APPENDIX D

OUTLINE DEVELOPMENT SURFACE WATER DRAINAGE CALCULATIONS

C & A Consulting Engineers Ltd		Page 1
Office 19 Hart House Priestly Road Basingstoke Hampshire RG24 9PU	Land South of Bartons Road Havant QBar calcs	
Date December 2015 File	Designed by TSH Checked by GAC	
XP Solutions	Source Control 2014.1.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	6.800	Urban	0.000
SAAR (mm)	771	Region Number	Region 7

Results l/s

QBAR Rural	25.9
QBAR Urban	25.9
Q100 years	82.6
Q1 year	22.0
Q30 years	58.7
Q100 years	82.6

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	6.169	0.283	21.8	0.050	5.00	0.0	0.600	o	100	
2.000	24.519	0.817	30.0	0.037	5.00	0.0	0.600	o	150	
2.001	2.458	0.083	29.6	0.000	0.00	0.0	0.600	o	150	
1.001	1.000	0.001	1000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.06	25.583	0.050	0.0	0.0	0.0	1.66	13.0	6.8
2.000	50.00	5.22	26.200	0.037	0.0	0.0	0.0	1.84	32.6	5.0
2.001	50.00	5.24	25.383	0.037	0.0	0.0	0.0	1.86	32.8	5.0
1.001	50.00	5.31	26.450	0.087	0.0	0.0	0.0	0.24	1.9«	11.8

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
3	26.900	1.317	Open Manhole	1200	1.000	25.583	100				
5	26.800	0.600	Open Manhole	1200	2.000	26.200	150				
6	26.750	1.367	Open Manhole	1200	2.001	25.383	150	2.000	25.383	150	
4	26.550	1.250	Open Manhole	1200	1.001	26.450	100	1.000	25.300	100	
								2.001	25.300	150	
	27.000	0.551	Open Manhole	0		OUTFALL		1.001	26.449	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		27.000	26.449	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 4, DS/PN: 1.001

Cellular Storage

Invert Level (m)	25.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	204.0	204.0	0.800	204.0	250.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.3
Membrane Percolation (mm/hr)	1000	Length (m)	14.3
Max Percolation (l/s)	56.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	26.100	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	30/15 Summer				
2.000	15 Winter	100	+30%					
2.001	2160 Winter	100	+30%	100/15 Summer				
1.001	2160 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	3	26.475	0.792	0.000	1.94	0.0	22.6	SURCHARGED
2.000	5	26.288	-0.062	0.000	0.64	0.0	19.8	OK
2.001	6	25.656	0.123	0.000	0.04	0.0	0.8	SURCHARGED
1.001	4	25.656	-0.894	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	8.000	0.100	80.0	0.092	5.00	0.0	0.600	o	225	
1.001	1.000	0.001	1000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.09	25.250	0.092	0.0	0.0	0.0	1.46	58.2	12.5
1.001	50.00	5.16	25.900	0.092	0.0	0.0	0.0	0.24	1.9«	12.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	25.800	0.550	Open Manhole	1200	1.000	25.250	225				
4	26.000	0.850	Open Manhole	1200	1.001	25.900	100	1.000	25.150	225	
	26.500	0.601	Open Manhole	0		OUTFALL		1.001	25.899	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		26.500	25.899	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 4, DS/PN: 1.001

Cellular Storage

Invert Level (m)	25.150	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	378.0	378.0	0.400	378.0	409.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	19.4
Membrane Percolation (mm/hr)	1000	Length (m)	19.4
Max Percolation (l/s)	104.5	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	25.550	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Winter				
1.001	960 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	25.490	0.015	0.000	1.09	0.0	48.6	SURCHARGED
1.001	4	25.331	-0.669	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	42.370	0.706	60.0	0.049	5.00	0.0	0.600	o	150	
2.000	24.633	0.706	34.9	0.039	5.00	0.0	0.600	o	150	
1.001	4.000	0.969	4.1	0.102	0.00	0.0	0.600	o	225	
3.000	8.000	0.750	10.7	0.030	5.00	0.0	0.600	o	150	
1.002	1.000	0.010	100.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.54	26.400	0.049	0.0	0.0	0.0	1.30	23.0	6.6
2.000	50.00	5.24	26.400	0.039	0.0	0.0	0.0	1.71	30.2	5.3
1.001	50.00	5.55	25.619	0.190	0.0	0.0	0.0	6.49	257.9	25.7
3.000	50.00	5.04	25.400	0.030	0.0	0.0	0.0	3.10	54.8	4.1
1.002	50.00	5.57	25.400	0.220	0.0	0.0	0.0	0.77	6.0«	29.8

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	27.000	0.600	Open Manhole	1200	1.000	26.400	150				
2	27.000	0.600	Open Manhole	1200	2.000	26.400	150				
3	27.000	1.381	Open Manhole	1200	1.001	25.619	225	1.000	25.694	150	
								2.000	25.694	150	
4	25.850	0.450	Open Manhole	1200	3.000	25.400	150				
4	25.500	0.850	Open Manhole	1200	1.002	25.400	100	1.001	24.650	225	
								3.000	24.650	150	
	26.000	0.610	Open Manhole	0		OUTFALL		1.002	25.390	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		26.000	25.390	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 4, DS/PN: 1.002

Cellular Storage

Invert Level (m)	24.650	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	655.0	655.0	0.400	655.0	696.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.6
Membrane Percolation (mm/hr)	1000	Length (m)	25.6
Max Percolation (l/s)	182.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	25.050	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840
Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Summer				
2.000	15 Winter	100	+30%					
1.001	15 Winter	100	+30%					
3.000	15 Winter	100	+30%					
1.002	1440 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.657	0.107	0.000	1.07	0.0	23.8	SURCHARGED
2.000	2	26.496	-0.054	0.000	0.73	0.0	20.9	OK
1.001	3	25.764	-0.080	0.000	0.73	0.0	101.8	OK
3.000	4	25.461	-0.089	0.000	0.34	0.0	16.1	OK
1.002	4	24.921	-0.579	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	46.902	0.585	80.2	0.064	5.00	0.0	0.600	o	225	
1.001	38.557	1.015	38.0	0.000	0.00	0.0	0.600	o	225	
1.002	1.036	0.050	20.7	0.095	0.00	0.0	0.600	o	225	
1.003	1.000	0.001	1000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.53	25.550	0.064	0.0	0.0	0.0	1.46	58.1	8.7
1.001	50.00	5.84	24.965	0.064	0.0	0.0	0.0	2.13	84.7	8.7
1.002	50.00	5.84	23.950	0.159	0.0	0.0	0.0	2.89	114.8	21.5
1.003	50.00	5.91	24.650	0.159	0.0	0.0	0.0	0.24	1.9«	21.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	26.000	0.450	Open Manhole	1200	1.000	25.550	225				
4	26.500	1.535	Open Manhole	1200	1.001	24.965	225	1.000	24.965	225	
5	24.750	0.800	Open Manhole	1200	1.002	23.950	225	1.001	23.950	225	
6	24.750	0.850	Open Manhole	1200	1.003	24.650	100	1.002	23.900	225	
	25.000	0.351	Open Manhole	0		OUTFALL		1.003	24.649	100	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 6, DS/PN: 1.003

Cellular Storage

Invert Level (m)	23.900	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	587.0	587.0	0.400	587.0	625.8

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	24.2
Membrane Percolation (mm/hr)	1000	Length (m)	24.2
Max Percolation (l/s)	162.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.300	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%					
1.001	15 Winter	100	+30%					
1.002	15 Winter	100	+30%	30/15 Summer				
1.003	1440 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	25.679	-0.096	0.000	0.61	0.0	33.8	OK
1.001	4	25.067	-0.123	0.000	0.42	0.0	33.9	OK
1.002	5	24.479	0.304	0.000	2.65	0.0	83.6	FLOOD RISK
1.003	6	24.107	-0.643	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	14.375	0.585	24.6	0.033	5.00	0.0	0.600	o	150	
1.001	1.539	0.065	23.7	0.051	0.00	0.0	0.600	o	150	
1.002	1.000	0.001	1000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.12	24.550	0.033	0.0	0.0	0.0	2.04	36.0	4.5
1.001	50.00	5.13	23.965	0.084	0.0	0.0	0.0	2.08	36.7	11.4
1.002	50.00	5.20	24.650	0.084	0.0	0.0	0.0	0.24	1.9«	11.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	25.000	0.450	Open Manhole	1200	1.000	24.550	150				
2	24.750	0.785	Open Manhole	1200	1.001	23.965	150	1.000	23.965	150	
3	24.750	0.850	Open Manhole	1200	1.002	24.650	100	1.001	23.900	150	
	25.000	0.351	Open Manhole	0		OUTFALL		1.002	24.649	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		25.000	24.649	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 3, DS/PN: 1.002

Cellular Storage

Invert Level (m)	23.900	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	162.0	162.0	0.400	162.0	182.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	12.7
Max Percolation (l/s)	44.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.300	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%					
1.001	15 Winter	100	+30%	30/15 Summer				
1.002	2160 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	24.673	-0.027	0.000	0.52	0.0	17.3	OK
1.001	2	24.537	0.422	0.000	2.72	0.0	43.4	FLOOD RISK
1.002	3	24.338	-0.412	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	10.000	0.125	80.0	0.075	5.00	0.0	0.600	o	150	
1.001	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.15	23.025	0.075	0.0	0.0	0.0	1.12	19.9	10.2
1.001	50.00	5.98	23.650	0.075	0.0	0.0	0.0	0.10	0.8«	10.2

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	23.750	0.725	Open Manhole	1200	1.000	23.025	150				
1	23.750	0.850	Open Manhole	1200	1.001	23.650	100	1.000	22.900	150	
	24.500	0.851	Open Manhole	0		OUTFALL		1.001	23.649	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		24.500	23.649	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 1, DS/PN: 1.001

Cellular Storage

Invert Level (m)	22.900	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	269.0	269.0	0.400	269.0	295.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.4
Membrane Percolation (mm/hr)	1000	Length (m)	16.4
Max Percolation (l/s)	74.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	23.300	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	30/15 Summer				
1.001	1440 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	23.602	0.427	0.000	2.08	0.0	36.8	FLOOD RISK
1.001	1	23.113	-0.637	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	10.000	0.125	80.0	0.069	5.00	0.0	0.600	o	225	
1.001	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.11	22.425	0.069	0.0	0.0	0.0	1.46	58.2	9.3
1.001	50.00	5.94	23.000	0.069	0.0	0.0	0.0	0.10	0.8«	9.3

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	22.975	0.550	Open Manhole	1200	1.000	22.425	225				
2	23.150	0.850	Open Manhole	1200	1.001	23.000	100	1.000	22.300	225	
	23.500	0.501	Open Manhole	0		OUTFALL		1.001	22.999	100	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 1.001

Cellular Storage

Invert Level (m)	22.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.02790	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.02790		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	162.0	162.0	0.400	162.0	182.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	12.7
Max Percolation (l/s)	44.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	22.700	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%					
1.001	360 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	22.575	-0.075	0.000	0.76	0.0	36.9	OK
1.001	2	22.540	-0.560	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	6.000	0.075	80.0	0.010	5.00	0.0	0.600	o	100	
1.001	5.000	0.001	5000.0	0.078	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.12	23.150	0.010	0.0	0.0	0.0	0.86	6.8	1.4
1.001	50.00	5.94	23.300	0.088	0.0	0.0	0.0	0.10	0.8«	11.9

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	23.750	0.600	Open Manhole	1200	1.000	23.150	100				
2	23.500	0.425	Open Manhole	1200	1.001	23.300	100	1.000	23.075	100	
	24.000	0.701	Open Manhole	0		OUTFALL		1.001	23.299	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		24.000	23.299	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 1.001

Cellular Storage

Invert Level (m)	22.650	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.02790	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.02790		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	270.0	270.0	0.400	270.0	296.3

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.4
Membrane Percolation (mm/hr)	1000	Length (m)	16.4
Max Percolation (l/s)	74.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	23.050	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%					
1.001	360 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	23.224	-0.026	0.000	0.88	0.0	5.3	OK
1.001	2	22.822	-0.578	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	8.266	0.105	78.7	0.018	5.00	0.0	0.600	o	100	
1.001	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.16	21.005	0.018	0.0	0.0	0.0	0.87	6.8	2.4
1.001	50.00	5.99	21.500	0.018	0.0	0.0	0.0	0.10	0.8«	2.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	21.500	0.495	Open Manhole	1200	1.000	21.005	100				
2	21.750	0.850	Open Manhole	1200	1.001	21.500	100	1.000	20.900	100	
	22.000	0.501	Open Manhole	0		OUTFALL		1.001	21.499	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		22.000	21.499	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 1.001

Cellular Storage

Invert Level (m)	20.900	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.02790	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.02790		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	402.0	402.0	0.400	402.0	434.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.1
Membrane Percolation (mm/hr)	1000	Length (m)	20.1
Max Percolation (l/s)	112.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.300	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Summer				
1.001	180 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	21.217	0.112	0.000	1.44	0.0	9.0	FLOOD RISK
1.001	2	20.920	-0.680	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	5.000	0.063	79.4	0.009	5.00	0.0	0.600	o	150	
1.001	5.000	0.001	5000.0	0.122	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.07	21.400	0.009	0.0	0.0	0.0	1.13	20.0	1.2
1.001	50.00	5.90	22.000	0.131	0.0	0.0	0.0	0.10	0.8«	17.7

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	22.000	0.600	Open Manhole	1200	1.000	21.400	150				
2	22.150	0.813	Open Manhole	1200	1.001	22.000	100	1.000	21.337	150	
	22.500	0.501	Open Manhole	0		OUTFALL		1.001	21.999	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		22.500	21.999	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 1.001

Cellular Storage

Invert Level (m)	21.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.02790	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.02790		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	479.0	479.0	0.400	479.0	514.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.9
Membrane Percolation (mm/hr)	1000	Length (m)	21.9
Max Percolation (l/s)	133.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.700	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%					
1.001	240 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	21.457	-0.093	0.000	0.31	0.0	4.8	OK
1.001	2	21.438	-0.662	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	8.000	0.100	80.0	0.025	5.00	0.0	0.600	o	100	
1.001	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.15	21.500	0.025	0.0	0.0	0.0	0.86	6.8	3.4
1.001	50.00	5.98	22.100	0.025	0.0	0.0	0.0	0.10	0.8«	3.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	21.950	0.450	Open Manhole	1200	1.000	21.500	100				
2	22.250	0.850	Open Manhole	1200	1.001	22.100	100	1.000	21.400	100	
	22.500	0.401	Open Manhole	0		OUTFALL		1.001	22.099	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		22.500	22.099	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 1.001

Cellular Storage

Invert Level (m)	21.400	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00716	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00716		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	167.0	167.0	0.400	167.0	187.7

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.9
Membrane Percolation (mm/hr)	1000	Length (m)	12.9
Max Percolation (l/s)	46.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	21.800	Cap Volume Depth (m)	0.000

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	30/15 Summer				
1.001	720 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	21.864	0.264	0.000	1.90	0.0	11.7	FLOOD RISK
1.001	2	21.500	-0.700	0.000	0.00	0.0	0.0	OK

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Land South of Bartons Road
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Designed by TSH
Checked by GAC

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	29.198	0.292	100.0	0.061	5.00	0.0	0.600	o	225	
2.000	16.116	0.160	100.7	0.051	5.00	0.0	0.600	o	150	
1.001	29.971	0.908	33.0	0.032	0.00	0.0	0.600	o	450	
3.000	15.723	0.500	31.4	0.051	5.00	0.0	0.600	o	150	
1.002	23.485	0.140	168.2	0.035	0.00	0.0	0.600	o	450	
1.003	30.325	1.060	28.6	0.047	0.00	0.0	0.600	o	450	
1.004	41.526	0.185	224.5	0.036	0.00	0.0	0.600	o	450	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.37	26.450	0.061	0.0	0.0	0.0	1.31	52.0	8.3
2.000	50.00	5.27	26.750	0.051	0.0	0.0	0.0	1.00	17.7	6.9
1.001	50.00	5.51	25.933	0.144	0.0	0.0	0.0	3.55	564.3	19.5
3.000	50.00	5.15	26.300	0.051	0.0	0.0	0.0	1.80	31.8	6.9
1.002	50.00	5.76	25.025	0.230	0.0	0.0	0.0	1.56	248.9	31.1
1.003	50.00	5.90	24.885	0.277	0.0	0.0	0.0	3.81	606.3	37.5
1.004	50.00	6.41	23.825	0.313	0.0	0.0	0.0	1.35	215.2	42.4

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.005	19.761	1.330	14.9	0.000	0.00	0.0	0.600	o	450	
1.006	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	50.00	6.47	23.640	0.313	0.0	0.0	0.0	5.30	842.2	42.4
1.006	50.00	7.30	24.000	0.313	0.0	0.0	0.0	0.10	0.8«	42.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	27.800	1.350	Open Manhole	1200	1.000	26.450	225				
2	28.000	1.250	Open Manhole	1200	2.000	26.750	150				
2	27.600	1.667	Open Manhole	1350	1.001	25.933	450	1.000	26.158	225	
								2.000	26.590	150	357
4	27.550	1.250	Open Manhole	1200	3.000	26.300	150				
4	26.800	1.775	Open Manhole	1350	1.002	25.025	450	1.001	25.025	450	
								3.000	25.800	150	475
6	26.750	1.865	Open Manhole	1350	1.003	24.885	450	1.002	24.885	450	
7	25.500	1.675	Open Manhole	1350	1.004	23.825	450	1.003	23.825	450	
8	25.800	2.160	Open Manhole	1350	1.005	23.640	450	1.004	23.640	450	
10	24.250	1.940	Open Manhole	1350	1.006	24.000	100	1.005	22.310	450	
	25.000	1.001	Open Manhole	0		OUTFALL		1.006	23.999	100	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 2, DS/PN: 1.001, Volume (m³): 3.8

Unit Reference	MD-SHE-0145-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	145
Invert Level (m)	26.158
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	10.0
Flush-Flo™	0.304	9.9
Kick-Flo®	0.672	8.3
Mean Flow over Head Range	-	8.5

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 (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	1.200	10.9	3.000	16.8	7.000	25.2
0.200	9.6	1.400	11.7	3.500	18.1	7.500	26.0
0.300	9.9	1.600	12.4	4.000	19.3	8.000	26.9
0.400	9.8	1.800	13.2	4.500	20.4	8.500	27.7
0.500	9.6	2.000	13.8	5.000	21.4	9.000	28.4
0.600	9.1	2.200	14.5	5.500	22.4	9.500	29.2
0.800	9.0	2.400	15.1	6.000	23.4		
1.000	10.0	2.600	15.7	6.500	24.3		

Hydro-Brake Optimum® Manhole: 7, DS/PN: 1.004, Volume (m³): 7.0

Unit Reference	MD-SHE-0239-3000-0750-3000
Design Head (m)	0.750
Design Flow (l/s)	30.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	239
Invert Level (m)	23.825
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	29.9
Flush-Flo™	0.356	29.9

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Hydro-Brake Optimum® Manhole: 7, DS/PN: 1.004, Volume (m³): 7.0

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	0.601	26.9
Mean Flow over Head Range	-	23.6

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	7.9	1.200	37.5	3.000	58.4	7.000	88.2
0.200	24.2	1.400	40.4	3.500	62.9	7.500	91.2
0.300	29.7	1.600	43.1	4.000	67.1	8.000	93.5
0.400	29.8	1.800	45.6	4.500	71.1	8.500	96.4
0.500	29.0	2.000	48.0	5.000	74.8	9.000	99.2
0.600	27.0	2.200	50.2	5.500	78.4	9.500	102.0
0.800	30.9	2.400	52.4	6.000	81.8		
1.000	34.4	2.600	54.5	6.500	85.0		

Hydro-Brake Optimum® Manhole: 8, DS/PN: 1.005, Volume (m³): 9.5

Unit Reference	MD-SHE-0230-3000-1500-3000
Design Head (m)	1.500
Design Flow (l/s)	30.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	230
Invert Level (m)	23.640
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	29.9
Flush-Flo™	0.465	29.7
Kick-Flo®	1.015	24.8
Mean Flow over Head Range	-	25.5

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 (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.6	0.800	28.4	2.000	34.3	4.000	47.9
0.200	23.0	1.000	25.2	2.200	35.9	4.500	50.7
0.300	28.8	1.200	26.8	2.400	37.4	5.000	53.3
0.400	29.6	1.400	28.9	2.600	38.9	5.500	55.9
0.500	29.7	1.600	30.8	3.000	41.7	6.000	58.3
0.600	29.4	1.800	32.6	3.500	44.9	6.500	60.6

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Hydro-Brake Optimum® Manhole: 8, DS/PN: 1.005, Volume (m³): 9.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.000	62.8	8.000	67.0	9.000	71.0		
7.500	64.9	8.500	69.0	9.500	72.9		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 2.000

Cellular Storage

Invert Level (m)	26.750	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	162.0	162.0	0.800	162.0	202.7

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	12.7
Max Percolation (l/s)	44.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	27.550	Cap Volume Depth (m)	0.000

Complex Manhole: 4, DS/PN: 3.000

Cellular Storage

Invert Level (m)	26.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	162.0	162.0	0.800	162.0	202.7

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	12.7
Max Percolation (l/s)	44.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	27.100	Cap Volume Depth (m)	0.000

Complex Manhole: 10, DS/PN: 1.006

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Filter Drain

Infiltration Coefficient Base (m/hr)	0.02790	Trench Length (m)	60.0
Infiltration Coefficient Side (m/hr)	0.02790	Pipe Diameter (m)	0.450
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	1000.0
Invert Level (m)	22.310	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.02790	Length (m)	60.0
Infiltration Coefficient Side (m/hr)	0.02790	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	80.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	23.310	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0	Include Swale Volume	Yes

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	30/15 Summer				
2.000	60 Winter	100	+30%	100/30 Summer				
1.001	15 Winter	100	+30%	30/15 Summer				
3.000	30 Winter	100	+30%					
1.002	30 Winter	100	+30%	100/30 Winter				
1.003	30 Winter	100	+30%	100/15 Winter				
1.004	30 Winter	100	+30%	30/15 Summer				
1.005	30 Winter	100	+30%	100/15 Summer				
1.006	600 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	27.594	0.919	0.000	0.60	0.0	29.0	FLOOD RISK
2.000	2	26.949	0.049	0.000	0.52	0.0	8.5	SURCHARGED
1.001	2	27.487	1.104	0.000	0.02	0.0	11.3	FLOOD RISK
3.000	4	26.362	-0.088	0.000	0.36	0.0	10.7	OK
1.002	4	25.511	0.036	0.000	0.14	0.0	28.9	SURCHARGED
1.003	6	25.501	0.166	0.000	0.09	0.0	45.0	SURCHARGED
1.004	7	25.486	1.211	0.000	0.21	0.0	40.3	FLOOD RISK
1.005	8	25.076	0.986	0.000	0.05	0.0	29.7	SURCHARGED

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.006	10	23.855	-0.245	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
2.000	17.429	0.175	99.6	0.051	5.00	0.0	0.600	o	150	
2.001	46.459	0.300	154.9	0.073	0.00	0.0	0.600	o	300	
2.002	74.254	4.125	18.0	0.084	0.00	0.0	0.600	o	300	
2.003	6.885	0.375	18.4	0.024	0.00	0.0	0.600	o	300	
2.004	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	50.00	5.29	27.750	0.051	0.0	0.0	0.0	1.01	17.8	6.9
2.001	50.00	5.90	26.800	0.124	0.0	0.0	0.0	1.26	89.1	16.8
2.002	50.00	6.23	26.500	0.208	0.0	0.0	0.0	3.72	263.2	28.2
2.003	50.00	6.27	22.375	0.232	0.0	0.0	0.0	3.69	260.6	31.4
2.004	50.00	7.09	23.900	0.232	0.0	0.0	0.0	0.10	0.8«	31.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
8	29.000	1.250	Open Manhole	1200	2.000	27.750	150				
9	28.250	1.450	Open Manhole	1200	2.001	26.800	300	2.000	27.575	150	625
10	28.000	1.500	Open Manhole	1200	2.002	26.500	300	2.001	26.500	300	
11	24.500	2.125	Open Manhole	1200	2.003	22.375	300	2.002	22.375	300	
5	24.000	2.000	Open Manhole	1200	2.004	23.900	100	2.003	22.000	300	
	24.000	0.101	Open Manhole	0		OUTFALL		2.004	23.899	100	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 9, DS/PN: 2.001, Volume (m³): 1.9

Unit Reference	MD-SHE-0189-1800-1000-1800
Design Head (m)	1.000
Design Flow (l/s)	18.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	189
Invert Level (m)	26.800
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	17.9
Flush-Flo™	0.331	17.9
Kick-Flo®	0.710	15.3
Mean Flow over Head Range	-	15.1

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	6.6	1.200	19.6	3.000	30.3	7.000	45.7
0.200	17.1	1.400	21.1	3.500	32.7	7.500	47.2
0.300	17.8	1.600	22.5	4.000	34.9	8.000	48.7
0.400	17.8	1.800	23.8	4.500	36.9	8.500	50.2
0.500	17.4	2.000	25.0	5.000	38.8	9.000	51.6
0.600	16.9	2.200	26.1	5.500	40.7	9.500	53.0
0.800	16.1	2.400	27.3	6.000	42.4		
1.000	17.9	2.600	28.3	6.500	44.1		

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Storage Structures for Storm

Complex Manhole: 8, DS/PN: 2.000

Cellular Storage

Invert Level (m)	27.750	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	162.0	162.0	0.800	162.0	202.7

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	12.7
Max Percolation (l/s)	44.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	28.550	Cap Volume Depth (m)	0.000

Complex Manhole: 5, DS/PN: 2.004

Filter Drain

Infiltration Coefficient Base (m/hr)	0.02790	Trench Length (m)	15.7
Infiltration Coefficient Side (m/hr)	0.02790	Pipe Diameter (m)	0.450
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	1000.0
Invert Level (m)	21.100	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.02790	Length (m)	15.7
Infiltration Coefficient Side (m/hr)	0.02790	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	23.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0	Include Swale Volume	Yes

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840
Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
2.000	30 Winter	100	+30%					
2.001	15 Winter	100	+30%	30/15 Summer				
2.002	15 Winter	100	+30%					
2.003	960 Winter	100	+30%	1/360 Winter				
2.004	960 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
2.000	8	27.852	-0.048	0.000	0.69	0.0	11.4	OK
2.001	9	28.169	1.069	0.000	0.24	0.0	20.4	FLOOD RISK
2.002	10	26.606	-0.194	0.000	0.27	0.0	67.2	OK
2.003	11	23.907	1.232	0.000	0.06	0.0	8.8	SURCHARGED
2.004	5	23.906	-0.094	0.000	0.00	0.0	0.0	FLOOD RISK

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Date December 2015 File Network 14 - Swale 2 - ...	Designed by TSH Checked by GAC
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	30.946	0.182	170.0	0.221	5.00	0.0	0.600	o	300	
2.000	16.800	0.170	98.8	0.051	5.00	0.0	0.600	o	100	
1.001	41.221	0.318	129.6	0.049	0.00	0.0	0.600	o	300	
3.000	27.971	2.175	12.9	0.071	5.00	0.0	0.600	o	150	
1.002	59.926	0.875	68.5	0.073	0.00	0.0	0.600	o	300	
1.003	33.652	1.350	24.9	0.036	0.00	0.0	0.600	o	300	
1.004	8.826	0.500	17.7	0.064	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.43	24.750	0.221	0.0	0.0	0.0	1.20	85.0	29.9
2.000	50.00	5.36	26.200	0.051	0.0	0.0	0.0	0.77	6.1«	6.9
1.001	50.00	5.93	24.568	0.321	0.0	0.0	0.0	1.38	97.5	43.5
3.000	50.00	5.17	26.500	0.071	0.0	0.0	0.0	2.82	49.9	9.6
1.002	50.00	6.45	24.175	0.465	0.0	0.0	0.0	1.90	134.5	63.0
1.003	50.00	6.63	23.300	0.501	0.0	0.0	0.0	3.16	223.5	67.8
1.004	50.00	6.67	21.950	0.565	0.0	0.0	0.0	3.76	265.8	76.5

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.005	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	50.00	7.50	23.300	0.565	0.0	0.0	0.0	0.10	0.8«	76.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	26.250	1.500	Open Manhole	1200	1.000	24.750	300				
2	27.450	1.250	Open Manhole	1200	2.000	26.200	100				
2	27.000	2.432	Open Manhole	1200	1.001	24.568	300	1.000	24.568	300	
								2.000	26.030	100	1262
4	28.000	1.500	Open Manhole	1200	3.000	26.500	150				
5	27.550	3.375	Open Manhole	1200	1.002	24.175	300	1.001	24.250	300	75
								3.000	24.325	150	
6	25.100	1.800	Open Manhole	1200	1.003	23.300	300	1.002	23.300	300	
7	23.600	1.650	Open Manhole	1200	1.004	21.950	300	1.003	21.950	300	
12	23.450	2.000	Open Manhole	1200	1.005	23.300	100	1.004	21.450	300	
	24.000	0.701	Open Manhole	0		OUTFALL		1.005	23.299	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005		24.000	23.299	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 2.000

Cellular Storage

Invert Level (m)	26.200	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	162.0	162.0	0.800	162.0	182.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.7
Membrane Percolation (mm/hr)	1000	Length (m)	12.7
Max Percolation (l/s)	44.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	27.000	Cap Volume Depth (m)	0.000

Complex Manhole: 12, DS/PN: 1.005

Filter Drain

Infiltration Coefficient Base (m/hr)	0.02790	Trench Length (m)	47.1
Infiltration Coefficient Side (m/hr)	0.02790	Pipe Diameter (m)	0.600
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	750.0
Invert Level (m)	21.250	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.02790	Length (m)	47.1
Infiltration Coefficient Side (m/hr)	0.02790	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	143.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	22.250	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0	Include Swale Volume	Yes

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Summer				
2.000	60 Winter	100	+30%					
1.001	15 Winter	100	+30%	100/15 Summer				
3.000	15 Winter	100	+30%					
1.002	15 Winter	100	+30%	100/15 Summer				
1.003	15 Winter	100	+30%	100/15 Summer				
1.004	960 Winter	100	+30%	1/180 Winter				
1.005	960 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.081	1.031	0.000	1.23	0.0	95.1	FLOOD RISK
2.000	2	26.284	-0.016	0.000	1.00	0.0	5.8	OK
1.001	2	25.802	0.934	0.000	1.26	0.0	114.5	SURCHARGED
3.000	4	26.603	-0.047	0.000	0.80	0.0	38.2	OK
1.002	5	25.297	0.822	0.000	1.35	0.0	172.7	SURCHARGED
1.003	6	23.822	0.222	0.000	0.85	0.0	173.9	SURCHARGED
1.004	7	23.240	0.990	0.000	0.12	0.0	21.6	SURCHARGED
1.005	12	23.238	-0.162	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	18.611	0.800	23.3	0.013	5.00	0.0	0.600	o	150	
1.001	62.953	1.650	38.2	0.058	0.00	0.0	0.600	o	150	
1.002	6.419	1.030	6.2	0.071	0.00	0.0	0.600	o	150	
1.003	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.15	22.450	0.013	0.0	0.0	0.0	2.10	37.1	1.8
1.001	50.00	5.79	21.650	0.071	0.0	0.0	0.0	1.63	28.9	9.6
1.002	50.00	5.82	20.000	0.142	0.0	0.0	0.0	4.06	71.8	19.2
1.003	50.00	6.64	20.800	0.142	0.0	0.0	0.0	0.10	0.8«	19.2

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	23.800	1.350	Open Manhole	1200	1.000	22.450	150				
2	23.000	1.350	Open Manhole	1200	1.001	21.650	150	1.000	21.650	150	
3	21.350	1.350	Open Manhole	1200	1.002	20.000	150	1.001	20.000	150	
4	20.950	1.980	Open Manhole	1200	1.003	20.800	100	1.002	18.970	150	
	21.500	0.701	Open Manhole	0		OUTFALL		1.003	20.799	100	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 4, DS/PN: 1.003

Filter Drain

Infiltration Coefficient Base (m/hr)	0.02790	Trench Length (m)	71.6
Infiltration Coefficient Side (m/hr)	0.02790	Pipe Diameter (m)	0.450
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	500.0
Invert Level (m)	18.950	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.02790	Length (m)	71.6
Infiltration Coefficient Side (m/hr)	0.02790	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	37.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	19.950	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0	Include Swale Volume	Yes

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%					
1.001	15 Winter	100	+30%	100/15 Summer				
1.002	15 Winter	100	+30%	100/15 Summer				
1.003	360 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	22.496	-0.104	0.000	0.20	0.0	7.0	OK
1.001	2	22.453	0.653	0.000	1.11	0.0	31.4	SURCHARGED
1.002	3	20.413	0.263	0.000	1.08	0.0	65.4	SURCHARGED
1.003	4	19.786	-1.114	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	27.117	0.500	54.2	0.046	5.00	0.0	0.600	o	150	
1.001	7.565	0.741	10.2	0.043	0.00	0.0	0.600	o	150	
1.002	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.33	19.250	0.046	0.0	0.0	0.0	1.37	24.2	6.2
1.001	50.00	5.37	18.750	0.089	0.0	0.0	0.0	3.17	56.1	12.1
1.002	50.00	6.20	19.850	0.089	0.0	0.0	0.0	0.10	0.8«	12.1

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	20.750	1.500	Open Manhole	1200	1.000	19.250	150				
2	20.250	1.500	Open Manhole	1200	1.001	18.750	150	1.000	18.750	150	
3	20.000	1.991	Open Manhole	1200	1.002	19.850	100	1.001	18.009	150	
	20.500	0.651	Open Manhole	0		OUTFALL		1.002	19.849	100	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 3, DS/PN: 1.002

Filter Drain

Infiltration Coefficient Base (m/hr)	0.02790	Trench Length (m)	45.9
Infiltration Coefficient Side (m/hr)	0.02790	Pipe Diameter (m)	0.450
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	500.0
Invert Level (m)	18.000	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.02790	Length (m)	45.9
Infiltration Coefficient Side (m/hr)	0.02790	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	51.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	19.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0	Include Swale Volume	Yes

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Winter				
1.001	15 Winter	100	+30%	100/15 Winter				
1.002	360 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	19.433	0.033	0.000	1.03	0.0	23.8	SURCHARGED
1.001	2	18.906	0.006	0.000	0.97	0.0	46.7	SURCHARGED
1.002	3	18.773	-1.177	0.000	0.00	0.0	0.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	30.415	0.975	31.2	0.044	5.00	0.0	0.600	o	150	
1.001	59.796	1.750	34.2	0.141	0.00	0.0	0.600	o	225	
1.002	28.806	0.575	50.1	0.044	0.00	0.0	0.600	o	225	
1.003	6.566	1.600	4.1	0.043	0.00	0.0	0.600	o	225	
1.004	5.000	0.001	5000.0	0.000	0.00	0.0	0.600	o	100	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.28	21.300	0.044	0.0	0.0	0.0	1.81	32.0	6.0
1.001	50.00	5.72	20.250	0.185	0.0	0.0	0.0	2.25	89.3	25.1
1.002	50.00	5.98	18.500	0.229	0.0	0.0	0.0	1.85	73.7	31.0
1.003	50.00	6.00	17.925	0.272	0.0	0.0	0.0	6.50	258.6	36.8
1.004	50.00	6.83	18.100	0.272	0.0	0.0	0.0	0.10	0.8«	36.8

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	22.650	1.350	Open Manhole	1200	1.000	21.300	150				
2	21.750	1.500	Open Manhole	1200	1.001	20.250	225	1.000	20.325	150	
3	20.000	1.500	Open Manhole	1200	1.002	18.500	225	1.001	18.500	225	
4	19.500	1.575	Open Manhole	1200	1.003	17.925	225	1.002	17.925	225	
5	18.300	1.975	Open Manhole	1200	1.004	18.100	100	1.003	16.325	225	
19	19.000	0.901	Open Manhole	0		OUTFALL		1.004	18.099	100	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	19	19.000	18.099	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.350		

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Storage Structures for Storm

Complex Manhole: 5, DS/PN: 1.004

Filter Drain

Infiltration Coefficient Base (m/hr)	0.02790	Trench Length (m)	78.5
Infiltration Coefficient Side (m/hr)	0.02790	Pipe Diameter (m)	0.450
Safety Factor	2.0	Pipe Depth above Invert (m)	0.000
Porosity	0.30	Slope (1:X)	500.0
Invert Level (m)	16.300	Cap Volume Depth (m)	0.000
Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.02790	Length (m)	78.5
Infiltration Coefficient Side (m/hr)	0.02790	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	46.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	17.300	Cap Infiltration Depth (m)	0.000
Base Width (m)	4.0	Include Swale Volume	Yes

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Summer				
1.001	15 Winter	100	+30%	100/15 Summer				
1.002	15 Winter	100	+30%	30/15 Summer				
1.003	15 Winter	100	+30%					
1.004	480 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	21.591	0.141	0.000	0.70	0.0	21.5	SURCHARGED
1.001	2	21.181	0.706	0.000	0.98	0.0	84.6	SURCHARGED
1.002	3	19.471	0.746	0.000	1.51	0.0	103.6	SURCHARGED
1.003	4	18.065	-0.085	0.000	0.69	0.0	123.8	OK
1.004	5	17.716	-0.484	0.000	0.00	0.0	0.0	OK

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APPENDIX E

EXISTING DRAINAGE CORRESPONDENCE & PUBLIC SEWER RECORDS

CHECKED

Southern Water

Atkins
Atkins Telecoms - Stats Enquiries Team
The Hub - 500 Park Avenue
Aztec West
Almondsbury
Bristol
Attention: Nicholas Westcott

Your Ref	LM 37493/SD
Our Ref	194153
Date	04 May 2015
Contact	searches@southernwater.co.uk Fax 01634 844514 DX:400450 Chatham 5

Dear Sirs

Provision of Sewer only Main Record Extracts – VAT Receipt

Bartons Road, Havant, Hampshire PO9 5NB
Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Therefore actual positions of the disclosed (and any undisclosed) infrastructure should be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan and accordingly it should not be considered to be a definitive document.

I confirm payment of the appropriate fee in the sum of £49.92

The breakdown of costs is as follows: -

- Provision of record extracts £41.60
- VAT @ 20.0% £8.32

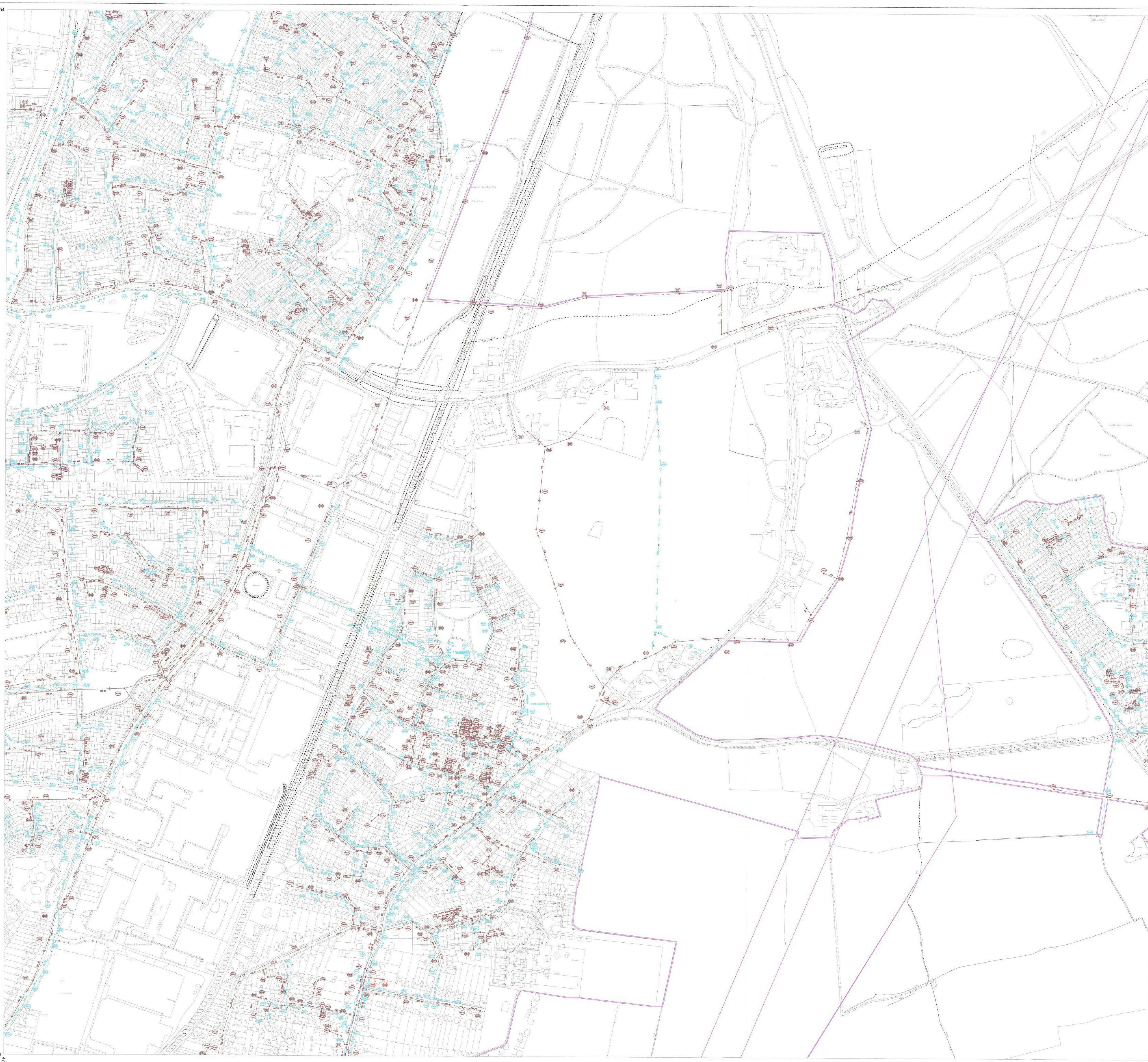
VAT Registration Number 813 0378 56

Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

Letter B



Node	Cover	Invert	Size	Material	Shape	
0001X	14.784	13.614	150	UNK	CIRC	
0002X			UNK	UNK	CIRC	
0003X			UNK	UNK	CIRC	
0004X			UNK	UNK	CIRC	
000DX			UNK	UNK	CIRC	
002DX			UNK	UNK	CIRC	
003DX			UNK	UNK	CIRC	
0050X	14.56	13.67	150	UNK	CIRC	
0051X	14.585	13.665	225	UNK	CIRC	
0053X			UNK	UNK	CIRC	
0101X			UNK	UNK	UNK	*
0101X	15.771		225	UNK	CIRC	*
0102X			UNK	UNK	CIRC	*
0102X	15.471	13.171	225	UNK	CIRC	*
0103X	15.526	13.766	225	UNK	CIRC	
0104X	15.305	12.935	150	UNK	CIRC	
0105X	15.135	12.635	225	UNK	CIRC	
0106X	15.238	13.168	150	UNK	CIRC	
010DX			225	UNK	CIRC	
0150X	14.735	13.235	225	UNK	CIRC	
0151X	14.86	14.19	225	UNK	CIRC	
0152X	14.905	14.315	225	UNK	CIRC	
0153X	14.855		UNK	UNK	UNK	
0154X	15.04	12.44	300	UNK	CIRC	
0155X	15.165	14.515	225	UNK	CIRC	
0156X	15.255	12.705	225	UNK	CIRC	
0157X	15.135		750	UNK	CIRC	
0158X	15.37	12.76	225	UNK	CIRC	
0159X	15.375		UNK	UNK	UNK	
0160X	15.445	14.035	225	UNK	CIRC	
0161X	14.595	13.955	225	UNK	CIRC	
0201X	15.493	12.493	225	UNK	CIRC	
0202X	15.93	13.47	150	UNK	CIRC	
0203X	15.864	13.554	150	UNK	CIRC	
0204X	15.658	13.479	225	UNK	CIRC	
0205X			UNK	UNK	CIRC	*
0205X			UNK	UNK	CIRC	*
0206X			UNK	UNK	CIRC	*
0206X			UNK	UNK	CIRC	*
0207X			UNK	UNK	CIRC	
0208X			UNK	UNK	CIRC	
0209X			UNK	UNK	CIRC	
020BX			UNK	UNK	CIRC	
020DX			100	VC	CIRC	
021DX			150	VC	CIRC	*
021DX			100	VC	CIRC	*
021DX			150	UNK	CIRC	*
022DX			150	VC	CIRC	
023DX			UNK	UNK	CIRC	
024DX			UNK	UNK	CIRC	
0250X	15.49	13.82	225	UNK	CIRC	
0251X	15.635	13.755	300	UNK	CIRC	
0252X	15.95	14.19	375	UNK	CIRC	
0253X	16.125	14.655	225	UNK	CIRC	
0254X	16.025	14.855	225	UNK	CIRC	
02ADX			UNK	UNK	CIRC	
02CDX			UNK	UNK	CIRC	
02FDX			UNK	UNK	CIRC	
02GDX			100	VC	CIRC	
02JDX			UNK	UNK	CIRC	
0301X			UNK	UNK	UNK	*
0301X	16.263	13.783	225	UNK	CIRC	*
0302X			UNK	UNK	CIRC	*
0302X	17.63	15.73	150	VC	CIRC	*
0303X			100	VC	CIRC	*
0303X			UNK	UNK	UNK	*
0304X			100	VC	CIRC	
0305X			100	VC	CIRC	
0306X			100	VC	CIRC	
0307X			100	VC	CIRC	
0309X			UNK	UNK	CIRC	
030DX			100	VC	CIRC	
0311X			UNK	UNK	CIRC	
031DX			100	VC	CIRC	
032DX			100	VC	CIRC	
033DX			100	VC	CIRC	
034DX			UNK	UNK	CIRC	
0350X	16.255	14.435	525	UNK	CIRC	*
0350X	15.659		UNK	UNK	UNK	*
0351X	16.555	14.585	525	UNK	CIRC	
0352X	16.73		225	UNK	CIRC	
0353X	17.65	16.4	300	CO	CIRC	
03ADX			UNK	UNK	CIRC	
03BDX			UNK	UNK	CIRC	
03DDX			UNK	UNK	CIRC	
03HDX			UNK	UNK	CIRC	
03KDX			UNK	VC	CIRC	
0400X	17.12	15.63	225	VC	CIRC	
0401X	16.88	15.49	225	VC	CIRC	
0402X	16.98	15.38	225	VC	CIRC	
0403X	17.25	15.27	225	VC	CIRC	
0450X	17.09	15.54	375	CP	CIRC	
0451X	18.14	15.37	300	CP	CIRC	
0452X	17.2	15.49	300	CP	CIRC	
0453X	17.2	15.36	300	CP	CIRC	
0454X		15.331	UNK	UNK	RECT	
045DX		15.31	450	CP	CIRC	
0500X	18.5	17.3	150	VC	CIRC	
0501X	18.84	17.69	150	VC	CIRC	
0502X	17.85	16.54	150	VC	CIRC	
0503X	17.59	16.4	150	VC	CIRC	
0550X	18.46	16.72	150	VC	CIRC	
0551X	18.83	17.28	150	VC	CIRC	
0552X	17.81	15.95	375	CP	CIRC	
0553X	17.56	15.81	375	CP	CIRC	
0600X	20.96	18.86	150	UNK	CIRC	
0601X	20.265	17.785	150	UNK	CIRC	*
0601X	21.29	18.73	150	VC	CIRC	*
0602X	18.99	17.63	150	VC	CIRC	*
0602X	21.876	19.416	150	UNK	CIRC	*
0603X	22.033	20.203	150	UNK	CIRC	*
0603X	20.91	19.08	225	UNK	CIRC	
0651X	21.18	18.96	225	UNK	CIRC	
0651X	21.847	20.307	225	UNK	CIRC	*
0652X	18.99	17.12	300	CP	CIRC	*
0652X	21.888	19.888	225	UNK	CIRC	*
0653X	16.553		225	UNK	CIRC	*
0653X	15.29	13.98	150	UNK	CIRC	*
0751X	22.486	20.566	225	UNK	CIRC	*
0752X	22.754	20.804	225	UNK	CIRC	
0800X	14.11	12.29	225	UNK	CIRC	
0801X	13.55	12.55	150	UNK	CIRC	
0850X			225	UNK	CIRC	
0902X	14.43	13.43	150	VC	CIRC	
0903X	14.62	13.29	150	VC	CIRC	
0904X	14.58	13.44	150	VC	CIRC	
0905X	14.51		225	UNK	CIRC	
0906X			UNK	UNK	CIRC	
0907X			UNK	UNK	CIRC	
0908X			UNK	UNK	CIRC	
0909X			UNK	UNK	CIRC	
090DX			UNK	UNK	CIRC	
0910X			225	VC	CIRC	
0911X			UNK	UNK	CIRC	
0912X			UNK	UNK	CIRC	
0913X			UNK	UNK	CIRC	
0940X			UNK	UNK	CIRC	
0950X	13.53		UNK	UNK	CIRC	
0951X	14.6	13.59	150	UNK	CIRC	
0952X	14.388	13.513	225	UNK	CIRC	
0953X	14.475	13.52	225	UNK	CIRC	
1001X	14.891	13.881	150	UNK	CIRC	
1002X	15.048	13.908	150	UNK	CIRC	
1003X	14.851	13.941	150	UNK	CIRC	
1004X	14.986		UNK	UNK	CIRC	
1050X	14.895	14.195	150	UNK	CIRC	
1051X	15.005		225	UNK	CIRC	
1052X	14.96	12.86	225	UNK	CIRC	
1053X	14.885	13.755	225	UNK	CIRC	
1054X	15.07	14.04	150	UNK	CIRC	
1100X	21.47	19.42	300	VC	CIRC	*
1100X	12.7	9.95	675	CP	CIRC	*
1101X			150	VC	CIRC	*
1101X	15.301	13.201	150	UNK	CIRC	*
1102X			150	VC	CIRC	
1103X	15.52	13.23	150	UNK	CIRC	
1104X	15.468	14.778	150	UNK	CIRC	
1105X	14.987	13.977	150	UNK	CIRC	
1105X	15.226	13.586	150	UNK	CIRC	
1106X	15.155		150	UNK	CIRC	
1150X			300	VC	CIRC	
1151X	15.655		UNK	UNK	CIRC	
1152Y	15.1	13.595	UNK	UNK	CIRC	*
1153X	15.11	14.16	300	UNK	CIRC	*
1154X	15.08		225	UNK	CIRC	
1155X			225	UNK	CIRC	
1200X	13.34	12.4	225	VC	CIRC	
1201X	15.123		225	UNK	CIRC	*
1202X	15.612	13.272	225	UNK	CIRC	*
1203X	15.558	12.948	225	UNK	CIRC	
1204X	16.236	13.576	225	UNK	CIRC	
1205X			225	UNK	CIRC	
1210X			225	UNK	CIRC	
1250X	15.41	12.92	UNK	UNK	CIRC	
1251X	15.285		750	UNK	CIRC	*
1252X	15.535	13.455	450	UNK	CIRC	*
1253X	24.89	23.16	225	VC	CIRC	*
1253X	15.845	14.365	UNK	UNK	CIRC	*
1254X	13.3	12.2	300	CP	CIRC	
1254X	15.09		300	UNK	CIRC	
1255X	15.16	14.21	525	UNK	CIRC	
1256X	15.935	14.205	525	UNK	CIRC	
1257X	16.075	14.195	UNK	UNK	CIRC	
1300X	16.09	13.94	225	VC	CIRC	
1301X	16.18	13.85	225	VC	CIRC	
1302X			UNK	UNK	CIRC	

Node	Cover	Invert	Size	Material	Shape	
1303X			UNK	UNK	CIRC	
1307X	14.54	12.76	225	VC	CIRC	
130DX			UNK	UNK	CIRC	
131DX			UNK	UNK	CIRC	
132DX			UNK	UNK	CIRC	
1350X	16.07	14.335	225	UNK	CIRC	
1351X	15.98	14.52	225	UNK	CIRC	
1352X			225	UNK	CIRC	*
1352X	16.21	14.56	225	VC	CIRC	*
1353X	16.31	14.61	225	VC	CIRC	
135DX	16.25	14.69	UNK	CP	RECT	
1400X	16.6	15.08	150	VC	CIRC	
1401X	16.47	14.59	150	VC	CIRC	
1402X	16.41	14.41	150	VC	CIRC	
1403X	16.04	14.08	225	VC	CIRC	
1450X	14.02	12.62	300	UNK	CIRC	*
1450X	16.61	15.32	225	VC	CIRC	*
1451X	16.47	15.09	225	VC	CIRC	*
1451X	14.66	13.46	UNK	UNK	CIRC	*
1452X	16.42	14.87	300	CP	CIRC	*
1452X	13.785		525	UNK	CIRC	*
1453X	16.08	14.8	300	CP	CIRC	
1500X	17.57	16.84	150	VC	CIRC	
1501X	15.591	13.611	UNK	UNK	CIRC	*
1501X			UNK	UNK	CIRC	*
1502X	17.836		150	UNK	CIRC	
1550X	17.6	16.42	150	VC	CIRC	
1551X	17.755		225	UNK	CIRC	
1552X	16.222	14.192	300	UNK	CIRC	
1553X	16.502	15.582	150	UNK	CIRC	
1601X	22.812	21.562	150	UNK	CIRC	*
1601X	22.298	20.298	150	UNK	CIRC	*
1601X			UNK	UNK	CIRC	*
1602X	19.644	17.454	UNK	UNK	CIRC	
1603X	18.214	16.074	150	UNK	CIRC	
1604X			UNK	UNK	CIRC	
1605X			UNK	UNK	CIRC	
160DX			UNK	UNK	CIRC	
161DX			150	UNK	CIRC	
1650X	18.215		300	UNK	CIRC	
1651X	20.632		300	UNK	CIRC	
1652X	22.044	20.324	225	UNK	CIRC	
1700X	12.13	9.94	225	VC	CIRC	
1701X	26.257	25.007	UNK	UNK	CIRC	
1702X			100	VC	CIRC	
1750X	12.06	10.33	675	CP	CIRC	*
1750X	22.892	21.342	225	UNK	CIRC	*
1751X	23.843	22.093	225	UNK	CIRC	
1752X	23.941	22.311	225	UNK	CIRC	
1801X	30.658	28.658	150	UNK	CIRC	
1802X			225	UNK	CIRC	*
1802X	29.306		150	UNK	CIRC	*
1856X			525	UNK	CIRC	
185DX			UNK	UNK	CIRC	
190DX			UNK	UNK	CIRC	
195DX			300	CP	CIRC	
2001X	14.988	14.278	150	UNK	CIRC	
2050X	21.95	19.91	450	CP	CIRC	
2051X	15.11	13.8	225	UNK	CIRC	*
2051X	22.31	20.26	450	CP	CIRC	*
2100X	22.09	20.39	225	VC	CIRC	*
2100X	12.8	10.2	675	CP	CIRC	*
2101X		11.302	150	VC	CIRC	*
2101X			UNK	UNK	CIRC	*
2101X	15.155		150	UNK	CIRC	*
2101X	23.15	20.97	300	VC	CIRC	*
2102X		11.232	150	VC	CIRC	
2103X		11.122	150	VC	CIRC	
2104X		10.925	150	VC	CIRC	
2105X		10.738	150	VC	CIRC	
2106X		10.12	675	CP	CIRC	
2150X			300	VC	CIRC	*
2150X	22.86	20.45	750	CP	CIRC	*
2150X	15.08	14.25	150	UNK	CIRC	*
2151X			300	VC	CIRC	*
2151X	15.05	14.38	150	UNK	CIRC	*
2152X			225	VC	CIRC	
2153X			225	VC	CIRC	
2154X			225	VC	CIRC	
2155X			375	CP	CIRC	
2156X			225	VC	CIRC	
2157X			225	VC	CIRC	
2158X			225	VC	CIRC	
2200X	25.17	21.63	225	VC	CIRC	
2201X			225	UNK	CIRC	*
2201X	13.5	12.23	225	VC	CIRC	*
2201X	25.39	22.77	300	VC	CIRC	*
2201X	15.113	14.203	150	UNK	CIRC	*
2202X	13.47	12.35	225	VC	CIRC	
220DX			225	VC	CIRC	
2250X	25.27	22.27	675	CP	CIRC	*
2250X	13.35	12	600	CP	CIRC	*
2250X	14.765	13.465	300	UNK	CIRC	*
2250X	10.77	8.97	600	UNK	CIRC	*
2251X	13.15	11.79	600	CP	CIRC	*
2251X	24.26	21.34	750	CP	CIRC	*
2252X	24.02	21.9	225	VC	CIRC	*
2252X	13.72	12.5	300	VC	CIRC	*
2300X	24.44	22.09	300	VC	CIRC	*
2300X	13.84	12.39	375	CP	CIRC	*
2301X			100	VC	CIRC	*
2301X	11.567	9.967	225	UNK	CIRC	*
2301X	15.129		225	UNK	CIRC	*
2302X			100	VC	CIRC	*
2302X			UNK	UNK	CIRC	*
2302X	12.311	11.181	225	UNK	CIRC	*
2303X	12.416	11.547	150	UNK	CIRC	*
2303X			100	VC	CIRC	*
2304X			UNK	UNK	CIRC	*
2304X			100	VC	CIRC	*
2305X			100	VC	CIRC	*
2305X			UNK	UNK	CIRC	*
2306X			UNK	UNK	CIRC	
232DX			UNK	UNK	CIRC	
2350X	12.42	11.4	300	UNK	CIRC	*
2350X	25.69	23.51	675	CP	CIRC	*
2350X	13.85	12.6	600	CP	CIRC	*
2351X	13.79	12.86	600	CP	CIRC	*
2351X	11.729	10.979	300	UNK	CIRC	*
2351X	26.89	24.69	225	VC	CIRC	*
2352X	12.204	10.854	300	UNK	CIRC	
2353X	12.034	10.714	300	UNK	CIRC	
2354X	12.27	10.69	600	UNK	CIRC	
2355X	11.437		600	UNK	CIRC	
235DX			600	UNK	CIRC	
23ADX			UNK	UNK	CIRC	
23BDX			UNK	UNK	CIRC	
2400X	26.55	24.1	300	VC	CIRC	
2401X	16.84	15.47	150	UNK	CIRC	*
2401X	30.39	28.01	225	VC	CIRC	*
2401X	14.22	13	225	VC	CIRC	*
2401X	13.891	11.351	225	UNK	CIRC	*
2402X	15.501		225	UNK	CIRC	*
2402X			UNK	UNK	CIRC	*
2402X	31.01		225	VC	CIRC	*
2403X			UNK	UNK	CIRC	
2404X			UNK	UNK	CIRC	
2405X			UNK	UNK	CIRC	
240DX			UNK	UNK	CIRC	
241DX			UNK	UNK	CIRC	
2450X	13.225	11.935	300	UNK	CIRC	*
2450X	29.06	25.56	600	CP	CIRC	*
2451X	27.17	24.64	675	CP	CIRC	*
2451X	12.809	12.079	225	UNK	CIRC	*
2452X	12.799	11.779	225	UNK	CIRC	*
2452X	27.04	25.3	225	VC	CIRC	*
2453X	12.734	11.614	225	UNK	CIRC	*
2453X	30.6	29.3	225	VC	CIRC	*
2454X	12.479	11.329	225	UNK	CIRC	
2455X	13.61	11.48	UNK	UNK	CIRC	
2456X	13.06	11.94	UNK	UNK	CIRC	
2457X	13.89		525	UNK	CIRC	
2500X	15.65	14.55	225	VC	CIRC	
2501X	19.522	18.302	UNK	UNK	CIRC	*
2501X	17.351	15.241	150	UNK	CIRC	*
2502X	16.09	13.87	150	UNK	CIRC	
2550X	14.439		525	UNK	CIRC	*
2550X	16.42	15.2	225	VC	CIRC	*
2551X	15.67	13.92	225	UNK	CIRC	
2552X	16.88		225	UNK	CIRC	
2553X	17.38	15.63	225	UNK	CIRC	
2554X	17.185	15.385	225	UNK	CIRC	
2600X	17.89	16.62	225	UNK	CIRC	*
2601X	19.054	17.264	150	UNK	CIRC	*
2601X	17.23	15.82	225	VC	CIRC	
2602X	16.38	14.79	225	VC	CIRC	
260DX			225	UNK	CIRC	
2650X	18.085	16.465	225	UNK	CIRC	
2651X	19.19	17.59	225	UNK	CIRC	
2652X	19.022	17.612	225	UNK	CIRC	
2653X	21.248	19.528	225	UNK	CIRC	
2700X	18.72	17.25	225	UNK	CIRC	
2701X	19.09	16.95	225	UNK	CIRC	
2702X			UNK	UNK	CIRC	
270DX			UNK	UNK	CIRC	
2750X	23.875	23.085	225	VC	CIRC	*
2750X	18.89	16.51	225	VC	CIRC	*
2800X	12.53	10.15	225	UNK	CIRC	*
2800X	19.56	17.58	150	PVC	CIRC	*
2801X			UNK	UNK	CIRC	*
2801X	19	16.75	150	PVC	CIRC	*
2802X	19.19	16.2	150	PVC	CIRC	
2803X	18.83	16.73	150	PVC	CIRC	
2804X	18.94	16.54	150	PVC	CIRC	
2805X	19.11	16.37	150	PVC	CIRC	
2806X			UNK	UNK	CIRC	
2807X			UNK	UNK	CIRC	
2850X	18.63	18.08	UNK	UNK	CIRC	*

Node	Cover	Invert	Size	Material	Shape	
2850X	12.4	10.57	675	CP	CIRC	*
2851X	12.59	10.72	675	CP	CIRC	*
2851X	18.75	18.24	150	UNK	CIRC	*
2852X	12.67	10.87	675	CP	CIRC	*
2852X	19.05	17.18	300	CP	CIRC	*
2853X	19.55	17.85	225	PVC	CIRC	
2854X	18.8	17.19	225	PVC	CIRC	
2855X	18.92	17.09	225	PVC	CIRC	
2856X	19.07	16.99	225	PVC	CIRC	
2857X	19.16	16.73	375	CP	CIRC	
2858X			UNK	UNK	CIRC	
285DX			375	CP	CIRC	
2900X			225	UNK	CIRC	
2901X	12.62	10.46	225	VC	CIRC	
2902X	12.67	10.65	225	VC	CIRC	
2950X	12.63	10.97	600	CP	CIRC	*
2950X	18.67		300	CP	CIRC	*
2951X	12.86	10.8	600	CP	CIRC	*
2951X	18.92	18.4	150	UNK	CIRC	*
2952X	12.58	11.09	450	CP	CIRC	
295IX	−1		UNK	UNK	CIRC	
3000X	12.5	10.33	225	VC	CIRC	
3050X	13		450	CP	CIRC	
3100X	23.96	21.56	225	VC	CIRC	*
3100X	14	12.15	225	VC	CIRC	*
3101X	13.17	11.26	300	VC	CIRC	*
3101X			225	UNK	CIRC	*
3101Y	13.17	11.26	225	VC	CIRC	*
3102X	13.06	11.06	300	VC	CIRC	
3103X	13.44	10.33	675	CP	CIRC	
3104X	13.5	10.63	675	CP	CIRC	
3105X	12.79	11.19	225	VC	CIRC	
3150X	22.86	20.73	450	CP	CIRC	*
3150X	12.4	11.79	300	VC	CIRC	*
3151X	13.18	11.92	450	CP	CIRC	*
3151X	23.68	21.88	225	VC	CIRC	*
3152X	13.13	11.81	450	CP	CIRC	
3153X	12.98	12.13	300	VC	CIRC	
3154X			450	CP	CIRC	
3155X			450	CP	CIRC	
3200X	14.32	12.04	225	VC	CIRC	*
3200X	27.09	25.15	225	VC	CIRC	*
3201X			150	UNK	CIRC	*
3201X	14.15	11.92	225	VC	CIRC	*
3202X	13.79	11.82	225	VC	CIRC	
3203X	13.71	11.75	225	VC	CIRC	
3204X	13.51	11.69	225	VC	CIRC	
3205X	13.93	10.98	600	CP	CIRC	
3206X			225	VC	CIRC	
3210X			150	UNK	CIRC	
3250X	13.69	12.62	600	CP	CIRC	*
3250X	25.36	24.16	225	VC	CIRC	*
3251X	13.76	12.27	600	CP	CIRC	*
3251X	26.2		300	CP	CIRC	*
3252X	13.42	12.14	600	CP	CIRC	
3253X	13.59	12.74	300	VC	CIRC	
3254X	14	13	225	VC	CIRC	
3300X	14.12	12.49	375	CP	CIRC	*
3300X	29.55		225	VC	CIRC	*
3301X	28.33	26.3	225	VC	CIRC	
3302X	27.95	26.01	225	VC	CIRC	
3303X	29.14	27.02	225	VC	CIRC	
3304X	28.39	25.38	225	VC	CIRC	
330DX			100	VC	CIRC	
3350X	11.659		375	UNK	CIRC	*
3350X	14.55	13.37	225	VC	CIRC	*
3350X	26.83	25.37	225	VC	CIRC	*
3351X	27.84	26.4	225	VC	CIRC	*
3351X	14.25	13.15	225	VC	CIRC	*
3352X	29.27	27.27	225	VC	CIRC	
3353X	28.05	26.5	225	VC	CIRC	
3354X	28.28	26.82	225	VC	CIRC	
3400X	30.03	26.66	225	VC	CIRC	*
3400X	14.45	13.83	225	VC	CIRC	*
3401X	14.12	13.19	225	VC	CIRC	*
3401X	16.395	14.625	150	UNK	CIRC	*
3401X	28.49	25.87	225	VC	CIRC	*
3402X	15.736	14.076	225	UNK	CIRC	*
3402X	29.43	25.41	300	VC	CIRC	*
3403X	27.46	24.79	225	VC	CIRC	
3404X	13.524	12.364	150	UNK	CIRC	*
3404X	29.32	26.84	225	VC	CIRC	*
3450X	29.06	26.53	600	CP	CIRC	*
3450X	14.65	13.41	600	CP	CIRC	*
3451X	14.72	13.28	600	CP	CIRC	*
3451X	31.23	28.08	225	VC	CIRC	*
3452X	27.77	25.63	225	VC	CIRC	*
3452X	14.25	13	600	CP	CIRC	*
3453X	14.53	13.17	600	CP	CIRC	*
3453X	29.28	27.45	300	VC	CIRC	*
3456X	12.9	11.44	UNK	UNK	CIRC	
3457X	13.05	11.77	UNK	UNK	CIRC	
3500X	33.07	29	225	VC	CIRC	
3501X	30.92	28.97	225	VC	CIRC	*
3501X	15.45	14.72	150	VC	CIRC	*
3502X	15.87	14.54	150	VC	CIRC	*
3502X	29.67	27.44	225	VC	CIRC	*
3503X	15.66	14.33	150	VC	CIRC	
3504X	15.37	13.9	225	VC	CIRC	
3505X	15	13.7	225	VC	CIRC	
3506X			UNK	UNK	CIRC	
3550X	15.19	13.69	450	CP	CIRC	*
3550X	17.134	15.704	375	UNK	CIRC	*
3550X	29.86	26.81	600	CP	CIRC	*
3551X	31.49	28.87	225	CP	CIRC	*
3551X	14.79	13.48	225	VC	CIRC	*
3552X	16.16	13.81	450	CP	CIRC	*
3552X	32.98	30.48	225	VC	CIRC	*
3553X	15.33	14.35	300	VC	CIRC	
3554X	15.26	14.68	150	UNK	CIRC	
3600X	17.28	14.54	225	VC	CIRC	
3601X	34.15	30.57	225	VC	CIRC	*
3601X			UNK	VC	CIRC	*
3601X	18.915	17.195	150	UNK	CIRC	*
3602X			UNK	UNK	CIRC	*
3602X			UNK	VC	CIRC	*
3603X			UNK	UNK	CIRC	
3604X			UNK	VC	CIRC	*
3604X			UNK	UNK	CIRC	*
3605X			100	VC	CIRC	
3650X	31.31	28.75	450	CP	CIRC	*
3650X	17.06	15.05	225	VC	CIRC	*
3650X	18.545	16.915	225	UNK	CIRC	*
3651X	16.23	14.68	225	VC	CIRC	
3652X	17	15.99	300	CP	CIRC	*
3652X	33.04	30.34	300	CP	CIRC	*
3655X	35.79	32.29	225	CP	CIRC	
3656X	31.68	30.06	300	CP	CIRC	
3700X	18.87	16.37	225	VC	CIRC	
3750X	18.91	16.14	225	VC	CIRC	
3751X	19.08	16.82	225	VC	CIRC	
3800X	19.84	17.22	150	PVC	CIRC	
3801X	20.79	18.96	150	PVC	CIRC	
3802X	20.46	18.06	150	PVC	CIRC	
3850X	20.79	19.27	150	PVC	CIRC	
3851X	20.46	18.33	150	PVC	CIRC	
3852X	20.09	18.13	150	PVC	CIRC	
3853X	19.98	18.04	150	PVC	CIRC	
3854X	19.82	17.68	300	CP	CIRC	
3901X			UNK	UNK	CIRC	
3950X	34.843		375	UNK	CIRC	*
3950X	22.01	21.17	200	VC	CIRC	*
3951X	20.17	19.2	200	VC	CIRC	*
3951X	32.49	31.225	375	UNK	CIRC	*
3952X	19.23	18.67	200	VC	CIRC	
3953X	22.52	21.86	150	VC	CIRC	
3954X	20.05	18.62	150	PVC	CIRC	
4050X	24.13	23.7	200	UNK	CIRC	
4100X	27.64	25.06	225	VC	CIRC	
4101X	25.5	23.17	225	VC	CIRC	*
4101X			UNK	UNK	CIRC	*
4150X	26.09		300	CP	CIRC	
4151X	24.84		375	CP	CIRC	
4200X	28.09	26.2	225	VC	CIRC	
4201X	28.56	26.57	225	VC	CIRC	
4202X	26.3	24.25	225	VC	CIRC	
421DX			150	VC	CIRC	
4250X	28.41	26.8	225	CP	CIRC	
4251X	30.26	29.01	225	VC	CIRC	
4252X	30	28.2	225	VC	CIRC	
4300X	31.56		225	VC	CIRC	*
4300X	14.37	11.26	600	CP	CIRC	*
4301X	14.55	12.6	375	CP	CIRC	*
4301X	29.21	27.09	225	VC	CIRC	*
4302X	31.68	30.1	225	VC	CIRC	*
4302X	14.54	12.74	225	VC	CIRC	*
4303X	14.36	12.92	150	VC	CIRC	
4350X	14.66	13.61	450	CP	CIRC	*
4350X	29.53	27.42	225	VC	CIRC	*
4351X	14.4	13.13	450	CP	CIRC	*
4351X	30.38	28.48	225	VC	CIRC	*
4353X	14.12	12.82	600	CP	CIRC	
4400X	14.81	12.83	375	VC	CIRC	
4401X	16.714	14.794	150	UNK	CIRC	*
4401X	14.79	11.49	600	CP	CIRC	*
4401Y	14.79	12.79	375	VC	CIRC	*
4402X	14.85	12.75	375	CP	CIRC	
4403X	15.08	13.05	225	VC	CIRC	
4404X	14.84	13.18	225	VC	CIRC	
4405X			UNK	UNK	CIRC	
440DX			UNK	UNK	CIRC	
441DX			225	VC	CIRC	
4450X	31.69	29.54	225	VC	CIRC	*
4450X	14.96	13.65	600	CP	CIRC	*
4451X	14.64	13.53	600	CP	CIRC	*
4451X	31.6	29.6	225	VC	CIRC	*
4452X	33.76	30.74	225	VC	CIRC	
4453X	34.87	32.75	225	VC	CIRC	
4500X	37.15	33.94	225	VC	CIRC	*

LINE STYLES / COLOURS
Brown: Foul; Foul Syphon Sewer; Foul Vacuum Main
Red: Foul Rising Main; Combined; Combined Syphon Sewer; Combined Rising Main
Orange: Lateral Drain; Building Over Agreement Area
Dark Blue: Treated Effluent
Purple: Sludge; Sewer Catchment; Section 104 Area
Light Blue: Surface Water; Surface Water Rising Main
Yellow: Private
Green: Access Shaft; Decommissioned

MATERIALS
AK Alkathene; BAC Bonded Asbestos Cement; BRC Brick (Common); BRE Brick (Engineering); CC Concrete Box Culvert; CI Cast Iron; CO Concrete (In-Situ); CP Concrete (Pre-Cast); CSB Concrete Segments (bolted); CSU Concrete Segments (unbolted); DI Ductile Iron; GRC Glass Reinforced Concrete; GRP Glass Reinforced Plastic; MAC Masonry in Regular Courses; MAR Masonry in Random Courses; PE Polyethylene; PF Pitch Fibre; PP Polypropylene; PVC Polyvinylchloride; RPM Reinforced Plastic Matrix; SI Spun Iron; ST Steel; VC Vitrified Clay; XXX Other; ZZZ Unknown

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

LEGEND - SEWERS
Manhole (SW); Manhole (F&C); Lamp hole (SW); Lamp hole (F&C); Pumping Station (SW); Pumping Station (F&C); Side entry manhole (SW); Side entry manhole (F&C); Blind shaft (SW); Blind shaft (F&C); Ejector station (SW); Ejector station (F&C); Flushing cn. Tank (SW); Flushing cn. Tank (F&C); Dummy/S24 manhole; Demarcation Chamber
Washout (SW); Washout (F&C); Rodding Eye (SW); Rodding Eye (F&C); Gauging point (SW); Gauging point (F&C); Intercept chamber (SW); Intercept chamber (F&C); Storm Tank (SW); Storm Tank (F&C); Vortex chamber (SW); Vortex chamber (F&C); Outfall; Penstock chamber; Contaminants; Storm Overflow; Balancing manhole
Other (s); Other; Change in sewer (s); Change in sewer; Reflux valve; Flap valve; Cascade; Anode; Closed Valve; Valve; Air Valve; Hatch box (SW); Hatch box (F&C); Direction arrow; Emptying valve; Catchpit; Soakaway; Inlet; Balancing Pond
Wastewater treatment works; Marine treatment works; Outfall headworks; Vent; Vent column; Tidal storage tank; Blank end; Head of Public Sewer; Micro Pumping Station

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

SHAPES (S)
A Arched; B Barrel; C Circular; E Egg; H Horseshoe; O Other; R Rectangular; S Square; T Trapezoidal; U U-Shape

NODE REFERENCING SYSTEM
1st digit: hundred metre easting identifier
2nd digit: hundred metre northing identifier
3rd digit: sewer type identifier (0-4 = Foul/Combined, 5-9 = Surface Water)
4th digit: next sequential node

O.S. Ref.	SU7307NW	Drawn by:	mondalb
Scale:	1:2500	Date:	04/05/2015

Title: 194153_Bartons Road, Havant, H

Southern Water

The information contained on this plan is provided as a guide to the approximate position of existing public sewers. The accuracy thereof cannot be guaranteed.
THIS INFORMATION MUST BE TREATED WITH CAUTION AND THE ACTUAL POSITION OF THE PUBLIC SEWERS MUST BE ESTABLISHED ON SITE IN ALL CASES.

Southern Water must be informed before lifting manhole covers or excavating trial holes.

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APPENDIX F

COUNCIL SRFA EXTRACTS

Guidance Document: Havant Borough Council

Flood Risk Overview

Sources of Flood Risk

Havant is the eastern-most Local Authority in the PUSH sub-region. It covers a total area of approximately 55 km² which is split between the mainland and Hayling Island. The council has approximately 56 km of coastal frontage (including 42 km around Hayling Island) and 32 km of main river. At present, approximately 22% of the Borough's land area is designated as within Flood Zones 2 and 3a/3b (see SFRA Map Set 1A).

The SFRA has shown that the primary source of flood risk to Havant is from the sea. The key parts of the Borough which are currently at risk of flooding from the extreme tides include Brockhampton, Langstone and Emsworth on the mainland and Eastoke, Selsmore and Mengham on Hayling Island. Flooding due to wave overtopping is known to occur on Hayling Island, particularly along the southern frontage. Land behind this frontage has suffered significant flooding from wave overtopping even though the land is relatively high and is shown to lie within Flood Zone 1, i.e. the zone of low probability of tidal flooding.

The secondary source of flood risk to Havant Borough is from fluvial sources including the Lavant Stream, the Hermitage Stream and associated tributaries. These watercourses flow through the town centre of Havant and discharge into Langstone Harbour. Additionally, the upper reaches of the Wallington River rise near Waterlooville in Havant Borough. The key parts of the Borough which are currently at risk of fluvial flooding include Havant town centre, Leigh Park, West Leigh and Stockheath.

Historically, Havant has also been susceptible to flooding from other sources including; groundwater, surface water and flooding caused by infrastructure failure. A number of previous groundwater flooding incidents have been observed in the upper parts of the Lavant Stream between Rowlands Castle and Havant in the north of the Borough. The town of Havant has a drainage system which in many places dates back to before the mid-1960s. As such, flooding from surface water drainage systems and sewers has occurred at many locations, including along The Florins, Petersfield Road, Park Lane and Hulbert Road.

Key physical characteristics that may constrain development

Approximately 58% of Havant Borough is currently covered by existing development, suggesting that much future development will need to be concentrated on brownfield sites. A number of environmentally designated areas represent a significant constraint on development in the Borough, covering approximately 24% of its area. As such there may be only limited Greenfield land upon which development can be permitted following consideration of other planning constraints.

The topography of Havant Borough ranges from sea level to approximately 80 metres above ordnance datum (mAOD). Hayling Island is entirely below approximately 9 mAOD. Further development on the island will likely increase the pressure for further maintenance and improvement to existing flood defences, particularly following predicted rises in sea level in future. The town of Havant itself varies in elevation from 5 mAOD near the coast to 40 mAOD in Leigh Park and West Leigh. The majority of the existing development on the mainland in Havant Borough will therefore not face increasing flood risk due to sea level rise. Waterlooville is situated between 30-50 mAOD while elevations in the Purbrook area rise to approximately 65 mAOD on the approach to Portsdown Hill.

Geologically, Havant Borough is underlain by a mix of low, moderate and highly permeable bedrock formations. The towns of Havant and Waterlooville and the southern part of Hayling Island are underlain by low and moderately permeable bedrock formations, while a highly permeable chalk layer exists between these two areas, resulting in the many springs used by Portsmouth Water. However, moderately permeable superficial deposits overlie the majority of this permeable layer, reducing its permeability in terms of surface water runoff generation. This may make the implementation of Sustainable Urban Drainage Systems (SUDS) difficult, which is of particular importance in the Cowplain and Waterlooville area where deep clay strata result in a lack of positive drainage and more frequent small surface water flooding incidents.

The existing drainage systems in Havant are known to be at or below capacity in key areas and it may therefore be difficult to provide new development in parts of the town without significant investment in drainage infrastructure.

Vulnerability to Climate Change

The SFRA has generated predicted tidal outlines for a number of years up to 2115 (see SFRA Map Set 1E). These outlines account for the most up-to-date predicted rises in sea-level over the coming century due to climate change and therefore allow the identification of locations that will be most vulnerable to this change due to their local topography. In Havant Borough, Hayling Island is the most sensitive area to sea level rise, particularly the southern half of the island. With much of the island low-lying, predicted sea-level rise could result in extreme tidal events inundating more of the island. In addition to this effect of rising sea levels, it is anticipated that climate change will result in an increase in fluvial flood flows. This may put additional pressure on areas in the town of Havant adjacent to the streams.

Vulnerability of existing communities

In general, the wards of Havant Borough have a mix of average and high social vulnerability to flooding (see SFRA Map Set 2). However, within Flood Zones 2 and 3 (i.e. those areas potentially likely to experience flooding) the wards generally have a high social vulnerability to flooding on the mainland and average social vulnerability to flooding on Hayling Island. It is likely that future investment in flood defences measures will need to strike a balance between protecting high risk areas on Hayling Island and areas of high social vulnerability on the mainland.

Existing defence assets and likely future investment

The coastal frontages of Havant Borough are almost entirely defended from either wave overtopping or tidal flooding by some form of coastal defence. Approximately half the coastal defences in Havant Borough have a crest level which is higher than a present day 1 in 200 year tide. Areas where defences are below the minimum standard of protection required for new development are the north western coast of Hayling Island south of Northney, the Chichester harbour frontage at Emsworth and the frontage at Langstone. The coastal defences in Havant Borough are, however, likely to be susceptible to climate change, as 100 years of predicted sea level rise would mean that most man-made defences at their current level would fail to offer protection from a 1 in 20 year tidal flood, with the exception of the southern frontage of Hayling Island. To sustain future development in Havant Borough, particularly on Hayling Island, significant investment in flood defences and flood defence infrastructure will be required (see SFRA Map Set 3). In order to consider the sustainability of investing in improved defences, the 'danger to people from breaching' index (SFRA Map Set 1D) will provide indications as to where the residual risk due to breaching may remain unfavourably high following improvements to defences to protect from extreme tidal floods.

Sequential and Exception Test

Planning Policy Statement 25 (PPS25) sets out the Government's objectives for achieving sustainable development through the avoidance and management of flood risk. The aim of PPS25 is to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas of flood risk. To achieve this aim, PPS25 provides a decision making tool to ensure that sites with a low probability of flooding are developed in preference to areas at higher risk. The Sequential Test is the decision process which Local Authorities must demonstrate when developing their Local Development Frameworks and Local Development Documents. This SFRA has developed a suite of mapping outputs to assist Local Authorities in applying the Sequential Test.

When applying the Sequential Test, Output Package 1 of the SFRA will provide all the necessary information required upon which to base decisions regarding the location of future development in relation to flood risk. Within Output Package 1, the key map required for applying the Sequential Test is the Flood Zones map, shown as Map Set 1A. This map shows the spatial extent of 3 of the 4 Flood Zones identified in PPS25, these include:

Map Set 1A

- **Flood Zone 2** – Medium Probability of Flooding

  Fluvial (river) and Tidal Flooding

- **Flood Zone 3a** – High Probability of Flooding, sub-divided into:

  Fluvial Flooding
  Tidal Flooding
  Tidal / Fluvial (combined flooding processes where known)

- **Flood Zone 3b** – Functional Floodplain

  Fluvial Flooding only

The area outside of these zones is considered to be the fourth zone, 'Flood Zone 1' which has a low probability of flooding.

Output Package 1 also contains 5 other Map sets which provide useful information to support Local Authorities when applying the Sequential Test, these include:

- Map Set 1B – Undefended Flood Hazard Maps (Zones 2 & 3)
- Map Set 1C – Indicative Areas Benefiting From Defences
- Map Set 1D – Danger to People from Breaching Maps
- Map Set 1E – Climate Change Outlines for 2025, 2055, 2085 and 2115
- Map Set 1F – Other sources of Flooding including:
  - Wave Energy
  - Groundwater Flooding
  - Impact of Land Use Change on Surface Water Runoff
  - Overland Flow
  - Historic Incidents of Surface Water Sewer Overload

When allocating a site in line with the Sequential Test, Figure 1 illustrates the decision process, the key questions that need to be answered and details of how the outputs of the SFRA can help inform the process.

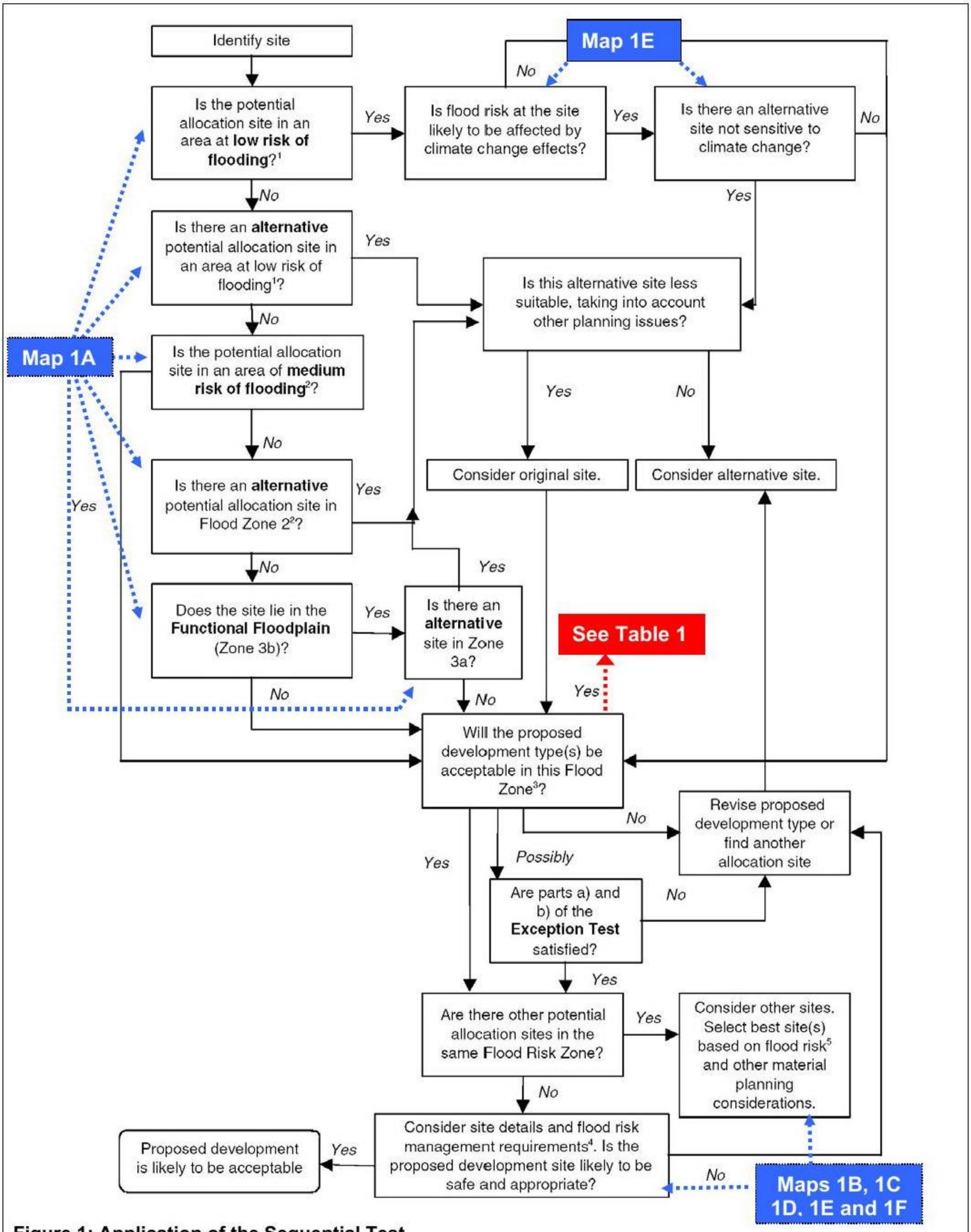


Figure 1: Application of the Sequential Test
Ref: Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft'

Notes on Figure 1 Flow Chart

1 Flood Zone 1 for fluvial and tidal flooding and with a low risk of flooding from other sources.
2 Flood Zone 2 for fluvial and tidal flooding and with a medium risk of flooding from other sources.
3 As defined by the Sequential Test.
4 Development to be safe and to not increase flood risk elsewhere. Required to pass part c) of the Exception Test, where applicable.
5 Including susceptibility to future climate change and residual flood risk.

Flood Risk Vulnerability Classification

Where there are no reasonably available sites in Flood Zone 1, Local Authorities should take account of the flood risk vulnerability of land uses when considering the suitability of sites in Flood Zone 2 and then if necessary Flood Zone 3, applying the Exception Test if required. With reference to PPS25, Table 1 provides a summary of the appropriateness of land uses in relation to the Flood Zones.

	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	×	Exception Test required	✓
Zone 3b	Exception Test required	✓	×	×	×

Table 1: Flood Risk Vulnerability and Flood Zone Compatibility (Ref: PPS25)

Key: ✓ Development is appropriate, subject to demonstrating the Sequential Test

× Development should not be permitted.

(*This table does not show: the application of the Sequential Test which guides development to FZ1 first, then FZ2, and then FZ3; FRA requirements; or the policy aims for each Flood Zone.)

If the application of the Sequential Test demonstrates a need to consider allocating sites within Flood Zones 2 or 3, a 'Sequential Approach' should also be applied within each of these Zones to steer new development to areas with the lowest probability and consequences of flooding. To facilitate this approach to site allocations within the Flood Zones, the SFRA Outputs (in particular Map Sets 1B, 1C, 1D and 3A / 3B) will provide useful information on the variation of flood hazard and the level of benefit provided by existing defences.

The findings of the Statistical Analysis undertaken in Stage 1 of this SFRA suggest that Havant Borough Council can achieve their draft South East Plan housing allocation in line with the Sequential Test. However, the need for potential commercial regeneration of the town centre and possible 'windfall' sites may mean that Havant Borough Council will need to consider development within Flood Zones 2 and 3. Where the Sequential Test alone cannot identify acceptable sites for urban regeneration or where windfall sites, having satisfied the Sequential Test, are located in Flood Zones 2 or 3, the Exception Test may need to be applied.

Exception Test

The Exception Test should only be applied following application of the Sequential Test. There are 3 elements of the Exception Test, all of which need to be demonstrated before the test can be passed. The 3 elements are:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;
b) The development should be on developable previously-developed land or, if it is not on previously-developed land, that there are no reasonable alternative sites on developable previously-developed land; and
c) A FRA must demonstrate that the development will be safe, without increasing flood risk

elsewhere, and, where possible, will reduce flood risk overall.

When developing LDDs, Local Authorities are advised by PPS25 to prepare criteria-based polices in line with their Core Strategy's Sustainability Appraisal, against which item a) of the Exception Test can be tested. This will minimise the need to consider this element of the Exception Test for each individual planning application.

By assisting Local Authorities, at the site allocation level, in steering new development to areas with the lowest probability and hazard of flooding, the use of the SFRA outputs (in particular Map Sets 1B, 1C, 1D and 3A / 3B) will mean that site specific flood risk assessments in these areas will be more likely to satisfy criteria c) of the Exception Test.

SFRA Mapping Outputs

Table 2 summaries the most relevant mapping outputs and their purpose, for each of the key users of the PUSH SFRA.

Key Users	Relevant SFRA Mapping Outputs	Purpose
Forward Planners	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 provides all the necessary information to help planners apply the Sequential Test and Exception Test when allocating new sites for development. Output Package 1 also allows planners to identify sites with the lowest probability of flooding and lowest flood hazard / danger and how the extent of flooding is likely to change in the future due to climate change.
Flood Risk Managers	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 helps Flood Risk Managers to identify variations in flood hazards / dangers to existing development. The data also provides mapping to show how the extent of flooding is likely to increase over time due to climate change.
	Output Package 2: Social Vulnerability of and Flood Hazard / Danger to Existing Development	Output Package 2 can help Flood Risk Managers to: o Identify critical areas where social vulnerability and flood hazard / danger are high. o Help inform assessments of the sustainability of existing development. o Help identify and prioritise asset management and improvements.
	Output Package 3: Appropriate Defence Standards and Levels of Investment	Output Package 3 can help Flood Risk Managers to: o Identify shortfalls in existing defences in providing appropriate standards of defence, now and in the future. o Identify indicative levels of investment required to provide the appropriate standards, now and in the future.
Development Control	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 can help Development Control personnel to: o Prepare specifications for site specific FRAs. o Review site specific FRAs for new development sites and check for compliance with PPS25.
Emergency Planners	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 can provide emergency planners with information on the variation of flood probability and hazard across the sub region. Such information can aid in the development of emergency plans and evacuation routes during flood events.
	Output Package 2: Social Vulnerability of and Flood Hazard / Danger to Existing Development	Output Package 2 can inform emergency planners of the locations where social vulnerability and flood hazard are highest. Such information can help emergency planners prioritise evacuation plans.

Table 2: The Mapping Output Packages appropriate for key users of the SFRA

Recommendations for Site Specific Flood Risk Assessments

Whilst the information presented in this SFRA will inform Local Authorities and facilitate their strategic allocation of sites for future development, it should not preclude the need for developers to undertake site specific flood risk assessments (FRAs). A SFRA, by its very nature, is a high level assessment of flood risk at the local authority level. It does not provide sufficiently detailed information to satisfy all of the requirements of a site specific FRA as outlined in PPS25.

On the 1st October 2006, the Town and Country Planning (General Development Procedure) (Amendment) (No 2) (England) Order 2006 (GDPO), made the Environment Agency a statutory consultee for planning applications involving flood risk in specified circumstances. To improve the efficiency of disseminating general guidance, the Environment Agency has produced a suite of standing advice. The advice is available to Local Authorities and the Public, via a web page http://www.pipernetworking.com/floodrisk/ . The standing advice also includes guidance on the requirements for site specific FRAs for both low and high risk developments. The web page provides Guidance Notes for 3 types of FRAs and advice on operational development less than 1 hectare in Flood Zone 1 as summarised below:

- Operational Development less than 1 hectare in Flood Zone 1.
- FRA Guidance Note 1: Development Greater than 1 hectare in Flood Zone 1.
- FRA Guidance Note 2: Minor Extensions.
- FRA Guidance Note 3: Development in Flood Zones 2 and 3.

The following sections provide additional specific guidance for assessing flood risk at the site specific level within Havant Borough and indicate how the outputs from the SFRA can inform such assessments.

Tidal Flooding

As previously discussed, flooding from tidal sources is the primary source of flood risk within Havant Borough and the areas at risk are predicted to increase significantly by 2115. Map Set 1A shows the existing areas at risk of tidal flooding and Map Set 1B shows the associated undefended flood hazard. The index of flood hazard represents a gradation of hazard within the Flood Zones based on a combination of the depth of flood water and the velocity of the water (indicative ranges for which have been assumed based on distance from the coastline).

The frontages where existing defences provide the minimum standards required for new development (i.e. 1 in 200 years for tidal flooding), are identified in Map Set 1C by a purple line. Indicative Areas Benefiting from Defences (ABDs) are also shown in Map Set 1C. The Indicative ABDs have been defined as areas where the crest levels of the existing defences are consistently equal to or higher than the present day 1 in 200 year extreme sea level.

If small lengths of defences have crest levels which fall below the 1 in 200 year extreme sea level (even for a short length), the area behind the defence has not been classed as an Indicative ABD. The frontage of Brockhampton is an example of where this study has not been able to define an Indicative ABD due to small lengths of defence where the crest levels fall below the 1 in 200 year extreme sea level. The gaps in the defence level can also be viewed in more detail using Map Set 3A. Further details of methodology and reasoning used to define the Indicative ABDs are described in Section 4.2.1.3 of the main report. It should be noted that other areas may potentially be classified as ABDs if more detailed modelling assessments of the defences, which is beyond the scope of this SFRA, are carried out.

Map Set 1D shows the flood hazard (in terms of danger to people) associated with a hypothetical breach in the defences for the whole of the tidal frontage. The Indicative ABDs shown in Map Set 1C define which of the hazard maps (1B or 1D) is most appropriate for consideration. Map Set 1D is only appropriate for considering present day flood hazards within an ABD. To aid the interpretation of Map Set 1D the areas where this index is not appropriate for present day analysis are hatched out. The benefit of showing hazard information in the hatched out areas is to allow planners and developers to understand the likely residual risks that would remain if they were to invest in defending an area to a 1 in 200 year standard. Map Set 1B (Undefended Flood Hazard) should be used to assess the variation of flood hazard within the Flood Zones for all areas outside the Indicative ABDs.

The benefit of both the undefended flood hazard maps (Map Set 1B) and the danger from breaching maps (Map Set 1D), is that the gradation of flood hazard within the Flood Zones can facilitate both planners and developers to ensure that development is steered away from the areas of highest hazard. The hazard mapping presented in Map Sets 1B and 1D, however, should only be applied when appropriate consideration has been taken of alternative sites at a lower probability of flood risk (i.e. within Flood Zone 1).

The flood hazard information, for both the undefended and breach scenario, developed as part of this SFRA, has been undertaken at a strategic level and is therefore at an appropriate level of detail to allow Local Authorities to strategically allocate sites for development. The hazard data has been classified into 4 categories to illustrate the gradation of flood hazard within Flood Zones 2 and 3 in line with best practice guidance as set out in Defra FD2320. The hazard data has not been calculated using modelling or other detailed numerical methods and is therefore not appropriate for identifying design parameters as part of site specific FRAs. It is therefore recommended that FRAs for sites located within the flood hazard zones should still include a quantitative assessment of flood hazard based on more detailed assessments of defence standards, defence failure scenarios and overland conveyance of flood flow.

The impact of climate change on increasing sea levels has a significant effect on the extents of Flood Zones 2 and 3 by 2115, especially on Hayling Island. Although present day planning decisions are based on the Flood Zones for 2007, at the site specific level consideration should be given to increases in risk as a result of climate change. The climate change flood extents presented in Map Set 1E should be used when undertaking a site specific FRA to inform the assessment of the long term sustainability of developments currently within Flood Zone 1 and the likely increases in flood risk in Flood Zones 2 and 3.

The defence information provided in Map Set 3 can provide developers undertaking site specific FRAs with an indication of the equivalent tidal return period of the crest level of the existing defences in 2007 and an indicative level of investment that may be required to raise defence standards to the minimum required for new development. Such investment could be secured through the development process by Section 106 agreements.

Wave Overtopping

Map Set 1F-1, Wave Energy, shows how exposure to wave energy varies along the frontage of the study area. Such information can be used to assess, at a high level, the risk of flooding caused by extreme wave overtopping. Historically, Hayling Island has suffered from flooding caused by extreme waver overtopping, most recently in November 2005. During this event, properties which are classified in Flood Zone 1 were flooded, as indicated on the historical information layer. It is recommended that all applications for development within the vicinity of the southern frontage of Hayling Island include an assessment of extreme wave overtopping, regardless of which Flood Zone the site is in. This will ensure that this risk is always considered for new development in the relevant locations. The assessment of extreme wave overtopping should be appropriate to the scale of risk and may, in some cases, be ruled out as a significant risk quite easily, but should nevertheless be addressed.

Fluvial Flooding

The mainland part of Havant Borough is at risk of fluvial flooding from the Lavant Stream, Hermitage Stream and, during extreme events (1 in 1000 years), the upper reaches of the River Wallington. Map Set 1A shows the fluvial Flood Zones, which show the town centre of Havant to be the key area at risk of fluvial flooding in the Borough.

Across Havant Borough, gaps in available fluvial flood risk data exist, which are being addressed by the Environment Agency's ongoing Strategic Flood Risk Mapping programme. Therefore, for the purposes of this SFRA, Flood Zone 3b (defined by PPS25 as the 'functional floodplain') has been defined as the entire extent of Flood Zone 3, as recommended by the PPS25 Draft Practice Guide. This is a precautionary approach and should be tested by site specific FRAs, where required.

Unlike the tidal Flood Zones, flood levels associated with the fluvial Flood Zones have not been identified as part of this SFRA. The variations in previous modelling approaches (some of which are awaiting EA approval) for the rivers within the PUSH sub-region, coupled with the spatial variation on flood levels along the river valleys, meant that it was not possible to provide a consistent approach to identifying fluvial flood levels without re-

modelling a number of rivers. Such detailed assessments were outside the scope of this SFRA. Developers undertaking a FRA for a site within the fluvial Flood Zones should obtain the most up to date flood risk data from the Environment Agency. If no further information is available then a site specific FRA may need to include a numerical assessment to refine the understanding of fluvial flood risk, and agree the form of this assessment with the Environment Agency.

The impacts of climate change on fluvial flooding are likely to result in a 10% increase in flows up to 2025 and 20% from 2025 to 2115. Again due to current gaps in available data that are being addressed by the Environment Agency's ongoing flood mapping programme, there are no consistent estimates for Havant Borough of the extreme fluvial flood extent taking climate change into account. Based on Environment Agency guidance, this SFRA has assumed that the present day Flood Zone 2 (medium probability) becomes Flood Zone 3 (high probability) by 2025. This is a conservative assumption which should be tested by site specific FRAs, where required. This also means that there is no data available to estimate Flood Zone 2 after the present day. Therefore, the fluvial climate change outline shown in Map Set 1E only shows a Flood Zone 3.

Undefended flood hazard information, shown in Map Set 1B, has also been developed for the fluvial Flood Zones 2 and 3. This information can provide developers with an indication of the varying degree of flood hazard within the Flood Zones which can facilitate the design and layout of development sites to avoid areas of high hazard. As with the tidal flood hazard data, it is recommended that FRAs for sites located within the flood hazard zones undertake a more detailed quantitative assessment of flood hazard based on an improved understanding of defences and flow routes.

Surface Water/Overland Flow Flooding

Map Set 1F-4 shows the variation in the potential source of overland flow across the PUSH sub-region. The areas shown in red and orange relate to areas of very high and high potential for generating overland flow. Notably, the urban areas are indicated as red or orange due to the high runoff potential from urban land uses. Within Havant Borough there is a large area of the mainland which has a high to very high potential for generating overland flow. FRAs for sites that are found to be within or in the vicinity of these areas, especially if the local topography places the site at a lower elevation than the surrounding land and hence downstream of the source, should consider the impacts and management of flooding due to overland flow.

In addition to the information provided in relation to the source of overland flow flooding, Map Set 1F-3 provides information to inform Local Authorities of the potential impacts of land use changes on the local surface water runoff regime. The areas showing diagonal hatching represent the urban areas, where a change in land use is unlikely to significantly affect the existing surface water runoff rates and volumes. This representation is a high level assessment across the PUSH sub-region and would therefore need to be confirmed when undertaking a site specific FRA. The areas outside of the hatching represent the effect that changes in land use are likely to have on the surface runoff rates and volumes from Greenfield sites. The data shows that new development located on the majority of the Greenfield Land in Havant Borough is likely to have a moderate impact on the surface water runoff regime. Site specific FRAs should therefore carefully consider the impact of development on the local surface water runoff regime and should investigate SUDS options to manage surface water where achievable.

Groundwater Flooding

Within the PUSH region the key areas at risk of groundwater flooding are north of Havant Borough in East Hampshire, Winchester, Eastleigh and Test Valley where highly permeable geology meets lower permeability geology as shown by Map Set 1F-2, which has been verified by inspection of the historical incident records. The key risks to new development in the Havant Borough come from increases in flows in the Lavant Stream as a result of high groundwater levels emerging in East Hampshire District. It is therefore recommended that site specific FRAs for sites located within the Flood Zone of the upper reaches of the Lavant Stream consider the joint effects of high groundwater flows in the Lavant Stream combined with rapid runoff from intense rainfall events.

Flooding from Infrastructure

Historically, the mainland part of Havant Borough has recorded the most incidents of flooding caused by problems relating to the drainage infrastructure as shown by Map Set 1F-5. The majority of these incidents have occurred in the vicinity of Havant Town Centre, Purbrook, Cowplain and Emsworth. When undertaking a site specific FRA for a large development site, consultation with Southern Water should always be undertaken to investigate whether the proposed development will have an adverse impact on the local drainage system.

Furthermore, a parallel study being undertaken on behalf of PUSH, 'Hampshire Integrated Water Management Study', is investigating the issues relating to the future management of surface water within the region with respect to the anticipated increases in housing as indicated in the draft South East Plan. It is recommended that those undertaking a site specific FRA within the urban areas of Havant Borough make reference to the findings of this study.

Sustainable Urban Drainage Systems (SUDS)

Conventional surface water drainage systems have traditionally used underground pipe networks to efficiently convey water away from sites. In the past this has led to problems of downstream flooding, reductions in groundwater recharge and waste pollution incidents associated with surface water overwhelming combined sewers. Both '*Making Space for Water*' and the '*Water Framework Directive*' have highlighted the need for an improved understanding and better management of how our urban environments are drained. The SUDS management train approach, as shown in Figure 2, is the principle that a range of SUDS which feed into each other can often offer benefits to the delivery of a successful surface water system/strategy.

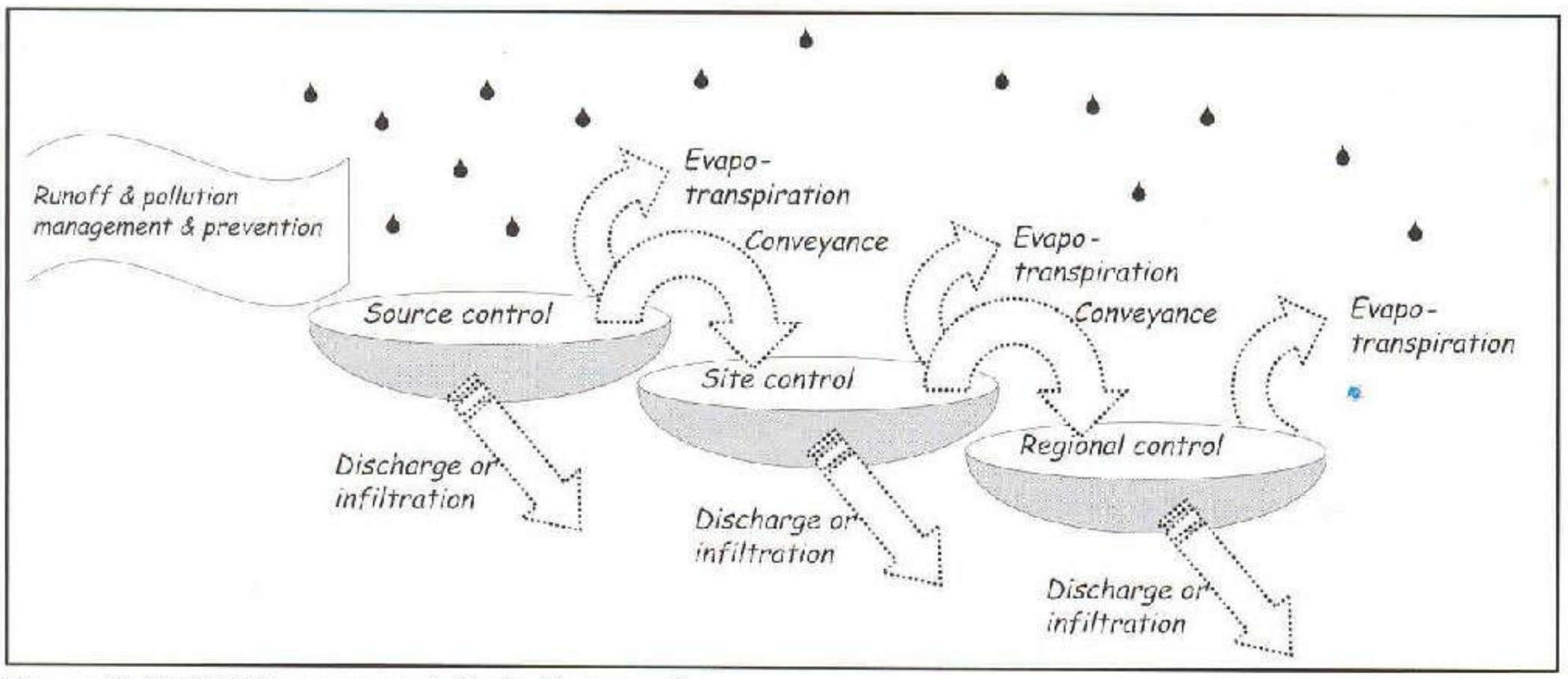


Figure 2: SUDS Management Train Approach

PPS25 states that Local Authorities should prepare and implement planning strategies that help to deliver sustainable development, by using opportunities offered by new development to reduce the causes and impacts of surface water flooding. By implementing polices to encourage developers to incorporate SUDS wherever possible, Local Authorities can help to mitigate the impacts that development has on surface water runoff rates and volumes. Appendix F of PPS25 states:

'the surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates/volumes prior to the proposed development, unless specific off-site arrangements are made and result in the same net affect.'

Map set 1F-2 provides information relating to the spatial variation of permeability across Havant Borough. This information can be used as a first estimate of the suitability of different types of SUDS within the Borough as shown in Table 3.

Permeability	Indicative Suitability of SUDS Techniques
High Permeability	Infiltration and Combined Systems
Moderate Permeability	Infiltration and Combined Systems
Low Permeability	Attenuation Systems

Table 3: Suitability of SUDS

It is important to note that the above assessment of the spatial suitability of SUDS is an indicative estimate and should be confirmed at the site specific level, using ground investigation data.

Infiltration Systems

Infiltration systems allow surface water to discharge directly into the ground. These systems are only appropriate 1) where ground conditions permit a suitable water acceptance potential and 2) in locations where groundwater recharge will not adversely affect drinking water aquifers as identified by the Environment Agency's source protection zones, available on their website http://www.environment-agency.gov.uk. Such systems may include:

- Permeable surfaces
  - Gravel
  - Permeable Paving
  - Block Paving with voids
  - Grassed areas
- Sub Surface Infiltration
  - Filter Drains
  - Geocellular Systems
  - Soakaways

Infiltration systems may not be appropriate in areas of potentially contaminated land. In such circumstances, other systems, such as contained attenuation systems, that avoid mobilisation of contaminants may be more appropriate.

Attenuation Systems

If ground conditions cannot support infiltration systems, surface water may need to be attenuated using measures to store surface water. Attenuation systems, if designed above ground, have the potential to take up large areas of development sites. Early consideration of such constraints is therefore essential. Attenuation systems may include:

- Landscaped
  - Detention Basins
  - Balancing Ponds
  - Retention Ponds
  - Wetlands
  - Lagoons
- Engineered
  - Underground Tanks
  - Ornate Water Features
  - Rainwater Harvesting
  - Green Roofs
  - Oversized Pipes

Combined Systems

SUDS designs for most sites can include a combination of infiltration and attenuation systems and they have

been categorised above according to the dominant process. Other forms of SUDS which can provide more balanced benefits of infiltration and attenuation include:

- Swales
- Filter Strips

Emergency Planning

As well as informing the development control process, the outputs of the SFRA can also be used by the Local Authority to inform their Emergency Planning Polices. Map Sets 1A, 1B, 1C, 1D and 1E are particularly useful when considering the feasibility and sustainability of key access routes within their administrative boundaries. The benefit of producing such outputs on a sub-regional scale mean that the Local Authority can also consider access to the Borough beyond their administrative boundary where key access routes (e.g. M27) cross a number of Local Authorities.

Additional Guidance

In addition to the guidance provided by the Environment Agency http://www.pipernetworking.com/floodrisk/, there are a number of other documents that provide detailed advice and guidance for undertaking site specific FRAs:

- Planning Policy Statement 25: Development and Flood Risk, (2006), Communities and Local Government.
- Development and Flood Risk: A Practice Guide Companion to PPS25 - 'Living Draft', (2007), Communities and Local Government
- Development and Flood Risk: Guidance for the Construction Industry, (2004), CIRIA (Based on PPG25)
- Flood Risk Assessment Guidance for New Development: FD2320/TR2, (2005), Defra (Based on PPG25)
- Sustainable Urban Drainage Systems: Best Practice Manual, (2001), CIRIA

Annex 1 – Data Source for Havant Borough Council

Further to the general technical details provided in the main SFRA Stage 2 report, this annex includes data issues specific to Havant Borough Council.

Defence Data

The majority of Havant Borough Council defence data in is provided by the Havant Asset Database which holds details of most of the Borough's coastal defences from recent surveys. Surveys recorded in the database were undertaken between 2002 and 2003. The defence database for Havant was supplemented with data from the Eastoke Sectoral Strategy Study (2005) and Portchester Castle to Emsworth Coastal Defence Strategy Study (2006). Coastal defence works in other parts of Havant's coastline undertaken since 2003 may supersede records in the SFRA Defence Database.

No information on fluvial defences in Havant was available.

Topographic Data

95% of the topographic grid in Havant Borough is composed of LiDAR data. Areas where LiDAR was not available are the northern slope of Portsdown Hill to the west of Bedhampton and to the north of the Borough between Lovedean and Cowplain. In these areas, NextMap data was used to fill in the gaps in the LiDAR.

Fluvial Flood Zone 3b

In Havant Borough, fluvial Flood Zone 3b was represented as the whole of Flood Zone 3. In the absence of data to prove otherwise (i.e. detailed 1 in 20 year modelling or observed historic flood extents), this approach is in accordance with PPS25 practice guide section 3.17 and was recommended by the Environment Agency.

Fluvial Climate Change Outlines

In Havant Borough, the fluvial outlines after the present day were represented by assuming that Flood Zone 3 will expand to fill the current area of Flood Zone 2. This means there is no estimate of fluvial Flood Zone 2 after the present day for the Borough. This approach was recommended by the Environment Agency.

Guidance Document: Havant Borough Council

Flood Risk Overview

Sources of Flood Risk

Havant is the eastern-most Local Authority in the PUSH sub-region. It covers a total area of approximately 55 km² which is split between the mainland and Hayling Island. The council has approximately 56 km of coastal frontage (including 42 km around Hayling Island) and 32 km of main river. At present, approximately 22% of the Borough's land area is designated as within Flood Zones 2 and 3a/3b (see SFRA Map Set 1A).

The SFRA has shown that the primary source of flood risk to Havant is from the sea. The key parts of the Borough which are currently at risk of flooding from the extreme tides include Brockhampton, Langstone and Emsworth on the mainland and Eastoke, Selsmore and Mengham on Hayling Island. Flooding due to wave overtopping is known to occur on Hayling Island, particularly along the southern frontage. Land behind this frontage has suffered significant flooding from wave overtopping even though the land is relatively high and is shown to lie within Flood Zone 1, i.e. the zone of low probability of tidal flooding.

The secondary source of flood risk to Havant Borough is from fluvial sources including the Lavant Stream, the Hermitage Stream and associated tributaries. These watercourses flow through the town centre of Havant and discharge into Langstone Harbour. Additionally, the upper reaches of the Wallington River rise near Waterlooville in Havant Borough. The key parts of the Borough which are currently at risk of fluvial flooding include Havant town centre, Leigh Park, West Leigh and Stockheath.

Historically, Havant has also been susceptible to flooding from other sources including; groundwater, surface water and flooding caused by infrastructure failure. A number of previous groundwater flooding incidents have been observed in the upper parts of the Lavant Stream between Rowlands Castle and Havant in the north of the Borough. The town of Havant has a drainage system which in many places dates back to before the mid-1960s. As such, flooding from surface water drainage systems and sewers has occurred at many locations, including along The Florins, Petersfield Road, Park Lane and Hulbert Road.

Key physical characteristics that may constrain development

Approximately 58% of Havant Borough is currently covered by existing development, suggesting that much future development will need to be concentrated on brownfield sites. A number of environmentally designated areas represent a significant constraint on development in the Borough, covering approximately 24% of its area. As such there may be only limited Greenfield land upon which development can be permitted following consideration of other planning constraints.

The topography of Havant Borough ranges from sea level to approximately 80 metres above ordnance datum (mAOD). Hayling Island is entirely below approximately 9 mAOD. Further development on the island will likely increase the pressure for further maintenance and improvement to existing flood defences, particularly following predicted rises in sea level in future. The town of Havant itself varies in elevation from 5 mAOD near the coast to 40 mAOD in Leigh Park and West Leigh. The majority of the existing development on the mainland in Havant Borough will therefore not face increasing flood risk due to sea level rise. Waterlooville is situated between 30-50 mAOD while elevations in the Purbrook area rise to approximately 65 mAOD on the approach to Portsdown Hill.

Geologically, Havant Borough is underlain by a mix of low, moderate and highly permeable bedrock formations. The towns of Havant and Waterlooville and the southern part of Hayling Island are underlain by low and moderately permeable bedrock formations, while a highly permeable chalk layer exists between these two areas, resulting in the many springs used by Portsmouth Water. However, moderately permeable superficial deposits overlie the majority of this permeable layer, reducing its permeability in terms of surface water runoff generation. This may make the implementation of Sustainable Urban Drainage Systems (SUDS) difficult, which is of particular importance in the Cowplain and Waterlooville area where deep clay strata result in a lack of positive drainage and more frequent small surface water flooding incidents.

The existing drainage systems in Havant are known to be at or below capacity in key areas and it may therefore be difficult to provide new development in parts of the town without significant investment in drainage infrastructure.

Vulnerability to Climate Change

The SFRA has generated predicted tidal outlines for a number of years up to 2115 (see SFRA Map Set 1E). These outlines account for the most up-to-date predicted rises in sea-level over the coming century due to climate change and therefore allow the identification of locations that will be most vulnerable to this change due to their local topography. In Havant Borough, Hayling Island is the most sensitive area to sea level rise, particularly the southern half of the island. With much of the island low-lying, predicted sea-level rise could result in extreme tidal events inundating more of the island. In addition to this effect of rising sea levels, it is anticipated that climate change will result in an increase in fluvial flood flows. This may put additional pressure on areas in the town of Havant adjacent to the streams.

Vulnerability of existing communities

In general, the wards of Havant Borough have a mix of average and high social vulnerability to flooding (see SFRA Map Set 2). However, within Flood Zones 2 and 3 (i.e. those areas potentially likely to experience flooding) the wards generally have a high social vulnerability to flooding on the mainland and average social vulnerability to flooding on Hayling Island. It is likely that future investment in flood defences measures will need to strike a balance between protecting high risk areas on Hayling Island and areas of high social vulnerability on the mainland.

Existing defence assets and likely future investment

The coastal frontages of Havant Borough are almost entirely defended from either wave overtopping or tidal flooding by some form of coastal defence. Approximately half the coastal defences in Havant Borough have a crest level which is higher than a present day 1 in 200 year tide. Areas where defences are below the minimum standard of protection required for new development are the north western coast of Hayling Island south of Northney, the Chichester harbour frontage at Emsworth and the frontage at Langstone. The coastal defences in Havant Borough are, however, likely to be susceptible to climate change, as 100 years of predicted sea level rise would mean that most man-made defences at their current level would fail to offer protection from a 1 in 20 year tidal flood, with the exception of the southern frontage of Hayling Island. To sustain future development in Havant Borough, particularly on Hayling Island, significant investment in flood defences and flood defence infrastructure will be required (see SFRA Map Set 3). In order to consider the sustainability of investing in improved defences, the 'danger to people from breaching' index (SFRA Map Set 1D) will provide indications as to where the residual risk due to breaching may remain unfavourably high following improvements to defences to protect from extreme tidal floods.

Sequential and Exception Test

Planning Policy Statement 25 (PPS25) sets out the Government's objectives for achieving sustainable development through the avoidance and management of flood risk. The aim of PPS25 is to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas of flood risk. To achieve this aim, PPS25 provides a decision making tool to ensure that sites with a low probability of flooding are developed in preference to areas at higher risk. The Sequential Test is the decision process which Local Authorities must demonstrate when developing their Local Development Frameworks and Local Development Documents. This SFRA has developed a suite of mapping outputs to assist Local Authorities in applying the Sequential Test.

When applying the Sequential Test, Output Package 1 of the SFRA will provide all the necessary information required upon which to base decisions regarding the location of future development in relation to flood risk. Within Output Package 1, the key map required for applying the Sequential Test is the Flood Zones map, shown as Map Set 1A. This map shows the spatial extent of 3 of the 4 Flood Zones identified in PPS25, these include:

Map Set 1A

- **Flood Zone 2** – Medium Probability of Flooding

  Fluvial (river) and Tidal Flooding

- **Flood Zone 3a** – High Probability of Flooding, sub-divided into:

  Fluvial Flooding
  Tidal Flooding
  Tidal / Fluvial (combined flooding processes where known)

- **Flood Zone 3b** – Functional Floodplain

  Fluvial Flooding only

The area outside of these zones is considered to be the fourth zone, 'Flood Zone 1' which has a low probability of flooding.

Output Package 1 also contains 5 other Map sets which provide useful information to support Local Authorities when applying the Sequential Test, these include:

- Map Set 1B – Undefended Flood Hazard Maps (Zones 2 & 3)
- Map Set 1C – Indicative Areas Benefiting From Defences
- Map Set 1D – Danger to People from Breaching Maps
- Map Set 1E – Climate Change Outlines for 2025, 2055, 2085 and 2115
- Map Set 1F – Other sources of Flooding including:
  - Wave Energy
  - Groundwater Flooding
  - Impact of Land Use Change on Surface Water Runoff
  - Overland Flow
  - Historic Incidents of Surface Water Sewer Overload

When allocating a site in line with the Sequential Test, Figure 1 illustrates the decision process, the key questions that need to be answered and details of how the outputs of the SFRA can help inform the process.

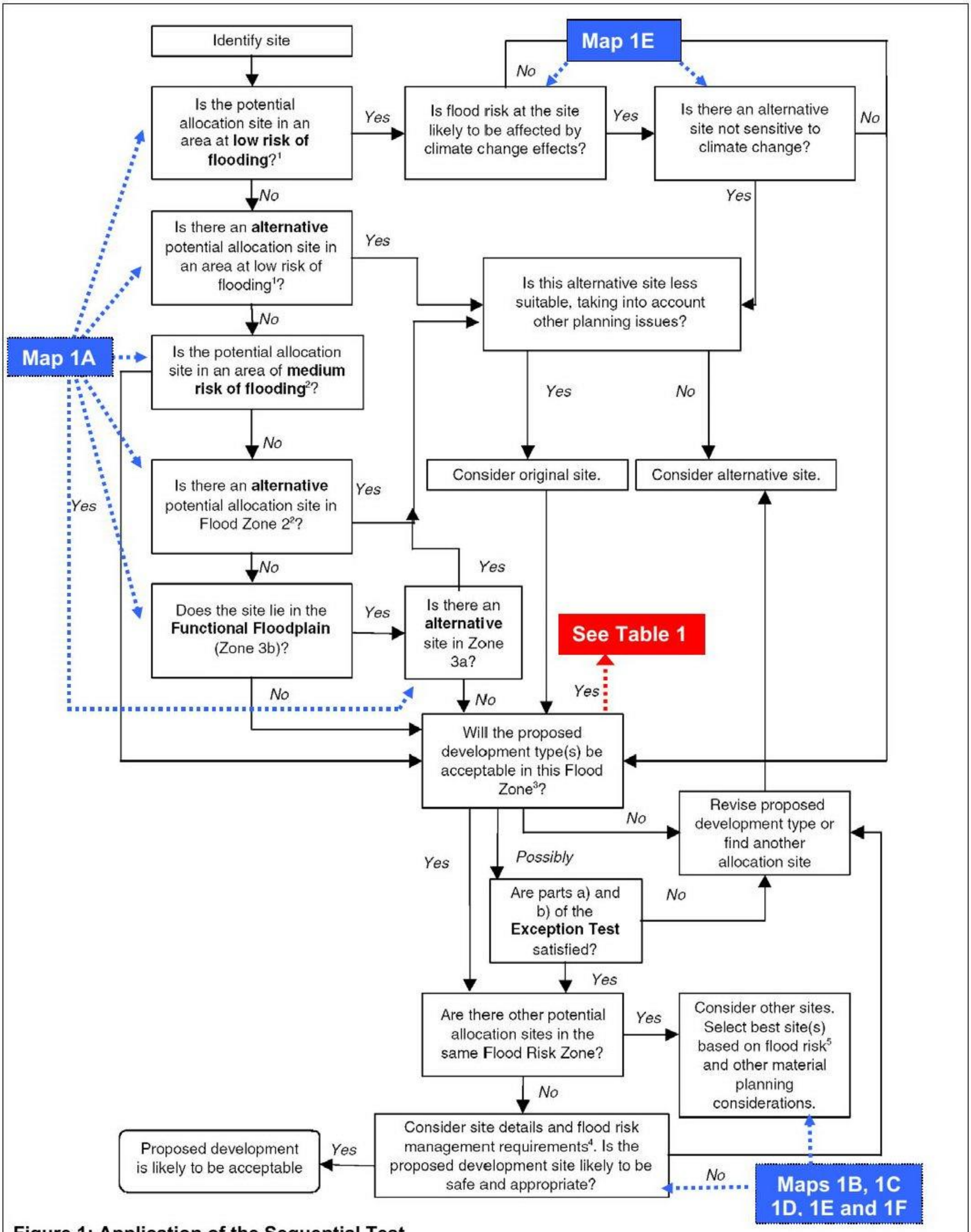


Figure 1: Application of the Sequential Test
Ref: Development and Flood Risk: A Practice Guide Companion to PPS25 'Living Draft'

Notes on Figure 1 Flow Chart

1 Flood Zone 1 for fluvial and tidal flooding and with a low risk of flooding from other sources.
2 Flood Zone 2 for fluvial and tidal flooding and with a medium risk of flooding from other sources.
3 As defined by the Sequential Test.
4 Development to be safe and to not increase flood risk elsewhere. Required to pass part c) of the Exception Test, where applicable.
5 Including susceptibility to future climate change and residual flood risk.

Flood Risk Vulnerability Classification

Where there are no reasonably available sites in Flood Zone 1, Local Authorities should take account of the flood risk vulnerability of land uses when considering the suitability of sites in Flood Zone 2 and then if necessary Flood Zone 3, applying the Exception Test if required. With reference to PPS25, Table 1 provides a summary of the appropriateness of land uses in relation to the Flood Zones.

	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	×	Exception Test required	✓
Zone 3b	Exception Test required	✓	×	×	×

Table 1: Flood Risk Vulnerability and Flood Zone Compatibility (Ref: PPS25)

Key: ✓ Development is appropriate, subject to demonstrating the Sequential Test

× Development should not be permitted.

(*This table does not show: the application of the Sequential Test which guides development to FZ1 first, then FZ2, and then FZ3; FRA requirements; or the policy aims for each Flood Zone.)

If the application of the Sequential Test demonstrates a need to consider allocating sites within Flood Zones 2 or 3, a 'Sequential Approach' should also be applied within each of these Zones to steer new development to areas with the lowest probability and consequences of flooding. To facilitate this approach to site allocations within the Flood Zones, the SFRA Outputs (in particular Map Sets 1B, 1C, 1D and 3A / 3B) will provide useful information on the variation of flood hazard and the level of benefit provided by existing defences.

The findings of the Statistical Analysis undertaken in Stage 1 of this SFRA suggest that Havant Borough Council can achieve their draft South East Plan housing allocation in line with the Sequential Test. However, the need for potential commercial regeneration of the town centre and possible 'windfall' sites may mean that Havant Borough Council will need to consider development within Flood Zones 2 and 3. Where the Sequential Test alone cannot identify acceptable sites for urban regeneration or where windfall sites, having satisfied the Sequential Test, are located in Flood Zones 2 or 3, the Exception Test may need to be applied.

Exception Test

The Exception Test should only be applied following application of the Sequential Test. There are 3 elements of the Exception Test, all of which need to be demonstrated before the test can be passed. The 3 elements are:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;
b) The development should be on developable previously-developed land or, if it is not on previously-developed land, that there are no reasonable alternative sites on developable previously-developed land; and
c) A FRA must demonstrate that the development will be safe, without increasing flood risk

elsewhere, and, where possible, will reduce flood risk overall.

When developing LDDs, Local Authorities are advised by PPS25 to prepare criteria-based polices in line with their Core Strategy's Sustainability Appraisal, against which item a) of the Exception Test can be tested. This will minimise the need to consider this element of the Exception Test for each individual planning application.

By assisting Local Authorities, at the site allocation level, in steering new development to areas with the lowest probability and hazard of flooding, the use of the SFRA outputs (in particular Map Sets 1B, 1C, 1D and 3A / 3B) will mean that site specific flood risk assessments in these areas will be more likely to satisfy criteria c) of the Exception Test.

SFRA Mapping Outputs

Table 2 summaries the most relevant mapping outputs and their purpose, for each of the key users of the PUSH SFRA.

Key Users	Relevant SFRA Mapping Outputs	Purpose
Forward Planners	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 provides all the necessary information to help planners apply the Sequential Test and Exception Test when allocating new sites for development. Output Package 1 also allows planners to identify sites with the lowest probability of flooding and lowest flood hazard / danger and how the extent of flooding is likely to change in the future due to climate change.
Flood Risk Managers	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 helps Flood Risk Managers to identify variations in flood hazards / dangers to existing development. The data also provides mapping to show how the extent of flooding is likely to increase over time due to climate change.
	Output Package 2: Social Vulnerability of and Flood Hazard / Danger to Existing Development	Output Package 2 can help Flood Risk Managers to: o Identify critical areas where social vulnerability and flood hazard / danger are high. o Help inform assessments of the sustainability of existing development. o Help identify and prioritise asset management and improvements.
	Output Package 3: Appropriate Defence Standards and Levels of Investment	Output Package 3 can help Flood Risk Managers to: o Identify shortfalls in existing defences in providing appropriate standards of defence, now and in the future. o Identify indicative levels of investment required to provide the appropriate standards, now and in the future.
Development Control	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 can help Development Control personnel to: o Prepare specifications for site specific FRAs. o Review site specific FRAs for new development sites and check for compliance with PPS25.
Emergency Planners	**Output Package 1:** PPS25 Sequential Test and Relevant Supporting Information	Output Package 1 can provide emergency planners with information on the variation of flood probability and hazard across the sub region. Such information can aid in the development of emergency plans and evacuation routes during flood events.
	Output Package 2: Social Vulnerability of and Flood Hazard / Danger to Existing Development	Output Package 2 can inform emergency planners of the locations where social vulnerability and flood hazard are highest. Such information can help emergency planners prioritise evacuation plans.

Table 2: The Mapping Output Packages appropriate for key users of the SFRA

Recommendations for Site Specific Flood Risk Assessments

Whilst the information presented in this SFRA will inform Local Authorities and facilitate their strategic allocation of sites for future development, it should not preclude the need for developers to undertake site specific flood risk assessments (FRAs). A SFRA, by its very nature, is a high level assessment of flood risk at the local authority level. It does not provide sufficiently detailed information to satisfy all of the requirements of a site specific FRA as outlined in PPS25.

On the 1st October 2006, the Town and Country Planning (General Development Procedure) (Amendment) (No 2) (England) Order 2006 (GDPO), made the Environment Agency a statutory consultee for planning applications involving flood risk in specified circumstances. To improve the efficiency of disseminating general guidance, the Environment Agency has produced a suite of standing advice. The advice is available to Local Authorities and the Public, via a web page http://www.pipernetworking.com/floodrisk/ . The standing advice also includes guidance on the requirements for site specific FRAs for both low and high risk developments. The web page provides Guidance Notes for 3 types of FRAs and advice on operational development less than 1 hectare in Flood Zone 1 as summarised below:

- Operational Development less than 1 hectare in Flood Zone 1.
- FRA Guidance Note 1: Development Greater than 1 hectare in Flood Zone 1.
- FRA Guidance Note 2: Minor Extensions.
- FRA Guidance Note 3: Development in Flood Zones 2 and 3.

The following sections provide additional specific guidance for assessing flood risk at the site specific level within Havant Borough and indicate how the outputs from the SFRA can inform such assessments.

Tidal Flooding

As previously discussed, flooding from tidal sources is the primary source of flood risk within Havant Borough and the areas at risk are predicted to increase significantly by 2115. Map Set 1A shows the existing areas at risk of tidal flooding and Map Set 1B shows the associated undefended flood hazard. The index of flood hazard represents a gradation of hazard within the Flood Zones based on a combination of the depth of flood water and the velocity of the water (indicative ranges for which have been assumed based on distance from the coastline).

The frontages where existing defences provide the minimum standards required for new development (i.e. 1 in 200 years for tidal flooding), are identified in Map Set 1C by a purple line. Indicative Areas Benefiting from Defences (ABDs) are also shown in Map Set 1C. The Indicative ABDs have been defined as areas where the crest levels of the existing defences are consistently equal to or higher than the present day 1 in 200 year extreme sea level.

If small lengths of defences have crest levels which fall below the 1 in 200 year extreme sea level (even for a short length), the area behind the defence has not been classed as an Indicative ABD. The frontage of Brockhampton is an example of where this study has not been able to define an Indicative ABD due to small lengths of defence where the crest levels fall below the 1 in 200 year extreme sea level. The gaps in the defence level can also be viewed in more detail using Map Set 3A. Further details of methodology and reasoning used to define the Indicative ABDs are described in Section 4.2.1.3 of the main report. It should be noted that other areas may potentially be classified as ABDs if more detailed modelling assessments of the defences, which is beyond the scope of this SFRA, are carried out.

Map Set 1D shows the flood hazard (in terms of danger to people) associated with a hypothetical breach in the defences for the whole of the tidal frontage. The Indicative ABDs shown in Map Set 1C define which of the hazard maps (1B or 1D) is most appropriate for consideration. Map Set 1D is only appropriate for considering present day flood hazards within an ABD. To aid the interpretation of Map Set 1D the areas where this index is not appropriate for present day analysis are hatched out. The benefit of showing hazard information in the hatched out areas is to allow planners and developers to understand the likely residual risks that would remain if they were to invest in defending an area to a 1 in 200 year standard. Map Set 1B (Undefended Flood Hazard) should be used to assess the variation of flood hazard within the Flood Zones for all areas outside the Indicative ABDs.

The benefit of both the undefended flood hazard maps (Map Set 1B) and the danger from breaching maps (Map Set 1D), is that the gradation of flood hazard within the Flood Zones can facilitate both planners and developers to ensure that development is steered away from the areas of highest hazard. The hazard mapping presented in Map Sets 1B and 1D, however, should only be applied when appropriate consideration has been taken of alternative sites at a lower probability of flood risk (i.e. within Flood Zone 1).

The flood hazard information, for both the undefended and breach scenario, developed as part of this SFRA, has been undertaken at a strategic level and is therefore at an appropriate level of detail to allow Local Authorities to strategically allocate sites for development. The hazard data has been classified into 4 categories to illustrate the gradation of flood hazard within Flood Zones 2 and 3 in line with best practice guidance as set out in Defra FD2320. The hazard data has not been calculated using modelling or other detailed numerical methods and is therefore not appropriate for identifying design parameters as part of site specific FRAs. It is therefore recommended that FRAs for sites located within the flood hazard zones should still include a quantitative assessment of flood hazard based on more detailed assessments of defence standards, defence failure scenarios and overland conveyance of flood flow.

The impact of climate change on increasing sea levels has a significant effect on the extents of Flood Zones 2 and 3 by 2115, especially on Hayling Island. Although present day planning decisions are based on the Flood Zones for 2007, at the site specific level consideration should be given to increases in risk as a result of climate change. The climate change flood extents presented in Map Set 1E should be used when undertaking a site specific FRA to inform the assessment of the long term sustainability of developments currently within Flood Zone 1 and the likely increases in flood risk in Flood Zones 2 and 3.

The defence information provided in Map Set 3 can provide developers undertaking site specific FRAs with an indication of the equivalent tidal return period of the crest level of the existing defences in 2007 and an indicative level of investment that may be required to raise defence standards to the minimum required for new development. Such investment could be secured through the development process by Section 106 agreements.

Wave Overtopping

Map Set 1F-1, Wave Energy, shows how exposure to wave energy varies along the frontage of the study area. Such information can be used to assess, at a high level, the risk of flooding caused by extreme wave overtopping. Historically, Hayling Island has suffered from flooding caused by extreme waver overtopping, most recently in November 2005. During this event, properties which are classified in Flood Zone 1 were flooded, as indicated on the historical information layer. It is recommended that all applications for development within the vicinity of the southern frontage of Hayling Island include an assessment of extreme wave overtopping, regardless of which Flood Zone the site is in. This will ensure that this risk is always considered for new development in the relevant locations. The assessment of extreme wave overtopping should be appropriate to the scale of risk and may, in some cases, be ruled out as a significant risk quite easily, but should nevertheless be addressed.

Fluvial Flooding

The mainland part of Havant Borough is at risk of fluvial flooding from the Lavant Stream, Hermitage Stream and, during extreme events (1 in 1000 years), the upper reaches of the River Wallington. Map Set 1A shows the fluvial Flood Zones, which show the town centre of Havant to be the key area at risk of fluvial flooding in the Borough.

Across Havant Borough, gaps in available fluvial flood risk data exist, which are being addressed by the Environment Agency's ongoing Strategic Flood Risk Mapping programme. Therefore, for the purposes of this SFRA, Flood Zone 3b (defined by PPS25 as the 'functional floodplain') has been defined as the entire extent of Flood Zone 3, as recommended by the PPS25 Draft Practice Guide. This is a precautionary approach and should be tested by site specific FRAs, where required.

Unlike the tidal Flood Zones, flood levels associated with the fluvial Flood Zones have not been identified as part of this SFRA. The variations in previous modelling approaches (some of which are awaiting EA approval) for the rivers within the PUSH sub-region, coupled with the spatial variation on flood levels along the river valleys, meant that it was not possible to provide a consistent approach to identifying fluvial flood levels without re-

modelling a number of rivers. Such detailed assessments were outside the scope of this SFRA. Developers undertaking a FRA for a site within the fluvial Flood Zones should obtain the most up to date flood risk data from the Environment Agency. If no further information is available then a site specific FRA may need to include a numerical assessment to refine the understanding of fluvial flood risk, and agree the form of this assessment with the Environment Agency.

The impacts of climate change on fluvial flooding are likely to result in a 10% increase in flows up to 2025 and 20% from 2025 to 2115. Again due to current gaps in available data that are being addressed by the Environment Agency's ongoing flood mapping programme, there are no consistent estimates for Havant Borough of the extreme fluvial flood extent taking climate change into account. Based on Environment Agency guidance, this SFRA has assumed that the present day Flood Zone 2 (medium probability) becomes Flood Zone 3 (high probability) by 2025. This is a conservative assumption which should be tested by site specific FRAs, where required. This also means that there is no data available to estimate Flood Zone 2 after the present day. Therefore, the fluvial climate change outline shown in Map Set 1E only shows a Flood Zone 3.

Undefended flood hazard information, shown in Map Set 1B, has also been developed for the fluvial Flood Zones 2 and 3. This information can provide developers with an indication of the varying degree of flood hazard within the Flood Zones which can facilitate the design and layout of development sites to avoid areas of high hazard. As with the tidal flood hazard data, it is recommended that FRAs for sites located within the flood hazard zones undertake a more detailed quantitative assessment of flood hazard based on an improved understanding of defences and flow routes.

Surface Water/Overland Flow Flooding

Map Set 1F-4 shows the variation in the potential source of overland flow across the PUSH sub-region. The areas shown in red and orange relate to areas of very high and high potential for generating overland flow. Notably, the urban areas are indicated as red or orange due to the high runoff potential from urban land uses. Within Havant Borough there is a large area of the mainland which has a high to very high potential for generating overland flow. FRAs for sites that are found to be within or in the vicinity of these areas, especially if the local topography places the site at a lower elevation than the surrounding land and hence downstream of the source, should consider the impacts and management of flooding due to overland flow.

In addition to the information provided in relation to the source of overland flow flooding, Map Set 1F-3 provides information to inform Local Authorities of the potential impacts of land use changes on the local surface water runoff regime. The areas showing diagonal hatching represent the urban areas, where a change in land use is unlikely to significantly affect the existing surface water runoff rates and volumes. This representation is a high level assessment across the PUSH sub-region and would therefore need to be confirmed when undertaking a site specific FRA. The areas outside of the hatching represent the effect that changes in land use are likely to have on the surface runoff rates and volumes from Greenfield sites. The data shows that new development located on the majority of the Greenfield Land in Havant Borough is likely to have a moderate impact on the surface water runoff regime. Site specific FRAs should therefore carefully consider the impact of development on the local surface water runoff regime and should investigate SUDS options to manage surface water where achievable.

Groundwater Flooding

Within the PUSH region the key areas at risk of groundwater flooding are north of Havant Borough in East Hampshire, Winchester, Eastleigh and Test Valley where highly permeable geology meets lower permeability geology as shown by Map Set 1F-2, which has been verified by inspection of the historical incident records. The key risks to new development in the Havant Borough come from increases in flows in the Lavant Stream as a result of high groundwater levels emerging in East Hampshire District. It is therefore recommended that site specific FRAs for sites located within the Flood Zone of the upper reaches of the Lavant Stream consider the joint effects of high groundwater flows in the Lavant Stream combined with rapid runoff from intense rainfall events.

Flooding from Infrastructure

Historically, the mainland part of Havant Borough has recorded the most incidents of flooding caused by problems relating to the drainage infrastructure as shown by Map Set 1F-5. The majority of these incidents have occurred in the vicinity of Havant Town Centre, Purbrook, Cowplain and Emsworth. When undertaking a site specific FRA for a large development site, consultation with Southern Water should always be undertaken to investigate whether the proposed development will have an adverse impact on the local drainage system.

Furthermore, a parallel study being undertaken on behalf of PUSH, 'Hampshire Integrated Water Management Study', is investigating the issues relating to the future management of surface water within the region with respect to the anticipated increases in housing as indicated in the draft South East Plan. It is recommended that those undertaking a site specific FRA within the urban areas of Havant Borough make reference to the findings of this study.

Sustainable Urban Drainage Systems (SUDS)

Conventional surface water drainage systems have traditionally used underground pipe networks to efficiently convey water away from sites. In the past this has led to problems of downstream flooding, reductions in groundwater recharge and waste pollution incidents associated with surface water overwhelming combined sewers. Both '*Making Space for Water*' and the '*Water Framework Directive*' have highlighted the need for an improved understanding and better management of how our urban environments are drained. The SUDS management train approach, as shown in Figure 2, is the principle that a range of SUDS which feed into each other can often offer benefits to the delivery of a successful surface water system/strategy.

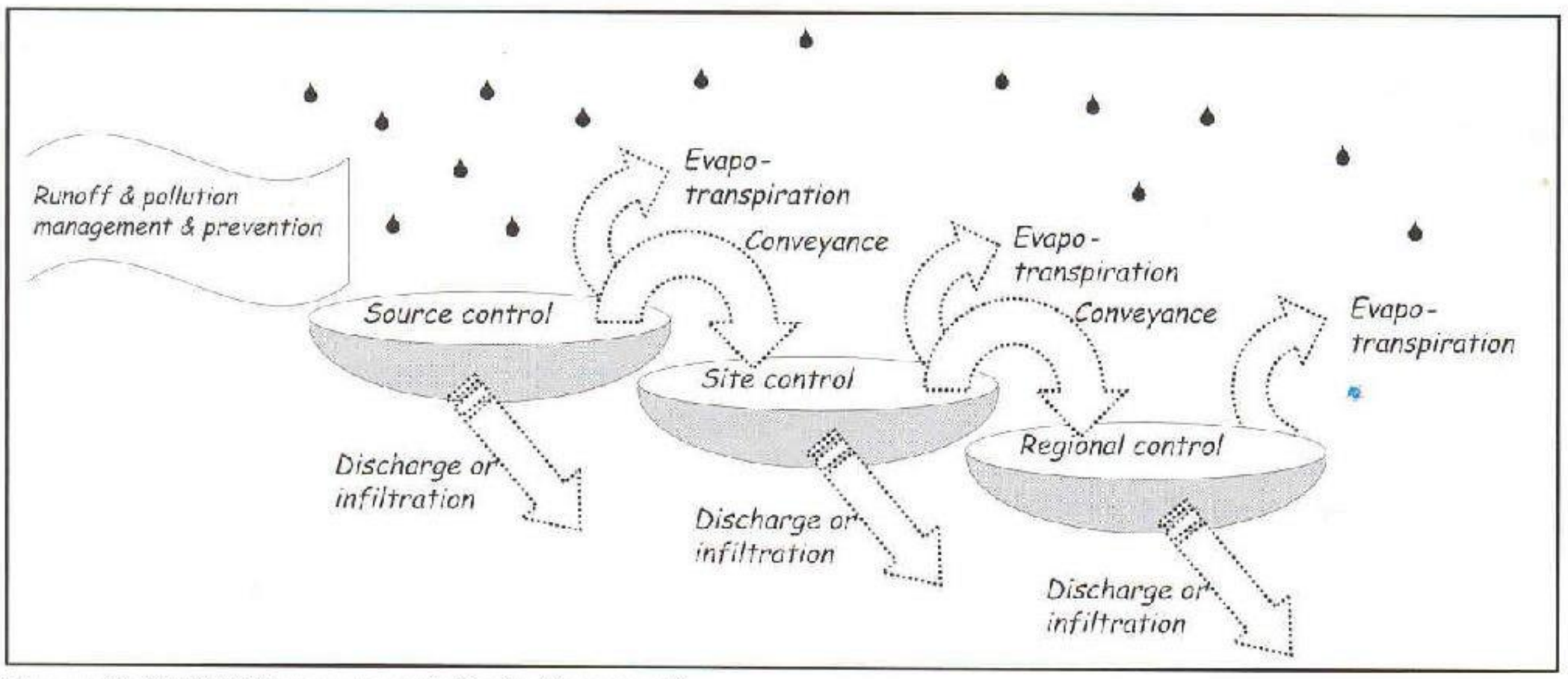


Figure 2: SUDS Management Train Approach

PPS25 states that Local Authorities should prepare and implement planning strategies that help to deliver sustainable development, by using opportunities offered by new development to reduce the causes and impacts of surface water flooding. By implementing polices to encourage developers to incorporate SUDS wherever possible, Local Authorities can help to mitigate the impacts that development has on surface water runoff rates and volumes. Appendix F of PPS25 states:

'the surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates/volumes prior to the proposed development, unless specific off-site arrangements are made and result in the same net affect.'

Map set 1F-2 provides information relating to the spatial variation of permeability across Havant Borough. This information can be used as a first estimate of the suitability of different types of SUDS within the Borough as shown in Table 3.

Permeability	Indicative Suitability of SUDS Techniques
High Permeability	Infiltration and Combined Systems
Moderate Permeability	Infiltration and Combined Systems
Low Permeability	Attenuation Systems

Table 3: Suitability of SUDS

It is important to note that the above assessment of the spatial suitability of SUDS is an indicative estimate and should be confirmed at the site specific level, using ground investigation data.

Infiltration Systems

Infiltration systems allow surface water to discharge directly into the ground. These systems are only appropriate 1) where ground conditions permit a suitable water acceptance potential and 2) in locations where groundwater recharge will not adversely affect drinking water aquifers as identified by the Environment Agency's source protection zones, available on their website http://www.environment-agency.gov.uk. Such systems may include:

- Permeable surfaces
  - Gravel
  - Permeable Paving
  - Block Paving with voids
  - Grassed areas
- Sub Surface Infiltration
  - Filter Drains
  - Geocellular Systems
  - Soakaways

Infiltration systems may not be appropriate in areas of potentially contaminated land. In such circumstances, other systems, such as contained attenuation systems, that avoid mobilisation of contaminants may be more appropriate.

Attenuation Systems

If ground conditions cannot support infiltration systems, surface water may need to be attenuated using measures to store surface water. Attenuation systems, if designed above ground, have the potential to take up large areas of development sites. Early consideration of such constraints is therefore essential. Attenuation systems may include:

- Landscaped
  - Detention Basins
  - Balancing Ponds
  - Retention Ponds
  - Wetlands
  - Lagoons
- Engineered
  - Underground Tanks
  - Ornate Water Features
  - Rainwater Harvesting
  - Green Roofs
  - Oversized Pipes

Combined Systems

SUDS designs for most sites can include a combination of infiltration and attenuation systems and they have

been categorised above according to the dominant process. Other forms of SUDS which can provide more balanced benefits of infiltration and attenuation include:

- Swales
- Filter Strips

Emergency Planning

As well as informing the development control process, the outputs of the SFRA can also be used by the Local Authority to inform their Emergency Planning Polices. Map Sets 1A, 1B, 1C, 1D and 1E are particularly useful when considering the feasibility and sustainability of key access routes within their administrative boundaries. The benefit of producing such outputs on a sub-regional scale mean that the Local Authority can also consider access to the Borough beyond their administrative boundary where key access routes (e.g. M27) cross a number of Local Authorities.

Additional Guidance

In addition to the guidance provided by the Environment Agency http://www.pipernetworking.com/floodrisk/, there are a number of other documents that provide detailed advice and guidance for undertaking site specific FRAs:

- Planning Policy Statement 25: Development and Flood Risk, (2006), Communities and Local Government.
- Development and Flood Risk: A Practice Guide Companion to PPS25 - 'Living Draft', (2007), Communities and Local Government
- Development and Flood Risk: Guidance for the Construction Industry, (2004), CIRIA (Based on PPG25)
- Flood Risk Assessment Guidance for New Development: FD2320/TR2, (2005), Defra (Based on PPG25)
- Sustainable Urban Drainage Systems: Best Practice Manual, (2001), CIRIA

Annex 1 – Data Source for Havant Borough Council

Further to the general technical details provided in the main SFRA Stage 2 report, this annex includes data issues specific to Havant Borough Council.

Defence Data

The majority of Havant Borough Council defence data in is provided by the Havant Asset Database which holds details of most of the Borough's coastal defences from recent surveys. Surveys recorded in the database were undertaken between 2002 and 2003. The defence database for Havant was supplemented with data from the Eastoke Sectoral Strategy Study (2005) and Portchester Castle to Emsworth Coastal Defence Strategy Study (2006). Coastal defence works in other parts of Havant's coastline undertaken since 2003 may supersede records in the SFRA Defence Database.

No information on fluvial defences in Havant was available.

Topographic Data

95% of the topographic grid in Havant Borough is composed of LiDAR data. Areas where LiDAR was not available are the northern slope of Portsdown Hill to the west of Bedhampton and to the north of the Borough between Lovedean and Cowplain. In these areas, NextMap data was used to fill in the gaps in the LiDAR.

Fluvial Flood Zone 3b

In Havant Borough, fluvial Flood Zone 3b was represented as the whole of Flood Zone 3. In the absence of data to prove otherwise (i.e. detailed 1 in 20 year modelling or observed historic flood extents), this approach is in accordance with PPS25 practice guide section 3.17 and was recommended by the Environment Agency.

Fluvial Climate Change Outlines

In Havant Borough, the fluvial outlines after the present day were represented by assuming that Flood Zone 3 will expand to fill the current area of Flood Zone 2. This means there is no estimate of fluvial Flood Zone 2 after the present day for the Borough. This approach was recommended by the Environment Agency.

APPENDIX G

EXTRACT GEOTECHNICAL REPORT



GTS-15-719

Chidden Farms

Bartons Road

Havant,

Hampshire

PO9 5NA

Appendix A

Exploratory Hole Records

Ground Technology Services

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

SA1
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level

Coordinates 473379.48 107807.24

Orientation of Trial Pit:

Length: 2.80 Width: 0.50 Depth: 2.30

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey slightly gravelly sandy silty CLAY. Gravel is angular to subangular fine to coarse flint.		0.20			B	1	0.20	0.40		
Firm yellowish grey friable sandy CLAY. [HEAD DEPOSITS]		0.40			D	1	0.40	0.60	HV=75 kPa	
Firm to stiff yellowish brown and yellowish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. Some black specks and staining. [HEAD DEPOSITS]		0.70			D	2	0.80		PP=65 kPa	
Stiff grey and yellowish brown slightly gravelly CLAY, with occasional cobbles. Gravel is angular to subrounded fine to coarse flint. Some sub horizontal uneven to smooth grey slip planes. Occasional fine roots and decayed root channels. [HEAD DEPOSITS]		1.30							PP=100 kPa	
Stiff grey and yellowish brown slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. [HEAD DEPOSITS]		2.00			D	3	1.80		PP=120 kPa	
Very stiff grey and brown CLAY. Some fine decayed root channels. [LONDON CLAY FORMATION]		2.30			D	4	2.10		HV=165 kPa	
Trial Pit completed at 2.300m										

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion. 3. Soakaway not undertaken in trial pit due difficulties in towing bowser to location after heavy rainfall.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

SA2
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level

Coordinates 473133.24 107811.30

Orientation of Trial Pit:

Length: 1.90 Width: 0.50 Depth: 2.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey sandy slightly gravelly CLAY. Gravel is angular fine to coarse flint.										
Firm to stiff yellowish brown and yellowish grey CLAY. [HEAD DEPOSITS]		0.25			D	1	0.40		HV=75 kPa	
Stiff to very stiff yellowish brown CLAY, with some grey sub horizontal smooth shear planes. [HEAD DEPOSITS]		0.80			D	2	1.00		HV=135 kPa	
Very stiff yellowish brown CLAY, with some yellowish brown sandy clay pockets, 6cm to 10cm, a little black specking and veining. [HEAD DEPOSITS]		1.30			D	3	1.40			
Stiff to very stiff greyish brown and grey CLAY, crumb texture, with some fine decayed root channels. [LONDON CLAY FORMATION]		1.50							PP=140 kPa	
Trial Pit completed at 2.000m		2.00			D	4	2.00		PP=150 kPa	

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion. 3. Soakaway undertaken in trial pit - please refer to supplementary soakaway sheet SA2

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

SA3
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level

Coordinates 473190.48 107607.25

Orientation of Trial Pit:

Length: 1.90 Width: 0.50 Depth: 2.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Brownish grey sandy slightly gravelly silty CLAY. Gravel is angular to subangular fine to coarse flint.					B	1	0.00	0.10		
Soft brown sandy SILT. [RIVER TERRACE DEPOSITS]		0.25			B	2	0.30	0.40		
Stiff brown sandy slightly gravelly silty CLAY. Gravel is angular fine to coarse flint. [RIVER TERRACE DEPOSITS]		0.70			B	3	0.70	4.00	HV=125 kPa	
									PP=85 kPa	
									PP=130 kPa	
					D	1	1.90			
Trial Pit completed at 2.000m		2.00								

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion. 3. Soakaway undertaken in trial pit - please refer to supplementary soakaway sheet SA3

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

SA4
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473124.26
107698.20

Orientation of Trial Pit:

Length: 1.90 Width: 0.50 Depth: 2.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Soft brownish grey sandy slightly gravelly CLAY. Gravel is angular fine to coarse flint.		0.25			B	1	0.00	0.10		
Stiff Brown slightly sandy silty CLAY. With occasional angular fine to coarse flint gravel. [RIVER TERRACE DEPOSITS]					B D	2 1	0.40 0.40	0.50 0.50		
Brown clayey very gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse flint. [RIVER TERRACE DEPOSITS]		1.40			B	3	1.40	1.60		
Stiff brown silty CLAY. [RIVER TERRACE DEPOSITS]		1.70 1.80			B D	4 2	1.70 1.70	1.80 1.80		
Brown clayey very gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse flint. [RIVER TERRACE DEPOSITS]		2.00								
Trial Pit completed at 2.000m										

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion. 3. Soakaway undertaken in trial pit - please refer to supplementary soakaway sheet SA4

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP1
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473410.30 107977.88

Orientation of Trial Pit:

Length: Width: Depth: 3.60

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey very silty gravelly fine to medium SAND. Gravel is angular to subangular fine to coarse flint.		0.20			B	1	0.20	0.40		
Light grey clayey medium and coarse SAND and GRAVEL. Gravel is angular to rounded fine to coarse flint. [HEAD DEPOSITS] *From 0.40mbgl yellowish brown*		0.80			B	2	0.80	1.00		
Stiff yellowish brown and grey sandy gravelly CLAY, with occasional cobbles. Gravel is angular to subrounded flint. Dense. Locally a clayey sand and gravel. [HEAD DEPOSITS]		1.70			B	3	1.20	2.00		
Yellowish brown clayey fine to coarse SAND and GRAVEL, with occasional cobbles. Gravel is angular to rounded fine to coarse flint. Dense. Locally a clayey sand and gravel. [HEAD DEPOSITS]		2.20			D	1	2.20	2.30		
Yellowish brown silty fine SAND. Some 5cm to 10cm silt bands. A little black specking and staining. [HEAD DEPOSITS]		3.60								
Trial Pit completed at 3.600m										

Date: 27/10/2015

Plant:

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP101
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473179.00 107594.00

Orientation of Trial Pit:

Length: 0.75 Width: 0.75 Depth: 0.70

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Greyish brown slightly gravelly sandy silty CLAY. Gravel is angular to subangular fine to coarse flint.										
Firm to stiff orangish brown sandy silty CLAY. [RIVER TERRACE DEPOSITS]		0.25			B	1	0.50	0.70		
Trial Pit completed at 0.700m		0.70								

Date: 02/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Soakaway test undertaken in exploratory hole, please refer to supplementary soakaway sheet 3. Exploratory hole backfilled upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP102
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473096.00 107698.00

Orientation of Trial Pit:

Length: 0.80 Width: 0.50 Depth: 0.70

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Brownish grey slightly gravelly sandy silty CLAY. Gravel is angular to subangular fine to coarse flint.										
Firm to stiff orangish brown sandy silty CLAY. [RIVER TERRACE DEPOSITS]		0.25			B	1	0.50	0.80		
Trial Pit completed at 0.700m		0.70								

Date: 01/12/2015
Plant: JCB3CX
Logged By: JT
Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Soakaway test undertaken in exploratory hole, please refer to supplementary soakaway sheet 3. Exploratory hole backfilled upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP103
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473116.00 107745.00

Orientation of Trial Pit:

Length: 0.80 Width: 0.50 Depth: 0.70

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark greyish brown silty gravelly fine to medium SAND. Gravel is angular to subangular fine to coarse flint.		0.25								
Firm to stiff orangish brown and greyish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. [RIVER TERRACE DEPOSITS]					B	1	0.40	0.70		
Trial Pit completed at 0.700m		0.70								

Date: 01/12/2015
Plant: JCB3CX
Logged By: JT
Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Soakaway test undertaken in exploratory hole, please refer to supplementary soakaway sheet 3. Exploratory hole backfilled upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP104
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473132.47 107784.75

Orientation of Trial Pit:

Length: 1.10 Width: 0.50 Depth: 0.75

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brown slightly gravelly fine very silty SAND . Gravel is angular to subangular fine to coarse flint.		0.25			B	1	0.25	0.50		
Firm to stiff greyish brown sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.50			B	2	0.50	0.75	PP=60 kPa	
Firm yellowish brown sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.75								
Trial Pit completed at 0.750m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP105
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level

Coordinates 473201.00 107686.00

Orientation of Trial Pit:

Length: 1.20 Width: 0.50 Depth: 0.75

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Greyish brown very silty fine SAND										
Firm to stiff orangish brown sandy CLAY, with occasional gravel. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.25			B	1	0.25	0.55		
Firm to stiff orangish brown and brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.55								
Trial Pit completed at 0.750m		0.75								

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP106
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473245.00 107726.00

Orientation of Trial Pit:

Length: 1.20 Width: 0.50 Depth: 0.75

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Brownish grey slightly gravelly fine very silty SAND . Gravel is angular to subangular fine to coarse flint.		0.25								
Firm to stiff light yellowish brown and yellowish brown sandy CLAY, with occasional gravel. Gravel is angular to subangular fine to medium flint. [HEAD DEPOSITS]		0.70			B	1	0.30	0.70		
Firm to stiff yellowish brown and yellowish grey slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.75								
Trial Pit completed at 0.750m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
Tel: 01553 817657
www.groundtechnology.co.uk

Trial Pit Record

TP107
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473300.00 107746.00

Orientation of Trial Pit:

Length: 1.10 Width: 0.50 Depth: 0.80

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey very silty gravelly fine to medium SAND. Gravel is angular to subangular fine to coarse flint.		0.25			B	1	0.25	0.50		
Grey clayey very sandy GRAVEL. Gravel is angular fine to medium flint. [HEAD DEPOSITS]		0.50			B	2	0.50	0.80		
Firm to stiff orangish brown and greyish brown sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.80								
Trial Pit completed at 0.800m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Norfolk, PE34 3AF
Tel: 01553 817657
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Trial Pit Record

TP108
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473249.17 107777.35

Orientation of Trial Pit:

Length: 0.90 Width: 0.50 Depth: 0.70

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Brownish grey silty gravelly fine to medium SAND. Gravel is angular to subangular fine to coarse flint.		0.25								
Light grey and yellowish brown clayey coarse SAND and GRAVEL. Gravel is angular to subrounded fine to coarse flint. [HEAD DEPOSITS]					B	1	0.50	0.70		
Trial Pit completed at 0.700m		0.70								

Date: 01/12/2015
Plant: JCB3CX
Logged By: JT
Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Soakaway test undertaken in exploratory hole, please refer to supplementary soakaway sheet 3. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP109
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473143.00 107780.00

Orientation of Trial Pit:

Length: 1.00 Width: 0.50 Depth: 0.80

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey slightly gravelly very silty fine to medium SAND. Gravel is angular to subangular fine to coarse flint.		0.30			B	1	0.30	0.50		
Yellowish grey clayey very gravelly fine to coarse SAND, with occasional cobbles. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.50			B	2	0.50	0.80		
Stiff orangish brown and yellowish brown sandy slightly gravelly CLAY, with occasional cobbles. Gravel is angular to subrounded fine to coarse flint. [HEAD DEPOSITS]		0.80								
Trial Pit completed at 0.800m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP110
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level

Coordinates 473071.84 107843.54

Orientation of Trial Pit:

Length: 0.80 Width: 0.50 Depth: 1.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Brownish grey sandy slightly gravelly SILT. Gravel is angular to subangular fine to coarse flint.		0.25			D	1	0.25	0.65		
Stiff yellowish brown slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.60			B	2	0.65	1.00		
Stiff light grey and yellowish brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. [HEAD DEPOSITS]		1.00								
Trial Pit completed at 1.000m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Soakaway test undertaken in exploratory hole, please refer to supplementary soakaway sheet 3. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP111
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473111.00
107845.00

Orientation of Trial Pit:

Length: 1.30 Width: 0.50 Depth: 0.75

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark greyish brown gravelly fine very silty SAND . Gravel is angular to subangular fine to coarse flint.		0.25								
Brownish grey sandy slightly gravelly CLAY, with occasional cobbles. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.35			B	1	0.35	0.70		
Firm to stiff light grey and yellowish brown slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.75							PP=65 kPa	
Trial Pit completed at 0.750m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP112
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473202.00 107846.00

Orientation of Trial Pit:

Length: 0.85 Width: 0.50 Depth: 0.70

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark greyish brown sandy gravelly SILT. Gravel is angular to subangular fine to coarse flint.		0.25			B	1	0.26	0.65		
Firm grey sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.65								
Firm to stiff light grey and yellowish brown slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.70								
Trial Pit completed at 0.700m										

Date: 01/12/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Soakaway test undertaken in exploratory hole, please refer to supplementary soakaway sheet 3. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP113
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473335.00
107826.00

Orientation of Trial Pit:

Length: 0.35 Width: 0.35 Depth: 0.70

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint.										
Firm yellowish brown slightly sandy CLAY, with occasional gravel. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.25			B	1	0.30	0.70		
Trial Pit completed at 0.700m		0.70								

Date: 01/12/2015
Plant: Hand Pit
Logged By: JT
Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using Hand Tools 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP114
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473249.00 107618.00

Orientation of Trial Pit:

Length: 1.30 Width: 0.50 Depth: 0.75

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Greyish brown slightly gravelly fine very silty SAND. Gravel is angular to subangular fine to coarse flint.										
Firm orangish brown sandy silty CLAY. [RIVER TERRACE DEPOSITS]		0.25			B	1	0.50	0.70		
Trial Pit completed at 0.750m		0.75								

Date: 01/12/2015
Plant: JCB3CX
Logged By: JT
Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled upon completion.

Hole Stability: Good

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Trial Pit Record

TP2
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473399.96 107854.22

Orientation of Trial Pit:

Length: 2.20 Width: 0.50 Depth: 3.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Greyish brown slightly gravelly sandy silty CLAY. Gravel is angular fine to coarse flint.										
Firm yellowish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.30			B D	1 1	0.50 0.50	0.60 0.60	PP=55 kPa	
Stiff yellowish brown and grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.70			B D	2 2	0.70 0.70	1.00 1.00	PP=90 kPa	
Stiff grey and brown CLAY, with a little fine decayed root channels. Occasional flint gravel with some gravelly bands. [HEAD DEPOSITS]		1.40			B D	3 3	1.60 1.60	1.80 1.80	PP=150 kPa	
Stiff to very stiff greyish brown and grey CLAY. Crumb texture. [LONDON CLAY FORMATION]		2.20			D	4	2.40		PP=150 kPa	
Trial Pit completed at 3.000m		3.00								

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability: Good

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Trial Pit Record

TP3
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473273.67 107813.28

Orientation of Trial Pit:

Length: 2.30 Width: 0.50 Depth: 3.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark greyish brown slightly gravelly fine very silty SAND . Gravel is angular fine to coarse flint.		0.20			B	1	0.20	0.40		
Greyish brown slightly gravelly fine very silty SAND. Gravel is angular fine to coarse flint. [HEAD DEPOSITS]		0.40			B	2	0.40	0.60		
Firm to stiff brown sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.70			B D	3 1	0.80 0.80	1.00 1.00	HV=105 kPa	
Stiff orangish brown and light grey slightly gravelly CLAY. Gravel is angular fine to coarse flint. [HEAD DEPOSITS]		1.20			B D	4 2	1.20 1.20	1.40 1.40		
Stiff brown and grey CLAY, with occasional angular fine to coarse flint gravel. [HEAD DEPOSITS]									HV=115 kPa	
					D	3	2.00		PP=110 kPa	
Stiff greyish brown and grey CLAY. A crumb texture, with a little sugary calcite granules. [LONDON CLAY FORMATION]		2.40			D	4	2.80		HV=135 kPa	
Trial Pit completed at 3.000m		3.00								

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability: Good

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Trial Pit Record

TP4
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473173.22 107760.65

Orientation of Trial Pit:

Length: 2.40 Width: 0.50 Depth: 3.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey sandy slightly gravelly SILT. Gravel is angular fine to coarse flint.		0.25			B	1	0.00	0.20		
Brownish grey sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. [HEAD DEPOSITS]		0.40			B	2	0.30	0.40		
					B	3	0.50	0.70		
					D	1	0.50	0.60		
Stiff orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.70			B	4	0.70	0.90		
					D	2	0.70	0.90		
Stiff brown and grey CLAY, with some fine roots and decayed root channels. [HEAD DEPOSITS]		1.30							HV=100 kPa	
Stiff orangish brown and grey slightly gravelly CLAY, with occasional cobbles. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]					B	5	1.30	1.50		
					D	3	1.30	1.50		
Very stiff brown and grey slightly gravelly CLAY. Gravel is angular fine to medium flint. [LONDON CLAY FORMATION]		2.00			D	4	2.20		PP=150 kPa	
Very stiff greyish brown and grey CLAY [LONDON CLAY FORMATION]		2.70			D	5	2.80		PP=150 kPa	
Trial Pit completed at 3.000m		3.00								

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability: Good

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Trial Pit Record

TP5
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473286.85 107735.14

Orientation of Trial Pit:

Length: 2.20 Width: 0.50 Depth: 3.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Brownish grey sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint.										
		0.30			B	1	0.30	0.50		
					D	1	0.30	0.50		
Firm to stiff grey sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. With some decayed roots. [HEAD DEPOSITS]		0.50			B	2	0.50	0.70		
					D	2	0.50	0.70		
Firm to stiff orangish brown with a little grey sandy slightly gravelly CLAY, with occasional cobbles. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		1.00			D	3	1.00	1.20		
Stiff orangish brown and light grey slightly gravelly CLAY, with occasional cobbles. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]									PP=100 kPa	
					D	4	1.80		PP=100 kPa	
Stiff to very stiff brown and grey CLAY, crumb texture, with occasional angular fine and medium flint gravel. [HEAD DEPOSITS]		1.90			D	5	2.10		PP=140 kPa	
					D	6	2.90		PP=160 kPa	
Trial Pit completed at 3.000m		3.00								

Date: 27/10/2015
Plant: JCB3CX
Logged By: J. Tomalin
Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability: Good

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Trial Pit Record

TP6
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473208.60 107715.21

Orientation of Trial Pit:

Length: Width: 0.50 Depth: 3.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark brownish grey slightly gravelly sandy SILT. Gravel is angular to subangular fine to coarse flint.		0.25								
Stiff greyish brown slightly sandy CLAY, with occasional flint gravel. [HEAD DEPOSITS]		0.40			B	1	0.40	0.60	HV=110 kPa	
Stiff yellowish brown slightly sandy CLAY, with occasional flint gravel. [HEAD DEPOSITS]		0.70								
Stiff orangish brown and light grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. Some black specks. [HEAD DEPOSITS]					B D	2 1	1.00 1.00	1.10 1.10	HV=110 kPa PP=10 kPa	
Firm to stiff orangish brown and light grey silty CLAY, with occasional flint gravel. [HEAD DEPOSITS]		1.50			D	2	1.60		PP=90 kPa	
					D	3	2.40		HV=95 kPa	
Stiff orangish brown and light grey sandy CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		2.70			B	3	2.70	2.90		
Stiff orangish brown and light grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		2.90			D	4	2.90	3.00		
Trial Pit completed at 3.000m		3.00								

Date: 27/10/2015

Plant: JCB3CX

Logged By: J. Tomalin

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Trial pit undertaken using mechanical excavator 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability: Good

GROUND TECHNOLOGY
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Window Sample Record

WS1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:
Coordinates: 473410.03
107904.36

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
TOPSOIL: dark brownish black sandy gravelly SILT, with some roots and rootlets. Gravel is angular to subrounded fine to medium flint.												
MADE GROUND: yellowish brown clayey GRAVEL. Gravel is subangular to subrounded fine to coarse flint. Water ingress from ceramic land drain.		0.30										
Loose yellowish brown clayey GRAVEL. Gravel is subangular to subrounded fine to coarse flint. [HEAD DEPOSITS]		0.60		D	1	1.20	1.65	0.00	1.2	N=8 (2,1/2,1,2,3)		
				B	3	1.40	1.60					
Soft orangish brown mottled grey sandy silty CLAY. [HEAD DEPOSITS]		1.60		D	4	1.60	1.70					
		1.70		B	5	1.70	2.00					
Loose orangish brown mottled grey silty clayey fine to medium SAND. with some 5mm wide pockets of grey sandy clay. [HEAD DEPOSITS]				D	2	2.00	2.45	0.00	2	N=11 (1,2/1,3,3,4)		
From 2.00mbgl medium dense.												
From 2.20m to 2.30mbgl soft orange brown sandy clay.		2.30										
Firm to stiff dark brown mottled grey silty CLAY. [LONDON CLAY FORMATION]				D	7	2.70	2.80					
				D	6	3.00	3.45	0.00	2.5	N=7 (2,1/1,1,2,3)		
Borehole completed at 3.450m		3.45										

Drive Records

Diameter	To (m)	Sample Recovery
102	2.00	100%
76	3.00	100%

Water Level Observations

Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
28-10-2015	0.50	0.50	0.00	20	

Dates: Start: 28/10/2015 End: 28/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 1.20mbgl 2. Exploratory hole terminated after reaching completion depth.

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Trial Pit Record

WS2
Sheet 1 of 1

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level
Coordinates 473314.78 107789.76

Orientation of Trial Pit:

Length: 2.50 Width: 0.50 Depth: 3.00

Description	Legend	Depth (m)	O.D. Level (m)	Water	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	Remarks and Test Results SPT/HV/PP	PID (ppm)
TOPSOIL: Dark greyish brown slightly gravelly sandy SILT/CLAY. Gravel is angular to subangular fine to coarse flint.		0.25								
Firm yellowish grey sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		0.50			B D	1 1	0.40 0.40	0.50 0.50	PP=60 kPa	
Stiff yellowish brown and grey slightly gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]					D	2	0.80		PP=80 kPa HV=70 kPa	
Stiff yellowish brown and grey sandy gravelly CLAY, with occasional cobbles. Gravel is angular to subrounded fine to coarse flint. Locally a clayey very gravelly fine to coarse sand. [HEAD DEPOSITS]		1.30			B	2	1.30	1.50		
					B	3	2.00	2.20		
Very stiff grey and brown CLAY, with some subhorozontal smooth grey shear planes. [LONDON CLAY FORMATION]		2.70			D	3	2.70	3.00	PP=165 kPa	
Trial Pit completed at 3.000m		3.00								

Date: 27/10/2015

Plant: JCB3CX

Logged By: JT

Checked By: P. Lewin

Water Level Observations

Date	Water Strike (m)	Standing Time (Mins)	Standing Level (m)

Groundwater Remarks

Remarks: 1. Location undertaken as machine excavated trial pit in place of window sampler borehole 2. Exploratory hole backfilled with arisings upon completion.

Hole Stability: GOOD

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Window Sample Record

WS3

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:
Coordinates: 473196.49
107811.39

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
TOPSOIL: dark brownish black sandy gravelly SILT, with some roots and rootlets. Gravel is angular to subrounded fine to medium flint.												
		0.30										
Dense dark orangish sandy silty GRAVEL. [HEAD DEPOSITS]				B	4	1.00	1.70					
				D	1	1.20	1.65	0.00	Dry	N=46 (5,9/13,11,12,10)		
		1.70										
Dark orangish brown gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]				D	5	1.80	2.00					
				D	2	2.00	2.45	0.00	Dry	N=18 (5,5/6,4,4,4)		
		2.60		D	6	2.60	2.80					
Very stiff dark brown and grey silty CLAY. [LONDON CLAY FORMATION]				D	3	3.00	3.45	0.00	Dry	N=17 (1,1/2,3,5,7)		
		3.45										
Borehole completed at 3.450m												

Drive Records		
Diameter	To (m)	Sample Recovery
1	2.00	100%
87	3.00	100%

Water Level Observations					
Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)

Dates: Start: 27/10/2015 End: 27/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 1.20mbgl 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS4

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:

Coordinates: 473077.73 107812.56

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	Remarks and Test Results PID (ppm)	Installations
TOPSOIL: dark brownish black sandy gravelly SILT, with some roots and rootlets. Gravel is angular to subrounded fine to medium flint.												
Soft dark orangish brown silty gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [RIVER TERRACE DEPOSITS]		0.30		D	1	0.60	0.70					
Dense brown very silty sandy fine to coarse GRAVEL. Gravel is angular to subangular fine to coarse flint. [RIVER TERRACE DEPOSITS]		0.80		B	6	1.00	1.50					
				D	2	1.20	1.65	1.00	1.2	N=33 (2,8/11,10,7,5)		
Firm dark orangish brown sandy gravelly CLAY. Gravel is angular to subangular fine to coarse flint. [RIVER TERRACE DEPOSITS]		1.50		D	4	1.70	1.80					
Stiff brown mottled grey silty CLAY. [LONDON CLAY FORMATION]		1.70		D	3	2.00	2.45	2.00	1.9	N=18 (1,2/3,5,5,5)		
From 2.50mbgl very mottling less apparent.				D	7	2.80	3.00					
From 3.00mbgl medium gravel size pockets of orange brown.				D	5	3.00	3.45	2.00	Dry	N=13 (1,2/2,3,3,5)		
				D	8	4.00	4.45	2.00	Dry	N=18 (2,2/4,4,5,5)		
'Borehole continued..'												

Drive Records

Diameter	To (m)	Sample Recovery
102	2.00	100%
87	3.00	100%
75	4.00	100%
65	5.00	100%
55	6.00	100%

Water Level Observations

Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
27-10-2015	0.80	0.50	0.00	20	2.00

Dates: Start: 27/10/2015 End: 27/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 0.80mbgl due to difficulty excavating with hand tools 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS4

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:
Coordinates: 473077.73
107812.56

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
From 4.00mbgl very stiff.				D	10	4.50	4.60					
				D	9	5.00	5.45	2.00	Dry	N=18 (2,2/4,4,5,5)		
Very stiff dark greyish brown silty CLAY. [LONDON CLAY FORMATION]		5.30		D	11	5.70	5.90					
				D	12	6.00	6.45	2.00	Dry	N=20 (3,3/4,5,6,5)		
Borehole completed at 6.450m		6.45										

Drive Records

Diameter	To (m)	Sample Recovery
102	2.00	100%
87	3.00	100%
75	4.00	100%
65	5.00	100%
55	6.00	100%

Water Level Observations

Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
27-10-2015	0.80	0.50	0.00	20	2.00

Dates: Start: 27/10/2015 End: 27/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 0.80mbgl due to difficulty excavating with hand tools 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS5

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:

Coordinates: 473242.68 107740.61

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
TOPSOIL: dark brownish black sandy gravelly SILT, with some roots and rootlets. Gravel is angular to subrounded fine to medium flint.												
Dark greyish black fine to coarse SAND and GRAVEL. Gravel is subangular to subrounded fine to coarse flint. [HEAD DEPOSITS]		0.30										
Dense orangish brown very clayey sandy GRAVEL. Gravel is subangular to subrounded fine to coarse flint. with fine to medium gravel size pockets of cohesive gravelly clay. [HEAD DEPOSITS]		0.60										
				D	1	1.20	1.65	0.00	Dry	N=41 (9,8/10,12,10,9)		
				B	4	1.60	2.00					
From 2.00mbgl loose. Band of gravelly clay between 2m and 2.30mbgl.				D	2	2.00	2.45	0.00	Dry	N=23 (4,4/3,4,8,8)		
				D	6	2.10	2.30					
				B	7	2.50	3.00					
From 3.00mbgl medium dense				D	3	3.00	3.45	0.00	Dry	N=29 (1,6/5,10,7,7)		
Stiff orangish brown gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint. [HEAD DEPOSITS]		3.50										
Medium dense orangish brown clayey GRAVEL. Gravel is subangular to subrounded fine to		3.80		D	8	3.60	3.70					
				D	5	4.00	4.45	0.00	Dry	N=20 (2,3/4,5,5,6)		

'Borehole continued..'

Drive Records

Diameter	To (m)	Sample Recovery
102	2.00	100%
87	3.00	100%
65	4.00	100%

Water Level Observations

Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)

Dates: Start: 28/10/2015 End: 28/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 1.20mbgl 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS5

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:

Coordinates: 473242.68 107740.61

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	Remarks and Test Results PID (ppm)	Installations
coarse flint. (Exhibits cohesion). [HEAD DEPOSITS]												
Borehole completed at 4.450m		4.45										

Drive Records		
Diameter	To (m)	Sample Recovery
102	2.00	100%
87	3.00	100%
65	4.00	100%

Water Level Observations					
Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)

Dates: Start: 28/10/2015 End: 28/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 1.20mbgl 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS6

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:
Coordinates: 473086.08
107734.24

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
TOPSOIL: dark brownish black sandy gravelly SILT, with some roots and rootlets. Gravel is angular to subrounded fine to medium flint.												
Dark greyish brown mottled orangish brown very clayey slightly gravelly fine to medium SAND. Gravel is angular to subangular fine to medium flint. Medium gravel size pockets of clay. [HEAD DEPOSITS]		0.25		B	1	0.30	0.80					
From 0.70mbgl very clayey.				D	3	0.70	0.80					
From 0.80mbgl bed of gravel.												
Firm orangish brown mottled grey silty gravelly CLAY. Gravel is angular to subangular fine to medium flint. [HEAD DEPOSITS]		1.00		D	2	1.20	1.65	0.00	Dry	N=11 (5,3/2,2,3,4)		
From 1.30m to 1.50mbgl bed of fine to medium sub-angular to angular flint gravel.				D	6	1.50	1.60					
				D	4	2.00	2.45	0.00	Dry	N=16 (1,1/5,4,4,3)		
Firm dark orangish brown silty gravelly CLAY, with some semi decayed root channels (2mm wide). Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		2.60										
Stiff dark brown silty CLAY. With rare fine flint gravel and black organic specks. [HEAD DEPOSITS]		3.00		D	5	3.00	3.45	0.00	Dry	N=15 (1,1/3,4,4,4)		
				D	8	3.50	3.60					
				D	7	4.00	4.45	0.00	Dry	N=23 (1,2/3,5,6,9)		
'Borehole continued..'												

Drive Records

Diameter	To (m)	Sample Recovery
117	2.00	100%
102	3.00	100%
75	4.00	100%
65	5.00	100%
55	6.00	100%

Water Level Observations

Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
27-10-2015	4.80	4.80	0.00	20	

Dates: Start: 27/10/2015 End: 27/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 0.80mbgl due to difficulty excavating with hand tools 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS6

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:
Coordinates: 473086.08
107734.24

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
From 4.10mbgl becoming sandier.												
Medium dense dark yellowish brown very silty fine to medium SAND. [HEAD DEPOSITS]		4.30		B	11	4.30	5.00					
				D	9	5.00	5.45	4.80	4.8	N=30 (2,6/7,7,7,9)		
				D	10	6.00	6.45	0.00	4.8	N=12 (1,1/2,3,3,4)		
Borehole completed at 6.450m		6.45										

Drive Records		
Diameter	To (m)	Sample Recovery
117	2.00	100%
102	3.00	100%
75	4.00	100%
65	5.00	100%
55	6.00	100%

Water Level Observations					
Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
27-10-2015	4.80	4.80	0.00	20	

Dates: Start: 27/10/2015 End: 27/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 0.80mbgl due to difficulty excavating with hand tools 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS7

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:

Coordinates: 473218.25 107679.54

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	SPT/CPT Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
TOPSOIL: dark brownish black sandy gravelly SILT, with some roots and rootlets. Gravel is angular to subrounded fine to medium flint.												
		0.30										
Firm dark orangish brown silty sandy CLAY. [HEAD DEPOSITS]												
From 0.80mbgl gravelly clay.												
From 1.20mbgl firm silty clay.				D	1	1.20	1.65	0.00	Dry	N=10 (1,1/3,2,2,3)		
				D	2	1.60	1.70					
From 2.00mbgl stiff.				D	3	2.00	2.45	0.00	Dry	N=15 (2,1/3,3,4,5)		
From 2.50mbgl very stiff with rare fine gravel of flint / possible shell fragments.				D	4	3.00	3.45	0.00	Dry	N=33 (1,3/3,7,11,12)		
		3.40		B	6	3.40	4.00					
Dense orangish brown very clayey sandy fine to coarse GRAVEL. Gravel is angular to subangular fine to coarse flint. (Exhibits cohesion) [HEAD DEPOSITS]				D	5	4.00	4.45	0.00	Dry	N=37 (4,8/10,7,9,11)		
'Borehole continued..'												

Drive Records		
Diameter	To (m)	Sample Recovery
102	2.00	100%
87	3.00	100%
76	4.00	100%
65	5.00	100%
55	6.00	100%

Water Level Observations					
Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
28-10-2015	6.00	6.00	0.00	20	

Dates: Start: 27/10/2015 End: 28/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 1.20mbgl 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.

GROUND TECHNOLOGY
Maple Road, Kings Lynn
Norfolk, PE34 3AF
(01553) 817657

Window Sample Record

WS7

Project: Chidden Farms, Havant

Project ID: GTS-15-719

Client: Bidwells LLP

Engineer: N/a

Ground Level:

Coordinates: 473218.25 107679.54

Description	Legend	Depth (m)	O.D. Level (m)	Sample Test Type	Ref	Depth Top (m)	Depth Base (m)	SPT/CPT Casing Depth	Water Depth	Remarks and Test Results SPT/HV/PP	PID (ppm)	Installations
Dense orangish brown slightly clayey sandy fine to coarse GRAVEL. Gravel is angular to subangular fine to coarse flint. [HEAD DEPOSITS]		4.60		B	7	4.60	5.00					
Medium dense orangish brown very clayey sandy fine to coarse GRAVEL. [HEAD DEPOSITS]		5.00		D	8	5.00	5.45	0.00	Dry	N=22 (6,6/6,6,5,5)		
				D	9	6.00	6.45	0.00	Dry	N=16 (3,6/5,3,4,4)		
Borehole completed at 6.450m		6.45										

Drive Records		
Diameter	To (m)	Sample Recovery
102	2.00	100%
87	3.00	100%
76	4.00	100%
65	5.00	100%
55	6.00	100%

Water Level Observations					
Date	Water Strike (m)	Standing Level (m)	Depth Casing (m)	Standing Time (mins)	Depth Sealed (m)
28-10-2015	6.00	6.00	0.00	20	

Dates: Start: 27/10/2015 End: 28/10/2015

Plant: Dando Terrier

Drilled By: Andrew Elshof

Logged By: G. Day

Checked By: P. Lewin

Remarks:

1. Inspection pit hand dug from ground level to 1.20mbgl 2. Exploratory hole terminated after reaching completion depth. 3. Exploratory hole backfilled with arisings upon completion.



GTS-15-719

Chidden Farms

Bartons Road

Havant,

Hampshire

PO9 5NA

Appendix D

Geotechnical Laboratory Test Results

Ground Technology Services

2788

Laboratory Report

GEO Site & Testing Services Ltd

Contract Number: 29020

Client's Reference: **GTS-15-719 PO GTS 4162**

Report Date: **01-12-2015**

Client **Ground Technology Services**
Maple Road
Kings Lynn
Norfolk
PE34 3AF

Contract Title: **Chidden Farms**

For the attention of: **Mail**

Date Received: **12-11-2015**
Date Commenced: **12-11-2015**
Date Completed: **01-12-2015**

Test Description	Qty
Moisture Content 1377 : 1990 Part 2 : 3.2 - * UKAS	6
4 Point Liquid & Plastic Limit (LL/PL) 1377 : 1990 Part 2 : 4.3 & 5.3 - * UKAS	6
PSD Wet Sieve method 1377 : 1990 Part 2 : 9.2 - * UKAS	3
Disposal of Samples on Project	1

Notes: Observations and Interpretations are outside the UKAS Accreditation
*** - denotes test included in laboratory scope of accreditation**
- denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Approved Signatories:
Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Vaughan Edwards (Managing Director)

GEO Site & Testing Services Ltd
Unit 4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@geo.uk.com geo.uk.com

Client ref: GTS-15-719

Location: Chidden Farms

Contract Number: 29020-121115

Hole Number	Sample Number	Type	Depth (m)	Description of Sample*
WS3	5	D	1.80 - 2.00	Orangy brown gravelly fine to coarse silty CLAY.
WS4	4	D	1.70 - 1.80	Orangy brown silty CLAY.
WS4	7	D	2.80 - 3.00	Orangy brown silty CLAY.
WS5	6	D	2.10 - 2.30	Orangy brown gravelly fine to coarse silty CLAY.
WS5	8	D	3.60 - 3.70	Orangy brown gravelly fine to coarse silty CLAY.
WS7	2	D	1.60 - 1.70	Orangy brown silty CLAY.

Note: Results on this table are in summary format and may not meet the requirements of the relevant standards, additional information is held by the laboratory

GSTL
GEO SITE & TESTING SERVICES LTD

For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Williams (Office Manager)

Date: 1.12.15

[redacted]

UKAS TESTING
2788

Test Report: **Method of the Determination of the plastic limit and plasticity index**
BS 1377 : Part 2 : 1990 Method 5

Client ref: **GTS-15-719**

Location: **Chidden Farms**

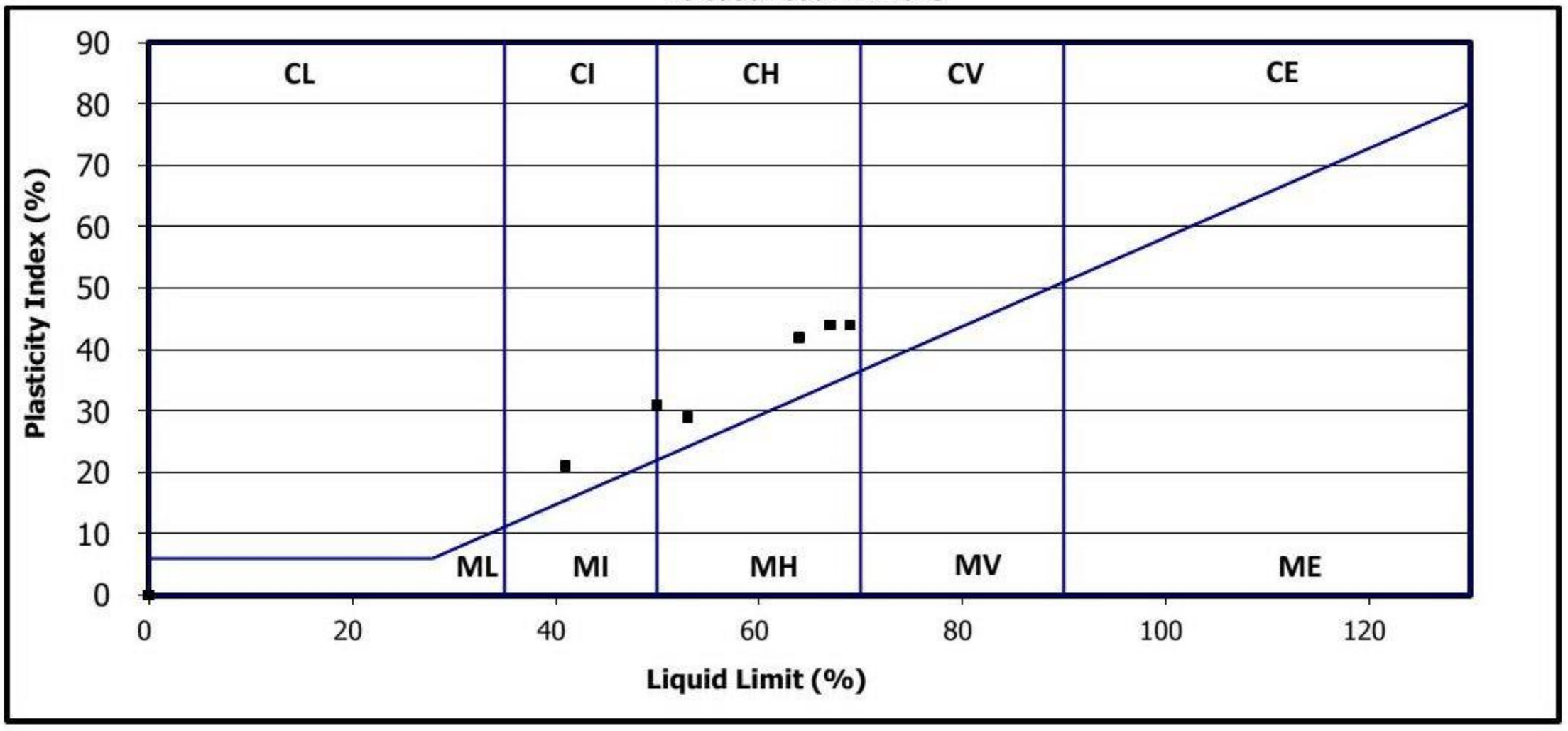
Contract Number: **29020-121115**

Hole/ Sample Number	Sample Type	Depth m	Moisture Content % Cl. 3.2	Liquid Limit % Cl. 4.3/4.4	Plastic Limit % Cl. 5.	Plasticity Index % Cl. 6.	% Passing .425mm	Remarks
WS3/5	D	1.80 - 2.00	15	50	19	31	68	CI/H Inter/High Plasticity
WS4/4	D	1.70 - 1.80	27	67	23	44	100	CH High Plasticity
WS4/7	D	2.80 - 3.00	28	69	25	44	100	CH High Plasticity
WS5/6	D	2.10 - 2.30	19	53	24	29	64	CH High Plasticity
WS5/8	D	3.60 - 3.70	30	64	22	42	64	CH High Plasticity
WS7/2	D	1.60 - 1.70	23	41	20	21	100	CI Intermediate Plasticity

Symbols: **NP : Non Plastic** **# : Liquid Limit and Plastic Limit Wet Sieved**

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

BS 5930:1999+A2:2010



GSTL
GEO SITE & TESTING SERVICES LTD

For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Sharp (Office Manager)
Date: 1.12.15

[redacted]

UKAS TESTING
2788

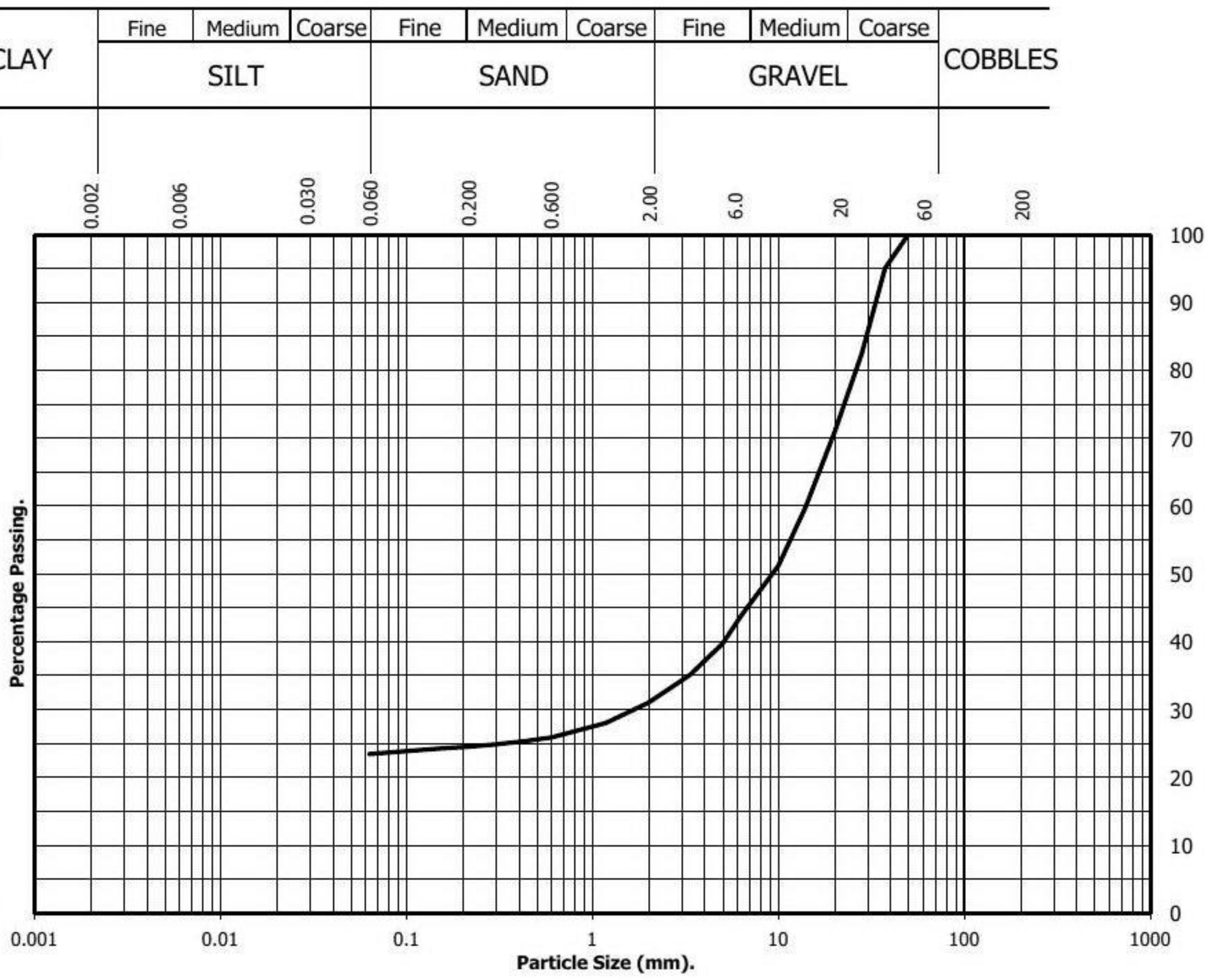
Test Report:

Particle Size Distribution Test
BS 1377 Part 2:1990.
Wet Sieve, Clause 9.2

Client ref:	**GTS-15-719**	**Sample Number:**	**4**
Contract Number:	**29020-121115**	**Depth from (m):**	**1.00**
Hole Number:	**WS3**	**Depth to (m):**	**1.70**
		Sample Type:	**B**

Location: **Chidden Farms**
Description: **Brown sandy silty clayey fine to coarse GRAVEL.**

BS Test Sieve	% Passing
125	100
90	100
75	100
63	100
50	100
37.5	95
28	82
20	71
14	60
10	51
6.3	44
5.0	40
3.35	35
2.00	31
1.18	28
0.60	26
0.425	25
0.300	25
0.212	25
0.150	24
0.063	24



Particle Diameter	% Passing
0.02	#
0.006	#
0.002	#

	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	24	7	69	0	Total Percentage

Remarks:
#- not determined

For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Sharp (Office Manager)

Date: 1.12.15

[redacted]

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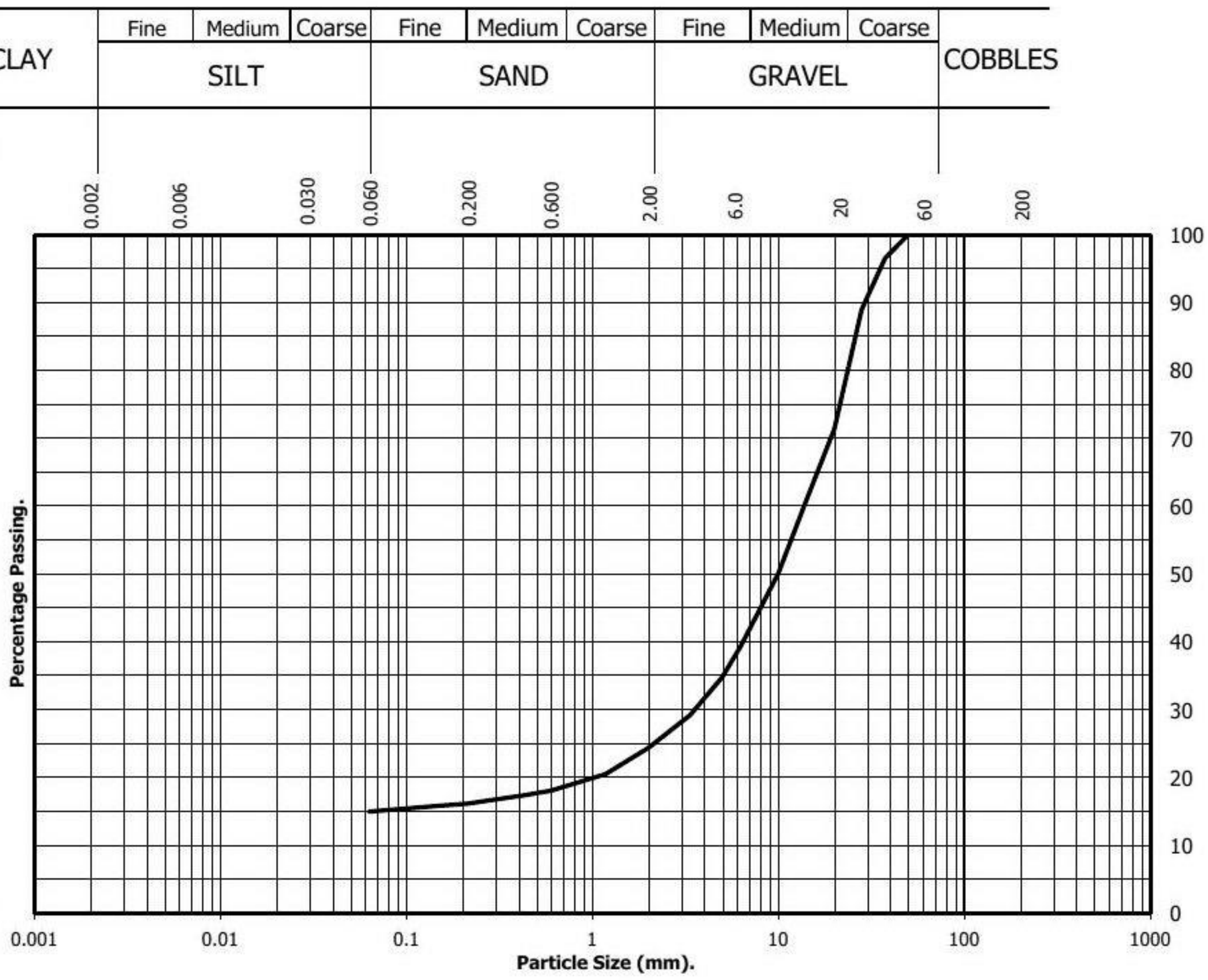
Test Report:

Particle Size Distribution Test
BS 1377 Part 2:1990.
Wet Sieve, Clause 9.2

Client ref:	**GTS-15-719**	**Sample Number:**	**6**
Contract Number:	**29020-121115**	**Depth from (m):**	**1.00**
Hole Number:	**WS4**	**Depth to (m):**	**1.50**
		Sample Type:	**B**

Location: **Chidden Farms**
Description: **Brown sandy silty clayey fine to coarse GRAVEL.**

BS Test Sieve	% Passing
125	100
90	100
75	100
63	100
50	100
37.5	97
28	89
20	71
14	61
10	50
6.3	40
5.0	35
3.35	29
2.00	24
1.18	21
0.60	18
0.425	17
0.300	17
0.212	16
0.150	16
0.063	15



Particle Diameter	% Passing
0.02	#
0.006	#
0.002	#

	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	15	9	76	0	Total Percentage

Remarks:
#- not determined

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Emma Sharp (Office Manager)

Date: 1.12.15

[redacted]

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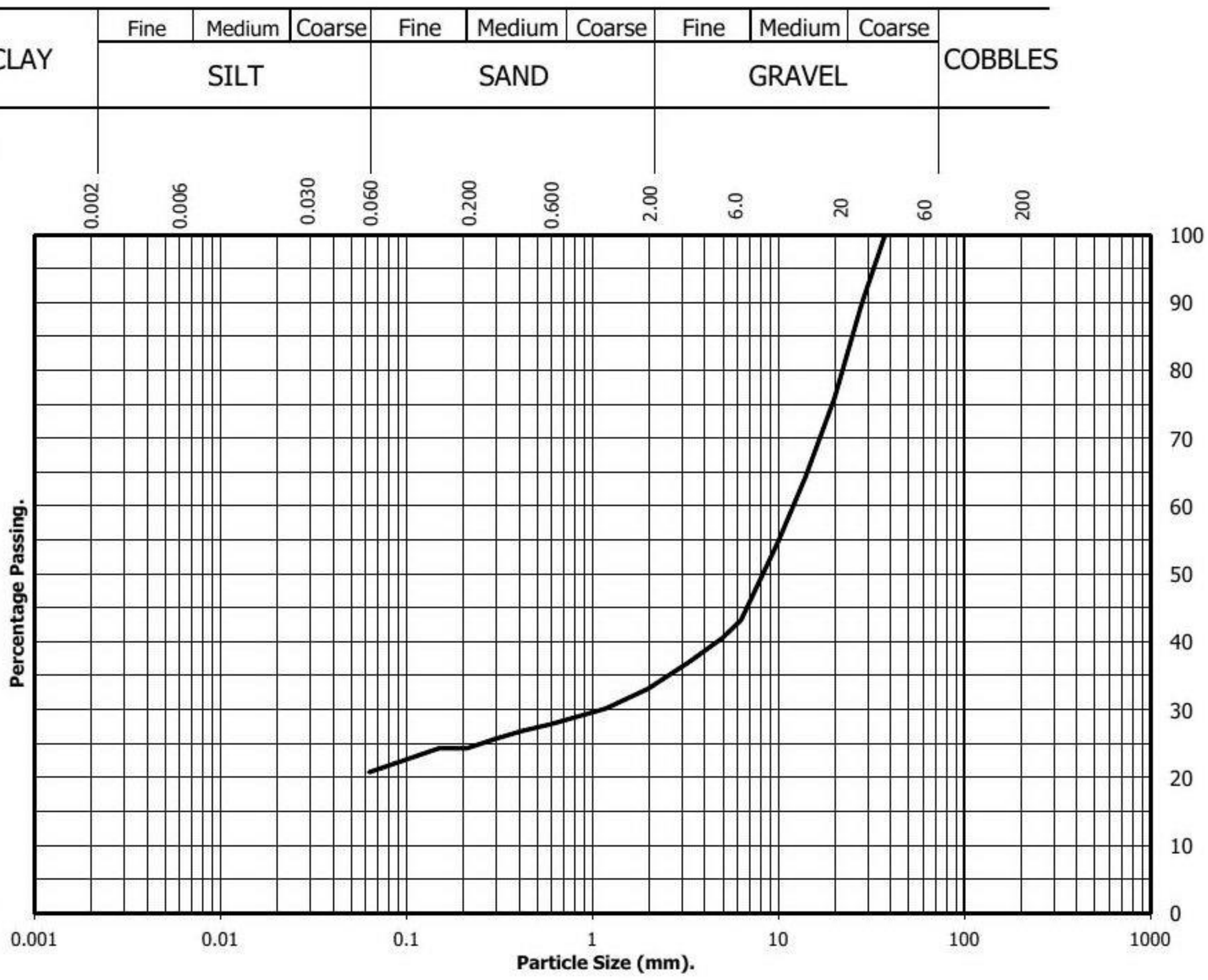
Test Report:

Particle Size Distribution Test
BS 1377 Part 2:1990.
Wet Sieve, Clause 9.2

Client ref:	**GTS-15-719**	**Sample Number:**	**4**
Contract Number:	**29020-121115**	**Depth from (m):**	**1.60**
Hole Number:	**WS5**	**Depth to (m):**	**2.00**
		Sample Type:	**B**

Location: **Chidden Farms**
Description: **Brown sandy silty clayey fine to coarse GRAVEL.**

BS Test Sieve	% Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	90
20	76
14	64
10	55
6.3	43
5.0	41
3.35	37
2.00	33
1.18	30
0.60	28
0.425	27
0.300	26
0.212	24
0.150	24
0.063	21



Particle Diameter	% Passing
0.02	#
0.006	#
0.002	#

	Silt and Clay	Sand	Gravel	Cobbles	Soil Fraction
	21	12	67	0	Total Percentage

Remarks:
#- not determined

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For and behalf of GEO Site & Testing Services Ltd

Authorised By:
Emma Sharp (Office Manager)

Date: 1.12.15

[redacted]

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Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

2183

Final Report

Report No.:	15-26236-1
Initial Date of Issue:	13-Nov-2015
Client	Ground Technology Services
Client Address:	Maple Road King's Lynn Norfolk PE34 3AF
Contact(s):	Paul Lewin
Project	GTS-15-719 Chidden Farms
Quotation No.:	
Order No.:	GTS 4161
No. of Samples:	3
Turnaround (Wkdays):	5
Date Approved:	13-Nov-2015
Approved By:	
Details:	Keith Jones, Technical Manager

Date Received:	09-Nov-2015
Date Instructed:	09-Nov-2015
Target Date:	13-Nov-2015
Results Due:	13-Nov-2015

Chemtest
The right chemistry to deliver results

Results - Soil

Project: GTS-15-719 Chidden Farms

Client: Ground Technology Services			Chemtest Job No.:		15-26236	15-26236	15-26236
Quotation No.:			Chemtest Sample ID.:		216407	216408	216409
Order No.: GTS 4161			Client Sample Ref.:		WS3	WS4	WS7
			Client Sample ID.:		D1	D2	D1
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		1.2	1.2	1.2
			Bottom Depth (m):		1.65	1.65	1.65
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Moisture	N	2030	%	0.020	13	12	16
Stones	N	2030	%	0.020	< 0.020	< 0.020	< 0.020
pH	U	2010		N/A	11.8	8.5	7.8
Magnesium (Water Soluble)	N	2120	g/l	0.010	< 0.010	< 0.010	< 0.010
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.070	0.032	< 0.010

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