUND FLOOR** SHEET 2 OF 2

Date Marc	ch 2016
Scale 1:10	)0 @A1
Drawn A	Ŵ
Engineer A	Ŵ
Project No <b>14087</b>	<u>'0</u>
 Drawing No	
C101	

Revision

**P4** 

DRAINAGE LAYOUT

Max. water depth = 0.10m

<u>70m³</u>

Total =20m<sup>3</sup>

Total = 47m<sup>3</sup>

63m<sup>2</sup> x 0.80m deep



THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS. DO NOT SCALE FROM THIS DRAWING.

		N	IOTES
pe Legend:		1.	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.
Site Bounda	агу	2.	All drainage works shall be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice and 'Sewers for Adoption' 7th Edition and any addendums as
Legend:		3.	All drainage shall comply with the typical details and the
		4	requirements of BS EN 752 and Part H of the Building Regulations.
		4.	new scheme shall be cleaned and inspected. Any structural defects shall be repaired using appropriate and approved means.
Blue Roof		5.	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.
Green Roof		6.	All foul and RWP connections shall be 100mm diameter unless otherwise specified.
		7.	All precast concrete units used in the drainage works shall be manufactured using sulphate resisting cement.
		8.	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.
		9.	All internal inspection chambers to be recessed, double sealed with screw down covers.
		10.	Cover levels are to be adjusted locally to suit finished ground levels.
		11.	At least one soil pipe at the head of each foul run shall vent to the atmosphere.
		12.	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.
		13.	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.
		14.	All manholes / inspection chambers in block paved areas, to have recessed covers. MH covers in paved areas to have cover & frame orientated 'square' with paving to minimise cut slabs or blocks.
		15.	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. Pipes below structural building slabs or basements shall be Cast Iron to BS 437.
		16.	Rodding eyes, etc are to be laid to manufacturers minimum cover and depth to allow adequate fall from adjoining unit.
		17.	All proposed trees to have appropriate tree barrier details linking pits to ensure roots are directed away from drainage.
		18.	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.
		19.	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.
		20.	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.
		21.	CDM note: All pipework, silt traps, catchpits, trapped gullies and attenuation tanks 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. Porous surface to be regularly swept three times a year to remove the silt.
		22.	This drawing is to be read in conjunction with all relevant Conisbee drawings.
		23.	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.
event = n event =	1.9 l/s 3.9 l/s	- F	P4 26.04.16 Green roof area revised AW TG
m event =	4.5 l/s 2.2 l/s	F	P3 25.04.16 Blue / green roof area revised AW TG
	2 0702	F	P2 08.04.16 Water depths revised. DN TG
neable Area: rmeable Area: n off from Impermeable	2,070 m <sup>2</sup> 2,070 m <sup>2</sup> 2,070m <sup>2</sup>	F	Rev Date Description Drawn Check
urface Water discharge rate	28.8 l/s 14.0 l/s		1-5 Offord St
<u>r 100YS + 30%CC:</u>	70 <u>m³</u>		CONISOEE London N1 1DH Tel 020 7700 6666 Eav 020 7700 6666
Je:	T.B.C. I/s.		Consulting Structural Engineers       design@conisbee.co.uk         Consulting Civil Engineers       www.conisbee.co.uk

Attenuat	Attenuation Notes			
	Roof Area = 54m² Max. water depth = 0.08m Total =3 <b>m</b> ³			
	Roof Area = 20m² Max. water depth = 0.10m Total =20 <b>m</b> ³			
	63m² x 0.80m deep <b>Total = 47m</b> ³			
ATION	<u>70m<sup>3</sup></u>			

Title DRAINAGE LAYOUT GROUND FLOOR

Drawing Status

Project

PRELIMINARY

London NW3 2I

5-17 Haverstock Hill

www.conispee.co.uk

Date	March 2016	
Scale	1:200 @A1	
Drawn	AW	
Engine	er AW	
 Project No <b>140870</b>		
Drawin	a No	

C105

Revision

**P4** 

Conisbee		Page 1
1-5 Offord Street		
Islington		<u> </u>
London N1 1DH		Micco
Date 17/03/2016 11:35	Designed by anna.wilk	
File	Checked by	Dialitada
XP Solutions	Source Control 2015.1	1
ICD SUD	S Mean Annual Flood	

#### ICP SUDS Mean Annual Flood

Input

Return Period (years)100Soil0.450Area (ha)0.207Urban0.750SAAR (mm)609RegionNumberRegion

#### Results 1/s

QBAR Rural 0.8 QBAR Urban 2.2 Q100 years 4.5 Q1 year 1.9 Q30 years 3.9 Q100 years 4.5

Conisbee			Page 1
1-5 Offord Street			
Islington			r a
London N1 1DH			Micco
Date 08/07/2016 14:29	Designed by anna	a.wilk	
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XP Solutions	Source Control 2	2015.1	
Greenf	ield Runoff Volu	me	
	ECP Data		
	FSK Dala		
Return Peric	d (years)	1	
Storm Durati	on (mins)	360	
Ν	Region England a: 15-60 (mm)	21.000	
	Ratio R	0.438	
Areal Reducti	on Factor	1.00	
	Area (ha) SAAR (mm)	609	
	CWI	88.620	
	Urban	0.000	
	SPR	47.000	
	Results		
Per	centage Runoff (%)	37.91	
Greentield	Runoll volume (m°)	17.304	
<u>@1982</u>	-2015 XP Solution	IS	

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1-5 Offord Street		
Islington		4
London N1 1DH		Micco
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XP Solutions	Source Control 2015.1	
Greenf	ield Runoff Volume	
	FSR Data	
Return Perio	d (years) 100	
Storm Durati	on (mins) 360	
	Region England and Wales	
M	5-60 (mm) 21.000 Ratio R 0.438	
Areal Reducti	on Factor 1.00	
	Area (ha) 0.207	
	SAAR (mm) 609	
	CWI 88.620	
	SPR 47.000	
	Results	
Per	centage Bunoff (%) 41 93	
Greenfield	Runoff Volume (m <sup>3</sup> ) 54.601	
©1982-	-2015 XP Solutions	

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XP Solutions	Source Cont	rol 2015.1	
Greenf	ield Bunoff	Volume	
<u>9166111</u>		Vorume	
	FSR Data		
Return Peric	od (years)	30	
Storm Durati	on (mins)	360	
N	Region Engl 15-60 (mm)	and and Wales	
Ľ	Ratio R	0.438	
Areal Reducti	on Factor	1.00	
	Area (ha)	0.207	
	SAAR (mm)	609	
	CWI	88.620	
	Urban	0.000	
	SPR	47.000	
	Results		
Per	centage Runoff	(응) 39.92	
Greeniieid	Runoll volume	(m°) 40.107	
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Conisbee		Page 1
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London N1 1DH		Micco
Date 08/07/2016 15:22	Designed by anna.wilk	
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XP Solutions	Source Control 2015.1	

#### Summary of Results for 1 year Return Period

	Sto Eve	rm nt	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360	min	Summer	8.034	0.034	34.1	O K
<mark>360</mark>	min	Winter	8.038		38.2	O K

	Storm Event		Rain (mm/hr)	Flooded Volume	Time-Peak (mins)
				(m³)	
360	min	Summer	3.663	0.0	376
360	min	Winter	3.663	0.0	376

-5 Offord Street slington ondon N1 1DB ate 08/07/2016 15:22 11e 1.srcx P Solutions Source Control 2015.1 Rainfall Model Return Period (years) N5-60 (mn) Summer Storms N5-60 (mn) Clinate Change % Summer Storms Yes Clinate Change % Clinate Change %	1-5 Offord Street Islington London N1 1DH Date 08/07/2016 15:22 Designed by anna.wilk File 1.srcx Checked by XP Solutions Source Control 2015.1 Rainfall Details Rainfall Model FSR Winter Storms Yes Return Period (years) 1 Cv (Summer) 0.750 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 21.000 Shortest Storm (mins) 360 Ratio R 0.441 Longest Storm (mins) 360 Summer Storms Yes Climate Change % +0 <u>Time Area Diagram</u> Total Area (ha) 0.207	U- D Iagi																sbee	Conis
slington ondon N1 DH ate 08/07/2016 15:22 P Solutions Source Control 2015.1 Eanfall Details Mainfall Model Second Version Region England and Wales Cr (Winter) 0.840 MS-60 (nm 21.000 Shortest Storm (mins) 360 MS-60 (nm 21.000 Shortest Storm (mins) 360 MS-60 (nm 21.000 Shortest Storm (mins) 360 MS-60 (nm 21.000 Shortest Storm (mins) 360 Summer Storms Yes Climate Change % +0 Time (mins) Area From: To: (ha) 0 4 0.051 4 8 0.052 8 12 0.052 12 16 0.052	Islington       London N1 1DH         Date 08/07/2016 15:22       Designed by anna.wilk         File 1.srcx       Checked by         XP Solutions       Source Control 2015.1         Rainfall Model         FSR       Winter Storms         Return Period (years)       1         Cv (Summer) 0.750         Region England and Wales       Cv (Winter) 0.840         M5-60 (mm)       21.000 Shortest Storm (mins)       360         Summer Storms       Yes       Climate Change %       +0         Time Area Diagram         Total Area (ha) 0.207	U D Iagi	<b>,</b>	ſ											t	eet	Stre	Offord	L-5 C
ondon N1 1DH	London N1 1DH       Designed by anna.wilk       Microsoft         Date 08/07/2016 15:22       Designed by anna.wilk       Checked by         File 1.srcx       Checked by       Checked by         KP Solutions       Source Control 2015.1       Rainfall Details         Rainfall Model       FSR       Winter Storms       Yes         Return Period (years)       1       Cv (Summer) 0.750       Region England and Wales       Cv (Winter) 0.840         M5-60 (mm)       21.000 Shortest Storm (mins)       360         Summer Storms       Yes       Climate Change %       +0         Time Area Diagram         Total Area (ha) 0.207	agi	L															ngton	Islin
ate 08/07/2016 15:22       Designed by anna.wilk Checked by         p Solutions       Source Control 2015.1             Solutions       Source Control 2015.1             Example 1 (Model Source Control 2015.1             Source Control 2015.1             Main Source Control 2015.1             Source Control 2015.1             Refinal Model FR       FX         Where Storms Ves       Region England and Wales         Summer Storms       1       CV (Winter) 0.780         Summer Storms       Yes       Climate Change 3       40             Time (mins) Area       Time (m	Date 08/07/2016 15:22       Designed by anna.wilk Checked by         File 1.srcx       Checked by         KP Solutions       Source Control 2015.1         Rainfall Model         FSR       Winter Storms         Return Period (years)       1         CV (Summer)       0.750         Region England and Wales       CV (Winter)         M5-60 (mm)       21.000 Shortest Storm (mins)         Ratio R       0.441 Longest Storm (mins)         Summer Storms       Yes         Climate Change %       +0         Time Area Diagram         Total Area (ha)       0.207	agi	Mirco														1DH	on N1	Londo
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London N1 1DH		Micco
Date 08/07/2016 15:22	Designed by anna.wilk	
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XP Solutions	Source Control 2015.1	1

#### <u>Model Details</u>

Storage is Online Cover Level (m) 10.000

#### Tank or Pond Structure

Invert Level (m) 8.000

Depth (m)	Area (m²)						
0.000	1000.0	2.800	0.0	5.600	0.0	8.400	0.0
0.400	1000.0	3.200	0.0	6.000	0.0	8.800	0.0
0.800	1000.0	3.600	0.0	6.400	0.0	9.200	0.0
1.200	0.0	4.000	0.0	6.800	0.0	9.600	0.0
1.600	0.0	4.400	0.0	7.200	0.0	10.000	0.0
2.000	0.0	4.800	0.0	7.600	0.0		
2.400	0.0	5.200	0.0	8.000	0.0		

Conisbee		Page 1
1-5 Offord Street		
Islington		<u> </u>
London N1 1DH		Micco
Date 08/07/2016 15:25	Designed by anna.wilk	
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XP Solutions	Source Control 2015.1	1

### Summary of Results for 100 year Return Period (+30%)

	Sto Eve	rm nt	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360	min	Summer	8.127	0.127	126.6	ОК
360	min	Winter	8.142	0.142	141.8	O K

	Sto	rm	Rain	Flooded	Time-Peak
	Eve	nt	(mm/hr)	Volume	(mins)
				(m-)	
360	min	Summer	13.593	0.0	376
360	min	Winter	13.593	0.0	376

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London N	1 1DH										Micco
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				Rai	nfall	Deta	ils				
	Potumn	Rainfal	1 Model	L		FSR 100		Winte	r Stori	ms Ye	s
	Recuill i	reriou	Region	Engla	nd and	Wales		CV	(Winte	r) 0.73	0
		м5-	60 (mm)	i nigra	2	21.000	Shortes	t Stor	m (min	s) 36	0
			Ratio H	ર		0.441	Longes	t Stor	m (min	s) 36	0
		Summer	Storms	3		Yes	Cl	imate	Change	% +3	0
				Tim	e Area	a Diag	ram				
				Tata	1 7 200	(ha) 0	207				
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	0 4	0.051	4	8	0.052	8	12	0.052	12	16	0.052

Conisbee		Page 3
1-5 Offord Street		
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London N1 1DH		Micco
Date 08/07/2016 15:25	Designed by anna.wilk	
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XP Solutions	Source Control 2015.1	

#### <u>Model Details</u>

Storage is Online Cover Level (m) 10.000

#### Tank or Pond Structure

Invert Level (m) 8.000

Depth (m)	Area (m²)						
0.000	1000.0	2.800	0.0	5.600	0.0	8.400	0.0
0.400	1000.0	3.200	0.0	6.000	0.0	8.800	0.0
0.800	1000.0	3.600	0.0	6.400	0.0	9.200	0.0
1.200	0.0	4.000	0.0	6.800	0.0	9.600	0.0
1.600	0.0	4.400	0.0	7.200	0.0	10.000	0.0
2.000	0.0	4.800	0.0	7.600	0.0		
2.400	0.0	5.200	0.0	8.000	0.0		

Conisbee		Page 1
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Islington		<u> </u>
London N1 1DH		Micco
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XP Solutions	Source Control 2015.1	1

### Summary of Results for 100 year Return Period

	Sto Eve	rm nt	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360	min	Summer	8.097	0.097	97.4	O K
<mark>360</mark>	min	Winter	8.109	0.109	109.1	O K

Storm		Rain	Flooded	Time-Peak	
	Eve	nt	(mm/hr)	Volume (m³)	(mins)
360	min	Summer	10.456	0.0	376
360	min	Winter	10.456	0.0	376

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		Deł		Data	41.5				
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F	ainfall Mode			FSR		Winte	r Stor	ms Ye	S
Return B	eriod (years)			100		Cv	(Summe	r) 0.75	0
	Region	n Engla	nd and	Wales		Cv	(Winte	r) 0.84	0
	M5-60 (mm)		2	21.000	Shortes	t Stor	m (min	s) 36	0
	Ratio H	۲. -		0.441 Ves	Longes	t Stor	m (min Change	s) 36 2 +	0
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From: To:	(ha) From:	To:	(ha)	From:	To:	(ha)	From:	To:	(ha)
0 4	0.051 4	8	0.052	8	12	0.052	12	16	0.052
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London N1 1DH		Micco
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#### <u>Model Details</u>

Storage is Online Cover Level (m) 10.000

#### Tank or Pond Structure

Invert Level (m) 8.000

Depth (m)	Area (m²)						
0.000	1000.0	2.800	0.0	5.600	0.0	8.400	0.0
0.400	1000.0	3.200	0.0	6.000	0.0	8.800	0.0
0.800	1000.0	3.600	0.0	6.400	0.0	9.200	0.0
1.200	0.0	4.000	0.0	6.800	0.0	9.600	0.0
1.600	0.0	4.400	0.0	7.200	0.0	10.000	0.0
2.000	0.0	4.800	0.0	7.600	0.0		
2.400	0.0	5.200	0.0	8.000	0.0		

Conisbee		Page 1
1-5 Offord Street		
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London N1 1DH		Micco
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XP Solutions	Source Control 2015.1	1

#### Summary of Results for 30 year Return Period

	Sto Eve	rm nt	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360	min	Summer	8.075	0.075	75.1	O K
<mark>360</mark>	min	Winter	8.084	0.084	84.1	O K

Storm		Rain	Flooded	Time-Peak	
	Eve	nt	(mm/hr)	Volume	(mins)
				(m³)	
360	min	Summer	8.066	0.0	376
360	min	Winter	8.066	0.0	376

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		0	2	1 0.051	4	8	0.052	8	12	0.052	12	16	0.052

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1-5 Offord Street		
Islington		<u> </u>
London N1 1DH		Micco
Date 08/07/2016 15:23	Designed by anna.wilk	
File 1.srcx	Checked by	Digitigh
XP Solutions	Source Control 2015.1	

#### Model Details

Storage is Online Cover Level (m) 10.000

#### Tank or Pond Structure

Invert Level (m) 8.000

Depth (m)	Area (m²)						
0.000	1000.0	2.800	0.0	5.600	0.0	8.400	0.0
0.400	1000.0	3.200	0.0	6.000	0.0	8.800	0.0
0.800	1000.0	3.600	0.0	6.400	0.0	9.200	0.0
1.200	0.0	4.000	0.0	6.800	0.0	9.600	0.0
1.600	0.0	4.400	0.0	7.200	0.0	10.000	0.0
2.000	0.0	4.800	0.0	7.600	0.0		
2.400	0.0	5.200	0.0	8.000	0.0		

Conisbee						Page 1
1-5 Offord Street						
Islington						4
London N1 1DH						- Com
Date 17/03/2016 11:49	Desi	gned by	/ anna	a.wilk		
File attenuation.srcx	Chec	ked by	2			Drainage
XP Solutions	Sour	ce Cont	rol 2	2015 1		
	5001		2101 2	-010.1		
Summary of Results	for 1	10 vear	Ratur	rn Par	(+30%)	
<u>Summary of Results</u>	, 101 1	<u>ycar</u>	ite cu.		100 (1008)	
Storm	Max	Max 1	Max	Max	Status	
Event	Level	Depth Co	ntrol	Volume		
	(m)	(m) (1	1/s)	(m³)		
15 min Cumpo	0 550	0 552	12 7	55 2	O V	
30 min Summe	r 8 666	0.552	13.7 13.8	55.Z	OK	
60 min Summe	r 8.683	0.683	13.9	68.3	0 K	
120 min Summe	r 8.624	0.624	13.7	62.4	0 K	
180 min Summe	r 8.556	0.556	13.7	55.6	0 K	
240 min Summe	r 8.486	0.486	13.7	48.6	0 K	
360 min Summe	r 8.358	0.358	13.7	35.8	O K	
480 min Summe	r 8.226	0.226	13.7	22.6	O K	
600 min Summe	r 8.128	0.128	13.7	12.8	O K	
720 min Summe	r 8.061	0.061	13.7	6.1	0 K	
960 min Summe	r 8.001	0.001	13.7	0.1	0 K	
1440 min Summe	r 8.000	0.000	9.9	0.0	0 K	
2160 min Summe	r 8.000	0.000	7.1	0.0	0 K	
2880 min Summe	r 8.000	0.000	5.6	0.0	0 K	
4320 min Summe	r 8.000	0.000	4.0	0.0	ΟK	
5760 min Summe	r 8.000	0.000	3.1	0.0	ΟK	
7200 min Summe	r 8.000	0.000	2.6	0.0	ΟK	
8640 min Summe	r 8.000	0.000	2.2	0.0	ΟK	
10080 min Summe	r 8.000	0.000	2.0	0.0	O K	
15 min Winte	r 8.554	0.554	13.7	55.4	O K	
30 min Winte	r 8.670	0.670	13.8	67.0	O K	
Storm	Rain	Flooded	Disch	arge T	ime-Peak	
Event	(mm/hr)	Volume	Volu	me	(mins)	
		(m³)	(m³	')		
15 min Summer	139.783	0.0		72.4	23	
30 min Summer	90.217	0.0		93.2	34	
60 min Summer	55.351	0.0	1	14.1	56	
120 min Summer	32.791	0.0	1	36.5	90	
180 min Summer	23.828	0.0	1	47.6	124	
240 min Summer	18.892	0.0	1	55.8	158	
360 min Summer	13.617	0.0	1	69.1	224	
480 min Summer	10.786	0.0	1	78.2	284	
600 min Summer	8.997	0.0	1	86.3	338	
720 min Summer	7.754	0.0	1	92.5	390	
960 min Summer	6.129	0.0	2	03.0	490	
1440 min Summer	4.394	0.0	2	18.3	0	
2160 min Summer	3.146	0.0	2	34.4	0	
2880 min Summer	2.480	0.0	2	46.4	0	
4320 min Summer	1.771	0.0	2	64.0	0	
5760 min Summer	1.394	0.0	2	77.0	0	
7200 min Summer	1.157	0.0	2	87.4	0	
8640 min Summer	0.993	0.0	2	96.1	0	
10080 min Summer	0.873	0.0	3	03.6	0	
15 min Winter	139.783	0.0		72.4	23	
30 min Winter	90.217	0.0		93.0	34	
	82-2015	XP SOL	ut i nn	1.S		

Conisbee						Page 2
1-5 Offord Street						
Islington						4
London N1 1DH						
Date 17/03/2016 11:49	Des	igned b	y anna	a.wil	k	
File attenuation.srcx	Cheo	cked by	<u> </u>			Drainag
XP Solutions	S0111	rce Con	trol	2015	1	
AI SOLUCIONS	5001			2010.	±	
Summary of Results	s for 1	00 vear	Retu	rn Pe	riod (+30%)	
		-				
Storm	Max	Max	Max	Max	Status	
Event	Level	Depth Co	ontrol	Volume	2	
	(m)	(m)	(1/S)	(m°)		
60 min Winter	r 8.691	0.691	13.9	69.1	ОК	
120 min Winter	r 8.606	0.606	13.7	60.6	о к	
180 min Winter	r 8.506	0.506	13.7	50.6	о к	
240 min Winter	r 8.401	0.401	13.7	40.1	. ОК	
360 min Winter	r 8.185	0.185	13.7	18.5	ОК	
480 min Winter	r 8.043	0.043	13.7	4.3	ОК	
600 min Winter	r 8.000	0.000	13.1	0.0	ОК	
720 min Winter	r 8.000	0.000	11.3	0.0	ОК	
960 min Winter	r 8.000	0.000	8.9	0.0	) OK	
1440 min Winter 2160 min Winter	r 8.000	0.000	6.4	0.0	) OK	
2160 min Winter	r 8.000	0.000	4.6	0.0		
2880 min Winter	r 8.000	0.000	3.6	0.0	) OK	
4320 Min Winter	r 8 000	0.000	2.0	0.0	) OK	
7200 min Winter	r 8 000	0.000	2.0	0.0		
8640 min Winter	r 8.000	0.000	1.4	0.0	) ОК	
10080 min Winter	r 8.000	0.000	1.3	0.0	) ОК	
Storm	Rain	Flooded	l Disch	arge 1	Time-Peak	
Event	(mm/hr)	Volume	Volu	ume	(mins)	
		(m³)	(m	3)		
60 min Winter	55.351	0.0	) 1	15.2	58	
120 min Winter	32.791	0.0	) 1	35.5	94	
180 min Winter	23.828	0.0	) 1	48.1	132	
240 min Winter	18.892	0.0	) 1	56.7	168	
360 min Winter	13.617	0.0	) 1	69.0	228	
480 min Winter	10.786	0.0	) 1	78.4	276	
600 min Winter	8.997	0.0	) 1 ) 7	.86.2	0	
/20 min Winter	1.154	0.0		92.0	U	
960 min Winter	0.129	0.0	) 2 ) 2	19 2	U	
1440 Min Winter 2160 min Winter	4.394		ν ∠ Γ Γ	. 10.J	0	
2880 min Winter	2 480		) 2	246 4	0	
4320 min Winter	2.400	0.0	, 2 ) 2	264.0	0	
5760 min Winter	1.394	0.0	) 2	277.0	0	
7200 min Winter	1.157	0.0	) 2	287.4	0	
8640 min Winter	0.993	0.0	) 2	96.1	ů 0	
10080 min Winter	0.873	0.0	) 3	803.6	0	

Conisbee		Page 3
1-5 Offord Street		
Islington		Y.,
London N1 1DH		Micro
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XP Solutions	Source Control 2015.1	
Ra	infall Details	
Rainfall Model Return Period (years) Region Engla M5-60 (mm) Ratio R Summer Storms	FSR Winter Storms Ye 100 Cv (Summer) 1.00 and and Wales Cv (Winter) 1.00 21.000 Shortest Storm (mins) 10 0.439 Longest Storm (mins) 1008 Yes Climate Change % +3	es 00 15 30 30
Tin	ne Area Diagram	
Tota	al Area (ha) 0.207	
Time (mins) Area Ti From: To: (ha) Fro	me (mins) Area Time (mins) Area om: To: (ha) From: To: (ha)	
0 4 0.069	4 8 0.069 8 12 0.069	
©1982-	2015 XP Solutions	

1-5 Offord Street         Jalington         London N1 10H         Date 17/03/2016 11:49         Designed by anna.wilk         Checked by         XP Solutions         Source Control 2015.1         Model Details         Storage is Online Cover Level (m) 10.000         Tank or Pond Structure         Invert Level (m) 8.000         Depth (n) Area (n') Depth (n) Area (n') Depth (n) Area (n') Depth (n) Area (n')         0.000       100.0       2.800       0.0       5.600       0.8.600       0.0         0.400       100.0       3.600       0.0       5.600       0.0       9.800       0.0         1.200       0.8       4.400       0.0       7.700       0.0       0.00       0.0         2.400       0.0       5.200       0.0       7.600       0.0       0.00       0.0       0.00         2.400       0.0       5.200       0.0       7.600       0.0       0.0       0.00       0.0       0.0         2.400       0.0       5.200       0.0       1.200       14.0       1200       0.0       0.0       0.0         2.400       0.0	Conisbee							Page 4
Islington London       Million       Million       Million         Date 17/03/2016 11:49 File attenuation.srcx       Designed by anna.wilk Checked by       Designed by anna.wilk Checked by         Y Solutions       Source Control 2015.1       Designed by anna.wilk Checked by       Designed by anna.wilk Checked by         Model Letails       Storage is online Cover Level (m) 10.000       External of the storage is online Cover Level (m) 10.000         Depth (n) Ares (n')       Pepth (n) Ares (n')       Pepth (n) Ares (n')       Pepth (n) Ares (n')         0.000       100.0       3.200       0.0       6.400       0.0       9.500       0.0         0.000       100.0       3.200       0.0       6.400       0.0       9.500       0.0         0.000       100.0       3.200       0.0       6.400       0.0       9.500       0.0         0.000       0.0       4.600       0.0       7.200       0.0       10.000       0.0         1.600       0.0       4.600       0.0       7.200       0.0       10.000       0.0         2.400       0.0       5.200       0.0       7.600       1.200       1.200       1.200         Design Plow (r/s)       Internal Medd (m)       1.200       1.200       1.200	1-5 Offord Str	eet						
London         N1 1DH         Designed by anna.wilk         Diversity           Date 17/03/2016 11:49         Checked by         Diversity         Diversity           XP Solutions         Source Control 2015.1         Designed by anna.wilk         Diversity           XP Solutions         Source Control 2015.1         Diversity         Diversity         Diversity           Kendel         Lance Control Structure         Diversity         Diversity         Diversity         Diversity           Diversity         New Level (n) 8.00         0.0         5.600         0.0         5.800         0.0           0.000         100.0         3.200         0.0         6.600         0.0         5.800         0.0           0.400         100.0         3.200         0.0         6.600         0.0         5.800         0.0           1.200         0.0         4.600         0.0         5.800         0.0	Islington							4
Date 17/03/2016 11:49         Designed by anna.wilk Checked by         Designed by anna.wilk Checked by         Designed by anna.wilk Checked by         Designed by anna.wilk Checked by           Source Control 2015.1           Model Details           Storage is Online Cover Level (m) 10.000           Details           Invert Level (m) 8.000           Depth (m) Area (n*)         Depth (m) Area (m*)         Desting Prove (1/s)           Minimum Outlet Pipe Diameter (mm)         1200           Suggested Kanhol Eisemeter (mm)         1200           Noter Prov (1/s)           Mean Flow over Head Pange         13.9            Pepth (n) Flow (1/s)<	London N1 1DH							1 mm
Description         Description         Description         Description           XP Solutions         Source Control 2015.1         Model Details         Checked by         Description           Model Details           Storage is Online Cover level (n) 10.000           Tank or Fond Structure           Invert level (n) 8.000           Depth (n) Area (n²)         Depth (n) Area (n²)           0.000         100.0         2.800         0.0         6.600         0.0         8.400         0.0           0.000         100.0         3.600         0.0         6.600         0.0         8.400         0.0           0.000         100.0         3.600         0.0         6.600         0.0         9.600         0.0           1.200         0.0         4.400         0.0         7.200         0.0         0.0           2.400         0.0         7.600         0.0         1.200         0.0         0.0           2.400         0.0         7.500         Minimum Outlet Pipe Diameter (rm)         1200         14.0           Flow (L/g)         14.0           Flow 1/grad         1.20           Minimum Outlet Pipe Dia	Date 17/03/201	6 11•4	9	Designe	d by ann	a wilk		MICIO
Model Details         Source Control 2015.1           Model Details           Source Control 2015.1           Model Details           Storage is Online Cover Level (m) 10.000           Tank or Pond Structure           Tovert Level (m) 8.000           Depth (n) Area (m') Depth (n) Area (m') Depth (n) Area (m') O.000           0.000         100.0         2.800         0.0         6.400         0.0           0.000         100.0         2.800         0.0         6.400         0.0         8.400         0.0           0.000         100.0         3.200         0.0         6.400         0.0         8.400         0.0           1.200         0.0         4.400         0.0         7.200         0.0         10.200         0.0           1.200         0.0         4.400         0.0         7.600         0.0         1.200           1.200         0.0         4.400         0.0         7.600         0.0         1.200           1.200         0.0         5.200         0.0         8.000         1.200         1.0           1.200         1.0         0.0         5.200         0.0         1.200 <t< td=""><td>Date 17/05/201</td><td>0 11.4</td><td><i>.</i></td><td>Charles</td><td>u by anno br</td><td>a.wiik</td><td></td><td>Drainage</td></t<>	Date 17/05/201	0 11.4	<i>.</i>	Charles	u by anno br	a.wiik		Drainage
Model Details           Model Details           Source Control 2015.1           Model Details           Storage is Online Cover Level (m) 10.000           Tark or Pond Structure           Invert Level (m) 8.000           Depth (m) Area (m <sup>2</sup> )         Depth (m) Area	File attenuati	on.src	X	Checked	y y			Brainage
Definition of the second seco	XP Solutions			Source	Control 2	2015.1		
Determine         Storage is Online Cover Level (m) 10.000         TARK OF POINT STUCTURE         Tark of Point (m) Area (m²)       Depth (m) Area (m²) <t< td=""><td></td><td></td><td></td><td>Madal Da</td><td></td><td></td><td></td><td></td></t<>				Madal Da				
Storage is Online Cover Level (m) 10.000         JAC PER				<u>Model De</u>	talls			
Extrage is contract based on the Bead/Discharge relationship for the approximate dependence of the store result.			Storago is	Online Cour	r Iovol (m	) 10 000		
Tark or Pond StructureThere for the formation of			Storage is	UNITINE COVE	T Tevet (m	10.000		
Invert Level (m) 8.000         Depth (m) Area (m²) Depth (m) Area (n²) Depth (m) Area (m²)         0.000       100.0       2.800       0.0       6.600       0.0       8.600       0.0         0.300       100.0       3.600       0.0       6.600       0.0       8.600       0.0         0.300       100.0       3.600       0.0       6.600       0.0       8.600       0.0         1.600       0.0       4.600       0.0       7.600       0.0       10.000       0.0         2.000       0.0       5.200       0.0       8.600       0.0       10.000       0.0         2.000       0.0       5.200       0.0       8.600       0.0       10.000       0.0         2.000       0.0       5.200       0.0       8.600       0.0       10.000       0.0         2.000       0.0       5.200       0.0       8.600       0.00       12.00         Design Filew (1/s)       Inter Ference MD-SHE-0166-1400-1200-1400       Design Filew (1/s)       Inter Filew       Calculated       0.50         Diameter (m)       12.00       13.9       Flush-Filew       0.363       13.9       Flush-Filew       0.363       13.9     <			Tanl	or Pond	Structur	e		
Invert Level (m) 8.000         Popth (m) Area (m')       Red (m)       <			<u>10111</u>		berdeedi	<u> </u>		
Depth (m) Area (m²)         Depth (m) Area (m²)         Depth (m) Area (m²)         Depth (m) Area (m²)           0.000         100.0         3.200         0.0         5.600         0.0         8.400         0.0           0.400         100.0         3.200         0.0         6.000         0.0         8.400         0.0           1.200         0.0         4.000         0.0         6.600         0.0         9.600         0.0           1.200         0.0         4.400         0.0         7.200         0.0         10.000         0.0           2.400         0.0         4.600         0.0         7.600         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         12.00            Missinger         1.200         1.200         12.0			In	vert Level	(m) 8.000			
0.000         100.0         2.800         0.0         5.600         0.0         8.400         0.0           0.400         100.0         3.200         0.0         6.000         0.0         8.400         0.0           1.200         0.0         4.000         0.0         6.600         0.0         9.200         0.0           1.200         0.0         4.000         0.0         7.200         0.0         9.600         0.0           2.000         0.0         4.800         0.0         7.600         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         8.000         0.0         10.000         0.0           2.400         0.0         5.200         0.0         1.200         1.200         1.200         1.200         1.200         1.200         1.200         1.200	Depth (m) A:	rea (m²)	Depth (m) A	area (m²) D	epth (m) An	rea (m²) De	epth (m) A	Area (m²)
0.400         100.0         3.200         0.0         6.000         0.0         8.800         0.0           0.800         100.0         3.600         0.0         6.400         0.0         9.200         0.0           1.200         0.0         4.400         0.0         7.200         0.0         9.600         0.0           2.400         0.0         5.200         0.0         8.000         0.0         0.00           2.400         0.0         5.200         0.0         8.000         0.0         0.00           2.400         0.0         5.200         0.0         8.000         0.0         0.00           2.400         0.0         5.200         0.0         8.000         0.0         0.00           Design Flow (1/2)         14.0         1.200         14.0         1.200         14.0           Flush-Flo <sup>m</sup> Calculated         0.503         13.9         15.0           Suggested Manhole Diameter (mm)         1500         15.0         15.0         15.0           Maintum Outlet Pipe Diameter (mm)         150         15.0         15.0         15.0           Mean Flow over Head Range         -         12.0         15.9         15.0	0.000	100.0	2.800	0.0	5.600	0.0	8.400	0.0
0.800       100.0       3.600       0.0       6.400       0.0       9.200       0.0         1.600       0.0       4.400       0.0       7.200       0.0       10.000       0.0         2.000       0.0       5.200       0.0       7.600       0.0       10.000       0.0         2.400       0.0       5.200       0.0       8.000       0.0       10.000       0.0         Head (m) Subol 0.0       7.600       0.0       10.000       0.0         Lydro-Brake Optimum® Outflow Control         Unit Reference MD-SHE-0166-1400-1200-1400         Design Head (m) 1.200         Design Flow (1/s)       14.0         Flush-Flo#       Calculated         Objective Minimise upstream storage         Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Design Point (Calculated)       1.200       13.9         Flush-Flow       0.363       13.9         Flush-Flow       0.363       15.9         Flush-Flow       0.799       11.5         Mean Flow over Head Range       12.0       14.	0.400	100.0	3.200	0.0	6.000	0.0	8.800	0.0
1.200       0.0       4.000       0.0       7.200       0.0       10.000       0.0         2.000       0.0       4.800       0.0       7.600       0.0       10.000       0.0         2.400       0.0       5.200       0.0       8.000       0.0       10.000       0.0         Hydro-Brake Optimum® Outflow Control         Unit Reference MD-SHE-0166-1400-1200-1400         Design Head (m)       1.200         Design Head (m)       1.200         Design Flow (1/s)       14.0         Flush-Flow         Calculated         Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Design Point (Calculated)       1.200       13.9         Flush-Flow       0.363       13.9         Flush-Flow       0.363       13.9         Flush-Flow       0.798       11.5         Mean Flow over Head Range       -       12.0         The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated         Depth (	0.800	100.0	3.600	0.0	6.400	0.0	9.200	0.0
1.600       0.0       4.400       0.0       7.200       0.0       10.000       0.0         2.400       0.0       5.200       0.0       8.000       0.0       0.0         2.400       0.0       5.200       0.0       8.000       0.0       0.0         Hydro-Brake Optimum® Outflow Control         Unit Reference MD-SHE-0166-1400-1200-1400         Design Head (m)       1.200         Design Flow (1/s)       14.0         Fluenter (mm)       1.200         Diameter (mm)       7.500         Minimum Outlet Pipe Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Design Foint (Calculated)       1.200       13.9         Fluenter' 0.363       13.9         Kick-Flow       0.798       11.5         Mean Flow over Head Range       -       12.0         The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified.         Mean Flow (1/s)       Pepth (m) Flow (1/s)       Pepth (m) Flow (1/s)         0.100       5.9       1.200       13.9       3.000       21.6	1.200	0.0	4.000	0.0	6.800	0.0	9.600	0.0
2.000       0.0       4.800       0.0       7.600       0.0         2.400       0.0       5.200       0.0       8.000       0.0         Hydro-Brake Optimum© Outflow Control         Unit Reference MD-SHE-0166-1400-1200-1400 Design Head (m)       1.200         Diameter (mn)       1.200         Diameter (mn)       1.66         Invert Level (m)       7.500         Diameter (mn)       1500         Control Points       Head (m) Flow (1/s)         Design Foint (Calculated)       1.200       13.9         Flush-Flo <sup>∞</sup> 0.363       13.9         Kick-Flo@       0.798       11.5         Mean Flow voer Head Range       -       12.0         They flow (1/s)       Pepth (m) Flow (1/s)         Depth (m) Flow (1/s)         Detext (m) Flow (1/s)         Depth (m) Flow (1/s)         Depth (m) Flow (1/s)      <	1.600	0.0	4.400	0.0	7.200	0.0	10.000	0.0
2.400       0.0       5.200       0.0       8.000       0.0         Hydro-Brake Optimum® Outflow Control         Hydro-Brake Optimum® Outflow Control         Unit Reference MD-SHE-0166-1400-1200-1400         Design Head (m)       1.200         Design Flow (1/s)       14.0         Flow (1/s)         Calculated         Objective Minimise upstream storage         Diameter (mm)         Invert Level (m)       7.500         Minimum Outlet Pipe plameter (mm)       1500         Control Points       Head (m) Flow (1/s)         Design Foint (Calculated)       1.200       13.9         Flush-Flow       0.363       13.9         Kick-Flo®       0.798       11.5         Mean Flow over Head Range       -       12.0         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 (1/s)       De	2.000	0.0	4.800	0.0	7.600	0.0		
Hydro-Brake Optimum® Outflow Control           Unit Reference MD-SHE-0166-1400-1200-1400 Design Flow (1/s)         1.200 Design Flow (1/s)         14.0           Flush-Flow         Calculated         0bjective Minimise upstream storage Diameter (mm)         166           Divert Level (m)         7.500         1500         225           Suggested Manhole Diameter (mm)         1500         1500           Control Point Read (m) Flow (1/s)           Design Point (Calculated)         1.200         13.9           Flush-Flow         0.363         13.9           Kick-Flow         0.363         15.5           Man Flow over Head Range         -         12.0           The hydrological calculations have been based on the Head/Discharge relationship for the Rydro-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 (1/s)         Pepth (m) Flow (1/s)         Pepth (m) Flow (1/s)         Pepth (m) Flow (1/s)           0.100         5.9         1.200         13.3         3.000         21.6         7.000         32.4           0.200         13.1         1.400         15.0         22.0         7.500         33.5           0.300         13.8         1.600	2.400	0.0	5.200	0.0	8.000	0.0		
Unit Reference MD-SHE-0166-1400-1200-1400 Design Head (m) 1.200 Design Flow (1/s) 14.0 Flush-FLO <sup>™</sup> Calculated Objective Minimise upstream storage Diameter (mm) 166 Invert Level (m) 7.500 Minimum Outlet Pipe Diameter (mm) 225 Suggested Manhole Diameter (mm) 1500 Control Points Head (m) Flow (1/s) Design Point (Calculated) 1.200 13.9 Flush-Flo <sup>™</sup> 0.363 13.9 Kick-Flo <sup>®</sup> 0.7398 11.5 Mean Flow over Head Range - 12.0 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 (1/s) Pepth (m) Flow (1/s) Pepth (m) Flow (1/s) 0.100 5.9 1.200 13.9 3.000 21.6 7.000 32.4 0.200 13.1 1.400 15.0 3.500 23.2 7.500 33.5 0.300 13.8 1.600 16.9 4.000 24.8 8.000 34.6 0.500 13.7 2.000 17.8 5.000 27.6 9.000 35.6 0.500 13.7 2.000 17.8 5.000 27.6 9.000 35.6 0.600 13.4 2.200 18.6 5.500 28.9 9.500 37.6 0.600 13.4 2.200 18.4 5.500 31.3		I	<u>lydro-Brake</u>	e Optimum@	Outflow	Control		
Design Head (m)       1.200         Design Flow (1/s)       14.0         Flush-Flo**       Calculated         Objective       Minimise upstream storage         Diameter (mm)       7.500         Minimum Outlet Pipe Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Control Points         Head (m) Flow (1/s)         Design Point (Calculated)         1.200       13.9         Flush-Flo**       0.363       13.9         Kick-Flo@       0.798       11.5         Mean Flow over Head Range       -       12.0         The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum@ be utilised then these storage routing calculations will be invalidated         Depth (m) Flow (1/s)         0.100       5.9       1.200       13.8         0.400       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.50         0.300       13.8       1.600       16.9       4.500       26.2       8.500       36.6         0.500       13.7			Un	it Referenc	e MD-SHE-0	166-1400-12	200-1400	
Design Flow (1/s)       14.0         Flush-Flow       Calculated         Objective       Minimise upstream storage         Diameter (mm)       166         Invert Level (m)       7.500         Minimum Outlet Pipe Diameter (mm)       1500         Control Points         Head (m) Flow (1/s)         Design Point (Calculated)         Control Points         Head (m) Flow (1/s)         Design Point (Calculated)         Lish-Flow         AGA (2000)         Kick-Flow       0.363         Kick-Flow       0.363         Mean Flow over Head Range       -         12.0         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® as specified. Should another type of 2.2         0.100       5.9       1.200       13.9         0.300       13.1       1.400       15.0         0.300       13.8       1.600       16.0       4.000       24.8         0.300       13.4			Des	ign Head (m	1)		1.200	
Flush-Flo#       Calculated         Objective       Minimise upstream storage         Diameter (mm)       7.500         Minimum Outlet Pipe Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Control Points       Head (m) Flow (l/s)         Design Foint (Calculated)       1.200       13.9         Flush-Flo@       0.363       13.9         Kick-Flo@       0.798       11.5         Mean Flow over Head Range       -       12.0         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)         0.100       5.9       1.200       13.9         0.300       13.8       1.600       16.0       4.000       24.8         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000			Desig	n Flow (l/s	)		14.0	
Objective         Minimise upstream storage Diameter (mm)         166 160           Invert Level (m)         7.500           Minimum Outlet Pipe Diameter (mm)         225           Suggested Manhole Diameter (mm)         1500           Control Points         Head (m) Flow (l/s)           Design Foint (Calculated)         1.200         13.9           Flush-Flo <sup>me</sup> 0.363         13.9           Kick-Flo®         0.798         11.5           Mean Flow over Head Range         -         12.0           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 (1/s)         Pepth (m) Flow (1/s)         Pepth (m) Flow (1/s)         Pepth (m) Flow (1/s)           0.100         5.9         1.200         13.9         3.000         21.6         7.000         32.4           0.200         13.1         1.400         15.0         3.500         23.2         7.500         33.5           0.300         13.8         1.600         16.9         4.500         26.2         8.500         35.6           0.500         13.7         2.000				Flush-Flc	TM	Cal	culated	
Diameter (mm)       166         Invert Level (m)       7.500         Minimum Outlet Pipe Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Control Points         Head (m) Flow (1/s)         Design Point (Calculated)         Flush-Flo®         Note: Control Points         Mead (m) Flow (1/s)         Design Point (Calculated)         Flush-Flo®         O.798         Mean Flow over Head Range         -         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 (1/s)         0.100       5.9         1.200       13.9         1.600       16.0         0.300       13.8         1.600       16.0         0.100       5.9         1.200       13.9         1.800       16.9         0.300       13.8         1.600       16.0         0.400       13.4			_	Objectiv	e Minimis	e upstream	storage	
Invert level (m)       7.300         Minimum Otlet Pipe Diameter (mm)       225         Suggested Manhole Diameter (mm)       1500         Control Points Head (m) Flow (1/s)         Design Point (Calculated)       1.200       13.9         Flush-Flo™       0.363       13.9         Kick-Flo@       0.798       11.5         Mean Flow over Head Range       -       12.0         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 (1/s)       Depth (m) Flow (1/s)       Depth (m) Flow (1/s)       Depth (m) Flow (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9			D	iameter (mm	1)		166	
Minimum Outlet Type Diameter (mm)       1500         Suggested Manhole Diameter (mm)       1500         Control Points Head (m) Flow (l/s)         Design Point (Calculated)       1.200       13.9         Flush-Flo™       0.363       13.9         Kick-Flo®       0.798       11.5         Mean Flow over Head Range       -       12.0         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       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800	M	inimum O	Inve utlet Pipe D	rt Level (m jameter (mm	1)		225	
Control Point         Head (m) Flow (l/s)           Design Point (Calculated)         1.200         13.9           Flush-Flow         0.363         13.9           Kick-Flow         0.798         11.5           Mean Flow over Head Range         -         12.0   The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated           Depth (m) Flow (l/s)         State (m) flow (l/s)         Depth (	141.	Suggest	ed Manhole D	iameter (mm	l)		1500	
Design Point (Calculated)       1.200       13.9         Flush-Flo™       0.363       13.9         Kick-Flo®       0.798       11.5         Mean Flow over Head Range       -       12.0         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 (1/s)       Depth (m) Flow (1/s)       Depth (m) Flow (1/s)       Depth (m) Flow (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.1       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       31.3       9.500       37.6			Control	Points	Head (m)	Flow (l/s)		
Flush-Flo <sup>M</sup> 0.363       13.9         Flush-Flo <sup>M</sup> 0.363       13.9         Kick-Flo®       0.798       11.5         Mean Flow over Head Range       -       12.0         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 (1/s)       Depth (m) Flow (1/s)       Depth (m) Flow (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.500       28.9       9.500       37.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       <		De	sign Point (	'Calculated'	1 200	13 9		
Kick-Flo®       0.798       11.5         Mean Flow over Head Range       -       12.0         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 (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       1.000       12.8       2.600       20.1       6.500       31.3		20	Jorgin rorne	Flush-Flo	<sup>™</sup> 0.363	13.9		
Mean Flow over Head Range       -       12.0         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 (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.800       11.5       2.400       19.4       6.000       30.1       1.000       37.6         0.800       11.5       2.400       19.4       6.000       30.1       31.3       1.000       37.6				Kick-Flo	0.798	11.5		
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 (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       1.000       12.8       2.600       20.1       6.500       31.3		Me	an Flow over	Head Range	e –	12.0		
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 (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       31.3       31.3								
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 (1/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       1.000       12.8       2.600       20.1       6.500       31.3         ©1982-2015 XP Solutions	The hydrologica	al calcu	lations have	been based	l on the He	ad/Discharg	e relatio	nship for the
Invalid       Depth (m) Flow (l/s)         0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1           1.000       12.8       2.600       20.1       6.500       31.3	Hydro-Brake Op	timum® a ⊧imum® b	s specified.	Snould an	torage rou	or control	aevice c	ll be
Depth (m)Flow(1/s)Depth (m)Flow(1/s)Depth (m)Flow(1/s)0.1005.91.20013.93.00021.67.00032.40.20013.11.40015.03.50023.27.50033.50.30013.81.60016.04.00024.88.00034.60.40013.91.80016.94.50026.28.50035.60.50013.72.00017.85.00027.69.00036.60.60013.42.20018.65.50028.99.50037.60.80011.52.40019.46.00030.11.00012.82.60020.16.50031.3	invalidated	cinding D	e utilista t		corage roa	cing carear	.acions wi	
Depth (m)         Flow (1/s)         Depth (m)         Flow (1/s)         Depth (m)         Flow (1/s)         Depth (m)         Flow (1/s)           0.100         5.9         1.200         13.9         3.000         21.6         7.000         32.4           0.200         13.1         1.400         15.0         3.500         23.2         7.500         33.5           0.300         13.8         1.600         16.0         4.000         24.8         8.000         34.6           0.400         13.9         1.800         16.9         4.500         26.2         8.500         35.6           0.500         13.7         2.000         17.8         5.000         27.6         9.000         36.6           0.600         13.4         2.200         18.6         5.500         28.9         9.500         37.6           0.800         11.5         2.400         19.4         6.000         30.1         4.500								
0.100       5.9       1.200       13.9       3.000       21.6       7.000       32.4         0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1           1.000       12.8       2.600       20.1       6.500       31.3	Depth (m) Flow	w (1/s)	Depth (m) Fl	.ow (1/s) D	epth (m) Fi	low (1/s) D	epth (m)	Flow (l/s)
0.200       13.1       1.400       15.0       3.500       23.2       7.500       33.5         0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       31.3       36.6         1.000       12.8       2.600       20.1       6.500       31.3       31.3       36.6	0.100	5.9	1.200	13.9	3.000	21.6	7.000	32.4
0.300       13.8       1.600       16.0       4.000       24.8       8.000       34.6         0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       31.3       1.000       12.8       2.600       20.1       6.500       31.3       1.3	0.200	13.1	1.400	15.0	3.500	23.2	7.500	33.5
0.400       13.9       1.800       16.9       4.500       26.2       8.500       35.6         0.500       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1       31.3       31.3       31.3	0.300	13.8	1.600	16.0	4.000	24.8	8.000	34.6
0.300       13.7       2.000       17.8       5.000       27.6       9.000       36.6         0.600       13.4       2.200       18.6       5.500       28.9       9.500       37.6         0.800       11.5       2.400       19.4       6.000       30.1         1.000       12.8       2.600       20.1       6.500       31.3	0.400	13.9	1.800	16.9	4.500	26.2	8.500	35.6
0.800       11.5       2.400       19.4       6.000       30.1         1.000       12.8       2.600       20.1       6.500       31.3	0.500	13./	2.000	10 6	5.000	21.6	9.000	30.0
0.000     11.0     2.400     19.4     0.000     30.1       1.000     12.8     2.600     20.1     6.500     31.3	0.600	11 5.4	2.200	10 1	5.500	20.9	9.000	37.0
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### APPENDIX F

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## The SUDS Management Train

#### The SUDS Management Train

#### **Prevention**

The use of good site design and site housekeeping measures to prevent runoff and pollution (eg sweeping to remove surface dust and detritus from car parks), and rainwater reuse/harvesting. Prevention policies should generally be included within the site management plan.

#### Source Control

Control of runoff at or very near its source (eg soakaways, other infiltration methods, green roofs, pervious pavements).

#### Site Control

Management of water in a local area or site (eg routing water from building roofs and car parks to a large soakaway, infiltration or detention basin).

#### Regional Control

Management of runoff from a site or several sites, typically in a balancing pond or wetland.

#### **Runoff Quality Control Processes**

There is a range of natural water quality treatment processes that can be exploited within the design of a sustainable drainage system.

#### **Sedimentation**

Sedimentation is one of the primary removal mechanisms in SUDS. Most pollution in runoff is attached to sediment particles and therefore removal of sediment results in a significant reduction in pollutant loads. Sedimentation is achieved by reducing flow velocities to a level at which the sediment particles fall out of suspension. Care has to be taken in design to minimise the risk of re-suspension when extreme rainfall events occur.

#### Filtration and Biofiltration

Pollutants that are conveyed in association with sediment may be filtered from percolating waters. This may occur through trapping within the soil or aggregate matrix, on plants or on geotextile layers within the construction. The location of any filtration will depend upon the internal structure of the particular SUDS technique, for example whether a geotextile layer is near the surface or at the subgrade in a previous surface.

#### Adsorption

Adsorption occurs when pollutants attach or bind to the surface of soil or aggregate particles. The actual process is complex but tends to be a combination of surface reactions grouped as sorption processes:

Adsorption Pollutants bind to surface of soil/aggregate

Cation exchange Attraction between cations and clay minerals

Chemisorption Solute is incorporated in the structure of a soil/aggregate

Absorption The solute diffuses into the soil/aggregate/organic maters

Change in acidity of runoff can either increase or decrease the adsorption of pollutants by construction materials or soils. Eventually the materials onto which pollutants adsorb will become saturated and thus this method of treatment will stop.

#### **Biodegration**

In addition to the physical and chemical processes, which may occur on and within a SUDS technique, biological treatment may also occur. Microbial communities may be established within the ground, using the oxygen within the free-draining materials and the nutrients supplied with the inflows, to degrade organic pollutants such as oils and grease. The level of activity of such bioremediation will be affected by the environmental conditions such as temperature and the supply of oxygen and nutrients. It also depends on the physical conditions within the ground such as the suitability of the materials for colonisation.

#### Volatilisation

Volatilisation comprises the transfer of a compound from solution in water to the soil atmosphere and then to the general atmosphere. The conversion to a gas or vapour occurs due to heat, reducing pressure, chemical reaction or a combination of these processes. The rate of volatilisation of a compound is controlled by a number of its properties and those of the surrounding soil. In SUDS schemes volatilisation is primarily concerned with organic compounds in petroleum products and pesticides.

#### Precipitation

This process is the most common mechanism for removing soluble metals. Precipitation involves chemical reactions between pollutants and the soil or aggregate that transform dissolved constituents to form a suspension of particles of insoluble precipitates. Metals are precipitated as hydroxides, sulphides, and carbonates depending on which precipitants are present and the pH level. Precipitation can remove most metals (arsenic, cadmium, chromium III, copper, iron, lead, mercury, nickel, zinc) and many anionic species (phosphates, sulphates, fluorides).

#### Uptake By Plants

In ponds and wetlands, uptake by plants is an important removal mechanism for nutrients (phosphorous and nitrogen). Metals can also be removed in this manner (although intermittent maintenance is required to remove the plants otherwise the metals will be returned to the water when the plants die). Plants also create suitable conditions for deposition of metals, for example as sulphides the root zone.

#### Nitrification

Ammonia and ammonium ions can be oxidised by bacteria in the ground to form nitrate, which is a highly soluble form of nitrogen. Nitrate is readily used as a nutrient by plants

### Photolysis

The breakdown of organic pollutants by exposure to ultra-violet light.

The removal mechanism appropriate for each pollutant category is presented in the Table below.

Pollutant	Removal mechanisms in SUDS
Nutrients	Sedimentation, biodegradation, precipitation, de-nitrification
Phosphorous, nitrogen	
Sediments	Sedimentation, filtration
Total suspended solids	
Hydrocarbons	Biodegradation, photolysis, filtration and adsorption
TPH, PAH, VOC, MTBE	
Metals	Sedimentation, adsorption, filtration, precipitation, plant uptake
Lead, copper, cadmium,	
mercury, zinc, chromium,	
aluminium	
Pesticides	Biodegradation, adsorption, volatilisation
Chlorides	Prevention
Cyanides	Volatilisation, photolysis
Litter	Trapping, removal during routine maintenance
Organic matter, BOD	Filtration, sedimentation, biodegradation

### Table 3 - removal mechanism appropriate for each pollutant