

**SURFACE & FOUL WATER DRAINAGE STRATEGY
FOR
PHASE 3
PROPOSED RESIDENTIAL DEVELOPMENT,
OFF WIGNALS GATE, HOLBEACH,
LINCOLNSHIRE**

PROJECT No: 36916

DOCUMENT REF: 36916-REP-01C

DATE: JAN. 2021

For D Brown Builders



Revisions:

- A – SRC Drawings Updated
- B – Drainage Strategy Generally Updated
- C – Minor Amendment To Drainage Layout

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1. INTRODUCTION

The following drainage strategy has been prepared on behalf of D. Brown Building Contractors Ltd. to support a full planning application for Phase 3 of the proposed residential development, at Land off Wignals Gate, Holbeach.

This strategy is based upon Andrew M Wright Ltd. Site Layout drawing 071605-PD102-D2, included within Appendix A.

The object of this report is to clarify the design philosophy followed when preparing the proposed surface & foul water drainage arrangement and to outline the proposed solution in sufficient detail for all relevant parties to be able to comment. This assessment also demonstrates that the proposals are within the guidance contained with the National Planning Policy Framework (NPPF).

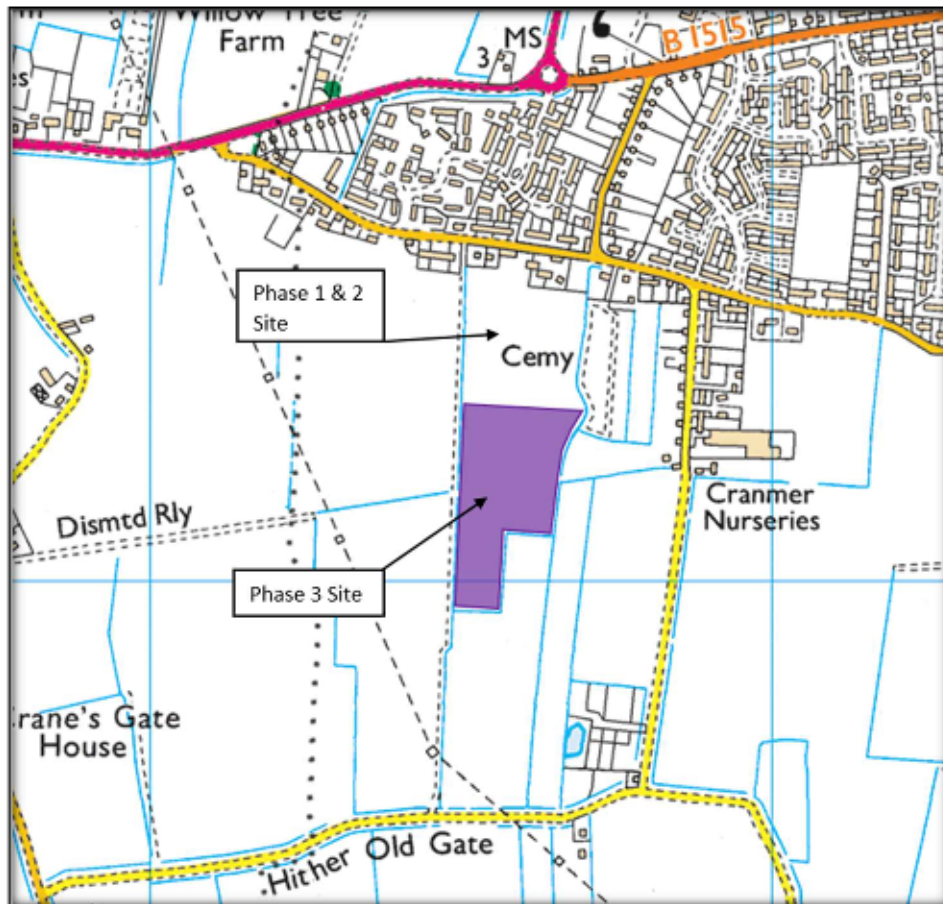
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2. LOCATION & SITE DESCRIPTION

See Appendix A for the proposed Block plan.

2.1 Site Location

The phase 3 site is approximately 4.636 hectare in size and is located off Wignals Gate, Holbeach, National Grid reference TF 345242.



2.2 Site Description

The site is located to the South of Wignals Gate and is accessed from the Phase 1 & 2 part of the development. The site is bound by Phases 1 & 2 to the North, South Holland IDB maintained watercourse to the East, and agricultural land to the South & West.

The site is a greenfield site used for agriculture and is accessed via the adjacent fields.

The topographical survey indicates that the site is flat, with no predominant falls, levels range between 2.5m & 2.8m AOD.

2.3 Site Geology

Ground investigations to determine soil infiltration rates took place on site, the location and results are attached within Appendix B. These results demonstrate that the soil infiltration rate is relatively poor and although they would be acceptable for the individual private plot drainage, they would be inadequate to provide infiltration as a disposal method for the Highway surface water.

2.4 Site Proposals

The Phase 3 part of the development is an extension to the South of the previously approved Phase 1 & 2. It is proposed that an additional 27 dwellings are to be provided. These will be accessed via either the previously approved Highway or an additional section of Highway to be adopted by Lincolnshire County Council.

The Andrew M Wright Ltd. Site Layout drawing 071605-PD102-D2, illustrates the proposal and is contained within Appendix A.

3. FLOOD RISK

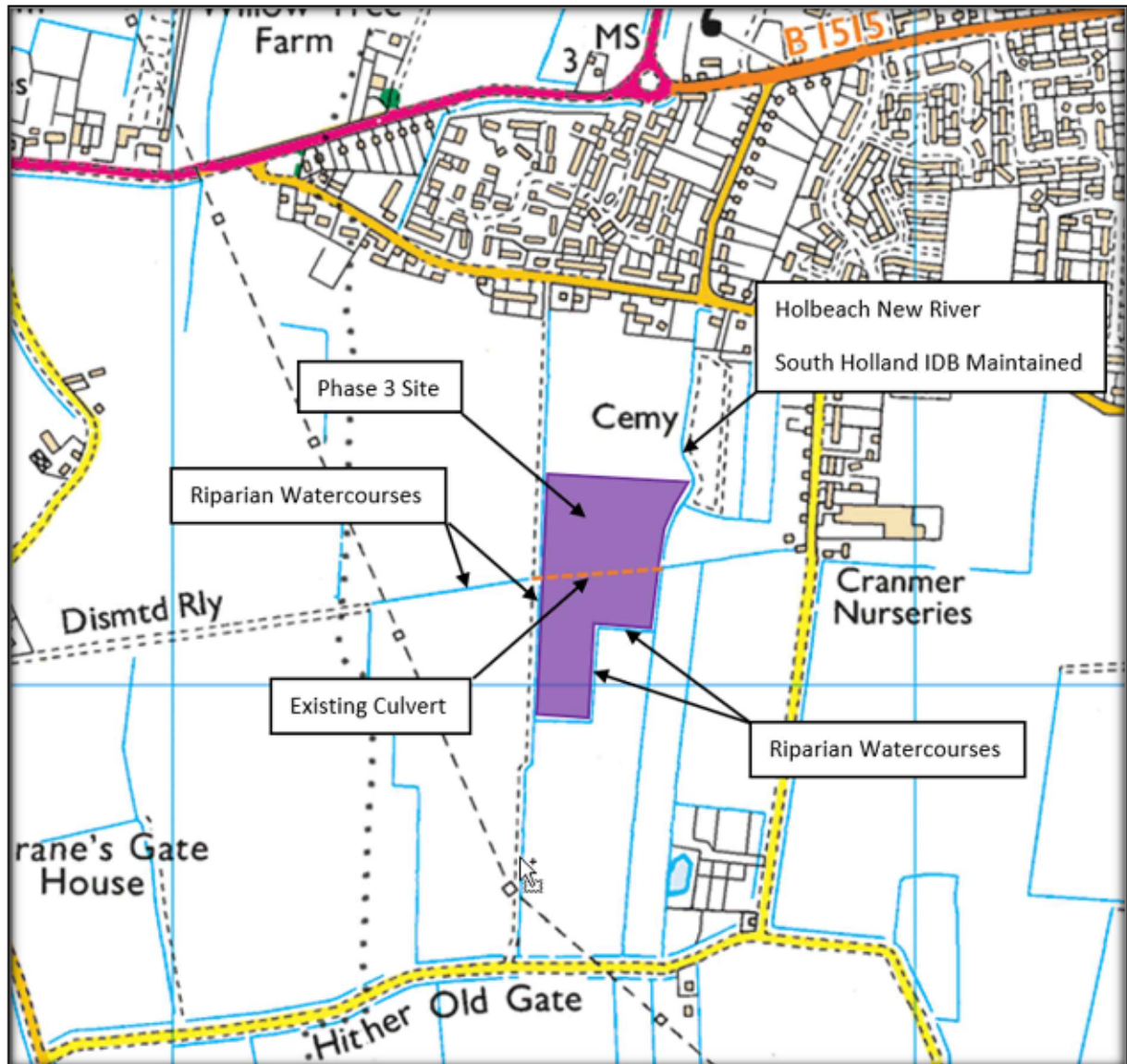
A site-specific flood risk assessment has been and identified that floor levels are to be raised 0.3m above the existing site level.

In reality floor levels for the Phase 3 part of the development will be raised further to enable a gravity discharge of the foul water system to be achieved, this will be discussed further within this report.

4. SURFACE WATER

4.1 Existing Surface Water

The site is located within South Holland Internal Drainage Board district. The below map shows the maintained watercourse local to the site.



There is an existing maintained watercourse, Holbeach New River, to the Eastern site boundary. This watercourse is approximately 2.2m deep with a bed level of approximately 0.3m AOD.

As the bed level is approximately 3.4m below the proposed furthest Highway road level, connection to the watercourse at a high level should be possible to prevent the proposed drainage system surcharging excessively.

The Highway drainage system for the Phase 1 & 2 elements of the development is a traditional system that utilises gullies and a pipe network beneath the carriageway.

The private plot drainage in the previous phases utilised infiltration, via permeable driveway and soakaways for the dwelling roofs located in the rear gardens.

4.2 SuDS Considerations

The SuDS hierarchy has been given consideration during the proposed drainage design, with the preferential hierarchy considered as follows:

- Infiltration
- Watercourse
- Surface Water Sewer
- Combined Sewer

The sites geotechnical characteristics do not lend themselves to the use of a site wide infiltration-based strategy, due to the underlying strata & relatively high-water table/poor infiltration. However, it may be possible to use infiltration for drainage features at a high level.

However, the adjacent South Holland IDB maintained watercourse to the East lends itself for the surface water discharge from the proposed development. The appropriate South Holland IDB consents would be obtained at the detailed design stage.

The use of various on-site SuDS features has been explored to improve the water quality of discharge from the site. The following hierarchy has been given consideration during the proposed drainage design.

Most Sustainable  Least Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviers	✓	✓	
	Tanked systems - over-sized pipes/tanks - storms cells	✓		

Living roofs have been considered inappropriate for the proposed development due to the style of housing to be provided.

The proposed site levels do create a nominal gradient which could lend itself to the use of basins and ponds. Their use will be explored and introduced within the public open space provided by the development.

Filter strips and swales could be a viable option for collecting the proposed highway surface water run-off. Due to the ground water level within the area these may have to be lined with an impermeable membrane and designed to convey water as opposed to infiltration. Their use would improve the water quality and slow down run-off into the proposed downstream network.

Permeable surfaces to the proposed driveways will be explored. As the existing site levels are to be raised, it should be possible to utilise the sites infiltration potential as these features would be suitably position above the ground water level. Permeable surfacing of the adoptable Highway will not be feasible due to the poor CBR value and LCC Highways design criteria with regards to this.

If the above solutions cannot be accommodated to attenuate the surface water run-off a tanked system could be introduced.

4.3 Surface Water Proposals

As discussed previously a site wide infiltration strategy cannot be introduced surface water is to be discharged into the maintained watercourse to the West.

The site area is 4.636 hectare, therefore as demonstrated by the following QBar calculations existing run off totals 6.7 litres per second.

SRC Ltd.		Page 1
15 High Street	Phase 3	
Spalding, Lincs	Wignals Gate	
PE11 1TW	Holbeach	
Date 06/05/2021 15:31	Designed by MP	
File	Checked by SRC	
XP Solutions		Source Control 2019.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	4.636	Urban	0.000
SAAR (mm)	573	Region Number	Region 5

Results l/s

QBAR Rural	6.7
QBAR Urban	6.7
Q100 years	23.8
Q1 year	5.8
Q30 years	16.1
Q100 years	23.8

However, it has been determined that a flow restriction of 5 litres per second would be more appropriate given the proposed site area to the South which is to remain as soft landscaping.

Therefore, a HydroBrake will be introduced into the downstream elements of the proposed drainage system to reduce flows to a maximum of 5 litres per second.

To attenuate the flows above 5 litres per second a number of devices will be introduced upstream to attenuate the additional flows.

The drainage arrangement drawing 36916/501 included within Appendix C demonstrates the sites surface water drainage proposals. Three separate areas of rainfall catchment within Phase 3 part of the development are identified:

1. Area A – Adoptable Highway,
2. Area B – Driveways / Shared accesses &
3. Area C – Dwelling Roofs

As discussed previously the potential use of infiltration for all the drainage elements is not possible. However, as the site is being raised to suit floor levels & the foul water drainage network it is possible to utilise infiltration for the Areas B & C.

Permeable paving is to be used for the private drives and shared accesses. It will be possible to maintain a minimum of 1m to the ground water table, for these features as the site is to be raised. As noted in the CIRIA SuDS Manual 2015, the use of permeable paving decreases concentrations of a range of surface water pollutants including, heavy metals, oil and grease, sediment, and some nutrients.

Soakaways will be used for Area C, dwelling roofs. It will be possible to locate these in the rear gardens, as they are generously sized so distances to dwellings and boundaries can be achieved in accordance with BRE365. Furthermore, as the site levels are to be raised, it will be possible to maintain a minimum of 1m to the ground water table. The proposed roof areas will be drained via rainwater pipes and underground networks local to each plot prior to discharging to their soakaway.

As a result of the above infiltration devices Area A only is to discharge by the restricted flow into the IDB maintained watercourse.

It is proposed that a filter strip and filter drain is to be located adjacent to the majority of the proposed phase 3 highway. This will collect the run-off from the surface of the adjacent footpaths and carriageways, and provide cleaning at source as the run-off passes the filter strip and soaks into the lined open graded stone material and perforated pipe. This in itself provides two treatment trains to the majority of the surfacing indicated by Area A on the proposed drainage arrangement drawing

36916/501 included within Appendix C. This drawing also shows the typical filter drain construction.

The length of proposed highway local to plots 70 to 72 does not lend itself to the introduction of a filter drain. Incorporating a filter drain in this location would greatly decrease the front gardens to these plots, and setting these plots further from the highway would alter the 'building line' compared to the proposed dwellings constructed within Phase 2. Therefore, it is proposed to drain this short section of highway via gullies. Cleaning of the surface water catchment will still be provided by the filter drain these gullies will discharge to, and the online attenuation basin.

A detention basin is to be located within the public open space to provide attenuation for flows in excess of 5 litres per second. This is online and provides additional source control through the proposed planting to the dry flow channel within the basin bed. The planting is to be in accordance with the CIRIA SuDS Manual 2015, with the vegetation at a suitable level for the 1:1 year event to provide pollutant removal of the surface water run-off. A typical basin cross section is shown on drawing 36916/501.

The system has been modelled utilising MicroDrainage and the calculation inputs and outputs are included within our calculation package 36916-MD-01C, contained with Appendix D. These calculations demonstrate that the run-off will be safely conveyed and attenuated during storms up to and including the 1 in 100 year event plus climate change allowance. The system has no flooding within events up to and including the 1:30 year return period. There is limited flooding within the 1:100 year plus climate change event, this flooding will be stored with the filter strip stone which has not been modelled at this stage.

The development proposals will require the existing piped culvert running from the West to the East of the site to be altered. As shown on drawing 36916/501 it is proposed that the existing riparian watercourse local to the site boundaries are improved to a suitable level to enable a discharge to the existing IDB watercourse. A relatively small section of open watercourse will be created across the site to connect two of the existing riparian watercourses.

4.4 Overland Exceedance Route

With regard to exceedance routing, drawing 36916/501 within Appendix C shows the overland flood flow route of the system, in the event of failure through blockage. As the site is to be raised to a greater extent on the Western side, this creates an overland flood route to the IDB system to the East via the public open space.

5. FOUL WATER

5.1 Existing Foul Water

There is an existing Anglian Water foul sewer local to the site which has been constructed as part of the Phase 1 & 2 works. This is shown on our drawing 36916/501.

5.2 Foul Water Proposals

Drawing 36916 / 501 demonstrates that the Anglian Water foul sewer which has been constructed during the Phase 1 & 2 works, is at an adequate depth to allow the proposed Phase 3 to drain via gravity.

It is necessary that site levels are to be raised to a certain extent to suit the Flood Risk Assessment and to allow the Highway drainage to outfall to the existing watercourse. This allows adequate cover to be provided over the proposed foul sewer in the South West corner of the site.

The proposed foul water sewer extension is be offered for adoption by Anglian Water as part of a further Section 104 agreement.

6. MAINTENANCE STRATEGY

The proposed foul and surface water drainage systems are to be maintained and owned by several different parties.

Four parties will be responsible for different elements of the drainage system. The assets are all required to be in reasonable working order for the systems to function as a whole and operate as anticipated in design models. Each parties' responsibilities are listed below:

1. Anglian Water:

- Foul water underground pipe network and chambers

These features will be adopted by Anglian Water Services Ltd under an agreement pursuant to Section 104 of the Water Industry Act.

2. LCC Highways:

- Carriageway
- Filter strips and filter drains
- Perforated pipes and inspection chambers
- HydroBrake flow control device
- Headwall

These features will be adopted by Lincolnshire County Council Highways under a Section 38 agreement.

3. Management Company:

- Detention basin
- Public open space (overland flood route)
- Shared driveways
- Riparian watercourse

4. Private Plot Owners:

- Permeable driveway construction
- Buried pipe networks and chambers local to plot
- Gutters, downpipes and other building rainwater goods

The scope/nature of inspection and maintenance is such that various facilities and structures are inspected and maintained at yearly intervals, as well as after or during use and/or heavy storms, in order that they continue to perform effectively.

The maintenance schedule for the foul water system, should as a minimum consist of annual inspections and 5 yearly rodding/jetting should no issue be encountered.

The maintenance schedule for the surface water system will comprise the following activities in accordance with the CIRIA publication C753 (The SuDS Manual)

Activity	Frequency	Typical Tasks
Routine/regular maintenance (including inspections and monitoring)	Monthly	- Litter/debris removal - Grass cutting (in season) - Inspection and clearance of gullies and drainage channels - Inspection of pumping station
Occasional maintenance	Annually	- Silt removal from catchpits/gullies - Pipe drainage every 3-5 years: suction sweeping (to Water Jetting Association standards) and CCTV where necessary
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)	- Silt removal - Inlet/outlet repair - Erosion repairs - System rehabilitation following a pollution event - Pump failure

On completion of the above, ensure the drainage system is running freely and cleanly. If not, repeat maintenance activities. Written records should be kept of all maintenance work carried out.

7. CONCLUSIONS

As illustrated by our design proposals on drawing 36916/501, surface water calculations and the information outlined within this report, it is demonstrable that a viable and robust surface water scheme that complies with the requirements of National Planning Guidance can be provided for the proposed residential development.

For and on behalf of **SIDEBOTTOM RICHARDSON CHENG LTD**

M PETT

26th May 2021

Approved By: J.A. RICHARDSON | Eng. AMIStructE

APPENDIX A – Site Layout Plan

All drawings to be worked on site by those Contractors taking the lead of the work and the responsibility of the work shall remain with the lead Contractor and not the architect.

Report any discrepancies to the Contract Administrator at once.

This drawing is to be used with all relevant Architects and Engineers drawings and other relevant information.

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LEGEND: DO NOT SCALE

Affordable dwellings
(affordable ownership or rent)

13 no. bungalows (2 bed)

2 no. bungalows (2 bed)

4 no. 2 storey houses (1 bed)

28 no. bungalows (3 bed)
(with single or double garage)

4 no. 2 storey houses (2 bed)

8 no. 2 storey houses (2 bed)

14 no. 2 storey houses (4 bed)
(with double garage)

1 no. 2 storey house (4 bed)

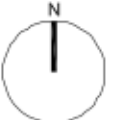
26 no. 2 storey houses (3 bed)
(with single or double garage)

4 no. 2 storey houses (3 bed)

Public open space

RCP Refuse collection point

Total no. of dwellings = 104



20	31.11.20	2020	2020
20	31.11.20	2020	2020
20	31.11.20	2020	2020
20	31.11.20	2020	2020

ANDREW M WRIGHT LTD
CHARTERED ARCHITECT



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Telephone: 01827 540073 Mobile: 07560 914778

Project:
Residential Development
Wigwags Gate
Holebeach
Lincs

Drawing Title:
Proposed Site Layout

Client:
Loosegate Developments Ltd

Drawn	Checked	Date	Scale	Project Date
AMW	AMW	03.11.20	1:1000	A1
07/1605	PD/02	Planning		D2



APPENDIX B – Ground Investigations



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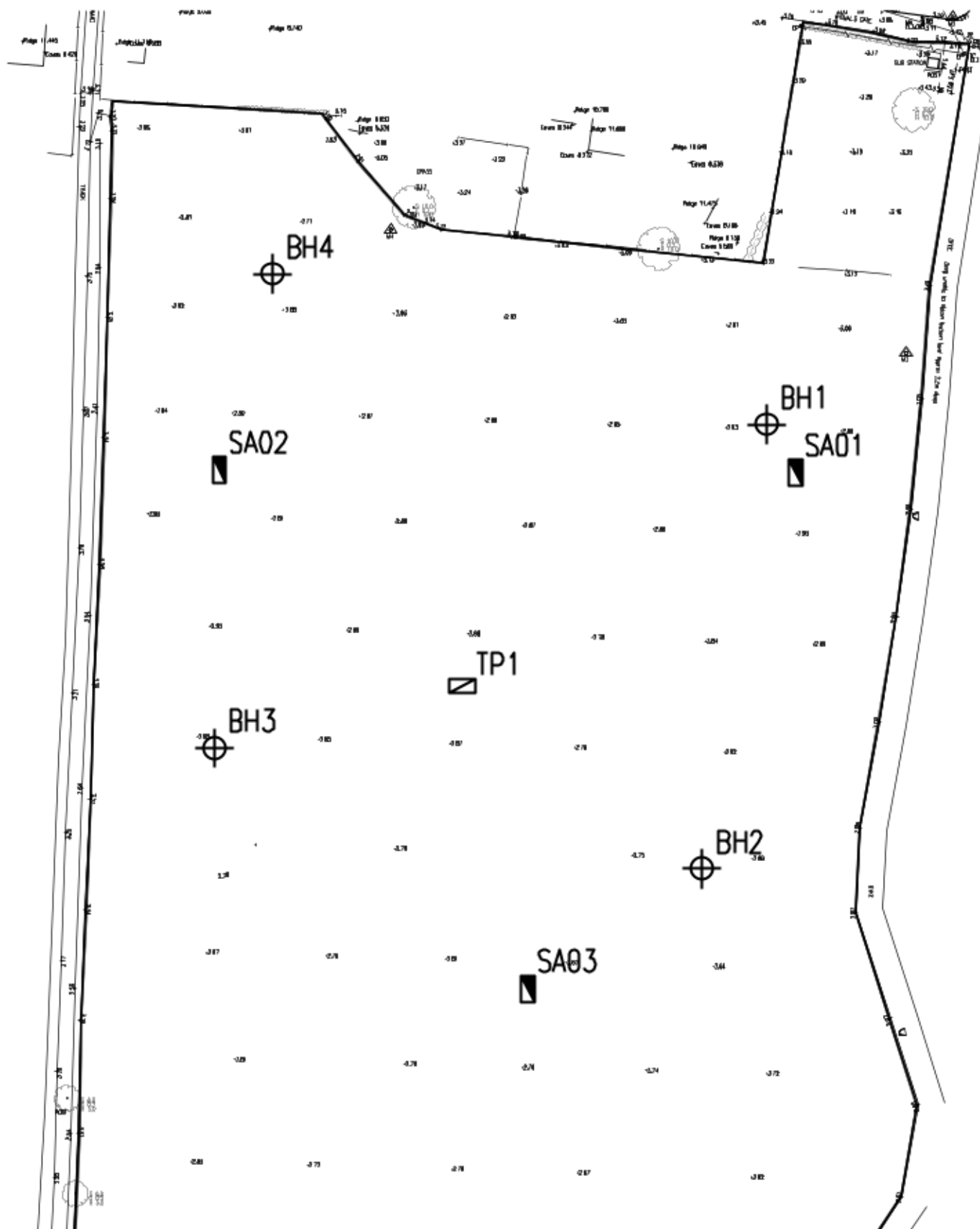
36916-SK02

Project

**Proposed Residential
Development off Wignals Gate,
Holbeach, Lincs.**

Title

**Plan Showing Ground Investigation
Trial Locations**



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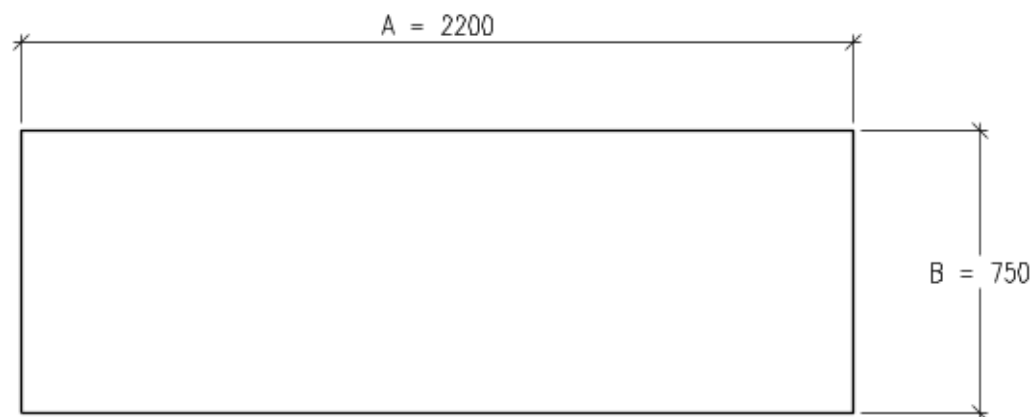
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Project

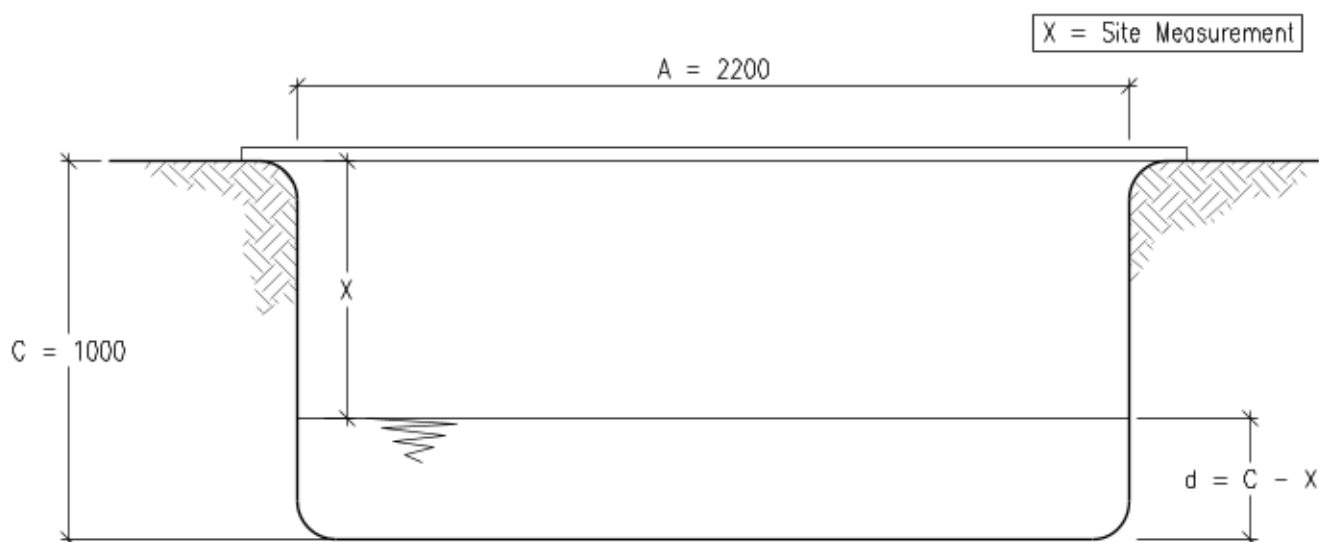
**Proposed Residential
Development off Wignals Gate,
Holbeach, Lincs.**

Title

Infiltration Soak Away Sketch



Plan On SA01



Section Through SA01

Soak-Away Test SA01

Job Reference Proposed Residential Development off
Wignals Gate, Holbeach, Lincs.

SA01	
TIME (Mins)	DEPTH mm (d)
0	320
10	310
40	305
70	290
110	290
145	280
180	270
215	260
275	255
320	240

Job No. 36916

Date 22/03/2018

Trial Dimensions

A = 2.2 m
B = 0.75 m
C = 1 m

C.S.Area of
SA01 = 1.65 m²

Total Volume = 0.132 m³
75% Volume = 0.099 m³
25% Volume = 0.033 m³

Time Taken From 75% Volume to 25% Volume

172 Mins

Effective Depth From 75% Volume to 25% Volume

0.04 m

50% Effective Internal Surface Area Including Base area

1.886 m²

Soil Infiltration rate, f

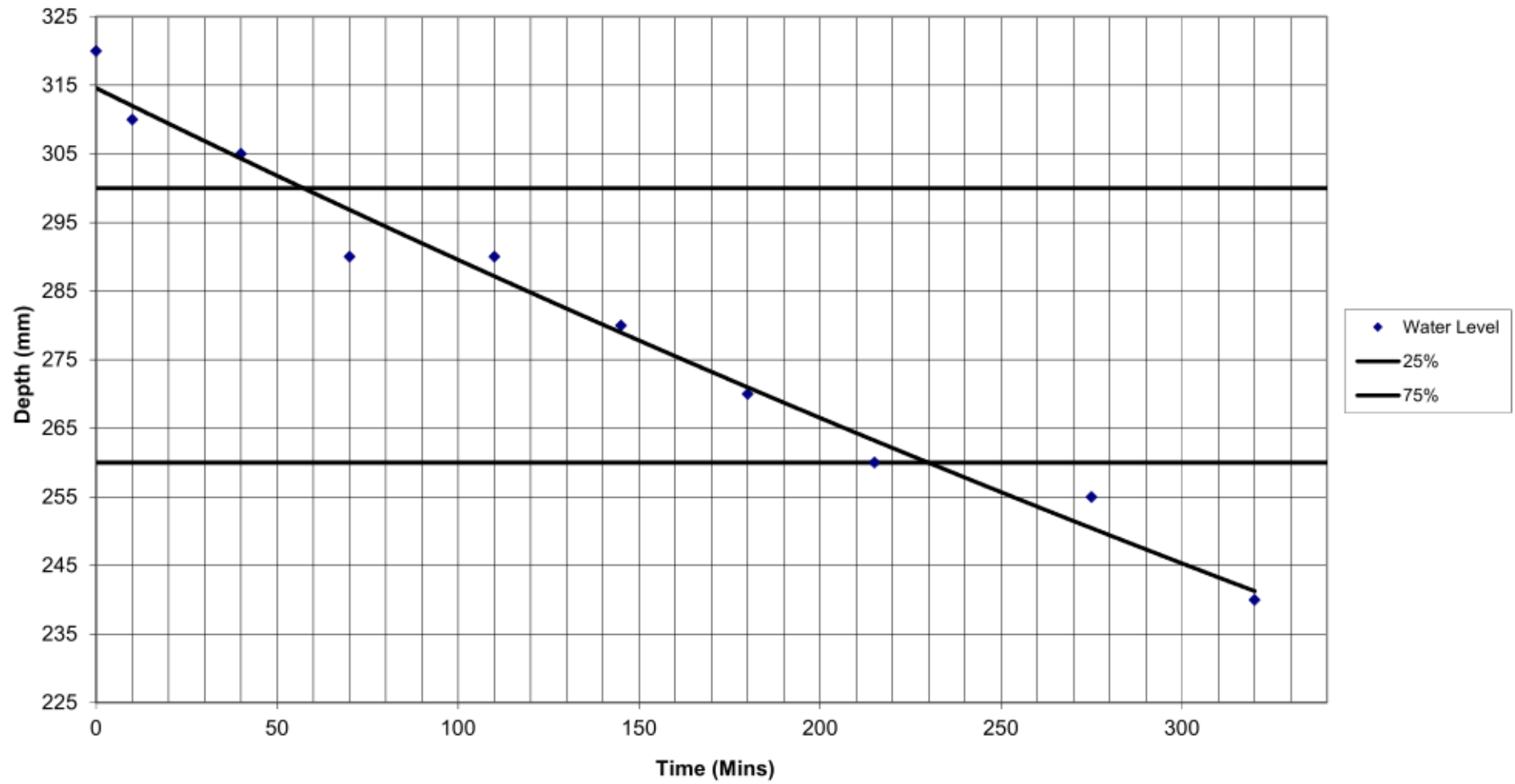
3.39096E-06 m/s

3.39 x 10⁻³ mm/s

Proposed Residential Development off Wignals Gate, Holbeach, Lincs.

Job No. 36916 22/03/18

Plot showing water level against time for SA01





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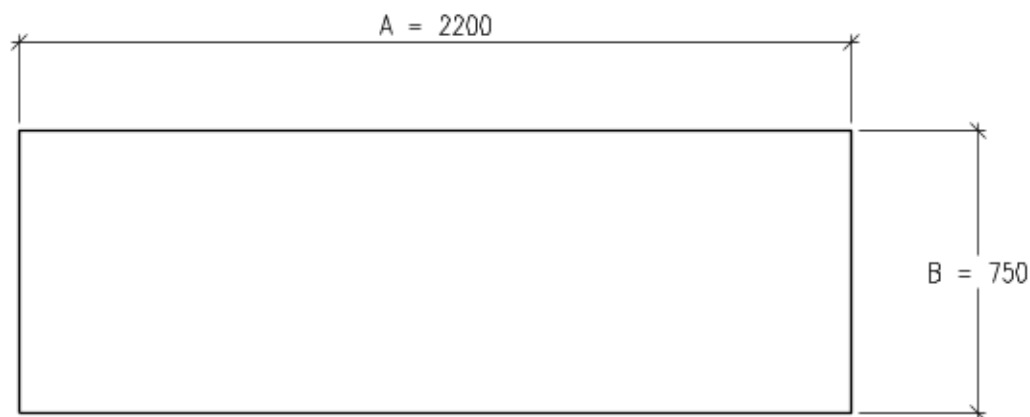
36916-SA02

Project

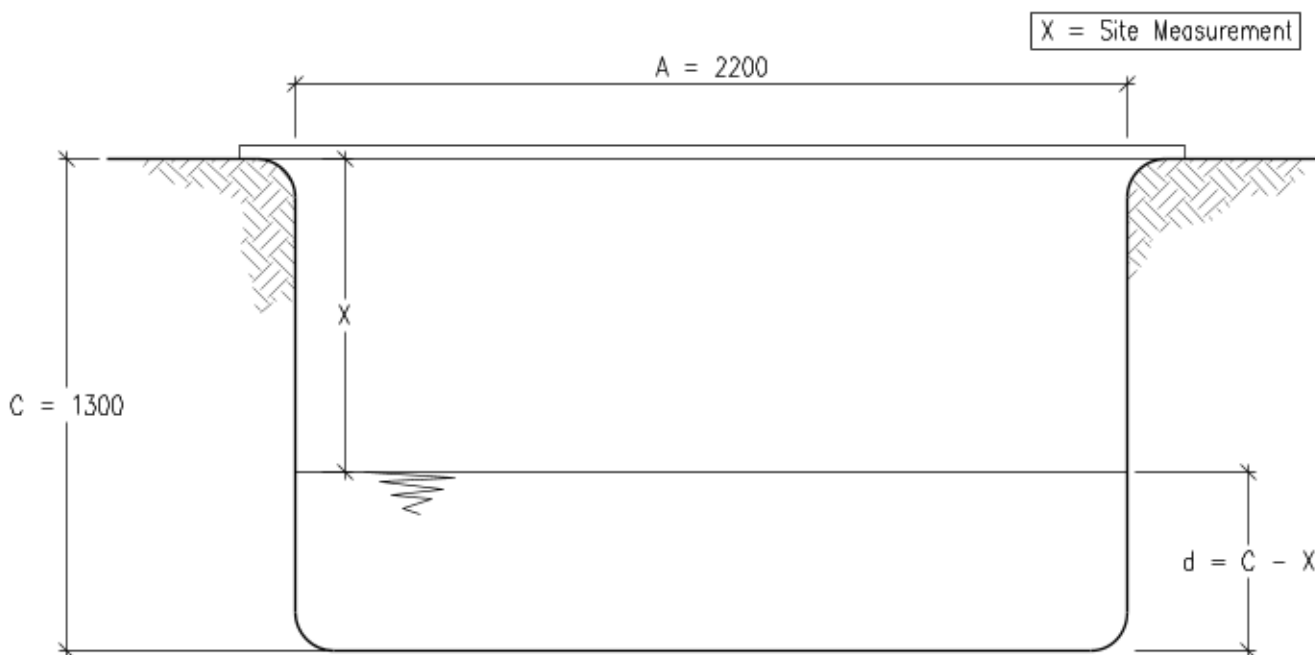
**Proposed Residential
Development off Wignals Gate,
Holbeach, Lincs.**

Title

Infiltration Soak Away Sketch



Plan On SA02



Section Through SA02

Soak-Away Test SA02

Job Reference Proposed Residential Development off
Wignals Gate, Holbeach, Lincs.

SA01	
TIME (Mins)	DEPTH mm (d)
0	475
15	430
35	410
80	400
110	385
145	375
180	350
205	340
235	330
275	325

Job No. 36916

Date 22/03/2018

Trial Dimensions

A = 2.2 m
B = 0.75 m
C = 1.3 m

C.S.Area of
SA01 = 1.65 m²

Total Volume = 0.248 m³
75% Volume = 0.186 m³
25% Volume = 0.062 m³

Time Taken From 75% Volume to 25% Volume

150 Mins

Effective Depth From 75% Volume to 25% Volume

0.075 m

50% Effective Internal Surface Area Including Base area

2.0925 m²

Soil Infiltration rate, f

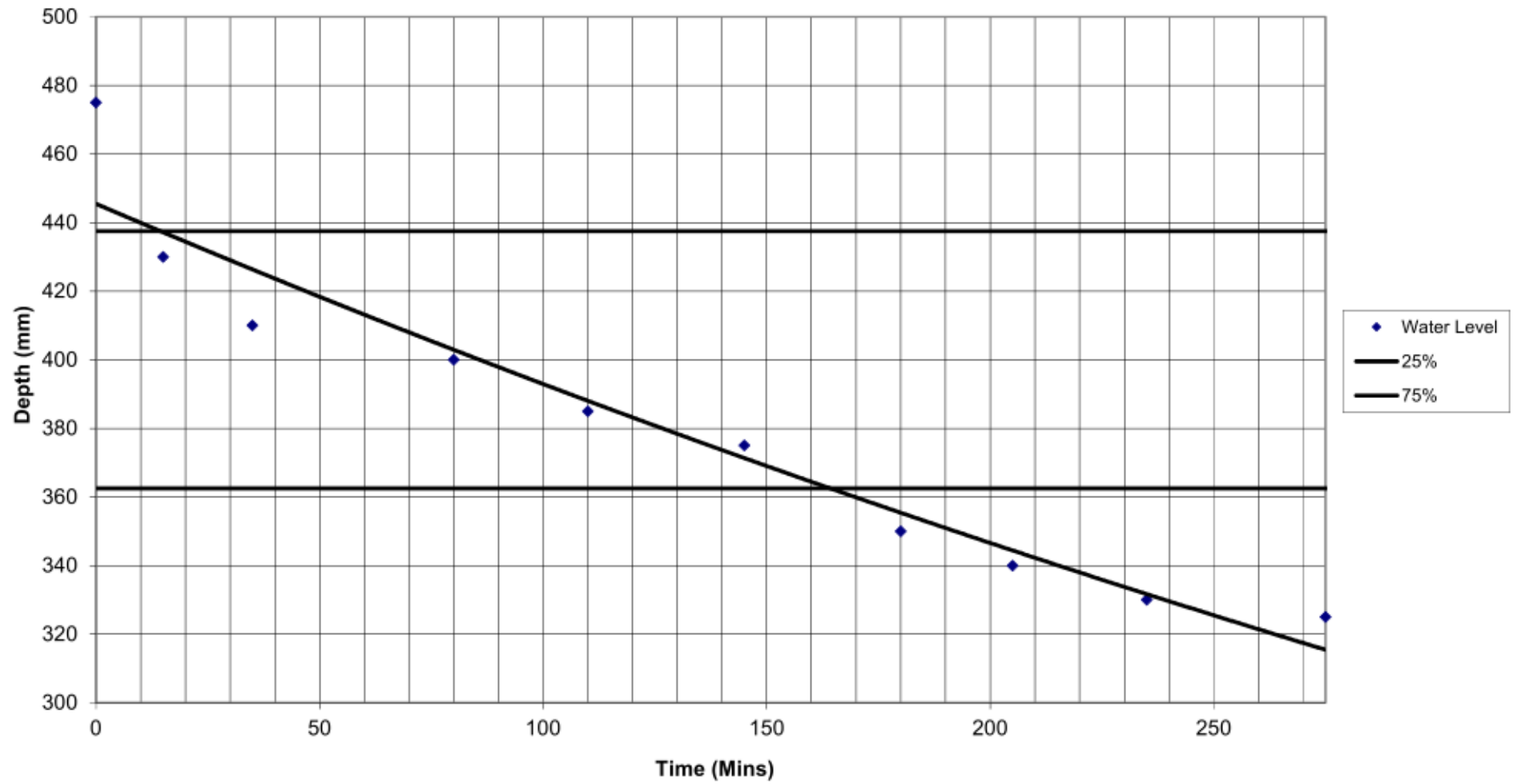
6.57109E-06 m/s

6.57 x 10⁻³ mm/s

Proposed Residential Development off Wignals Gate, Holbeach, Lincs.

Job No. 36916 22/03/18

Plot showing water level against time for SA02





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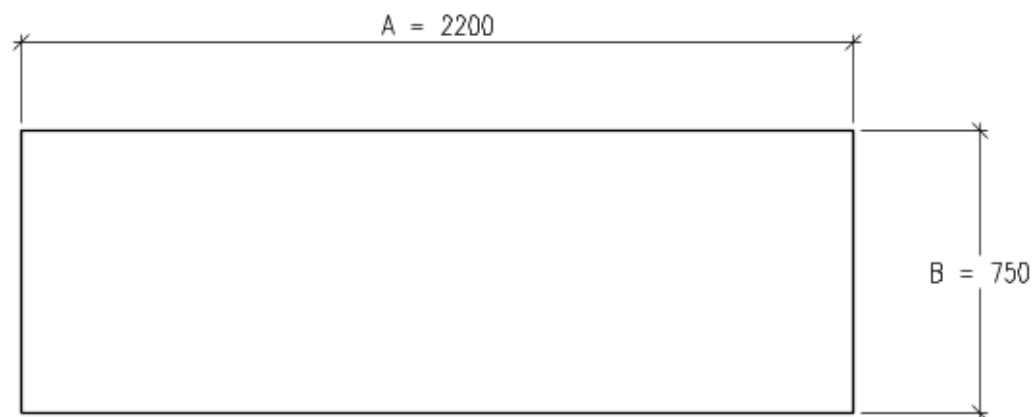
36916-SA03

Project

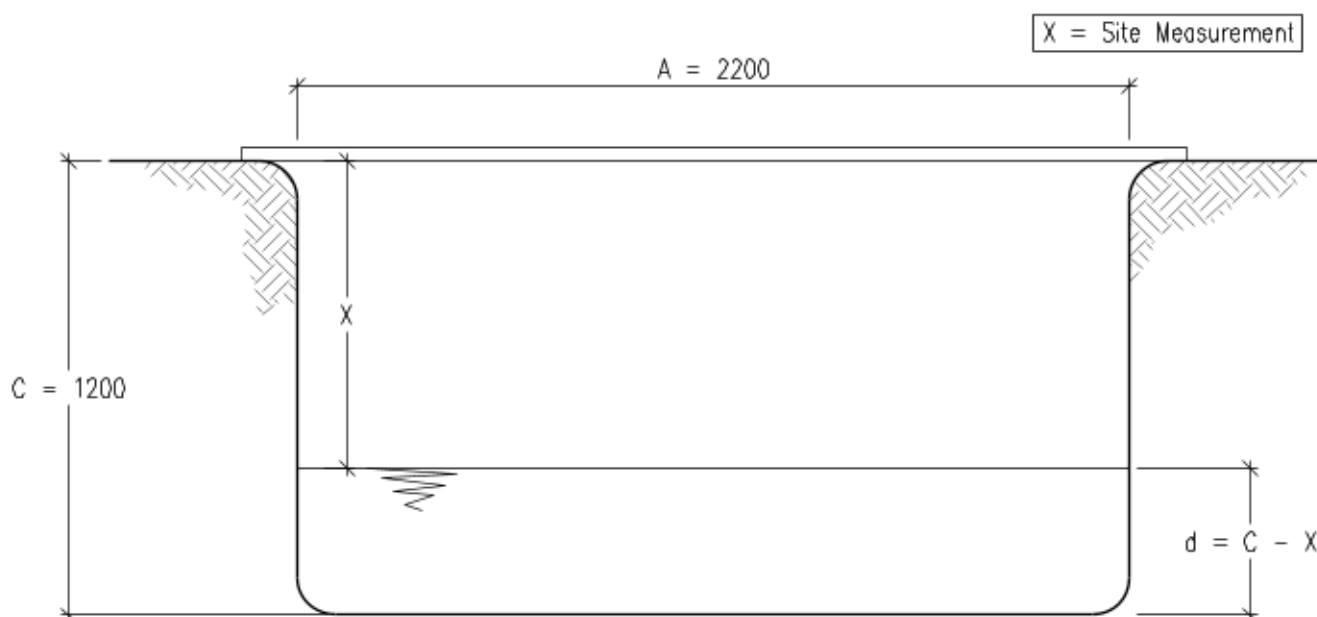
**Proposed Residential
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Holbeach, Lincs.**

Title

Infiltration Soak Away Sketch



Plan On SA03



Section Through SA03

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Soak-Away Test SA03

Job Reference Proposed Residential Development off
Wignals Gate, Holbeach, Lincs.

SA01	
TIME (Mins)	DEPTH mm (d)
0	390
25	385
60	380
90	375
130	370
185	365
230	360

Job No. 36916

Date 22/03/2018

Trial Dimensions

A = 2.2 m
B = 0.75 m
C = 1.2 m

C.S.Area of
SA01 = 1.65 m²

Total Volume = 0.050 m³
75% Volume = 0.037 m³
25% Volume = 0.012 m³

Time Taken From 75% Volume to 25% Volume

117 Mins

Effective Depth From 75% Volume to 25% Volume

0.015 m

50% Effective Internal Surface Area Including Base area

1.7385 m²

Soil Infiltration rate, f

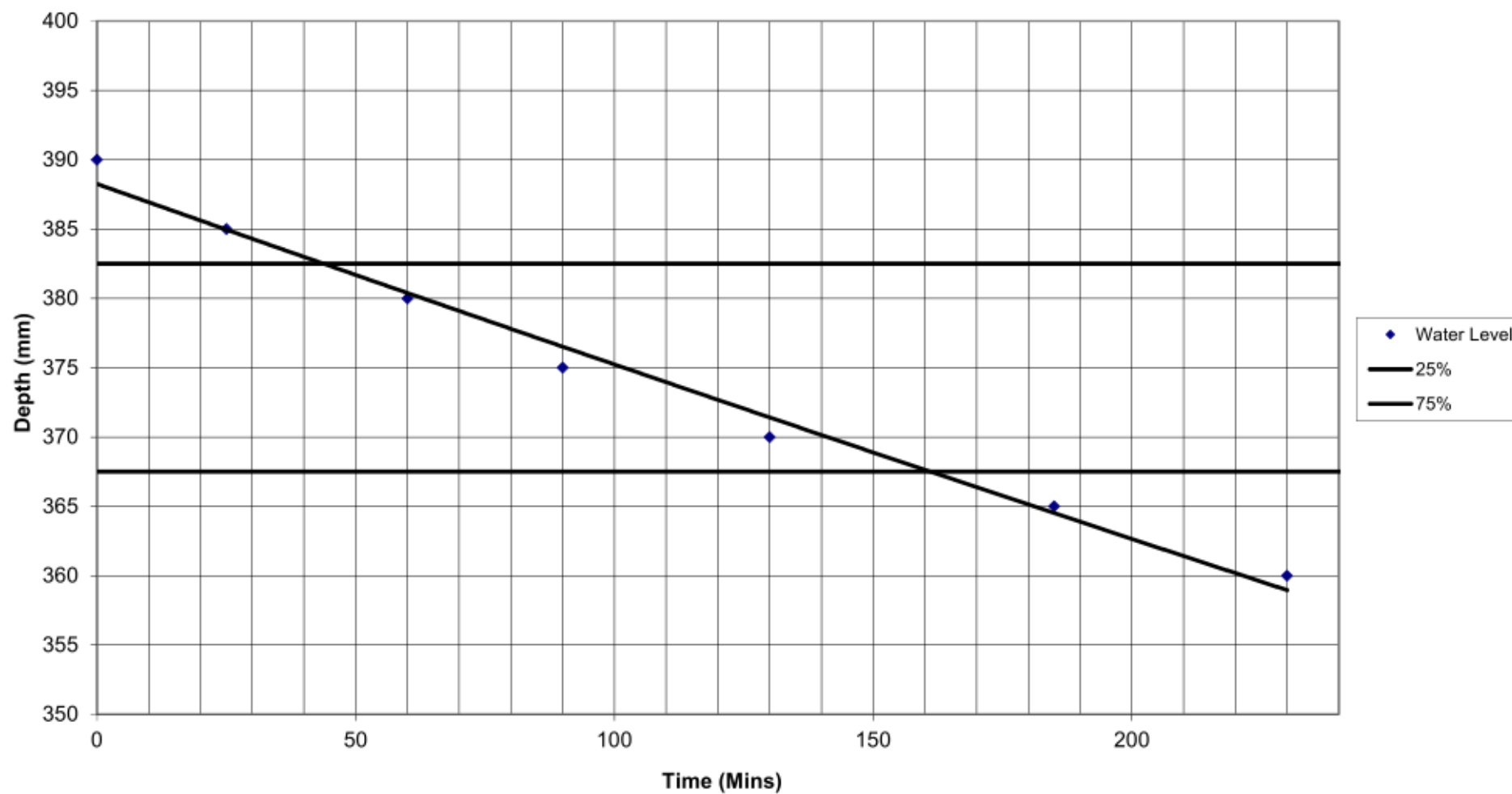
2.02798E-06 m/s

2.03 x 10⁻³ mm/s

Proposed Residential Development off Wignals Gate, Holbeach, Lincs.

Job No. 36916 22/03/18

Plot showing water level against time for SA03



Location Proposed Residential Development off Wignals Gate, Holbeach, Lincs.	Carried Out For D Brown Builders	Date Undertaken 22/03/18
		Logged By MP

Equipment & Methods 100mmØ HandAuger Mackintosh Probe	Site Coordinates:	Borehole No. 1
	Ground Level:	

Description	Reduced Level	Legend	Depth (Thick)	Samples			Test Required	M.P.I. Blow Count (Depth)
				Depth	Sample Reference	Sample Type No.		
Topsoil.			450mm					
Mid Brown Moist Fine Sandy Silt.			1200mm (750mm)					0.6m Below G.L. 92 Blows For 300mm Movement
Orangey Brown Moist Silty Sand, Becoming Coarser With Depth.			1700mm (500mm)					1.55m Below G.L. 100 Blows For 230mm Movement
Brown Wet Silty Sand.			1900mm (200mm)					

Remarks

Standing Water @ 1.6m.
Borehole Terminated @ 1.9m Due To Collapse/Strata Washing Out.

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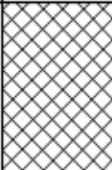
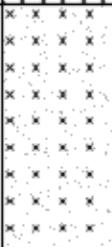
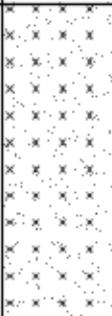
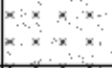
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Sheet No. 36916/BH02					Rev -	
Status FOR INFORMATION						
Date	Mar. '18	Drawn	MP	Checked	SRC	
Scale		Design	-	File Name	36916-BH02	

Location Proposed Residential Development off Wignals Gate, Holbeach, Lincs.	Carried Out For D Brown Builders	Date Undertaken 22/03/18
		Logged By MP

Equipment & Methods 100mmØ HandAuger Mackintosh Probe	Site Coordinates:	Borehole No. 2
	Ground Level:	

Description	Reduced Level	Legend	Depth (Thick)	Samples			Test Required	M.P.I. Blow Count (Depth)
				Depth	Sample Reference	Sample Type No.		
Topsoil.			450mm					
Orangey Brown Moist Sandy Silt.			1100mm (650mm)					0.6m Below G.L. 103 Blows For 300mm Movement 0.9m Below G.L. 97 Blows For 300mm Movement
Mid Brown Moist Silty Fine Sand, Becoming Sandier With Depth.			2100mm (1000mm)					1.2m Below G.L. 96 Blows For 300mm Movement 1.5m Below G.L. 96 Blows For 300mm Movement
Very Moist.			2300mm (200mm)					
Brown/Grey Wet Silt/Coarse Sand.								

Remarks
 Standing Water @ 1.6m After 1 Hour.
 Borehole Terminated @ 2.3m Due To Collapse/Strata Washing Out.

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Sheet No. 36916/BH03					Rev -	
Status FOR INFORMATION						
Date	Mar. '18	Drawn	MP	Checked	SRC	
Scale		Design	-	File Name	36916-BH03	

Location Proposed Residential Development off Wignals Gate, Holbeach, Lincs.	Carried Out For D Brown Builders	Date Undertaken 22/03/18
		Logged By MP

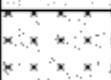
Equipment & Methods 100mmØ HandAuger Mackintosh Probe	Site Coordinates:	Borehole No. 3
	Ground Level:	

Description	Reduced Level	Legend	Depth (Thick)	Samples			Test Required	M.P.I. Blow Count (Depth)
				Depth	Sample Reference	Sample Type No.		
Topsoil.			500mm					
Orangey Brown Moist Sandy Silt.			1200mm (700mm)					0.6m Below G.L. 123 Blows For 300mm Movement 0.9m Below G.L. 62 Blows For 300mm Movement 1.2m Below G.L.
Orangey Brown Very Moist Silty Sand, Becoming Wetter & Coarser With Depth. @ 1700mm Black Inclusions With Tiny Shells.			2100mm (900mm)					45 Blows For 300mm Movement
Dark Brown Very Wet Silty Sand.			2300mm (200mm)					

Remarks Standing Water @ 1.4m After 1 Hour. Borehole Terminated @ 2.3m Due To Collapse/Strata Washing Out.

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Status FOR INFORMATION													
Date		Mar. '18		Drawn		MP		Checked		SRC			
Scale				Design		-		File Name		36916-BH04			
Location Proposed Residential Development off Wignals Gate, Holbeach, Lincs.				Carried Out For D Brown Builders				Date Undertaken 22/03/18					
								Logged By MP					
Equipment & Methods 100mmØ HandAuger Mackintosh Probe				Site Coordinates:				Borehole No. 4					
				Ground Level:									
Description	Reduced Level	Legend	Depth (Thick)	Samples				Test Required	M.P.I. Blow Count (Depth)				
				Depth	Sample Reference	Sample Type No.							
Topsoil.			500mm										
Orangey Moist Sand / Silt.			900mm (400mm)						0.6m Below G.L. 104 Blows For 300mm Movement				
Orangey Moist Silty Sand.			1200mm (300mm)						0.9m Below G.L. 70 Blows For 300mm Movement				
Brown Very Moist Fine Sandy Silt.			1600mm (400mm)						1.2m Below G.L. 34 Blows For 300mm Movement				
Brown Wet Sandy Silt.			1800mm (200mm)										
Remarks Standing Water @ 1.3m After 1 Hour. Borehole Terminated @ 1.8m Due To Collapse/Strata Washing Out.													

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File Name

36916-TP01

Location

**Proposed Residential
Development off Wignals Gate,
Holbeach, Lincs.**

Carried Out For

D Brown Builders

Date Undertaken

22/03/18

Logged By

MP

Equipment & Methods

Site Coordinates:

Trial Pit No.

Ground Level:

1

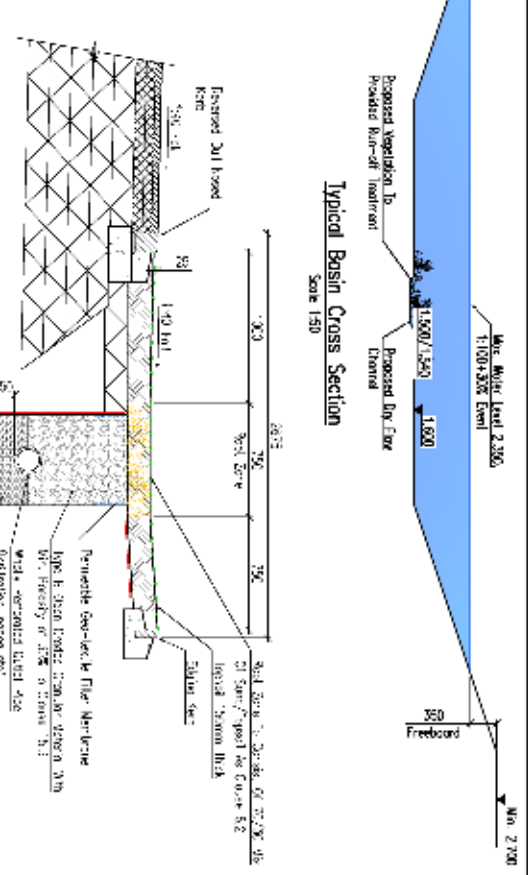
<u>Description</u>	<u>Reduced Level</u>	<u>Legend</u>	<u>Depth (Thick)</u>
Topsoil.			500mm
Mid Brown Moist Fine Sandy Silt.			1200mm (700mm)
Orangey Brown Moist Silty Sand.			2200mm (1000mm)
Very Moist Firm Grey Clayey Silt. Becoming Clayier With Depth.			2900mm (700mm)

Remarks

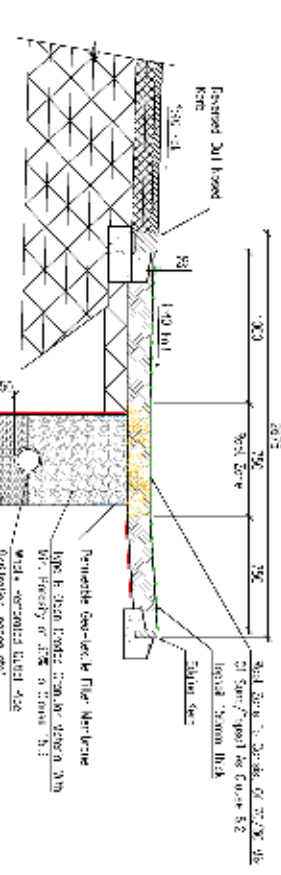
Trial Pit Terminated @ 2.9m.

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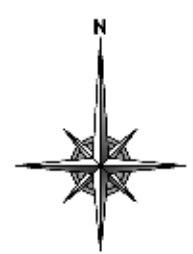
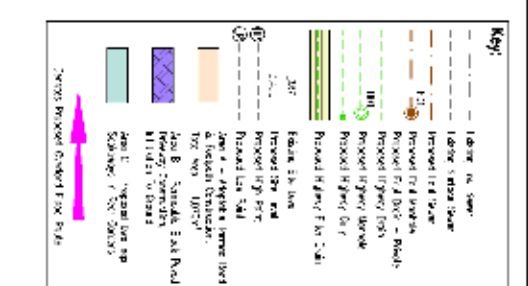
[APPENDIX C – Proposed Drainage Arrangement Drawing](#)



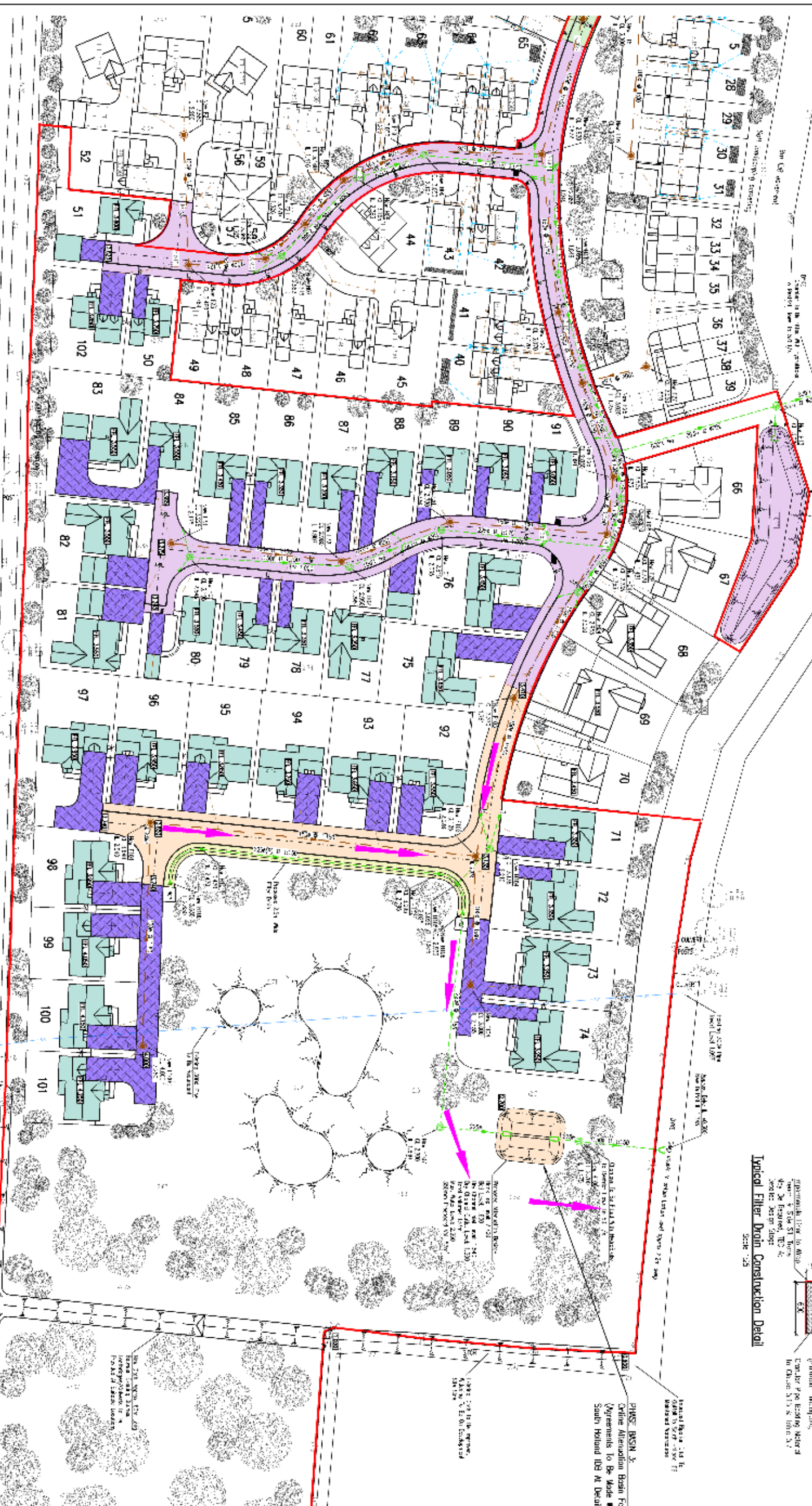
Typical Filter Drain Construction Detail



Typical Filter Drain Construction Detail



PROJECT: BASIN 3:
Online Attention Basin For Storage Of Orange Road Area
(Agreements To Be Made With ICG Highways &
South Holland IDG At Detailed Design Stage)



C	20.0.20	W/C Amendment to Design doc.
C	06.06.2	Points issued to make Tier 1 & 2's imperfect.
A	16.02.21	W/C Amendment
Draw	Rev	Notes

FOR PLANNING

Proposed Residential Development off Wignalls Gate,
Holbeach, Lincs.
For D Brown Builders

Phase 3
Proposed Drainage Layout



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APPENDIX D – MicroDrainage Calculations

Project: Proposed Residential Development off Wignals Gate, Holbeach

Title: Phase 3 Road Drainage Calculations

Project: Proposed Residential Development

Location: Wignals Gate, Holbeach, Lincs.

Client: D Brown Builders

Project Ref: 36916

Prepared By: M.Pett

Date: January 2021

Doc Ref: 36916-MD-01

Revision: C

Revisions:

- A – Basin Size Amended
- B – Drainage Design Amended To include Filter Drains
- C – Minor amendment to drainage layout.

Project: Proposed Residential Development off Wignals Gate, Holbeach

Calculation Summary:

The following calculations demonstrate the design of the surface water drainage system serving the adoptable Highway and footpath. The design proposals are shown on SRC drawing 36916/501.

The system has been designed for storms up to and including the 1:100yr +30% climate change event.

The majority of the Highway drainage is collected via filter drains, at this stage the storage associated with these structures have not been included within the calculations.

An online attenuation basin has been modelled on PN9.007, please refer to page 14 for details.

A proposed flow control has been incorporated within H108 to limit discharge to a maximum of 5 litres / second.

The system outfalls Holbeach New River which is maintained by South Holland IDB. A surcharged outfall has been modelled to suit the 1:100 year plus climate change level of 1.63 ODN.

The purpose of these calculation is to support the planning application and therefore they should not be used solely, for the detailed design/construction.

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Date 26/05/2021 14:31 File 36916-MD-01C.MDX	Designed by MP Checked by SRC
XP Solutions	Network 2019.1



STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
9.000	12.230	0.160	76.4	0.029	8.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.001	55.944	0.375	149.2	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.002	5.116	0.070	73.1	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
10.000	11.104	0.110	100.9	0.022	5.00	0.0	0.600	o	150	Pipe/Conduit	⚠
9.003	7.150	0.090	79.4	0.012	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.004	50.405	0.305	165.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.005	16.722	0.090	185.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.006	9.013	0.040	225.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.007	6.926	0.025	277.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	⚠
9.008	19.000	0.130	146.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	⚠

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E (m)	I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
9.000	75.00	8.14	2.630	0.029	0.0	0.0	0.0	1.50	59.5	5.8
9.001	75.00	9.01	2.470	0.082	0.0	0.0	0.0	1.07	42.5	16.7
9.002	75.00	9.06	2.095	0.096	0.0	0.0	0.0	1.53	60.9	19.4
10.000	75.00	5.19	2.210	0.022	0.0	0.0	0.0	1.00	17.7	4.4
9.003	75.00	9.15	2.025	0.129	0.0	0.0	0.0	1.47	58.4	26.2
9.004	75.00	9.97	1.935	0.129	0.0	0.0	0.0	1.01	40.3	26.2
9.005	75.00	10.27	1.630	0.129	0.0	0.0	0.0	0.96	38.0	26.2
9.006	75.00	10.44	1.540	0.129	0.0	0.0	0.0	0.87	34.5	26.2
9.007	75.00	10.59	1.500	0.129	0.0	0.0	0.0	0.78	31.0	26.2
9.008	75.00	10.97	1.475	0.129	0.0	0.0	0.0	0.83	14.7«	26.2

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Bac
H100	3.630	1.000	Open Manhole	1200	9.000	2.630	225				
H101	3.470	1.000	Open Manhole	1200	9.001	2.470	225	9.000	2.470	225	
H102	3.095	1.000	Open Manhole	1200	9.002	2.095	225	9.001	2.095	225	
H104	3.135	0.925	Open Manhole	1200	10.000	2.210	150				
H105	3.025	1.000	Open Manhole	1200	9.003	2.025	225	9.002	2.025	225	
								10.000	2.100	150	
H106	2.935	1.000	Open Manhole	1200	9.004	1.935	225	9.003	1.935	225	
H107	2.800	1.170	Open Manhole	1200	9.005	1.630	225	9.004	1.630	225	
Basin Inlet	2.700	1.160	Open Manhole	1200	9.006	1.540	225	9.005	1.540	225	
Basin Outlet	2.700	1.200	Open Manhole	1200	9.007	1.500	225	9.006	1.500	225	
H108	2.700	1.225	Open Manhole	1200	9.008	1.475	150	9.007	1.475	225	
	2.500	1.155	Open Manhole	0		OUTFALL		9.008	1.345	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
H100	534460387.395	324390282.729	534460387.395	324390282.729	Required	
H101	534460394.748	324390290.585	534460394.748	324390290.585	Required	
H102	534460450.391	324390284.795	534460450.391	324390284.795	Required	
H104	534460462.276	324390290.605	534460462.276	324390290.605	Required	
H105	534460454.766	324390282.425	534460454.766	324390282.425	Required	
H106	534460455.969	324390275.593	534460455.969	324390275.593	Required	
H107	534460450.752	324390225.458	534460450.752	324390225.458	Required	
Basin Inlet	534460467.383	324390223.714	534460467.383	324390223.714	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
Basin Outlet	534460476.348	324390222.794	534460476.348	324390222.794	Required	
H108	534460483.237	324390222.078	534460483.237	324390222.078	Required	
	534460502.137	324390220.136			No Entry	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.000	o	225	H100	3.630	2.630	0.775	Open Manhole	1200
9.001	o	225	H101	3.470	2.470	0.775	Open Manhole	1200
9.002	o	225	H102	3.095	2.095	0.775	Open Manhole	1200
10.000	o	150	H104	3.135	2.210	0.775	Open Manhole	1200
9.003	o	225	H105	3.025	2.025	0.775	Open Manhole	1200
9.004	o	225	H106	2.935	1.935	0.775	Open Manhole	1200
9.005	o	225	H107	2.800	1.630	0.945	Open Manhole	1200
9.006	o	225	Basin Inlet	2.700	1.540	0.935	Open Manhole	1200
9.007	o	225	Basin Outlet	2.700	1.500	0.975	Open Manhole	1200
9.008	o	150	H108	2.700	1.475	1.075	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.000	12.230	76.4	H101	3.470	2.470	0.775	Open Manhole	1200
9.001	55.944	149.2	H102	3.095	2.095	0.775	Open Manhole	1200
9.002	5.116	73.1	H105	3.025	2.025	0.775	Open Manhole	1200
10.000	11.104	100.9	H105	3.025	2.100	0.775	Open Manhole	1200
9.003	7.150	79.4	H106	2.935	1.935	0.775	Open Manhole	1200
9.004	50.405	165.3	H107	2.800	1.630	0.945	Open Manhole	1200
9.005	16.722	185.8	Basin Inlet	2.700	1.540	0.935	Open Manhole	1200
9.006	9.013	225.3	Basin Outlet	2.700	1.500	0.975	Open Manhole	1200
9.007	6.926	277.0	H108	2.700	1.475	1.000	Open Manhole	1200
9.008	19.000	146.2		2.500	1.345	1.005	Open Manhole	0

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XP Solutions	Network 2019.1	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
9.000	User	-	100	0.029	0.029	0.029
9.001	User	-	100	0.054	0.054	0.054
9.002	User	-	100	0.013	0.013	0.013
10.000	User	-	100	0.022	0.022	0.022
9.003	User	-	100	0.012	0.012	0.012
9.004	-	-	100	0.000	0.000	0.000
9.005	-	-	100	0.000	0.000	0.000
9.006	-	-	100	0.000	0.000	0.000
9.007	-	-	100	0.000	0.000	0.000
9.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.129	0.129	0.129

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
9.008		2.500	1.345	0.000	0	0
Datum (m) 0.000 Offset (mins) 0						

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	1.630	24	1.630	47	1.630	70	1.630	93	1.630	116	1.630
2	1.630	25	1.630	48	1.630	71	1.630	94	1.630	117	1.630
3	1.630	26	1.630	49	1.630	72	1.630	95	1.630	118	1.630
4	1.630	27	1.630	50	1.630	73	1.630	96	1.630	119	1.630
5	1.630	28	1.630	51	1.630	74	1.630	97	1.630	120	1.630
6	1.630	29	1.630	52	1.630	75	1.630	98	1.630	121	1.630
7	1.630	30	1.630	53	1.630	76	1.630	99	1.630	122	1.630
8	1.630	31	1.630	54	1.630	77	1.630	100	1.630	123	1.630
9	1.630	32	1.630	55	1.630	78	1.630	101	1.630	124	1.630
10	1.630	33	1.630	56	1.630	79	1.630	102	1.630	125	1.630
11	1.630	34	1.630	57	1.630	80	1.630	103	1.630	126	1.630
12	1.630	35	1.630	58	1.630	81	1.630	104	1.630	127	1.630
13	1.630	36	1.630	59	1.630	82	1.630	105	1.630	128	1.630
14	1.630	37	1.630	60	1.630	83	1.630	106	1.630	129	1.630
15	1.630	38	1.630	61	1.630	84	1.630	107	1.630	130	1.630
16	1.630	39	1.630	62	1.630	85	1.630	108	1.630	131	1.630
17	1.630	40	1.630	63	1.630	86	1.630	109	1.630	132	1.630
18	1.630	41	1.630	64	1.630	87	1.630	110	1.630	133	1.630
19	1.630	42	1.630	65	1.630	88	1.630	111	1.630	134	1.630
20	1.630	43	1.630	66	1.630	89	1.630	112	1.630	135	1.630
21	1.630	44	1.630	67	1.630	90	1.630	113	1.630	136	1.630
22	1.630	45	1.630	68	1.630	91	1.630	114	1.630	137	1.630
23	1.630	46	1.630	69	1.630	92	1.630	115	1.630	138	1.630

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15 High Street Spalding, Lincs PE11 1TW	Residential Development off Wignals Gate, Holbeach, Lincs. For D Brown Builders	
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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
139	1.630	189	1.630	239	1.630	289	1.630	339	1.630	389	1.630
140	1.630	190	1.630	240	1.630	290	1.630	340	1.630	390	1.630
141	1.630	191	1.630	241	1.630	291	1.630	341	1.630	391	1.630
142	1.630	192	1.630	242	1.630	292	1.630	342	1.630	392	1.630
143	1.630	193	1.630	243	1.630	293	1.630	343	1.630	393	1.630
144	1.630	194	1.630	244	1.630	294	1.630	344	1.630	394	1.630
145	1.630	195	1.630	245	1.630	295	1.630	345	1.630	395	1.630
146	1.630	196	1.630	246	1.630	296	1.630	346	1.630	396	1.630
147	1.630	197	1.630	247	1.630	297	1.630	347	1.630	397	1.630
148	1.630	198	1.630	248	1.630	298	1.630	348	1.630	398	1.630
149	1.630	199	1.630	249	1.630	299	1.630	349	1.630	399	1.630
150	1.630	200	1.630	250	1.630	300	1.630	350	1.630	400	1.630
151	1.630	201	1.630	251	1.630	301	1.630	351	1.630	401	1.630
152	1.630	202	1.630	252	1.630	302	1.630	352	1.630	402	1.630
153	1.630	203	1.630	253	1.630	303	1.630	353	1.630	403	1.630
154	1.630	204	1.630	254	1.630	304	1.630	354	1.630	404	1.630
155	1.630	205	1.630	255	1.630	305	1.630	355	1.630	405	1.630
156	1.630	206	1.630	256	1.630	306	1.630	356	1.630	406	1.630
157	1.630	207	1.630	257	1.630	307	1.630	357	1.630	407	1.630
158	1.630	208	1.630	258	1.630	308	1.630	358	1.630	408	1.630
159	1.630	209	1.630	259	1.630	309	1.630	359	1.630	409	1.630
160	1.630	210	1.630	260	1.630	310	1.630	360	1.630	410	1.630
161	1.630	211	1.630	261	1.630	311	1.630	361	1.630	411	1.630
162	1.630	212	1.630	262	1.630	312	1.630	362	1.630	412	1.630
163	1.630	213	1.630	263	1.630	313	1.630	363	1.630	413	1.630
164	1.630	214	1.630	264	1.630	314	1.630	364	1.630	414	1.630
165	1.630	215	1.630	265	1.630	315	1.630	365	1.630	415	1.630
166	1.630	216	1.630	266	1.630	316	1.630	366	1.630	416	1.630
167	1.630	217	1.630	267	1.630	317	1.630	367	1.630	417	1.630
168	1.630	218	1.630	268	1.630	318	1.630	368	1.630	418	1.630
169	1.630	219	1.630	269	1.630	319	1.630	369	1.630	419	1.630
170	1.630	220	1.630	270	1.630	320	1.630	370	1.630	420	1.630
171	1.630	221	1.630	271	1.630	321	1.630	371	1.630	421	1.630
172	1.630	222	1.630	272	1.630	322	1.630	372	1.630	422	1.630
173	1.630	223	1.630	273	1.630	323	1.630	373	1.630	423	1.630
174	1.630	224	1.630	274	1.630	324	1.630	374	1.630	424	1.630
175	1.630	225	1.630	275	1.630	325	1.630	375	1.630	425	1.630
176	1.630	226	1.630	276	1.630	326	1.630	376	1.630	426	1.630
177	1.630	227	1.630	277	1.630	327	1.630	377	1.630	427	1.630
178	1.630	228	1.630	278	1.630	328	1.630	378	1.630	428	1.630
179	1.630	229	1.630	279	1.630	329	1.630	379	1.630	429	1.630
180	1.630	230	1.630	280	1.630	330	1.630	380	1.630	430	1.630
181	1.630	231	1.630	281	1.630	331	1.630	381	1.630	431	1.630
182	1.630	232	1.630	282	1.630	332	1.630	382	1.630	432	1.630
183	1.630	233	1.630	283	1.630	333	1.630	383	1.630	433	1.630
184	1.630	234	1.630	284	1.630	334	1.630	384	1.630	434	1.630
185	1.630	235	1.630	285	1.630	335	1.630	385	1.630	435	1.630
186	1.630	236	1.630	286	1.630	336	1.630	386	1.630	436	1.630
187	1.630	237	1.630	287	1.630	337	1.630	387	1.630	437	1.630
188	1.630	238	1.630	288	1.630	338	1.630	388	1.630	438	1.630

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
439	1.630	489	1.630	539	1.630	589	1.630	639	1.630	689	1.630
440	1.630	490	1.630	540	1.630	590	1.630	640	1.630	690	1.630
441	1.630	491	1.630	541	1.630	591	1.630	641	1.630	691	1.630
442	1.630	492	1.630	542	1.630	592	1.630	642	1.630	692	1.630
443	1.630	493	1.630	543	1.630	593	1.630	643	1.630	693	1.630
444	1.630	494	1.630	544	1.630	594	1.630	644	1.630	694	1.630
445	1.630	495	1.630	545	1.630	595	1.630	645	1.630	695	1.630
446	1.630	496	1.630	546	1.630	596	1.630	646	1.630	696	1.630
447	1.630	497	1.630	547	1.630	597	1.630	647	1.630	697	1.630
448	1.630	498	1.630	548	1.630	598	1.630	648	1.630	698	1.630
449	1.630	499	1.630	549	1.630	599	1.630	649	1.630	699	1.630
450	1.630	500	1.630	550	1.630	600	1.630	650	1.630	700	1.630
451	1.630	501	1.630	551	1.630	601	1.630	651	1.630	701	1.630
452	1.630	502	1.630	552	1.630	602	1.630	652	1.630	702	1.630
453	1.630	503	1.630	553	1.630	603	1.630	653	1.630	703	1.630
454	1.630	504	1.630	554	1.630	604	1.630	654	1.630	704	1.630
455	1.630	505	1.630	555	1.630	605	1.630	655	1.630	705	1.630
456	1.630	506	1.630	556	1.630	606	1.630	656	1.630	706	1.630
457	1.630	507	1.630	557	1.630	607	1.630	657	1.630	707	1.630
458	1.630	508	1.630	558	1.630	608	1.630	658	1.630	708	1.630
459	1.630	509	1.630	559	1.630	609	1.630	659	1.630	709	1.630
460	1.630	510	1.630	560	1.630	610	1.630	660	1.630	710	1.630
461	1.630	511	1.630	561	1.630	611	1.630	661	1.630	711	1.630
462	1.630	512	1.630	562	1.630	612	1.630	662	1.630	712	1.630
463	1.630	513	1.630	563	1.630	613	1.630	663	1.630	713	1.630
464	1.630	514	1.630	564	1.630	614	1.630	664	1.630	714	1.630
465	1.630	515	1.630	565	1.630	615	1.630	665	1.630	715	1.630
466	1.630	516	1.630	566	1.630	616	1.630	666	1.630	716	1.630
467	1.630	517	1.630	567	1.630	617	1.630	667	1.630	717	1.630
468	1.630	518	1.630	568	1.630	618	1.630	668	1.630	718	1.630
469	1.630	519	1.630	569	1.630	619	1.630	669	1.630	719	1.630
470	1.630	520	1.630	570	1.630	620	1.630	670	1.630	720	1.630
471	1.630	521	1.630	571	1.630	621	1.630	671	1.630	721	1.630
472	1.630	522	1.630	572	1.630	622	1.630	672	1.630	722	1.630
473	1.630	523	1.630	573	1.630	623	1.630	673	1.630	723	1.630
474	1.630	524	1.630	574	1.630	624	1.630	674	1.630	724	1.630
475	1.630	525	1.630	575	1.630	625	1.630	675	1.630	725	1.630
476	1.630	526	1.630	576	1.630	626	1.630	676	1.630	726	1.630
477	1.630	527	1.630	577	1.630	627	1.630	677	1.630	727	1.630
478	1.630	528	1.630	578	1.630	628	1.630	678	1.630	728	1.630
479	1.630	529	1.630	579	1.630	629	1.630	679	1.630	729	1.630
480	1.630	530	1.630	580	1.630	630	1.630	680	1.630	730	1.630
481	1.630	531	1.630	581	1.630	631	1.630	681	1.630	731	1.630
482	1.630	532	1.630	582	1.630	632	1.630	682	1.630	732	1.630
483	1.630	533	1.630	583	1.630	633	1.630	683	1.630	733	1.630
484	1.630	534	1.630	584	1.630	634	1.630	684	1.630	734	1.630
485	1.630	535	1.630	585	1.630	635	1.630	685	1.630	735	1.630
486	1.630	536	1.630	586	1.630	636	1.630	686	1.630	736	1.630
487	1.630	537	1.630	587	1.630	637	1.630	687	1.630	737	1.630
488	1.630	538	1.630	588	1.630	638	1.630	688	1.630	738	1.630

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
739	1.630	789	1.630	839	1.630	889	1.630	939	1.630	989	1.630
740	1.630	790	1.630	840	1.630	890	1.630	940	1.630	990	1.630
741	1.630	791	1.630	841	1.630	891	1.630	941	1.630	991	1.630
742	1.630	792	1.630	842	1.630	892	1.630	942	1.630	992	1.630
743	1.630	793	1.630	843	1.630	893	1.630	943	1.630	993	1.630
744	1.630	794	1.630	844	1.630	894	1.630	944	1.630	994	1.630
745	1.630	795	1.630	845	1.630	895	1.630	945	1.630	995	1.630
746	1.630	796	1.630	846	1.630	896	1.630	946	1.630	996	1.630
747	1.630	797	1.630	847	1.630	897	1.630	947	1.630	997	1.630
748	1.630	798	1.630	848	1.630	898	1.630	948	1.630	998	1.630
749	1.630	799	1.630	849	1.630	899	1.630	949	1.630	999	1.630
750	1.630	800	1.630	850	1.630	900	1.630	950	1.630	1000	1.630
751	1.630	801	1.630	851	1.630	901	1.630	951	1.630	1001	1.630
752	1.630	802	1.630	852	1.630	902	1.630	952	1.630	1002	1.630
753	1.630	803	1.630	853	1.630	903	1.630	953	1.630	1003	1.630
754	1.630	804	1.630	854	1.630	904	1.630	954	1.630	1004	1.630
755	1.630	805	1.630	855	1.630	905	1.630	955	1.630	1005	1.630
756	1.630	806	1.630	856	1.630	906	1.630	956	1.630	1006	1.630
757	1.630	807	1.630	857	1.630	907	1.630	957	1.630	1007	1.630
758	1.630	808	1.630	858	1.630	908	1.630	958	1.630	1008	1.630
759	1.630	809	1.630	859	1.630	909	1.630	959	1.630	1009	1.630
760	1.630	810	1.630	860	1.630	910	1.630	960	1.630	1010	1.630
761	1.630	811	1.630	861	1.630	911	1.630	961	1.630	1011	1.630
762	1.630	812	1.630	862	1.630	912	1.630	962	1.630	1012	1.630
763	1.630	813	1.630	863	1.630	913	1.630	963	1.630	1013	1.630
764	1.630	814	1.630	864	1.630	914	1.630	964	1.630	1014	1.630
765	1.630	815	1.630	865	1.630	915	1.630	965	1.630	1015	1.630
766	1.630	816	1.630	866	1.630	916	1.630	966	1.630	1016	1.630
767	1.630	817	1.630	867	1.630	917	1.630	967	1.630	1017	1.630
768	1.630	818	1.630	868	1.630	918	1.630	968	1.630	1018	1.630
769	1.630	819	1.630	869	1.630	919	1.630	969	1.630	1019	1.630
770	1.630	820	1.630	870	1.630	920	1.630	970	1.630	1020	1.630
771	1.630	821	1.630	871	1.630	921	1.630	971	1.630	1021	1.630
772	1.630	822	1.630	872	1.630	922	1.630	972	1.630	1022	1.630
773	1.630	823	1.630	873	1.630	923	1.630	973	1.630	1023	1.630
774	1.630	824	1.630	874	1.630	924	1.630	974	1.630	1024	1.630
775	1.630	825	1.630	875	1.630	925	1.630	975	1.630	1025	1.630
776	1.630	826	1.630	876	1.630	926	1.630	976	1.630	1026	1.630
777	1.630	827	1.630	877	1.630	927	1.630	977	1.630	1027	1.630
778	1.630	828	1.630	878	1.630	928	1.630	978	1.630	1028	1.630
779	1.630	829	1.630	879	1.630	929	1.630	979	1.630	1029	1.630
780	1.630	830	1.630	880	1.630	930	1.630	980	1.630	1030	1.630
781	1.630	831	1.630	881	1.630	931	1.630	981	1.630	1031	1.630
782	1.630	832	1.630	882	1.630	932	1.630	982	1.630	1032	1.630
783	1.630	833	1.630	883	1.630	933	1.630	983	1.630	1033	1.630
784	1.630	834	1.630	884	1.630	934	1.630	984	1.630	1034	1.630
785	1.630	835	1.630	885	1.630	935	1.630	985	1.630	1035	1.630
786	1.630	836	1.630	886	1.630	936	1.630	986	1.630	1036	1.630
787	1.630	837	1.630	887	1.630	937	1.630	987	1.630	1037	1.630
788	1.630	838	1.630	888	1.630	938	1.630	988	1.630	1038	1.630

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XP Solutions	Network 2019.1	

Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1039	1.630	1089	1.630	1139	1.630	1189	1.630	1239	1.630	1289	1.630
1040	1.630	1090	1.630	1140	1.630	1190	1.630	1240	1.630	1290	1.630
1041	1.630	1091	1.630	1141	1.630	1191	1.630	1241	1.630	1291	1.630
1042	1.630	1092	1.630	1142	1.630	1192	1.630	1242	1.630	1292	1.630
1043	1.630	1093	1.630	1143	1.630	1193	1.630	1243	1.630	1293	1.630
1044	1.630	1094	1.630	1144	1.630	1194	1.630	1244	1.630	1294	1.630
1045	1.630	1095	1.630	1145	1.630	1195	1.630	1245	1.630	1295	1.630
1046	1.630	1096	1.630	1146	1.630	1196	1.630	1246	1.630	1296	1.630
1047	1.630	1097	1.630	1147	1.630	1197	1.630	1247	1.630	1297	1.630
1048	1.630	1098	1.630	1148	1.630	1198	1.630	1248	1.630	1298	1.630
1049	1.630	1099	1.630	1149	1.630	1199	1.630	1249	1.630	1299	1.630
1050	1.630	1100	1.630	1150	1.630	1200	1.630	1250	1.630	1300	1.630
1051	1.630	1101	1.630	1151	1.630	1201	1.630	1251	1.630	1301	1.630
1052	1.630	1102	1.630	1152	1.630	1202	1.630	1252	1.630	1302	1.630
1053	1.630	1103	1.630	1153	1.630	1203	1.630	1253	1.630	1303	1.630
1054	1.630	1104	1.630	1154	1.630	1204	1.630	1254	1.630	1304	1.630
1055	1.630	1105	1.630	1155	1.630	1205	1.630	1255	1.630	1305	1.630
1056	1.630	1106	1.630	1156	1.630	1206	1.630	1256	1.630	1306	1.630
1057	1.630	1107	1.630	1157	1.630	1207	1.630	1257	1.630	1307	1.630
1058	1.630	1108	1.630	1158	1.630	1208	1.630	1258	1.630	1308	1.630
1059	1.630	1109	1.630	1159	1.630	1209	1.630	1259	1.630	1309	1.630
1060	1.630	1110	1.630	1160	1.630	1210	1.630	1260	1.630	1310	1.630
1061	1.630	1111	1.630	1161	1.630	1211	1.630	1261	1.630	1311	1.630
1062	1.630	1112	1.630	1162	1.630	1212	1.630	1262	1.630	1312	1.630
1063	1.630	1113	1.630	1163	1.630	1213	1.630	1263	1.630	1313	1.630
1064	1.630	1114	1.630	1164	1.630	1214	1.630	1264	1.630	1314	1.630
1065	1.630	1115	1.630	1165	1.630	1215	1.630	1265	1.630	1315	1.630
1066	1.630	1116	1.630	1166	1.630	1216	1.630	1266	1.630	1316	1.630
1067	1.630	1117	1.630	1167	1.630	1217	1.630	1267	1.630	1317	1.630
1068	1.630	1118	1.630	1168	1.630	1218	1.630	1268	1.630	1318	1.630
1069	1.630	1119	1.630	1169	1.630	1219	1.630	1269	1.630	1319	1.630
1070	1.630	1120	1.630	1170	1.630	1220	1.630	1270	1.630	1320	1.630
1071	1.630	1121	1.630	1171	1.630	1221	1.630	1271	1.630	1321	1.630
1072	1.630	1122	1.630	1172	1.630	1222	1.630	1272	1.630	1322	1.630
1073	1.630	1123	1.630	1173	1.630	1223	1.630	1273	1.630	1323	1.630
1074	1.630	1124	1.630	1174	1.630	1224	1.630	1274	1.630	1324	1.630
1075	1.630	1125	1.630	1175	1.630	1225	1.630	1275	1.630	1325	1.630
1076	1.630	1126	1.630	1176	1.630	1226	1.630	1276	1.630	1326	1.630
1077	1.630	1127	1.630	1177	1.630	1227	1.630	1277	1.630	1327	1.630
1078	1.630	1128	1.630	1178	1.630	1228	1.630	1278	1.630	1328	1.630
1079	1.630	1129	1.630	1179	1.630	1229	1.630	1279	1.630	1329	1.630
1080	1.630	1130	1.630	1180	1.630	1230	1.630	1280	1.630	1330	1.630
1081	1.630	1131	1.630	1181	1.630	1231	1.630	1281	1.630	1331	1.630
1082	1.630	1132	1.630	1182	1.630	1232	1.630	1282	1.630	1332	1.630
1083	1.630	1133	1.630	1183	1.630	1233	1.630	1283	1.630	1333	1.630
1084	1.630	1134	1.630	1184	1.630	1234	1.630	1284	1.630	1334	1.630
1085	1.630	1135	1.630	1185	1.630	1235	1.630	1285	1.630	1335	1.630
1086	1.630	1136	1.630	1186	1.630	1236	1.630	1286	1.630	1336	1.630
1087	1.630	1137	1.630	1187	1.630	1237	1.630	1287	1.630	1337	1.630
1088	1.630	1138	1.630	1188	1.630	1238	1.630	1288	1.630	1338	1.630

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Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1339	1.630	1356	1.630	1373	1.630	1390	1.630	1407	1.630	1424	1.630
1340	1.630	1357	1.630	1374	1.630	1391	1.630	1408	1.630	1425	1.630
1341	1.630	1358	1.630	1375	1.630	1392	1.630	1409	1.630	1426	1.630
1342	1.630	1359	1.630	1376	1.630	1393	1.630	1410	1.630	1427	1.630
1343	1.630	1360	1.630	1377	1.630	1394	1.630	1411	1.630	1428	1.630
1344	1.630	1361	1.630	1378	1.630	1395	1.630	1412	1.630	1429	1.630
1345	1.630	1362	1.630	1379	1.630	1396	1.630	1413	1.630	1430	1.630
1346	1.630	1363	1.630	1380	1.630	1397	1.630	1414	1.630	1431	1.630
1347	1.630	1364	1.630	1381	1.630	1398	1.630	1415	1.630	1432	1.630
1348	1.630	1365	1.630	1382	1.630	1399	1.630	1416	1.630	1433	1.630
1349	1.630	1366	1.630	1383	1.630	1400	1.630	1417	1.630	1434	1.630
1350	1.630	1367	1.630	1384	1.630	1401	1.630	1418	1.630	1435	1.630
1351	1.630	1368	1.630	1385	1.630	1402	1.630	1419	1.630	1436	1.630
1352	1.630	1369	1.630	1386	1.630	1403	1.630	1420	1.630	1437	1.630
1353	1.630	1370	1.630	1387	1.630	1404	1.630	1421	1.630	1438	1.630
1354	1.630	1371	1.630	1388	1.630	1405	1.630	1422	1.630	1439	1.630
1355	1.630	1372	1.630	1389	1.630	1406	1.630	1423	1.630	1440	1.630

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: H108, DS/PN: 9.008, Volume (m³): 1.6

Unit Reference	MD-SHE-0090-5000-2155-5000
Design Head (m)	2.155
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	1.475
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.155	5.0
Flush-Flo™	0.393	4.0
Kick-Flo®	0.805	3.2
Mean Flow over Head Range	-	3.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.8	3.000	5.8	7.000	8.7
0.200	3.7	1.400	4.1	3.500	6.3	7.500	9.0
0.300	3.9	1.600	4.4	4.000	6.7	8.000	9.3
0.400	4.0	1.800	4.6	4.500	7.1	8.500	9.5
0.500	3.9	2.000	4.8	5.000	7.4	9.000	9.8
0.600	3.8	2.200	5.0	5.500	7.8	9.500	10.1
0.800	3.2	2.400	5.3	6.000	8.1		
1.000	3.5	2.600	5.5	6.500	8.4		

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Storage Structures for Storm

Tank or Pond Manhole: Basin Outlet, DS/PN: 9.007

Invert Level (m) 1.600

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	54.0	1.100	188.0

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	5	Number of Time/Area Diagrams	0
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 534616 324343 TF 34616 24343
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
9.000	H100	15 Winter	2	+0%	100/15 Summer		
9.001	H101	15 Winter	2	+0%	100/15 Summer	100/15 Winter	
9.002	H102	15 Winter	2	+0%	30/15 Summer	100/15 Winter	
10.000	H104	15 Winter	2	+0%	100/15 Summer		
9.003	H105	15 Winter	2	+0%	30/15 Summer		
9.004	H106	15 Winter	2	+0%	30/15 Summer		
9.005	H107	120 Winter	2	+0%	30/15 Summer		
9.006	Basin Inlet	120 Winter	2	+0%	2/120 Winter		
9.007	Basin Outlet	120 Winter	2	+0%	2/30 Winter		
9.008	H108	120 Winter	2	+0%	2/15 Summer		

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
9.000	H100		2.670	-0.185	0.000	0.07		3.8	OK
9.001	H101		2.550	-0.145	0.000	0.27		10.9	OK
9.002	H102		2.186	-0.134	0.000	0.34		12.6	OK
10.000	H104		2.258	-0.102	0.000	0.22		3.6	OK
9.003	H105		2.126	-0.124	0.000	0.42		17.6	OK
9.004	H106		2.042	-0.118	0.000	0.44		17.2	OK
9.005	H107		1.776	-0.079	0.000	0.21		7.2	OK
9.006	Basin Inlet		1.769	0.004	0.000	0.24		6.9	SURCHARGED
9.007	Basin Outlet		1.765	0.040	0.000	0.13		3.1	SURCHARGED
9.008	H108		1.762	0.137	0.000	0.22		3.1	SURCHARGED

PN	US/MH Name	Level Exceeded
9.000	H100	
9.001	H101	1
9.002	H102	1
10.000	H104	
9.003	H105	
9.004	H106	
9.005	H107	
9.006	Basin Inlet	
9.007	Basin Outlet	
9.008	H108	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 3
Number of Online Controls 5 Number of Time/Area Diagrams 0
Number of Offline Controls 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 534616 324343 TF 34616 24343
Data Type Point
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
9.000	H100	15 Winter	30	+0%	100/15 Summer		
9.001	H101	15 Winter	30	+0%	100/15 Summer	100/15 Winter	
9.002	H102	15 Winter	30	+0%	30/15 Summer	100/15 Winter	
10.000	H104	15 Winter	30	+0%	100/15 Summer		
9.003	H105	15 Winter	30	+0%	30/15 Summer		
9.004	H106	15 Winter	30	+0%	30/15 Summer		
9.005	H107	30 Winter	30	+0%	30/15 Summer		
9.006	Basin Inlet	120 Winter	30	+0%	2/120 Winter		
9.007	Basin Outlet	120 Winter	30	+0%	2/30 Winter		
9.008	H108	120 Winter	30	+0%	2/15 Summer		

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
9.000	H100		2.694	-0.161	0.000	0.18		9.3	OK
9.001	H101		2.622	-0.073	0.000	0.75		30.8	OK
9.002	H102		2.405	0.085	0.000	0.81		30.1	SURCHARGED
10.000	H104		2.348	-0.012	0.000	0.54		8.6	OK
9.003	H105		2.321	0.071	0.000	0.96		40.7	SURCHARGED
9.004	H106		2.218	0.058	0.000	1.02		39.3	SURCHARGED
9.005	H107		2.014	0.159	0.000	0.96		32.6	SURCHARGED
9.006	Basin Inlet		2.005	0.240	0.000	0.58		16.3	SURCHARGED
9.007	Basin Outlet		2.000	0.275	0.000	0.17		4.0	SURCHARGED
9.008	H108		1.996	0.371	0.000	0.29		3.9	SURCHARGED

PN	US/MH Name	Level Exceeded
9.000	H100	
9.001	H101	1
9.002	H102	1
10.000	H104	
9.003	H105	
9.004	H106	
9.005	H107	
9.006	Basin Inlet	
9.007	Basin Outlet	
9.008	H108	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	5	Number of Time/Area Diagrams	0
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 534616 324343 TF 34616 24343
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
9.000	H100	15 Winter	100	+30%	100/15 Summer		
9.001	H101	15 Winter	100	+30%	100/15 Summer	100/15 Winter	
9.002	H102	15 Winter	100	+30%	30/15 Summer	100/15 Winter	
10.000	H104	15 Winter	100	+30%	100/15 Summer		
9.003	H105	15 Winter	100	+30%	30/15 Summer		
9.004	H106	15 Winter	100	+30%	30/15 Summer		
9.005	H107	240 Winter	100	+30%	30/15 Summer		
9.006	Basin Inlet	240 Winter	100	+30%	2/120 Winter		
9.007	Basin Outlet	240 Winter	100	+30%	2/30 Winter		
9.008	H108	240 Winter	100	+30%	2/15 Summer		

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100 year Return Period Summary of Critical Results by Maximum Level (Rank
1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
9.000	H100		3.498	0.643	0.000	0.35	17.7		FLOOD RISK
9.001	H101		3.470	0.775	0.023	1.06	43.4		FLOOD
9.002	H102		3.095	0.775	0.260	1.29	48.1		FLOOD
10.000	H104		3.071	0.711	0.000	0.73	11.6		FLOOD RISK
9.003	H105		3.012	0.762	0.000	1.46	61.9		FLOOD RISK
9.004	H106		2.852	0.692	0.000	1.50	58.1		FLOOD RISK
9.005	H107		2.355	0.500	0.000	0.55	18.7		FLOOD RISK
9.006	Basin Inlet		2.348	0.583	0.000	0.66	18.6		FLOOD RISK
9.007	Basin Outlet		2.343	0.618	0.000	0.17	4.2		FLOOD RISK
9.008	H108		2.348	0.723	0.000	0.29	4.0		FLOOD RISK

PN	US/MH Name	Level Exceeded
9.000	H100	
9.001	H101	1
9.002	H102	1
10.000	H104	
9.003	H105	
9.004	H106	
9.005	H107	
9.006	Basin Inlet	
9.007	Basin Outlet	
9.008	H108	