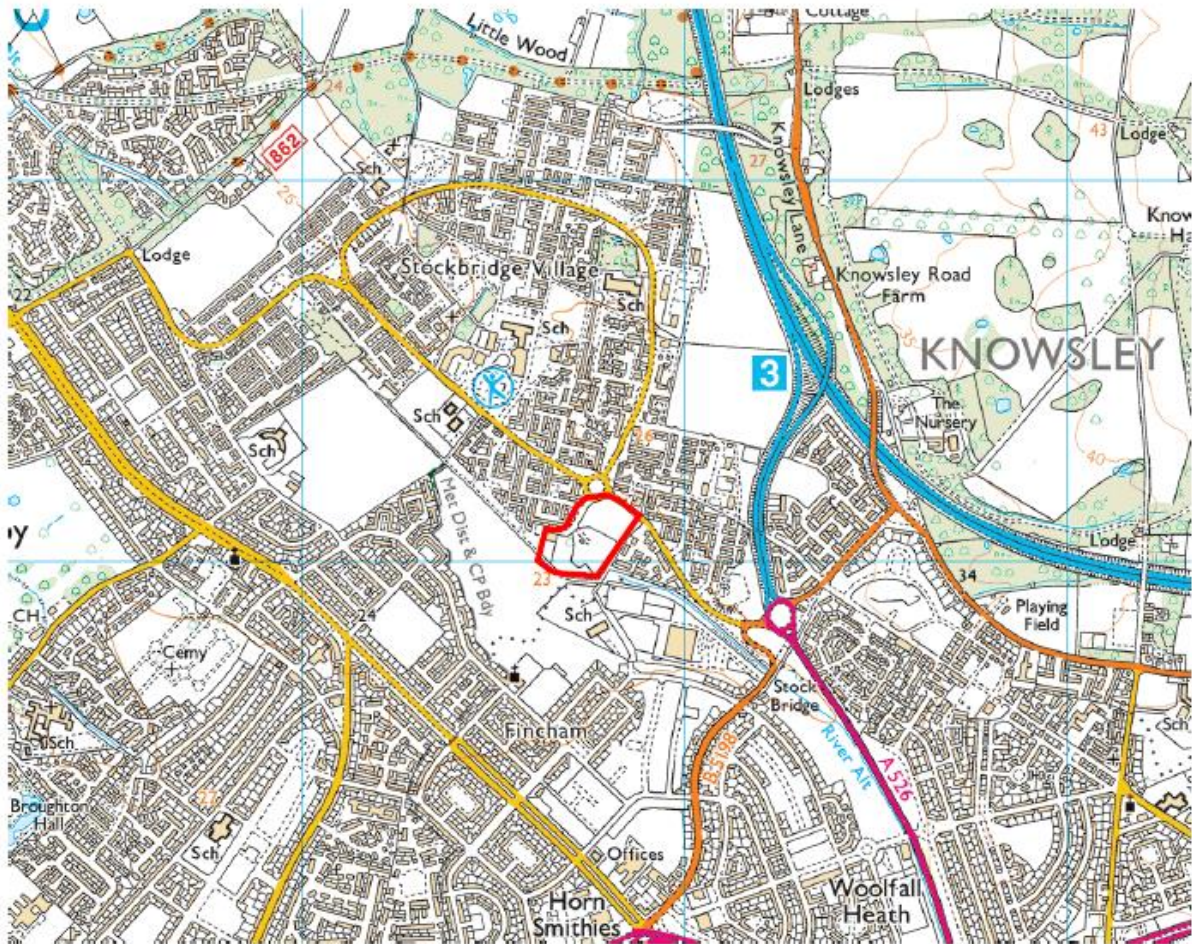


LOCATION PLAN

Waterpark Drive, Knowsley



OS X (Eastings)	342767
OS Y (Northings)	392938
Nearest Post Code	L28 3QD
Lat (WGS84)	N53:25:48 (53.430107)
Long (WGS84)	W2:51:46 (-2.862854)
Lat,Long	53.430107,-2.862854
Nat Grid	SJ427929 / SJ4276792938
mX	-318691
mY	7028614

APPENDIX F: TOPOGRAPHIC SURVEY

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Note:

The survey is plotted on a plane local
grid. Orientation to National Grid.
All levels relate to Ordnance Datum,
achieved using the
OS National GPS Network.

Survey Control Markers established for
Mapping purposes only and should not be
used for Construction without the written
approval of Survey Operations Ltd.

SURVEY STATIONS			
Point	Easting	Nord	Height
S01	342776.75	392014.12	23.89
S010	342777.24	392006.71	23.95
S020	342784.46	393107.45	24.02
S08	342785.59	392947.07	23.59
S09	342786.07	393126.09	24.43
S05	342805.35	393177.33	24.49
S03	342718.87	393906.22	23.44
S02	342694.41	393906.96	23.27

Survey

Smith Street, Skewerside, Lincs. NN8 8JN
Tel: 01695 725662 Fax: 01695 51816
Email: mail@surtops.co.uk — www.surtops.co.uk



Client

Knowsley Metropolitan Borough Council

Drawing Title

Topographical Survey of Land at:
Brookside Community College Waterpark
Huyton, Knowsley

Scale(s)		Surveyor
1 : 500		CW
Date		Drawn
JULY 14		PM
Job Number		Checked
14F069		MH

Sheet Size & Dwg Number & Revision

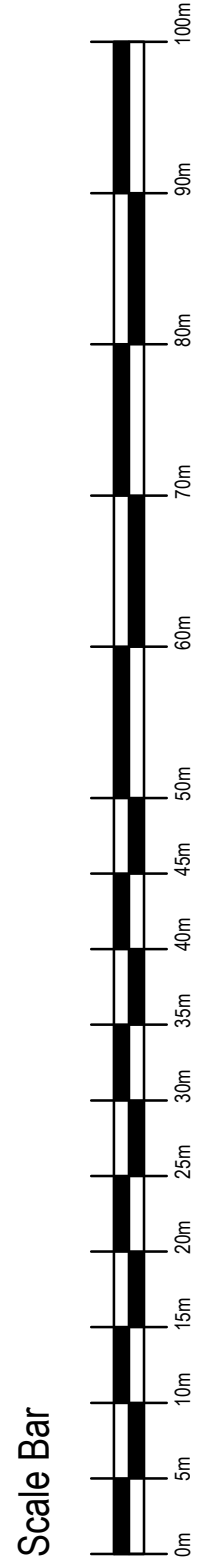
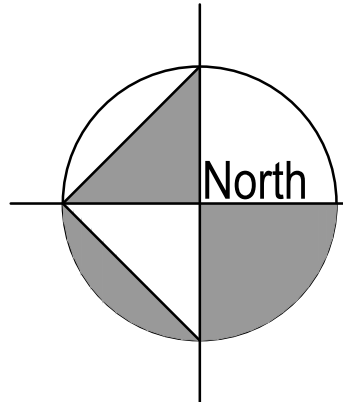
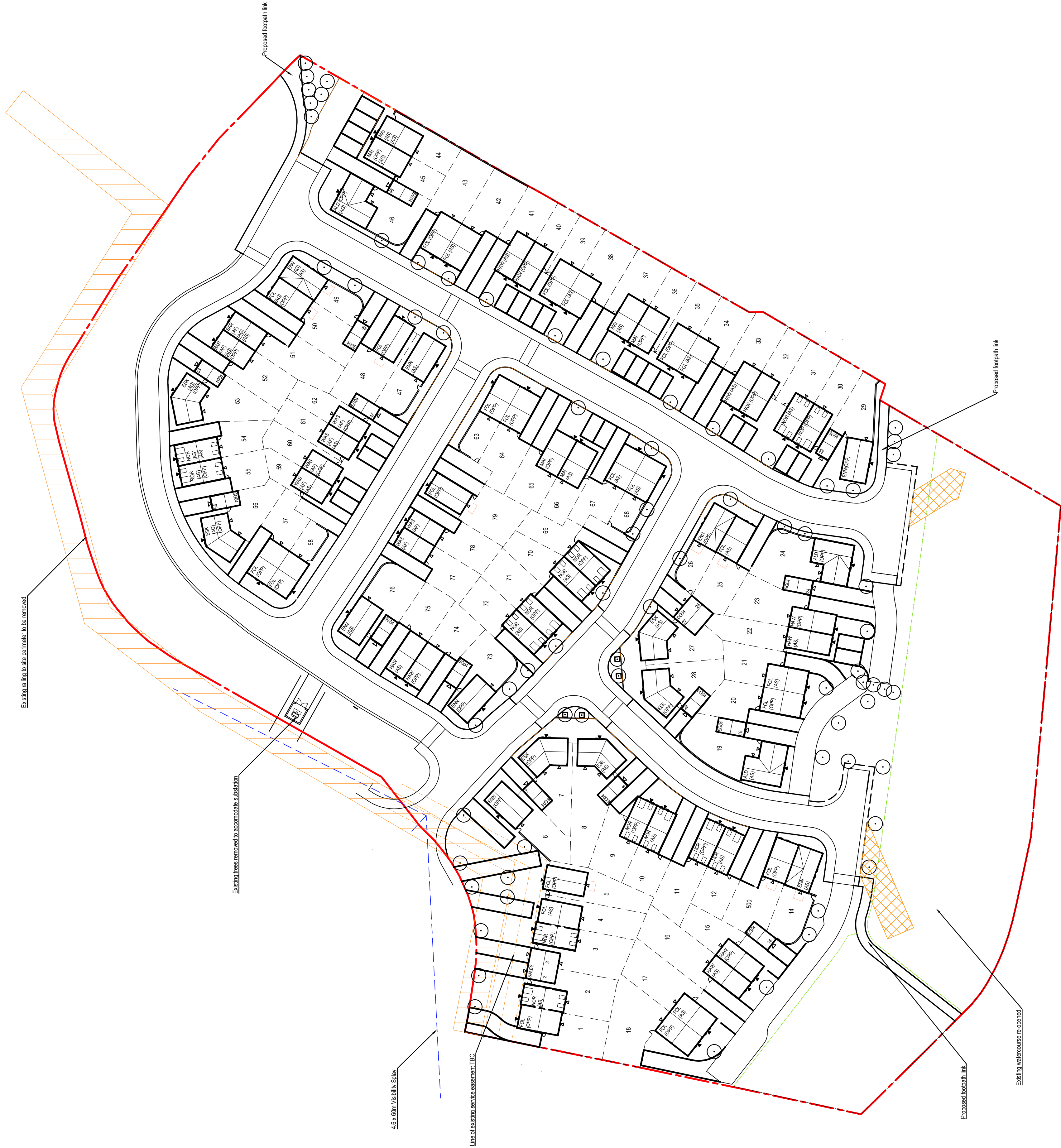
A1 14F069/001

APPENDIX G: PROPOSED PLANNING LAYOUT

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WARNING TO HOUSE PURCHASERS
Property Misdescriptions Act 1991

Buyers are warned that this is a working drawing and is not intended to be read as descriptive material describing, in relation to any particular property or development, any of the specified matters prescribed by any Order made under the above act. The contents of this drawing may be subject to change at any time, and alterations and variations can occur during the progress of the works without revisions of the drawing. Consequently the layout, form, content and dimensions of the finished construction may differ materially from those shown. Nor do the contents of this drawing constitute a contract, part of any contract, or warranty.



M	Area of subdivision amended due to Scottish power. Substation added (visibility splits added)	2007/17	SSWNC
L	Fence boundary to designated plots realigned to cross rather than centre line.	2008/17	JSM
K	Overall block dimension reduced by 42mm to 6051.14.500.25.38 & 49.50	1407/17	SC
J	Private drive to 14.5	1608/17	AA
H	Plot 29 wall boundary and turning lead amended to plot 17 amended to L4 comment	1306/17	AA
G	Amended to L4 comments	8008/17	AA
F	Amended to L4 comments	2308/17	SSA
E	Amended to L4 comments	2104/17	AA
D	Scale bar added	0907/17	AA
C	Amended to L4 comments	1412/16	AA
B	Scale area waived to comment	31/10/16	AA
A	Design revised in line with sketch S405	01/10/16	AA
Rev	Date	Drawn	Chkd



BARRATT
HOMES

MANCHESTER

Barratt Homes Manchester
(A division of BDW Trading Ltd)

**City Park
Manchester
M16 9HQ**
Tel: 0161 872 0161
Fax: 0161 855 2828

Job
WATERPARK DRIVE
KNOWLSLEY

Scale Bar

Title PLANNING LAYOUT	Design By JP	Date 00-00-16	Drawing Number 463-PL01	Rev M
	Drawn By AA	Scale @ A1 1:500		

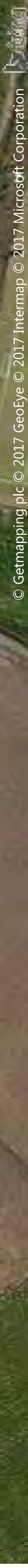
APPENDIX H: OVERLAND FLOW PLANS

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DO NOT SCALE

TOTAL SITE - 2.906ha

OVERLAND FLOW



						KW
A	26.10.16	P.T.	PRELIMINARY DRAWING			KW
REV:	DATE	BY	DESCRIPTION			CWK
DRAWING STATUS: PRELIMINARY						
 BETTS HYDRO CONSULTING ENGINEERS Near Newbold, Leamington Spa, CV32 2YF Tel: 0244 288178 enquiries@betts-hydro.co.uk  BARRATT HOMES Building around you						
PROJECT: WATERPARK DRIVE						
TITLE: PRE-DEVELOPMENT OVERLAND FOW PLAN						
DATE: 26.10.16	SCALE @ SIZE: 1:500	DRAWN: PT	CHECKED: KW			
PROJECT No: HYD104		DRAWING No: 102		REV: A		

DO NOT SCALE

TOTAL SITE – 2.906ha

OVERLAND FLOW

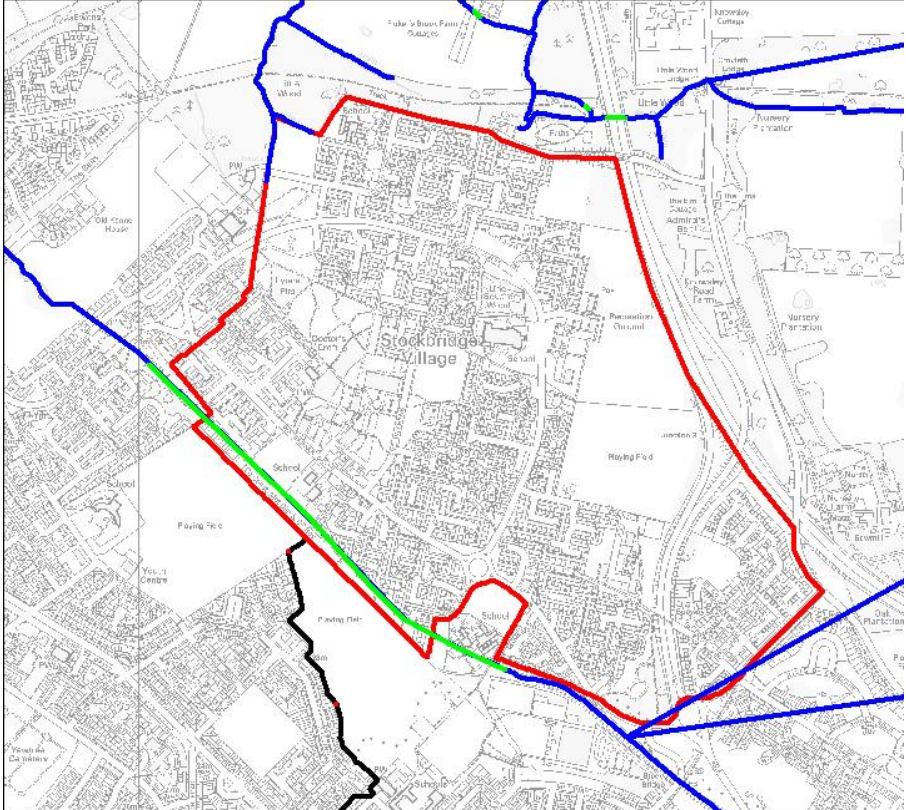


C	23.01.18	MB	UPDATED PLANNING LAYOUT	KW
B	10.01.17	CP	IMPROVED TO MEET REVISED LAYOUT	KW
A	23.01.16	PI	PRELIMINARY DRAWING	KW
REV	DATE	BY	DESCRIPTION	CHK
DRAWING STATUS				
PRELIMINARY				
BETTS HYDRO CONSULTING ENGINEERS Old Moor, 17000, Wetherby, West Yorkshire, LS23 7LY Tel: 01937 546175 www.betts-hydro.co.uk				
BARRATT HOUSES built around you				
PROJECT: WATERPARK DRIVE KNOWSLEY				
TITLE: POST-DEVELOPMENT OVERLAND FLOW PLANS				
DATE: 23.01.18	SCALE: 1:500	SIZE: A1	DRAWN: MB	CHECKED: KW
PROJECT NO: HYD104	DRAWING NO: 202	REV: C		

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APPENDIX I: PFRA/SFRA PLANNING EXTRACTS

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Site Number	CS9B
Site Name	Stockbridge Village
Grid Reference	343330 392830
Location Plan   KMBC Boundary  Site Boundary  Watercourse  Culverted Channel	
Size of Site (ha)	123ha
Type of development proposed / vulnerability classification	Mix of land uses including residential (More Vulnerable).
No. Of Dwellings Proposed	Stockbridge Village is within the proposed North Huyton and Stockbridge Village Principal Regeneration Area. Proposals include up to 800 additional dwellings, new leisure facilities, Community education and training facilities and local retail provision.
Rivers, watercourses and water bodies	There are a number of watercourses around the boundaries of the site. The River Alt is the principal watercourse, running through and in places just outside of the south western boundary of the site, largely in culvert. A private sewer that may be a culverted watercourse originating to the east of the M57 runs along the south eastern boundary to discharge to the River Alt. A second runs nearly parallel just outside of the boundary. To the north west, Croxteth Brook heads northwards along the

Site Number	CS9B
Site Name	Stockbridge Village
	boundary of the site.
Description of Existing Flood Management Infrastructure (and condition)	The River Alt flows in culvert along the south-western boundary of Stockbridge Village. NFCDD states that the culvert is Local Authority maintained and that it has a design standard of 50 years with a condition assessed as 3 (fair). The River Alt is in culvert from west of Chalfont Way (NGR 342839 392956) and is in open channel in the greenfield north of Hare Croft (NGR 341871 393773). Croxteth Brook rises in the north west corner of the area and flows in a northerly direction to meet the Knowsley Brook. NFCDD states that it is Environment Agency maintained, has a design standard of 100 years and has a condition of 3 (fair). It is described as a Major flood defence asset. The Standard of Protection is likely to decrease over time as the effects of climate change are realised.
Existing Land use	Predominantly residential with a number of open spaces.
Topography	Ground Levels adjacent to the River Alt are approximately 22m AOD. Ground Levels in the east are the highest around the playing field and recreation ground are 27-28m AOD. Ground levels in the centre of Stockbridge Village are 23m AOD.
Risk Assessment	There is no detailed modelling available of the River Alt or its tributaries upstream of the confluence with Kirkby Brook, therefore the EA flood zones are the best information available to determine flood risk. Out of bank flooding is shown to occur upstream of Stockbridge Village at Seth Powell Way (NGR 343572 392338). The flood zones do not take account of structures therefore the River Alt culvert would not be represented. It is recommended that a hydraulic model is built to inform future development proposals.

Site Number

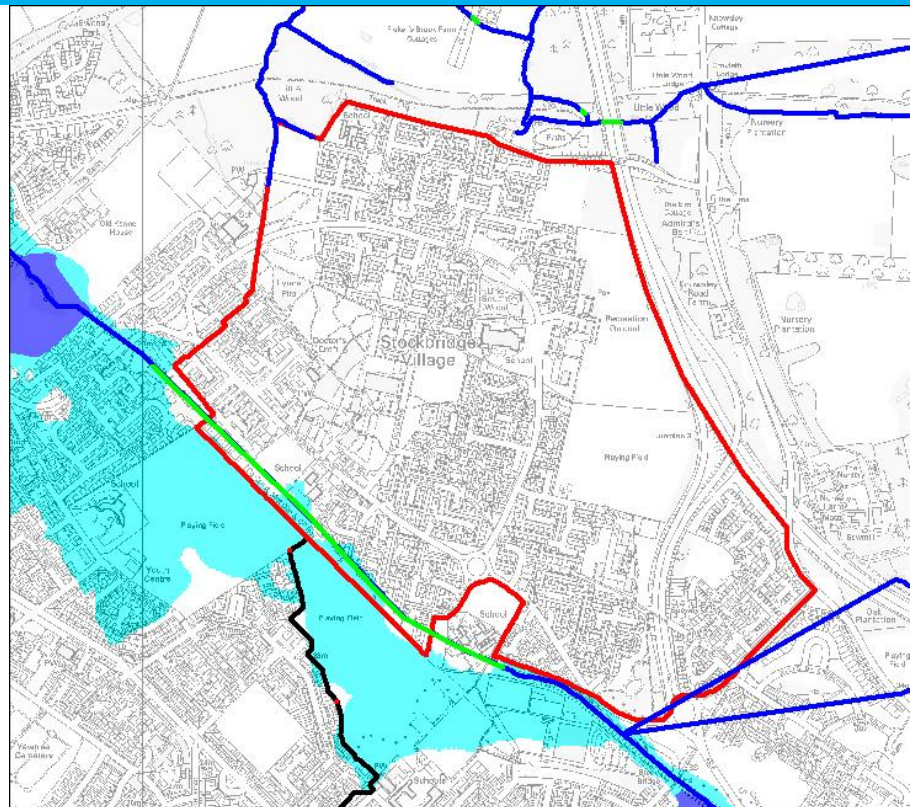
CS9B

Site Name

Stockbridge Village

Flood Zone Map

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Channel
-  Flood Zone 3
-  Flood Zone 2



Proportion in FZ1

120.3ha

Proportion in FZ2

2.7ha

Proportion in FZ3a

0ha

Proportion in FZ3b

There is no detailed modelling to identify the extent of Flood Zone 3b

Actual Flood Risk

There is no detailed modelling to identify how the actual risk of flooding differs to the Environment Agency's Flood Zone 3, the impacts of climate change on Flood Zone 3 or to identify the extent of Flood Zone 3b.

Site Number

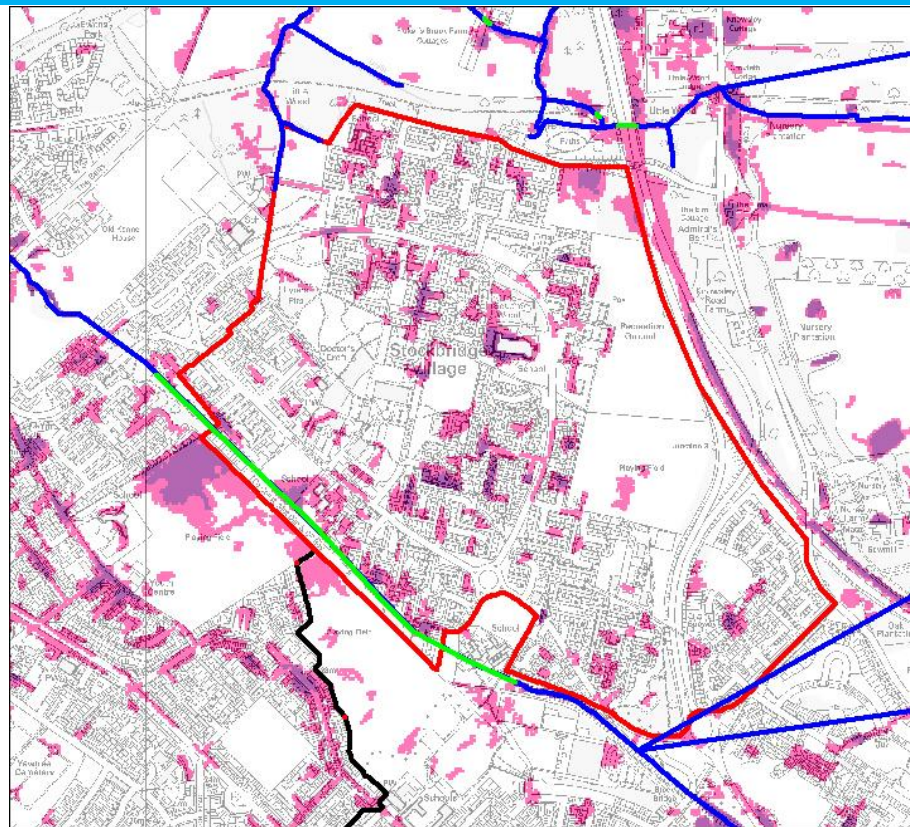
CS9B

Site Name

Stockbridge Village

**Surface Water
(Pluvial) Map**

-  KMBC Boundary
-  Site Boundary
-  Watercourse
-  Culverted Channel
-  FMfSW 200yr deep
-  FMfSW 200yr



Groundwater

According to the EA groundwater susceptibility map, Stockbridge Village resides in a series of 1km squares where the proportion of each 1km square that is susceptible to groundwater flooding is less than 25%. The area to the north of Haswell Drive is shown to be located in a Groundwater Source Protection Zone 3, (SPZ). Consultation should be held with the Environment Agency to determine their policy position. SPZs are established to protect groundwater from pollution within a catchment of a public water supply borehole.

Artificial Sources

Significant areas of Stockbridge Village are shown to be potentially at risk of flooding from two reservoirs, Prescot No.4 and White Mans Dam. White Mans Dam is located within Knowsley Park approximately 1.8km east of the area and is maintained by the Earl of Derby's Estate (NGR 344965 394135). Prescot No.4 is located slightly outside of Knowsley (NGR 347090 394112) and is maintained by United Utilities Plc. The northern part of Stockbridge Village is shown to be at potential risk of reservoir flooding from both reservoirs, the south west boundary is shown to be at risk from Prescot No. 4 reservoir only.

Site Number

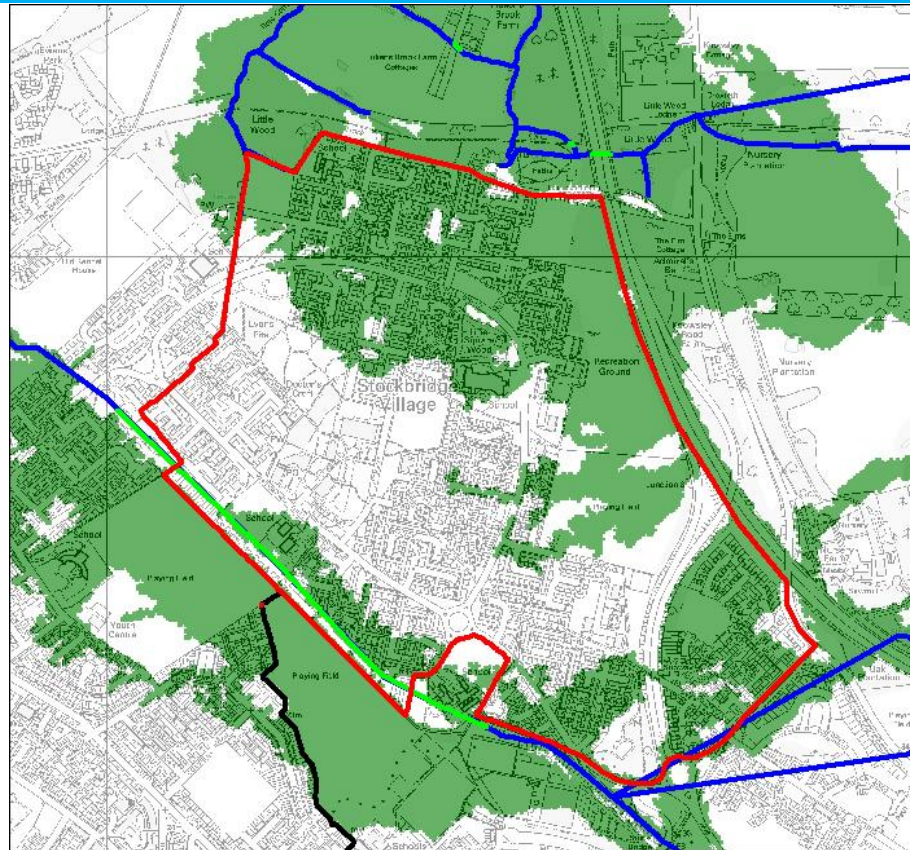
CS9B

Site Name

Stockbridge Village

Reservoir Flooding Map

- Site Boundary
- Watercourse
- Culverted Channel
- Reservoir Inundation



Residual Risk

There is no detailed modelling to identify how the actual residual risk of flooding differs to the Environment Agency's Flood Zone 2.

Summary of Risk

Stockbridge Village is largely located in Flood Zone 1 with Flood Zone 2 located in only 2.7ha (2.2% of the area). There is no detailed modelled flood risk information available for River Alt or the Croxteth Brook in this location and therefore it is not possible to identify the Actual Risk associated with either watercourse or to define the functional floodplain for the area. The Environment Agency's Flood Zones therefore remain the most appropriate source of information with respect to Stockbridge Village.

Surface water flooding is predicted to occur in a number of locations across the area, however the majority of depths are shown to be between 100-300mm. The area is shown to be susceptible to ground water flooding and reservoir flooding should a breach occur in either Prescott No.4 reservoir or White Mans Dam.

Site Number

CS9B

Site Name

Stockbridge Village

Flood risk mitigation recommendations

Given the small area shown to be at risk of flooding from the River Alt and that it is a residual risk (Flood Zone 2), the development potential of this proposed Principal Regeneration Area is not likely to be compromised. The lack of detailed modelling, however, limits the accuracy of the understanding of flood risk from this culverted watercourse and that of Croxteth Brook. A more detailed flood risk assessment is therefore recommended.

It is recommended that given the large area, More Vulnerable development avoid where possible any High Risk areas related to surface water flooding and if possible the Moderate Risk areas associated with fluvial flood risk from the River Alt until such time as more detailed modelling is available to confirm the extent of this area. In this regard the area adjacent to the River Alt could be incorporated into a green corridor, facilitating the de-culverting of the watercourse and allowing the area to flood more naturally. This also has the potential to decrease flood risk overall, both here and downstream.

Should More Vulnerable development be located in yet to be defined High Risk or Moderate areas associated with the River Alt or Croxteth Brook then finished floor levels should be set 600mm above the 1% AEP plus climate change flood event. Less Vulnerable development should incorporate flood resistance and resilience techniques within the Moderate Risk zone. Elsewhere, ground levels should be raised to ensure that there is no ingress of surface water.

The Environment Agency require that the full width of its statutory by-law distance (8 metres) is left undeveloped so that sufficient access is provided for maintenance and emergency response activities to be carried out. Where drains form part of the sewer network, these too will require an appropriate easement to facilitate maintenance.

Any works that lie in, over, under or next to a main river will require flood defence consent from the Environment Agency under the Water Resources Act 1991. Works affecting ordinary watercourses now require the consent of KMBC. Additional consents under the Land Drainage Act may be required if a culvert or structure, such as a weir, is proposed to control flow on any ordinary watercourse.

Flood risk management recommendations

There maybe opportunities to open up the River Alt channel in this location. De-culverting and re-naturalisation would help to increase the capacity of the channel along this section of the river and may help to meet the requirements of the Water Framework Directive

Site Number	CS9B
Site Name	Stockbridge Village
	(WFD). De-culverting should be applied with caution, however, as there could be an increased flood risk within Stockbridge Village and potentially downstream areas. A large proportion of the area is shown to be at risk from reservoir flooding. As individual sites come forward, the residual risk of reservoir flooding should be acknowledged within the FRAs and where possible site-specific flood mitigation measures, e.g. resilient and resistant construction methods, safe refuge areas within developments and appropriate evacuation plans should be developed for review and approval by the Council's emergency planners. The adopted measures will need to be appropriate to the vulnerability of the individual development and the vulnerability of its users.
SuDS Options appraisal	Stockbridge Village is predominantly within land identified as having a Medium (2) probability of being suitable for infiltration SuDS, with the remainder identified as being a mixture of High suitability Medium (1) suitability and Low suitability. Some SuDS measures may be suitable depending on the final layout and results of permeability testing of the insitu soils. It is recommended that infiltration testing is undertaken to determine the suitability of infiltration devices within Stockbridge Village. As individual sites come forward, the following principals should be adopted for development sites: *A Surface Water Flood Risk Assessment should be undertaken on all sites and should be compliant with the NPPF and local requirements. *New Brownfield development should seek to reduce peak runoff by at least 50% from the existing, achieving this through discharging to soakaways as well as through the provision of storage and flow restrictions devices that discharge at low rates. Where this level of runoff reduction is not practicable, the developer should provide appropriate evidence to that effect and show that the maximum reduction that can be achieved from the site is being proposed. At the very least development should not increase runoff rates above existing levels. All new development should include at least one 'at source' SuDS measure. Where no "at source" SuDS measure is proposed, evidence should be provided to show that such measures are not feasible because of existing ground conditions. Taking the site as a whole and assuming a long-term strategy to restrict runoff to 5l/s/ha and the developable area being

Site Number	CS9B
Site Name	Stockbridge Village
	approximately 50% hard standing in total, a worse-case estimate is that there will be a need to provide in the region of 34,000m³ of storage. This could result in the loss of approximately 2.8% of the developable land area and could have capital costs ranging between £513,000 (infiltration basin) and £3.4M (soakaway) depending upon the options adopted.
Site Considerations (summary)	Stockbridge Village covers an area of 120ha of which 2.7ha (2.2%) is located in Flood Zone 2. The area does not benefit from defences, however the River Alt is culvert and the Croxteth channel both have a high Standard of Protection (100years). There is the opportunity to open up the River Alt culvert. Stockbridge Village is within the proposed North Huyton and Stockbridge Village Principal Regeneration Area. The current flood risk to the area is not shown to be significant constraint to development. Indeed there are opportunities to reduce flood risk locally. It is recommended that detailed modelling is carried out to refine the flood zones in the area in particular the conveyance capacity of the River Alt culvert and Croxteth Brook, however, it is estimated that currently 96% of the area is developable for More Vulnerable development.

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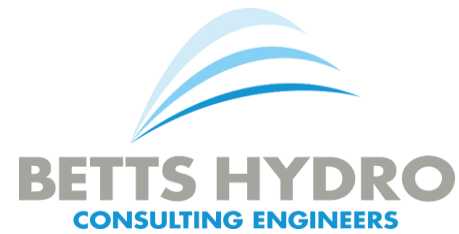
APPENDIX J: SURFACE WATER RUN-OFF CALCULATIONS

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SURFACE WATER RUN-OFF CALCULATION SHEET

Development	Waterpark Drive, Knowsley
Project No.	HYD104

Revision	3.1	Completed by	MB/PT
Date	23.01.2018	Checked by	DK



Areas		Catchment Characteristics	
Total Site	2.906 ha	SAAR	878 mm
Development Area (for SW Strategy)	2.300 ha	SPR	38.49 %
Existing Impermeable	0.042 ha	i_1	13.6 mm/hr
Existing Impermeable (for SW Strategy)	0.000 ha	i_{30}	31.4 mm/hr
Existing Pervious	2.864 ha	i_{100}	42.4 mm/hr
Existing Pervious (for SW Strategy)	2.300 ha	d_1	13.3 mm
Proposed Impermeable (total)	1.233 ha	d_{100}	63.9 mm
Proposed Impermeable (domestic only)	ha		

Run-off Rates				Volumes			
<i>Pre-development</i>				<i>Pre-development</i>			
Impermeable	1yr	0.0 l/s		Impermeable	1yr	0.0 cu.m	
	30yr	0.0 l/s			100yr	0.0 cu.m	
	100yr	0.0 l/s		Pervious	1yr	224.6 cu.m	
	50mm/hr	0.0 l/s			100yr	699.1 cu.m	
	QBar	13.2 l/s		Total	1yr	224.6 cu.m	
Pervious	1yr	11.5 l/s			100yr	699.1 cu.m	
	30yr	22.3 l/s		<i>Post-development</i>			
	100yr	27.4 l/s		Impermeable (total)	1yr	164.0 cu.m	
Total	1yr	11.5 l/s			100yr+CC	1024.3 cu.m	
	30yr	22.3 l/s		Impermeable (domestic only)	1yr	cu.m	
	100yr	27.4 l/s			100yr+CC	cu.m	
<i>Post-development</i>				Reduction (total)			
Impermeable (total)	1yr	46.7 l/s		Reduction (domestic only)	-47%	-325.1 cu.m	
	30yr	107.7 l/s				cu.m	
	100yr+CC	188.9 l/s					
Impermeable (domestic only)	1yr	l/s					
	30yr	l/s					
	100yr+CC	l/s					

Quick storage Estimates		low	high	mean	Imp. Area (ha)	Max. Discharge (l/s)	Rainfall	CC
Return Period	1yr	87	149	118	1.233	11.5	FEH	0
Return Period	30yr	227	349	288	1.233	22.3	FEH	0
Return Period	100yr+CC	400	585	492.5	1.233	27.4	FEH	20%
Return Period	100yr+CC	497	712	604.5	1.233	27.4	FEH	40%

Old Marsh Farm Barns
Welsh Road
Sealand Flintshire CH5 2LY

Date 27/10/2016 09:56
File

Designed by patricktaylor
Checked by



Micro Drainage

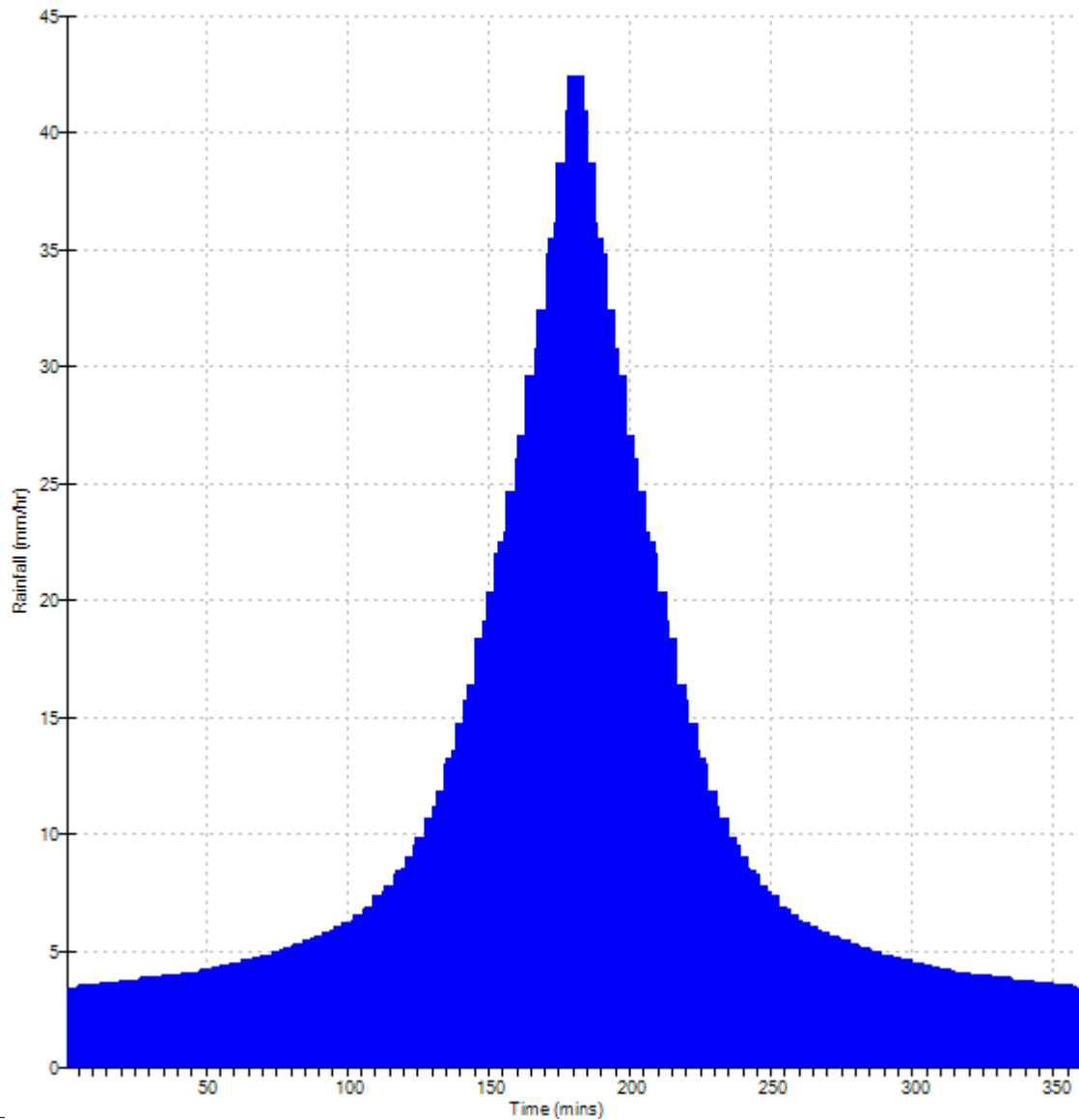
Network 2014.1.1

Rainfall profile

Storm duration (mins) 360

FEH Data

C (1km)	-0.022
D1 (1km)	0.301
D2 (1km)	0.321
D3 (1km)	0.328
E (1km)	0.286
F (1km)	2.500
Peak Intensity (mm/hr)	42.435
Ave. Intensity (mm/hr)	10.825
Return Period (years)	100



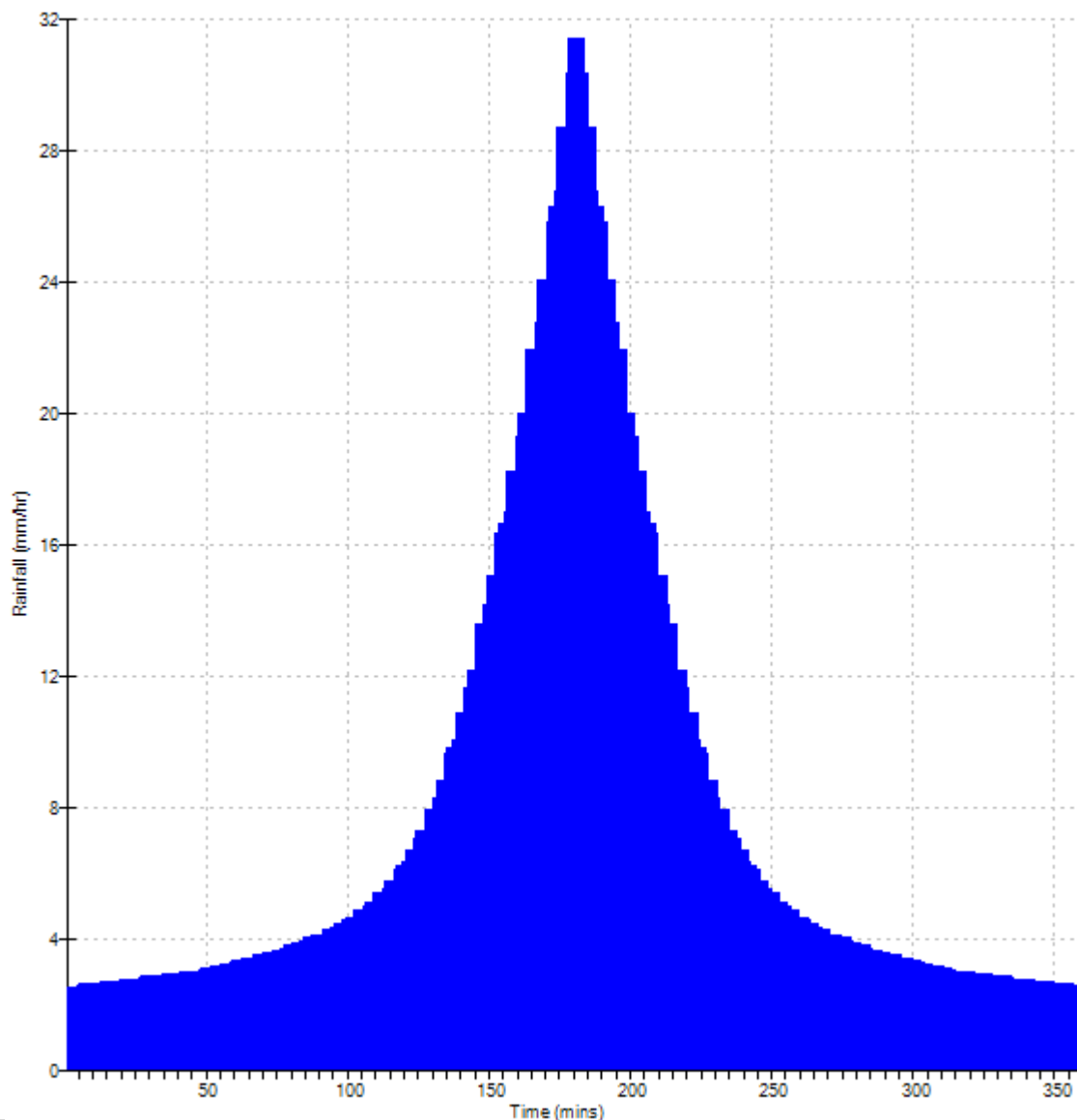
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Date 27/10/2016 09:57	Designed by patricktaylor	
File	Checked by	
Micro Drainage	Network 2014.1.1	

Rainfall profile

Storm duration (mins) 360

FEH Data

C (1km)	-0.022
D1 (1km)	0.301
D2 (1km)	0.321
D3 (1km)	0.328
E (1km)	0.286
F (1km)	2.500
Peak Intensity (mm/hr)	31.442
Ave. Intensity (mm/hr)	8.021
Return Period (years)	30



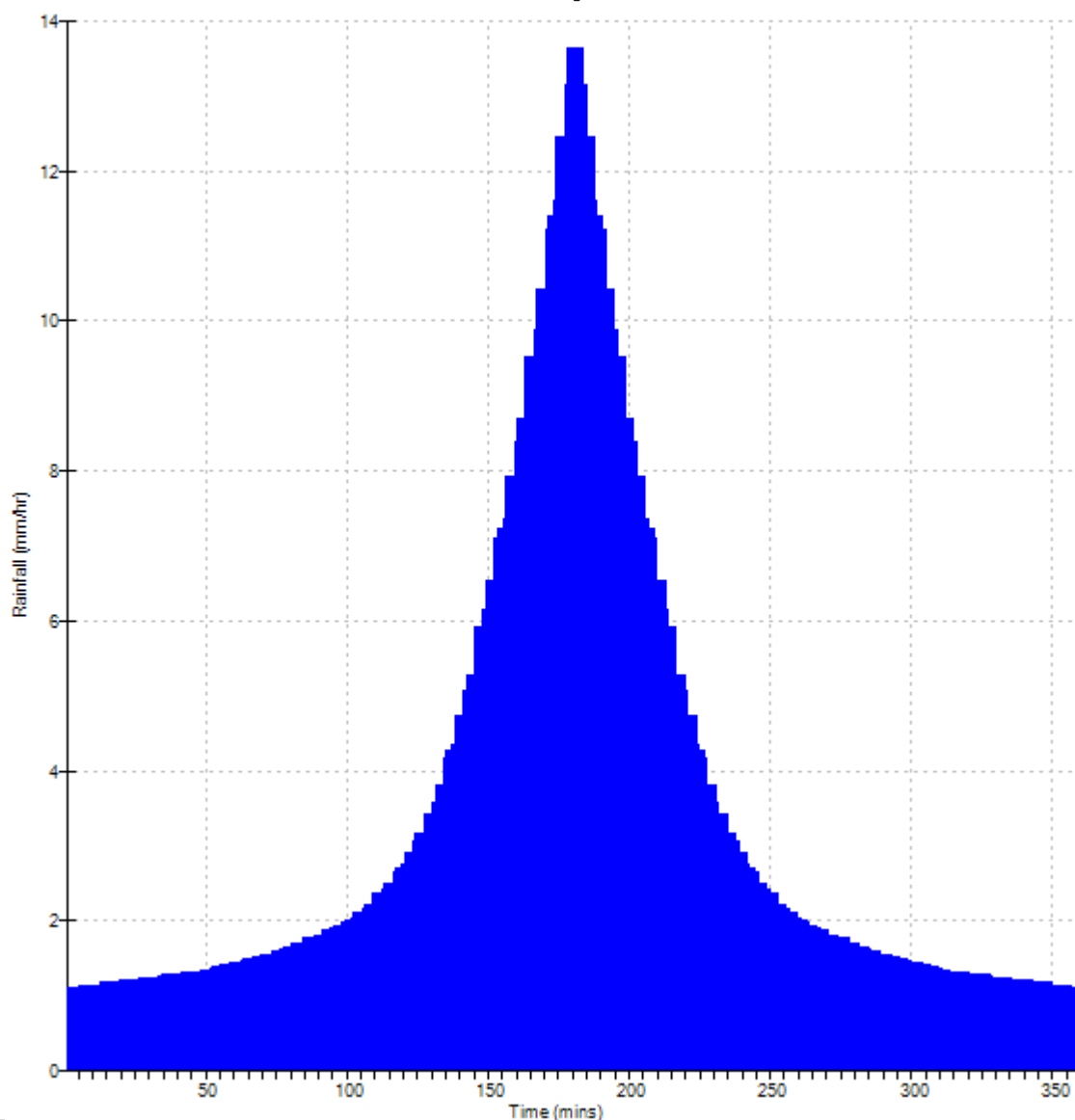
Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	WATERPARK DRIVE	
Date 27.10.16	Designed by PT	
File	Checked by	
Micro Drainage	Network 2014.1.1	

Rainfall profile

Storm duration (mins) 360

FEH Data

C (1km)	-0.022
D1 (1km)	0.301
D2 (1km)	0.321
D3 (1km)	0.328
E (1km)	0.286
F (1km)	2.500
Peak Intensity (mm/hr)	13.649
Ave. Intensity (mm/hr)	3.482
Return Period (years)	1



Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	WATERPARK DRIVE KNOWSLEY	
Date 23.01.18 File	Designed by MB Checked by DK	
Micro Drainage Source Control 2014.1.1		
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 1 Soil 0.450 Area (ha) 2.300 Urban 0.000 SAAR (mm) 878 Region Number Region 10 Results l/s QBAR Rural 13.2 QBAR Urban 13.2 Q1 year 11.5 Q1 year 11.5 Q30 years 22.3 Q100 years 27.4		
©1982-2014 XP Solutions		

Betts Associates Ltd		Page 1																										
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	WATERPARK DRIVE KNOWSLEY																											
Date 23.01.18 File	Designed by MB Checked by DK																											
Micro Drainage Source Control 2014.1.1																												
<u>Greenfield Runoff Volume</u> FSR Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.400</td> </tr> <tr> <td>Ratio R</td> <td>0.398</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>2.300</td> </tr> <tr> <td>SAAR (mm)</td> <td>878</td> </tr> <tr> <td>CWI</td> <td>121.121</td> </tr> <tr> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SPR</td> <td>47.000</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>49.82</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>699.117</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	Region	England and Wales	M5-60 (mm)	19.400	Ratio R	0.398	Areal Reduction Factor	1.00	Area (ha)	2.300	SAAR (mm)	878	CWI	121.121	Urban	0.000	SPR	47.000	Percentage Runoff (%)	49.82	Greenfield Runoff Volume (m ³)	699.117
Return Period (years)	100																											
Storm Duration (mins)	360																											
Region	England and Wales																											
M5-60 (mm)	19.400																											
Ratio R	0.398																											
Areal Reduction Factor	1.00																											
Area (ha)	2.300																											
SAAR (mm)	878																											
CWI	121.121																											
Urban	0.000																											
SPR	47.000																											
Percentage Runoff (%)	49.82																											
Greenfield Runoff Volume (m ³)	699.117																											
©1982-2014 XP Solutions																												

Betts Associates Ltd		Page 1																										
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY	WATERPARK DRIVE KNOWSLEY																											
Date 23.01.18 File	Designed by MB Checked by DK																											
Micro Drainage Source Control 2014.1.1																												
<u>Greenfield Runoff Volume</u> FSR Data <table> <tr> <td>Return Period (years)</td> <td>1</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.400</td> </tr> <tr> <td>Ratio R</td> <td>0.398</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>2.300</td> </tr> <tr> <td>SAAR (mm)</td> <td>878</td> </tr> <tr> <td>CWI</td> <td>121.121</td> </tr> <tr> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SPR</td> <td>47.000</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>46.03</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>224.587</td> </tr> </table>			Return Period (years)	1	Storm Duration (mins)	360	Region	England and Wales	M5-60 (mm)	19.400	Ratio R	0.398	Areal Reduction Factor	1.00	Area (ha)	2.300	SAAR (mm)	878	CWI	121.121	Urban	0.000	SPR	47.000	Percentage Runoff (%)	46.03	Greenfield Runoff Volume (m ³)	224.587
Return Period (years)	1																											
Storm Duration (mins)	360																											
Region	England and Wales																											
M5-60 (mm)	19.400																											
Ratio R	0.398																											
Areal Reduction Factor	1.00																											
Area (ha)	2.300																											
SAAR (mm)	878																											
CWI	121.121																											
Urban	0.000																											
SPR	47.000																											
Percentage Runoff (%)	46.03																											
Greenfield Runoff Volume (m ³)	224.587																											
©1982-2014 XP Solutions																												

APPENDIX K: FEH CATCHMENT DATA

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VERSION	FEH CD-RO Version	3 exported at	07:43:08 GMT	Fri	07-Oct-16
CATCHMENT GB	342750	393000 SJ	42750 93000		
CENTROID GB	344211	392285 SJ	44211 92285		
AREA	6.53				
ALTBAR	40				
ASPBAR	257				
ASPVAR	0.52				
BFIHOST	0.387				
DPLBAR	2.4				
DPSBAR	18.1				
FARL	1				
FPEXT	0.2102				
FPDBAR	1.135				
FPLOC	0.872				
LDP	4.48				
PROPWET	0.37				
RMED-1H	11.2				
RMED-1D	30.9				
RMED-2D	41.3				
SAAR	878				
SAAR4170	982				
SPRHOST	38.49				
URBCONC1	0.864				
URBEXT199	0.3006				
URBLOC199	0.965				
URBCONC2	0.879				
URBEXT200	0.2778				
URBLOC200	0.947				
C	-0.02205				
D1	0.30302				
D2	0.3124				
D3	0.34093				
E	0.28834				
F	2.50852				
C(1 km)	-0.022				
D1(1 km)	0.301				
D2(1 km)	0.321				
D3(1 km)	0.328				
E(1 km)	0.286				
F(1 km)	2.5				

Design Rainfall

FEH CD-ROM 3 - Design Rainfall and Rainfall Event Rarity

Calculate : **Design rainfall** for

☒ catchment 342750 393000 [SJ 42750 93000]
☐ 1 km grid point 343000 393000 [SJ 43000 93000]
☐ Manually entered values for a point

Area : 6.5275 km²

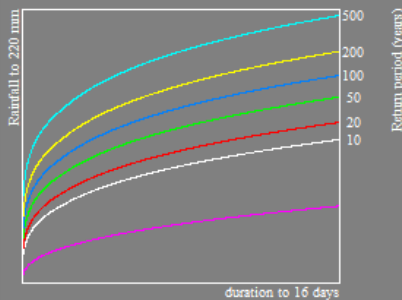
C : -0.02205 D3 : 0.34093
D1 : 0.30302 E : 0.28834
D2 : 0.31240 F : 2.50852

Duration : 6 Hours ☐ Fixed ☒ Sliding
Return period : 1.004 Years ☒ AM ☐ POT

Rainfall depth 13.2837 mm

Calculate... **Export...** **Cancel**

An areal reduction factor of 0.961 has been applied to a point rainfall of 13.8 mm to yield a catchment design rainfall of 13.3 mm.



FEH CD-ROM 3 - Design Rainfall and Rainfall Event Rarity

Calculate : **Design rainfall** for

☒ catchment 342750 393000 [SJ 42750 93000]
☐ 1 km grid point 343000 393000 [SJ 43000 93000]
☐ Manually entered values for a point

Area : 6.5275 km²

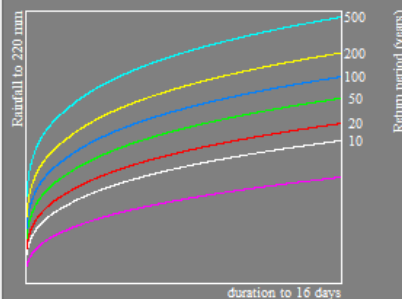
C : -0.02205 D3 : 0.34093
D1 : 0.30302 E : 0.28834
D2 : 0.31240 F : 2.50852

Duration : 6 Hours ☐ Fixed ☒ Sliding
Return period : 2.0 Years ☒ AM ☐ POT

Rainfall depth 22.2665 mm

Calculate... **Export...** **Cancel**

An areal reduction factor of 0.961 has been applied to a point rainfall of 23.2 mm to yield a catchment design rainfall of 22.3 mm.



FEH CD-ROM 3 - Design Rainfall and Rainfall Event Rarity

Calculate: **Design rainfall** for

☒ catchment 342750 393000 [SJ 42750 93000]
☐ 1 km grid point 343000 393000 [SJ 43000 93000]
☐ Manually entered values ☐ for a point

Area: 6.5275 km²

C: -0.02205 D3: 0.34093
 D1: 0.30302 E: 0.28834
 D2: 0.31240 F: 2.50852

Duration: 6 Hours ☐ Fixed ☒ Sliding
 Return period: 30.0 Years ☒ AM ☐ POT

Rainfall depth: 47.1815 mm

Calculate... Export... Cancel

An areal reduction factor of 0.961 has been applied to a point rainfall of 49.1 mm to yield a catchment design rainfall of 47.2 mm.

FEH CD-ROM 3 - Design Rainfall and Rainfall Event Rarity

Calculate: **Design rainfall** for

☒ catchment 342750 393000 [SJ 42750 93000]
☐ 1 km grid point 343000 393000 [SJ 43000 93000]
☐ Manually entered values ☐ for a point

Area: 6.5275 km²

C: -0.02205 D3: 0.34093
 D1: 0.30302 E: 0.28834
 D2: 0.31240 F: 2.50852

Duration: 6 Hours ☐ Fixed ☒ Sliding
 Return period: 100.0 Years ☒ AM ☐ POT

Rainfall depth: 63.8505 mm

Calculate... Export... Cancel

An areal reduction factor of 0.961 has been applied to a point rainfall of 66.4 mm to yield a catchment design rainfall of 63.9 mm.

APPENDIX L: IMPERMEABLE AREAS PLANS

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DO NOT SCALE

TOTAL SITE - 2.906ha

IMPERMEABLE AREAS—0.041ha

						KW
A	26.10.16	PT	PRELIMINARY DRAWING			KW
REV	DATE	BY	DESCRIPTION			
DRAWING STATUS:						
PRELIMINARY						
BETT'S HYDRO CONSULTING ENGINEERS Old House Farm, Northwood Road, Old Oak, Uxbridge Tel: 01894 288178 enquiries@betts-engineers.co.uk						
BARRATT HOMES <i>built around you</i>						
PROJECT:						
WATERPARK DRIVE						
TITLE:						
PRE-DEVELOPMENT IMPERMEABLE AREAS PLAN						
DRAWING No:						
HYD104						
SCALE @ SIZE:						
1:500 PT						
CHECKED:						
KW						
REVISIONS:						
A						

DO NOT SCALE

- TOTAL SITE – 2.906ha
- IMPERMEABLE AREAS – 1.233ha
- ROOFS – 0.394ha
- ROADS – 0.572ha
- DRIVEWAYS – 0.267ha



C	23.01.18	MB	UPDATED PLANNING LAYOUT	KW	
B	18.01.17	PT	PRELIMINARY DRAWING	KW	
A	23.01.16	PT	PRELIMINARY DRAWING	KW	
REV	DATE	BY	DESCRIPTION	CHK	
DRAWING STATUS					
PRELIMINARY					
BETTS HYDRO CONSULTING ENGINEERS Old Market, 100-102, Waterpark Drive, Knowsley, Merseyside, L35 2LY Tel: 01244 280175 Email: info@betts-hydro.co.uk BARRATT HOMES <i>Build around you</i>					
PROJECT: WATERPARK DRIVE KNOWSLEY					
TITLE: POST-DEVELOPMENT IMPERMEABLE AREAS PLAN					
DATE	23.01.18	SCALE & SIZE	1:500 @ A1	DRAWN: CP	CHECKED: KW
PROJECT No:	HYD104		DRAWING No:	201	REV: C

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APPENDIX M: PRELIMINARY PROPOSED DRAINAGE PLANS

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WATERPARK DRIVE, KNOWSLEY

EXISTING DRAINAGE SITUATION PLAN

OUR REF. HYD104



LEGEND

- Site Extents
- Main River
- Main River (culvert)

EXISTING DRAINAGE INFRASTRUCTURE

- Foul Water
- Surface Water (public)
- Overland Flow Route(s)

Notes:

THIS DRAWING IS NOT A DRAINAGE 'DESIGN' IT IS A PRELIMINARY DRAINAGE STRATEGY SHOWING INDICATIVE SEWER LOCATIONS.

NO HYDRAULIC SIMULATION OR ASSESSMENT OF THESE PROPOSALS HAS BEEN UNDERTAKEN.

PROPOSED POINTS OF CONNECTION TO THE EXISTING CULVERTS REQUIRE INVERT LEVELS TO BE ACCURATELY ESTABLISHED.

SURCHARGING OF THE PROPOSED OUTFALL WILL REQUIRE MODELLING TO SATISFY THE REQUIREMENTS OF UNITED UTILITIES ALONG WITH FULL HYDRAULIC ANALYSIS.

Surface Water: In accordance with the drainage hierarchy, the surface water run-off generated by the development are proposed to discharge at a restricted rate to the culverted Main River within the southern portion of the site. The proposals are for two new outfalls to the River Alt. Discharge rates are proposed to be restricted to mimic the pre-development greenfield rates (Q1, Q30 and Q100).

Detailed design will be required to confirm the above strategy following a more in depth review of levels and layout. Consent for works to the main river will be required from the Environment Agency, this should be discussed early and the LLFA will agree discharge rates.

Foul Water: The foul water flows generated by the development are proposed to discharge to the public foul water sewer (manhole ref:7002, 225mm dia.) at the western boundary within site.

It is assumed a gravity solution will be likely based on existing ground levels; however further investigation during detailed will be required to confirm whether discharging the whole of site under gravity is feasible.

Consent to discharge to the sewer will be required from UU, currently UU agree in principle to connect foul water to the public sewer system.



Site Extents

LEGEND

EXISTING DRAINAGE INFRASTRUCTURE

- Foul Water (public)
- Surface Water (public)

EXISTING DRAINAGE INFRASTRUCTURE

- Main River (open channel)
- Main River (culverted)

PROPOSED DRAINAGE CONNECTIONS

- Surface Water connection 2no.
- Foul water connection

Notes:

THIS DRAWING IS NOT A DRAINAGE 'DESIGN' IT IS A PRELIMINARY DRAINAGE STRATEGY SHOWING INDICATIVE SEWER LOCATIONS.

NO HYDRAULIC SIMULATION OR ASSESSMENT OF THESE PROPOSALS HAS BEEN UNDERTAKEN.

PROPOSED POINTS OF CONNECTION TO THE EXISTING CULVERTS REQUIRE INVERT LEVELS TO BE ACCURATELY ESTABLISHED.

SURCHARGING OF THE PROPOSED OUTFALL WILL REQUIRE MODELLING TO SATISFY THE REQUIREMENTS OF UNITED UTILITIES ALONG WITH FULL HYDRAULIC ANALYSIS.

APPENDIX N: STORMWATER STORAGE ESTIMATES

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QUICK STORAGE ESTIMATES

WATERPARK DRIVE

1 YEAR RETURN PERIOD STORM EVENT

Variables	
FSR Rainfall	Cv (Summer) 0.750
Return Period (years) 1	Cv (Winter) 0.840
Region England and Wales	Impermeable Area (ha) 1.233
Map	Maximum Allowable Discharge (l/s) 11.5
M5-60 (mm) 19.400	Infiltration Coefficient (m/hr) 0.00000
Ratio R 0.395	Safety Factor 2.0
	Climate Change (%) 0

Results
Global Variables require approximate storage of between 87 m³ and 149 m³. These values are estimates only and should not be used for design purposes.

30 YEAR RETURN PERIOD STORM EVENT

Variables	
FSR Rainfall	Cv (Summer) 0.750
Return Period (years) 30	Cv (Winter) 0.840
Region England and Wales	Impermeable Area (ha) 1.233
Map	Maximum Allowable Discharge (l/s) 22.3
M5-60 (mm) 19.400	Infiltration Coefficient (m/hr) 0.00000
Ratio R 0.395	Safety Factor 2.0
	Climate Change (%) 0

Results
Global Variables require approximate storage of between 227 m³ and 349 m³. These values are estimates only and should not be used for design purposes.

100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE

Micro Drainage		Variables		
Variables Results Design Overview 2D Overview 3D Vt	FSR Rainfall	Cv (Summer)	0.750	
	Return Period (years)	100	Cv (Winter)	0.840
	Region	England and Wales	Impervious Area (ha)	1.233
	Map	M5-60 (mm)	Maximum Allowable Discharge (l/s)	27.4
		Ratio R	Infiltration Coefficient (m/hr)	0.00000
		Safety Factor	2.0	
		Climate Change (%)	20	

Micro Drainage		Results
Global Variables require approximate storage of between 400 m³ and 585 m³.		
These values are estimates only and should not be used for design purposes.		

100 YEAR RETURN PERIOD STORM EVENT + 40% CLIMATE CHANGE

Micro Drainage		Variables		
Variables Results Design Overview 2D Overview 3D Vt	FSR Rainfall	Cv (Summer)	0.750	
	Return Period (years)	100	Cv (Winter)	0.840
	Region	England and Wales	Impervious Area (ha)	1.233
	Map	M5-60 (mm)	Maximum Allowable Discharge (l/s)	27.4
		Ratio R	Infiltration Coefficient (m/hr)	0.00000
		Safety Factor	2.0	
		Climate Change (%)	40	

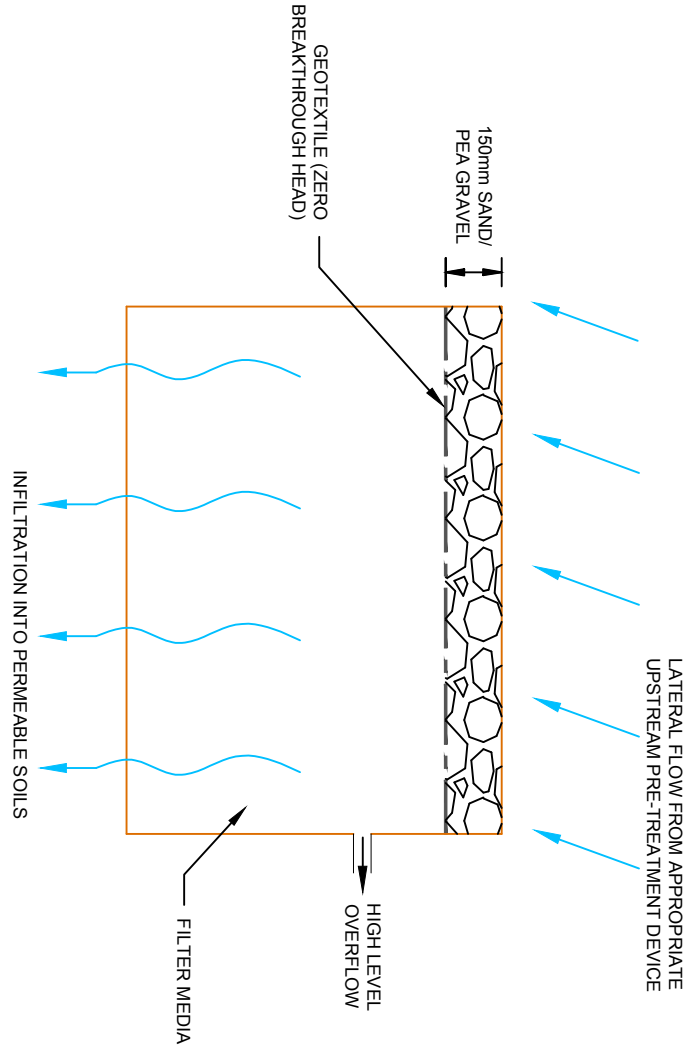
Micro Drainage		Results
Global Variables require approximate storage of between 497 m³ and 712 m³.		
These values are estimates only and should not be used for design purposes.		

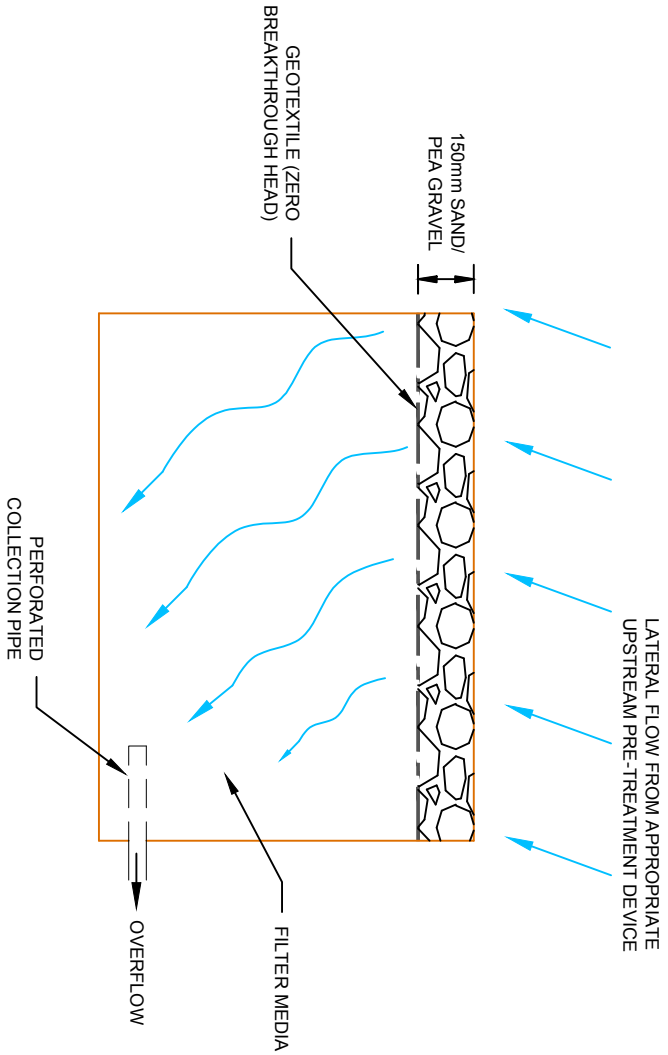
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APPENDIX O: TYPICAL SUDS DETAILS

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DRAWING STATUS:



BETT'S ASSOCIATES

CIVIL AND STRUCTURAL ENGINEERS

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Tel: 01244 288178 Fax: 01244 288516
enquiries@betts-associates.co.uk

PROJECT:

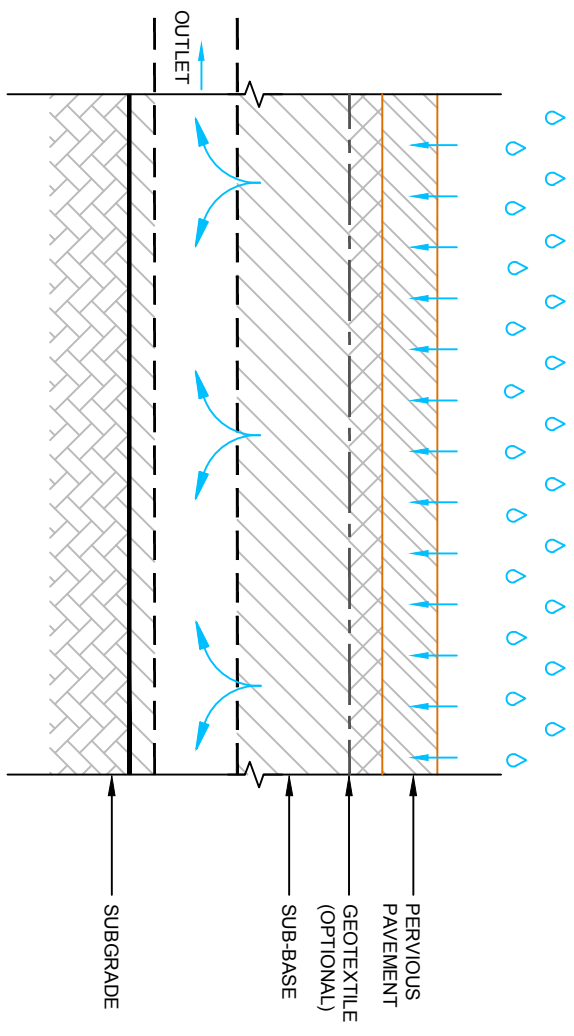
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TITLE:

TRENCHES

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SEP 2014	@ A3	CP	RDN
PROJECT No:	DRAWING No:	REV:	
BETTS	105	A	

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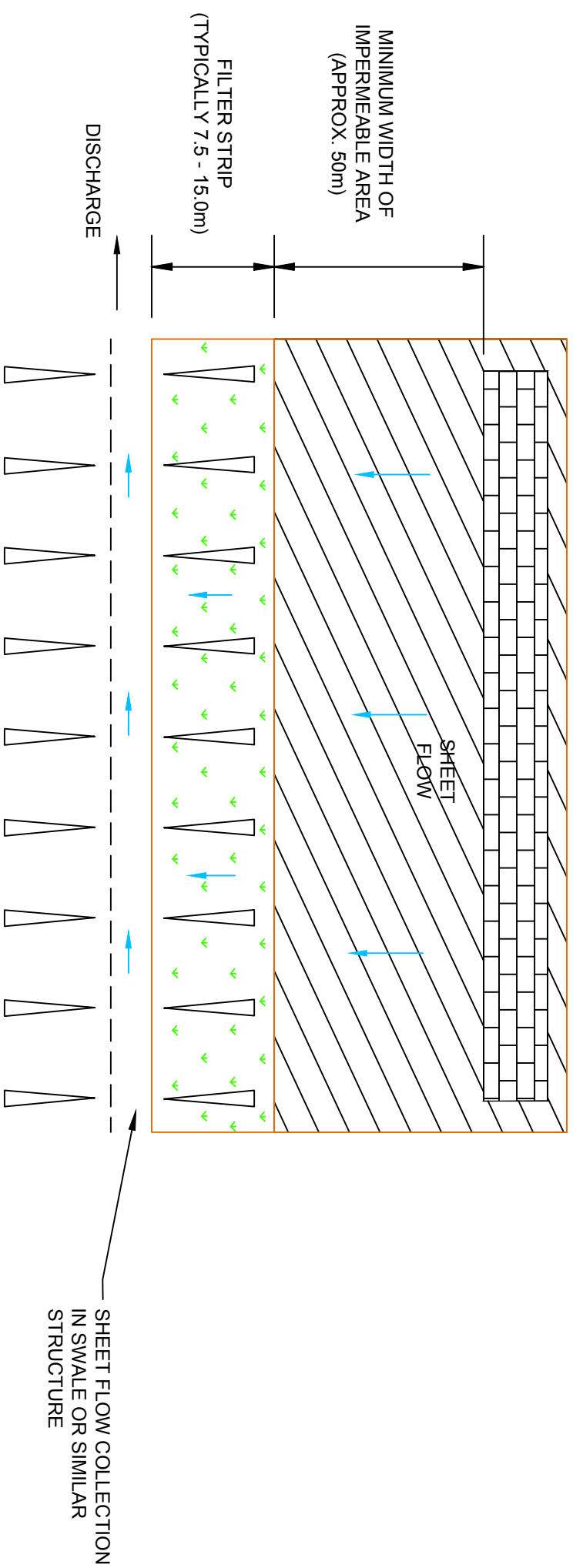


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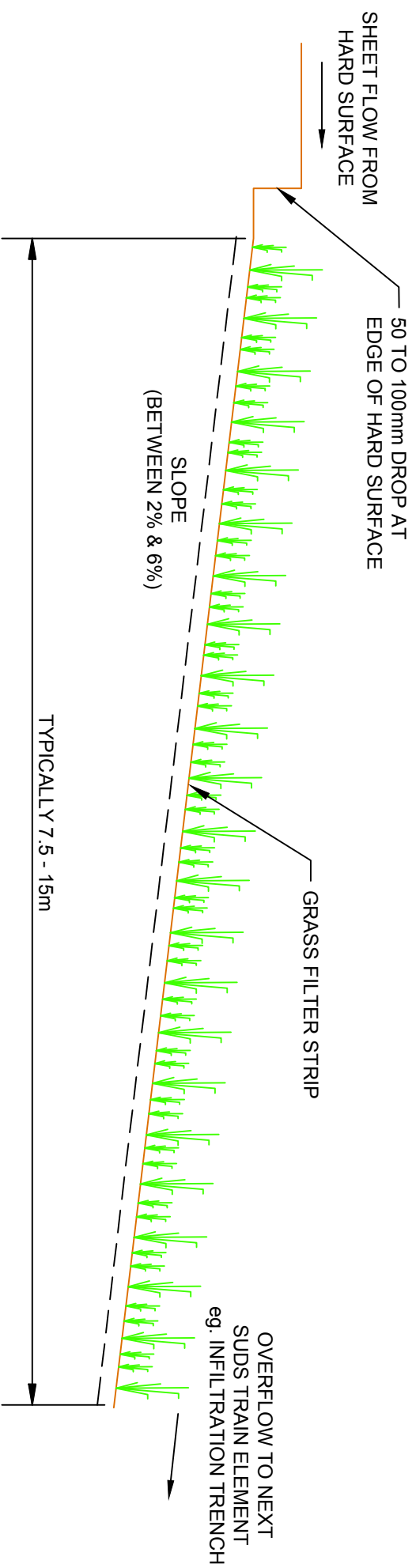
Unit 6, Old Marsh Farm Banns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 Fax: 01244 288516 enquiries@betts-associates.co.uk

PROJECT No:	DRAWING No:	REV:
BETTS	105	A

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PLAN



ELEVATION

REV	DATE	BY	DESCRIPTION	CHK
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DRAWING STATUS:

PRELIMINARY

BETTS ASSOCIATES

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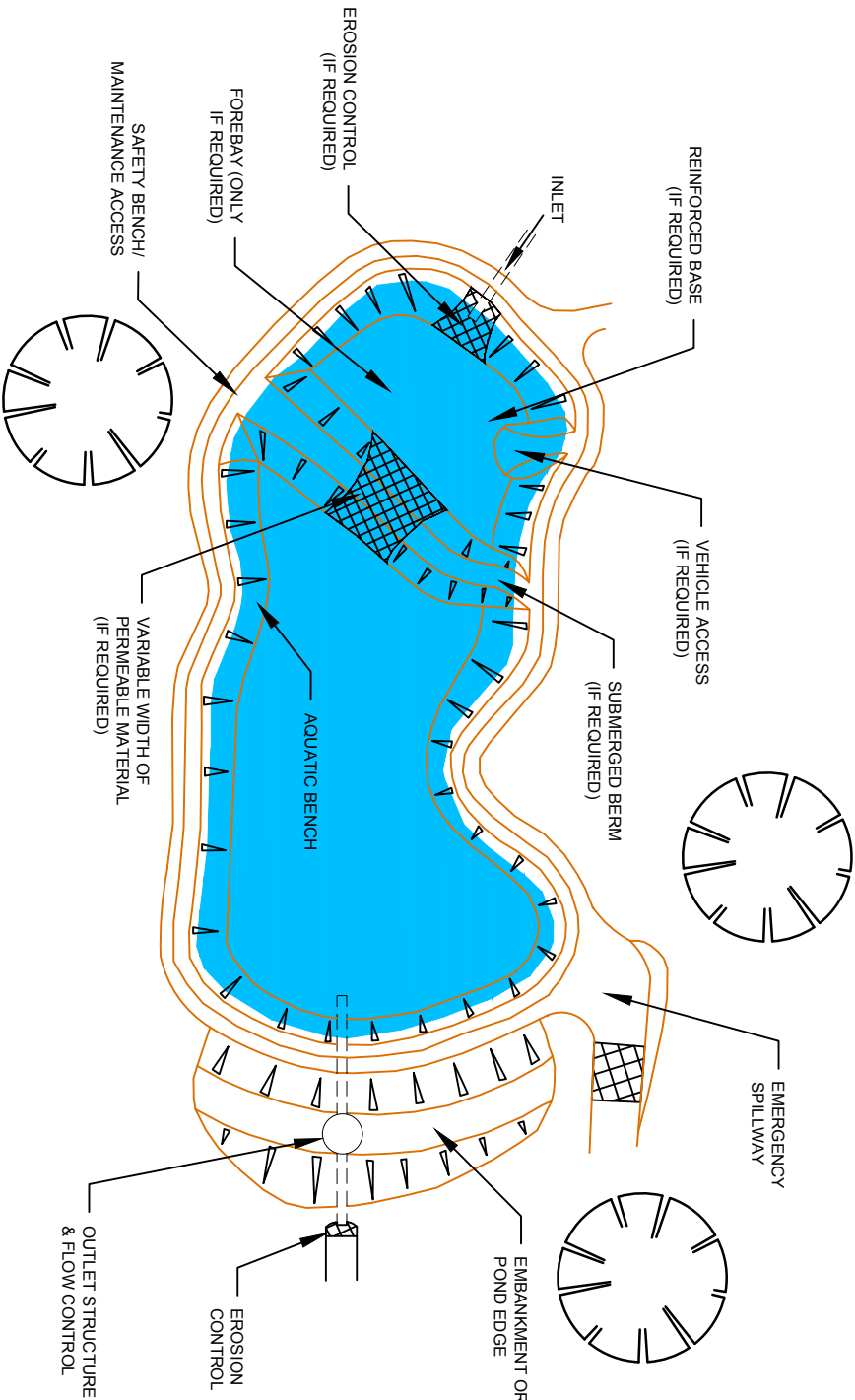
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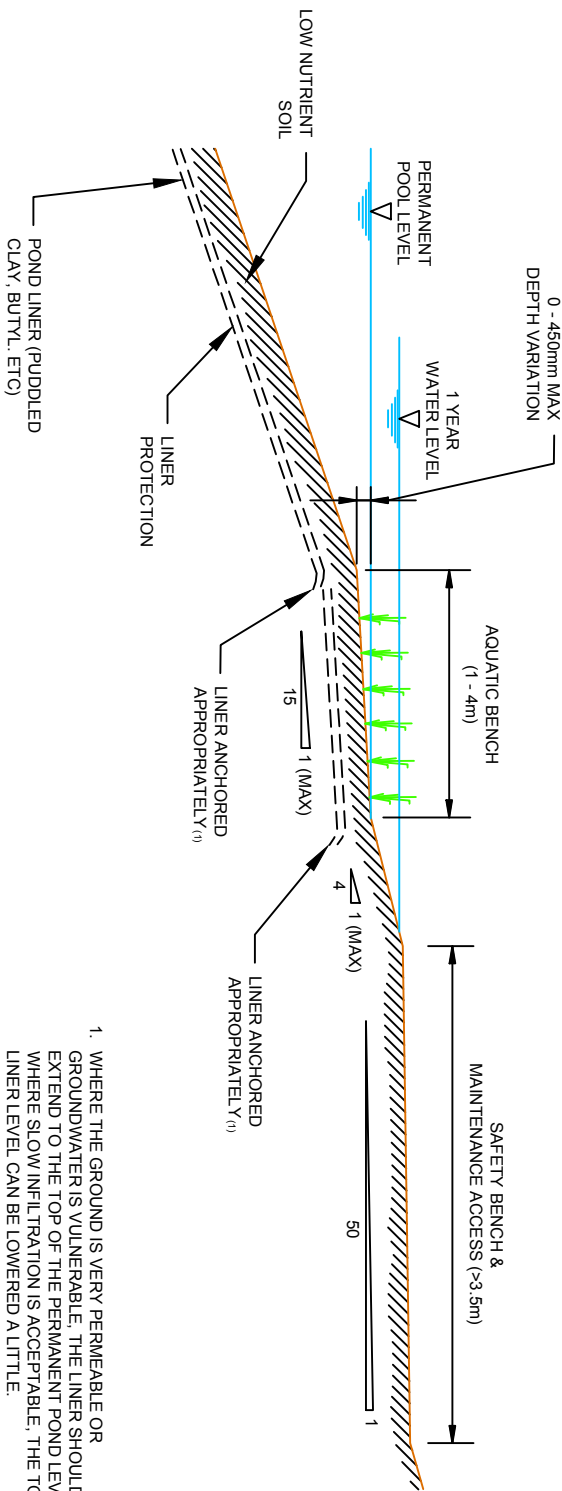
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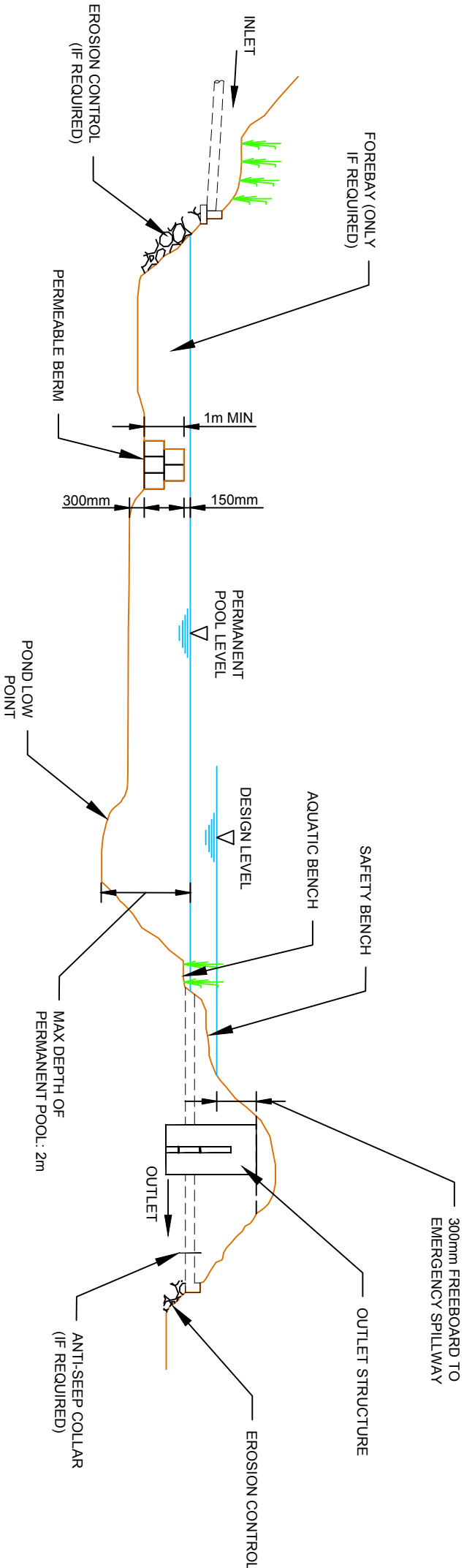


PLAN VIEW



TYPICAL POND EDGE GEOMETRY

1. WHERE THE GROUND IS VERY PERMEABLE OR GROUNDWATER IS VULNERABLE, THE LINER SHOULD EXTEND TO THE TOP OF THE PERMANENT POND LEVEL, WHERE SLOW INFILTRATION IS ACCEPTABLE, THE TOP LINER LEVEL CAN BE LOWERED A LITTLE.



PROFILE

REV	DATE	BY	DESCRIPTION	CHK	
DRAWING STATUS: PRELIMINARY					
PROJECT: TYPICAL SUDS DETAIL					
TITLE: WET PONDS					
DATE: SEP 2014 PROJECT No: BETTS					
SCALE @ SIZE: A3 DRAWING No: 111					
CHECKED: RDN REV: A					



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APPENDIX P: NOTES OF LIMITATIONS

The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

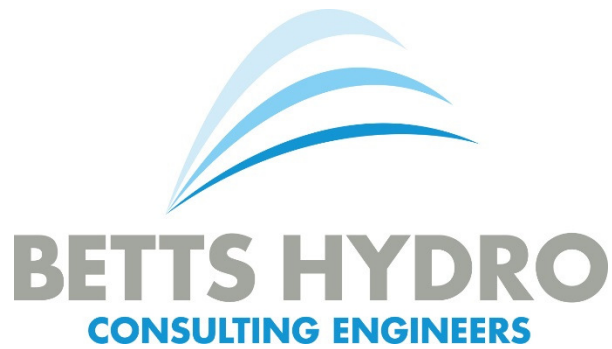
It should be noted that any risks identified in this report are perceived risks based on the available information.

This report was prepared by Betts Hydro Ltd for the sole and exclusive use of the titled client in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

This document has been prepared for the titled project only and should any third party wish to use or rely upon the contents of the report, written approval from Betts Hydro Ltd must be sought.

Betts Hydro Ltd accepts no responsibility or liability for the consequences of this document being used for the purpose other than that for which it was commissioned and for this document to any other party other than the person by whom it was commissioned.

Appendix B



**WATERPARK DRIVE,
KNOWSLEY**

HYDRAULIC ASSESSMENT



For
Barratt Homes Manchester Division
4 Brindley Road,
City Park,
Manchester
M16 9HQ.

June 2016

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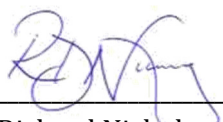
**WATERPARK DRIVE,
KNOWSLEY**

HYDRAULIC ASSESSMENT

Document Tracking Sheet

Document Reference: HYD104_WATERPARKDRIVE_HYDRAULIC_ASSESSMENT
Revision: 0.0
Date of Issue: 1st July 2016
Report Status: DRAFT

Prepared by: 
Dominic Kearney BEng (Hons), MSc, PhD
Principal Hydraulic Analyst

Checked by: 
Richard Nicholas BEng (Hons) MBA
Director

Authorised by: 
Rob Ankers
Director

Revision History:

Rev.:	Date:	Status:	Prepared by:	Checked by:	Issued by:
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Specialist Software

 ISIS 3.7

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	mAOD	Metres Above Ordnance Datum
BGL	Below Ground Level	NGR	National Grid Reference
CC	Climate Change	NPPF	National Planning Policy Framework
EA	Environment Agency	OS	Ordnance Survey
FEH	Flood Estimation Handbook	PFRA	Preliminary Flood Risk Assessment
FRA	Flood Risk Assessment	PPS	Planning Policy Statement
FBC	Fylde Borough Council	SFRA	Strategic Flood Risk Assessment
FZ	Flood Zone	LCC	Lancashire County Council
Ha	Hectare	TWL	Top Water Level
LLFA	Lead Local Flood Authority	UU	United Utilities
LPA	Local Planning Authority		