

ROGERS GEOTECHNICAL SERVICES LTD

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REPORT ON A GEOTECHNICAL INVESTIGATION

at

BROOKFIELDS ROAD, WYKE.

for

MARAMAR PROPERTIES Ltd.

CONSULTANTS: PHILIP S. RYLEY & Co.

Report No J1664/10/E

August 2010

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1. SYNOPSIS

This investigation has demonstrated that a nominal thickness of topsoil overlies highly weathered coal measures. A coal seam outcrops across the site, thus careful inspection of foundation excavations, particularly in the eastern part of the site will be required. If coal is encountered then the excavation shall be continued though the seam and the use of trench fill footings should be adopted. In general terms, however, it is considered that shallow strip or spread footings could be adopted in this instance. The results of the monitoring suggest that there is a very low risk of harm due to the presence of landfill gas.

2. INTRODUCTION

It is understood that Maramar Properties Ltd plan to demolish the existing property and construct a combination of 9 semi-detached and detached properties with gardens and driveways. The drawings provided indicate that the properties are to be of traditional brick construction. Accordingly, a site investigation has been undertaken in order to determine the nature of the underlying soils and to assess their engineering properties, which is intended to assist in the design of safe and economical foundations for the proposed development.

This report presents the data obtained and discusses the ground conditions in relation to the proposed development.

3. LIMITATIONS

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

4. FIELDWORKS

The fieldworks were undertaken on the 25th February 2010 and included the following:

- Five trial pits
- Three soakaway tests
- Five windowless sample boreholes (three with gas monitoring standpipes).
- Five dynamic probes.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report. The major details of this drawing were obtained from a block plan provided by the Lynn Construction Ltd.

4.1 Machine Dug Trialpits

Five trialpits were excavated across the site area using a JCB 3CX back-acting excavator. The soils were logged on site in general accordance with BS5930: 1999, as amended in 2007, and full descriptions are given on the trialpit records which are presented in Appendix 2. Samples were taken from the trialpits for geotechnical testing.

4.2 Soakaway Tests

Soakaway tests were undertaken within TP1, 2 and 5. The soakage rates achieved were calculated based on the principles outlined within the BRE Digest 365 for trial pits and BS: 5930 code of practice for site investigations.

4.3 Windowless Sample Boreholes

Five boreholes were sunk using a drive-in windowless sampler and the cores were undertaken in 1m lengths, reducing in diameter from 90mm for the first 1m through 80mm, 70mm and 60mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 1999, as amended in 2007, and full descriptions are given on the window sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

4.4 Gas Monitoring Standpipes

Gas monitoring standpipes were installed to the full depth of WS1, 2 and 5 and the details of the installations are shown on the appropriate borehole records. In all cases, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to between 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal above and the installation was capped with a stop box cover in a concrete surround.

4.5 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to the windowless sample boreholes in accordance with the procedure given in BS1377: 1990: Part 9, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 3.

5. GEOLOGY

An examination of the 1: 50 000 scale Geological Survey map of the area¹ indicates that the site is underlain by un-named sandstones and mudstones of the Pennine Lower Coal Measures. The BGS Lexicon of named rock units describes the Pennine Lower Coal Measures lithologically as interbedded grey mudstone, siltstone and pale grey sandstone commonly with mudstones containing marine fossils in the lower part and more numerous and thicker coal seams in the upper part.

The Map further indicates that there is an outcropping north-south trending coal seam crossing the site, which is known as the Linfit Lousey Coal. The Shertcliffe Coal also outcrops a short distance to the west of the site trending in the same

¹ Sheet 77, solid and drift edition, Huddersfield.

direction. As the map shows that the Shertcliffe Coal underlies the Linfit Coal, it may be deduced that the strata are dipping towards the east.

A short distance to the south of the site there is a large area of in filled ground marked on the map, which is probably associated with former opencast or quarrying.

6. **STRATA CONDITIONS**

In accordance with the geology of the area, the succession has been shown to include the following:

Table 1: Generalised strata profile

Depth (m)	Strata type	Groundwater strikes (m)
0.2 – 0.35	Dark brown clayey TOPSOIL	none
+2.6m	Residual and destructured MUDSTONE and SANDSTONE	none

This profile is considered in more detail below.

6.1 **Topsoil**

Dark brown clayey topsoil with abundant root remains was revealed in all the trialpits and boreholes to depths varying from 0.2m and 0.35m.

6.2 **Residual and Destructured Mudstone and Sandstone**

On penetrating the topsoil, predominantly firm, becoming stiff or very stiff, friable brown silty sandy clay with sandstone and siltstone lithorelicts was proved to the full depth of TP2 and WS1, 2, 4 and 5. At the locations of TP1, 4 and 5, as well as WS3, very weak laminated brown flaggy fine grained sandstone with subordinate siltstone was then proved to the full depth of these investigatory locations. Within TP3 extremely and very weak laminated dark grey shaly mudstone was encountered beneath the stiff clay.

A 0.25m thick coal seam was noted immediately beneath the topsoil (0.35m depth) in WS1 and at 2.2m depth in WS5. It is considered that this represents the outcropping Linfit Lousey Coal, which is shown to cross this site. The approximate position of the outcrop is shown on the site plan

6.3 **Groundwater**

No groundwater strikes were encountered during the drilling operations however, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

7. INSITU TESTING

7.1 Dynamic Penetration Tests

Dynamic penetration tests were conducted adjacent to the windowless sample boreholes. These results demonstrated that generally low resistances to penetration between zero and 3 blows/100mm were revealed within the topsoil and upper levels of the residual coal measures mudstone, to depths of between 0.7m and 1.2m. From these depths the penetration resistance gradually increased to effective refusal², which was recorded at depths varying from 2.1m and 2.6m.

An anomaly to the above was noted at the location of DP5, where a thin coal seam was recorded at 2.2m depth. At this location variable resistances to penetration of between 0 and 5 blows/100mm were recorded to 2.3m depth (i.e. below the coal seam). From this depth the results gradually increased, with effective refusal being recorded at 3.6m below ground level.

7.2 Soakaway Tests

Three soakaway tests were conducted at this site and the results are presented in Appendix 4. These results illustrate that the soakage rate was very slow, and in all cases the test did not achieve 25% of the effective depth, thus the infiltration rate could not be determined. In order to obtain an approximate percolation rate the results of the test undertaken in TP1 have been extrapolated assuming a straight line plot. The results obtained from the soakaway tests are summarised below

Table 2: Soakaway Test Results

TP	TP Depth (m)	Soil Description (Base of TP)	Infiltration Rate (m/sec)	Drainage Characteristics
TP1	1.33	Flaggy fine grained sandstone with subordinate siltstone.	Low	Poor
TP1	1.33*	Flaggy fine grained sandstone with subordinate siltstone.	3.1×10^{-6}	Poor
TP2	0.93	Silty Clay with mudstone and sandstone lithorelicts	Very Low	Very Poor
TP5	2.35	Flaggy fine grained sandstone with subordinate siltstone.	Very Low	Very Poor

* Extrapolated result

7.3 Landfill Gas and Water Level Monitoring

The standpipes were monitored on the 28th August and the 14th September 2009. Further testing will be undertaken and the results will be issued under separate cover. The results of the gas monitoring undertaken to date are tabulated below.

² 25 blows/100mm

Table 3: Landfill gas monitoring

Borehole No	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow	Barometric Pressure (mb)	Water Level (m)	Borehole Depth (m)
WS1	09.08.10	0.1	1.1	19.2	0	990	-	2.0
	17.08.10	0.1	0.9	19.6	0	988	-	
	23.08.10	0.1	0.9	19.4	0	977	-	
	31.08.10	0.1	0.8	19.1	0	1005	-	
WS2	09.08.10	0.1	1.5	18.9	0	990	-	2.0
	17.08.10	0.1	1.3	19.4	0	988	-	
	23.08.10	0.1	1.3	19.4	0	977	-	
	31.08.10	0.1	1.5	18.8	0	1005	-	
WS5	09.08.10	0	0.5	19.9	0	990	1.44	3.0
	17.08.10	0.1	1.1	19.4	0	988	1.45	
	23.08.10	0.1	1.0	19.3	0	977	-	
	31.08.10	0.1	0.9	19.5	0	1005	-	

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA2000+ (serial No GA08272) which was last calibrated on the 4th June 2010.

8. **LABORATORY TESTING - GEOTECHNICAL**

A programme of laboratory testing has been undertaken in accordance with BS1377 unless stated otherwise and the results are presented in Appendix 5. Each type of test is briefly summarised below and the results have been used to assist in the formulation of the discussion of ground conditions.

8.1 **Moisture Content Determinations (Part 2 : 1990 : 3)**

Selected samples of the weathered fraction of the Coal Measures have been subject to moisture content determinations. These results illustrate that the natural water content of the generally varied between 9% and 37%, with a reduction in moisture content with depth being evident.

8.2 **Index Property Tests (Part 2 : 1990 : 4, 5 and 6.5)**

The liquid and plastic limits of the weathered Coal Measures were determined and the results yielded liquid limits in the range 32% to 63%, in association with plastic limits of 19% to 34%. These results demonstrate that the cohesive soils are variable in nature, being classified as clays/silts of low to high plasticity. The linear shrinkage tests conducted on samples of the fill indicated that these soils exhibit a relatively variable shrinkage potential.

On the basis of these results the NHBC classification³ indicates that at worst the highly weathered material possesses a medium volume change potential.

³ NHBC Standards, Chapter 4.2, *Building near trees*, Table 1 – Volume change potential

8.3 Sulphate Content and pH Values

Sulphate content and pH values of selected samples of soil were determined and the results are presented on the chemical test results sheet. Soluble sulphate contents of <0.01g/l were recorded, these being associated with pH values of 6.0 and 6.8.

9. DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL

It is understood that the site is to be developed by the demolition of the existing property and construct a combination of 9 semi-detached and detached properties with gardens and driveways. Whilst it is anticipated that the houses will be of traditional brick construction the precise foundation loads are not currently available, thus the discussion below is of a generalised nature.

It cannot be recommended that foundations be constructed within the topsoil or weak near surface soils revealed by this investigation. These soils are generally present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading.

9.1 Foundation Design

On penetrating the topsoil, highly weathered mudstone will be revealed, with a seam of weathered coal being encountered at depths of 0.35m and 2.2m in WS 1 and 5 respectively. It is presumed that this coal seam dips to the east, with the seam outcropping across the site (see site plan). In order to avoid the risk of combustion of the coal resulting in collapse of the structure it is generally considered that at least 1m cover of inert material to the coal seam is required. Therefore it is considered that traditional strip foundations beneath the structures in the western part of the site should not represent an issue. With regard to the buildings in the eastern part of the site it would appear that there will be sufficient cover to the seam to enable the use of shallow strip footings without modification. However, it is essential that the foundation excavations be carefully inspected and if coal is revealed it should be removed and replaced by lean-mixed concrete.

Bearing in mind the comments provided above, it is considered that strip foundations constructed within the weathered mudstone, at a minimum depth of say 1m, could be designed assuming an allowable increase in load given in the following table.

Table 4: Allowable increase in stress

Foundation type	Strip Footings			Spread Footings		
Foundation Breadth, B	0.6	1.0	1.5	1.0	2.0	3.0
Foundation Depth, D	3.0			3.0		
Allowable Increase in Stress kN/m ²	110	105	100	125	115	110

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 50kN/m^2 at the foundation depths. Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately final trimming has taken place. Should any soft or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil. In addition, if the excavations are required to stand open for any period of time then a blinding layer of lean-mix concrete should be placed in the excavation bases. This expedient will reduce softening or loosening of the sub-grade due to the ingress of surface water.

Should seepages of groundwater be encountered it is considered that they could be dealt with using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped.

The stability of the excavation faces cannot be guaranteed thus temporary support to the excavation faces may become necessary unless the foundations are constructed using trench-fill techniques. In this method the foundation trenches should be excavated, inspected and backfilled with concrete as a continuous operation. Under no circumstances should operatives be allowed to enter unsupported excavations.

9.2 Soakaway Design

The results of the soakaway tests indicate that the soakage rate of the underlying soils is very low. Therefore, it is considered that the use of soakaways to dispose surface water would not be appropriate in this instance.

9.3 Gas Monitoring

With respect to ground gas, the results of the monitoring visits indicated that there were low levels of methane present, these ranging from zero to 0.1%. Moreover, concentrations of carbon dioxide were noted to range between 0.5% and 1.5%, in association with oxygen levels of between 18.8% and 19.6%. It should be appreciated that on non contaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. In addition, the flow rate on all occasions was nil, although a machine flow detection limit of 0.1 litres per hour will be employed in any calculations.

The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure conditions may be of lesser value. At this site the readings undertaken to date were at atmospheric pressures ranging between 977mb and 1005mb.

In order to establish the gas screening value (GSV) for CO₂ or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case the maximum gas concentration of 0.1% (0.001) of methane and 1.5% (0.015) of CO₂ was recorded, in association with a flow detection limit of 0.1l/hr. This resulted in a GSV of 0.0016l/hr for methane and CO₂.

In accordance with Table 8.5, *Modified Wilson and Card classification* of the CIRIA report C665, *Assessing risks posed by ground gasses to building*, the site may be characterised as *Characteristic Situation Level 1*. Therefore, it may be concluded that there is a very low risk of harm to the end users. Consequently, in accordance with Table 8.6, *typical scope of gas protection measures*, no special precautions are required.

9.4 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C1⁴, which is provided in BRE Special Digest 1, *Concrete in aggressive ground: Part C*. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 requirements. Assuming static groundwater at this site, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1⁵, which can be found in Part D, *Specifying concrete for general cast-in-situ use*, of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 100 years the concrete design class DC-1 is required.

10. REFERENCES

- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes*, B.S.I., London.
Part 9: 1990: *In situ tests*.
- British Standards Institution (1999) BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Standards Institution (2007) BS5930: *Code of practice for site investigations, Amendment No 1*, B.S.I., London.

⁴ Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations*.

⁵ Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete*.

- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition:
Concrete in aggressive ground.
Part C: *Assessing the aggressive chemical environment.*
Part D: *Specifying concrete for general cast-in-situ use.*

For and on behalf of
Rogers Geotechnical Services Ltd,

S.P. Rogers CEng, CGeol, MICE, MCIHT, FGS
Technical Director

APPENDIX 1

SITE PLAN

the 1980s, the 1990s, and the 2000s. The 1980s were characterized by a focus on the environment, the 1990s by a focus on the economy, and the 2000s by a focus on the war in Iraq. The 1980s were also characterized by a focus on the environment, the 1990s by a focus on the economy, and the 2000s by a focus on the war in Iraq.

ADVERTISED PLAN
21 JUL 2000

Age	Age	Age	Age	Age
12.2	12.2	12.2	12.2	12.2
12.2	12.2	12.2	12.2	12.2

to Abolishing Socialism in
Soviet Russia.

BROOKFIELDS AVENUE

Building No. 2 to be demolished.
Approx 1889.0m² of site to be re-developed

Representative studies of controlled trials

Abstract

Proposed Site	Patient
	1-7000

ADDITION METHOD



PHILIP S.

RYLEY

CHARTERED BUILDING SURVEYORS
R. W.

BUCKLEY

PROPOSED DEVELOPMENT
AND OFF BROOKFIELDS ROAD
TYPE
BRADFORD

Study Subjects

PROPOSED SITE LAYOUT.

	Designated	Inputs	Outputs
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100

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APPENDIX 2

TRIALPIT AND WINDOW
SAMPLE BOREHOLE RECORDS

Project Name

Project No.

Co-ords: -

Date

Wyke

J1664/10/E

Level: -

29/07/2010

Location: Brookfields Avenue, Wyke

Dimensions: 1.60m

Scale

1:25

Client: Maramar Properties Ltd.

Depth

1.33m

0.65m

Logged By
RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.30			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)
0.50	D					Firm becoming very stiff slightly fissured friable brown silty sandy CLAY with occasional becoming many angular and subangular fine to coarse occasionally cobble sized lithorelicts of predominantly very fine grained micaceous sandstone occasionally siltstone. Fissures clean. Fissure surfaces dull. (RESIDUAL SANDSTONE/subordinate SILTSTONE (CLASS E))
0.80	D					
1.20	B		1.20			Very weak thinly and thickly laminated brown flaggy fine grained SANDSTONE/subordinate SILTSTONE recovered as clayey silty sandy angular and subangular fine to coarse gravel with many cobbles. (DESTRUCTURED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS D))
			1.33			Trialpit Complete at 1.33 m

Remarks:

Groundwater:

RGS

WWW.Rogersgeotech.co.uk

Trialpit No

TP 2

Sheet 1 of 1

Project Name
WykeProject No.
J1664/10/ECo-ords: -
Level: -Date
29/07/2010

Location: Brookfields Avenue, Wyke

Dimensions: 1.30m

Scale
1:25

Client: Maramar Properties Ltd.

Depth
0.93m

0.70m

Logged By
RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.30			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)	
0.40	D					Firm becoming stiff slightly fissured yellow-brown/grey mottled silty CLAY with occasional angular to subrounded fine to coarse lithorelicts of predominantly fine grained sandstone occasionally mudstone/siltstone. (RESIDUAL SANDSTONE/subordinate MUDSTONE/SILTSTONE (CLASS E))	
0.60	D						
			0.93				
Trialpit Complete at 0.93 m							1
							2
							3
							4

Remarks:

Groundwater:



Project Name
Wyke

Project No.
J1664/10/E

Co-ords: -
Level: -

Date
29/07/2010

Location: Brookfields Avenue, Wyke

Dimensions: 1.20m

Scale
1:25

Client: Maramar Properties Ltd.

Depth
2.30m

0.80m

Logged By
RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
0.40	D		0.30			Dark brown clayey TOPSOIL with abundant root remains retaining some strength and salt glazed clayware fragments. (MG)	
1.00	D					Firm becoming stiff slightly fissured yellow-brown/grey mottled silty CLAY with occasional angular to subrounded fine to coarse lithorelicts of predominantly fine grained sandstone occasionally mudstone/siltstone. (RESIDUAL SANDSTONE/subordinate MUDSTONE/SILTSTONE (CLASS E))	1
1.30	D						
			1.80			Extremely and very weak thinly and thickly laminated dark grey carbonaceous SHALY MUDSTONE with frequent thin and thick coal laminae recovered as clayey silty angular and subangular fine to coarse gravel with many cobbles. (DESTRUCTURED SHALY MUDSTONE (CLASS D))	2
2.20	C		2.30				
Trialpit Complete at 2.30 m							
							3
							4

Remarks:

Groundwater:



Project Name

Wyke

Project No.

J1664/10/E

Co-ords: -

Level: -

Date

29/07/2010

Location: Brookfields Avenue, Wyke

Dimensions: 2.20m

Scale

1:25

Client: Maramar Properties Ltd.

Depth

2.60m

0.70m

Logged By

RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.40	D		0.35			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)
			0.70			Firm to stiff slightly fissured yellow-brown/grey mottled silty CLAY with occasional angular to subrounded fine and medium lithorelicts of mudstone/siltstone/fine grained sandstone. Flecks of black carbonaceous material. (RESIDUAL MUDSTONE/SILTSTONE/SANDSTONE (CLASS E))
1.00	D		1.20			Firm to stiff friable dark grey-brown slightly sandy silty carbonaceous CLAY with frequent very narrow to very thin coal lenses and seams. Occasional angular to subrounded fine and medium lithorelicts of mudstone/siltstone/fine grained sandstone. (RESIDUAL MUDSTONE/SILTSTONE/SANDSTONE (CLASS E))
			2.50			
			2.60			Firm becoming very stiff slightly fissured friable brown silty sandy CLAY with occasional becoming many angular and subangular fine to coarse occasionally cobble sized lithorelicts of predominantly very fine grained sandstone occasionally siltstone. (RESIDUAL SANDSTONE/SILTSTONE (CLASS E))
						Very weak thinly and thickly laminated brown flaggy very fine grained SANDSTONE/subordinate SILTSTONE recovered as clayey silty sandy angular and subangular fine to coarse gravel with many cobbles. (DESTRUCTURED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS D))
						Trialpit Complete at 2.60 m

Remarks:

Groundwater:

Project Name

Project No.

Co-ords: -

Date

Wyke

J1664/10/E

Level: -

29/07/2010

Location: Brookfields Avenue, Wyke

Dimensions: 1.70m

Scale

1:25

Client: Maramar Properties Ltd.

Depth
2.35m

0.60m

Logged By
RB

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.30			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)
0.60	D					Firm becoming very stiff slightly fissured friable brown silty sandy CLAY with occasional becoming many angular to subrounded fine to coarse occasionally cobble sized lithorelicts of predominantly very fine grained sandstone occasionally siltstone. (RESIDUAL SANDSTONE/subordinate SILTSTONE (CLASS E))
1.20	D					
			2.00			Very weak thinly and thickly laminated brown flaggy fine grained SANDSTONE/subordinate SILTSTONE recovered as clayey silty sandy angular and subrounded fine to coarse gravel with many cobbles. (DESTRUCTURED INTERBEDDED SANDSTONE/subordinate SILTSTONE (CLASS D))
2.10	D		2.35			
						Trialpit Complete at 2.35 m

Remarks:

Groundwater:



Project Name

Wyke

Project No.

J1664/10/E

Co-ords: -

Hole Type

WLS

Location: Brookfields Avenue, Wyke

Level: -

Scale

1:25

Client: Maramar Properties Ltd.

Dates: 29/07/2010

Logged By

RB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.00-1.00	C		0.35			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)	
					0.55			Thin to medium seam of poorly, thinly and thickly laminated black COAL recovered as clayey silty angular and subangular fine and medium gravel.	
		1.00-2.00	C		1.40			Firm becoming stiff variably friable yellow-brown/grey mottled silty carbonaceous CLAY with occasional weakly cemented angular and subangular fine and medium lithorelicts of silty shaly mudstone. Frequent becoming occasional very narrow and narrow coal laminae. (RESIDUAL SHALY MUDSTONE (CLASS E))	
					2.00			Stiff becoming very stiff poorly, thinly and thickly laminated fissured friable brown silty CLAY with frequent angular and subangular fine to coarse lithorelicts of silty mudstone. Fissures predominantly clean. Fissure surfaces dull. Bedding planes display local occasionally pervasive slight discolouration. (DESTRUCTURED MUDSTONE (CLASS D))	
End of Borehole at 2.00 m									

Project Name

Wyke

Project No.

J1664/10/E

Co-ords: -

Hole Type

WLS

Location: Brookfields Avenue, Wyke

Level: -

Scale

1:25

Client:

Maramar Properties Ltd.

Dates: 29/07/2010

Logged By

RB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-1.00	C		0.20			Dark brown clayey TOPSOIL, with abundant root remains retaining some strength. (MG)
		1.00-2.00	C		2.00			Firm becoming very stiff poorly and thickly laminated slightly fissured friable brown locally grey mottled slightly sandy CLAY/SILT with occasional becoming many angular to subrounded fine to coarse lithorelicts of predominantly siltstone occasionally silty mudstone/very fine grained sandstone. Fissures generally infilled with up to 1mm grey clay/silt occasionally clean. Fissure surfaces dull. Bedding planes display local slight discolouration. (RESIDUAL INTERBEDDED SILTSTONE/subordinate MUDSTONE/SANDSTONE (CLASS E))
								End of Borehole at 2.00 m

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 2.0m = 100% Recovery

Project Name
Wyke

Project No.
J1664/10/E

Co-ords: -

Hole Type
WLS

Location: Brookfields Avenue, Wyke

Level: -

Scale
1:25

Client: Maramar Properties Ltd.

Dates: 29/07/2010

Logged By
RB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-1.00	C		0.35			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)
						1.00		
		1.00-2.00	C		1.90			Firm to stiff becoming very stiff poorly, thinly and thickly laminated friable yellow-brown slightly sandy silty CLAY/SILT with many weakly cemented fine to coarse lithorelicts of predominantly siltstone occasionally silty mudstone/very fine grained sandstone. Bedding planes display local slight discolouration. (RESIDUAL INTERBEDDED SILTSTONE/subordinate MUDDSTONE/SANDSTONE (CLASS E))
						2.00		
								End of Borehole at 2.00 m

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 2.0m = 100% Recovery

Project Name

Wyke

Project No.

J1664/10/E

Co-ords: -

Hole Type

WLS

Location: Brookfields Avenue, Wyke

Level: -

Scale

1:25

Client: Maramar Properties Ltd.

Dates: 29/07/2010

Logged By

RB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00-1.00	C		0.30			Dark brown clayey TOPSOIL with abundant root remains retaining some strength. (MG)
		1.00-2.00	C					Firm becoming stiff locally poorly, thinly and thickly laminated slightly fissured friable brown/grey and orange mottled slightly sandy CLAY/SILT with occasional becoming many weakly cemented angular to subrounded fine to coarse lithorelicts of silty mudstone/siltstone/very fine grained sandstone. Fissures generally infilled with up to 1mm grey clay/silt occasionally clean. Fissure surfaces dull. Bedding planes display local slight discolouration. (RESIDUAL INTERBEDDED MUDSTONE/SILTSTONE/SANDSTONE (CLASS E))
		2.00-2.30	C		2.30			
								End of Borehole at 2.30 m

Remarks: 0.0 - 1.0m = 100% Recovery 1.0 - 2.0m = 100% Recovery 2.0 - 2.3m = 100% Recovery

Logged By
RB



APPENDIX 3

DYNAMIC PROBE RESULTS

DYNAMIC PROBING

Probe No **DP01**

Client

Sheet 1 of 1

Site **Wyke**

Project No **J1664/10/E**

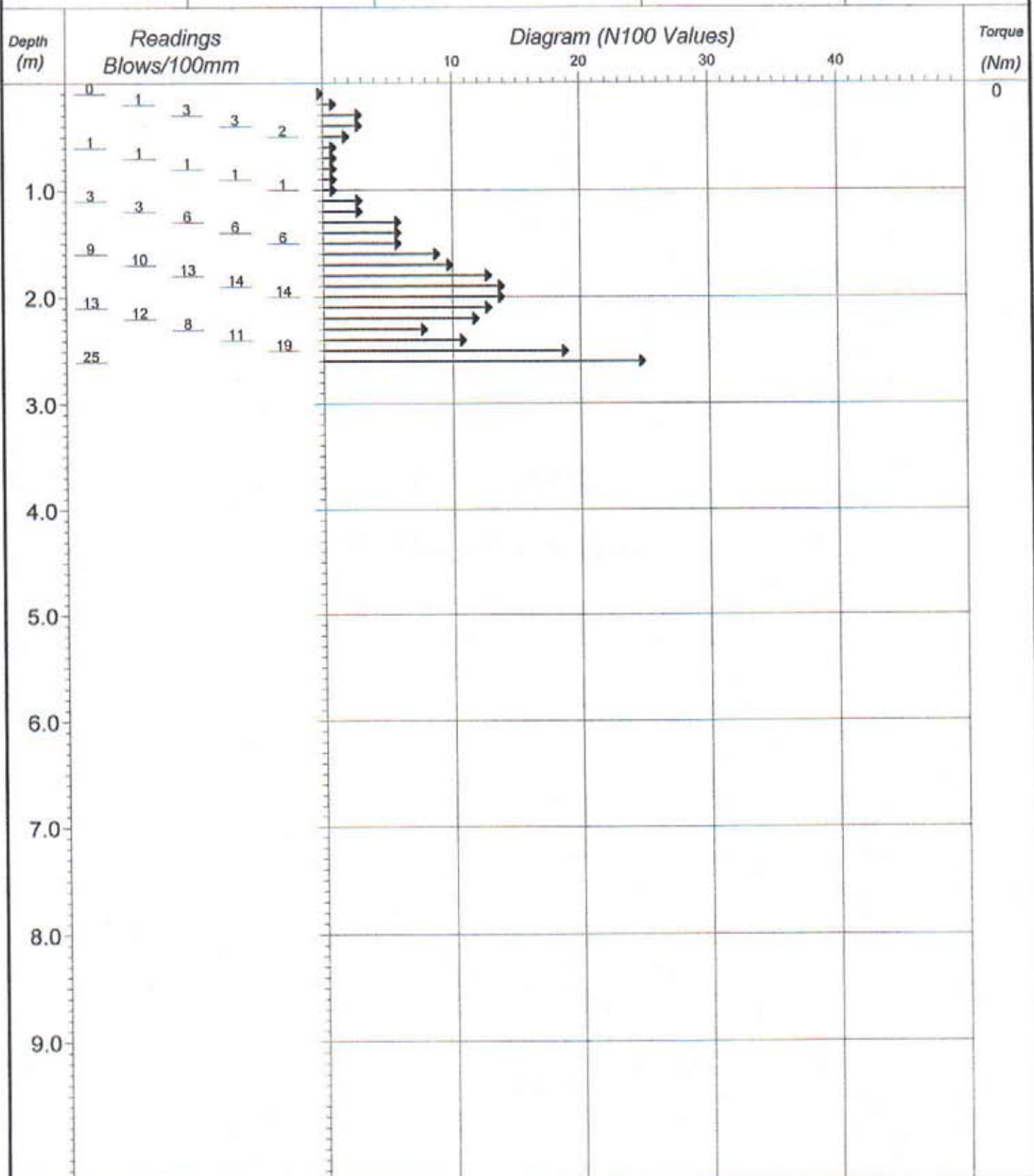
E -

N -

Level -

Date **29/07/2010**

Logged by **CR & SW**



WWW.Rogersgeotech.co.uk

Fall Height **750**

Cone Base Diameter **0**

Hammer Wt **63.50**

Final Depth **2.50**

Probe Type **DPSH**

Log Scale **1:50**

RGS



DYNAMIC PROBING

Probe No **DP02**

Client

Sheet 1 of 1

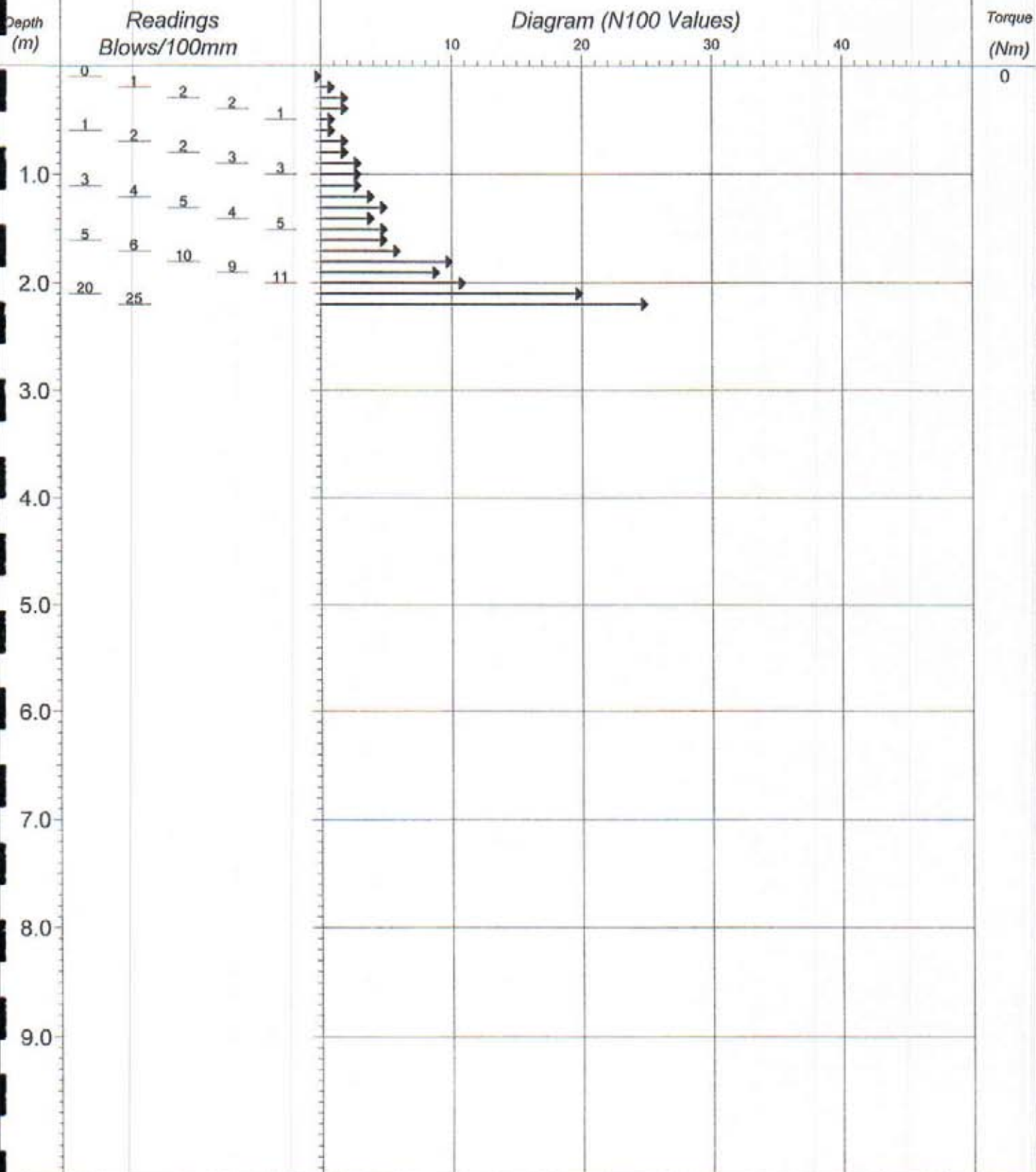
Site **Wyke**

Project No **J1664/10/E**

E - N - Level -

Date **29/07/2010**

Logged by **CR & SW**



WWW.Rogersgeotech.co.uk

Fall Height **750**

Cone Base Diameter **0**

Hammer Wt **63.50**

Final Depth **2.10**

Probe Type **DPSH**

Log Scale **1:50**

RGS



DYNAMIC PROBING

Probe No **DP03**

Client

Sheet 1 of 1

Site **Wyke**

Project No **J1664/10/E**

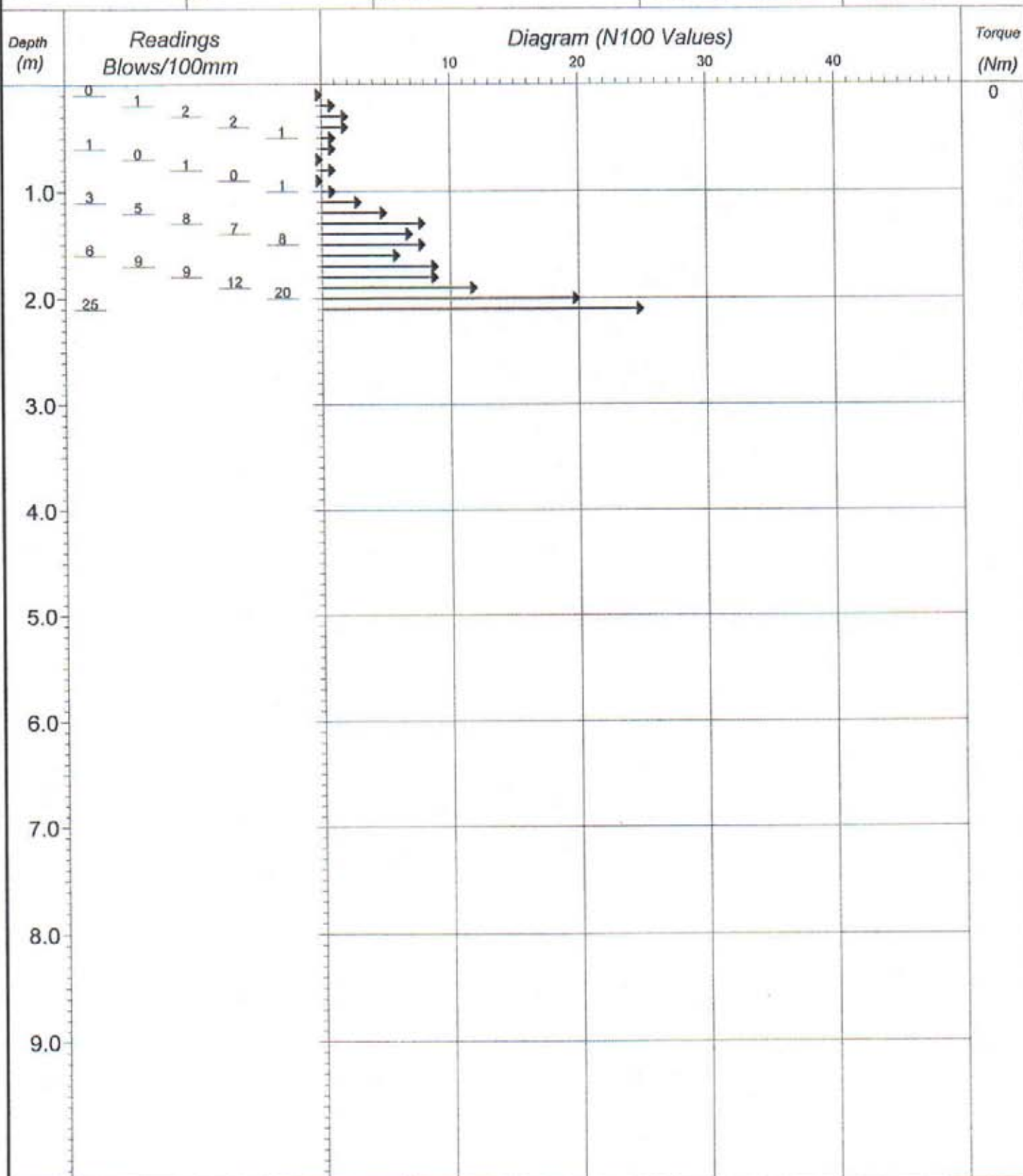
E -

N -

Level -

Date **29/07/2010**

Logged by **CR & SW**



www.rogersgaotech.co.uk

RGS

Fall Height

750

Cone Base Diameter 0

Hammer Wt

63.50

Final Depth

2.00

Probe Type

DPSH

Log Scale

1:50



DYNAMIC PROBING

Probe No **DP04**

Client

Sheet 1 of 1

Site **Wyke**

Project No **J1664/10/E**

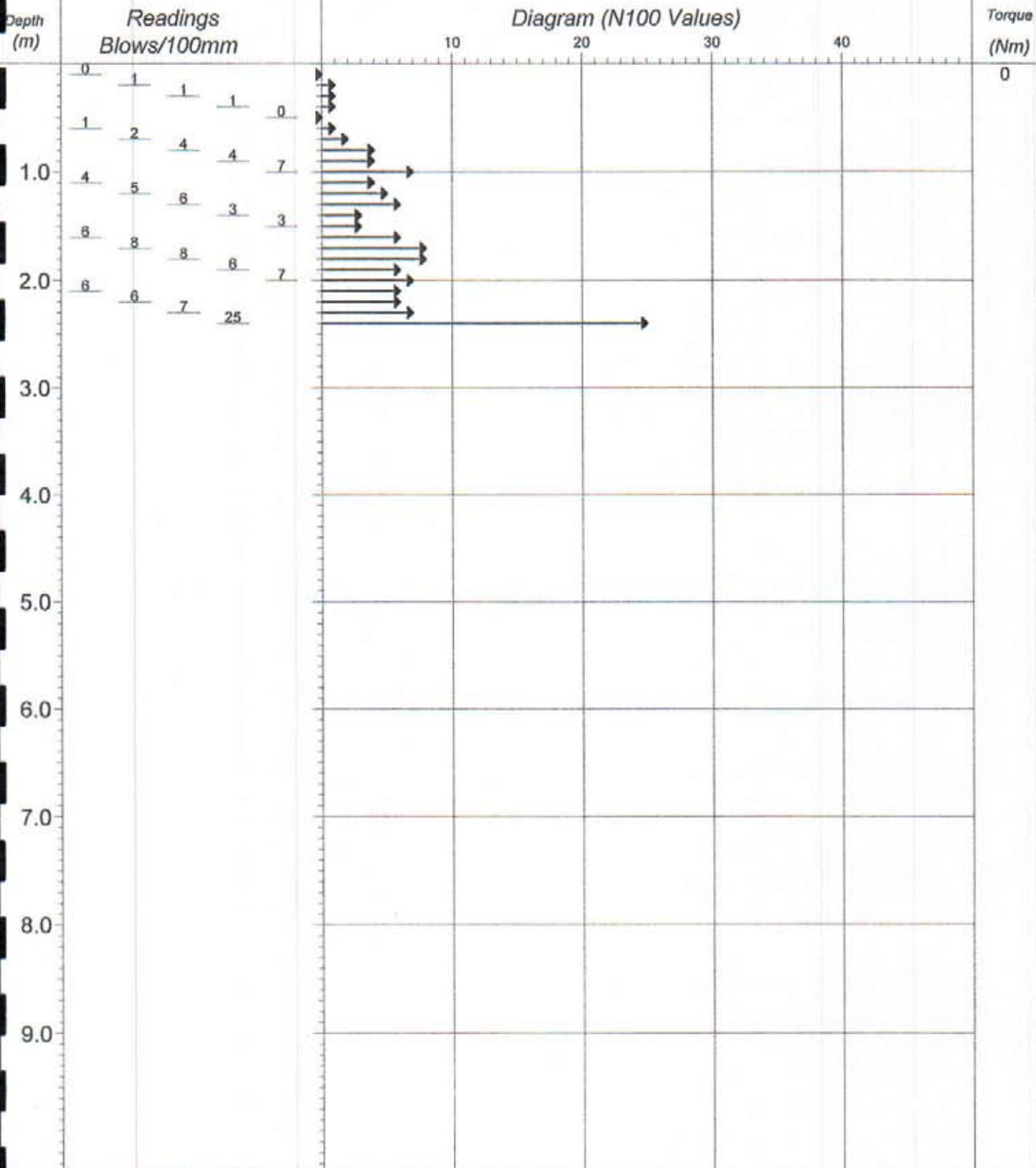
E -

N -

Level -

Date **29/07/2010**

Logged by **CR & SW**



WWW.Rogersgeotech.co.uk

Fall Height **750**

Cone Base Diameter **0**

Hammer Wt **63.50**

Final Depth **2.30**

Probe Type **DPSH**

Log Scale **1:50**

RGS

AGS

DYNAMIC PROBING

Probe No **DP05**

Client

Sheet 1 of 1

Site **Wyke**

Project No **J1664/10/E**

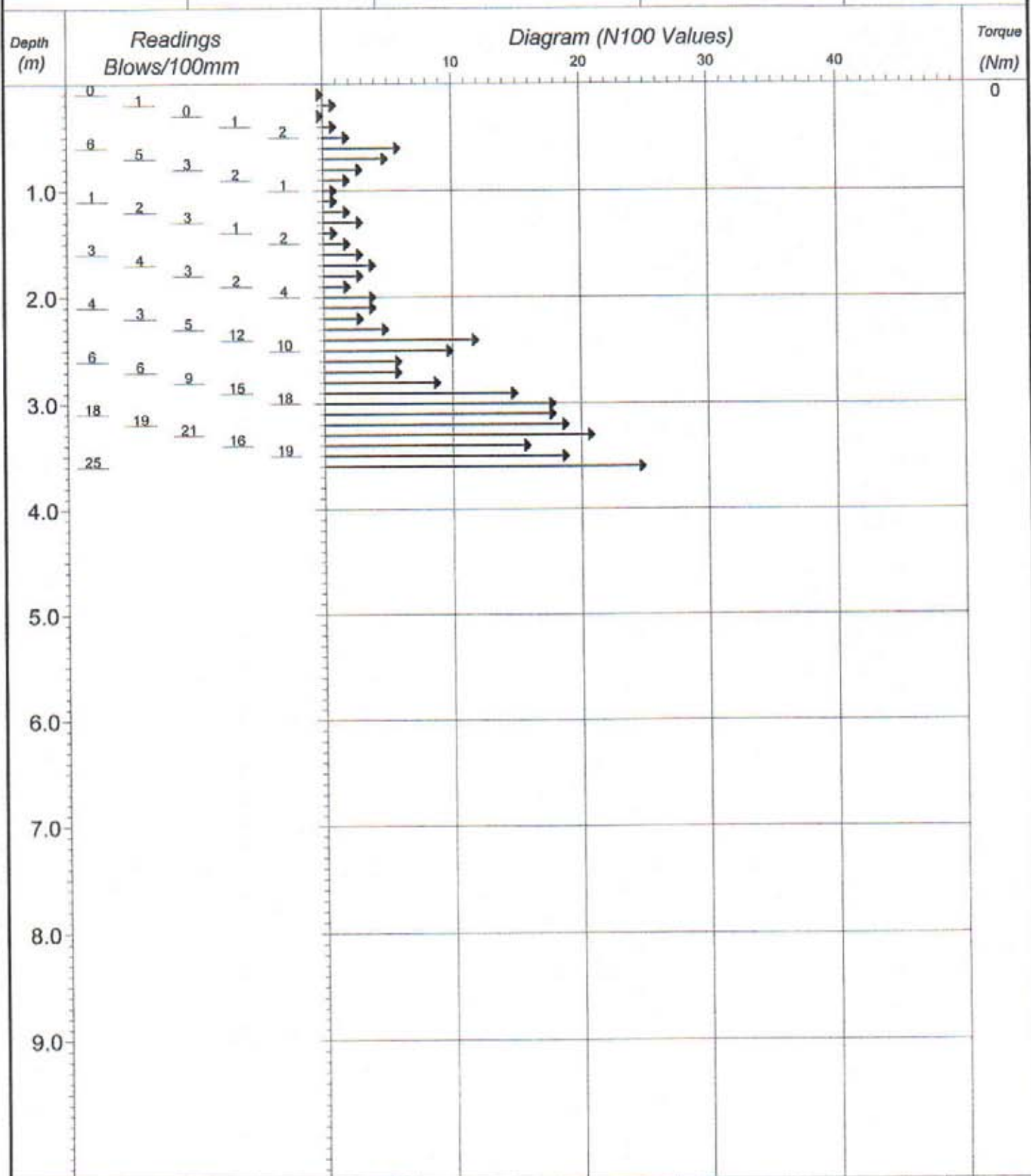
E -

N -

Level -

Date **29/07/2010**

Logged by **CR & SW**



WWW.Rogersgeotech.co.uk

RGS

Fall Height

750

Cone Base Diameter 0

Hammer Wt

63.50

Final Depth

3.50

Probe Type

DPSH

Log Scale

1:50



APPENDIX 4

SOAKAWAY RESULTS

Soakaway Test

RGS

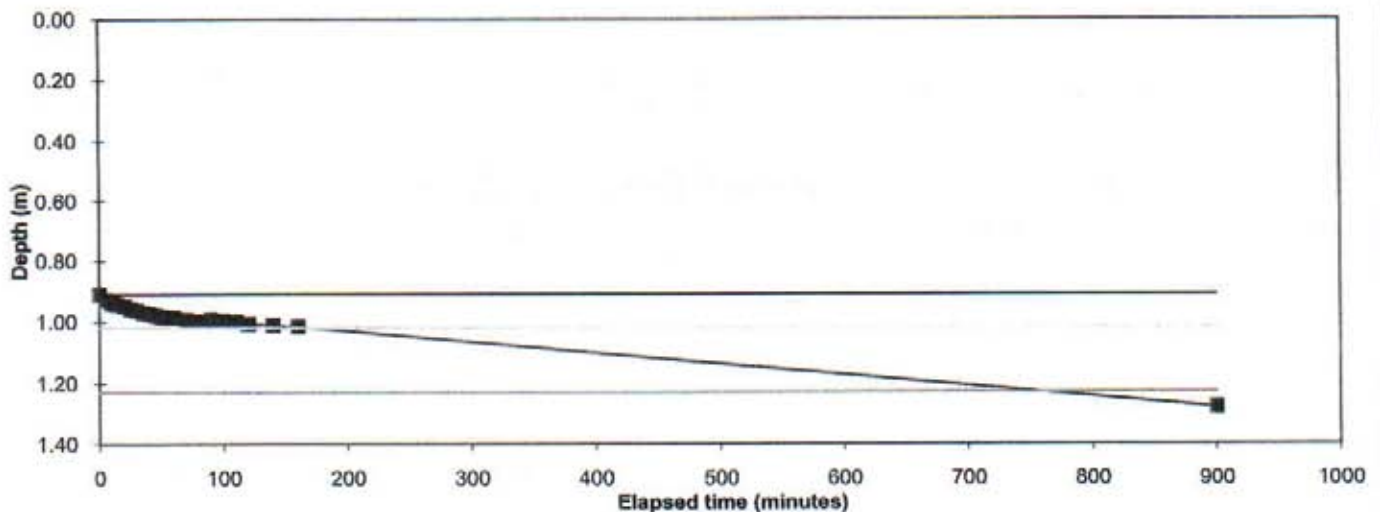


Trial Pit No: TP1
Length (m): 1.600
Width (m): 0.65
Depth (m): 1.33

Test No: 1
Datum height:
Granular infill: None
Porosity of infill: 1 (assumed)

Date: 29/07/2010
0.00 m agl

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.910	80	0.998
5	0.928	90	0.992
10	0.939	100	0.996
14	0.943	110	0.999
20	0.950	120	1.007
25	0.958	140	1.011
30	0.964	160	1.016
35	0.970	900	1.280
40	0.974		
45	0.978		
50	0.983		
55	0.985		
60	0.987		
70	0.993		



Start water depth for analysis (mbgl): 0.91
75% effective depth (mbgl): 1.02 Elapsed time (mins): 171.2
50% effective depth (mbgl): 1.12 Elapsed time (mins): 759.8
25% effective depth (mbgl): 1.23
Base of soakage zone (mbgl): 1.33

Volume outflow between 75% and 25% effective depth (m3): 0.218
Mean surface area of outflow (m²): 1.99
(side area at 50% effective depth + base area)
Time for outflow between 75% and 25% effective depth (mins): 588.6

Soil infiltration rate (m/s):

3.1E-6

Remarks Results processed following BRE 365 (2007).

Client: Maramar Properties Ltd
Site: Brookfields Avenue, Wyke

Figure
TP1
Sheet 1 of 1

Soakaway Test

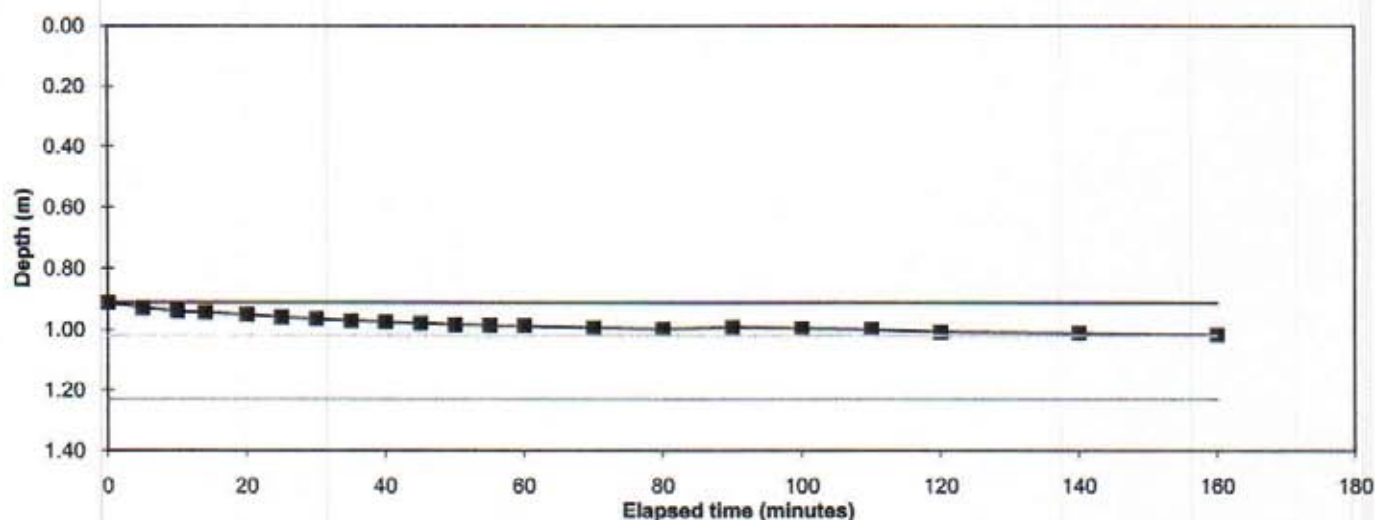
RGS



Trial Pit No: TP1
Length (m): 1.600
Width (m): 0.65
Depth (m): 1.33

Test No: 1
Datum height: 0.00 m agl
Granular infill: None
Porosity of infill: 1 (assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.910	80	0.998
5	0.928	90	0.992
10	0.939	100	0.996
14	0.943	110	0.999
20	0.950	120	1.007
25	0.958	140	1.011
30	0.964	160	1.016
35	0.970		
40	0.974		
45	0.978		
50	0.983		
55	0.985		
60	0.987		
70	0.993		



Start water depth for analysis (mbgl): 0.91
75% effective depth (mbgl): 1.02 Elapsed time (mins): #N/A
50% effective depth (mbgl): 1.12 Elapsed time (mins): #N/A
25% effective depth (mbgl): 1.23
Base of soakage zone (mbgl): 1.33

Volume outflow between 75% and 25% effective depth (m3):

Mean surface area of outflow (m²): 1.99

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):

Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate

Remarks Results processed following BRE 365 (2007).

Client:

Maramar Properties Ltd

Site:

Brookfields Avenue, Wyke

Figure

TP1

Sheet 1 of 1

Soakaway Test

RGS



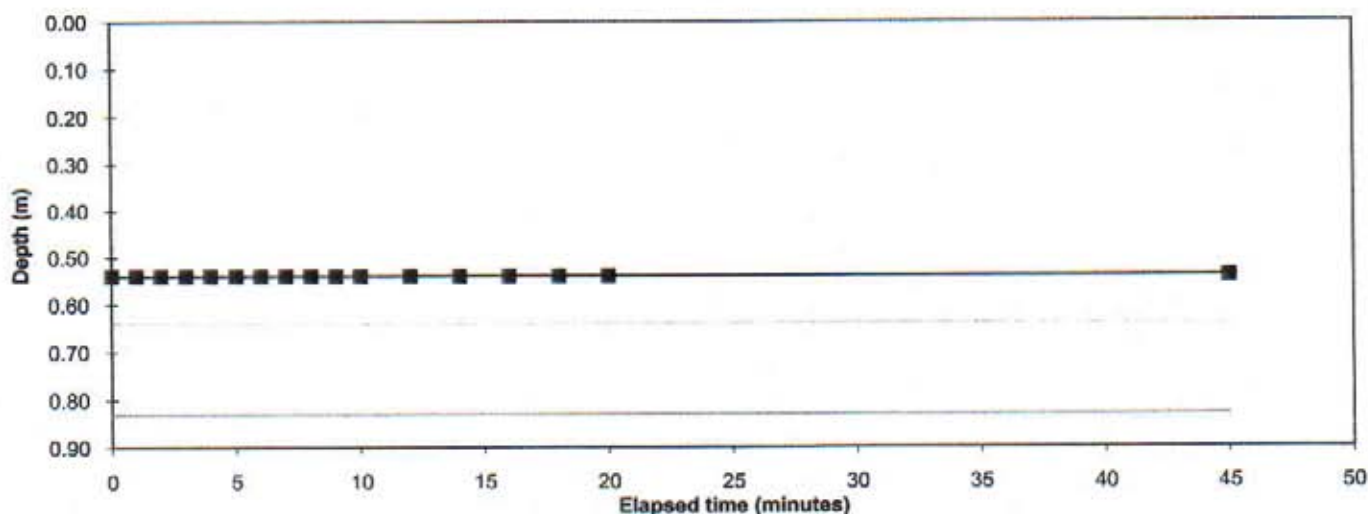
Trial Pit No: TP2
Length (m): 1.300
Width (m): 0.70
Depth (m): 0.93

Test No: 2

Datum height: 0.00 m agl
Granular infill: None
Porosity of infill: 1 (assumed)

Date: 29/07/2010

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.540	16	0.540
1	0.540	18	0.540
2	0.540	20	0.540
3	0.540		
4	0.540		
5	0.540		
6	0.540		
7	0.540		
8	0.540		
45	0.540		
9	0.540		
10	0.540		
12	0.540		
14	0.540		



Start water depth for analysis (mbgl): 0.54
75% effective depth (mbgl): 0.64
50% effective depth (mbgl): 0.74
25% effective depth (mbgl): 0.83
Base of soakage zone (mbgl): 0.93

Elapsed time (mins): #N/A

Elapsed time (mins): #N/A

Volume outflow between 75% and 25% effective depth (m3):

Mean surface area of outflow (m²):

1.67

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):

Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate

Remarks

Results processed following BRE 365 (2007).

Client:

Maramar Properties Ltd

Site:

Brookfields Avenue, Wyke

Figure

TP2

Sheet 1 of 1

Soakaway Test

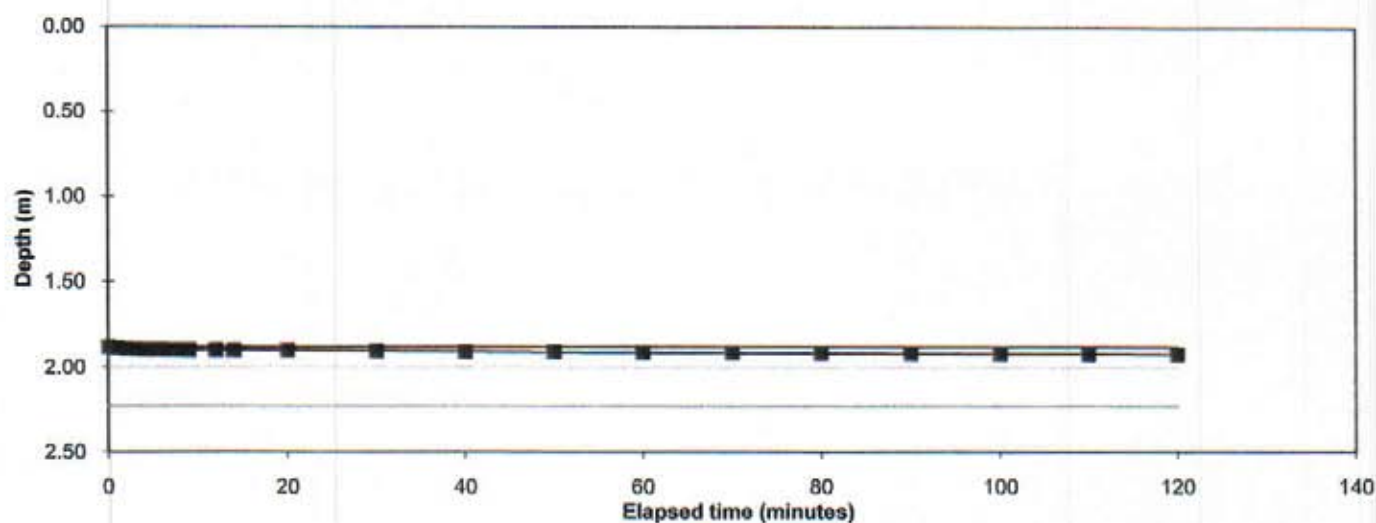
RGS



Trial Pit No: TP5
Length (m): 1.700
Width (m): 0.60
Depth (m): 2.35

Test No: 3
Datum height: 0.00 m agl
Granular infill: None
Porosity of infill: 1 (assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.880	40	1.907
1	1.885	50	1.910
2	1.890	60	1.913
3	1.892	70	1.915
4	1.894	80	1.916
5	1.895	90	1.919
6	1.895	100	1.921
7	1.896	110	1.922
8	1.896	120	1.924
9	1.897		
12	1.897		
14	1.898		
20	1.899		
30	1.903		



Start water depth for analysis (mbgl):	1.88		
75% effective depth (mbgl):	2.00	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	2.12		
25% effective depth (mbgl):	2.23	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	2.35		

Volume outflow between 75% and 25% effective depth (m3):

Mean surface area of outflow (m²): 2.08

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

Soil infiltration rate (m/s):

Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate

Remarks Results processed following BRE 365 (2007).

Client:
Site:

Maramar Properties Ltd
Brookfields Avenue, Wyke

Figure

TP5

Sheet 1 of 1

APPENDIX 5

LABORATORY TESTING – GEOTECHNICAL

Rogers Geotechnical Services Ltd.
MOISTURE CONTENT, LIQUID AND PLASTIC LIMITS
BS.1377 : Part 2 : 1990 : 3.2, 4 and 5

Client: Maramar Properties Ltd.
Site: Brookfields Avenue, Wyke.

Input by : RB **Chkd by :** RB

Date: 11.08.10 **Date:** 11.08.10

borehole/ trial pit no.	sample no.	sample depth (m)	natural moisture content (%)	sample prep.	test method	fraction >0.425mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	descriptions/remarks
WS 1		0.6	37	A	Y	0	63	29	34	Firm silty CLAY
WS 1		1.3	13							Stiff silty CLAY
WS 1		1.8	10							Very stiff silty gravelly CLAY
WS 2		0.4	20							Firm slightly sandy CLAY/SILT
WS 2		0.8	16							Stiff slightly sandy CLAY/SILT
WS 2		1.3	12	A	Y	25	35	19	16	Very stiff slightly sandy gravelly CLAY/SILT
WS 2		1.8	12							Very stiff slightly sandy gravelly CLAY/SILT
WS 3		0.4	28							Firm silty CLAY
WS 3		0.8	30	A	Y	0	59	25	34	Firm silty CLAY
WS 3		1.3	9							Very stiff slightly sandy gravelly CLAY/SILT
WS 3		1.8	11							Very stiff slightly sandy gravelly CLAY/SILT
remarks: moisture content undertaken in accordance with BS1377 : Part 2 : 1990 : 3.2 (unless specified)										
sample preparation :					test method (liquid limit)				CONTRACT	FIGURE
A - as received			D - oven dried (50°C)		X - cone penetrometer (test 4.3)				J1664/10/E	1
B - washed on 0.425mm sieve			E - not known		Y - one point cone penetrometer (test 4.4)					
C - air dried					Z - Casagrande apparatus (test 4.5)					

Rogers Geotechnical Services Ltd.
MOISTURE CONTENT, LIQUID AND PLASTIC LIMITS
BS.1377 : Part2 : 1990 : 3.2, 4 and 5

Client: Maramar Properties Ltd.
Site: Brookfields Avenue, Wyke.

Input by : RB **Chkd by :** RB

Date: 11.08.10 **Date:** 11.08.10

borehole/ trial pit no.	sample no.	sample depth (m)	natural moisture content (%)	sample prep.	test method	fraction >0.425mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	descriptions/remarks
WS 4		0.4	13							Stiff slightly sandy gravelly CLAY/SILT
WS 4		0.8	12							Stiff slightly sandy gravelly CLAY/SILT
WS 4		1.3	19							Stiff slightly sandy gravelly CLAY/SILT
WS 4		1.8	13	A	Y	10	32	19	13	Stiff slightly sandy gravelly CLAY/SILT
WS 4		2.3	13							Stiff slightly sandy gravelly CLAY/SILT
WS 5		0.4	30	A	Y	0	44	24	20	Firm silty CLAY
WS 5		0.8	22							Firm silty CLAY
WS 5		1.3	19	A	Y	0	51	21	30	Firm to stiff silty CLAY
WS 5		1.8	18							Firm to stiff silty CLAY
WS 5		2.6	11							Stiff silty gravelly CLAY
remarks: moisture content undertaken in accordance with BS1377 : Part 2 : 1990 : 3.2 (unless specified)										
sample preparation :					test method (liquid limit)				CONTRACT	FIGURE
A - as received					X - cone penetrometer (test 4.3)				J1664/10/E	2
B - washed on 0.425mm sieve					Y - one point cone penetrometer (test 4.4)					
C - air dried					Z - Casagrande apparatus (test 4.5)					
D - oven dried (50°C)										
E - not known										

Rogers Geotechnical Services Ltd.
LINEAR SHRINKAGE
BS.1377 : Part2 : 1990 : 6.5

Client: Maramar Properties Ltd.
Site: Brookfields Avenue, Wyke.

Input by : RB **Chkd by :** RB

Date: 11.08.10 **Date:** 11.08.10

borehole/ trial pit no.	sample no.	sample depth (m)	sample prep.	fraction >0.425mm (%)	linear shrinkage (%)	descriptions/remarks
WS 1		0.8	A	0	89	Firm silty CLAY
WS 2		1.3	A	25	92	Very stiff slightly sandy gravelly CLAY/SILT
WS 3		0.8	A	0	92	Firm silty CLAY
WS 4		1.8	A	10	94	Stiff slightly sandy gravelly CLAY/SILT
WS 5		0.4	A	0	89	Firm silty CLAY
WS 5		1.3	A	0	91	Firm to stiff silty CLAY
Remarks:						
Sample preparation: A - as received B - washed on 0.425mm sieve C - air dried D - oven dried (105°C) E - not known					CONTRACT J1664/10/E	FIGURE 3

Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Rogers Geotechnical Services Ltd
Unit 12, Emley Business Park
Leys Lane
Huddersfield
HD8 9QY

FAO Steve Rogers
23 August 2010

Dear Steve Rogers

Test Report Number 130364
Your Project Reference J1664/10/E - Brookfields Road, Wyke

Please find enclosed the results of analysis for the samples received 9 August 2010.

All soil samples will be retained for a period of one month and all water samples will be retained for 7 days following the date of the test report. Should you require an extended retention period then please detail your requirements in an email to customerservices@chemtest.co.uk. Please be aware that charges may be applicable for extended sample storage.

If you require any further assistance, please do not hesitate to contact the Customer Services team.

Yours sincerely

☐ Darrell Hall	Director
☐ Phil Hellier	Director
☒ Keith Jones	Technical Manager
☐ John Crawford	Quality Manager
☐ Malcolm Avis	Director

Authorised Signatory



Notes to accompany report:

- The sign < means 'less than'
- Tests marked 'U' hold UKAS accreditation
- Tests marked 'M' hold MCertS (and UKAS) accreditation
- Tests marked 'N' do not currently hold UKAS accreditation
- Tests marked 'S' were subcontracted to an approved laboratory
- n/e means 'not evaluated'
- i/s means 'insufficient sample'
- u/s means 'unsuitable sample'
- Comments or interpretations are beyond the scope of UKAS accreditation
- The results relate only to the items tested

Test Report 130364 Cover Sheet

Results of analysis of 2 samples
received 09 August 2010

J1664/10/E - Brookfields Road, Wyke

FAO Steve Rogers

Login Batch No

Chemtest LIMS ID

Sample ID

Sample No

Sampling Date

Depth

Matrix

SOP ↓ Determinand ↓

2120 Sulfate (2:1 water soluble) as SO₄

2010 pH

Units ↓

g l⁻¹

-

CAS No ↓

14808798

M

*

M

M

130364

AF19608 AF19609

WS2 WS4

06/08/2010 06/08/2010

0.4m 0.5m

SO/L SO/L

<0.01 <0.01

6.0 6.8

Project No.: 8444
Client: Buckley
Project: Proposed Development
Land Off Brookfields Road
Wyke, BRADFORD

FOUL & SURFACE DRAINAGE DESIGN

APPENDICES:

- A Foul water drainage calculation
- B Surface water drainage calculation
- C Determination of desired water volume of proposed storage tank
- D Surface water drainage - simulation

Designed by: Ing.Petr Hanus
Date: 21.09.2010

A Foul water drainage calculation

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke. BRADFORD

Date 21.09.2010

File 8444-FOUL DRAINAGE FINAL.MDD

Designed By PH

Checked By

Micro Drainage

DrawNet W.11.2



FOUL SEWERAGE DESIGN (Foul - Unit)

Global Variables

Size File C:\Program Files\Micro Drainage Ltd\WinDes\pipes & manholes\pipes\Plastic pipe HEPWORTH.F
ole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.M

Industrial Flow (l/s/ha)	1.00	Maximum Backdrop Height (m)	0.200
Industrial Peak Flow Factor	3.00	Min Cover Depth for Optimisation (m)	0.600
Calculation Method	EN 752	Min Vel for Auto Design Only (m/s)	0.75
Frequency Factor	0.50	Min Slope for Optimisation (1:X)	500
Domestic (l/s/ha)	0.00	Minimum Outfall Invert (m)	0.000
Domestic Peak Flow Factor	6.00	Ground Level at Outfall (m)	165.037
O'flow Setting (*Foul only)	0	Outfall Manhole Name	OF
Add Flow / Climate Change (%)	20	Outfall Manhole Dia/Length (mm)	225
Minimum Backdrop Height (m)	0.200	Outfall Manhole Width (mm)	0

Designed with Level Inverts

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
F1.000	9.38	0.481	19.5	0.000	13.3	0.0	1.500	o	110
F1.001	11.84	0.296	40.0	0.000	0.0	0.0	1.500	o	110
F2.000	11.70	0.777	15.1	0.000	13.3	0.0	1.500	o	110
F1.002	3.32	0.083	40.0	0.000	0.0	0.0	1.500	o	110
F3.000	12.34	1.460	8.5	0.000	13.3	0.0	1.500	o	110
F1.003	13.63	0.341	40.0	0.000	0.0	0.0	1.500	o	110
F4.000	15.11	2.244	6.7	0.000	13.3	0.0	1.500	o	110
F1.004	14.05	0.176	79.8	0.000	0.0	0.0	1.500	o	110

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Units	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
F1.000	167.040	0.000	0.0	13.3	0.4	28	1.14	1.61	15.3	2.2
F1.001	166.559	0.000	0.0	13.3	0.4	34	0.88	1.13	10.7	2.2
F2.000	167.040	0.000	0.0	13.3	0.4	27	1.24	1.84	17.5	2.2
F1.002	166.263	0.000	0.0	26.6	0.5	41	0.97	1.13	10.7	3.1
F3.000	167.640	0.000	0.0	13.3	0.4	23	1.52	2.45	23.3	2.2
F1.003	166.180	0.000	0.0	39.9	0.6	45	1.03	1.13	10.7	3.8
F4.000	168.083	0.000	0.0	13.3	0.4	22	1.65	2.75	26.1	2.2
F1.004	165.839	0.000	0.0	53.2	0.7	60	0.82	0.80	7.6	4.4

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke. BRADFORD

Date 21.09.2010

File 8444-FOUL DRAINAGE FINAL.MDD

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Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
F1.005	15.42	1.921	8.0	0.000	0.0	0.0	1.500	o	110
F5.000	11.46	2.860	4.0	0.000	3.9	0.0	1.500	o	110
F5.001	6.65	0.166	40.1	0.000	2.9	0.0	1.500	o	110
F6.000	1.45	0.393	3.7	0.000	3.9	0.0	1.500	o	110
F5.002	3.41	0.085	40.1	0.000	0.0	0.0	1.500	o	110
F7.000	10.90	3.111	3.5	0.000	3.9	0.0	1.500	o	110
F5.003	4.78	0.119	40.2	0.000	0.0	0.0	1.500	o	110
F8.000	1.02	0.493	2.1	0.000	6.8	0.0	1.500	o	110
F5.004	5.83	0.145	40.2	0.000	0.0	0.0	1.500	o	110
F9.000	13.28	3.400	3.9	0.000	3.9	0.0	1.500	o	110
F5.005	7.29	0.182	40.1	0.000	0.0	0.0	1.500	o	110
F5.006	3.82	0.614	6.2	0.000	6.8	0.0	1.500	o	110
F1.006	1.40	0.010	140.0	0.000	0.0	0.0	1.500	o	160

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Units	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
F1.005	164.000	0.000	0.0	53.2	0.7	32	1.91	2.52	23.9	4.4
F5.000	166.250	0.000	0.0	3.9	0.2	14	1.63	3.57	33.9	1.2
F5.001	163.390	0.000	0.0	6.8	0.3	29	0.80	1.12	10.7	1.6
F6.000	163.617	0.000	0.0	3.9	0.2	14	1.68	3.72	35.3	1.2
F5.002	163.224	0.000	0.0	10.7	0.3	32	0.85	1.12	10.7	2.0
F7.000	166.250	0.000	0.0	3.9	0.2	14	1.71	3.81	36.2	1.2
F5.003	163.139	0.000	0.0	14.6	0.4	35	0.89	1.12	10.7	2.3
F8.000	163.513	0.000	0.0	6.8	0.3	14	2.23	4.96	47.2	1.6
F5.004	163.020	0.000	0.0	21.4	0.5	38	0.94	1.12	10.7	2.8
F9.000	166.275	0.000	0.0	3.9	0.2	14	1.64	3.61	34.3	1.2
F5.005	162.875	0.000	0.0	25.3	0.5	40	0.96	1.12	10.7	3.0
F5.006	162.693	0.000	0.0	32.1	0.6	26	1.93	2.86	27.2	3.4
F1.006	162.079	0.000	0.0	85.3	0.9	66	0.71	0.77	15.5	5.5

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke. BRADFORD

Date 21.09.2010

File 8444-FOUL DRAINAGE FINAL.MDD

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PIPELINE SCHEDULES (Foul - Unit)Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
F1.000	o	110	F1	167.750	167.040	0.600		475
F1.001	o	110	F2	167.269	166.559	0.600		475
F2.000	o	110	F7	167.750	167.040	0.600		475
F1.002	o	110	F3	167.422	166.263	1.049		110
F3.000	o	110	F8	168.650	167.640	0.900		475
F1.003	o	110	F4	167.537	166.180	1.247		110
F4.000	o	110	F9	168.793	168.083	0.600		475
F1.004	o	110	F5	168.033	165.839	2.084		1200
F1.005	o	110	F6	167.000	164.000	2.890		1200
F5.000	o	110	F10	166.850	166.250	0.490		300
F5.001	o	110	F11	164.100	163.390	0.600		475
F6.000	o	110	F17	164.217	163.617	0.490		300
F5.002	o	110	F12	164.133	163.224	0.799		110
F7.000	o	110	F18	166.850	166.250	0.490		300

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
F1.000	9.38	19.5	F2	167.269	166.559	0.600		475
F1.001	11.84	40.0	F3	167.422	166.263	1.049		110
F2.000	11.70	15.1	F3	167.422	166.263	1.049		110
F1.002	3.32	40.0	F4	167.537	166.180	1.247		110
F3.000	12.34	8.5	F4	167.537	166.180	1.247		110
F1.003	13.63	40.0	F5	168.033	165.839	2.084		1200
F4.000	15.11	6.7	F5	168.033	165.839	2.084		1200
F1.004	14.05	79.8	F6	167.000	165.663	1.227		1200
F1.005	15.42	8.0	F09	164.250	162.079	2.061		1200
F5.000	11.46	4.0	F11	164.100	163.390	0.600		475
F5.001	6.65	40.1	F12	164.133	163.224	0.799		110
F6.000	1.45	3.7	F12	164.133	163.224	0.799		110
F5.002	3.41	40.1	F13	164.150	163.139	0.901		110
F7.000	10.90	3.5	F13	164.150	163.139	0.901		110

Philip S Ryley & Co		Page 4
Wards End Chambers Wards End Halifax	Proposed Development Land Off Brookfields Rd Wyke. BRADFORD	
Date 21.09.2010 File 8444-FOUL DRAINAGE FINAL.MDD	Designed By PH Checked By	
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PIPELINE SCHEDULES (Foul - Unit)

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
F5.003	o	110	F13	164.150	163.139	0.901		110
F8.000	o	110	F19	164.223	163.513	0.600		475
F5.004	o	110	F14	164.175	163.020	1.045		110
F9.000	o	110	F20	166.875	166.275	0.490		300
F5.005	o	110	F15	164.204	162.875	1.219		110
F5.006	o	110	F16	164.241	162.693	1.438		475
F1.006	o	160	F09	164.250	162.079	2.011		1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
F5.003	4.78	40.2	F14	164.175	163.020	1.045		110
F8.000	1.02	2.1	F14	164.175	163.020	1.045		110
F5.004	5.83	40.2	F15	164.204	162.875	1.219		110
F9.000	13.28	3.9	F15	164.204	162.875	1.219		110
F5.005	7.29	40.1	F16	164.241	162.693	1.438		475
F5.006	3.82	6.2	F09	164.250	162.079	2.061		1200
F1.006	1.40	140.0	FOF	165.037	162.069	2.808		225

Wards End Chambers
Wards End
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Wyke. BRADFORD

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MANHOLE SCHEDULES (Foul - Unit)

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam., L*W (mm)	PN	Pipes Out IL. (m)	D (mm)	PN	Pipes In IL. (m)	D (mm)
F1	167.750	0.710	475	F1.000	167.040	110			
F2	167.269	0.710	475	F1.001	166.559	110	F1.000	166.559	110
F7	167.750	0.710	475	F2.000	167.040	110			
F3	167.422	1.159	110	F1.002	166.263	110	F1.001 F2.000	166.263 166.263	110 110
F8	168.650	1.010	475	F3.000	167.640	110			
F4	167.537	1.357	110	F1.003	166.180	110	F1.002 F3.000	166.180 166.180	110 110
F9	168.793	0.710	475	F4.000	168.083	110			
F5	168.033	2.194	1200	F1.004	165.839	110	F1.003 F4.000	165.839 165.839	110 110
F6	167.000	3.000	1200	F1.005	164.000	110	F1.004	165.663	110
F10	166.850	0.600	300	F5.000	166.250	110			
F11	164.100	0.710	475	F5.001	163.390	110	F5.000	163.390	110
F17	164.217	0.600	300	F6.000	163.617	110			
F12	164.133	0.909	110	F5.002	163.224	110	F5.001 F6.000	163.224 163.224	110 110
F18	166.850	0.600	300	F7.000	166.250	110			
F13	164.150	1.011	110	F5.003	163.139	110	F5.002 F7.000	163.139 163.139	110 110
F19	164.223	0.710	475	F8.000	163.513	110			
F14	164.175	1.155	110	F5.004	163.020	110	F5.003 F8.000	163.020 163.020	110 110
F20	166.875	0.600	300	F9.000	166.275	110			
F15	164.204	1.329	110	F5.005	162.875	110	F5.004 F9.000	162.875 162.875	110 110
F16	164.241	1.548	475	F5.006	162.693	110	F5.005	162.693	110
F09	164.250	2.171	1200	F1.006	162.079	160	F1.005 F5.006	162.079 162.079	110 110
FOF	165.037	2.968	225		OUTFALL		F1.006	162.069	160

B Surface water drainage calculation

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields RD
Wyke. BRADFORD

Date 21.09.2010

Designed By PH

File 8444-Surface drainage Final.mdd

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STORM SEWER DESIGN by the Modified Rational Method (Storm)

Global Variables

Size File C:\Program Files\Micro Drainage Ltd\WinDes\pipes & manholes\pipes\Plastic pipe HEPWORTH.F
 Hole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.M

Location - England & Wales

Return Period (years)	50	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	19.000	Min Cover Depth for Optimisation (m)	0.600
Ratio R	0.325	Min Vel for Auto Design Only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Min Slope for Optimisation (1:X)	500
Foul Sewage (l/s/ha)	0.00	Minimum Outfall Invert (m)	0.000
O'flow Setting (*Foul only)	0	Ground Level at Outfall (m)	165.037
Volumetric Runoff Coeff.	0.75	Outfall Manhole Name	OF
Add Flow / Climate Change (%)	20	Outfall Manhole Dia/Length (mm)	225
Minimum Backdrop Height (m)	0.200	Outfall Manhole Width (mm)	0

Designed with Level Inverts

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	10.65	0.158	67.4	0.016	4.00	0.0	0.600	o	110
S1.001	12.72	0.189	67.4	0.003	0.00	0.0	0.600	o	110
S2.000	11.12	0.476	23.4	0.003	4.00	0.0	0.600	o	110
S1.002	12.15	0.991	12.3	0.000	0.00	0.0	0.600	o	110
S3.000	7.79	0.626	12.4	0.003	4.00	0.0	0.600	o	110
S3.001	12.30	0.112	109.8	0.043	0.00	0.0	0.600	o	160
S1.003	15.53	0.142	109.3	0.017	0.00	0.0	0.600	o	160
S4.000	9.43	0.140	67.4	0.006	4.00	0.0	0.600	o	110

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
S1.000	50.0	4.2	166.740	0.016	0.0	0.0	0.4	1.00	9.5	2.6
S1.001	50.0	4.4	166.582	0.019	0.0	0.0	0.5	1.00	9.5	3.1
S2.000	50.0	4.1	166.869	0.003	0.0	0.0	0.1	1.71	16.2	0.5
S1.002	50.0	4.5	166.393	0.022	0.0	0.0	0.6	2.36	22.5	3.6
S3.000	50.0	4.1	166.140	0.003	0.0	0.0	0.1	2.35	22.3	0.5
S3.001	50.0	4.3	165.514	0.046	0.0	0.0	1.2	1.00	20.1	7.5
S1.003	50.0	4.7	165.402	0.085	0.0	0.0	2.3	1.00	20.1	13.8
S4.000	50.0	4.2	167.640	0.006	0.0	0.0	0.2	1.00	9.5	1.0

Wards End Chambers
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Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S4.001	12.74	1.001	12.7	0.008	0.00	0.0	0.600	o	110
S5.000	10.62	0.867	12.2	0.003	4.00	0.0	0.600	o	110
S4.002	15.21	1.239	12.3	0.008	0.00	0.0	0.600	o	160
S1.004	8.67	0.705	12.3	0.000	0.00	0.0	0.600	o	160
S1.005	9.00	1.150	7.8	0.004	0.00	0.0	0.600	o	160
S1.006	5.75	0.738	7.8	0.003	0.00	0.0	0.600	o	160
S6.000	6.98	1.309	5.3	0.007	4.00	0.0	0.600	o	110
S6.001	23.80	0.119	200.0	0.000	0.00	0.0	0.600	o	1050
S1.007	3.28	0.033	99.5	0.000	0.00	0.0	0.600	o	160
S1.008	1.40	0.010	145.6	0.000	0.00	5.5	0.600	o	200

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
S4.001	50.0	4.2	167.500	0.014	0.0	0.0	0.4	2.32	22.0	2.3
S5.000	50.0	4.1	167.366	0.003	0.0	0.0	0.1	2.36	22.5	0.5
S4.002	50.0	4.3	166.499	0.025	0.0	0.0	0.7	3.01	60.6	4.1
S1.004	50.0	4.8	165.260	0.110	0.0	0.0	3.0	3.01	60.6	17.9
S1.005	50.0	4.8	164.000	0.114	0.0	0.0	3.1	3.78	76.0	18.5
S1.006	50.0	4.8	162.850	0.117	0.0	0.0	3.2	3.79	76.2	19.0
S6.000	50.0	4.0	163.540	0.007	0.0	0.0	0.2	3.59	34.1	1.1
S6.001	50.0	4.2	162.231	0.007	0.0	0.0	0.2	2.43	2106.9	1.1
S1.007	50.0	4.9	162.112	0.124	0.0	0.0	3.4	1.05	21.1	20.1
S1.008	50.0	4.9	162.079	0.124	5.5	0.0	4.5	1.00	31.5	26.7

Wards End Chambers
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Time Area Diagram (Storm)

Time From (mins)	Time To (mins)	Area (ha)
0	4	0.107
4	8	0.017

Total Area Contributing (ha) = 0.124

Total Pipe Volume (m³) = 22.951

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PIPELINE SCHEDULES (Storm)

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
S1.000	o	110	S1	167.750	166.740	0.900		110
S1.001	o	110	S2	167.750	166.582	1.058		475
S2.000	o	110	S10	167.579	166.869	0.600		110
S1.002	o	110	S3	167.679	166.393	1.176		475
S3.000	o	110	S11	166.850	166.140	0.600		110
S3.001	o	160	S12	166.874	165.514	1.200		1050
S1.003	o	160	S4	167.103	165.402	1.541		110
S4.000	o	110	S13	168.650	167.640	0.900		110
S4.001	o	110	S14	169.022	167.500	1.412		475
S5.000	o	110	S16	168.376	167.366	0.900		110
S4.002	o	160	S15	168.545	166.499	1.886		475
S1.004	o	160	S5	167.424	165.260	2.004		110
S1.005	o	160	S6	167.000	164.000	2.840		1200
S1.006	o	160	S7	164.250	162.850	1.240		1050
S6.000	o	110	S17	164.250	163.540	0.600		110

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
S1.000	10.65	67.4	S2	167.750	166.582	1.058		475
S1.001	12.72	67.4	S3	167.679	166.393	1.176		475
S2.000	11.12	23.4	S3	167.679	166.393	1.176		475
S1.002	12.15	12.3	S4	167.103	165.402	1.591		110
S3.000	7.79	12.4	S12	166.874	165.514	1.250		1050
S3.001	12.30	109.8	S4	167.103	165.402	1.541		110
S1.003	15.53	109.3	S5	167.424	165.260	2.004		110
S4.000	9.43	67.4	S14	169.022	167.500	1.412		475
S4.001	12.74	12.7	S15	168.545	166.499	1.936		475
S5.000	10.62	12.2	S15	168.545	166.499	1.936		475
S4.002	15.21	12.3	S5	167.424	165.260	2.004		110
S1.004	8.67	12.3	S6	167.000	164.555	2.285		1200
S1.005	9.00	7.8	S7	164.250	162.850	1.240		1050
S1.006	5.75	7.8	S8	164.226	162.112	1.954		1800
S6.000	6.98	5.3	S18	163.881	162.231	1.540		1800

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PIPELINE SCHEDULES (Storm)

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
S6.001	o	1050	S18	163.881	162.231	0.600	1800
S1.007	o	160	S8	164.226	162.112	1.954	1800
S1.008	o	200	S9	164.250	162.079	1.971	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
S6.001	23.80	200.0	S8	164.226	162.112	1.064	1800
S1.007	3.28	99.5	S9	164.250	162.079	2.011	1200
S1.008	1.40	145.6	SOF	165.037	162.069	2.768	225

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields RD
Wyke. BRADFORD



Date 21.09.2010

Designed By PH

File 8444-Surface drainage Final.mdd

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DrawNet W.11.2

MANHOLE SCHEDULES (Storm)

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam., L*W (mm)	Pipes Out			Pipes In		
				PN	IL. (m)	D (mm)	PN	IL. (m)	D (mm)
S1	167.750	1.010	110	S1.000	166.740	110			
S2	167.750	1.168	475	S1.001	166.582	110	S1.000	166.582	110
S10	167.579	0.710	110	S2.000	166.869	110			
S3	167.679	1.286	475	S1.002	166.393	110	S1.001 S2.000	166.393 166.393	110 110
S11	166.850	0.710	110	S3.000	166.140	110			
S12	166.874	1.360	1050	S3.001	165.514	160	S3.000	165.514	110
S4	167.103	1.701	110	S1.003	165.402	160	S1.002 S3.001	165.402 165.402	110 160
S13	168.650	1.010	110	S4.000	167.640	110			
S14	169.022	1.522	475	S4.001	167.500	110	S4.000	167.500	110
S16	168.376	1.010	110	S5.000	167.366	110			
S15	168.545	2.046	475	S4.002	166.499	160	S4.001 S5.000	166.499 166.499	110 110
S5	167.424	2.164	110	S1.004	165.260	160	S1.003 S4.002	165.260 165.260	160 160
S6	167.000	3.000	1200	S1.005	164.000	160	S1.004	164.555	160
S7	164.250	1.400	1050	S1.006	162.850	160	S1.005	162.850	160
S17	164.250	0.710	110	S6.000	163.540	110			
S18	163.881	1.650	1800	S6.001	162.231	1050	S6.000	162.231	110
S8	164.226	2.114	1800	S1.007	162.112	160	S1.006 S6.001	162.112 162.112	160 1050
S9	164.250	2.171	1200	S1.008	162.079	200	S1.007	162.079	160
SOF	165.037	2.968	225		OUTFALL		S1.008	162.069	200

Micro Drainage output:

Critical rain for storm return period 30 years (winter): 60 min duration

Maximum Storage Volume for the above rain: $24.2 \text{ m}^3 < 24.35 \text{ m}^3$ (proposed Storage Volume)OK

Maximum water level in the Storage Tank for the above rain: 163.207 m.

Maximum allowable water level in the Storage Tank (Invert Level + Design Head): $162.112 + 1.10 =$
 $= 163.212\text{m}$

$163.207 < 163.212\text{m}$ OK **Proposed Storage Tank is sufficient for the critical rain.**

N.B. For further information on Storage Tank please see drawings No. 8444/10/24

Wards End Chambers
Wards End
Halifax

PROPOSED DEVELOPMENT
LAND OFF BROOKFIELDS RD
WYKE- BRADFORD

**Micro
Drainage®**

Date 21.09.2010

Designed By PH

File 8444-Storage Tank design Final.SRC

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Source Control W.11.2

Summary of Results for 30 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	4.1	4.1	162.8248	0.7128	15.8	O K
30 Summer	4.5	4.5	162.9833	0.8713	19.3	O K
60 Summer	4.7	4.7	163.0678	0.9558	21.1	O K
120 Summer	4.7	4.7	163.0748	0.9628	21.3	O K
180 Summer	4.6	4.6	163.0288	0.9168	20.3	O K
240 Summer	4.5	4.5	162.9698	0.8578	19.0	O K
360 Summer	4.2	4.2	162.8568	0.7448	16.5	O K
480 Summer	3.9	3.9	162.7507	0.6388	14.1	O K
600 Summer	3.9	3.9	162.6532	0.5412	12.0	O K
720 Summer	3.9	3.9	162.5587	0.4467	9.9	O K
960 Summer	3.9	3.9	162.3918	0.2797	6.2	O K
1440 Summer	3.4	3.4	162.2728	0.1608	3.5	O K
2160 Summer	2.7	2.7	162.2117	0.0998	2.2	O K
2880 Summer	2.2	2.2	162.1927	0.0808	1.8	O K
4320 Summer	1.6	1.6	162.1718	0.0598	1.3	O K
5760 Summer	1.3	1.3	162.1602	0.0482	1.1	O K
7200 Summer	1.1	1.1	162.1528	0.0407	0.9	O K
8640 Summer	1.0	1.0	162.1478	0.0357	0.8	O K
10080 Summer	0.9	0.9	162.1438	0.0317	0.7	O K
15 Winter	4.4	4.4	162.9208	0.8088	17.9	O K
30 Winter	4.8	4.8	163.1098	0.9978	22.1	O K
60 Winter	5.0	5.0	163.2073	1.0953	24.2	O K
120 Winter	5.0	5.0	163.1988	1.0868	24.0	O K
180 Winter	4.8	4.8	163.1188	1.0068	22.2	O K
240 Winter	4.6	4.6	163.0253	0.9133	20.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
-----------------------------	-----------------	---------------------

15 Summer	80.56	17
30 Summer	54.29	30
60 Summer	35.09	48
120 Summer	22.01	82
180 Summer	16.55	116
240 Summer	13.45	150
360 Summer	10.03	218
480 Summer	8.14	284
600 Summer	6.91	348
720 Summer	6.05	408
960 Summer	4.90	520
1440 Summer	3.63	738
2160 Summer	2.68	1100
2880 Summer	2.17	1468
4320 Summer	1.60	2200
5760 Summer	1.29	2920
7200 Summer	1.09	3568
8640 Summer	0.95	4288
10080 Summer	0.85	5008
15 Winter	80.56	17
30 Winter	54.29	30
60 Winter	35.09	50
120 Winter	22.01	88
180 Winter	16.55	126
240 Winter	13.45	162

Wards End Chambers
Wards End
Halifax

PROPOSED DEVELOPMENT
LAND OFF BROOKFIELDS RD
WYKE- BRADFORD

**Micro
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Summary of Results for 30 year Return Period (+20%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m ³)	Status
360 Winter	4.2	4.2	162.8513	0.7393	16.3	O K
480 Winter	3.9	3.9	162.6933	0.5812	12.8	O K
600 Winter	3.9	3.9	162.5338	0.4217	9.3	O K
720 Winter	3.9	3.9	162.3777	0.2657	5.9	O K
960 Winter	3.5	3.5	162.2767	0.1647	3.6	O K
1440 Winter	2.6	2.6	162.2097	0.0978	2.2	O K
2160 Winter	2.0	2.0	162.1848	0.0728	1.6	O K
2880 Winter	1.6	1.6	162.1707	0.0588	1.3	O K
4320 Winter	1.2	1.2	162.1552	0.0432	1.0	O K
5760 Winter	0.9	0.9	162.1467	0.0347	0.8	O K
7200 Winter	0.8	0.8	162.1418	0.0297	0.7	O K
8640 Winter	0.7	0.7	162.1378	0.0257	0.6	O K
10080 Winter	0.6	0.6	162.1353	0.0232	0.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
360 Winter	10.03	232
480 Winter	8.14	300
600 Winter	6.91	364
720 Winter	6.05	412
960 Winter	4.90	508
1440 Winter	3.63	736
2160 Winter	2.68	1100
2880 Winter	2.17	1452
4320 Winter	1.60	2196
5760 Winter	1.29	2936
7200 Winter	1.09	3640
8640 Winter	0.95	4400
10080 Winter	0.85	5032

Wards End Chambers
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PROPOSED DEVELOPMENT
LAND OFF BROOKFIELDS RD
WYKE- BRADFORD



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Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	30	Longest Storm (mins)	10080
M5-60 (mm)	19.000	Summer Storms	Yes
Ratio-R	0.325	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+20
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.124

Time	(mins)	Area
from:	to:	(ha)
0	4	0.124

Philip S Ryley & Co		Page 4
Wards End Chambers Wards End Halifax	PROPOSED DEVELOPMENT LAND OFF BROOKFIELDS RD WYKE - BRADFORD	
Date 21.09.2010 File 8444-Storage Tank design Final.SRC	Designed By PH Checked By	
Micro Drainage	Source Control W.11.2	

Tank/Pond Details

Invert Level (m) 162.112 Ground Level (m) 164.226

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	22.1	0.50	22.1	1.00	22.1	1.50	22.1	2.00	22.1	2.50	22.1
0.10	22.1	0.60	22.1	1.10	22.1	1.60	22.1	2.10	22.1		
0.20	22.1	0.70	22.1	1.20	22.1	1.70	22.1	2.20	22.1		
0.30	22.1	0.80	22.1	1.30	22.1	1.80	22.1	2.30	22.1		
0.40	22.1	0.90	22.1	1.40	22.1	1.90	22.1	2.40	22.1		

Hydro-Brake Outflow Control

Design Head (m) 1.100 Hydro-Brake Type MD6 Invert Level (m) 162.112
Design Flow (l/s) 5.0 Diameter (mm) 92

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	2.7	0.60	3.8	1.60	6.1	2.60	7.8	5.00	10.8	7.50	13.2
0.20	3.9	0.80	4.3	1.80	6.5	3.00	8.3	5.50	11.3	8.00	13.6
0.30	3.7	1.00	4.8	2.00	6.8	3.50	9.0	6.00	11.8	8.50	14.1
0.40	3.5	1.20	5.3	2.20	7.1	4.00	9.6	6.50	12.3	9.00	14.5
0.50	3.6	1.40	5.7	2.40	7.5	4.50	10.2	7.00	12.8	9.50	14.9

D Surface water drainage - simulation

Philip S Ryley & Co		Page 1
Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_RP1_SD30_W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Global Variables

Region	FSR - England & Wales
Return Period (yrs)	1
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	30
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1_Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010
File 8444_ RP1_ SD30_ W.SIM

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Simulation W.11.2



On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

Wards End Chambers

Wards End

Halifax

Proposed Development

Land Off Brookfields Rd

Wyke, Bradford

Date 21.09.2010

File 8444_ RP1_ SD30_ W.SIM

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Simulation W.11.2


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Network Details

* - Indicates pipe has been modified outside of WinDes's Storm/Foul & Schedules

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
1.000	10.65	0.158	67.4	0.016	4.00	1	0.600	o	110
1.001	12.72	0.189	67.4	0.003	0.00	1	0.600	o	110
2.000	11.12	0.476	23.4	0.003	4.00	1	0.600	o	110
1.002	12.15	0.991	12.3	0.000	0.00	1	0.600	o	110
3.000	7.79	0.626	12.4	0.003	4.00	1	0.600	o	110
3.001	12.30	0.112	109.8	0.043	0.00	1	0.600	o	160
1.003	15.53	0.142	109.3	0.017	0.00	1	0.600	o	160
4.000	9.43	0.140	67.4	0.006	4.00	1	0.600	o	110
4.001	12.74	1.001	12.7	0.008	0.00	1	0.600	o	110
5.000	10.62	0.867	12.2	0.003	4.00	1	0.600	o	110
4.002	15.21	1.239	12.3	0.008	0.00	1	0.600	o	160
1.004	8.67	0.705	12.3	0.000	0.00	1	0.600	o	160
1.005	9.00	1.150	7.8	0.004	0.00	1	0.600	o	160
1.006	5.75	0.738	7.8	0.003	0.00	1	0.600	o	160
6.000	6.98	1.309	5.3	0.007	4.00	1	0.600	o	110
6.001	23.80	0.119	200.0	0.000	0.00	1	0.600	o	1050

PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
1.000	1	167.750	166.740	0.900	167.750	166.582	1.058		110
1.001	2	167.750	166.582	1.058	167.679	166.393	1.176		475
2.000	10	167.579	166.869	0.600	167.679	166.393	1.176		110
1.002	3	167.679	166.393	1.176	167.103	165.402	1.591		475
3.000	11	166.850	166.140	0.600	166.874	165.514	1.250		110
3.001	12	166.874	165.514	1.200	167.103	165.402	1.541		1050
1.003	4	167.103	165.402	1.541	167.424	165.260	2.004		110
4.000	13	168.650	167.640	0.900	169.022	167.500	1.412		110
4.001	14	169.022	167.500	1.412	168.545	166.499	1.936		475
5.000	16	168.376	167.366	0.900	168.545	166.499	1.936		110
4.002	15	168.545	166.499	1.886	167.424	165.260	2.004		475
1.004	5	167.424	165.260	2.004	167.000	164.555	2.285		110
1.005	6	167.000	164.000	2.840	164.250	162.850	1.240		1200
1.006	7	164.250	162.850	1.240	164.226	162.112	1.954		1050
6.000	17	164.250	163.540	0.600	163.881	162.231	1.540		110
6.001	18	163.881	162.231	0.600	164.226	162.112	1.064		1800

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010
File 8444_RP1_SD30_W.SIM

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Simulation W.11.2

Network Details

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
1.007	3.28	0.033	99.5	0.000	0.00	1	0.600	o	160
* 1.008	1.40	0.010	145.6	0.000	0.00	1	0.600	o	160

PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
1.007	8	164.226	162.112	1.954	164.250	162.079	2.011	9	1800
* 1.008	9	164.250	162.079	2.011	165.037	162.069	2.808		1200

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Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

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Summary of Results

Return Period (year)	1	Analysis Time Step	Fine
Storm Duration (mins)	30	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.775	-0.075	0.000	0.22	0.0	1.9	O K
1.001	166.620	-0.072	0.000	0.25	0.0	2.3	O K
2.000	166.881	-0.098	0.000	0.02	0.0	0.4	O K
1.002	166.419	-0.084	0.000	0.13	0.0	2.6	O K
3.000	166.150	-0.100	0.000	0.02	0.0	0.4	O K
3.001	165.572	-0.102	0.000	0.28	0.0	5.1	O K
1.003	165.484	-0.078	0.000	0.52	0.0	9.5	O K
4.000	167.661	-0.089	0.000	0.08	0.0	0.7	O K
4.001	167.520	-0.090	0.000	0.08	0.0	1.6	O K
5.000	167.375	-0.101	0.000	0.02	0.0	0.4	O K
4.002	166.522	-0.137	0.000	0.05	0.0	2.8	O K
1.004	165.312	-0.108	0.000	0.24	0.0	12.4	O K
1.005	164.048	-0.112	0.000	0.19	0.0	12.8	O K
1.006	162.900	-0.110	0.000	0.21	0.0	13.2	O K
6.000	163.552	-0.098	0.000	0.03	0.0	0.9	O K
6.001	162.534	-0.747	0.000	0.00	0.0	0.5	O K
1.007	162.534	0.262	0.000	0.30	0.0	3.9	SURCH'ED
1.008	162.190	-0.049	0.000	0.82	0.0	10.5	O K

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Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP1_ SD10080_ W.SIM

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Simulation W.11.2



Global Variables

Region	FSR - England & Wales
Return Period (yrs)	1
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	10080
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1 Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers

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Proposed Development

Land Off Brookfields Rd

Wyke, Bradford

Date 21.09.2010

File 8444_ RP1_ SD10080_ W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


**Micro
Drainage®**
On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	2.0	6.8
								2.2	7.1
								0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

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File 8444_ RP1_ SD10080_ W.SIM

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Micro Drainage

Simulation W.11.2



Summary of Results

Return Period (year)	1	Analysis Time Step	Fine
Storm Duration (mins)	10080	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.743	-0.107	0.000	0.01	0.0	0.0	O K
1.001	166.585	-0.107	0.000	0.01	0.0	0.1	O K
2.000	166.869	-0.110	0.000	0.00	0.0	0.0	O K
1.002	166.395	-0.108	0.000	0.00	0.0	0.1	O K
3.000	166.140	-0.110	0.000	0.00	0.0	0.0	O K
3.001	165.520	-0.154	0.000	0.01	0.0	0.1	O K
1.003	165.412	-0.150	0.000	0.01	0.0	0.2	O K
4.000	167.641	-0.109	0.000	0.00	0.0	0.0	O K
4.001	167.501	-0.109	0.000	0.00	0.0	0.0	O K
5.000	167.366	-0.110	0.000	0.00	0.0	0.0	O K
4.002	166.500	-0.159	0.000	0.00	0.0	0.1	O K
1.004	165.265	-0.155	0.000	0.01	0.0	0.3	O K
1.005	164.004	-0.156	0.000	0.01	0.0	0.3	O K
1.006	162.854	-0.156	0.000	0.01	0.0	0.3	O K
6.000	163.540	-0.110	0.000	0.00	0.0	0.0	O K
6.001	162.231	-1.050	0.000	0.00	0.0	0.0	O K
1.007	162.176	-0.096	0.000	0.03	0.0	0.3	O K
1.008	162.163	-0.076	0.000	0.54	0.0	6.9	O K

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Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

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File 8444_ RP1_ SD10080_ W.SIM

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Simulation W.11.2



Rainfall Hyetograph

Region

FSR - England & Wales

Profile Type Winter

Return Period (yrs)

1

Storm Duration (mins)

10080

M5-60 (mm)

19.000

Ratio R

0.325

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
24	0.01	1320	0.18	2616	0.27	3912	0.69	5208	1.03
48	0.01	1344	0.18	2640	0.28	3936	0.70	5232	1.03
72	0.01	1368	0.18	2664	0.29	3960	0.73	5256	1.02
96	0.01	1392	0.18	2688	0.29	3984	0.73	5280	1.01
120	0.04	1416	0.18	2712	0.29	4008	0.73	5304	1.01
144	0.05	1440	0.18	2736	0.30	4032	0.73	5328	1.01
168	0.05	1464	0.18	2760	0.31	4056	0.77	5352	1.00
192	0.05	1488	0.18	2784	0.31	4080	0.77	5376	0.98
216	0.07	1512	0.18	2808	0.31	4104	0.77	5400	0.98
240	0.09	1536	0.18	2832	0.32	4128	0.77	5424	0.98
264	0.09	1560	0.18	2856	0.34	4152	0.80	5448	0.98
288	0.09	1584	0.18	2880	0.34	4176	0.81	5472	0.95
312	0.10	1608	0.18	2904	0.34	4200	0.81	5496	0.95
336	0.11	1632	0.18	2928	0.34	4224	0.81	5520	0.95
360	0.11	1656	0.18	2952	0.36	4248	0.84	5544	0.95
384	0.11	1680	0.18	2976	0.36	4272	0.85	5568	0.92
408	0.12	1704	0.18	3000	0.36	4296	0.85	5592	0.92
432	0.13	1728	0.19	3024	0.36	4320	0.85	5616	0.92
456	0.13	1752	0.19	3048	0.39	4344	0.87	5640	0.92
480	0.13	1776	0.19	3072	0.39	4368	0.89	5664	0.90
504	0.13	1800	0.19	3096	0.39	4392	0.89	5688	0.89
528	0.15	1824	0.19	3120	0.39	4416	0.89	5712	0.89
552	0.15	1848	0.19	3144	0.42	4440	0.90	5736	0.89
576	0.15	1872	0.19	3168	0.42	4464	0.92	5760	0.87
600	0.15	1896	0.19	3192	0.42	4488	0.92	5784	0.85
624	0.16	1920	0.19	3216	0.42	4512	0.92	5808	0.85
648	0.16	1944	0.19	3240	0.44	4536	0.92	5832	0.85
672	0.16	1968	0.19	3264	0.46	4560	0.95	5856	0.84
696	0.16	1992	0.19	3288	0.46	4584	0.95	5880	0.81
720	0.17	2016	0.19	3312	0.46	4608	0.95	5904	0.81
744	0.17	2040	0.20	3336	0.47	4632	0.95	5928	0.81
768	0.17	2064	0.20	3360	0.49	4656	0.98	5952	0.80
792	0.17	2088	0.20	3384	0.49	4680	0.98	5976	0.77
816	0.17	2112	0.20	3408	0.49	4704	0.98	6000	0.77
840	0.18	2136	0.21	3432	0.50	4728	0.98	6024	0.77
864	0.18	2160	0.21	3456	0.53	4752	1.00	6048	0.77
888	0.18	2184	0.21	3480	0.53	4776	1.01	6072	0.73
912	0.18	2208	0.21	3504	0.53	4800	1.01	6096	0.73
936	0.18	2232	0.22	3528	0.53	4824	1.01	6120	0.73
960	0.18	2256	0.22	3552	0.57	4848	1.02	6144	0.73
984	0.18	2280	0.22	3576	0.57	4872	1.03	6168	0.70
1008	0.18	2304	0.22	3600	0.57	4896	1.03	6192	0.69
1032	0.18	2328	0.23	3624	0.57	4920	1.03	6216	0.69
1056	0.18	2352	0.23	3648	0.60	4944	1.03	6240	0.69
1080	0.18	2376	0.23	3672	0.61	4968	1.04	6264	0.67
1104	0.18	2400	0.23	3696	0.61	4992	1.04	6288	0.65
1128	0.18	2424	0.24	3720	0.61	5016	1.04	6312	0.65
1152	0.18	2448	0.25	3744	0.63	5040	1.04	6336	0.65
1176	0.18	2472	0.25	3768	0.65	5064	1.04	6360	0.63
1200	0.18	2496	0.25	3792	0.65	5088	1.04	6384	0.61
1224	0.18	2520	0.25	3816	0.65	5112	1.04	6408	0.61
1248	0.18	2544	0.27	3840	0.67	5136	1.04	6432	0.61
1272	0.18	2568	0.27	3864	0.69	5160	1.03	6456	0.60
1296	0.18	2592	0.27	3888	0.69	5184	1.03	6480	0.57

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_RP1_SD10080_W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2



Rainfall Hyetograph

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
6504	0.57	7224	0.34	7944	0.21	8664	0.18	9384	0.17
6528	0.57	7248	0.34	7968	0.21	8688	0.18	9408	0.16
6552	0.57	7272	0.32	7992	0.20	8712	0.18	9432	0.16
6576	0.53	7296	0.31	8016	0.20	8736	0.18	9456	0.16
6600	0.53	7320	0.31	8040	0.20	8760	0.18	9480	0.16
6624	0.53	7344	0.31	8064	0.20	8784	0.18	9504	0.15
6648	0.53	7368	0.30	8088	0.19	8808	0.18	9528	0.15
6672	0.50	7392	0.29	8112	0.19	8832	0.18	9552	0.15
6696	0.49	7416	0.29	8136	0.19	8856	0.18	9576	0.15
6720	0.49	7440	0.29	8160	0.19	8880	0.18	9600	0.13
6744	0.49	7464	0.28	8184	0.19	8904	0.18	9624	0.13
6768	0.47	7488	0.27	8208	0.19	8928	0.18	9648	0.13
6792	0.46	7512	0.27	8232	0.19	8952	0.18	9672	0.13
6816	0.46	7536	0.27	8256	0.19	8976	0.18	9696	0.12
6840	0.46	7560	0.27	8280	0.19	9000	0.18	9720	0.11
6864	0.44	7584	0.25	8304	0.19	9024	0.18	9744	0.11
6888	0.42	7608	0.25	8328	0.19	9048	0.18	9768	0.11
6912	0.42	7632	0.25	8352	0.19	9072	0.18	9792	0.10
6936	0.42	7656	0.25	8376	0.19	9096	0.18	9816	0.09
6960	0.42	7680	0.24	8400	0.18	9120	0.18	9840	0.09
6984	0.39	7704	0.23	8424	0.18	9144	0.18	9864	0.09
7008	0.39	7728	0.23	8448	0.18	9168	0.18	9888	0.07
7032	0.39	7752	0.23	8472	0.18	9192	0.18	9912	0.05
7056	0.39	7776	0.23	8496	0.18	9216	0.18	9936	0.05
7080	0.36	7800	0.22	8520	0.18	9240	0.18	9960	0.05
7104	0.36	7824	0.22	8544	0.18	9264	0.18	9984	0.04
7128	0.36	7848	0.22	8568	0.18	9288	0.17	10008	0.01
7152	0.36	7872	0.22	8592	0.18	9312	0.17	10032	0.01
7176	0.34	7896	0.21	8616	0.18	9336	0.17	10056	0.01
7200	0.34	7920	0.21	8640	0.18	9360	0.17	10080	0.01

Wards End Chambers
Wards End
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Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

Designed By PH

File 8444_ RP30_ SD30_ W.SIM

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Micro Drainage

Simulation W.11.2


Global Variables

Region	FSR - England & Wales
Return Period (yrs)	30
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	30
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1 Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP30_ SD30_ W.SIM

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Micro Drainage

Simulation W.11.2


On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

Wards End Chambers
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Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

Designed By PH

File 8444_ RP30_ SD30_ W.SIM

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Micro Drainage

Simulation W.11.2



Summary of Results

Return Period (years)	30	Analysis Time Step	Fine
Storm Duration (mins)	30	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.798	-0.052	0.000	0.54	0.0	4.8	O K
1.001	166.646	-0.046	0.000	0.63	0.0	5.7	O K
2.000	166.886	-0.093	0.000	0.06	0.0	0.9	O K
1.002	166.435	-0.068	0.000	0.31	0.0	6.5	O K
3.000	166.155	-0.095	0.000	0.04	0.0	0.9	O K
3.001	165.730	0.056	0.000	0.74	0.0	13.3	SURCH'ED
1.003	165.668	0.106	0.000	1.34	0.0	24.8	SURCH'ED
4.000	167.674	-0.076	0.000	0.21	0.0	1.8	O K
4.001	167.534	-0.076	0.000	0.20	0.0	4.2	O K
5.000	167.381	-0.095	0.000	0.04	0.0	0.9	O K
4.002	166.538	-0.121	0.000	0.13	0.0	7.5	O K
1.004	165.351	-0.069	0.000	0.61	0.0	32.1	O K
1.005	164.080	-0.080	0.000	0.50	0.0	33.2	O K
1.006	163.104	0.094	0.000	0.55	0.0	33.8	SURCH'ED
6.000	163.559	-0.091	0.000	0.07	0.0	2.1	O K
6.001	163.096	-0.185	0.000	0.00	0.0	0.5	O K
1.007	163.096	0.824	0.000	0.35	0.0	4.6	SURCH'ED
1.008	162.195	-0.044	0.000	0.88	0.0	11.2	O K

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010
File 8444_ RP30_ SD30_ W.SIM

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Micro Drainage

Simulation W.11.2

Rainfall Hyetograph

Region	FSR - England & Wales	Profile Type	Winter
Return Period (yrs)	30	Storm Duration (mins)	30
M5-60 (mm)	19.000		
Ratio R	0.325		

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	6.23	7	23.37	13	90.13	19	75.11	25	20.80
2	15.31	8	28.46	14	103.04	20	60.61	26	20.14
3	19.17	9	36.39	15	112.19	21	47.50	27	20.13
4	20.13	10	47.50	16	112.19	22	36.39	28	19.17
5	20.14	11	60.61	17	103.04	23	28.46	29	15.31
6	20.80	12	75.11	18	90.13	24	23.37	30	6.23

Wards End Chambers

Wards End

Halifax

Proposed Development

Land Off Brookfields Rd

Wyke, Bradford

Date 21.09.2010

File 8444_ RP30_ SD60_ W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


**Micro
Drainage®**
Global Variables

Region	FSR - England & Wales
Return Period (yrs)	30
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	60
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1_Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP30_ SD60_ W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	2.0	6.8
								2.2	7.1
								0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

Wards End Chambers

Proposed Development

Wards End

Land Off Brookfields Rd

Halifax

Wyke, Bradford

Date 21.09.2010

Designed By PH

File 8444_ RP30_ SD60_ W.SIM

Checked By

Micro Drainage

Simulation W.11.2


**Micro
Drainage®**

Summary of Results

Return Period (years)	30	Analysis Time Step	Fine
Storm Duration (mins)	60	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.786	-0.064	0.000	0.37	0.0	3.2	O K
1.001	166.632	-0.060	0.000	0.43	0.0	3.8	O K
2.000	166.883	-0.096	0.000	0.04	0.0	0.6	O K
1.002	166.427	-0.076	0.000	0.21	0.0	4.4	O K
3.000	166.152	-0.098	0.000	0.03	0.0	0.6	O K
3.001	165.595	-0.079	0.000	0.51	0.0	9.3	O K
1.003	165.523	-0.039	0.000	0.92	0.0	17.0	O K
4.000	167.667	-0.083	0.000	0.14	0.0	1.2	O K
4.001	167.527	-0.083	0.000	0.14	0.0	2.8	O K
5.000	167.378	-0.098	0.000	0.03	0.0	0.6	O K
4.002	166.531	-0.128	0.000	0.09	0.0	5.0	O K
1.004	165.333	-0.087	0.000	0.42	0.0	22.0	O K
1.005	164.065	-0.095	0.000	0.34	0.0	22.7	O K
1.006	163.222	0.212	0.000	0.38	0.0	23.2	SURCH'ED
6.000	163.555	-0.095	0.000	0.05	0.0	1.4	O K
6.001	163.213	-0.068	0.000	0.00	0.0	0.7	O K
1.007	163.213	0.941	0.000	0.37	0.0	4.9	SURCH'ED
1.008	162.197	-0.042	0.000	0.90	0.0	11.5	O K

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke. Bradford

Date 21.09.2010
File 8444_ RP30_ SD60_ W.SIM

Designed By PH
Checked By



Micro Drainage

Simulation W.11.2

Rainfall Hyetograph

Region	FSR - England & Wales	Profile Type	Winter
Return Period (yrs)	30	Storm Duration (mins)	60
M5-60 (mm)	19.000		
Ratio R	0.325		

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
2	4.03	14	15.10	26	58.25	38	48.54	50	13.44
4	9.89	16	18.39	28	66.59	40	39.17	52	13.02
6	12.39	18	23.52	30	72.51	42	30.70	54	13.01
8	13.01	20	30.70	32	72.51	44	23.52	56	12.39
10	13.02	22	39.17	34	66.59	46	18.39	58	9.89
12	13.44	24	48.54	36	58.25	48	15.10	60	4.03

Wards End Chambers

Wards End

Halifax

Proposed Development

Land Off Brookfields Rd

Wyke, Bradford

Date 21.09.2010

File 8444_RP30_SD10080_W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


**Micro
Drainage®**
Global Variables

Region	FSR - England & Wales
Return Period (yrs)	30
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	10080
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1_Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP30_ SD10080_ W.SIM

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Micro Drainage

Simulation W.11.2


On-Line Controls (Hydro-Brake®)

US/PN	Volume (m ³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

Wards End Chambers

Proposed Development

Wards End

Land Off Brookfields Rd

Halifax

Wyke, Bradford

Date 21.09.2010

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File 8444_ RP30_ SD10080_ W.SIM

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Micro Drainage

Simulation W.11.2


**Micro
Drainage®**
Summary of Results

Return Period (years)	30	Analysis Time Step	Fine
Storm Duration (mins)	10080	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.745	-0.105	0.000	0.01	0.0	0.1	O K
1.001	166.588	-0.104	0.000	0.01	0.0	0.1	O K
2.000	166.870	-0.109	0.000	0.00	0.0	0.0	O K
1.002	166.396	-0.107	0.000	0.01	0.0	0.1	O K
3.000	166.140	-0.110	0.000	0.00	0.0	0.0	O K
3.001	165.524	-0.150	0.000	0.01	0.0	0.2	O K
1.003	165.418	-0.144	0.000	0.02	0.0	0.4	O K
4.000	167.642	-0.108	0.000	0.00	0.0	0.0	O K
4.001	167.502	-0.108	0.000	0.00	0.0	0.1	O K
5.000	167.366	-0.110	0.000	0.00	0.0	0.0	O K
4.002	166.501	-0.158	0.000	0.00	0.0	0.1	O K
1.004	165.268	-0.152	0.000	0.01	0.0	0.5	O K
1.005	164.007	-0.153	0.000	0.01	0.0	0.6	O K
1.006	162.857	-0.153	0.000	0.01	0.0	0.6	O K
6.000	163.541	-0.109	0.000	0.00	0.0	0.0	O K
6.001	162.231	-1.050	0.000	0.00	0.0	0.0	O K
1.007	162.187	-0.085	0.000	0.05	0.0	0.6	O K
1.008	162.165	-0.074	0.000	0.56	0.0	7.2	O K

Philip S Ryley & Co		Page 4
Wards End Chambers Wards End Halifax	Proposed Development Land Off Brookfields Rd Wyke, Bradford	
Date 21.09.2010 File 8444_ RP30_ SD10080_ W.SIM	Designed By PH Checked By	
Micro Drainage	Simulation W.11.2	

Rainfall Hyetograph

Region FSR - England & Wales Profile Type Winter
 Return Period (yrs) 30 Storm Duration (mins) 10080
 M5-60 (mm) 19.000
 Ratio R 0.325

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
24	0.02	1320	0.31	2616	0.46	3912	1.19	5208	1.76
48	0.02	1344	0.31	2640	0.49	3936	1.20	5232	1.76
72	0.02	1368	0.31	2664	0.49	3960	1.26	5256	1.74
96	0.02	1392	0.31	2688	0.49	3984	1.26	5280	1.73
120	0.08	1416	0.31	2712	0.49	4008	1.26	5304	1.73
144	0.09	1440	0.31	2736	0.52	4032	1.26	5328	1.73
168	0.09	1464	0.31	2760	0.53	4056	1.32	5352	1.71
192	0.09	1488	0.31	2784	0.53	4080	1.32	5376	1.68
216	0.12	1512	0.31	2808	0.53	4104	1.32	5400	1.68
240	0.15	1536	0.31	2832	0.55	4128	1.32	5424	1.68
264	0.15	1560	0.31	2856	0.57	4152	1.38	5448	1.67
288	0.15	1584	0.31	2880	0.57	4176	1.39	5472	1.64
312	0.16	1608	0.31	2904	0.57	4200	1.39	5496	1.64
336	0.19	1632	0.32	2928	0.58	4224	1.39	5520	1.64
360	0.19	1656	0.32	2952	0.62	4248	1.43	5544	1.64
384	0.19	1680	0.32	2976	0.62	4272	1.46	5568	1.58
408	0.20	1704	0.32	3000	0.62	4296	1.46	5592	1.58
432	0.23	1728	0.32	3024	0.62	4320	1.46	5616	1.58
456	0.23	1752	0.32	3048	0.67	4344	1.48	5640	1.58
480	0.23	1776	0.32	3072	0.67	4368	1.52	5664	1.53
504	0.23	1800	0.32	3096	0.67	4392	1.52	5688	1.52
528	0.26	1824	0.32	3120	0.67	4416	1.52	5712	1.52
552	0.26	1848	0.32	3144	0.72	4440	1.53	5736	1.52
576	0.26	1872	0.32	3168	0.73	4464	1.58	5760	1.48
600	0.26	1896	0.32	3192	0.73	4488	1.58	5784	1.46
624	0.27	1920	0.33	3216	0.73	4512	1.58	5808	1.46
648	0.28	1944	0.33	3240	0.76	4536	1.58	5832	1.46
672	0.28	1968	0.33	3264	0.79	4560	1.64	5856	1.43
696	0.28	1992	0.33	3288	0.79	4584	1.64	5880	1.39
720	0.29	2016	0.33	3312	0.79	4608	1.64	5904	1.39
744	0.29	2040	0.34	3336	0.81	4632	1.64	5928	1.39
768	0.29	2064	0.34	3360	0.85	4656	1.67	5952	1.38
792	0.29	2088	0.34	3384	0.85	4680	1.68	5976	1.32
816	0.30	2112	0.34	3408	0.85	4704	1.68	6000	1.32
840	0.30	2136	0.36	3432	0.86	4728	1.68	6024	1.32
864	0.30	2160	0.36	3456	0.91	4752	1.71	6048	1.32
888	0.30	2184	0.36	3480	0.91	4776	1.73	6072	1.26
912	0.30	2208	0.36	3504	0.91	4800	1.73	6096	1.26
936	0.31	2232	0.37	3528	0.91	4824	1.73	6120	1.26
960	0.31	2256	0.38	3552	0.98	4848	1.74	6144	1.26
984	0.31	2280	0.38	3576	0.98	4872	1.76	6168	1.20
1008	0.31	2304	0.38	3600	0.98	4896	1.76	6192	1.19
1032	0.31	2328	0.39	3624	0.98	4920	1.76	6216	1.19
1056	0.31	2352	0.40	3648	1.03	4944	1.76	6240	1.19
1080	0.31	2376	0.40	3672	1.05	4968	1.78	6264	1.14
1104	0.31	2400	0.40	3696	1.05	4992	1.78	6288	1.11
1128	0.31	2424	0.41	3720	1.05	5016	1.78	6312	1.11
1152	0.31	2448	0.43	3744	1.09	5040	1.78	6336	1.11
1176	0.31	2472	0.43	3768	1.11	5064	1.78	6360	1.09
1200	0.31	2496	0.43	3792	1.11	5088	1.78	6384	1.05
1224	0.31	2520	0.43	3816	1.11	5112	1.78	6408	1.05
1248	0.31	2544	0.46	3840	1.14	5136	1.78	6432	1.05
1272	0.31	2568	0.46	3864	1.19	5160	1.76	6456	1.03
1296	0.31	2592	0.46	3888	1.19	5184	1.76	6480	0.98

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

Designed By PH

File 8444_ RP30_ SD10080_ W.SIM

Checked By

Micro Drainage

Simulation W.11.2



Rainfall Hyetograph

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
6504	0.98	7224	0.57	7944	0.36	8664	0.31	9384	0.29
6528	0.98	7248	0.57	7968	0.36	8688	0.31	9408	0.28
6552	0.98	7272	0.55	7992	0.34	8712	0.31	9432	0.28
6576	0.91	7296	0.53	8016	0.34	8736	0.31	9456	0.28
6600	0.91	7320	0.53	8040	0.34	8760	0.31	9480	0.27
6624	0.91	7344	0.53	8064	0.34	8784	0.31	9504	0.26
6648	0.91	7368	0.52	8088	0.33	8808	0.31	9528	0.26
6672	0.86	7392	0.49	8112	0.33	8832	0.31	9552	0.26
6696	0.85	7416	0.49	8136	0.33	8856	0.31	9576	0.26
6720	0.85	7440	0.49	8160	0.33	8880	0.31	9600	0.23
6744	0.85	7464	0.49	8184	0.33	8904	0.31	9624	0.23
6768	0.81	7488	0.46	8208	0.32	8928	0.31	9648	0.23
6792	0.79	7512	0.46	8232	0.32	8952	0.31	9672	0.23
6816	0.79	7536	0.46	8256	0.32	8976	0.31	9696	0.20
6840	0.79	7560	0.46	8280	0.32	9000	0.31	9720	0.19
6864	0.76	7584	0.43	8304	0.32	9024	0.31	9744	0.19
6888	0.73	7608	0.43	8328	0.32	9048	0.31	9768	0.19
6912	0.73	7632	0.43	8352	0.32	9072	0.31	9792	0.16
6936	0.73	7656	0.43	8376	0.32	9096	0.31	9816	0.15
6960	0.72	7680	0.41	8400	0.32	9120	0.31	9840	0.15
6984	0.67	7704	0.40	8424	0.32	9144	0.31	9864	0.15
7008	0.67	7728	0.40	8448	0.32	9168	0.31	9888	0.12
7032	0.67	7752	0.40	8472	0.32	9192	0.30	9912	0.09
7056	0.67	7776	0.39	8496	0.31	9216	0.30	9936	0.09
7080	0.62	7800	0.38	8520	0.31	9240	0.30	9960	0.09
7104	0.62	7824	0.38	8544	0.31	9264	0.30	9984	0.08
7128	0.62	7848	0.38	8568	0.31	9288	0.30	10008	0.02
7152	0.62	7872	0.37	8592	0.31	9312	0.29	10032	0.02
7176	0.58	7896	0.36	8616	0.31	9336	0.29	10056	0.02
7200	0.57	7920	0.36	8640	0.31	9360	0.29	10080	0.02

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP100_ SD15_ W.SIM

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Micro Drainage

Simulation W.11.2



Global Variables

Region	FSR - England & Wales
Return Period (yrs)	100
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	15
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1 Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers

Wards End

Halifax

Proposed Development

Land Off Brookfields Rd

Wyke, Bradford

Date 21.09.2010

File 8444_ RP100_ SD15_ W.SIM

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Micro Drainage

Simulation W.11.2


**Micro
Drainage®**
On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	2.0	6.8
								2.2	7.1
								0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_RP100_SD15_W.SIM

Designed By PH

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Micro Drainage

Simulation W.11.2



Summary of Results

Return Period (years)	100	Analysis Time Step	Fine
Storm Duration (mins)	15	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.839	-0.011	0.000	0.90	0.0	7.9	O K
1.001	166.709	0.017	0.000	1.05	0.0	9.3	SURCH'ED
2.000	166.892	-0.087	0.000	0.10	0.0	1.5	O K
1.002	166.449	-0.054	0.000	0.51	0.0	10.8	O K
3.000	166.217	-0.033	0.000	0.07	0.0	1.5	O K
3.001	166.209	0.535	0.000	1.15	0.0	20.8	SURCH'ED
1.003	166.062	0.500	0.000	2.11	0.0	39.1	SURCH'ED
4.000	167.684	-0.066	0.000	0.34	0.0	3.0	O K
4.001	167.544	-0.066	0.000	0.34	0.0	7.0	O K
5.000	167.385	-0.091	0.000	0.07	0.0	1.5	O K
4.002	166.550	-0.109	0.000	0.23	0.0	12.5	O K
1.004	165.387	-0.033	0.000	0.97	0.0	50.8	O K
1.005	164.109	-0.051	0.000	0.80	0.0	52.7	O K
1.006	163.338	0.328	0.000	0.85	0.0	51.8	SURCH'ED
6.000	163.565	-0.085	0.000	0.12	0.0	3.5	O K
6.001	163.190	-0.091	0.000	0.00	0.0	0.8	O K
1.007	163.190	0.918	0.000	0.37	0.0	4.8	SURCH'ED
1.008	162.197	-0.042	0.000	0.89	0.0	11.4	O K

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Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_ RP100_ SD15_ W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Rainfall Hyetograph

Region	FSR - England & Wales	Profile Type	Winter
Return Period (yrs)	100	Storm Duration (mins)	15
M5-60 (mm)	19.000		
Ratio R	0.325		

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	20.65	4	49.69	7	185.20	10	130.12	13	39.25
2	37.68	5	80.42	8	215.12	11	80.42	14	37.69
3	39.25	6	130.12	9	185.20	12	49.69	15	20.65

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP100_ SD120_ W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


Global Variables

Region	FSR - England & Wales
Return Period (yrs)	100
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	120
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1_Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers
Wards End
Halifax

Proposed Development
Land Off Brookfields Rd
Wyke, Bradford

Date 21.09.2010

File 8444_ RP100_ SD120_ W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


On-Line Controls (Hydro-Brake®)

US/PN	Volume (m ³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

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Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_ RP100_ SD120_ W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100	Analysis Time Step	Fine
Storm Duration (mins)	120	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.781	-0.069	0.000	0.30	0.0	2.7	O K
1.001	166.627	-0.065	0.000	0.36	0.0	3.2	O K
2.000	166.882	-0.097	0.000	0.03	0.0	0.5	O K
1.002	166.424	-0.079	0.000	0.18	0.0	3.7	O K
3.000	166.152	-0.098	0.000	0.02	0.0	0.5	O K
3.001	165.587	-0.087	0.000	0.42	0.0	7.7	O K
1.003	165.508	-0.054	0.000	0.77	0.0	14.2	O K
4.000	167.665	-0.085	0.000	0.11	0.0	1.0	O K
4.001	167.525	-0.085	0.000	0.11	0.0	2.3	O K
5.000	167.377	-0.099	0.000	0.02	0.0	0.5	O K
4.002	166.528	-0.131	0.000	0.08	0.0	4.2	O K
1.004	165.325	-0.095	0.000	0.35	0.0	18.4	O K
1.005	164.065	-0.095	0.000	0.29	0.0	19.1	O K
1.006	164.052	1.042	0.000	0.31	0.0	18.9	FLD RISK
6.000	163.859	0.209	0.000	0.04	0.0	1.2	SURCH'ED
6.001	163.895	0.614	14.419	0.00	0.0	5.7	FLOOD
1.007	164.230	1.958	3.726	0.45	0.0	5.8	FLOOD
1.008	162.205	-0.034	0.000	0.97	0.0	12.4	O K

Philip S Ryley & Co		Page 4
Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_ RP100_ SD120_ W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Rainfall Hyetograph

Region	FSR - England & Wales	Profile Type	Winter
Return Period (yrs)	100	Storm Duration (mins)	120
M5-60 (mm)	19.000		
Ratio R	0.325		

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
4	3.32	28	12.45	52	48.03	76	40.03	100	11.08
8	8.16	32	15.16	56	54.91	80	32.30	104	10.73
12	10.22	36	19.39	60	59.79	84	25.31	108	10.73
16	10.73	40	25.31	64	59.79	88	19.39	112	10.22
20	10.73	44	32.30	68	54.91	92	15.16	116	8.16
24	11.08	48	40.03	72	48.03	96	12.45	120	3.32

Philip S Ryley & Co		Page 1
Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_ RP100_ SD10080_ W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Global Variables

Region	FSR - England & Wales
Return Period (yrs)	100
M5-60 (mm)	19.000
Ratio R	0.325
Volumetric Runoff Coef	0.840
Profile Type	Winter
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	10080
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	20
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	2

Starting Storm file name

D:\Work\UK-WORK\PSR\8000\8444-Wake\Microdrainage\1_Working
Folder\1_Surface\1_Drawnet\8444-Surface drainage Final.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D,L (mm)	B (mm)
1.008	OF	165.037	162.069	225	0

Wards End Chambers

Wards End

Halifax

Proposed Development

Land Off Brookfields Rd

Wyke, Bradford

Date 21.09.2010

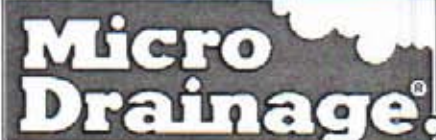
File 8444_ RP100_ SD10080_ W.SIM

Designed By PH

Checked By

Micro Drainage

Simulation W.11.2


**Micro
Drainage®**

On-Line Controls (Hydro-Brake®)

US/PN	Volume (m³)	Ctrl MH Name	Invert (m)	Type	Dia (m)	D.Head (m)	D.Flow (l/s)	Headloss (m)	Flow (l/s)
1.006	0.087	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1
6.001	19.051	8	162.112	Md6 SW Only	0.092	1.100	5.0	0.1	2.7
								0.2	3.9
								0.3	3.7
								0.4	3.5
								0.5	3.6
								0.6	3.8
								0.7	4.1
								0.8	4.3
								0.9	4.6
								1.0	4.8
								1.2	5.3
								1.4	5.7
								1.6	6.1
								1.8	6.5
								2.0	6.8
								2.2	7.1

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Wards End Chambers Wards End Halifax	Proposed Development Land Off Brookfields Rd Wyke, Bradford	
Date 21.09.2010 File 8444_ RP100_ SD10080_ W.SIM	Designed By PH Checked By	
Micro Drainage	Simulation W.11.2	

Summary of Results

Return Period (years)	100	Analysis Time Step	Fine
Storm Duration (mins)	10080	DTS Status	ON
Profile Type	Winter	DVD Status	OFF
Margin for Flood Risk warning (mm)	200	Inertia Status	OFF

PN	Water Lev. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/ Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	166.746	-0.104	0.000	0.01	0.0	0.1	O K
1.001	166.589	-0.103	0.000	0.01	0.0	0.1	O K
2.000	166.870	-0.109	0.000	0.00	0.0	0.0	O K
1.002	166.396	-0.107	0.000	0.01	0.0	0.1	O K
3.000	166.140	-0.110	0.000	0.00	0.0	0.0	O K
3.001	165.525	-0.149	0.000	0.02	0.0	0.3	O K
1.003	165.419	-0.143	0.000	0.03	0.0	0.5	O K
4.000	167.642	-0.108	0.000	0.00	0.0	0.0	O K
4.001	167.502	-0.108	0.000	0.00	0.0	0.1	O K
5.000	167.366	-0.110	0.000	0.00	0.0	0.0	O K
4.002	166.501	-0.158	0.000	0.00	0.0	0.1	O K
1.004	165.269	-0.151	0.000	0.01	0.0	0.7	O K
1.005	164.008	-0.152	0.000	0.01	0.0	0.7	O K
1.006	162.859	-0.151	0.000	0.01	0.0	0.7	O K
6.000	163.541	-0.109	0.000	0.00	0.0	0.0	O K
6.001	162.231	-1.050	0.000	0.00	0.0	0.0	O K
1.007	162.194	-0.078	0.000	0.06	0.0	0.7	O K
1.008	162.166	-0.073	0.000	0.58	0.0	7.3	O K

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Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_ RP100_ SD10080_ W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Rainfall Hyetograph

Region FSR - England & Wales Profile Type Winter
 Return Period (yrs) 100 Storm Duration (mins) 10080
 M5-60 (mm) 19.000
 Ratio R 0.325

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
24	0.03	1320	0.38	2616	0.55	3912	1.41	5208	2.10
48	0.03	1344	0.37	2640	0.58	3936	1.43	5232	2.10
72	0.03	1368	0.37	2664	0.59	3960	1.50	5256	2.08
96	0.03	1392	0.37	2688	0.59	3984	1.50	5280	2.06
120	0.09	1416	0.37	2712	0.59	4008	1.50	5304	2.06
144	0.11	1440	0.37	2736	0.62	4032	1.50	5328	2.06
168	0.11	1464	0.37	2760	0.63	4056	1.58	5352	2.04
192	0.11	1488	0.37	2784	0.63	4080	1.58	5376	2.01
216	0.15	1512	0.37	2808	0.63	4104	1.58	5400	2.01
240	0.17	1536	0.37	2832	0.65	4128	1.58	5424	2.01
264	0.17	1560	0.37	2856	0.69	4152	1.65	5448	2.00
288	0.17	1584	0.37	2880	0.69	4176	1.66	5472	1.95
312	0.20	1608	0.37	2904	0.69	4200	1.66	5496	1.95
336	0.23	1632	0.38	2928	0.70	4224	1.66	5520	1.95
360	0.23	1656	0.38	2952	0.74	4248	1.71	5544	1.95
384	0.23	1680	0.38	2976	0.74	4272	1.74	5568	1.89
408	0.24	1704	0.38	3000	0.74	4296	1.74	5592	1.89
432	0.27	1728	0.38	3024	0.74	4320	1.74	5616	1.89
456	0.27	1752	0.38	3048	0.80	4344	1.77	5640	1.89
480	0.27	1776	0.38	3072	0.80	4368	1.82	5664	1.83
504	0.27	1800	0.38	3096	0.80	4392	1.82	5688	1.82
528	0.31	1824	0.38	3120	0.80	4416	1.82	5712	1.82
552	0.31	1848	0.39	3144	0.86	4440	1.83	5736	1.82
576	0.31	1872	0.39	3168	0.87	4464	1.89	5760	1.77
600	0.31	1896	0.39	3192	0.87	4488	1.89	5784	1.74
624	0.33	1920	0.39	3216	0.87	4512	1.89	5808	1.74
648	0.33	1944	0.40	3240	0.91	4536	1.89	5832	1.74
672	0.33	1968	0.40	3264	0.94	4560	1.95	5856	1.71
696	0.33	1992	0.40	3288	0.94	4584	1.95	5880	1.66
720	0.34	2016	0.40	3312	0.94	4608	1.95	5904	1.66
744	0.35	2040	0.41	3336	0.97	4632	1.95	5928	1.66
768	0.35	2064	0.41	3360	1.01	4656	2.00	5952	1.65
792	0.35	2088	0.41	3384	1.01	4680	2.01	5976	1.58
816	0.35	2112	0.41	3408	1.01	4704	2.01	6000	1.58
840	0.36	2136	0.43	3432	1.03	4728	2.01	6024	1.58
864	0.36	2160	0.43	3456	1.09	4752	2.04	6048	1.58
888	0.36	2184	0.43	3480	1.09	4776	2.06	6072	1.50
912	0.36	2208	0.43	3504	1.09	4800	2.06	6096	1.50
936	0.37	2232	0.44	3528	1.09	4824	2.06	6120	1.50
960	0.37	2256	0.45	3552	1.17	4848	2.08	6144	1.50
984	0.37	2280	0.45	3576	1.17	4872	2.10	6168	1.43
1008	0.37	2304	0.45	3600	1.17	4896	2.10	6192	1.41
1032	0.37	2328	0.46	3624	1.17	4920	2.10	6216	1.41
1056	0.37	2352	0.48	3648	1.23	4944	2.11	6240	1.41
1080	0.37	2376	0.48	3672	1.25	4968	2.13	6264	1.36
1104	0.37	2400	0.48	3696	1.25	4992	2.13	6288	1.33
1128	0.37	2424	0.48	3720	1.25	5016	2.13	6312	1.33
1152	0.38	2448	0.51	3744	1.30	5040	2.13	6336	1.33
1176	0.38	2472	0.51	3768	1.33	5064	2.13	6360	1.30
1200	0.38	2496	0.51	3792	1.33	5088	2.13	6384	1.25
1224	0.38	2520	0.51	3816	1.33	5112	2.13	6408	1.25
1248	0.38	2544	0.55	3840	1.36	5136	2.13	6432	1.25
1272	0.38	2568	0.55	3864	1.41	5160	2.11	6456	1.23
1296	0.38	2592	0.55	3888	1.41	5184	2.10	6480	1.17

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Wards End Chambers	Proposed Development	
Wards End	Land Off Brookfields Rd	
Halifax	Wyke, Bradford	
Date 21.09.2010	Designed By PH	
File 8444_ RP100_ SD10080_ W.SIM	Checked By	
Micro Drainage	Simulation W.11.2	

Rainfall Hyetograph

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
6504	1.17	7224	0.69	7944	0.43	8664	0.37	9384	0.34
6528	1.17	7248	0.69	7968	0.43	8688	0.37	9408	0.33
6552	1.17	7272	0.65	7992	0.41	8712	0.37	9432	0.33
6576	1.09	7296	0.63	8016	0.41	8736	0.37	9456	0.33
6600	1.09	7320	0.63	8040	0.41	8760	0.37	9480	0.33
6624	1.09	7344	0.63	8064	0.41	8784	0.38	9504	0.31
6648	1.09	7368	0.62	8088	0.40	8808	0.38	9528	0.31
6672	1.03	7392	0.59	8112	0.40	8832	0.38	9552	0.31
6696	1.01	7416	0.59	8136	0.40	8856	0.38	9576	0.31
6720	1.01	7440	0.59	8160	0.40	8880	0.38	9600	0.27
6744	1.01	7464	0.58	8184	0.39	8904	0.38	9624	0.27
6768	0.97	7488	0.55	8208	0.39	8928	0.38	9648	0.27
6792	0.94	7512	0.55	8232	0.39	8952	0.38	9672	0.27
6816	0.94	7536	0.55	8256	0.39	8976	0.37	9696	0.24
6840	0.94	7560	0.55	8280	0.38	9000	0.37	9720	0.23
6864	0.91	7584	0.51	8304	0.38	9024	0.37	9744	0.23
6888	0.87	7608	0.51	8328	0.38	9048	0.37	9768	0.23
6912	0.87	7632	0.51	8352	0.38	9072	0.37	9792	0.20
6936	0.87	7656	0.51	8376	0.38	9096	0.37	9816	0.17
6960	0.86	7680	0.48	8400	0.38	9120	0.37	9840	0.17
6984	0.80	7704	0.48	8424	0.38	9144	0.37	9864	0.17
7008	0.80	7728	0.48	8448	0.38	9168	0.37	9888	0.15
7032	0.80	7752	0.48	8472	0.38	9192	0.36	9912	0.11
7056	0.80	7776	0.46	8496	0.37	9216	0.36	9936	0.11
7080	0.74	7800	0.45	8520	0.37	9240	0.36	9960	0.11
7104	0.74	7824	0.45	8544	0.37	9264	0.36	9984	0.09
7128	0.74	7848	0.45	8568	0.37	9288	0.35	10008	0.03
7152	0.74	7872	0.44	8592	0.37	9312	0.35	10032	0.03
7176	0.70	7896	0.43	8616	0.37	9336	0.35	10056	0.03
7200	0.69	7920	0.43	8640	0.37	9360	0.35	10080	0.03

