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Proposed Residential Development
Land off Oak Close
Castle Gresley
Swadlincote
Derbyshire

Flood Risk Assessment

Revision 0: October 2019
R-FRA-11285R-01-0

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1.0 Introduction

1.1 Background

1.1.1 This report is a Flood Risk Assessment which has been prepared by JPP Consulting Limited on behalf of EMH Group for a proposed residential development. The benefit of this report is to our instructing Client.

1.1.2 The proposed development is located at Land off Oak Close, Castle Gresley, Swadlincote, Derbyshire, as shown in Figure 1.1 below and enclosed in Appendix A. Swadlincote is located to the north-east of Birmingham and south-west of Nottingham. The National Grid Reference for the site is E428560 N317165. The proposed development has a total development area of 2.858ha (28,579m^2) of which 0.923ha (9,228m^2) will be impermeable.

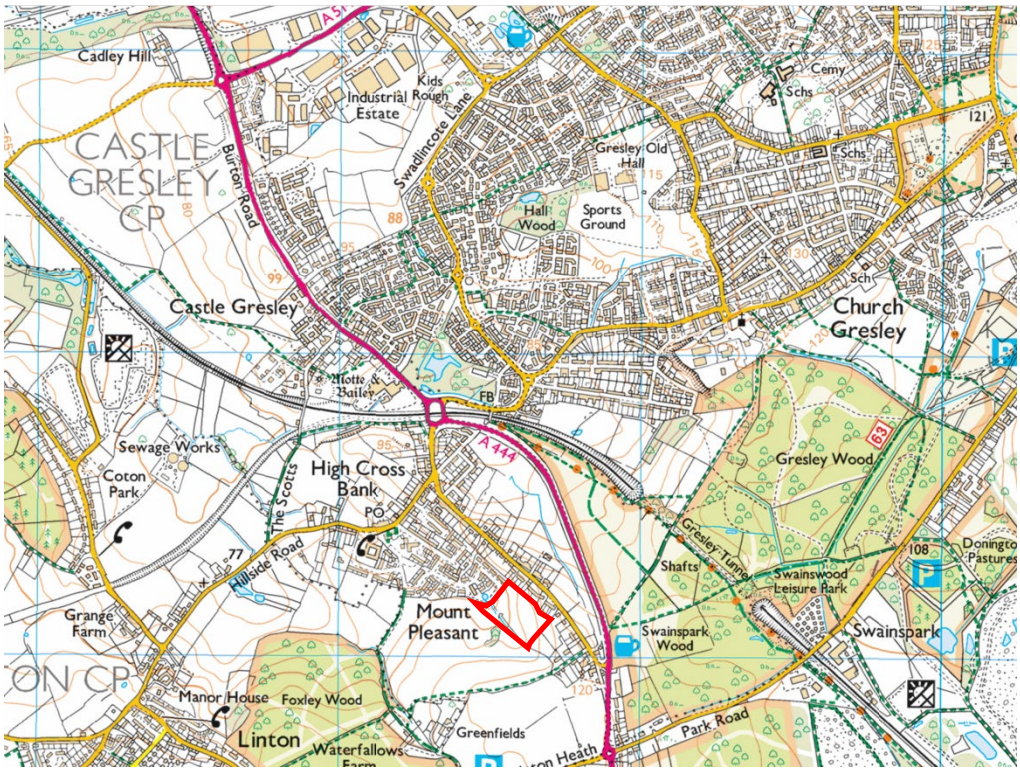

Figure 1.1 Site Location

1.2 Objectives

1.2.1 The objective of this report is to advise interested parties in the development to the potential risk of flooding and the management of surface water from a drainage perspective.

1.2.2 This report has been prepared to support a detailed planning application.

1.3 Reference documents

1.3.1 This report has been prepared with reference to the following publications:-

- Ministry of Housing, Communities and Local Government (July 2018), National Planning Policy Framework
- Ministry of Housing, Communities and Local Government (July 2018), Planning Practice Guidance 'Flood Risk and Coastal Change'
- Department for Environment, Food and Rural Affairs (March 2015), Non-statutory technical standards for sustainable drainage systems
- Environment Agency (September 2013), Climate Change Allowances for Planners: Guidance to support the National Planning Policy Framework
- Environment Agency (October 2013), Delivering benefits through evidence: Rainfall runoff management for developments
- HM Government (2010), The Building Regulations (2010), Drainage and Waste Disposal, Approved Document H, The NBS, Newcastle Upon Tyne
- Wilson, Bray, Cooper (2004), Sustainable drainage systems: Hydraulic, structural and water quality advise,C609, CIRIA, London
- Woods-Ballard et al (2015), The SUDS Manual, C753, CIRIA, London
- CIRIA Report C624 Development and flood risk
- National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage Systems,
- Institute of Hydrology (1999), Flood Estimation Handbook, Institute of Hydrology, Wallingford
- BS EN 752:2008 Drain and sewer systems outside buildings. Hydraulic design and environmental considerations
- BS 8533:2011 Assessing and managing flood risk in development – Code of Practice
- CIRIA Report C635 Designing for exceedance in urban drainage – good practice

2.0 Description and history of the site and development proposals

2.1 Location and description of the site

2.1.1 The proposed development is located at Land off Oak Close, Castle Gresley, Swadlincote, Derbyshire, as shown in Figure 1.1 above and enclosed in Appendix A. The site is bound by existing residential dwellings to the north-east and the north-west and agricultural land to the south-east and the south-west.

2.1.2 There is an existing drain that crosses the site alongside the south-western boundary. This drain connects into the pond located just north of the site. The route of the drain will be diverted slightly to accommodate the proposed development, see Appendix B.

2.2 History of the site

2.2.1 The site is currently agricultural land, as shown on the topographical survey enclosed in Appendix B. We are not aware of any previous development on the site.

2.3 Proposed development

2.3.1 The proposed development will comprise 70 residential dwellings with associated highway infrastructure. The proposed development layout is shown on the plan enclosed in Appendix C.

2.4 Geology of the site and ground investigation data

2.4.1 Inspection of the geological maps show that there are no recorded superficial deposits at the site. The bedrock geology which underlies the site is Helsby Sandstone Formation (Mudstone).

2.4.2 JPP Geotechnical & Environmental have completed a Geotechnical Investigation (GI) on the site, see Appendix D. This investigation found that the majority of the site comprises topsoil (from ground level to between 0.25m and 0.40m) which generally comprised a brown silty gravelly sand with roots and rootlets. In the northern area of the site, the underlying topsoil was a sand with rare rounded gravel (from between 0.40m to 2.95m – base not proved within TP-1 at 2.20m due to sidewall collapse) which is the basal layer of the Chester Formation. In the southern portion of the site, sands and clays associated with the weathered Helsby Formation were present at depths of between 0.30m to 1.75m. The firm to stiff and stiff clay were encountered within TP04, TP06, TP08 and TP09. The bedrock of the Helsby Sandstone Formation was encountered as an extremely weak to weak sandstone from 0.30m to greater than 3.1m in all trip pits except for TP01 and TP06.

2.4.3 The GI included soakaway tests, which identified that infiltration is not a viable method of discharging surface water from the site.

2.5 Development proposals and flood risk vulnerability

2.5.1 With reference to Table 2 of the Planning Practice Guidance (PPG) to the National Planning Policy Framework (NPPF), the proposed development would be classed as More Vulnerable development.

2.5.2 An extract from Table 2 of the PPG for Flood Risk and Coastal Change is replicated below in Table 2.1 with the proposed development type highlighted.

Flood Risk Vulnerability Classification	
Vulnerability	**Development Types**
More Vulnerable	Hospitals.
	Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
	Buildings used for **dwelling houses**, student halls of residence, drinking establishments, nightclubs and hotels.
	Non-residential uses for health services, nurseries and educational establishments.
	Landfill and site used for waste management facilities for hazardous waste.
	Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Source: Planning Practice Guidance - 2018	

Table 2.1

3.0 Flood risk

3.1 Fluvial / Tidal flooding

3.1.1 An extract of the Environment Agency's Flood Map for Planning (Rivers and Sea) is provided below in Figure 3.1. The flood map was extracted from the GOV.UK website on 12th March 2019. The approximate application site boundary is shown in red. The map indicates that the development site is located within Flood Zone 1 (Low Probability) and as such, the report considers the development to be in Flood Zone 1 and at a low risk of flooding from rivers or the sea.

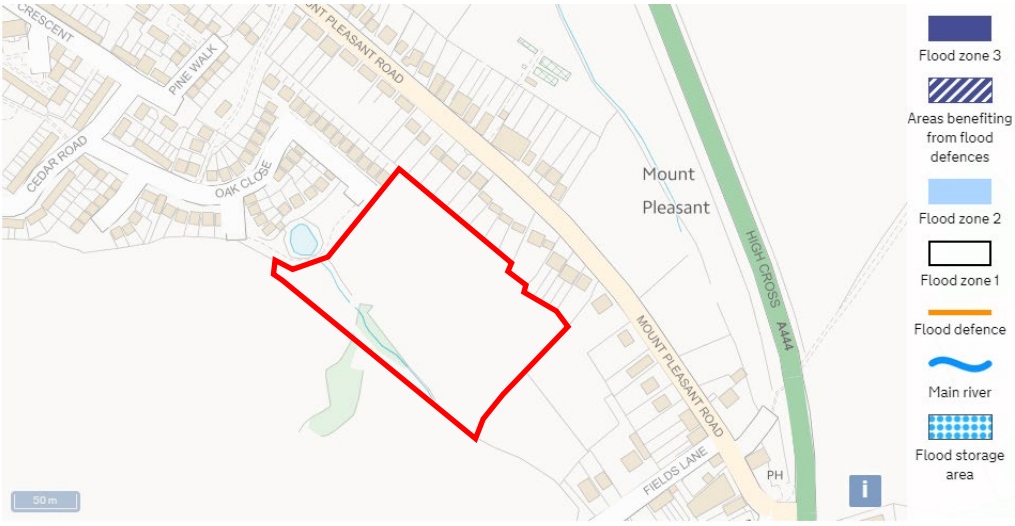

Figure 3.1 Flood Map for Planning (Rivers and Sea)
Source: GOV.UK website – 12th March 2019

3.1.2 Table 3.1 below is a copy of Table 1 from Planning Practice Guidance for *'Flood Risk and Coastal Change'* to the National Planning Policy Framework which defines Flood Zones. The proposed development, which is located within Flood Zone 1, is defined as having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Flood Zone Definitions	
Flood Zone	**Definition**
Zone 1: **Low Probability**	**Land having a less than 1 in 1,000 annual probability of river or sea flooding.**
Zone 2: Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a: High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
Zone 3b: The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.
Source: Planning Practice Guidance - 2018	

Table 3.1

3.2 Flooding from surface water

3.2.1 An extract of the Environment Agency map 'Risk of Flooding from Surface Water' is provided below in Figure 3.2. The approximate application site boundary is shown in red. The site is predominantly located in an area of very low (less than 1 in 1000) risk of surface water flooding in a given year.

3.2.2 The north-western corner of the site is shown to be at low (1 in 100 to 1 in 1000) and medium (1 in 30 to 1 in 100) risk of surface water flooding in a given year. A surface water flow route is shown to cross the site here, originating from the adjacent field. This flow route will be maintained post-development as this corner comprises public open space.

3.2.3 An area towards the southern corner of the site is shown to be at low risk of surface water flooding. This is likely to be associated with the drain that crosses the site along the south-western boundary. There is also a small area at low risk of surface water flooding located towards the north of the site.

3.2.4 Levels of the site will be designed to ensure no dwellings are at risk of surface water flooding. We therefore consider the risk of surface water flooding to the development to be low.

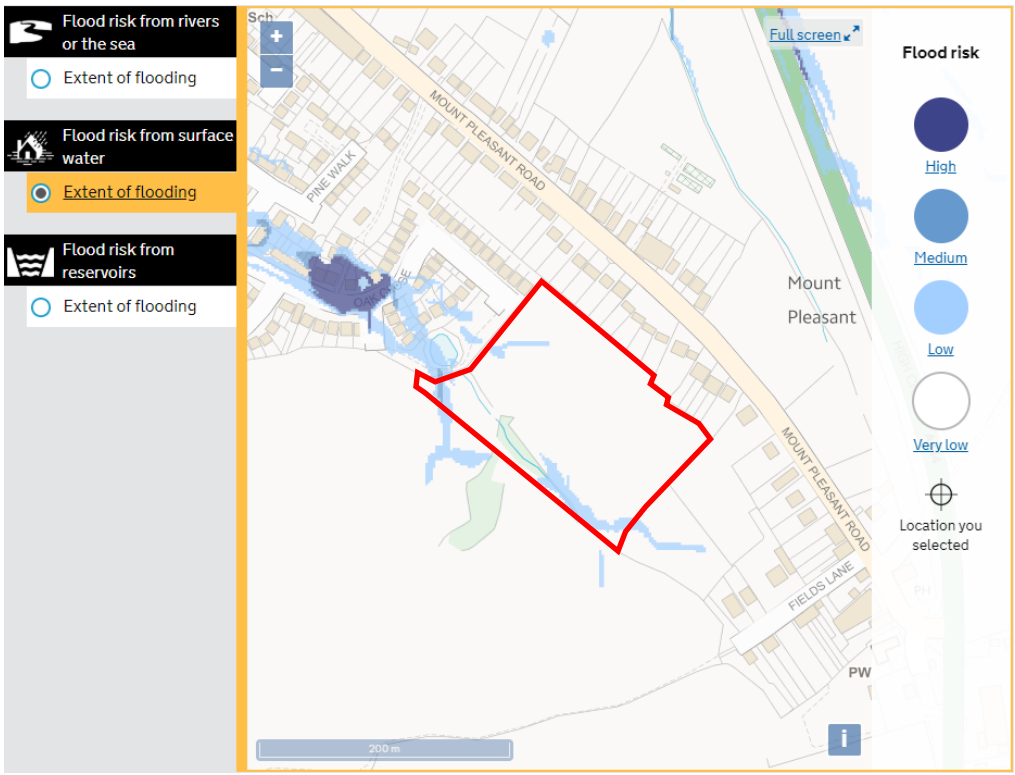

Figure 3.2 Risk of Flooding from Surface Water
Source: GOV.UK website – 12th March 2019

3.3 Flooding from groundwater

3.3.1 From information provided on DEFRA's Magic Map website, see Figure 3.3 and Figure 3.4 below, the site does appears to be partially underlain by a Secondary A aquifer in the superficial deposits. The site appears to be underlain by a principal aquifer in the bedrock layer. We are not aware of any flooding on the site caused by groundwater. We would therefore consider the probability of flooding on the site from groundwater as low.

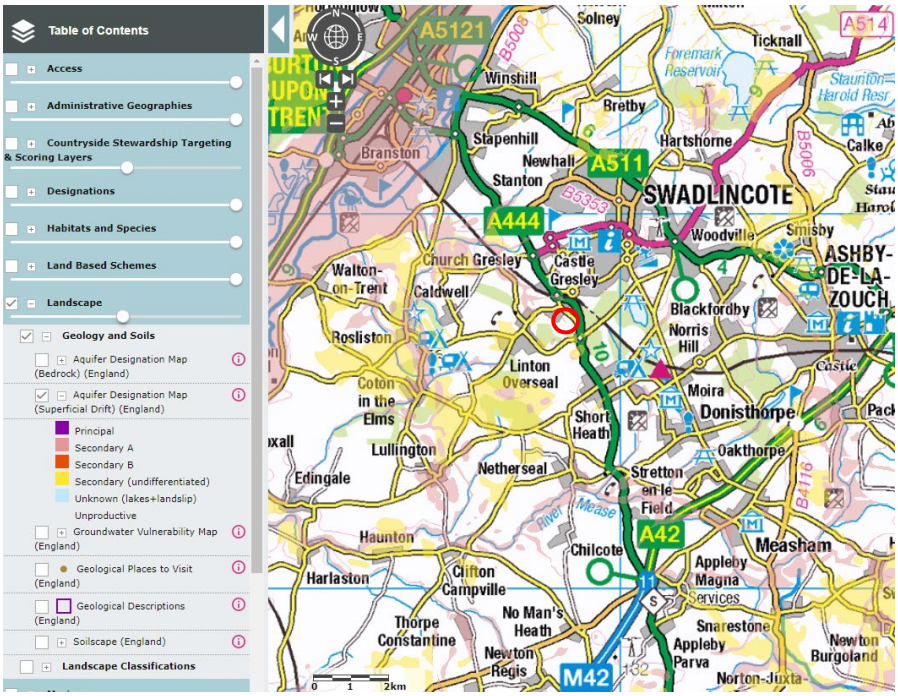

Figure 3.3 Groundwater – Superficial Designation
Source: DEFRA's Magic Map website – 12th March 2019

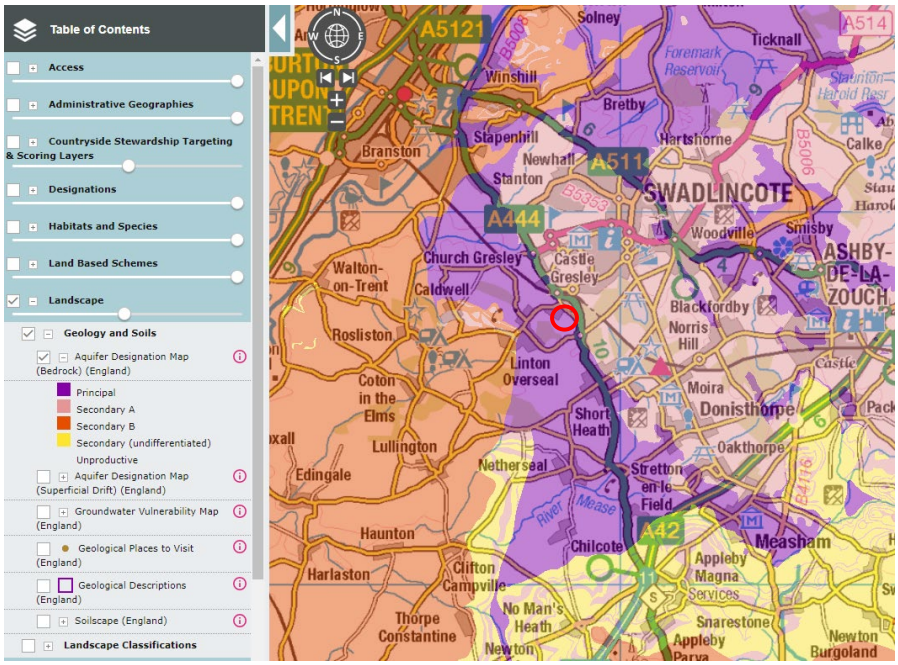

Figure 3.4 Groundwater – Bedrock Designation
Source: DEFRA's Magic Map website – 12th March 2019

3.4 Flooding from sewers

3.4.1 An existing combined gravity sewer is located within the application site along the south-western boundary, as shown on the plan enclosed in Appendix E. We do not have any records of sewer flooding within the vicinity of the proposed development.

3.4.2 We therefore do not consider the risk of flooding from sewers to be a significant risk to the proposed development.

3.5 Flooding from reservoirs, canals and other artificial sources

3.5.1 We are not aware of any canals or artificial water sources that may result in flooding of this site.

3.5.2 An extract of the Environment Agency map 'Risk of Flooding from Reservoirs' is provided below in Figure 3.5. It can be seen that the proposed development site, shown in red, is not at a risk of flooding from reservoirs.

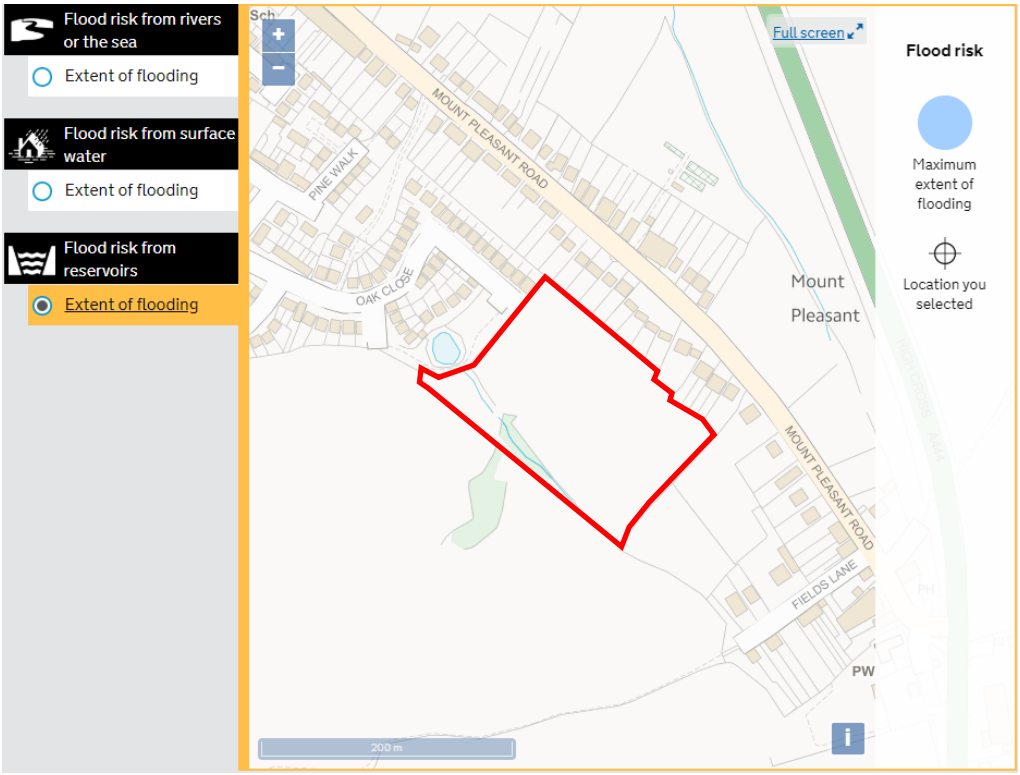

Figure 3.5 Risk of Flooding from Reservoirs
Source: GOV.UK website – 12th March 2019

3.5.3 It can therefore be concluded that the risk of flooding from reservoirs and other artificial sources is low.

3.6 Historic flooding

3.6.1 We are aware that there are known flooding and drainage issues within the vicinity of the site. Information regarding these issues has been obtained from Derbyshire County Council (DCC) as the Lead Local Flood Authority (LLFA), see Appendix F.

3.6.2 We understand that the flooding issues are resultant of overtopping of the existing pond, located to the north-west of the site, and surcharging of the existing land drain to the west of the pond. The information obtained from the LLFA identifies that 10 properties experienced internal flooding during 2016.

3.6.3 Discussions with the LLFA and the local drainage engineer at South Derbyshire District Council are ongoing with regards to determining a solution to the existing issues.

3.7 Flood risk vulnerability and flood zone compatibility

3.7.1 Based on the above assessment of the site being located within Flood Zone 1 and classified as a More Vulnerable development, and with reference to Table 3.2 below (Planning Practice Guidance for 'Flood Risk and Coastal Change' to the National Planning Policy Framework, Table 3), the proposed development of this site would be considered "appropriate". A copy of Table 3 is presented below highlighting the above. Neither a sequential or exception test will be required.

Table 3 – Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatibility	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	X	Exception test required	✓
Zone 3b	Exception test required	✓	X	X	X
✓ = Development is appropriate			X = Development should not be permitted		

Source: Planning Practice Guidance - 2018

Table 3.2

3.8 Flood compensation

3.8.1 Flood compensation measures will not be required for this site as it is located within Flood Zone 1.

3.9 Access and egress

3.9.1 Access and egress to and from this site in the event of flooding will be via the proposed development's access road which will allow residents of the development to move to higher ground.

4.0 Management of surface water

4.1 Current conditions

4.1.1 The site is currently open and is fully permeable and therefore considered a greenfield site with no existing drainage. Therefore greenfield runoff calculations shall be used to derive the allowable run off rate from the site.

4.2 Surface water drainage outfalls

4.2.1 It is a requirement of The Building Regulations (2010), Drainage and Waste Disposal, Approved Document H, to dispose of surface water collected by a development in the following list of priorities:-

1. Infiltration systems where ground condition permit
2. To watercourses
3. To sewers

4.2.2 Each of these is considered separately below:

4.2.3 Infiltration systems

4.2.3.1 The geology of the site is described in Section 2.4 above. Soakaway tests carried out at the site identified that infiltration is not a viable method of discharging surface water from the proposed development.

4.2.4 Watercourses / Main River

4.2.4.1 A drain crosses the site near the south-western boundary, flowing from south to north towards the adjacent pond. Surface water from the proposed development will outfall to this existing drain.

4.2.5 Sewers

4.2.5.1 Draining the site to an existing drain is a viable option therefore the use of surface water sewers will not be considered further.

4.3 SUDS assessment

4.3.1 We have considered the suitability of SUDS for use on the development site. The review is set out in below Table 4.1.

SUDS Assessment		
SUDS Technique	**Suitability**	**Justification**
Rain Water Harvesting	Yes	Use will only mitigate a small proportion of the increase in volume of runoff created by the proposed development. Rainwater butts can be used to save water use.
Green Roofs	No	Green roofs are not considered feasible with pitched roofs.
Infiltration	No	Not feasible due to ground conditions.
Filter Strips / Filter Drains	No	Not feasible due to ground conditions.
Swales	No	No open spaces
Bioretention Systems	No	No open spaces
Trees	Yes	A number of the existing trees will remain post-development. New landscaping is proposed within the site layout.
Pervious Pavements	Yes	Tanked permeable paving will be provided to all private drives to provide a level of surface water treatment.
Attenuation Tanks	No	Attenuation will be provided above ground in a detention basin.
Detention Basin	Yes	Attenuation provided in a detention basin, which will be online with a low flow channel for water quality purposes.
Ponds and Wetlands	No	Attenuation will be provided in a detention basin.
Trapped Drainage	No	Treatment of surface water will be achieved through permeable paving and a detention basin with low flow channel.

Table 4.1

4.4 Surface water drainage strategy

4.4.1 Surface water discharge rates will be restricted to greenfield equivalent runoff rates to ensure that the rate of surface water runoff from the site does not increase as a result of the proposed development.

4.4.2 The proposed drainage strategy will comprise a piped network with attenuation provided in a detention basin to the south west of the site. Surface water will outfall to the existing drain that crosses the site, which connects with another detention basin to the north of the site. Tanked permeable paving will be provided for all private drives.

4.4.3 An indicative surface water layout plan is enclosed in Appendix G. The drawing shows that surface water attenuation can be accommodated on the site and the method of discharge. The detail design parameters of the drainage are described in detail in Section 4.5.

4.5 Surface water drainage design and management

4.5.1 Proposals are to design the surface water drainage system to accommodate storms up to the 1 in 100 year event plus an allowance of 40% for climate change. The design life of a residential development is considered to be greater than 60 years. Table 4.2 below is a copy of Table 2 from the Environment Agency's guidance 'Flood risk assessments: climate change allowances' to support the National Planning Policy Framework, which defines the climate change allowances.

Peak rainfall intensity allowance in small and urban catchments			
Allowance	**'2020s' (2015 to 2039)**	**'2050s' (2040 to 2069)**	**'2080s' (2070 to 2115)**
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%
Source: Environment Agency - 2016			

Table 4.2

4.6 Existing runoff rates

4.6.1 To reflect the changes in the near surface geology across the site the greenfield runoff rates have been calculated. The method used to calculate the greenfield run off rates is the ICP SUDS and the calculations are presented in Appendix H.

4.6.2 The greenfield run off rate, for the application site is:

Soil type	= 0.450 – based on underlying strata
SAAR	= 657mm – obtained from the FEH parameters
Urban	= 0.000
Region number	= 4
Proposed imp area	= 0.923ha
Q_1	= 3.1 l/s
Q_{bar}	= 3.8 l/s
Q_{30}	= 7.4 l/s
Q_{100}	= 9.7 l/s

4.6.3 To provide a betterment on the existing greenfield runoff rate of 3.8 l/s, runoff from the proposed development will be restricted to the minimum viable rate of 2.5 l/s. To reduce the risk of blockage, a minimum aperture size of 75mm is considered viable, resulting in a flow restriction of 2.5 l/s. A flow rate of 2.5 l/s will provide a 34% betterment on the existing runoff arrangement.

4.7 Attenuation requirements

4.7.1 Surface water will discharge into the existing drain that crosses the site and will be attenuated to a minimum viable runoff rate of 2.5 l/s. To achieve this, surface water will be attenuated via a detention basin in the north-west corner to accommodate a 1 in 100 year event plus an allowance of 40% for climate change.

4.7.2 The proposed impermeable area of the development is 0.923ha as shown on the plan enclosed in Appendix I. Based on the proposed impermeable area and allowable discharge rate of 2.5 l/s, the storage requirement for the 1 in 100 year plus climate change event has been calculated utilising the following parameters. Full calculations are enclosed in Appendix J.

Rainfall profile	= Flood Estimation Handbook
Return period	= 100 year
Durations	= 15 to 10080 minutes
Climate change	= 40%
Drained area	= 0.923 ha
Limiting flow to SW sewer	= 2.5 l/s
Control	= Vortex flow control
Total storage required	= 781m^3

4.7.3 The surface water drainage layout incorporating the attenuation is shown on the plan enclosed in Appendix G.

4.8 Overland flows

4.8.1 Proposals are to design the surface water drainage to accommodate the 1 in 100 year storm event taking into account the predicted future effects of climate. Clearly there is a risk of this storm event being exceeded, albeit this risk is considered very low. In such an event the proposed drainage systems will become overwhelmed and overland flows could occur. Overland flows will be directed to follow the path that overland flows currently follow.

4.9 Foul water drainage strategy

4.9.1 An existing combined sewer crosses the site, near to the south-western boundary, as shown on the Severn Trent Water (STW) asset plans enclosed in Appendix E. The route of this sewer will be diverted slightly to accommodate the proposed development, as shown on the site layout enclosed in Appendix C.

4.9.2 Foul water will discharge to the existing STW combined sewer that crosses the site. STW have confirmed that a gravity connection can be made to the existing 225mm diameter combined sewer, see correspondence enclosed in Appendix K. Hydraulic modelling is required to understand the impact of the additional foul flows on the downstream sewer network. STW have been instructed on this work.

5.0 Maintenance

5.1 Surface drainage maintenance

5.1.1 The drainage system will be designed to minimise maintenance requirements, however, a full maintenance scheme will be established for those elements not being offered for adoption. The various areas will be maintained as set out in Table 5.1 below.

Maintenance Areas – Surface Water	
Aspect	**Maintainer**
Private Drains	Home owner
SUDS – Private	Home owner
SUDS – Communal	SUDS Adoption Authority / Management Company
Adopted Sewers	Severn Trent Water

Table 5.1

5.2 Foul drainage maintenance

5.2.1 The drainage system will be designed to minimise maintenance requirements, however, a full maintenance scheme will be established for those elements not being offered for adoption. The various areas will be maintained as set out in Table 5.2 below.

Maintenance Areas – Foul Water	
Aspect	**Maintainer**
Private Drains	Home owner
Adopted Sewers	Severn Trent Water

Table 5.2

6.0 Conclusions and flood risk from site drainage proposals

6.1 The proposed development is located at Land off Oak Close, Castle Gresley, Swadlincote, Derbyshire. The site is bound by existing residential dwellings to the north, north-east and the north-west and agricultural land to the south, south-east and the south-west. The site is currently agricultural land.

6.2 The proposed development will comprise 70 residential dwellings with associated highway infrastructure.

6.3 An existing drain crosses the site near the south-western boundary. This will be diverted slightly to accommodate the proposed development.

6.4 The development site is located in Flood Zone 1 and is therefore considered at a low risk of flooding from rivers and seas.

6.5 The site is predominantly located in an area of very low (less than 1 in 1000) risk of surface water flooding in a given year.

6.6 The site is shown to be at a low risk flooding from groundwater, sewers and other artificial sources such as reservoirs.

6.7 The proposed drainage strategy will comprise a piped network with attenuation provided in a detention basin to the south west of the site. Surface water will outfall to the existing drain that crosses the site, which connects with another detention basin to the north of the site. Tanked permeable paving will be provided for all private drives. Surface water will be restricted to the minimum viable runoff rate of 2.5 l/s, with attenuation provided to accommodate storms up to the 1 in 100 year event plus 40% allowance for climate change. The total volume of storage required is 781m^3.

6.8 An existing combined sewer crosses the site, near to the south-western boundary, as shown on the Severn Trent Water. The route of this sewer will be diverted slightly to accommodate the proposed development. Foul water will discharge to the existing STW combined sewer that crosses the site. STW have confirmed that a gravity connection can be made to the existing 225mm diameter combined sewer. Hydraulic modelling is required to understand the impact of the additional foul flows on the downstream sewer network. STW have been instructed on this work.

6.9 The surface water drainage from this site, post development, is such that the surface water will be managed and disposed of within the site boundary, thus complying with the Planning Practice Guidance for *'Flood Risk and Climate Change'* to the National Planning Policy Framework. Based on the above, providing the above strategies are adopted the developed site will not contribute further to flood risk thus satisfying the principles of the National Planning Policy Framework.

Appendix A

Site Location Plan
Promap Extract

Ordnance Survey © Crown Copyright 2018. All rights reserved. Licence number 100022432. Plotted Scale - 1:1500

Proman®

Appendix B

Existing Site Details

Castle Surveys Ltd drawing no. 18074-18-01

This plan should only be used for its original purpose.

Castle Survey Ltd does not accept any responsibility for this plan if supplied to any other party, other than the original client.

All dimensions and levels should be checked on-site prior to the design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Some services may have been obstructed due to parked vehicles or an overgrown site.

Tree information (where applicable) has been surveyed from ground level and therefore should be treated as approximate only.

Roof linework is indicative only.

The survey has been fixed to GPS OSGB 1936 using the active GPS network.

Floor Plan Legend:

- WINDOW CILL HT 1.00m HEAD HT 2.00m — Window Cill & Head Height
- Door
- Ht 1.99m — Door Height
- Stairs/Step
- RAD — Radiator
- Ventilation / Overhead
- Hatch — Access Hatch
- TV Point
- Phone Point
- 13A Power Socket
- Fused Socket
- Shaver Socket
- Extractor Fan
- Lantern Light
- Down Light
- Light Dimmer Switch
- Light Switch
- Fixed Lighting
- FA — Fire Alarm Button
- FX — Fire Extinguisher
- FL 123.45 — Floor Level to Datum
- SCH 2.27 — Structural Ceiling Height
- FCH 2.27 — False Ceiling Height

Topographic Legend:

- Buildings / Walls
- Building Canopy / Overhang
- Concrete edge
- Kerb line
- Centre Line
- Barrier
- Hedge
- Security Fence
- Panel Fence
- Gate
- Overhead Line
- SAP — Tree / Sapling
- Tree Canopy Line
- Chambers
- STP1 — Survey Station & Name
- BM 100.00 — Bench Mark
- TBM 100.00 — Temporary Bench Mark
- CL — Cover level
- IL — Invert level
- Inv Ø0.25 — Pipe invert (diameter)
- GU — Gully
- MH — Manhole
- IC — Inspection chamber

Trig	Trig Pillar	FS	Flag Staff
Rdg	Ridge Level	MK	Gas Marker
Eave	Eave Level	EP	Electric Post
DPC	Dpc Level	TP	Telegraph Post
FL	Floor Level	Inv	Pipe Invert
Soff	Soffit Level	GU	Gully
T/Bo	Control Box	RP	Rodding Point
LP	Lamp Post	BT	Bt Cover
SP post	Sign Post Post	CO	Cover Unknown
		EC	Electricity Cover
WM	Water Meter	TL	Traffic Light
BB	Beacon	FH	Fire Hydrant
BOL	Bollard	GAS	Gas Cover
BS	Bus Stop	SV	Stop Valve
ER	Earthing Rod	TV	Tv Cover
Box	Post Box	GV	Gas Valve
MS	Mile Stone	PIG	Peg

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CLIENT:

Sutton & Wilkinson

SITE DETAILS:

Land Of Oak Close

DRAWING:

Existing Site Details

SCALE AT A0:	DRAWN
1:500	PJ
DATE ISSUED:	DRAWING NUMBER:
06-06-2018	18074-18-01

DO NOT SCALE

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Appendix C

Site Layout

Sutton and Wilkinson Chartered Architects drawing no. 2494-12 Rev C

HOUSE TYPE LEGEND

A	Type A - 2bed 4p Semi-detached house (71.7m² /772 sqft)	25 No.
B	Type B - 3bed 5p Semi-detached house (89.4m² /962 sqft)	2 No.
C	Type C - 2bed 4p Semi-detached house (70m² /753 sqft)	8 No.
D	Type D - 3bed 5p Semi-detached house (85m² /889 sqft)	9 No.
E	Type E - 4bed 6p Semi-detached house (114m² /1227 sqft)	4 No.
F	Type F - 3bed 5p Split Level Semi-detached house (100m² /1076 sqft)	10 No.
G	Type G - 1bed 2p Flats (45.8m² /493 sqft)	8 No.
H	Type H - 2bed 3p Semi-detached bungalow (62.5m² /672 sqft)	2 No.
car port J	Type J - 4bed 7p Cat. 3 Semi-detached Dormer bungalow (137.4m² /1479 sqft)	2 No.

Total Dwellings - 70No.
Parking - 142No.

- Total Developable Site Area: 5.96 Acres (2.41 Hectares) including P.O.S: 1.13 Acres (0.47 Hectares)
- Total Forestry Planting: 1.59 Acres (0.64 Hectares)
- Total Site Area inc forestry planting: 7.06 Acres (2.85 Hectares)

MATERIALS LEGEND

- 1.8m High brick piers at 2m centres, 600mm low level wall with 1.2m close boarded infill panels
- 1.8m High close boarded fencing.
- 1.2m High post & rail fencing
- Areas of turf / soft landscaping
- Areas of P.O.S.
- Areas of Forestry Planting
- Macadam road to adoptable standards
- Macadam footway to highway standards.
- 450x450x35mm concrete slabs. Suitable edging to all interfaces.
- Permeable Block Paving to driveways. Colour - Brindle with Charcoal demarcation lines
- Existing trees
- Existing trees to be removed
- Proposed trees

NOTES:

The copyright © of this drawing is vested in the Architect and must not be copied or reproduced without consent.

All Contractors must visit the site and be responsible for taking and checking dimensions relative to their work. Sutton and Wilkinson Chartered Architects to be advised of any variation between drawings and site conditions.

DO NOT SCALE OFF THIS DRAWING... IF IN DOUBT ASK

REV:	AMENDMENT:	INT:	DATE:
A	DETENTION BASIN ADDED	SD	19.09.19
B	PLOTS TO NORTH EAST BOUNDARY REPOSITIONED	SD	25.09.19
C	PLOTS 21 TO 24 REVISED. BIN & CYCLE ST. ADDED TO FLATS	SD	09.10.19

PLANNING

PROJECT:
Residential Development at:
Land off Oak Close
Castle Gresley
Swadlincote

CLIENT:
EMH Group

TITLE:
Site Layout

SUTTON AND WILKINSON
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SCALE	DRAWN	DATE	SIZE
1:500	SD	Sept. 19	A3
DRAWING NUMBER			REVISION
2494 - 12			C

Appendix D

Extract of Site Investigation
JPP Geo report ref. R-SI-11282G-1-0

4.0 Walkover Survey

4.1 General description and boundaries

4.1.1 At the time of the walkover survey the vast majority of the site comprised an uncropped agricultural field, with electric fence present across the site. The south and south western area of the site is overgrown with bushes and mature trees along the line of the drain noted on historical mapping. At the time of the walkover survey the drainage ditch was noted to be dry.

4.1.2 Along the northwestern site boundary are mature and semi mature trees with some hedgerows present. The south eastern site boundary is a hedgerow with a few mature trees present. The southern boundary is undefined and part of the agricultural field. The north western site boundary contains mature trees.

4.1.3 The site is located to the south of residential properties on Mount Pleasant Road and to the south east of residential properties on Oak Close. To the west and south of the site are agricultural fields and to the south east of the site are large, grassed rear gardens of residential houses on Fields Lane.

4.1.4 Just off the south western site boundary is an agricultural shed.

4.2 Vegetation

4.2.1 As discussed in section 4.1 all boundaries apart from the eastern portion of the southern boundary of the site were vegetated with hedgerows, semi mature and mature deciduous trees. A small row of conifers was noted along the north western boundary of the site and mature silver birches are located off the north western site boundary. An overgrown area in the south west contained mature trees.

4.2.2 No vegetation was present within the agricultural field area on site.

4.2.3 It is recommended an arboricultural assessment for the site is completed to record the trees and vegetation on site and along the site boundaries.

4.3 Topography and drainage

4.3.1 The site has large topographical variance across the site, which will be a major driver of geotechnical design.

4.3.2 The site falls from the eastern corner, approximately 115m OD, down to the western corner across the site to approximately 95m OD with a significant fall of 20m. In general, the fall from the north eastern site boundary down to the south western site boundary is approximately 10m.

4.3.3 An existing sewer is present running along the south western boundary of the site, with an adjoining sewer present across the site from the residential housing just off the site's north eastern boundary. A surface water drain also runs along the southern boundary of the site, the drain was dry at the time of the walkover.

5.0 Fieldwork

5.1.1 A site investigation was carried out on the 20th March 2019 and comprised the following activities:

- 9 No. Trial Pits to a maximum depth of 3.1 m excavated using a JCB 3CX or similar;
- 3 No. TRL DCP tests; and
- Soakaway testing generally in accordance with BRE 365 in 5 No. locations.

5.1.2 Each position was scanned using a cable avoidance tool prior to positioning and proceeding. Statutory service asset records were also obtained and reviewed in advance of the investigations.

5.1.3 The south western area of the site was not accessed due to the presence of a buried service (foul sewer as indicated on Drawing 01) and dense vegetation. For plots that extend within this area further investigation will be required to confirm the ground conditions.

5.1.4 The exploratory hole plan is included within Appendix A showing the test locations. Exploratory hole logs are included within Appendix B.

6.0 Ground conditions

6.1 Soils

6.1.1 All of the trial pits across the site encountered Topsoil (from ground level to between 0.25m and 0.40m) which generally comprised a brown silty gravelly sand with roots and rootlets.

6.1.2 In the northern area of the site, underlying the topsoil was a sand with rare rounded gravel (from between 0.40m to 2.95m – base not proven within TP01 at 2.20m due to sidewall collapse) which is the basal layer of the Chester Formation. In the southern portion of the site sands and clays associated with the weathered Helsby Formation were present at depths of between 0.30m to 1.75m). The firm to stiff and stiff clay were encountered within TP04, TP06, TP08 and TP09.

6.1.3 The bedrock of the Helsby Sandstone Formation was encountered as an extremely weak to weak sandstone (from 0.30m (TP03) to greater than 3.1 m) in all of the trial pits except for TP01 and TP06.

6.1.4 It should be noted that due to the similar visual appearance of the Chester Formation and the weathered Helsby Sandstone it has been difficult to distinguish the boundary between the two units.

6.1.5 Made Ground was not encountered during the investigation.

6.1.6 The south western area of the site where Alluvium is shown on geological mapping was not investigated as part of this investigation due to the vegetation cover, services present and the drainage ditch. Further investigation will be required to confirm if Alluvium is present and if it encroaches within any plots.

6.2 Groundwater

6.2.1 The groundwater observations and a summary of the trial pit stability are summarised in the following table.

Summary of groundwater and stability observations			
TP reference	**Depth(s)**	**Groundwater**	**Excavation issues**
TP01	--	--	Soils from 2.0m depth were damp Sidewall collapse prevented further progress – trial pit abandoned at 2.20m
TP09	1.5m	Seepage	

Table 6.2

11.9 Infiltration potential

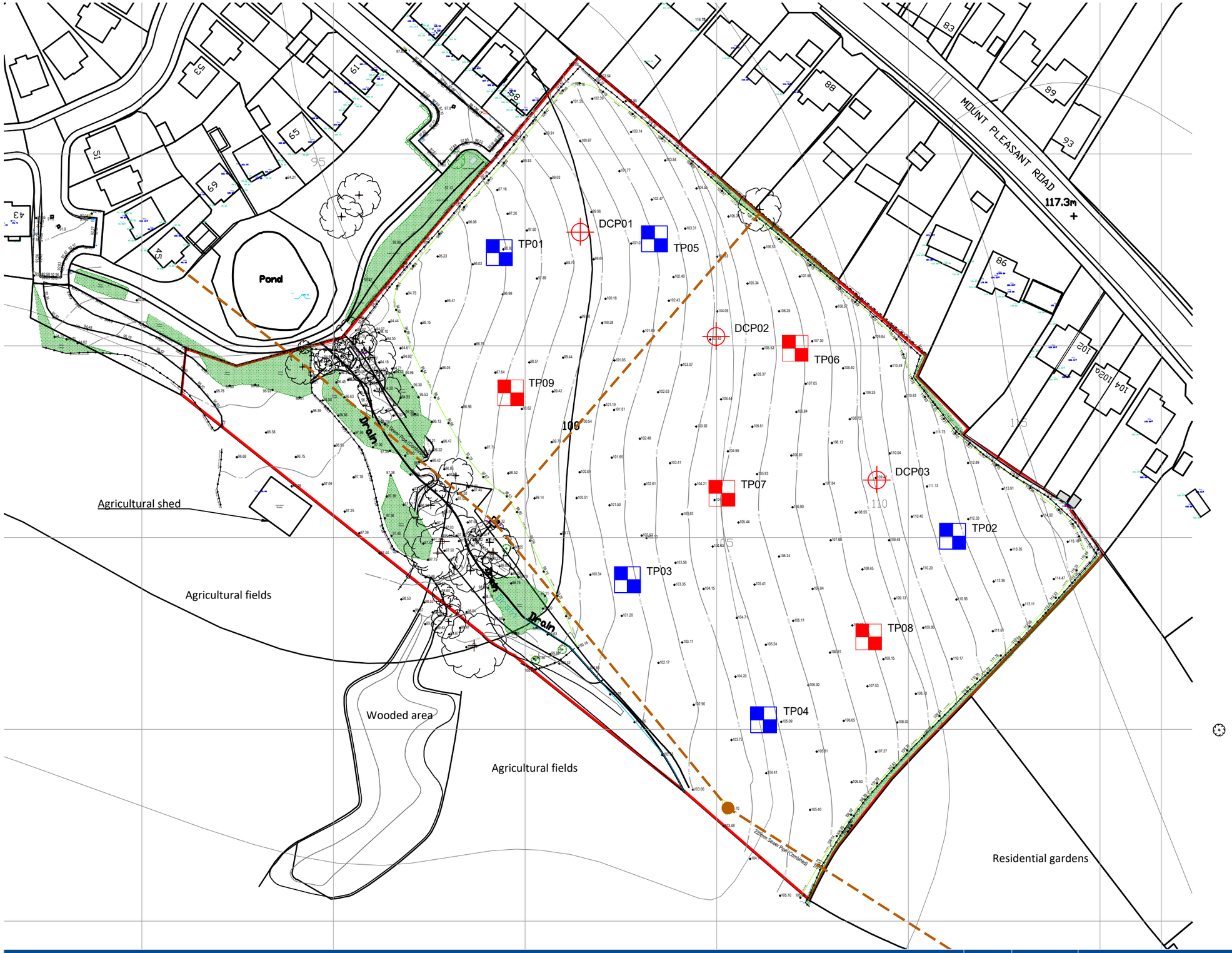
11.9.1 Infiltration testing was carried out in accordance with BRE 365 'Soakaway Design' at five locations across the site. However, in all cases three cycles could not be carried out due to the general impermeable nature of the soils. The soakaway results are included within Appendix C.

Summary of soakage results				
Soakage test location	Soil type	Soakage test base depth (m)	Cycle number	Soakage rate achieved
TP01	Chester Formation	1.6	1	No soakage achieved
TP02	Chester Formation	1.2	1	No soakage achieved
TP03	Helsby Sandstone Formation	1.5	1	No soakage achieved
TP04	Helsby Sandstone Formation	2.35	1	No soakage achieved
TP05	Chester Formation	1.6	1	No soakage achieved
Table 11.9				

11.9.2 Although the soils can be considered granular where testing occurred, there was a considerable fines fraction (<0.063mm) in the trial pits as noted by logging on site and the particle size distribution testing as seen in section 11.2 above. This fines fraction has reduced the amount of infiltration achieved.

11.9.3 Within TP03, soakage testing was completed within sandstone rock within similar results. This can attributed to the sandstone grains being fine and gently cemented together precluding soakage.

11.9.4 Based on these results soakaways as form of drainage for the development will not be feasible.



Notes:
Base drawing - Sutton and Wilkinson Chartered Architects, Sketch Site Layout - Scheme 3, 2494 - 05, January 2019

KEY:

- TP — Machine excavated trial pit
- TP — Machine excavated trial pit with soakaway testing
- DCP — TRL - Dynamic cone penetration test
- Existing sewer

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Drawn By:	MK
Chkd By:	AP
Scale @A3:	1:1000
Date:	15/05/2019
Status:	FOR INFORMATION
Project No.:	11282G

Client EMH Group

Project Land off Oak Close, Castle Gresley

Title Investigation positions

Drawing No: 01 Rev:

jpp

Key to Exploratory Hole Logs

General

Descriptions for soils and rocks generally following:

BS 5930:2015

BS EN ISO 14688-2:2004

BS EN ISO 14689-1:2003

Sampling

ES	Environmental Sample (taken in appropriate sampling container)
D	Disturbed Sample
B	Bulk Sample
C	Core Sample
U	Undisturbed Sample (number of blows indicated in results column)
UT	Thinwalled Undisturbed (number of blows indicated in results column)
W	Water Sample

Insitu Tests

SPT	Standard Penetration Test
SPT (C)	Cone Penetration Test
PID	Photo Ionisation Detector Results (ppm)
PP	Pocket Penetrometer reading converted to shear strength kPa
HV	Converted Shear Vane measurement kPa

Drilling Records

▼	Depth to standing water level
▽	Depth to water strike
TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Designation (%)

Backfill Symbols

Arisings

Concrete

Blacktop

Bentonite Seal

Gravel Filter

Sand Filter

Pipe Symbols

Plain Pipe

Slotted Pipe

Filter Tip

Principal Soil Types

Topsoil

Made Ground

Clay

Silt

Sand

Gravel

Peat

Principal Rock Types

Mudstone

Siltstone

Sandstone

Limestone

Chalk

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP01	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	D		0.40			Dark brown silty fine to coarse sandy TOPSOIL with roots
		1.00	D					Orange brown silty slightly gravelly fine to coarse SAND. Gravel consists of subangular to subrounded fine to coarse flint (CHESTER FORMATION)
		2.20	D		2.20			End of Trial Pit at 2.200m

1
2
3
4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Trial pit terminated due to side collapse					

Remarks

Damp conditions encountered from 2.0 m
Trial pit terminated due to sidewall collapse

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP02	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.30			Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL with roots
		0.80	D					Red brown silty slightly gravelly fine to coarse SAND. Gravel consists of subangular to subrounded fine to coarse flint (CHESTER FORMATION)
		1.80	D		1.90			*... with clayey pockets and becoming gravelly. Gravel is subangular to subrounded fine to coarse flint and angular to subrounded fine to medium extremely weak sandstone*
					2.10			Very weak pale yellow brown SANDSTONE recovered as gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)

End of Trial Pit at 2.100m

1 2 3 4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP03	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.30			Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL with roots
		0.80	D		1.65			Extremely weak to very weak pale yellow brown SANDSTONE recovered as gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)
								End of Trial Pit at 1.650m

1
2
3
4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP04	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL with roots
		0.25	ES		0.25			Stiff high strength red brown slightly sandy CLAY (HELSBY SANDSTONE FORMATION)
		0.50		HVP=106				
		0.80	D					
		1.00		HVP=145				
					1.70			Extremely weak to very weak red brown SANDSTONE recovered as slightly silty gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)
		2.00	D					
					2.30			End of Trial Pit at 2.300m

1
2
3
4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP05	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL with roots
		0.30	ES		0.30			Light brown slightly silty gravelly fine to coarse SAND. Gravel consists of subangular to rounded fine to coarse flint (CHESTER FORMATION)
		0.70	ES					
		1.80	B					
		2.50	D					
								... gravel is subangular to rounded fine to coarse flint and angular to subrounded fine to coarse extremely weak sandstone
					2.95			Extremely weak to very weak pale yellow brown SANDSTONE recovered as gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)
					3.10			End of Trial Pit at 3.100m

1 2 3 4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP06	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL with roots
		0.40	ES		0.40			Brown silty slightly clayey gravelly fine to coarse SAND. Gravel consists of subangular to subrounded fine to coarse flint (CHESTER FORMATION)
		0.70	ES					
		1.60	B		1.80			Stiff red brown slightly sandy CLAY (HELSBY SANDSTONE FORMATION)
		2.30	D					
					3.00			End of Trial Pit at 3.000m

1 2 3 4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP07	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL with roots
		0.40	ES		0.40			Yellow brown slightly silty fine to coarse SAND (HELSBY SANDSTONE FORMATION)
		0.60	ES					
								... becoming slightly gravelly. Gravel is angular to subrounded fine to medium extreamly weak to very weak sandstone
		1.30	B					
								... gravel becoming fine to coarse
					1.60			Extremely weak to very weak off white pale yellow SANDSTONE recovered as gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)
		2.30	D					
					2.40			End of Trial Pit at 2.400m

1
2
3
4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP08	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Dark brown slightly silty slightly gravelly fine to coarse sandy TOPSOIL	
		0.35	ES		0.35				
		0.60	ES					Brown clayey silty slightly gravelly fine to coarse SAND. Gravel consists of subangular to subrounded fine to medium flint (CHESTER FORMATION)	
					0.80				
		1.00		HVP=145				Stiff high strength red brown slightly sandy CLAY (HELSBY SANDSTONE FORMATION)	1
		1.30	D						
					1.75			Extremely weak to weak pale yellow brown SANDSTONE recovered as very gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)	
								... becoming yellow brown	2
		2.20	D		2.20			End of Trial Pit at 2.200m	
									3
									4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

No groundwater encountered
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Trial Pit Log

Project Name: Land off Oak Close	Client: EMH Group	Date: 20/03/2019
Location: Castle Gresley	Contractor: Anglia Crane & Plant	
Project No. : 11282G	Crew Name:	Equipment: JCB 3CX

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP09	TP		JR	1:20	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Dark brown silty fine to coarse sandy TOPSOIL
		0.30	ES		0.30			Loose to medium dense red brown slightly clayey silty fine to coarse SAND (HELSBY SANDSTONE FORMATION)
		0.70	ES					
					0.90			Firm to stiff high strength red brown slightly sandy CLAY (HELSBY SANDSTONE FORMATION)
		1.20		HVP=136				
		1.40	D					
					1.60			Very weak to weak off white pale yellow SANDSTONE recovered as very gravelly fine to coarse sand (HELSBY SANDSTONE FORMATION)
					2.40			End of Trial Pit at 2.400m

1 2 3 4

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
		Stable					

Remarks

Groundwater seepage encountered at 1.5 m
Trial pit sidewalls stable
Trial pit terminated due to competence of bedrock

Soakaway Test TP01 Cycle 1

Project: Oak Close, Castle Gresley

Project Ref: 11282G

Date: 20th March 2019

Revision:

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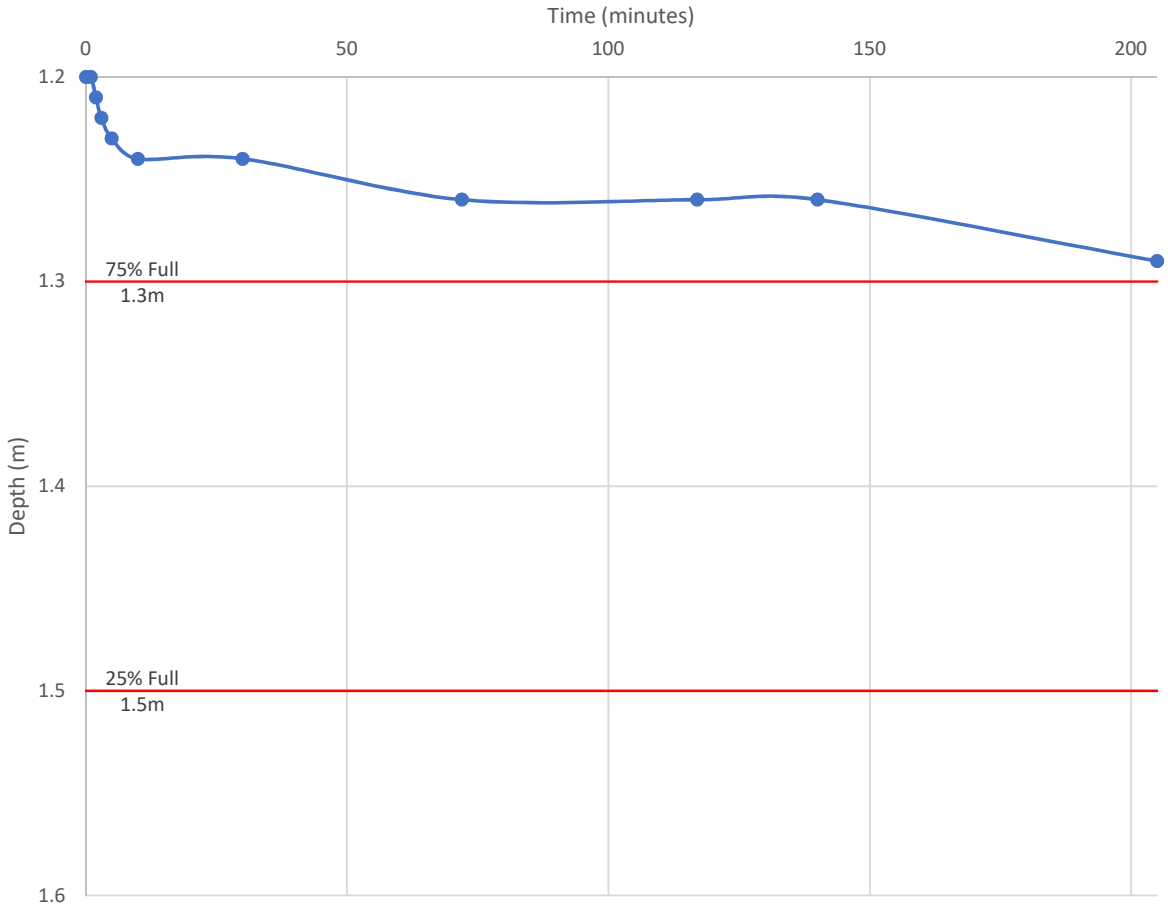


Trial pit width = 0.6m
Trial pit length = 1.2m
Trial pit depth = 1.6m

Soil infiltration rate *f* = $\frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$

Insufficient soakage achieved and therefore the soils can be considered to be impermeable

V_{p75-25}: the effective storage volume of water in the soakage trial pit between 75% and 25% effective
a_{s50}: the internal surface area of the soakage trial pit up to 50% effective storage depth and including
t_{p75-25}: the time for the water level to fall from 75% to 25% effective storage depth

Soakaway Test TP02 Cycle 1

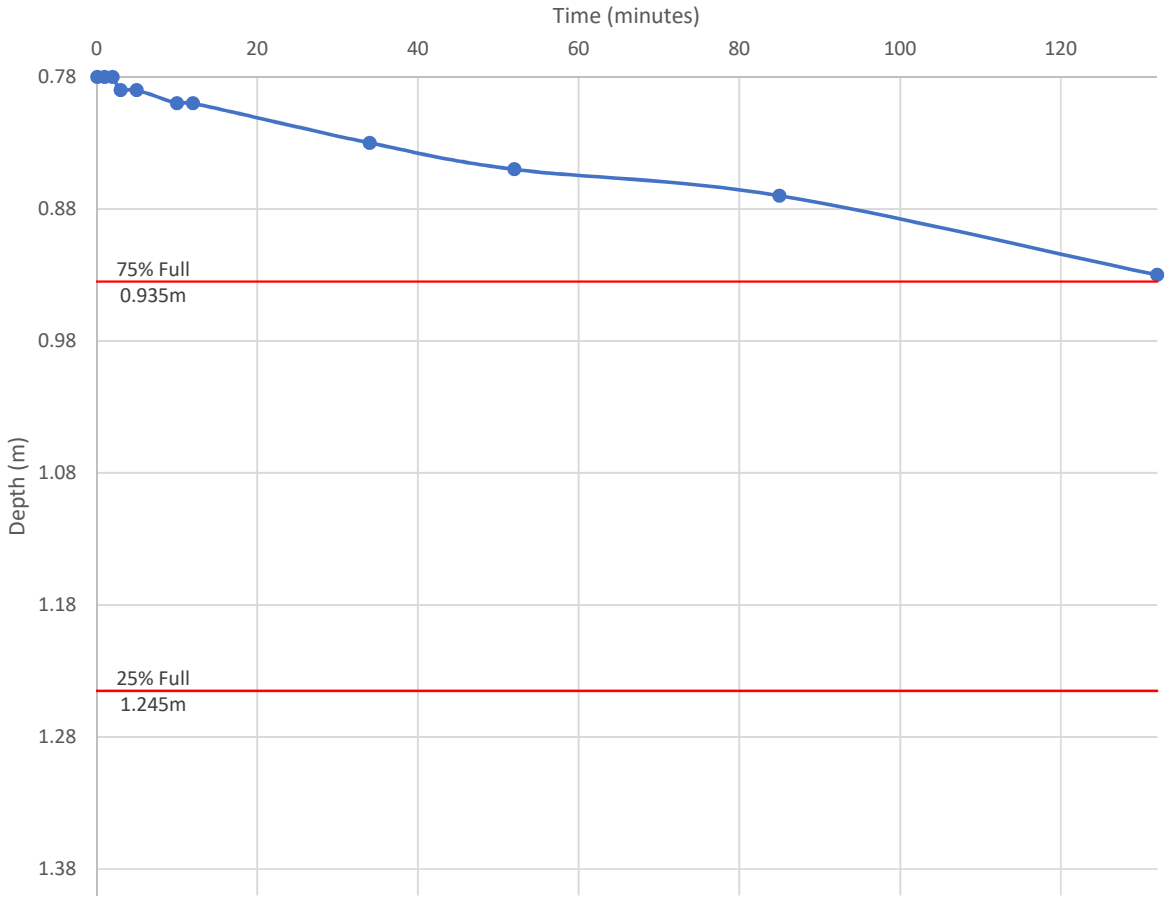
Project: Oak Close, Castle Gresley

Project Ref: 11282G

Date: 20th March 2019

Revision:

T: 01604 781811
E: mail@jppuk.net
W: www.jppuk.net



Trial pit width = 0.6m
Trial pit length = 1.2m
Trial pit depth = 1.4m

Soil infiltration rate *f* = $\frac{V_{p75\text{-}25}}{a_{s50} \times t_{p75\text{-}25}}$

Insufficient soakage achieved and therefore the soils can be considered to be impermeable

$V_{p75\text{-}25}$: the effective storage volume of water in the soakage trial pit between 75% and 25% effective
a_{s50}: the internal surface area of the soakage trial pit up to 50% effective storage depth and including
$t_{p75\text{-}25}$: the time for the water level to fall from 75% to 25% effective storage depth

Soakaway Test TP03 Cycle 1

Project: Oak Close, Castle Gresley

Project Ref: 11282G

Date: 20th March 2019

Revision:

T: 01604 781811
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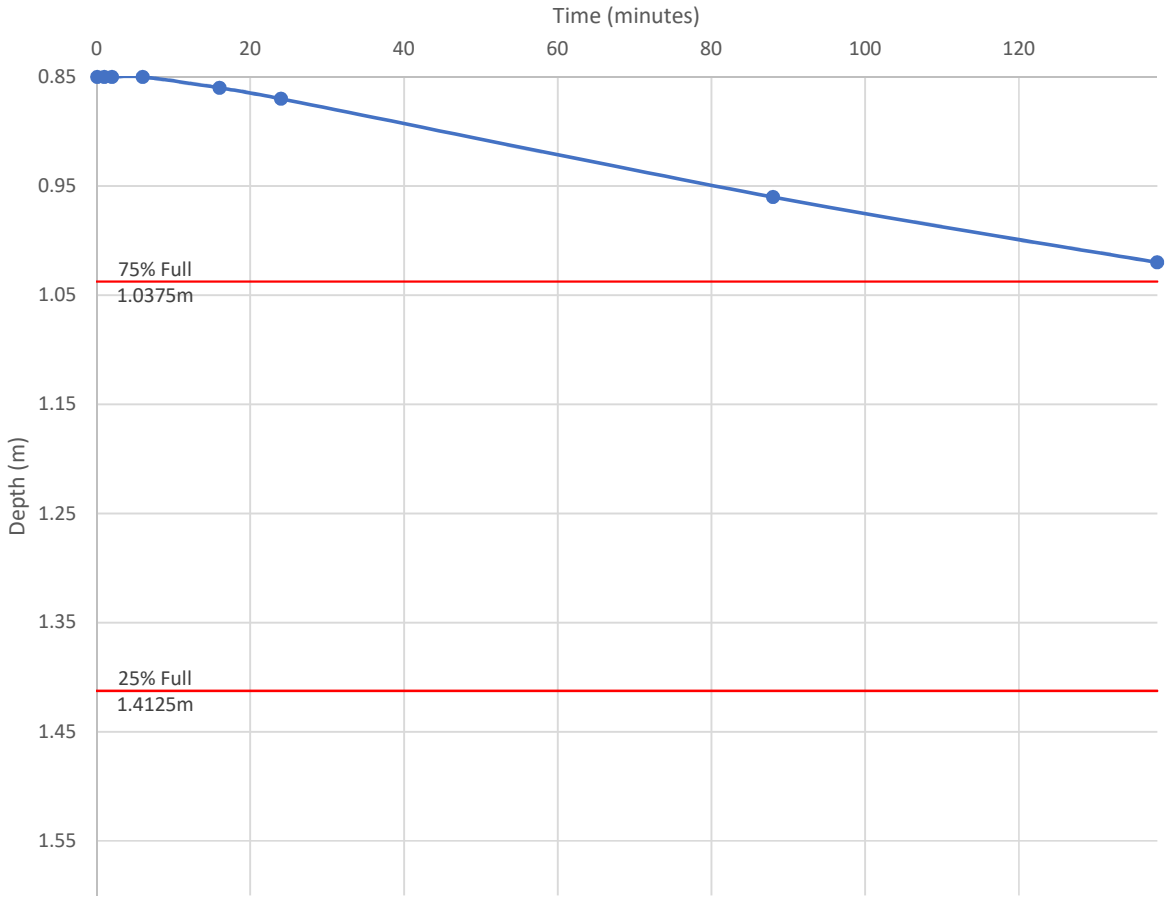

Trial pit width = 0.6m
Trial pit length = 1.2m
Trial pit depth = 1.6m

Soil infiltration rate *f* = $\frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$

Insufficient soakage achieved and therefore the soils can be considered to be impermeable

V_{p75-25}: the effective storage volume of water in the soakage trial pit between 75% and 25% effective
a_{s50}: the internal surface area of the soakage trial pit up to 50% effective storage depth and including
t_{p75-25}: the time for the water level to fall from 75% to 25% effective storage depth

Soakaway Test TP04 Cycle 1

Project: Oak Close, Castle Gresley

Project Ref: 11282G

Date: 20th March 2019

Revision:

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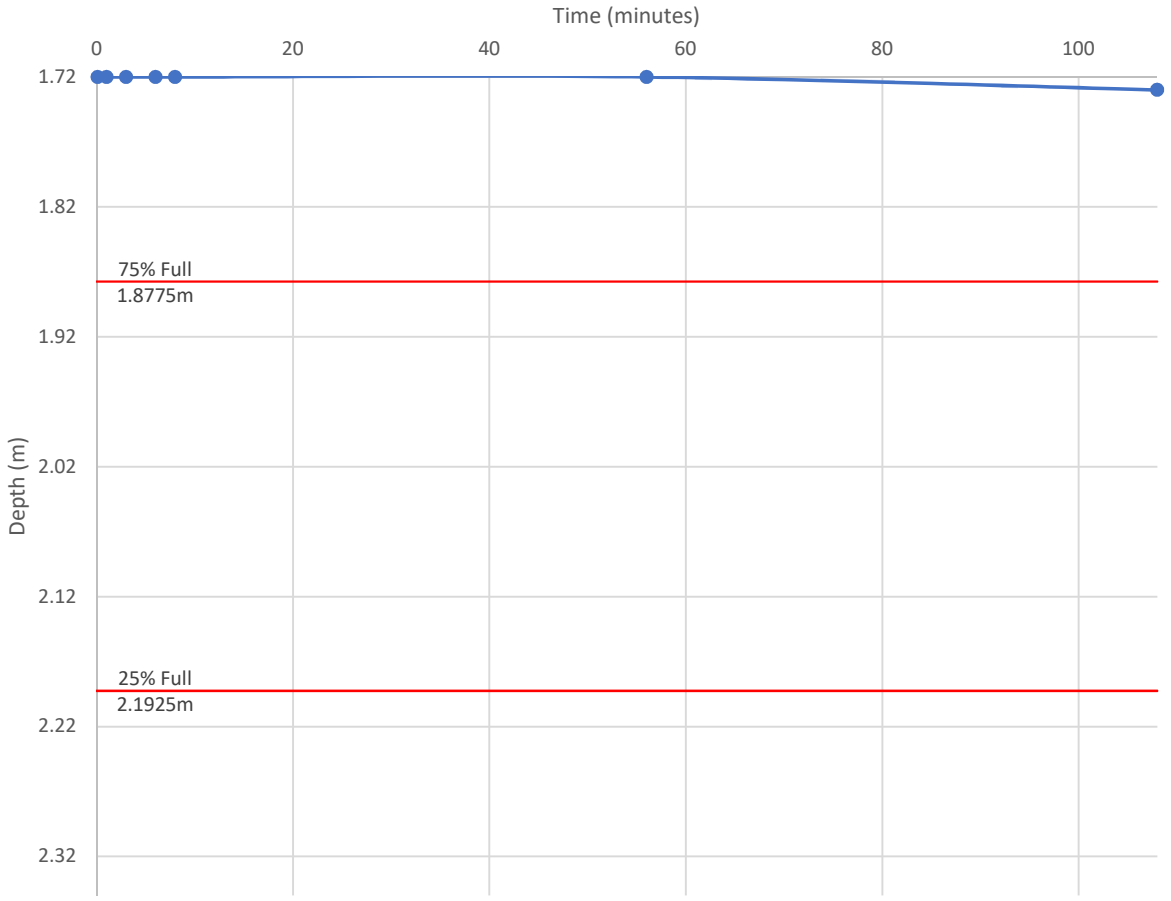
E: mail@jppuk.net
W: www.jppuk.net



Trial pit width = 0.6m
Trial pit length = 1.2m
Trial pit depth = 2.35m

Soil infiltration rate *f* = $\frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$

Insufficient soakage achieved and therefore the soils can be considered to be impermeable

V_{p75-25}: the effective storage volume of water in the soakage trial pit between 75% and 25% effective
a_{s50}: the internal surface area of the soakage trial pit up to 50% effective storage depth and including
t_{p75-25}: the time for the water level to fall from 75% to 25% effective storage depth

Soakaway Test TP05 Cycle 1

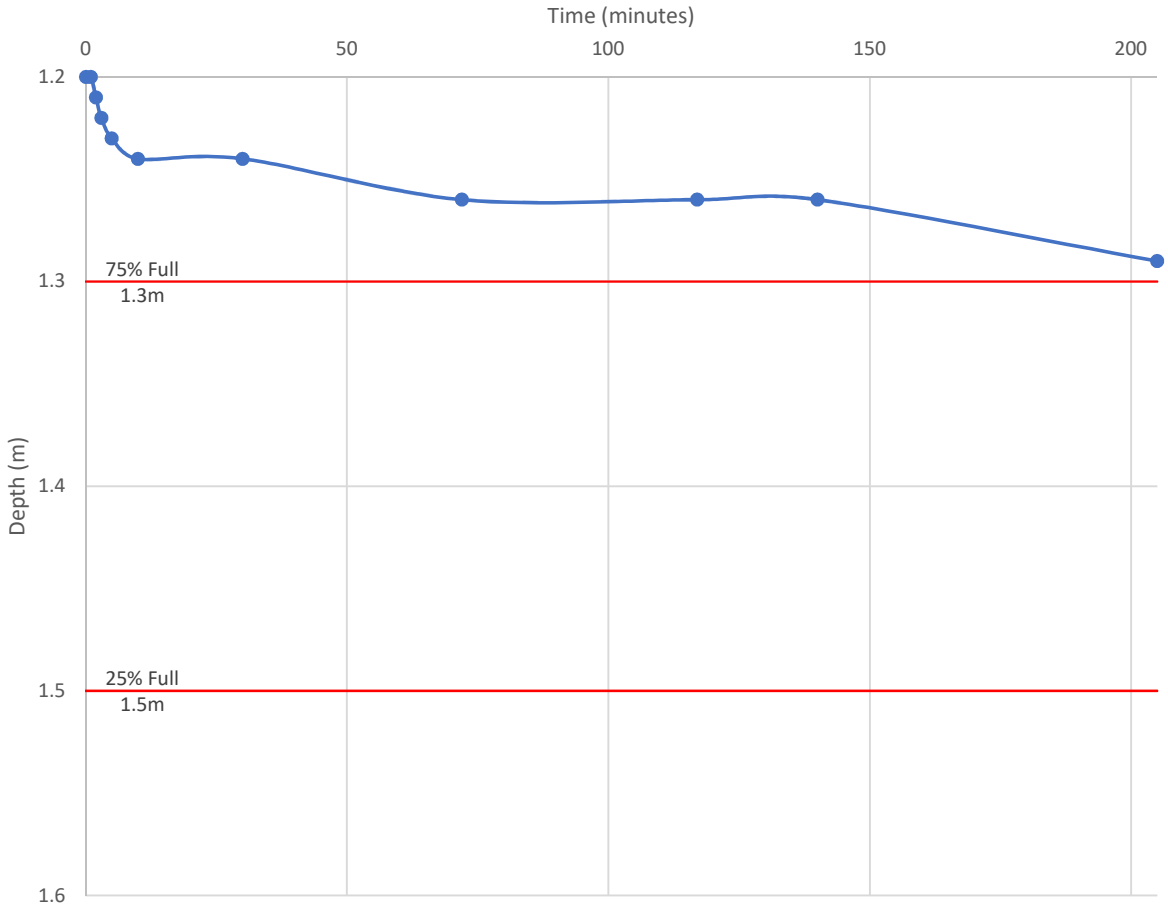
Project: Oak Close, Castle Gresley

Project Ref: 11282G

Date: 20th March 2019

Revision:

T: 01604 781811
E: mail@jppuk.net
W: www.jppuk.net



Trial pit width = 0.6m
Trial pit length = 1.2m
Trial pit depth = 1.6m

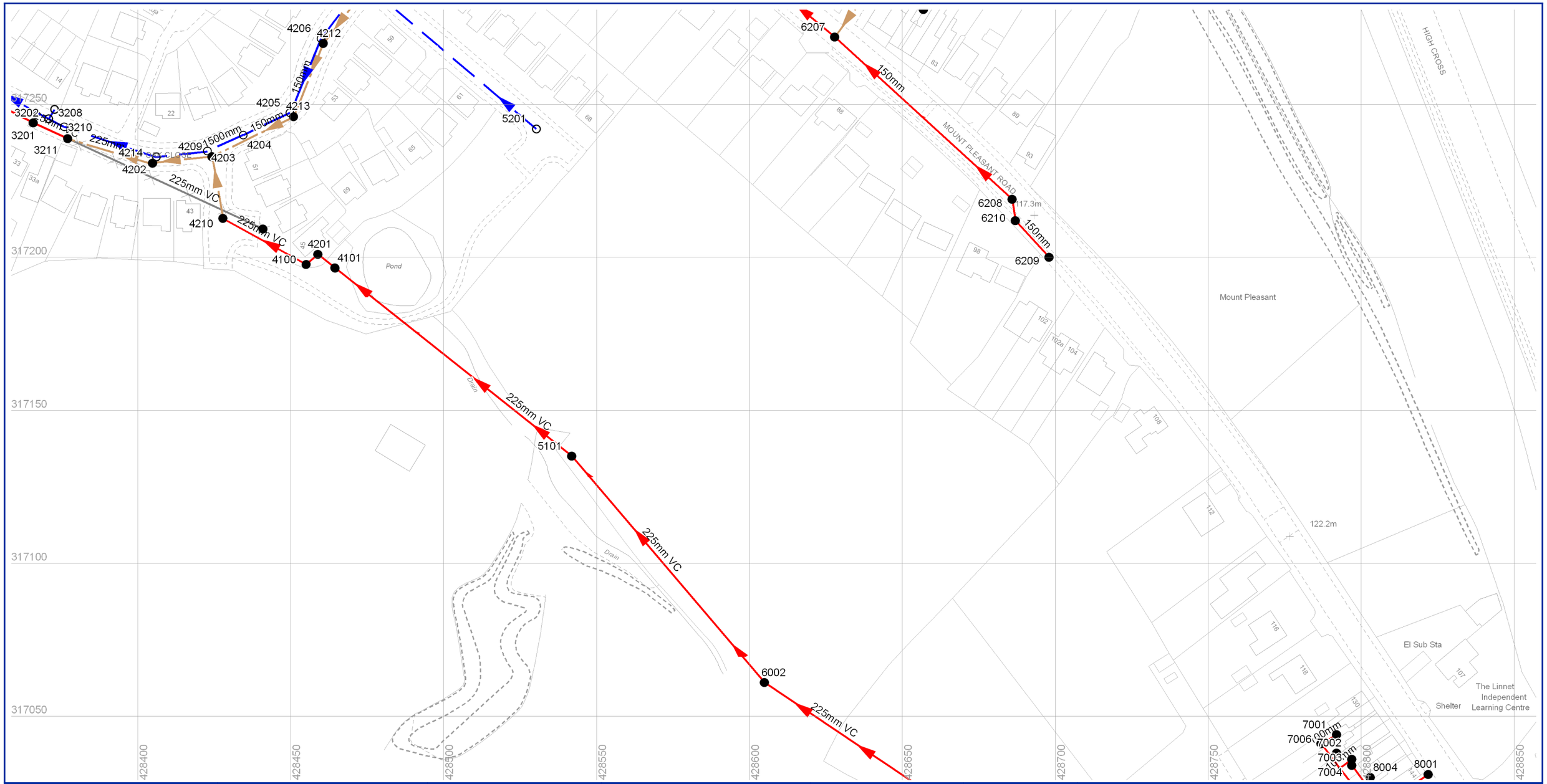
Soil infiltration rate $f = \dfrac{V_{p75\text{-}25}}{a_{s50} \times t_{p75\text{-}25}}$

Insufficient soakage achieved and therefore the soils can be considered to be impermeable

$V_{p75\text{-}25}$: the effective storage volume of water in the soakage trial pit between 75% and 25% effective
a_{s50}: the internal surface area of the soakage trial pit up to 50% effective storage depth and including
$t_{p75\text{-}25}$: the time for the water level to fall from 75% to 25% effective storage depth

Appendix E

Severn Trent Water: Asset Plan



- Abandoned Gravity Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)

All Private Sewers are shown in magenta
All section 104 sewers are shown in green
All Sewers that have been transferred to Severn Trent Water after the 1st October 2011, but have not been surveyed and confirmed by Severn Trent Water are shown in orange

- Culverted Watercourse
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet

- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor

- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Pre-1937 Properties

MATERIALS

- - NONE
AC - ASBESTOS CEMENT
BR - BRICK
CC - CONCRETE BOX CULVERT
CI - CAST IRON
CO - CONCRETE
CSB - CONCRETE SEGMENTS (BOLTED)
CSU - CONCRETE SEGMENTS (UNBOLTED)
DI - DUCTILE IRON
GRC - GLASS REINFORCED CONCRETE
GRP - GLASS REINFORCED PLASTIC
MAC - MASONRY IN REGULAR COURSES
MAR - MASONRY RANDOMLY COURSED
PE - POLYETHLENE
PF - PITCH
PP - POLYPROPYLENE
PSC - PLASTIC STEEL COMPOSITE
PVC - POLYVINYL CHLORIDE
RPM - REINFORCED PLASTIC MATRIX
SI - SPUN (GREY) IRON
ST - STEEL
U - UNKNOWN
VC - VITRIFIED CLAY
XXX - OTHER

SHAPE

C - CIRCULAR
E - EGG SHAPED
O - OTHER
R - RECTANGLE
S - SQUARE
T - TRAPEZOIDAL
U - UNKNOWN

PURPOSE

C - COMBINED
E - FINAL EFFLUENT
F - FOUL
L - SLUDGE
S - SURFACE WATER

CATEGORIES

W - WEIR
C - CASCADE
DB - DAMBOARD
SE - SIDE ENTRY
FV - FLAP VALVE
BD - BACK DROP
S - SIPHON
HD - HIGHWAY DRAIN
S104 - SECTION 104

N
W E
S

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD

O/S Map scale: 1:1250

Date of issue: 05.03.19

This map is centred upon:
O / S Grid reference:

x : 428608

y : 317155

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Private pumping stations, which form part of these sewers or lateral drains, will transfer to the ownership of Severn Trent Water on or before 1 October 2016.
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Sewer Node Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SK28167904	118.25	117.49	nil	C	nil	C	100	nil	0.00	nill
SK28174100	nil	90.52	nil	C	VC	C	225	nil	0.37	nill
SK28174101	nil	95.27	90.56	C	VC	C	225	nil	22.51	nill
SK28174201	92.93	nil	nil	C	VC	C	225	nil	0.00	nill
SK28174205	nil	nil	nil	S	nil	C	nil	nil	0.00	nill
SK28174206	nil	nil	nil	S	nil	C	nil	nil	0.00	nill
SK28174207	nil	nil	nil	S	nil	C	nil	nil	0.00	nill
SK28174211	nil	nil	nil	F	nil	C	150	nil	0.00	nill
SK28174212	nil	nil	nil	F	nil	C	150	nil	0.00	nill
SK28174213	nil	nil	nil	F	nil	C	150	nil	0.00	nill
SK28175101	98.41	95.27	90.56	C	VC	C	225	nil	22.51	nill
SK28175201	nil	nil	nil	S	nil	C	nil	nil	0.00	nill
SK28175301	110.96	110.33	nil	C	nil	C	100	nil	0.00	nill
SK28175303	110.68	108.67	105.37	C	nil	C	150	nil	24.29	nill
SK28176001	111.49	109.85	102.09	C	VC	C	225	nil	13.19	nill
SK28176002	103.64	101.98	95.32	C	VC	C	225	nil	14.59	nill
SK28176201	111.80	111.44	111.06	C	nil	C	100	nil	15.34	nill
SK28176202	112.09	111.54	nil	C	nil	C	100	nil	0.00	nill
SK28176204	112.48	111.73	nil	C	nil	C	100	nil	0.00	nill
SK28176205	nil	nil	111.05	C	nil	nil	nil	nil	0.00	nill
SK28176206	nil	nil	nil	C	nil	nil	nil	nil	0.00	nill
SK28176207	112.60	110.81	108.71	C	nil	C	150	nil	39.57	nill
SK28176208	116.44	114.72	110.85	C	nil	C	150	nil	20.30	nill
SK28176209	117.50	115.21	115.13	C	nil	C	150	nil	203.50	nill
SK28176210	116.90	115.11	114.94	C	nil	C	150	nil	41.59	nill
SK28176301	111.07	110.49	nil	C	nil	C	100	nil	0.00	nill
SK28176302	111.35	110.31	nil	C	nil	C	100	nil	0.00	nill
SK28176303	111.63	110.69	110.39	C	nil	C	100	nil	10.53	nill
SK28176304	111.64	111.00	110.71	C	nil	C	100	nil	29.45	nill
SK28176306	111.65	110.85	110.76	C	nil	C	100	nil	40.11	nill
SK28176307	111.59	110.95	110.76	C	nil	C	100	nil	37.21	nill
SK28176308	111.57	110.97	110.96	C	nil	C	100	nil	100.00	nill
SK28176309	nil	111.44	111.06	C	nil	C	100	nil	38.32	nill
SK28177010	113.43	nil	109.88	C	nil	nil	nil	nil	0.00	nill
nil	nil	nil	nil	C	nil	nil	nil	nil	0.00	nill

MATERIALS

-	- NONE	PE	- POLYETHLENE
AC	- ASBESTOS CEMENT	PF	- PITCH
BR	- BRICK	PP	- POLYPROPYLENE
CC	- CONCRETE BOX CULVERT	PSC	- PLASTIC STEEL COMPOSITE
CI	- CAST IRON	PVC	- POLYVINYL CHLORIDE
CO	- CONCRETE	RPM	- REINFORCED PLASTIC MATRIX
CSB	- CONCRETE SEGMENTS (BOLTED)	SI	- SPUN (GREY) IRON
CSU	- CONCRETE SEGMENTS (UNBOLTED)	ST	- STEEL
DI	- DUCTILE IRON	U	- UNKNOWN
GRC	- GLASS REINFORCED CONCRETE	VC	- VITRIFIED CLAY
RP	- GLASS REINFORCED PLASTIC	XXX	- OTHER
MAC	- MASONRY IN REGULAR COURSES		
MAR	- MASONRY RANDOMLY COURSED		

SHAPE

C	- CIRCULAR
E	- EGG SHAPED
O	- OTHER
R	- RECTANGLE
S	- SQUARE
T	- TRAPEZOIDAL
U	- UNKNOWN

PURPOSE

C	- COMBINED
E	- FINAL EFFLUENT
F	- FOUL
L	- SLUDGE
S	- SURFACE WATER

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.

B. Where the node bifurcates (splits) X and Y indicates downstream sewer pipe.

C. Gradient is stated a 1 in...

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD DATA TABLE

O/S Map scale:	1:1750	**This map is centred upon: O / S Grid reference:**	
Date of issue:	05.03.19	**x:**	428608
Sheet No.	2 of 2	**y :**	317155

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Appendix F
LLFA Flooding Information

Oak Close, Castle Gresley, DE11 9RU

The existing (historical) pond drains fields to the south and south-west via a surface land drain. The outlet is to a land drain culvert that originally joined a watercourse to the north of Hillside Road. When the development was built in 2002 this was diverted – through the back garden of no. 43 Oak Close and in between nos. 43 and 41, apparently joining the surface water sewer at the manhole in front of 33 Oak Close. In the flooding incidents, this drain was apparently overwhelmed, and the pond overflowed into gardens, houses and along Oak Close. In 2014, 10 houses were flooded internally and 9 externally as far as Cedar Road. In 2016, sandbags were given out to 4 properties and an unconfirmed number were flooded. There are also anecdotal reports of flooding incidents in 2012. (See Figure 1.)

Figure 1. Flood history and flows

The pond is adopted by South Derbyshire District Council as Public Open Space and maintained by a management company. The onward land drain is under riparian ownership to the point where it joins the sewer.

A further flooding problem is caused by the fact that the back gardens of numbers 33a to 43 Oak Close are set approximately 1 metre lower than the adjacent field. Runoff from the field flows directly into the gardens. The landowner has cut a channel along the garden fences in an attempt to direct water into the road. (See Figure 1.)

<u>Possible Solutions</u>

Regarding the pond overflow, the land drain from the pond could be diverted along the cul-de-sac adjacent to 43 Oak Close and connected into the 1500 mm diameter surface water sewer in Oak Close. (See Figure 2.) This would reduce the bottle neck effect of the existing culvert and be easier to maintain, in terms of the shape and ownership.

Regarding the field runoff, no solution has been discussed as yet.

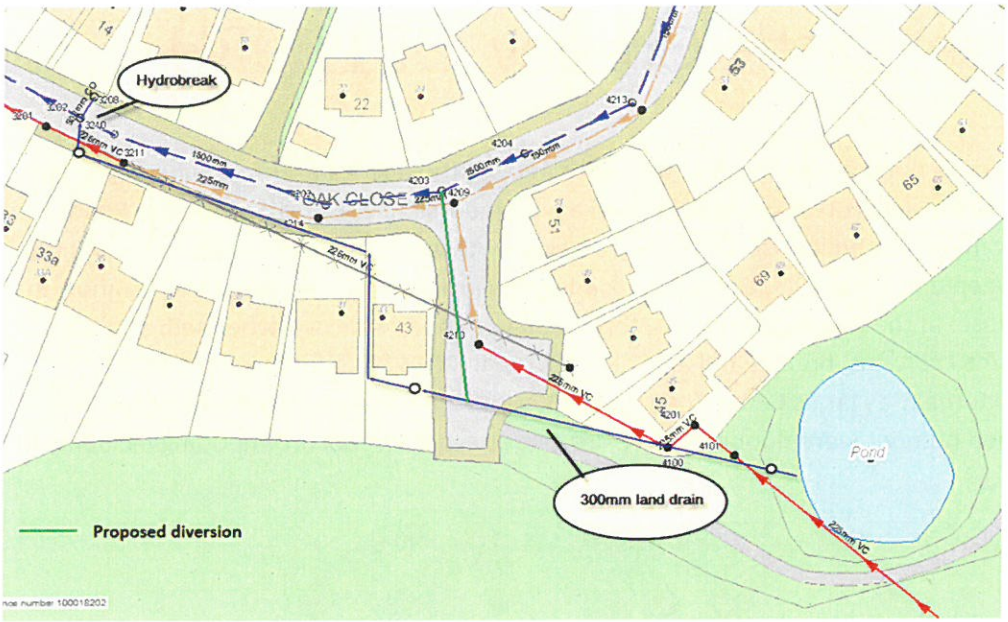
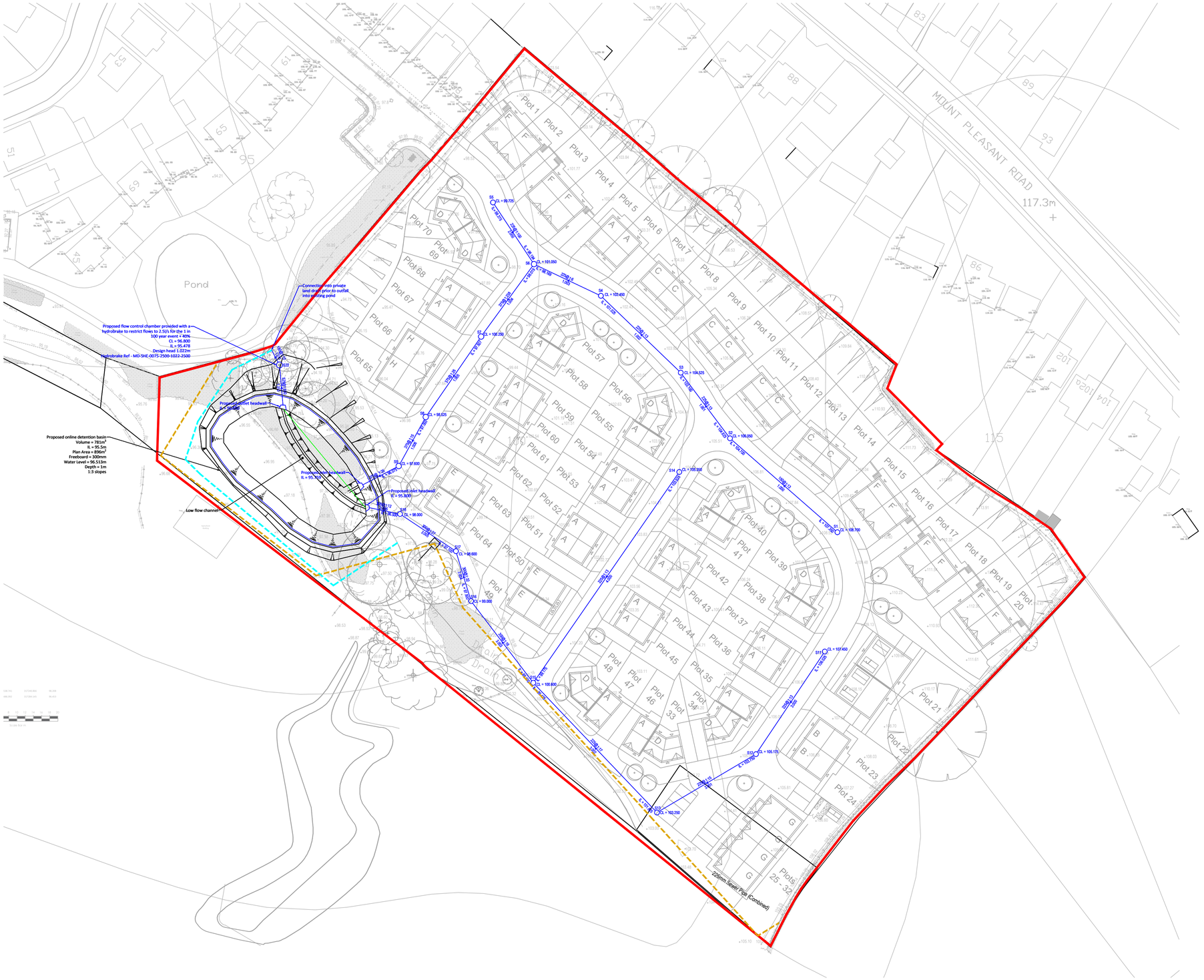


Figure 2. Proposed diversion of land drain

Appendix G

Surface Water Drainage Strategy
JPP drawing no. 11285R-FRA03



General Notes

1. All dimensions are in metres unless otherwise stated.
2. All levels are in metres.
3. This drawing is to be read in conjunction with all relevant Engineers and Architect's drawings, Specifications, Reports and Engineering Details.
4. Do not scale from this drawing.
5. Site layout taken from Sutton and Wilkinson Chartered Architects Site Layout Plan drawing no. 2494 - 12 rev. C dated 19.09.2019.
6. Topographical Survey taken from JPP Consulting drawing no. 11961Y - 01 rev. A dated 18.06.2019.

Drawing key

- Site boundary (Taken from latest site layout referenced above)
- 150Ø @ 1 in 150 S1 — Adoptable surface water sewer with pipe diameter, gradient and manhole
- Proposed Diversion of Land Drain (indicative)
- Proposed Diversion of Combined Sewer (indicative)
- Banking works

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- Surveying
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Drawn By:	RS
Chkd By:	WRA
Scale @A1:	1:500
Date:	10.10.2019
Status:	FOR INFORMATION
Project No.:	11285R

Client EHM Group

Project Proposed Residential Development, Land off Oak Close, Castle Gresley, Swadlincote, Derbyshire

Title Proposed Surface Water Drainage Strategy

Drawing No: FRA03 Revision:

Appendix H
Greenfield Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.923	Urban	0.000
SAAR (mm)	657	Region Number	Region 4

Results	**l/s**
QBAR Rural	3.8
QBAR Urban	3.8
Q100 years	9.7
Q1 year	3.1
Q30 years	7.4
Q100 years	9.7

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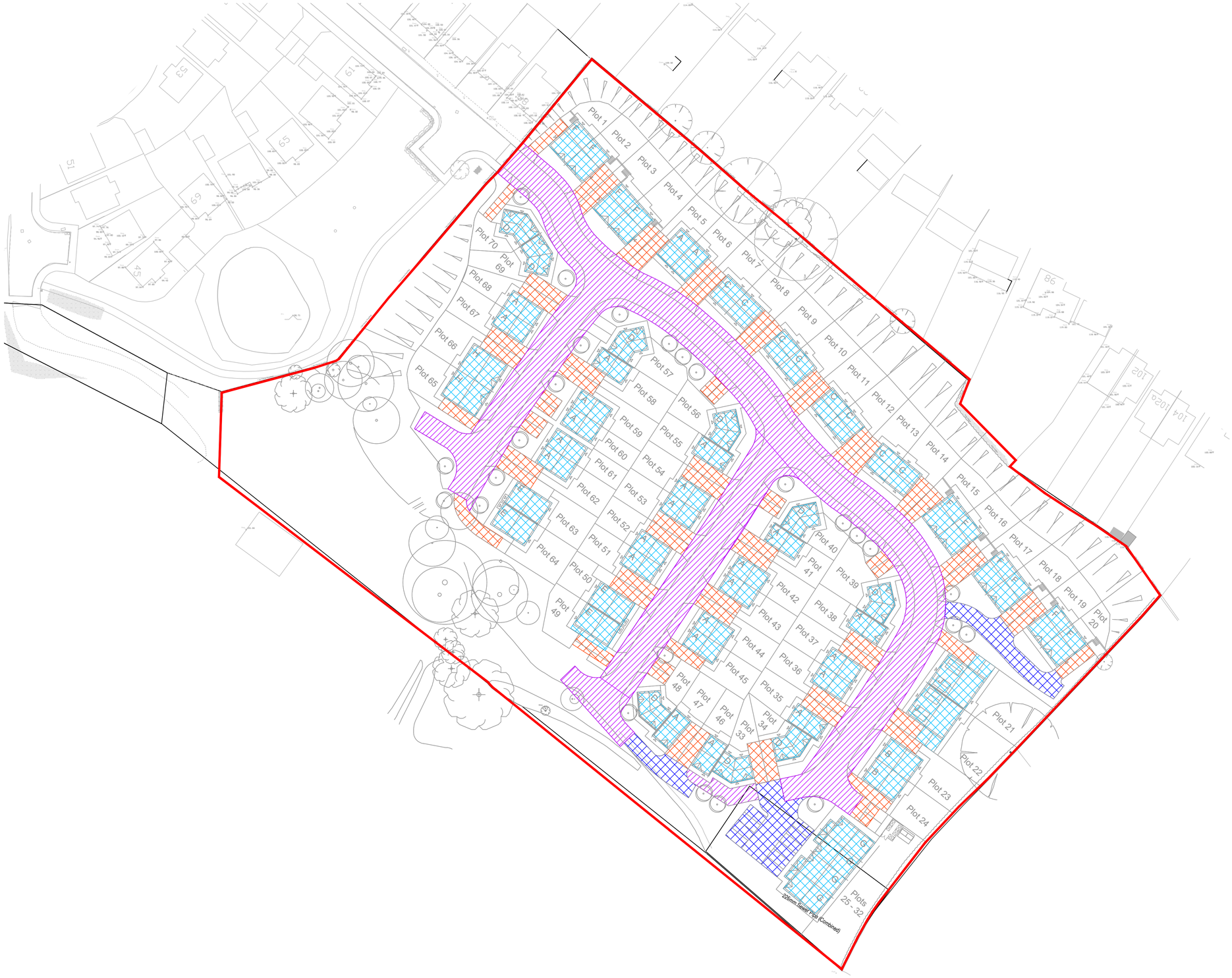
Appendix I

Proposed Impermeable Area
JPP drawing no. 11285R-FRA02A



NOTES

1. Based on Preliminary Site Layout by Sutton & Wilkinson, drawing number 2494-12 dated September 2019.

2. Based on Ordnance Survey mapping enclosed within Site Layout CAD file. Crown Copyright 2018. Supplied by Copla Ltd trading as UKPlanningMaps.com a licensed Ordnance Survey partner (100054135).

KEY

Site Boundary = 28,579m^2

Impermeable Areas:

Roofs = 3,463m^2

Private Drives = 1,911m^2

Shared Drives = 502m^2

Road = 3,352m^2

Total Impermeable Area = 9,228m^2

Rev A Revised to suit latest site layout. Drawn NB Checked WRA 10.10.2019

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Manchester
T:0161 6822927

Milton Keynes
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- Planning Services
- Geotechnical & Environmental
- Surveying
- Professional Advice

Drawn By:	JP
Chkd By:	KER
Scale @A1:	1:1000
Date:	13.03.2019
Status:	FOR INFORMATION
Project No.:	11285R

Client EHM Group

Project Proposed Residential Development, Land off Oak Close, Castle Gresley, Swadlincote, Derbyshire

Title Proposed Impermeable Area

Drawing No: FRA02 Revision: A

jpp

Appendix J
Network Calculations

FEH: 1 in 100 year + 40% CC

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.640	4-8	0.283

Total Area Contributing (ha) = 0.923

Total Pipe Volume (m³) = 32.052

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.898	2.650	13.2	0.066	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.052	1.525	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	27.109	2.075	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.105	2.856	6.3	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	18.110	0.181	100.1	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.85	4.21	107.350	0.066	0.0	0.0	0.0	2.79	49.3	13.2
1.001	73.22	4.30	104.625	0.132	0.0	0.0	0.0	3.63	144.3	26.2
1.002	72.40	4.42	103.100	0.198	0.0	0.0	0.0	3.64	144.7	38.8
1.003	72.03	4.48	101.025	0.264	0.0	0.0	0.0	5.23	208.0	51.5
2.000	73.69	4.23	98.375	0.066	0.0	0.0	0.0	1.31	52.0	13.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	21.930	0.092	238.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.877	0.927	25.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	13.678	0.925	14.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.039	0.316	34.9	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.065	0.007	295.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	30.199	2.275	13.3	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	28.102	1.925	14.6	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	43.839	2.650	16.5	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	62.702	4.750	13.2	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	25.113	1.600	15.7	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	12.737	0.400	31.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.005	16.413	0.600	27.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.006	8.583	0.700	12.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.007	5.477	0.023	238.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.009	25.860	0.052	497.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.010	10.839	0.022	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.011	4.075	0.408	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	70.07	4.79	98.019	0.396	0.0	0.0	0.0	1.17	129.2	75.1
1.005	69.41	4.91	97.927	0.462	0.0	0.0	0.0	3.58	395.7	86.8
1.006	69.12	4.95	97.000	0.528	0.0	0.0	0.0	4.73	522.7	98.8
1.007	68.77	5.01	96.075	0.593	0.0	0.0	0.0	3.07	339.6	110.4
1.008	68.62	5.04	95.609	0.593	0.0	0.0	0.0	1.30	281.2	110.4
3.000	74.32	4.14	106.025	0.066	0.0	0.0	0.0	3.61	143.6	13.3
3.001	73.39	4.28	103.750	0.132	0.0	0.0	0.0	3.44	136.9	26.2
3.002	71.90	4.50	101.825	0.198	0.0	0.0	0.0	3.23	128.6	38.6
4.000	73.30	4.29	103.925	0.066	0.0	0.0	0.0	3.62	144.0	13.1
3.003	71.24	4.61	99.100	0.330	0.0	0.0	0.0	3.99	281.9	63.7
3.004	70.76	4.68	97.500	0.330	0.0	0.0	0.0	2.80	197.6	63.7
3.005	70.20	4.77	97.100	0.330	0.0	0.0	0.0	3.02	213.3	63.7
3.006	70.01	4.80	96.500	0.330	0.0	0.0	0.0	4.51	319.1	63.7
3.007	69.59	4.87	95.650	0.330	0.0	0.0	0.0	1.31	208.8	63.7
1.009	66.23	5.47	95.552	0.923	0.0	0.0	0.0	1.00	216.0	165.5
1.010	65.28	5.65	95.500	0.923	0.0	0.0	0.0	0.99	215.4	165.5
1.011	75.15	4.02	95.478	0.000	2.5	0.0	0.0	3.20	56.6	2.5

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.800	95.071	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.011, Volume (m³): 4.4

Unit Reference	MD-SHE-0075-2500-1022-2500
Design Head (m)	1.022
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	95.478
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.022	2.5
Flush-Flo™	0.309	2.5
Kick-Flo®	0.636	2.0
Mean Flow over Head Range	-	2.2

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.2	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.010

Invert Level (m) 95.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	781.0	1.000	781.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	428050 317750 SK 28050 17750
C (1km)	-0.028
D1 (1km)	0.338
D2 (1km)	0.323
D3 (1km)	0.256
E (1km)	0.309
F (1km)	2.402
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Sensitivity flows(s) (%)	0, +40

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	60 Summer	+40%					107.439
1.001	2	60 Summer	+40%					104.734
1.002	3	60 Summer	+40%					103.239
1.003	4	60 Summer	+40%					101.160
2.000	5	60 Summer	+40%	+40%/60 Summer				98.663
1.004	6	60 Summer	+40%	+0%/60 Summer				98.548
1.005	7	60 Summer	+40%					98.143
1.006	8	60 Summer	+40%					97.290
1.007	9	60 Summer	+40%	+40%/60 Summer				96.903
1.008	10	1440 Winter	+40%	+0%/60 Summer				96.485

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.061	0.000	0.65		31.0	OK	
1.001	2	-0.116	0.000	0.47		61.9	OK	
1.002	3	-0.086	0.000	0.69		92.6	OK	
1.003	4	-0.090	0.000	0.66		123.1	OK	
2.000	5	0.063	0.000	0.66		30.8	SURCHARGED	
1.004	6	0.154	0.000	1.68		184.6	SURCHARGED	
1.005	7	-0.158	0.000	0.63		214.8	OK	
1.006	8	-0.085	0.000	0.64		241.0	OK	
1.007	9	0.453	0.000	1.22		269.3	SURCHARGED	
1.008	10	0.351	0.000	0.10		18.0	SURCHARGED	

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

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	11	60 Summer	+40%					106.098
3.001	12	60 Summer	+40%					103.861
3.002	13	60 Summer	+40%					101.973
4.000	14	60 Summer	+40%					103.997
3.003	15	60 Summer	+40%					99.271
3.004	16	60 Summer	+40%					97.738
3.005	17	60 Summer	+40%					97.315
3.006	18	60 Summer	+40%					96.713
3.007	19	1440 Winter	+40%	+0%/60 Summer				96.485
1.009	20	1440 Winter	+40%	+0%/60 Summer				96.485
1.010	21	1440 Winter	+40%	+0%/180 Winter				96.484
1.011	22	1440 Winter	+40%	+0%/60 Summer				96.513

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	11	-0.152	0.000	0.23		31.0	OK	
3.001	12	-0.114	0.000	0.49		61.9	OK	
3.002	13	-0.077	0.000	0.76		92.6	OK	
4.000	14	-0.153	0.000	0.22		30.9	OK	
3.003	15	-0.129	0.000	0.61		153.8	OK	
3.004	16	-0.062	0.000	0.97		154.3	OK	
3.005	17	-0.085	0.000	0.86		154.9	OK	
3.006	18	-0.087	0.000	0.74		154.1	OK	
3.007	19	0.385	0.000	0.08		10.0	SURCHARGED	
1.009	20	0.408	0.000	0.16		28.1	SURCHARGED	
1.010	21	0.459	0.000	0.03		3.3	SURCHARGED	
1.011	22	0.885	0.000	0.06		2.5	FLOOD RISK	

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FSR: 1 in 100 year + 40% CC

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.640	4-8	0.283

Total Area Contributing (ha) = 0.923

Total Pipe Volume (m³) = 32.052

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.898	2.650	13.2	0.066	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.052	1.525	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	27.109	2.075	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.105	2.856	6.3	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	18.110	0.181	100.1	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.85	4.21	107.350	0.066	0.0	0.0	0.0	2.79	49.3	13.2
1.001	73.22	4.30	104.625	0.132	0.0	0.0	0.0	3.63	144.3	26.2
1.002	72.40	4.42	103.100	0.198	0.0	0.0	0.0	3.64	144.7	38.8
1.003	72.03	4.48	101.025	0.264	0.0	0.0	0.0	5.23	208.0	51.5
2.000	73.69	4.23	98.375	0.066	0.0	0.0	0.0	1.31	52.0	13.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	21.930	0.092	238.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.877	0.927	25.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	13.678	0.925	14.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.039	0.316	34.9	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.065	0.007	295.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	30.199	2.275	13.3	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	28.102	1.925	14.6	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	43.839	2.650	16.5	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	62.702	4.750	13.2	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	25.113	1.600	15.7	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	12.737	0.400	31.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.005	16.413	0.600	27.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.006	8.583	0.700	12.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.007	5.477	0.023	238.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.009	25.860	0.052	497.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.010	10.839	0.022	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.011	4.075	0.408	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	70.07	4.79	98.019	0.396	0.0	0.0	0.0	1.17	129.2	75.1
1.005	69.41	4.91	97.927	0.462	0.0	0.0	0.0	3.58	395.7	86.8
1.006	69.12	4.95	97.000	0.528	0.0	0.0	0.0	4.73	522.7	98.8
1.007	68.77	5.01	96.075	0.593	0.0	0.0	0.0	3.07	339.6	110.4
1.008	68.62	5.04	95.609	0.593	0.0	0.0	0.0	1.30	281.2	110.4
3.000	74.32	4.14	106.025	0.066	0.0	0.0	0.0	3.61	143.6	13.3
3.001	73.39	4.28	103.750	0.132	0.0	0.0	0.0	3.44	136.9	26.2
3.002	71.90	4.50	101.825	0.198	0.0	0.0	0.0	3.23	128.6	38.6
4.000	73.30	4.29	103.925	0.066	0.0	0.0	0.0	3.62	144.0	13.1
3.003	71.24	4.61	99.100	0.330	0.0	0.0	0.0	3.99	281.9	63.7
3.004	70.76	4.68	97.500	0.330	0.0	0.0	0.0	2.80	197.6	63.7
3.005	70.20	4.77	97.100	0.330	0.0	0.0	0.0	3.02	213.3	63.7
3.006	70.01	4.80	96.500	0.330	0.0	0.0	0.0	4.51	319.1	63.7
3.007	69.59	4.87	95.650	0.330	0.0	0.0	0.0	1.31	208.8	63.7
1.009	66.23	5.47	95.552	0.923	0.0	0.0	0.0	1.00	216.0	165.5
1.010	65.28	5.65	95.500	0.923	0.0	0.0	0.0	0.99	215.4	165.5
1.011	75.15	4.02	95.478	0.000	2.5	0.0	0.0	3.20	56.6	2.5

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.800	95.071	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.011, Volume (m³): 4.4

Unit Reference	MD-SHE-0075-2500-1022-2500
Design Head (m)	1.022
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	95.478
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.022	2.5
Flush-Flo™	0.309	2.5
Kick-Flo®	0.636	2.0
Mean Flow over Head Range	-	2.2

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.2	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.010

Invert Level (m) 95.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	781.0	1.000	781.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
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
Return Period(s) (years) 100
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%					107.461
1.001	2	15 Winter	100	+40%					104.758
1.002	3	15 Summer	100	+40%					103.275
1.003	4	15 Winter	100	+40%					101.216
2.000	5	15 Winter	100	+40%	100/15 Summer				99.047
1.004	6	15 Winter	100	+40%	100/15 Summer				98.920
1.005	7	15 Winter	100	+40%	100/15 Summer				98.521
1.006	8	15 Winter	100	+40%	100/15 Summer				97.976
1.007	9	15 Winter	100	+40%	100/15 Summer				97.387
1.008	10	15 Winter	100	+40%	100/15 Summer				96.648
3.000	11	15 Winter	100	+40%					106.112
3.001	12	15 Winter	100	+40%					103.886
3.002	13	15 Summer	100	+40%	100/15 Summer				102.191
4.000	14	15 Winter	100	+40%					104.010
3.003	15	15 Winter	100	+40%	100/15 Winter				99.416
3.004	16	15 Winter	100	+40%	100/15 Summer				98.464
3.005	17	15 Winter	100	+40%	100/15 Summer				97.860
3.006	18	15 Winter	100	+40%	100/15 Summer				97.167
3.007	19	15 Winter	100	+40%	100/15 Summer				96.578
1.009	20	15 Winter	100	+40%	100/15 Summer				96.460

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.039	0.000	0.90		42.9	OK	
1.001	2	-0.092	0.000	0.66		85.9	OK	
1.002	3	-0.050	0.000	0.96		128.9	OK	
1.003	4	-0.034	0.000	0.92		171.2	OK	
2.000	5	0.447	0.000	0.86		40.1	SURCHARGED	
1.004	6	0.526	0.000	2.26		247.9	SURCHARGED	
1.005	7	0.219	0.000	0.80		272.7	SURCHARGED	
1.006	8	0.602	0.000	0.79		297.9	SURCHARGED	
1.007	9	0.937	0.000	1.50		329.6	FLOOD RISK	
1.008	10	0.514	0.000	1.88		330.7	FLOOD RISK	
3.000	11	-0.138	0.000	0.32		42.9	OK	
3.001	12	-0.089	0.000	0.67		85.8	OK	
3.002	13	0.141	0.000	1.01		124.2	SURCHARGED	
4.000	14	-0.140	0.000	0.31		42.9	OK	
3.003	15	0.016	0.000	0.82		206.6	SURCHARGED	
3.004	16	0.664	0.000	1.25		198.0	SURCHARGED	
3.005	17	0.460	0.000	1.07		193.7	SURCHARGED	
3.006	18	0.367	0.000	0.92		193.0	SURCHARGED	
3.007	19	0.478	0.000	1.58		192.3	FLOOD RISK	
1.009	20	0.383	0.000	2.92		516.4	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.010	21	30 Winter	100	+40%					95.924
1.011	22	30 Winter	100	+40%	100/15 Summer				95.924

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.010	21	-0.101	0.000	0.05		5.7	OK	
1.011	22	0.296	0.000	0.06		2.4	SURCHARGED	

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FEH: 1 in 30 year

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.640	4-8	0.283

Total Area Contributing (ha) = 0.923

Total Pipe Volume (m³) = 32.052

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.898	2.650	13.2	0.066	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.052	1.525	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	27.109	2.075	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.105	2.856	6.3	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	18.110	0.181	100.1	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.85	4.21	107.350	0.066	0.0	0.0	0.0	2.79	49.3	13.2
1.001	73.22	4.30	104.625	0.132	0.0	0.0	0.0	3.63	144.3	26.2
1.002	72.40	4.42	103.100	0.198	0.0	0.0	0.0	3.64	144.7	38.8
1.003	72.03	4.48	101.025	0.264	0.0	0.0	0.0	5.23	208.0	51.5
2.000	73.69	4.23	98.375	0.066	0.0	0.0	0.0	1.31	52.0	13.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	21.930	0.092	238.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.877	0.927	25.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	13.678	0.925	14.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.039	0.316	34.9	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.065	0.007	295.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	30.199	2.275	13.3	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	28.102	1.925	14.6	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	43.839	2.650	16.5	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	62.702	4.750	13.2	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	25.113	1.600	15.7	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	12.737	0.400	31.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.005	16.413	0.600	27.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.006	8.583	0.700	12.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.007	5.477	0.023	238.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.009	25.860	0.052	497.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.010	10.839	0.022	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.011	4.075	0.408	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	70.07	4.79	98.019	0.396	0.0	0.0	0.0	1.17	129.2	75.1
1.005	69.41	4.91	97.927	0.462	0.0	0.0	0.0	3.58	395.7	86.8
1.006	69.12	4.95	97.000	0.528	0.0	0.0	0.0	4.73	522.7	98.8
1.007	68.77	5.01	96.075	0.593	0.0	0.0	0.0	3.07	339.6	110.4
1.008	68.62	5.04	95.609	0.593	0.0	0.0	0.0	1.30	281.2	110.4
3.000	74.32	4.14	106.025	0.066	0.0	0.0	0.0	3.61	143.6	13.3
3.001	73.39	4.28	103.750	0.132	0.0	0.0	0.0	3.44	136.9	26.2
3.002	71.90	4.50	101.825	0.198	0.0	0.0	0.0	3.23	128.6	38.6
4.000	73.30	4.29	103.925	0.066	0.0	0.0	0.0	3.62	144.0	13.1
3.003	71.24	4.61	99.100	0.330	0.0	0.0	0.0	3.99	281.9	63.7
3.004	70.76	4.68	97.500	0.330	0.0	0.0	0.0	2.80	197.6	63.7
3.005	70.20	4.77	97.100	0.330	0.0	0.0	0.0	3.02	213.3	63.7
3.006	70.01	4.80	96.500	0.330	0.0	0.0	0.0	4.51	319.1	63.7
3.007	69.59	4.87	95.650	0.330	0.0	0.0	0.0	1.31	208.8	63.7
1.009	66.23	5.47	95.552	0.923	0.0	0.0	0.0	1.00	216.0	165.5
1.010	65.28	5.65	95.500	0.923	0.0	0.0	0.0	0.99	215.4	165.5
1.011	75.15	4.02	95.478	0.000	2.5	0.0	0.0	3.20	56.6	2.5

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.800	95.071	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.011, Volume (m³): 4.4

Unit Reference	MD-SHE-0075-2500-1022-2500
Design Head (m)	1.022
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	95.478
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.022	2.5
Flush-Flo™	0.309	2.5
Kick-Flo®	0.636	2.0
Mean Flow over Head Range	-	2.2

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.2	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.010

Invert Level (m) 95.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	781.0	1.000	781.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	1999
Site Location	428050 317750 SK 28050 17750
C (1km)	-0.028
D1 (1km)	0.338
D2 (1km)	0.323
D3 (1km)	0.256
E (1km)	0.309
F (1km)	2.402
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Sensitivity flows(s) (%)	0

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	60 Summer	+0%					107.408
1.001	2	60 Summer	+0%					104.698
1.002	3	60 Summer	+0%					103.191
1.003	4	60 Summer	+0%					101.113
2.000	5	60 Summer	+0%					98.463
1.004	6	60 Summer	+0%					98.281
1.005	7	60 Summer	+0%					98.070
1.006	8	60 Summer	+0%					97.145
1.007	9	60 Summer	+0%					96.288
1.008	10	60 Summer	+0%	+0%/60 Summer				96.141

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.092	0.000	0.32		15.2	OK	
1.001	2	-0.152	0.000	0.23		30.3	OK	
1.002	3	-0.134	0.000	0.34		45.3	OK	
1.003	4	-0.137	0.000	0.32		60.2	OK	
2.000	5	-0.137	0.000	0.32		15.1	OK	
1.004	6	-0.113	0.000	0.82		90.6	OK	
1.005	7	-0.232	0.000	0.31		105.6	OK	
1.006	8	-0.230	0.000	0.32		120.5	OK	
1.007	9	-0.162	0.000	0.61		134.9	OK	
1.008	10	0.007	0.000	0.77		134.9	SURCHARGED	

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

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	11	60 Summer	+0%					106.075
3.001	12	60 Summer	+0%					103.824
3.002	13	60 Summer	+0%					101.920
4.000	14	60 Summer	+0%					103.974
3.003	15	60 Summer	+0%					99.213
3.004	16	60 Summer	+0%					97.647
3.005	17	60 Summer	+0%					97.235
3.006	18	60 Summer	+0%					96.624
3.007	19	60 Summer	+0%					96.100
1.009	20	60 Summer	+0%					96.077
1.010	21	960 Winter	+0%					95.965
1.011	22	960 Winter	+0%	+0%/60 Summer				95.965

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	11	-0.175	0.000	0.11		15.2	OK	
3.001	12	-0.151	0.000	0.24		30.3	OK	
3.002	13	-0.130	0.000	0.37		45.3	OK	
4.000	14	-0.176	0.000	0.11		15.1	OK	
3.003	15	-0.187	0.000	0.30		75.2	OK	
3.004	16	-0.153	0.000	0.48		75.5	OK	
3.005	17	-0.165	0.000	0.42		75.8	OK	
3.006	18	-0.176	0.000	0.36		75.8	OK	
3.007	19	0.000	0.000	0.62		75.9	OK	
1.009	20	0.000	0.000	1.18		208.2	OK	
1.010	21	-0.060	0.000	0.02		2.7	OK	
1.011	22	0.337	0.000	0.06		2.4	SURCHARGED	

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FSR: 1 in 30 year

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.640	4-8	0.283

Total Area Contributing (ha) = 0.923

Total Pipe Volume (m³) = 32.052

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.898	2.650	13.2	0.066	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.052	1.525	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	27.109	2.075	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.105	2.856	6.3	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	18.110	0.181	100.1	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.85	4.21	107.350	0.066	0.0	0.0	0.0	2.79	49.3	13.2
1.001	73.22	4.30	104.625	0.132	0.0	0.0	0.0	3.63	144.3	26.2
1.002	72.40	4.42	103.100	0.198	0.0	0.0	0.0	3.64	144.7	38.8
1.003	72.03	4.48	101.025	0.264	0.0	0.0	0.0	5.23	208.0	51.5
2.000	73.69	4.23	98.375	0.066	0.0	0.0	0.0	1.31	52.0	13.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	21.930	0.092	238.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.877	0.927	25.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	13.678	0.925	14.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.039	0.316	34.9	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.065	0.007	295.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	30.199	2.275	13.3	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	28.102	1.925	14.6	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	43.839	2.650	16.5	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	62.702	4.750	13.2	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	25.113	1.600	15.7	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	12.737	0.400	31.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.005	16.413	0.600	27.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.006	8.583	0.700	12.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.007	5.477	0.023	238.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.009	25.860	0.052	497.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.010	10.839	0.022	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.011	4.075	0.408	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	70.07	4.79	98.019	0.396	0.0	0.0	0.0	1.17	129.2	75.1
1.005	69.41	4.91	97.927	0.462	0.0	0.0	0.0	3.58	395.7	86.8
1.006	69.12	4.95	97.000	0.528	0.0	0.0	0.0	4.73	522.7	98.8
1.007	68.77	5.01	96.075	0.593	0.0	0.0	0.0	3.07	339.6	110.4
1.008	68.62	5.04	95.609	0.593	0.0	0.0	0.0	1.30	281.2	110.4
3.000	74.32	4.14	106.025	0.066	0.0	0.0	0.0	3.61	143.6	13.3
3.001	73.39	4.28	103.750	0.132	0.0	0.0	0.0	3.44	136.9	26.2
3.002	71.90	4.50	101.825	0.198	0.0	0.0	0.0	3.23	128.6	38.6
4.000	73.30	4.29	103.925	0.066	0.0	0.0	0.0	3.62	144.0	13.1
3.003	71.24	4.61	99.100	0.330	0.0	0.0	0.0	3.99	281.9	63.7
3.004	70.76	4.68	97.500	0.330	0.0	0.0	0.0	2.80	197.6	63.7
3.005	70.20	4.77	97.100	0.330	0.0	0.0	0.0	3.02	213.3	63.7
3.006	70.01	4.80	96.500	0.330	0.0	0.0	0.0	4.51	319.1	63.7
3.007	69.59	4.87	95.650	0.330	0.0	0.0	0.0	1.31	208.8	63.7
1.009	66.23	5.47	95.552	0.923	0.0	0.0	0.0	1.00	216.0	165.5
1.010	65.28	5.65	95.500	0.923	0.0	0.0	0.0	0.99	215.4	165.5
1.011	75.15	4.02	95.478	0.000	2.5	0.0	0.0	3.20	56.6	2.5

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.800	95.071	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.011, Volume (m³): 4.4

Unit Reference	MD-SHE-0075-2500-1022-2500
Design Head (m)	1.022
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	95.478
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.022	2.5
Flush-Flo™	0.309	2.5
Kick-Flo®	0.636	2.0
Mean Flow over Head Range	-	2.2

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.2	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.010

Invert Level (m) 95.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	781.0	1.000	781.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
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
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%					107.425
1.001	2	15 Winter	30	+0%					104.718
1.002	3	15 Summer	30	+0%					103.217
1.003	4	15 Summer	30	+0%					101.139
2.000	5	15 Winter	30	+0%					98.488
1.004	6	15 Winter	30	+0%	30/15 Summer				98.437
1.005	7	15 Winter	30	+0%					98.111
1.006	8	15 Summer	30	+0%					97.188
1.007	9	15 Winter	30	+0%	30/15 Summer				96.495
1.008	10	15 Winter	30	+0%	30/15 Summer				96.201
3.000	11	15 Winter	30	+0%					106.088
3.001	12	15 Winter	30	+0%					103.845
3.002	13	15 Summer	30	+0%					101.948
4.000	14	15 Winter	30	+0%					103.987
3.003	15	15 Summer	30	+0%					99.245
3.004	16	15 Summer	30	+0%					97.695
3.005	17	15 Winter	30	+0%					97.277
3.006	18	15 Winter	30	+0%					96.661
3.007	19	15 Winter	30	+0%	30/15 Summer				96.194
1.009	20	15 Winter	30	+0%	30/15 Summer				96.172

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.075	0.000	0.50		23.6	OK	
1.001	2	-0.132	0.000	0.36		47.3	OK	
1.002	3	-0.108	0.000	0.53		71.0	OK	
1.003	4	-0.111	0.000	0.51		94.6	OK	
2.000	5	-0.112	0.000	0.51		23.6	OK	
1.004	6	0.043	0.000	1.27		140.0	SURCHARGED	
1.005	7	-0.191	0.000	0.47		161.2	OK	
1.006	8	-0.187	0.000	0.48		182.0	OK	
1.007	9	0.045	0.000	0.94		206.5	SURCHARGED	
1.008	10	0.067	0.000	1.17		206.3	SURCHARGED	
3.000	11	-0.162	0.000	0.18		23.6	OK	
3.001	12	-0.130	0.000	0.37		47.3	OK	
3.002	13	-0.102	0.000	0.58		71.0	OK	
4.000	14	-0.163	0.000	0.17		23.6	OK	
3.003	15	-0.155	0.000	0.47		118.2	OK	
3.004	16	-0.105	0.000	0.74		118.0	OK	
3.005	17	-0.123	0.000	0.65		117.4	OK	
3.006	18	-0.139	0.000	0.56		116.3	OK	
3.007	19	0.094	0.000	0.96		117.1	SURCHARGED	
1.009	20	0.095	0.000	1.79		315.6	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.010	21	30 Winter	30	+0%					95.732
1.011	22	30 Winter	30	+0%	30/15 Summer				95.731

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.010	21	-0.293	0.000	0.04		4.2	OK	
1.011	22	0.103	0.000	0.06		2.3	SURCHARGED	

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FEH: 1 in 1 year

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.640	4-8	0.283

Total Area Contributing (ha) = 0.923

Total Pipe Volume (m³) = 32.052

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.898	2.650	13.2	0.066	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.052	1.525	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	27.109	2.075	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.105	2.856	6.3	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	18.110	0.181	100.1	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.85	4.21	107.350	0.066	0.0	0.0	0.0	2.79	49.3	13.2
1.001	73.22	4.30	104.625	0.132	0.0	0.0	0.0	3.63	144.3	26.2
1.002	72.40	4.42	103.100	0.198	0.0	0.0	0.0	3.64	144.7	38.8
1.003	72.03	4.48	101.025	0.264	0.0	0.0	0.0	5.23	208.0	51.5
2.000	73.69	4.23	98.375	0.066	0.0	0.0	0.0	1.31	52.0	13.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	21.930	0.092	238.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.877	0.927	25.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	13.678	0.925	14.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.039	0.316	34.9	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.065	0.007	295.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	30.199	2.275	13.3	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	28.102	1.925	14.6	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	43.839	2.650	16.5	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	62.702	4.750	13.2	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	25.113	1.600	15.7	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	12.737	0.400	31.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.005	16.413	0.600	27.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.006	8.583	0.700	12.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.007	5.477	0.023	238.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.009	25.860	0.052	497.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.010	10.839	0.022	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.011	4.075	0.408	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	70.07	4.79	98.019	0.396	0.0	0.0	0.0	1.17	129.2	75.1
1.005	69.41	4.91	97.927	0.462	0.0	0.0	0.0	3.58	395.7	86.8
1.006	69.12	4.95	97.000	0.528	0.0	0.0	0.0	4.73	522.7	98.8
1.007	68.77	5.01	96.075	0.593	0.0	0.0	0.0	3.07	339.6	110.4
1.008	68.62	5.04	95.609	0.593	0.0	0.0	0.0	1.30	281.2	110.4
3.000	74.32	4.14	106.025	0.066	0.0	0.0	0.0	3.61	143.6	13.3
3.001	73.39	4.28	103.750	0.132	0.0	0.0	0.0	3.44	136.9	26.2
3.002	71.90	4.50	101.825	0.198	0.0	0.0	0.0	3.23	128.6	38.6
4.000	73.30	4.29	103.925	0.066	0.0	0.0	0.0	3.62	144.0	13.1
3.003	71.24	4.61	99.100	0.330	0.0	0.0	0.0	3.99	281.9	63.7
3.004	70.76	4.68	97.500	0.330	0.0	0.0	0.0	2.80	197.6	63.7
3.005	70.20	4.77	97.100	0.330	0.0	0.0	0.0	3.02	213.3	63.7
3.006	70.01	4.80	96.500	0.330	0.0	0.0	0.0	4.51	319.1	63.7
3.007	69.59	4.87	95.650	0.330	0.0	0.0	0.0	1.31	208.8	63.7
1.009	66.23	5.47	95.552	0.923	0.0	0.0	0.0	1.00	216.0	165.5
1.010	65.28	5.65	95.500	0.923	0.0	0.0	0.0	0.99	215.4	165.5
1.011	75.15	4.02	95.478	0.000	2.5	0.0	0.0	3.20	56.6	2.5

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.800	95.071	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.011, Volume (m³): 4.4

Unit Reference	MD-SHE-0075-2500-1022-2500
Design Head (m)	1.022
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	95.478
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.022	2.5
Flush-Flo™	0.309	2.5
Kick-Flo®	0.636	2.0
Mean Flow over Head Range	-	2.2

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.2	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.010

Invert Level (m) 95.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	781.0	1.000	781.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
FEH Rainfall Version	1999
Site Location	428050 317750 SK 28050 17750
C (1km)	-0.028
D1 (1km)	0.338
D2 (1km)	0.323
D3 (1km)	0.256
E (1km)	0.309
F (1km)	2.402
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Sensitivity flows(s) (%)	0

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	60 Summer	+0%					107.383	-0.117
1.001	2	60 Summer	+0%					104.666	-0.184
1.002	3	60 Summer	+0%					103.150	-0.175
1.003	4	60 Summer	+0%					101.073	-0.177
2.000	5	60 Summer	+0%					98.426	-0.174
1.004	6	60 Summer	+0%					98.151	-0.243
1.005	7	60 Summer	+0%					98.006	-0.295
1.006	8	60 Summer	+0%					97.080	-0.294
1.007	9	60 Summer	+0%					96.188	-0.262
1.008	10	60 Summer	+0%					95.786	-0.348

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.11		5.3	OK	
1.001	2	0.000	0.08		10.1	OK	
1.002	3	0.000	0.11		14.9	OK	
1.003	4	0.000	0.11		19.7	OK	
2.000	5	0.000	0.11		5.3	OK	
1.004	6	0.000	0.27		29.6	OK	
1.005	7	0.000	0.10		34.2	OK	
1.006	8	0.000	0.10		39.0	OK	
1.007	9	0.000	0.20		43.8	OK	
1.008	10	0.000	0.25		43.8	OK	

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

PN	US/MH Name	Storm	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	11	60 Summer	+0%					106.054
3.001	12	60 Summer	+0%					103.792
3.002	13	60 Summer	+0%					101.877
4.000	14	60 Summer	+0%					103.953
3.003	15	60 Summer	+0%					99.163
3.004	16	60 Summer	+0%					97.579
3.005	17	60 Summer	+0%					97.174
3.006	18	60 Summer	+0%					96.568
3.007	19	60 Summer	+0%					95.793
1.009	20	60 Summer	+0%					95.778
1.010	21	960 Winter	+0%					95.675
1.011	22	960 Winter	+0%	+0%/180 Winter				95.676

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	11	-0.196	0.000	0.04		5.3	OK	
3.001	12	-0.183	0.000	0.08		10.1	OK	
3.002	13	-0.173	0.000	0.12		14.9	OK	
4.000	14	-0.197	0.000	0.04		5.3	OK	
3.003	15	-0.237	0.000	0.10		24.9	OK	
3.004	16	-0.221	0.000	0.16		24.9	OK	
3.005	17	-0.226	0.000	0.14		24.9	OK	
3.006	18	-0.232	0.000	0.12		24.8	OK	
3.007	19	-0.307	0.000	0.20		24.9	OK	
1.009	20	-0.299	0.000	0.39		68.3	OK	
1.010	21	-0.350	0.000	0.02		2.5	OK	
1.011	22	0.048	0.000	0.06		2.3	SURCHARGED	

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FSR: 1 in 1 year

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	550	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.640	4-8	0.283

Total Area Contributing (ha) = 0.923

Total Pipe Volume (m³) = 32.052

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.898	2.650	13.2	0.066	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.052	1.525	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	27.109	2.075	13.1	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.105	2.856	6.3	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	18.110	0.181	100.1	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.85	4.21	107.350	0.066	0.0	0.0	0.0	2.79	49.3	13.2
1.001	73.22	4.30	104.625	0.132	0.0	0.0	0.0	3.63	144.3	26.2
1.002	72.40	4.42	103.100	0.198	0.0	0.0	0.0	3.64	144.7	38.8
1.003	72.03	4.48	101.025	0.264	0.0	0.0	0.0	5.23	208.0	51.5
2.000	73.69	4.23	98.375	0.066	0.0	0.0	0.0	1.31	52.0	13.2

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	21.930	0.092	238.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	23.877	0.927	25.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	13.678	0.925	14.8	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.039	0.316	34.9	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.065	0.007	295.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	30.199	2.275	13.3	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	28.102	1.925	14.6	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	43.839	2.650	16.5	0.066	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	62.702	4.750	13.2	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	25.113	1.600	15.7	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	12.737	0.400	31.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.005	16.413	0.600	27.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.006	8.583	0.700	12.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.007	5.477	0.023	238.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.009	25.860	0.052	497.3	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.010	10.839	0.022	500.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.011	4.075	0.408	10.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	70.07	4.79	98.019	0.396	0.0	0.0	0.0	1.17	129.2	75.1
1.005	69.41	4.91	97.927	0.462	0.0	0.0	0.0	3.58	395.7	86.8
1.006	69.12	4.95	97.000	0.528	0.0	0.0	0.0	4.73	522.7	98.8
1.007	68.77	5.01	96.075	0.593	0.0	0.0	0.0	3.07	339.6	110.4
1.008	68.62	5.04	95.609	0.593	0.0	0.0	0.0	1.30	281.2	110.4
3.000	74.32	4.14	106.025	0.066	0.0	0.0	0.0	3.61	143.6	13.3
3.001	73.39	4.28	103.750	0.132	0.0	0.0	0.0	3.44	136.9	26.2
3.002	71.90	4.50	101.825	0.198	0.0	0.0	0.0	3.23	128.6	38.6
4.000	73.30	4.29	103.925	0.066	0.0	0.0	0.0	3.62	144.0	13.1
3.003	71.24	4.61	99.100	0.330	0.0	0.0	0.0	3.99	281.9	63.7
3.004	70.76	4.68	97.500	0.330	0.0	0.0	0.0	2.80	197.6	63.7
3.005	70.20	4.77	97.100	0.330	0.0	0.0	0.0	3.02	213.3	63.7
3.006	70.01	4.80	96.500	0.330	0.0	0.0	0.0	4.51	319.1	63.7
3.007	69.59	4.87	95.650	0.330	0.0	0.0	0.0	1.31	208.8	63.7
1.009	66.23	5.47	95.552	0.923	0.0	0.0	0.0	1.00	216.0	165.5
1.010	65.28	5.65	95.500	0.923	0.0	0.0	0.0	0.99	215.4	165.5
1.011	75.15	4.02	95.478	0.000	2.5	0.0	0.0	3.20	56.6	2.5

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		96.800	95.071	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 22, DS/PN: 1.011, Volume (m³): 4.4

Unit Reference	MD-SHE-0075-2500-1022-2500
Design Head (m)	1.022
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	95.478
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.022	2.5
Flush-Flo™	0.309	2.5
Kick-Flo®	0.636	2.0
Mean Flow over Head Range	-	2.2

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.2	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Storage Structures for Storm

Tank or Pond Manhole: 21, DS/PN: 1.010

Invert Level (m) 95.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	781.0	1.000	781.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
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
Return Period(s) (years) 1
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					107.396
1.001	2	15 Winter	1	+0%					104.679
1.002	3	15 Winter	1	+0%					103.165
1.003	4	15 Winter	1	+0%					101.088
2.000	5	15 Summer	1	+0%					98.444
1.004	6	15 Winter	1	+0%					98.197
1.005	7	15 Winter	1	+0%					98.030
1.006	8	15 Winter	1	+0%					97.104
1.007	9	15 Winter	1	+0%					96.222
1.008	10	15 Winter	1	+0%					95.865
3.000	11	15 Winter	1	+0%					106.064
3.001	12	15 Winter	1	+0%					103.805
3.002	13	15 Winter	1	+0%					101.894
4.000	14	15 Winter	1	+0%					103.964
3.003	15	15 Winter	1	+0%					99.182
3.004	16	15 Winter	1	+0%					97.605
3.005	17	15 Winter	1	+0%					97.198
3.006	18	15 Winter	1	+0%					96.591
3.007	19	15 Winter	1	+0%					95.869
1.009	20	15 Winter	1	+0%					95.860

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.104	0.000	0.20		9.6	OK	
1.001	2	-0.171	0.000	0.13		17.3	OK	
1.002	3	-0.160	0.000	0.19		24.9	OK	
1.003	4	-0.162	0.000	0.17		32.3	OK	
2.000	5	-0.156	0.000	0.21		9.6	OK	
1.004	6	-0.197	0.000	0.45		49.2	OK	
1.005	7	-0.272	0.000	0.17		57.1	OK	
1.006	8	-0.271	0.000	0.17		64.7	OK	
1.007	9	-0.228	0.000	0.33		72.0	OK	
1.008	10	-0.269	0.000	0.41		71.4	OK	
3.000	11	-0.186	0.000	0.07		9.6	OK	
3.001	12	-0.170	0.000	0.14		17.3	OK	
3.002	13	-0.156	0.000	0.20		24.9	OK	
4.000	14	-0.186	0.000	0.07		9.6	OK	
3.003	15	-0.218	0.000	0.17		42.0	OK	
3.004	16	-0.195	0.000	0.26		41.7	OK	
3.005	17	-0.202	0.000	0.23		42.0	OK	
3.006	18	-0.209	0.000	0.20		42.2	OK	
3.007	19	-0.231	0.000	0.35		42.0	OK	
1.009	20	-0.217	0.000	0.64		113.6	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.010	21	30 Winter	1	+0%					95.594
1.011	22	30 Winter	1	+0%					95.592

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.010	21	-0.431	0.000	0.02		2.3	OK	
1.011	22	-0.037	0.000	0.05		2.1	OK	

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Appendix K

Severn Trent Water: Correspondence

WONDERFUL ON TAP

SEVERN TRENT

JPP Consulting
4, Ironstone Way
Brixworth
Northamptonshire
NN6 9UD

FAO: Ram Sarpal

Severn Trent Water Ltd
Leicester Water Centre
Gorse Hill
Anstey
Leicester
LE7 7GU

Tel: 024 777 16843

www.stwater.co.uk
net.dev.east@severntrent.co.uk

Contact: Asset Protection East
(waste water)

Your Ref:
Our Ref: 8349506

18th March 2019

Dear Sir,

Land off Oak Close, Castle Gresley, Derbyshire, DE11 9RU
Proposed 71 dwellings (428559, 317152)

I refer to your 'Development Enquiry Request' in respect of the above named site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes (SGN) which refer to surface water disposal from development sites.

Protective Strips

Due to recent change in legislation, there could be sewers, which have transferred over to the Company that are not shown on the statutory sewer records, but are located on your clients land. These sewers will have protective strips that we will not allow to be built over. The sewers could be identified whilst the land is being surveyed. If this is the case, please contact us for further guidance upon discovery.

Foul Water Drainage

Although a gravity foul discharge can be achieved into the 225mm dia public combined sewer crossing through the site, even though just 71 houses, sewer modelling will still be required due to the downstream sewer network surcharging in very small rainfall events. In some cases the sewers are running high in DWF conditions.

Sewer modelling will be raised and paid for by Severn Trent. Please note sewer modelling is scored under the new system where we score

depending on planning status, urgency etc. Once the modelling request is raised with or modelling contractors the timescale for completion is between 4 – 8 weeks, subject to model complexity and current workload.

Surface Water Drainage

Under the terms of Section H of the Building Regulations 2010, the disposal of surface water by means of soakaways should be considered as the primary method. If this is not practical and no watercourse is available as an alternative, the use of sewerage should be considered. In addition, other sustainable drainage methods should also be explored before a discharge to the public sewerage system is considered.

If ground conditions are not favourable, for soakaways and other SUDs techniques, evidence should be submitted. The evidence should be either percolation test results or by the submission of a statement from the SI consultant (extract or a supplementary letter). This would satisfy the SGN (enclosed).

The application has stated that surface water is to drain to the watercourse within the site boundaries. Therefore there is no further comment to make for Severn Trent Water. The surface water discharge shall be determined by the lead local flood authority (LLFA).

Any flows generated by the site in excess of the permitted discharge rate will have to be attenuated within the development site.

Connections

For any new connections including the use, reuse and indirect to the public sewerage system, the developer will need to submit Section 106 application. Our Developer Services department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 707 6600 or download from www.stwater.co.uk

Please quote the above reference number in any future correspondence (including e-mails) with STW Limited. Please send **all correspondence** to the net.dev.east@severntrent.co.uk email inbox address, a response will be made within 15 days.

Please note that Developer Enquiry responses are only valid for 6 months from the date of this letter.

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SEVERN TRENT

Yours sincerely,

[redacted]

Keith Baker
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Asset Protection East (wastewater)
Asset Data
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