ARMSTRONG STOKES & CLAYTON LIMITED
Civil & Structural Engineering Consultants

ASC

PEVERIL HOMES LTD

LAND WEST OF BURTON ROAD, WEST TUTBURY, STAFFORDSHIRE

LEVEL 3 FLOOD RISK ASSESSMENT

APRIL 2011

P-2011-00546

Received 16/05/11

AUTHOR:	JS/RF
CHECKED:	JLW
APPROVED:	JS
REPORT REF:	P119 Tutbury FRA3
STATUS:	FINAL

The Book Shop Chambers, 54 King Street, Southwell, Nottinghamshire NG25 0EN
Tel: 01636 814815 Fax: 01636 816343
Email: jstokes@ravenshead.fsnet.co.uk

Registered office 1 Mavis Avenue, Ravenshead, Nottinghamshire NG15 9EB
Registered in England No. 04960061

FSB
MEMBER OF THE FEDERATION OF SMALL BUSINESSES

CONTENTS

APPENDICES

1 INTRODUCTION

1.1.1 This Flood Risk Assessment (FRA) has been produced on behalf of Peveril Homes Ltd by Armstrong Stokes & Clayton in support of the proposed development of land located to the west of Burton Road, West Tutbury, Staffordshire.

1.1.2 This FRA has been prepared in accordance with PPS25/PPS25 Development and Flood Risk Practice Guidance and in consultation with the Environment Agency.

1.1.3 This FRA has also been prepared in accordance with East Staffordshire Borough Council's Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA).

2 EXISTING SITE

2.1 General

2.1.1 The application site has a gross area of approx. 15.2ha and is located to the south east of West Tutbury, Staffordshire. The site boundary is indicated on the OS based site location plan included within Appendix A.

2.1.2 The site is Greenfield consisting of open grazing land divided up by various post and rail fence/hedge field boundaries. There are no significant features identified within the site boundary.

2.1.3 The site is bound to the north by an area of dense vegetation/scrub and residential property beyond, to the west by existing residential property and Green Lane. It is bound to the east by the Burton Road (A511) and to the south by further open grazing land.

2.1.4 A small pond is located within the dense undergrowth, immediately adjacent to the northern boundary. The purpose of this pond is unknown.

2.1.5 The existing site layout is indicated on the topographical survey Dwg No. 13583_OGL produced by Greenhatch Group included within Appendix B.

2.2 Levels

2.2.1 The contoured topographical survey confirms that the site falls predominantly from the south west to the north east by approx. 10m. The lowest spot level shown is 79.04m AOD where the site bounds the A511 Burton Road roundabout. The highest spot level shown is 89.49m AOD towards the south western corner of the site. The south western corner itself falls away to the west towards Green Lane, the lowest level within the site boundary being approx. 87.70m AOD.

2.3 Foul Drainage

2.3.1 The public sewer records have been obtained from Severn Trent Water Limited (STWL). It is evident from the records that the nearest public foul/combined sewer is a 225mm diameter located within Ironwalls Lane and Green Lane. STWL correspondence and record plan illustrating approximate location of the public sewers is included within Appendix C.

2.3.2 The existing site is Greenfield and therefore does not benefit from any existing foul drainage systems.

2.4 Surface Water Drainage

2.4.1 The public sewer records confirm that the nearest public surface water sewers are 225mm diameter and located within Cromwell Close and the northern portion of the site. The sewer within the site would appear to be an overflow discharging to the existing pond north of the site boundary. STWL correspondence and record plan illustrating approximate location of the public sewers is included within Appendix C.

2.4.2 The site is Greenfield and therefore does not benefit from any existing positive surface water drainage systems.

2.4.3 Based on existing local topography, it is clear that the site falls within the Greenfield catchment of the River Dove. An assessment of the Greenfield run-off from the site has been made using the IH 124 method, giving an average (QBAR) discharge of 76.1l/s which equates to a Greenfield rate of 5.01l/s/ha. A copy of the rural run-off calculations produced with the Micro Drainage software suite is included within Appendix E.

3 PROPOSED DEVELOPMENT

3.1 General

3.1.1 It is proposed to provide a predominantly residential development consisting of a total of 224 units together with approx. 1800m2 of B1 office accommodation to the south east.

3.1.2 The proposed development layout is included within Appendix D.

3.2 Levels

3.2.1 The proposed finished ground floor levels are yet to be determined, however, they will generally reflect the existing topography.

3.3 Foul Drainage

3.3.1 Based on a residential development of 224 units, the peak foul drainage discharge generated will be approx. 10.4l/s.

3.3.2 Assuming occupancy of 1 person/15m2, the maximum occupancy of the proposed B1 office accommodation will be 120 persons. Based on a maximum discharge of 100l/person/day the peak foul discharge will be less than approx. 1.0l/s.

3.3.3 It is proposed to connect the foul drainage from the development to the 225mm diameter public foul sewer located at the junction of Ironwalls Lane and Burton Road. A short length of off site outfall sewer laid within Burton Road will be necessary but, as no third party land will be involved, this could be constructed by the developer without the need for a requisition agreement. With consideration of the invert level of the public sewer and the site topography a pumped outfall will be required to connect to the public sewer network.

3.3.4 It may be necessary for STWL to carry out a capacity check of the existing public foul sewer network to confirm the available capacity and the scope of any off site improvement works that may be required.

3.3.5 It is expected that the main on site foul sewers will be offered to STWL for adoption under Section 104 of the Water Industry Act 1991.

3.4 Surface Water Drainage

3.4.1 In accordance with PPS25, a surface water drainage strategy will be required that does not increase discharge levels and therefore does not increase the risk of flooding to other areas. Furthermore, the surface water drainage strategy should actively seek to reduce positive discharge levels via the use of SUDS (Sustainable Urban Drainage Systems) wherever possible.

3.4.2 Whilst no specific information relating to soil infiltration rates is available, based on ground investigation information, the entire site is indicated to be underlain by boulder clay and/or mudstone which are highly unlikely to be suitable for the use of soakaways. The soil index value of 0.45 indicated by the rural run off calculations also suggests low permeability.

3.4.3 In order to fully confirm the viability of infiltration SUDS techniques it will be necessary to carry out percolation testing on site in accordance with BRE Digest 365.

3.4.4 Based on the information currently available in respect of ground conditions, it is clear that the surface water strategy cannot rely on the use of infiltration SUDS techniques. On site attenuation will therefore be essential in restricting surface water run-off from the proposed development. Preference should always be given to above ground attenuation techniques such as ponds, swales, etc. wherever possible.

3.4.5 Discounting infiltration SUDS techniques at this stage, the proposed surface water drainage strategy should consider the incorporation of the following SUDS options at the detailed design stage.

Domestic/Office Roof Run-Off

- Water Butts (incorporating overflows)
- Rainwater / Grey Water Harvesting

Highways/Hardstanding Areas

- Above Ground Attenuation (detention pond/s or swales)
- Below Ground Attenuation (cellular storage or oversized pipes/culverts)

3.4.6 Permeable paving may also be a consideration at the detailed design stage as it can prove effective where ground conditions are not suitable for primary infiltration techniques.

3.4.7 The proposed surface water/highway drainage network that will utilise attenuation SUDS will require a restricted Greenfield equivalent discharge. Whilst the site lies within the River Dove catchment, the nearest ditch/watercourse to the site that has been identified at this stage is the Mill Fleam, approx. 700m to the north. Further investigation beyond the scope of the topographical survey will be required to identify a suitable outfall location closer to the site. It is likely that an off site surface water outfall sewer will be required and, depending on its route and outfall location, it may need to be laid within 3rd party land and thus will need to be constructed under a requisition agreement.

3.4.8 An outfall to a watercourse will require the consent under the Land Drainage Act 1991 from the relevant authority as well as any relevant riparian owners.

3.4.9 The existing pond to the northern boundary of the site has been investigated, and whilst STWL have a surface water sewer discharging to the pond, there does not appear to be a positive outfall from the pond and thus the pond has been discounted, at this stage, as a potential outfall for surface water flows from the new development.

3.4.10 Based on the current proposed development layout, it is estimated that approx. 40%, of the gross site area, approx. 6.08ha, will become impermeable. It has also been estimated that up to half of the impermeable area, approx 3.04ha, will be associated with adoptable highways or other hardstanding areas.

3.4.11 With consideration of the Greenfield run-off from the pre-developed site as illustrated within paragraph 2.4.3, flows generated by the post development in excess of this will need to be attenuated on site for the 100 year + 30% climate change event. Should this not be possible, flood flow paths taking flood water away from buildings will need to be demonstrated.

3.4.12 The final outfall point for the restricted discharge from the proposed development will need to be agreed with the relevant authorities prior to detailed design. However, with consideration of the distance to the nearest watercourse and the possibility of having to access third party land for this outfall, a limited surface water discharge to the existing combined sewer at the junction of Ironwalls Lane and Burton Road is to be pursued.

3.4.13 When considering the existing catchment of the 225mm diameter sewer with a gradient of 1:94.05 and a pipe capacity of 47.0l/s it is unlikely that this sewer has sufficient spare capacity to accept the Greenfield run-off from the development site as illustrated within paragraph 2.4.3. With this in mind, it is proposed to discharge 10.0l/s surface water flow from the development to the existing combined sewer. It should be noted that this discharge figure and the connection to the combined sewer will need the approval of STWL.

3.4.14 With consideration of the site topography a pumped outfall to existing manhole 4501 will be necessary.

3.4.15 With consideration of the current proposed development layout and existing topography, there is scope to provide staged attenuation systems to serve the development. It would be feasible to provide open and/or below ground attenuation for the majority of the developments surface water run-off within the landscape areas located centrally within the site as illustrated on the Architects layout within Appendix D. Preliminary attenuation calculations for an off-line detention pond have been prepared using the Micro Drainage software suite to give an indication of the attenuation volume and pond plan and swale areas that would be required. The calculations have been based on a 1.5m deep pond/swale (1.2m effective) with 1 in 4 side slopes. The critical duration for a 1 in 100 year event plus a 30% allowance for climate change has been used with a discharge of 60.0l/s. Using these design criteria, it will be necessary to attenuate approx. 1649m3 within a pond and associated swales, occupying a total plan area of approx. 2890m2.

3.4.16 In addition, the current proposed development layout constraints prohibit the pond and swales being of sufficient size to accommodate all of the attenuation necessary for the development. With this in mind, a two stage below ground attenuation system will also be required within the site. The first stage, which will support the ponds and swales, could take the form of underground cellular storage. A copy of the preliminary calculations included within Appendix E illustrates that 1112.0m3 of cellular attenuation with a limited discharge of 16.0l/s will be required, located adjacent to the pond. Alternatively, this could take the form of pipe storage situated within the adjacent highway.

3.4.17 The area to the north east corner of the site, downstream of the new pond and at the lowest point of the site, will need to include the second phase of below ground surface water attenuation. This will be located within the highway and is likely to take the form of oversized pipework or a box culvert, in an on-line arrangement. Preliminary attenuation calculations for an on-line box culvert have been prepared using the Micro Drainage software suite and give an indication of the attenuation volume and size of pipe/culvert required. At this stage, the calculations have been based on a 2100 x 1500mm culvert. As with the pond and cellular attenuation, the critical duration for a 1 in 100 year event plus a 30% allowance for climate change has been used with a maximum discharge of 10.0l/s. The combined flow from the upstream pond/swales and cellular attenuation system of 76.0l/s will also drain into this catchment. Using these design criteria, it will be necessary to attenuate approx. 551m3 in 180m of 2100 x 1500mm culvert. A copy of the preliminary box culvert calculations is included within Appendix E.

3.4.18 It should be noted that the preliminary calculations included within this report are indicative and intended to provide a conservative and robust approach. The detailed design calculations/simulations will be subject to the technical approval of the relevant adopting authority and the Environment Agency. Should domestic water butts be proposed, then overflows to the attenuated systems will be necessary and an allowance has been included for this within the hydraulic calculations.

3.4.19 Whilst the site does not lie within a groundwater Source Protection Zone (SPZ), the proposed surface water drainage system should be designed in accordance with all relevant Environment Agency Pollution Prevention Guidance (PPG).

3.4.20 It is expected that the main on site surface water sewers serving the development will be offered to either STWL or the Highway Authority for adoption, depending on the areas they serve and the final outfall arrangement.

3.4.21 As STWL or the Highway Authority is unlikely to adopt the off-line attenuation features, a future maintenance regime, will need to be agreed with the Environment Agency and the LPA and secured by way of a planning condition.

4 POTENTIAL SOURCES OF FLOODING

4.1 Fluvial/Tidal Flooding

4.1.1 The nearest potential source of fluvial flooding is represented by the River Dove located approx. 1km to the north of the application site. The Mill Fleam, a man-made watercourse originally built to serve the old Tutbury cotton mill, runs between the site and the River Dove to the north of the town, lies within the River Dove floodplain.

4.1.2 The Environment Agency on line flood mapping, below, indicates that the site lies outside of the River Dove floodplain. The site is therefore located within Flood Zone 1 and assessed as having a less than 1 in 1000 annual probability of fluvial or tidal flooding in any year (<0.1%). This is confirmed by the SFRA

4.1.3 The SFRA and East Staffordshire Borough Council's records confirm that there are no recorded flooding incidents for this site.

4.2 Groundwater

4.2.1 No information is readily available with respect to groundwater flooding. We are not aware of any specific existing problems.

4.2.2 The site is not located within an Environment Agency Source Protection Zone (SPZ).

4.3 Foul & Surface Water Sewers

4.3.1 We are not aware of any flooding to the application site resulting from hydraulic deficiencies with the existing public foul or surface water sewer networks.

5 VULNERABILITY & COMPATIBILITY

5.1 General

5.1.1 In accordance with Table D2 of PPS25, residential development use is classified as 'more vulnerable' and office development is classified as 'less vulnerable'.

5.1.2 In accordance with Table D3 of PPS25, both 'more vulnerable' and 'less vulnerable' development is suitable for location within Flood Zone 1.

5.2 Sequential Test

5.2.1 Annex D of PPS25 recommends that the risk based Sequential Test should be applied at all stages of the planning process to steer new development to areas at the lowest probability of flooding.

5.2.2 In accordance with PPS25 and the Environment Agency's Standing Advice, the Sequential Test is only required for sites located within Flood Zones 2 and 3. Furthermore, as the proposed development will be located within Flood Zone 1, the sequential process can be deemed to have been followed.

5.3 Exception Test

5.3.1 The Exception Test is not applicable in this instance.

6 ASSESSMENT OF FLOOD IMPACT

6.1 Fluvial Flooding

6.1.1 As the site is located within Flood Zone 1, the proposed development will be at low risk of fluvial flooding and will not therefore increase the risk of flooding to other areas via the displacement of floodwater.

6.2 Groundwater

6.2.1 To our knowledge the site is not susceptible to groundwater flooding. The proposed development is unlikely to increase flood risk in this respect.

6.3 Surface Water

6.3.1 The implementation of a surface water drainage strategy, as identified within Section 3.4 of this report, will ensure that positive surface water run-off is restricted to equivalent Greenfield levels thus ensuring that flood risk to the surrounding area is not increased

7 CONCLUSIONS & RECOMMENDATIONS

7.1 General

7.1.1 The application site is located within Flood Zone 1 so the proposed development will have a low probability of fluvial flooding.

7.1.2 In accordance with PPS25, the proposed development classifications are suitable for location within Flood Zone 1.

7.1.3 To our knowledge, the site has not been subject to flooding from any source.

7.2 Mitigation Measures

7.2.1 No formal flood defence measures are proposed.

7.2.2 As the proposed development will not displace floodwater, no floodwater storage mitigation measures are proposed.

7.2.3 The implementation of a sustainable surface water drainage strategy, as outlined within Section 3.4 of this report, will ensure that flood risk via surface water run-off to other areas is not increased.

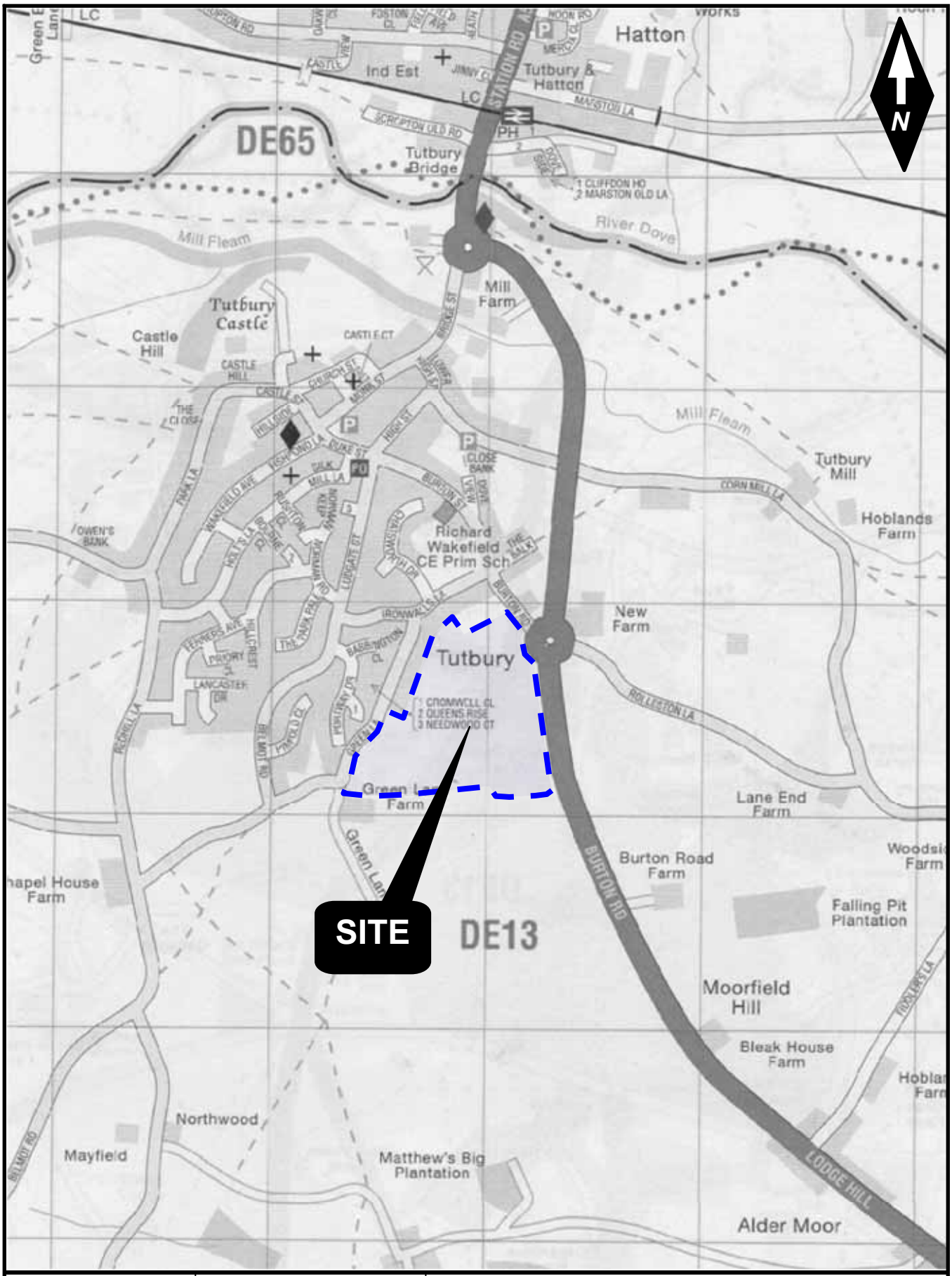
7.3 Residual Flood Risk

7.3.1 No significant residual flood risks have been identified.

7.3.2 Safe routes of emergency access/egress will be readily available from all parts of the proposed development.

APPENDICES

APPENDIX A



SCALE: **Do Not Scale**	CLIENT: **Peveril Homes Ltd**	JOB TITLE: **Land at Tutbury**	
DATE: **24/04/09**			
DRAWN: **AG**	TITLE: **SITE LOCATION PLAN**	JOB NUMBER: **P119**	FIGURE: **1**

APPENDIX B

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
L1	421615.406	328140.504	83.805
L2	421333.509	328136.235	88.928
L3	421666.121	328150.310	80.663
L4	421619.534	328400.479	80.319
L5	421559.929	328492.547	79.869
L6	421398.445	328328.206	88.789
L7	421399.803	328220.051	88.620
L19	421188.728	328186.769	87.189
L20	421220.571	328211.540	87.745
L21	421256.047	328291.671	88.405

Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings *Surveyed Buildings*

This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via a Global Position System (GPS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models.
The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid.

Legend:

greenhatch group

Topographical Surveys
Site Engineering

Measured Building Surveys
3D Laser Scanning

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk

CLIENT

Peveril Homes

PROJECT

Tutbury

TITLE

Topographical Survey

SCALE	DATE	DRAWN	QUALITY REF
1: 500	Aug/Sep 09	LP	FO346

Level datum	O.S (GPS)
Grid orientation	O.S (GPS)
Job number	13583

Drawing No.	Rev.
13583_OGL	0

Comments
This plan should only be used for its original purpose. GreenHatch Ltd accepts no responsibility for this plan if supplied to any party other than the original client.

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

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

Notes:

DO NOT SCALE

APPENDIX C

Severn Trent Water

Asset Protection (Waste Water) West
Regis Road
Tettenhall
Wolverhampton
WV6 8RU
Tel 01902 793960
Fax 01902 793971
Contact Dave Hadley
Our Ref DJH/WT25695
Your Ref JS/P119/001

E mail: net.dev.west@severntrent.co.uk

09 January 2010

Armstrong Stokes & Clayton Limited
The Book Shop Chambers
54 King Street
Southwell
Nottinghamshire
NG25 0EN
For the attention of Jon Stokes

Dear Mr Stokes,

Proposed Development at Burton Road, Tutbury, Derbyshire
Co-Ords X421424, Y328263

I refer to your recent Development Enquiry Request in respect of the above. Please find a copy of the sewer records and additional guidance notes enclosed for your information.

Foul Water Drainage

The nearest point of connection to the foul system is at the junction of Burton Road and Ironwalks Lane. The sewer is 225mm diameter and conveys sewage from the catchment area to a pumping station located about 700 metres to the north of the site. As this is a Greenfield site for possibly 220 dwellings and 2000 sq.m of office units we will need a modelling exercise undertaken to assess the hydraulic impact on the existing system. Please find a leaflet enclosed in this respect and I would ask you to contact Steve Ralph direct for an estimate and timescale.

Surface Water Drainage

The site is greenfield and therefore soakaways must be used wherever possible unless proved unsuitable. If this is the case there might be a local watercourse system within the development area as there is a pond located to the north of the site. Alternatively the Mill Fleam watercourse is located approximately 600 metres to the north east and a connection to this waterway might be possible with flow rates and attenuation details to be agreed with the Environment Agency. (Please see paragraphs 1. and 3. overleaf for more detailed information.) Please note that the 225mm diameter surface water sewer to the north of the development will need to be accommodated within the housing layout and a 'no build' zone of 5.0 metres centred over the sewer will be applied.

For any new connections into the public sewer network **or the use of existing sewer connections**, you will need a Section 106 pack that includes guidance notes and an application form. Our Developer Services Team handles new connections. To contact them for an application pack please call 0116 234 3320 (or visit www.stwater.co.uk) and quote the reference number above. For the avoidance of doubt, it is suggested that a copy of this letter, highlighting this paragraph is submitted with the future Section 106 submission.

Please quote WT25695 in any future correspondence (including e-mails) with Severn Trent Water Limited. I must also inform you that this evaluation is only valid for 6 months from the date of this letter.

Yours Sincerely,

D J Hadley
Asset Protection (Waste Water) West

Guidance Notes

Surface Water Disposal

As you may be aware the Government has issued national advice in the form of "Planning Policy Statement 25: Development and Flood Risk" that seeks to reduce the impact of development on surface water runoff. Annex F of PPS25 is particularly relevant. This advice is generally followed by Local Authorities through both the Building Regulations (Approved Document H) and the imposition of appropriate planning conditions. Severn Trent seeks to implement this advice by requesting such planning conditions.

The use of SUDS principles is encouraged by Severn Trent as an environment-friendly approach to the disposal of surface water runoff from development sites. This is consistent with the weight given to such principles in the Building Regulations (Approved Document H, April 2002). In accordance with current guidance, disposal of storm runoff from the development is to be dealt with as follows:

1. By soakage into the site's subsoil, subject to suitable ground soakage capacity and any contamination present. As you may know, in addition to traditional soakaways, a popular approach is the use of permeable pavements or storm cells located under parking areas. Soakage capability is to be determined in accordance with Section 2 of Approved Document H3 (2002 Edition) of the Building Regulations and so certified by a suitably qualified person. If ground soakage proves inadequate, evidence must be submitted to Severn Trent Water Limited. The evidence should be either percolation test results or a statement from the SI consultant (extract from report or a supplementary letter) stating that soakaways would be ineffective. **A connection to the public sewerage system will then be considered with flows as:**

2. Brown field development site: If storm runoff from the existing development is connected to the public sewerage system, then peak storm flows from the proposed development up to that deriving from the previous connected impermeable area, less 20%, may be connected to the public sewerage system. This is subject to both the details of the existing storm connection arrangements and hydraulic calculations, including any attenuation structures and controls for a 30 year design, being submitted to Severn Trent Water Limited. For existing storm connections to the public foul sewerage system, any new storm connection to the public storm sewerage system (if available) will be limited to 5 litres/sec/ha (option A) OR a peak flow to be determined by the Company from its developer-funded hydraulic modelling of the public storm sewerage system (option B). The developer may choose either option. Please note existing flows must be assessed as the lower of $Q=2.78x50xA_{imp}$ l/s (A_{imp} ha) and the unsurcharged capacity of the outfall pipe(s). This will be an improvement, as sought by PPS25.

3. Green field development site: **Please note there is no automatic right of connection from Greenfield sites.** The development should connect to infiltration systems, local ditches or watercourses before consideration of a connection to the public sewerage system. Only if these options are not viable will we consider a potential connection to a surface water or combined sewer. Depending on available capacity we would allow a maximum of 5 litres per second per hectare for a 30 year design storm (equivalent to average Greenfield run-off rate) but this may be subject to modelling as advised.

Please note that if a watercourse exists within a reasonable distance from the development site paragraphs 2. and 3. are not applicable and you should contact the Environment Agency and/or the Local Land Drainage Authority for permission and flow attenuation details.

General

All potentially adoptable sewers must be designed and constructed in accordance with the current edition of 'Sewers for Adoption'. A Severn Trent Water Addendum for Foul Sewage Pumping Stations is available at www.wrcplc.co.uk/sfa.

All enquiries with respect to the supply of sewer records only should be directed to Severn Trent Water Limited, Record Management Centre, Waterworks Road, Edgbaston, Birmingham, B16 9DD (Tel: 0845
601 6616)

For Brownfield developments we are requesting a reduction in surface water flow to surface water and combined sewers of 20% in line with Environment Agency policy and current Government guidance. However, our requirement for flow attenuation differs from the EA and is currently based on a 30 year critical duration design storm until further notice.

Networks Sewerage Modelling Service

We now offer developers, through our Networks Modelling Section, a service where we provide a feasibility assessment of the hydraulic performance of our sewerage system to enable optimum solutions to be designed for draining new developments.

This service encompasses:

- On-site sewer diversions (including those in a highway where the developer has the permission of the Highways Authority to construct the work)
- On-site public sewerage assessments to provide hydraulic capacity for the developer's proposals.
- Detailed analysis of developer's proposals to ensure that downstream hydraulic problems are not exacerbated by their developments.
- Identification of available capacity within the public sewerage network for speculative development.

In order to undertake the required analysis the developer needs to provide:

1. Reference details of any drainage enquiry that we have already done.
2. On-site drainage proposals – including indicative road and housing layout together with plans of impermeable areas.
3. For brown field sites – existing drainage survey indicating areas positively drained and the drains etc which serve them.
4. On-site level survey, preferably based on Ordnance Survey datum, but at a minimum with reference points to tie the data to Ordnance Survey.
5. Ordnance Survey co-ordinates for proposed manholes.

For further details and/or a site specific quotation please contact either of our modelling teams or our New Connections office:

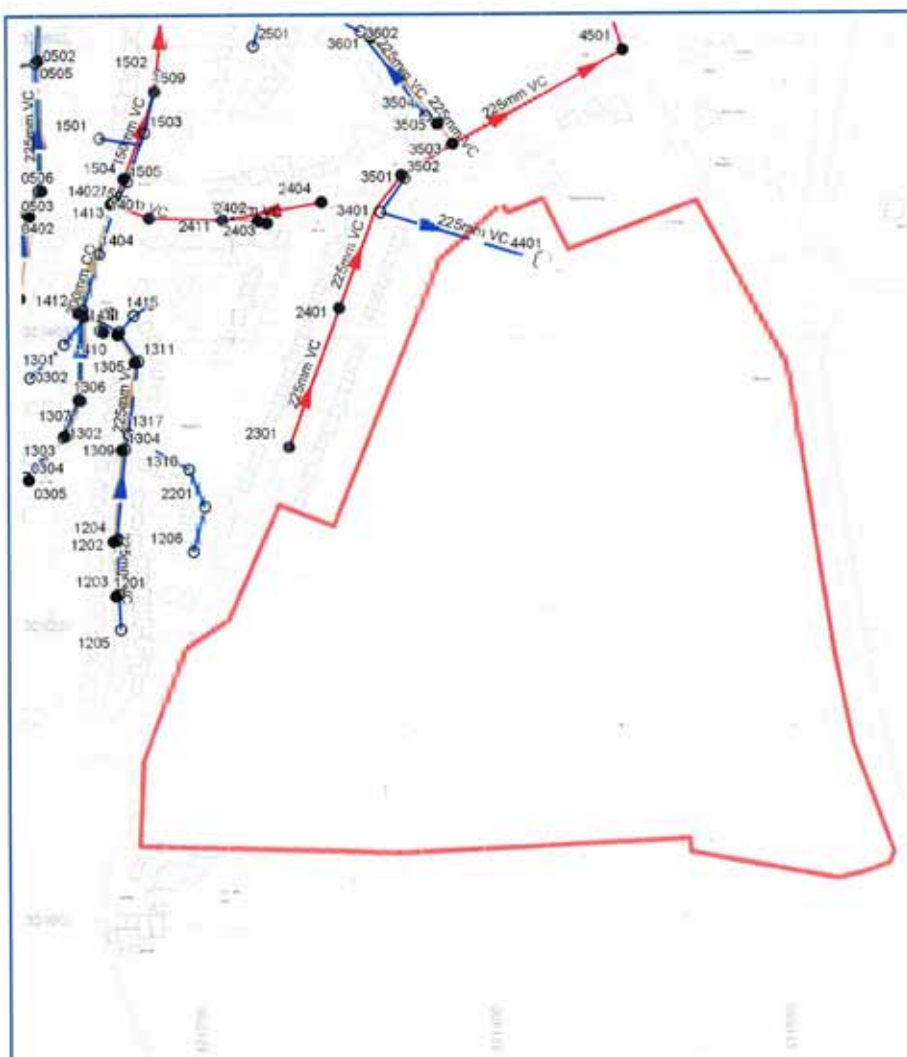
Modelling Teams:

For sites in Nottinghamshire, Derbyshire, Leicestershire, Coventry and Warwickshire
Contact Jim Borrington on Tel. No. 01332 683430
Email jim.borrington@severntrent.co.uk

For sites in Staffordshire, Shropshire, Powys, Gloucestershire, Worcestershire and West Midlands
Contact Steve Ralph on Tel. No. 01782 654231
Email steve.ralph@severntrent.co.uk

New Connections:

Severn Trent Water, New Connections, Gorse Hill, Anstey, Leicester, LE7 7GU
Tel. No. 0800 707 6600
Email new.connections@severntrent.co.uk



Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SK21280304	83.34	80.43	76.94	S	VC	C	225	nil	10.95	nil
SK21280305	83.39	80.21	76.06	F	VC	C	150	nil	11.08	nil
SK21280302	78.30	75.72	74.48	S	VC	C	225	nil	14.21	nil
SK21280402	80.03	77.77	77.67	S	CO	C	225	nil	170.00	nil
SK21280401	80.03	77.38	77.22	F	VC	C	225	nil	117.44	nil
SK21280506	79.18	77.61	76.87	S	CO	C	225	nil	117.59	nil
SK21280503	79.16	77.22	76.48	F	VC	C	225	nil	120.30	nil
SK21280506	78.85	76.86	74.17	S	CO	C	300	nil	20.50	nil
SK21280502	78.80	76.49	73.78	F	VC	C	225	nil	19.31	nil
SK21281201	85.96	83.81	82.45	F	VC	C	225	nil	27.21	nil
SK21281202	85.54	82.42	80.49	F	VC	C	225	nil	31.33	nil
SK21281204	85.02	82.84	82.24	S	VC	C	225	nil	103.82	nil
SK21281206	86.38	84.83	84.53	S	VC	C	150	nil	80.07	nil
SK21281203	85.90	84.47	82.86	S	VC	C	225	nil	22.99	nil
SK21281302	78.35	76.89	nil	S	VC	C	225	nil	0.00	nil
SK21281303	78.32	76.55	nil	F	VC	C	150	nil	0.00	nil
SK21281301	76.46	74.41	nil	S	VC	C	225	nil	0.00	nil
SK21281306	nil	nil	nil	S	VC	C	225	nil	0.00	nil
SK21281307	nil	nil	73.58	F	VC	C	150	nil	0.00	nil
SK21281304	83.20	80.33	77.12	F	VC	C	225	nil	18.28	nil
SK21281309	84.66	82.20	80.20	S	VC	C	225	nil	5.10	nil
SK21281317	82.97	80.14	77.68	S	VC	C	225	nil	20.12	nil
SK21281305	79.77	76.57	75.12	F	VC	C	225	nil	15.50	nil
SK21281311	79.86	76.87	75.23	S	VC	C	225	nil	13.71	nil
SK21281310	85.64	84.93	80.22	S	VC	C	225	nil	10.89	nil
SK21281412	75.13	73.17	71.21	F	VC	C	225	nil	39.54	nil
SK21281403	75.17	73.23	73.19	F	VC	C	225	nil	534.75	nil
SK21281411	75.09	73.10	72.07	S	CO	C	300	nil	38.69	nil
SK21281406	76.71	74.88	nil	S	VC	C	150	nil	0.00	nil
SK21281404	73.71	72.96	71.54	S	CO	C	300	nil	70.56	nil
SK21281406	76.84	74.63	nil	F	VC	C	150	nil	0.00	nil
SK21281407	76.71	74.34	nil	F	VC	C	150	nil	0.00	nil
SK21281408	76.85	74.71	nil	S	VC	C	150	nil	0.00	nil
SK21281402	72.85	71.13	70.66	C	VC	C	150	nil	40.94	nil
SK21281413	72.94	71.32	70.90	S	CO	C	300	nil	38.38	nil
SK21281410	77.19	74.44	nil	F	VC	C	225	nil	0.00	nil
SK21281409	77.20	74.37	nil	S	CO	C	225	nil	0.00	nil
SK21281416	77.59	75.57	74.43	S	VC	C	225	nil	13.04	nil
SK21281416	79.47	77.45	75.63	S	VC	C	225	nil	7.92	nil
SK21281401	75.46	72.54	71.20	C	VC	C	150	nil	20.79	nil
SK21281501	73.82	71.53	nil	S	VC	C	150	nil	0.00	nil
SK21281504	72.52	70.95	nil	S	CO	C	300	nil	0.00	nil
SK21281505	72.44	70.65	nil	C	VC	C	150	nil	0.00	nil
SK21281503	71.58	70.11	69.17	S	CO	C	300	nil	42.83	nil

- 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 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

- 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 Blockage
- Sewer Collapse

- 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
- SSSI Area
- Access Right
- Pre-1937 Properties

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.
B. Where the node bifurcates (splits) X and Y's indicates downstream sewer pipe.
C. Gradient is stated x 1 in...

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 - POLYETHYLENE
- PI - PITCH
- PP - POLYPROPYLENE
- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN IRON/IRON
- ST - STEEL
- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

CATEGORIES

- W - WEIR
- C - CASCADE
- DB - DASHBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SYPHON
- HD - HIGHWAY DRAIN
- SXH - SECTION 104

N / W / E / S

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

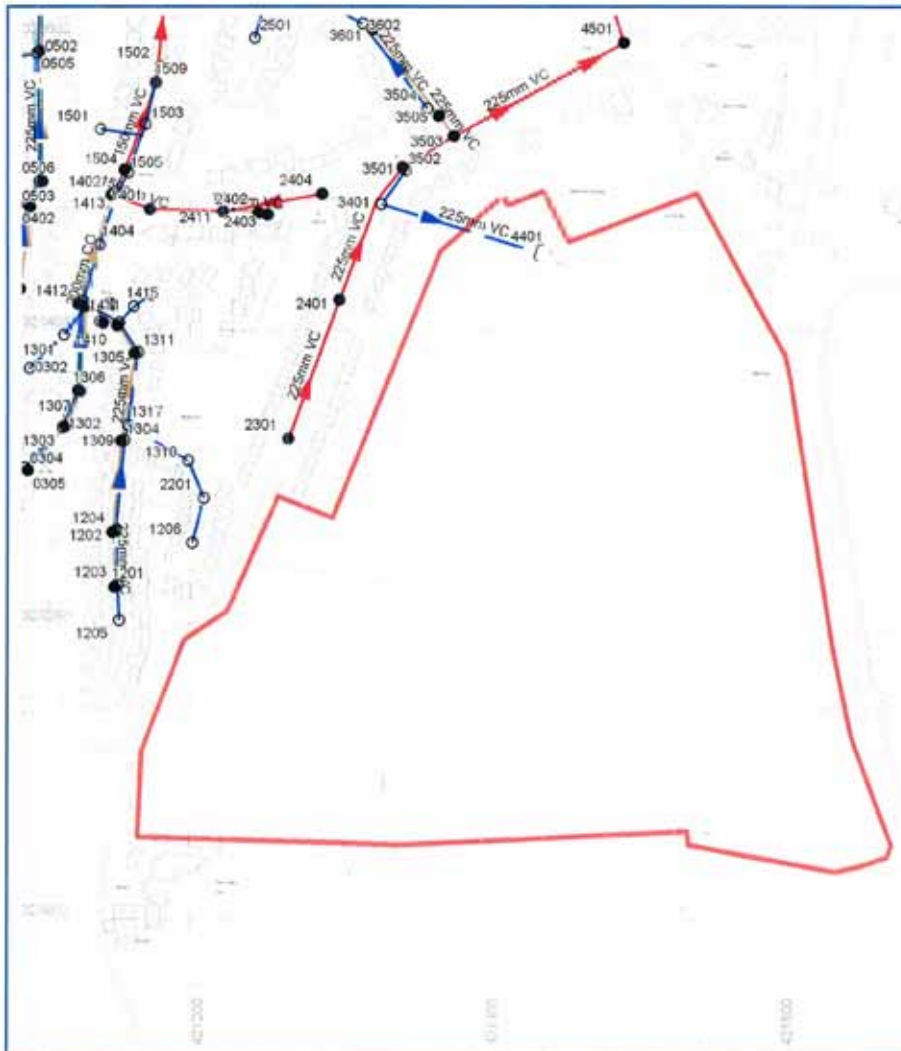
Severn Trent Water

Severn Trent Water Limited
Waterworks Road
Edgbaston
Birmingham
B16 9DD
Telephone: 0845 601 6666

SEWER RECORD (Tabular)

O/S Map scale: 1:3500
Date of issue: 29.12.09
Sheet No. 1 of 2

This map is centred upon:
O / S Grid reference:
x : 421424
y : 328263



Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SK21281509	nil	nil	86.25	C	nil	nil	nil	nil	0.00	nill
SK21281502	70.81	nil	nil	nil	nil	nil	nil	nil	0.00	nill
SK21281206	86.71	85.44	85.06	S	VC	C	225	nil	83.11	nill
SK21282201	87.24	85.03	84.71	S	VC	C	225	nil	84.16	nill
SK21282301	88.88	87.49	87.16	C	VC	C	225	nil	303.94	nill
SK21282411	81.00	79.84	74.12	C	VC	C	150	nil	10.85	nill
SK21282402	84.60	82.33	nil	F	VC	C	100	nil	0.00	nill
SK21282403	84.92	84.37	84.20	F	VC	C	100	nil	35.76	nill
SK21282404	85.17	83.53	nil	C	VC	C	150	nil	0.00	nill
SK21282501	80.78	79.75	nil	S	VC	C	225	nil	0.00	nill
SK21282401	89.13	87.10	85.79	C	VC	C	225	nil	76.16	nill
SK21283401	88.60	86.06	nil	S	VC	C	225	nil	0.00	nill
SK21283501	88.27	86.52	86.10	S	VC	C	150	nil	66.71	nill
SK21283502	88.59	85.73	85.11	C	VC	C	225	nil	65.84	nill
SK21283506	87.66	85.41	85.24	F	VC	C	225	nil	101.18	nill
SK21283504	87.75	86.44	85.97	S	VC	C	225	nil	154.89	nill
SK21283503	87.52	85.08	81.71	C	VC	C	225	nil	39.31	nill
SK21283602	88.20	85.92	84.54	S	VC	C	225	nil	21.40	nill
SK21283601	88.27	86.23	85.41	F	VC	C	225	nil	90.49	nill
SK21284501	83.88	81.68	80.54	C	VC	C	225	nil	94.08	nill

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

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 Blockage
Sewer Collapse

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
SSSI Area
Access Right
Pre-1937 Properties

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 rise/fall in...

MATERIALS

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

CATEGORIES

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

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

N
W E
S

Severn Trent Water

Severn Trent Water Limited
Waterworks Road
Edgbaston
Birmingham
B16 9DD
Telephone: 0845 601 5011

SEWER RECORD (Tabular)

O/S Map scale: 1:3500
Date of issue: 29.12.09
Sheet No. 2 of 2

This map is centred upon:
O / S Grid reference:
x : 421424
y : 328263

Do not scale off drawing
Disclaimer:

1. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.
2.
3. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and no further copies should be made from it.

APPENDIX D

APPENDIX E

IH 124 Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (Ha)	15.200	Urban	0.000
SAAR (mm)	700.000	Region Number	4

Results	**l/s**
QBAR Rural	76.1
QBAR Urban	76.1
Q 2 years	68.2
Q 1 year	63.2
Q 2 years	68.2
Q 5 years	93.6
Q 10 years	113.4
Q 20 years	135.3
Q 25 years	143.0
Q 30 years	149.1
Q 50 years	167.6
Q 100 years	195.6
Q 200 years	229.9
Q 250 years	241.3
Q 1000 years	316.7

Armstrong Stokes & Clayton Ltd
1 Mavis Avenue
Ravenshead
Nottinghamshire NG15 9EB
Date April 2011
File Balancing Pond.SRC
Micro Drainage

West Tutbury
Staffordshire
Peveril Homes Ltd
Designed By JS
Checked By
Source Control W.11.2

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	59.9	59.9	100.7803	0.7803	816.4	O K
30 Summer	59.9	59.9	100.9208	0.9208	1053.2	O K
60 Summer	59.9	59.9	101.0323	1.0323	1263.6	O K
120 Summer	59.9	59.9	101.1018	1.1018	1405.7	O K
180 Summer	59.9	59.9	101.1118	1.1118	1426.4	O K
240 Summer	59.9	59.9	101.1018	1.1018	1405.7	O K
360 Summer	59.9	59.9	101.0763	1.0763	1352.2	O K
480 Summer	59.9	59.9	101.0468	1.0468	1293.0	O K
600 Summer	59.9	59.9	101.0153	1.0153	1229.8	O K
720 Summer	59.9	59.9	100.9818	0.9818	1165.5	O K
960 Summer	59.9	59.9	100.9138	0.9138	1040.0	O K
1440 Summer	59.9	59.9	100.7793	0.7793	815.4	O K
2160 Summer	59.9	59.9	100.6032	0.6033	562.1	O K
2880 Summer	58.0	58.0	100.4807	0.4807	412.3	O K
4320 Summer	48.8	48.8	100.3557	0.3557	279.2	O K
5760 Summer	40.9	40.9	100.2933	0.2932	219.9	O K
7200 Summer	34.8	34.8	100.2562	0.2562	186.9	O K
8640 Summer	30.3	30.3	100.2292	0.2292	163.8	O K
10080 Summer	26.8	26.8	100.2083	0.2082	146.7	O K
15 Winter	59.9	59.9	100.8433	0.8433	918.9	O K
30 Winter	59.9	59.9	100.9933	0.9933	1188.0	O K
60 Winter	59.9	59.9	101.1143	1.1143	1432.1	O K
120 Winter	59.9	59.9	101.1943	1.1943	1608.3	O K
180 Winter	59.9	59.9	101.2118	1.2118	1648.9	O K
240 Winter	59.9	59.9	101.2053	1.2053	1633.5	O K
360 Winter	59.9	59.9	101.1703	1.1703	1554.7	O K
480 Winter	59.9	59.9	101.1338	1.1338	1474.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	128.29	19
30 Summer	84.23	34
60 Summer	52.66	62
120 Summer	31.80	122
180 Summer	23.35	180
240 Summer	18.64	208
360 Summer	13.54	270
480 Summer	10.79	336
600 Summer	9.04	404
720 Summer	7.82	470
960 Summer	6.22	604
1440 Summer	4.49	854
2160 Summer	3.24	1208
2880 Summer	2.57	1536
4320 Summer	1.85	2248
5760 Summer	1.46	2944
7200 Summer	1.22	3672
8640 Summer	1.05	4408
10080 Summer	0.92	5136
15 Winter	128.29	20
30 Winter	84.23	33
60 Winter	52.66	62
120 Winter	31.80	120
180 Winter	23.35	176
240 Winter	18.64	230
360 Winter	13.54	290
480 Winter	10.79	364

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
600 Winter	59.9	59.9	101.0913	1.0913	1383.3	O K
720 Winter	59.9	59.9	101.0443	1.0443	1288.1	O K
960 Winter	59.9	59.9	100.9443	0.9443	1096.0	O K
1440 Winter	59.9	59.9	100.7393	0.7393	753.8	O K
2160 Winter	58.6	58.6	100.4952	0.4952	429.0	O K
2880 Winter	51.4	51.4	100.3777	0.3777	301.3	O K
4320 Winter	38.5	38.5	100.2787	0.2787	206.8	O K
5760 Winter	30.7	30.7	100.2318	0.2317	166.0	O K
7200 Winter	25.8	25.8	100.2018	0.2017	141.2	O K
8640 Winter	22.2	22.2	100.1803	0.1803	124.2	O K
10080 Winter	19.6	19.6	100.1643	0.1643	111.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	9.04	440
720 Winter	7.82	514
960 Winter	6.22	654
1440 Winter	4.49	908
2160 Winter	3.24	1228
2880 Winter	2.57	1552
4320 Winter	1.85	2248
5760 Winter	1.46	2944
7200 Winter	1.22	3672
8640 Winter	1.05	4408
10080 Winter	0.92	5136

Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 3.600

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	3.000	4	8	0.600

Tank/Pond Details

Invert Level (m) 100.000 Ground Level (m) 101.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	600.0	0.60	1300.0	1.20	2290.0	1.80	2890.0	2.40	2890.0
0.10	700.0	0.70	1450.0	1.30	2480.0	1.90	2890.0	2.50	2890.0
0.20	800.0	0.80	1600.0	1.40	2680.0	2.00	2890.0		
0.30	920.0	0.90	1760.0	1.50	2890.0	2.10	2890.0		
0.40	1040.0	1.00	1930.0	1.60	2890.0	2.20	2890.0		
0.50	1170.0	1.10	2100.0	1.70	2890.0	2.30	2890.0		

Hydro-Brake Outflow Control

Design Head (m) 1.200 Hydro-Brake Type MD6 Invert Level (m) 100.000
Design Flow (l/s) 55.0 Diameter (mm) 275

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	9.0	0.80	58.4	2.00	62.0	4.00	86.4	7.00	114.3
0.20	25.5	1.00	56.0	2.20	64.6	4.50	91.6	7.50	118.3
0.30	42.1	1.20	55.0	2.40	67.2	5.00	96.6	8.00	122.2
0.40	54.1	1.40	55.6	2.60	69.8	5.50	101.3	8.50	125.9
0.50	58.9	1.60	57.3	3.00	74.9	6.00	105.8	9.00	129.6
0.60	59.9	1.80	59.5	3.50	80.8	6.50	110.1	9.50	133.2

Armstrong Stokes & Clayton Ltd
1 Mavis Avenue
Ravenshead
Nottinghamshire NG15 9EB
Date April 2011
File CELLULAR.SRC
Micro Drainage

West Tutbury
Staffordshire
Peveril Homes Ltd
Designed By JS
Checked By
Source Control W.11.2

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 651 minutes

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	13.4	0.0	13.4	100.6113	0.6113	464.5	O K
30 Summer	13.4	0.0	13.4	100.7968	0.7968	605.6	O K
60 Summer	13.4	0.0	13.4	100.9793	0.9793	744.3	O K
120 Summer	14.2	0.0	14.2	101.1428	1.1428	868.6	O K
180 Summer	14.6	0.0	14.6	101.2168	1.2168	924.8	O K
240 Summer	14.8	0.0	14.8	101.2528	1.2528	952.1	O K
360 Summer	14.9	0.0	14.9	101.2777	1.2777	971.1	O K
480 Summer	14.9	0.0	14.9	101.2728	1.2728	967.3	O K
600 Summer	14.8	0.0	14.8	101.2593	1.2593	957.0	O K
720 Summer	14.7	0.0	14.7	101.2443	1.2443	945.6	O K
960 Summer	14.6	0.0	14.6	101.2103	1.2103	919.9	O K
1440 Summer	14.2	0.0	14.2	101.1363	1.1363	863.6	O K
2160 Summer	13.6	0.0	13.6	101.0233	1.0233	777.8	O K
2880 Summer	13.4	0.0	13.4	100.9158	0.9158	696.1	O K
4320 Summer	13.4	0.0	13.4	100.7183	0.7183	545.9	O K
5760 Summer	13.4	0.0	13.4	100.5412	0.5412	411.5	O K
7200 Summer	13.4	0.0	13.4	100.4027	0.4027	305.9	O K
8640 Summer	13.4	0.0	13.4	100.3148	0.3147	239.1	O K
10080 Summer	12.7	0.0	12.7	100.2647	0.2647	201.3	O K
15 Winter	13.4	0.0	13.4	100.6863	0.6863	521.5	O K
30 Winter	13.4	0.0	13.4	100.8948	0.8948	680.2	O K
60 Winter	14.0	0.0	14.0	101.1013	1.1013	837.1	O K
120 Winter	15.0	0.0	15.0	101.2887	1.2887	979.5	O K
180 Winter	15.4	0.0	15.4	101.3762	1.3762	1046.0	O K
240 Winter	15.7	0.0	15.7	101.4207	1.4207	1079.9	O K
360 Winter	15.9	0.0	15.9	101.4587	1.4587	1108.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	128.29	22
30 Summer	84.23	36
60 Summer	52.66	64
120 Summer	31.80	124
180 Summer	23.35	182
240 Summer	18.64	242
360 Summer	13.54	360
480 Summer	10.79	468
600 Summer	9.04	518
720 Summer	7.82	578
960 Summer	6.22	704
1440 Summer	4.49	980
2160 Summer	3.24	1388
2880 Summer	2.57	1792
4320 Summer	1.85	2592
5760 Summer	1.46	3296
7200 Summer	1.22	3960
8640 Summer	1.05	4584
10080 Summer	0.92	5248
15 Winter	128.29	22
30 Winter	84.23	36
60 Winter	52.66	64
120 Winter	31.80	122
180 Winter	23.35	180
240 Winter	18.64	238
360 Winter	13.54	352

Armstrong Stokes & Clayton Ltd
1 Mavis Avenue
Ravenshead
Nottinghamshire NG15 9EB
Date April 2011
File CELLULAR.SRC
Micro Drainage

West Tutbury
Staffordshire
Peveril Homes Ltd
Designed By JS
Checked By
Source Control W.11.2

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Filtration (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
480 Winter	15.9	0.0	15.9	101.4632	1.4632	1112.0	O K
600 Winter	15.8	0.0	15.8	101.4492	1.4492	1101.3	O K
720 Winter	15.7	0.0	15.7	101.4252	1.4252	1083.2	O K
960 Winter	15.5	0.0	15.5	101.3827	1.3827	1051.1	O K
1440 Winter	14.9	0.0	14.9	101.2828	1.2828	974.9	O K
2160 Winter	14.1	0.0	14.1	101.1208	1.1208	851.9	O K
2880 Winter	13.4	0.0	13.4	100.9638	0.9638	732.6	O K
4320 Winter	13.4	0.0	13.4	100.6653	0.6653	505.7	O K
5760 Winter	13.4	0.0	13.4	100.4032	0.4032	306.5	O K
7200 Winter	13.0	0.0	13.0	100.2772	0.2772	210.7	O K
8640 Winter	11.7	0.0	11.7	100.2162	0.2162	164.2	O K
10080 Winter	10.6	0.0	10.6	100.1882	0.1883	142.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
480 Winter	10.79	462
600 Winter	9.04	566
720 Winter	7.82	658
960 Winter	6.22	746
1440 Winter	4.49	1054
2160 Winter	3.24	1512
2880 Winter	2.57	1936
4320 Winter	1.85	2764
5760 Winter	1.46	3352
7200 Winter	1.22	3960
8640 Winter	1.05	4584
10080 Winter	0.92	5240

Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 1.980

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	1.500	4	8	0.480

Cellular Storage Details

Infil Coef - Base (m/hr)	0.000000	Porosity	0.95
Infil Coef - Sides (m/hr)	0.000000	Invert Level (m)	100.000
Safety Factor	1.0	Ground Level (m)	101.500

Depth (m)	Area (m²)	Infil. Area (m²)	Depth (m)	Area (m²)	Infil. Area (m²)	Depth (m)	Area (m²)	Infil. Area (m²)
0.00	800.0	800.0	0.90	800.0	908.0	1.80	0.0	980.0
0.10	800.0	812.0	1.00	800.0	920.0	1.90	0.0	980.0
0.20	800.0	824.0	1.10	800.0	932.0	2.00	0.0	980.0
0.30	800.0	836.0	1.20	800.0	944.0	2.10	0.0	980.0
0.40	800.0	848.0	1.30	800.0	956.0	2.20	0.0	980.0
0.50	800.0	860.0	1.40	800.0	968.0	2.30	0.0	980.0
0.60	800.0	872.0	1.50	800.0	980.0	2.40	0.0	980.0
0.70	800.0	884.0	1.60	0.0	980.0	2.50	0.0	980.0
0.80	800.0	896.0	1.70	0.0	980.0			

Hydro-Brake Outflow Control

Design Head (m)	1.500	Hydro-Brake Type	MD6	Invert Level (m)	100.000
Design Flow (l/s)	16.1	Diameter (mm)	152		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	5.0	0.80	12.6	2.00	18.6	4.00	26.3	7.00	34.7
0.20	11.4	1.00	13.5	2.20	19.5	4.50	27.9	7.50	36.0
0.30	13.4	1.20	14.5	2.40	20.3	5.00	29.4	8.00	37.1
0.40	13.4	1.40	15.6	2.60	21.2	5.50	30.8	8.50	38.3
0.50	12.9	1.60	16.6	3.00	22.7	6.00	32.2	9.00	39.4
0.60	12.5	1.80	17.6	3.50	24.6	6.50	33.5	9.50	40.5

Armstrong Stokes & Clayton Ltd
1 Mavis Avenue
Ravenshead
Nottinghamshire NG15 9EB
Date April 2011
File PIPE.SRC
Micro Drainage

West Tutbury
Staffordshire
Peveril Homes Ltd
Designed By JS
Checked By
Source Control W.11.2

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	7.1	7.1	100.8223	0.8223	243.6	O K
30 Summer	7.8	7.8	101.0138	1.0138	316.2	O K
60 Summer	8.5	8.5	101.1978	1.1978	385.8	O K
120 Summer	9.0	9.0	101.3532	1.3532	444.8	O K
180 Summer	9.2	9.2	101.4147	1.4147	468.2	O K
240 Summer	9.3	9.3	101.4367	1.4367	476.4	O K
360 Summer	9.3	9.3	101.4327	1.4327	475.0	O K
480 Summer	9.2	9.2	101.4072	1.4072	465.4	O K
600 Summer	9.1	9.1	101.3807	1.3807	455.2	O K
720 Summer	9.0	9.0	101.3532	1.3532	444.9	O K
960 Summer	8.8	8.8	101.3022	1.3022	425.5	O K
1440 Summer	8.5	8.5	101.2108	1.2108	390.8	O K
2160 Summer	8.1	8.1	101.0888	1.0888	344.6	O K
2880 Summer	7.7	7.7	100.9778	0.9778	302.6	O K
4320 Summer	7.0	7.0	100.7843	0.7843	229.1	O K
5760 Summer	6.9	6.9	100.6168	0.6168	165.7	O K
7200 Summer	6.9	6.9	100.4652	0.4652	108.3	O K
8640 Summer	6.9	6.9	100.3438	0.3437	62.4	O K
10080 Summer	6.9	6.9	100.2627	0.2627	36.5	O K
15 Winter	7.4	7.4	100.9018	0.9018	273.7	O K
30 Winter	8.2	8.2	101.1183	1.1183	355.7	O K
60 Winter	8.9	8.9	101.3282	1.3282	435.4	O K
120 Winter	9.5	9.5	101.5112	1.5112	504.6	O K
180 Winter	9.8	9.8	101.6027	1.6027	533.9	O K
240 Winter	9.9	9.9	101.6532	1.6532	546.2	O K
360 Winter	10.0	10.0	101.6747	1.6747	550.8	O K
480 Winter	9.9	9.9	101.6402	1.6402	543.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	128.29	22
30 Summer	84.23	36
60 Summer	52.66	64
120 Summer	31.80	124
180 Summer	23.35	182
240 Summer	18.64	242
360 Summer	13.54	360
480 Summer	10.79	418
600 Summer	9.04	480
720 Summer	7.82	544
960 Summer	6.22	676
1440 Summer	4.49	954
2160 Summer	3.24	1364
2880 Summer	2.57	1764
4320 Summer	1.85	2556
5760 Summer	1.46	3336
7200 Summer	1.22	4032
8640 Summer	1.05	4664
10080 Summer	0.92	5248
15 Winter	128.29	22
30 Winter	84.23	36
60 Winter	52.66	64
120 Winter	31.80	122
180 Winter	23.35	180
240 Winter	18.64	236
360 Winter	13.54	348
480 Winter	10.79	454

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
600 Winter	9.8	9.8	101.5887	1.5887	529.8	O K
720 Winter	9.6	9.6	101.5507	1.5507	518.2	O K
960 Winter	9.4	9.4	101.4822	1.4822	493.7	O K
1440 Winter	9.0	9.0	101.3527	1.3527	444.7	O K
2160 Winter	8.4	8.4	101.1743	1.1743	376.9	O K
2880 Winter	7.8	7.8	101.0138	1.0138	316.1	O K
4320 Winter	6.9	6.9	100.7343	0.7343	210.2	O K
5760 Winter	6.9	6.9	100.4732	0.4732	111.3	O K
7200 Winter	6.9	6.9	100.2667	0.2667	37.6	O K
8640 Winter	6.4	6.4	100.1888	0.1888	18.9	O K
10080 Winter	5.7	5.7	100.1643	0.1643	14.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	9.04	542
720 Winter	7.82	570
960 Winter	6.22	724
1440 Winter	4.49	1030
2160 Winter	3.24	1472
2880 Winter	2.57	1904
4320 Winter	1.85	2724
5760 Winter	1.46	3464
7200 Winter	1.22	3960
8640 Winter	1.05	4408
10080 Winter	0.92	5144

Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Summer Storms	Yes
Ratio-R	0.400	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+30
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 1.046

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.750	4	8	0.296

Box Culvert Details

Height (m)	1.500	Width (m)	2.100	Invert Level (m)	100.000
Length (m)	180.000	Slope (1:x)	500.0	Cover Level (m)	102.500

Hydro-Brake Outflow Control

Design Head (m)	1.700	Hydro-Brake Type	MD6	Invert Level (m)	100.000
Design Flow (l/s)	10.0	Diameter (mm)	116		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	3.7	0.80	7.1	2.00	10.9	4.00	15.5	7.00	20.5
0.20	6.8	1.00	7.8	2.20	11.5	4.50	16.4	7.50	21.2
0.30	6.9	1.20	8.5	2.40	12.0	5.00	17.3	8.00	21.9
0.40	6.6	1.40	9.2	2.60	12.5	5.50	18.1	8.50	22.6
0.50	6.4	1.60	9.8	3.00	13.4	6.00	18.9	9.00	23.2
0.60	6.5	1.80	10.4	3.50	14.5	6.50	19.7	9.50	23.8