LAND OFF
SOUTH NEWINGTON ROAD
BLOXHAM

FLOOD RISK ASSESSMENT
& OUTLINE DRAINAGE STRATEGY

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EXECUTIVE SUMMARY

Scope and Background

This Flood Risk Assessment (FRA) has been undertaken by LK Consult Ltd (LKC) to support a planning application for the development of land off South Newington Road, Bloxham. The development comprises of a residential development with provision for soft landscaping and car parking.

LKC has prepared this Flood Risk Assessment (FRA) in line with the NPPF and Technical Guidance where appropriate.

In considering the proposals the following key principles have therefore been applied:-

- Identification of flood risks.
- Protection of users of the new development.
- No increased flood risk to third parties.

Consultations

The Environment Agency (EA) has been consulted during the preparation of this report. They have provided a more detailed flood map, but no modelled data was available.

Oxfordshire County Council and Thames Water were also consulted concerning flood risk.

All relevant consultees have confirmed that there is a Negligible to Very Low Risk of flooding to this site from all sources except Fluvial, Pluvial and Surface Water which are recorded as Low.

Flood Risk

Environment Agency flood maps indicate that part of the site is potentially vulnerable to fluvial flooding from the nearest main watercourse, approximately 100m north of the site.

The site is mostly within Flood Zone 1 – Very Low Risk – low annual probability of flooding less than 0.1% (1 in 1000). Part of the north eastern corner site is within Flood Zone 2 and 3 – Low Risk – Medium annual probability of flooding between 1% and 0.1% (1 in 100 – 1 in 1000)

The majority of the site is in an area of Very Low surface water flood risk, with the exception of areas of higher risk near the northern and western boundaries. This may be due to the potential for surface water to be trapped by the railway embankment if the onward culverted route is blocked.

Mitigation

Design

Site falls will be arranged to allow reasonably level access for occupants and visitors and allowing the site to be free draining in case of local ponding at times of heavy rainfall. Floor levels of dwellings will be set as high as possible above the flood level giving regard to necessary access for the less able.

The development will not result in any reduction in flood plain storage compared to the existing situation.

In considering the potential drainage options for the site at present it is assumed that surface water runoff arising from the development will discharge into the existing culverted watercourse.

The proposed development will increase the proportion of the site covered by impermeable surfaces and will therefore generate more runoff. Attenuation will therefore be required.

The outline drainage strategy considers the use of attenuation based SuDS to be feasible with a discharge to the watercourse at the northern site boundary. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a detention basin at the northern boundary. The required detention pond or similar has been estimated to be between **359.5m^3** and **375.0m^3** for the 1 in 30 year greenfield flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100 year storm event including the allowance for climate change is between **612.7m^3** and **761.5m^3**.

The residential development is considered to be at low risk of flooding. It is recommended that the minimum finished floor levels for the development should be set at 113.1m AOD for the lower areas of the site and a nominal height above the proposed ground levels elsewhere. This is to allow for overland flow during exceedance flows from an extreme event or a drainage failure.

Access

Access close to the site is elevated above potential flood levels and will always provide safe access to and from the site from South Newington Road.

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APPENDICES

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1 INTRODUCTION

1.1 Background

LK Consult Ltd (LKC) were commissioned by Gladman Developments Ltd to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy. The report was undertaken in support of a planning application to redevelop the site for residential use.

The report will address the vulnerability to flooding from all possible sources and will also consider the impact of the development on surface water runoff accounting for climate change and the potential to increase flood risk elsewhere. The Outline Drainage Strategy in Section 5 will provide an overview of the SuDS techniques which could be considered on the site. The issues of actual flood risk are discussed in Section 4.

Government policy with respect to development in flood risk areas is contained within the Department of Communities and Local Government National Planning Policy Framework[1] and accompanying Technical Guidance of March 2012 (revised to the Planning Practice Guidance (PPG)[2], which supersedes Planning Policy Statement 25 (PPS25) 'Development and Flood Risk'. The guidance on Climate Change allowance issued by the Environment Agency in February 2016 has also been considered.

LKC has prepared this Flood Risk Assessment (FRA) in line with the NPPF and the PPG where appropriate. The level of detail entered into in any FRA is dependent upon the scale and potential impact of the proposed development, and the vulnerability classification of the proposed land-use.

1.2 Site Details

A summary of general site settings is presented in Table 1-1. Plans, Drawings and Figures are provided in Appendix A. Figures 1 and 2 indicate the site location and boundary.

Site Details	
Location	Land off South Newington Road, Bloxham, Banbury, OX15 4HZ. Centred at approximate National Grid Reference 442380E 235310N.
Area	Approximately 6.0ha.
Topography	116 metres above ordnance datum (AOD) in the south of the site and 111.3m AOD in the northeast. The site slopes down gently to the northeast and northwest from a central ridge.
Current Land Use	Site Agricultural Land (Pasture) Surrounding Area/ Boundary Treatment North: Residential Properties and former railway. East: South Newington Road; Agricultural Land and the recreation ground. South: Agricultural Land. West: Agricultural Land.
Proposed Development	Residential properties including soft landscaping and car parking. Access will be from South Newington Road.

Table 1-1: Summary of site details

[1] DCL (2019). "National Planning Policy Framework." Department of Communities and Local Government. February 2019.
[2] DCL (2014). "Planning Practice Guidance" http://planningguidance.communities.gov.uk, April 2014.

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2 SITE SETTING

2.1 Vulnerability

As an initial phase in identifying whether a site is potentially at risk of flooding, LKC has consulted the Environment Agency's (EA) website Flood Zone Mapping. This mapping is (often) based on coarse scale modelling and provides only an initial indication of the flood risk to a site. The Environment Agency Flood Zone maps were developed using a very coarse Digital Elevation Map (DEM) and are superseded by a more detailed analysis of modelled flood levels and topographic survey levels.

The Flood Zones divide the floodplain into three categories of flood risk, and do not take flood defences into account. The NPPF defines the Flood Zones as:-

- Flood Zone 1 – little or no risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).
- Flood Zone 2 – low to medium risk, with annual probability of flooding of 0.1 to 1.0% from rivers and 0.1 to 0.5% from the sea.
- Flood Zone 3 – medium to high risk of flooding with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.

The Flood Zone Mapping indicates the site as being mostly within Flood Zone 1 with a small area within Flood Zones 2 & 3 (PPG paragraph 065, Table 1).

The development site is over 1 hectare in size, so under current regulations a Flood Risk Assessment will be necessary to accompany the Planning Application.

The proposed development is for residential end use and this is classified within the 'More Vulnerable' category in Table 2 of paragraph 066 of the PPG Technical Guidance.

2.2 The Sequential and Exception Tests

The NPPF requires that the Sequential Test be applied to development proposals in Flood Zones 2 or 3 to determine if there are any 'reasonably available' and suitable alternative sites at lower flood risk. In this case a limited area of the overall site area is within Flood Zones 2 & 3, but the development area is outside of these Flood Zones.

However, the principles should still be applied for developments within the site such that, for example, dwellings are situated on a high part of the site when there is a risk of local surface water flooding. The issues of actual flood risk are discussed below. The issues of safety and reduction in flood risk to others required by an Exception Test are also addressed in this document.

The Local Planning Authority (LPA) will make the final decision with regard to any planning application.

2.3 Environmental Setting

LKC have previously undertaken a Preliminary Risk Assessment for the site (LKC 16 1314, September 2016) and pertinent environmental information for the site is provided in Table 2-1 below.

Summary of Environmental Setting		
Geology	Superficial	None recorded.
	Bedrock	Eastern area of site: Marlstone Rock Formation (Ferruginous Limestone and Ironstone Western area of site: Whitby Mudstone Formation (Mudstone), Toarcian.
	BGS Boreholes	BH Ref: SP43NW54, 135m NE: Marlstone Rock Beds, loose brown rubbly sandstone to 5.75m, Middle Lias – Silts and clays, mudstone, Grey silty Clay to 9m. Water struck at 6.5m.
Hydrogeology	Superficial	Not applicable.
	Bedrock	Eastern area of site: Secondary A Western area of site: Unproductive
Hydrology	All adjacent and internal surface water	A watercourse flows adjacent to the western boundary of the site towards the former railway line. Bloxham Brook flows in a westerly direction, approximately 40m to the north of the site boundary. There is a partially culverted watercourse that enters the site from the east and runs along the boundary between the recreation ground and the site before turning north to cross the railway line.
Site History		Agricultural land, pre-dating 1881.

Table 2-1: Environmental setting

2.4 Site Reconnaissance

A site visit was undertaken in September 2016 and photographs are provided in Appendix B.

The site generally slopes to the northeast and northwest either side of a ridge. It is bordered by a residential area, the recreation ground, the disused railway to the north; and agricultural fields to the south, west and east. South Newington Road runs alongside the eastern boundary.

There is a partially culverted watercourse at the north eastern boundary, which is partially within the boundary and partially within the recreation ground. This was diverted around the boundary of the recreation ground and along the former railway line boundary in the past. This is then culverted beneath the railway within a 300mm diameter pipe along Hyde Grove and discharges into – Bloxham Brook – to the north of the site.

There is a land drain entering the site from the south in a shallow 300mm diameter pipe which discharges into a shallow ditch that flows to the north before connecting to the watercourse that flows adjacent to the recreation ground.

There is a watercourse flowing along the western boundary that falls towards the former railway line embankment. It is culverted beneath the railway and flows north to Bloxham Brook.

The ground is comprised of slightly clayey, slightly silty sand. There are potential outfalls into the surrounding watercourses and sewers within the adjacent residential area.

2.5 Site and Access Levels

A topographic survey of the site has been undertaken to OS GPS datum, and information is included on the drawings in Appendix A. The highest point is approximately 116.3m AOD on a ridge towards the western half of the site. The site generally falls to the northern boundary, with a fall of approximately 5m to the northeast (111.3m AOD), and 3m to the northwest (113.3m AOD).

The final site levels and ground floor levels of dwellings have not yet been determined. The proposed access would join South Newington Road at around 114.2m AOD.

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3 CONSULTATIONS

Information from consultees (Environment Agency (EA), Oxfordshire County Council, Thames Water) is summarised in Table 3-1 below.

Relevant correspondence / information is provided in Appendices C (EA) and D (others).

Source	Details	
Environment Agency	The majority of the site is in Flood Zone 1: Very Low risk, with annual probability of flooding from rivers and the sea of less than 0.1% for the majority of the site, with a small area at the northeast in Flood Zone 3: Medium risk of flooding with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.	
	Modelled Levels for Bloxham Brook	No modelled information is available for Bloxham Brook.
	Records of Flooding	No previous records of flooding in the area.
	Records of Flood Warning Service	The northeast corner of the site is within a flood warning area.
	Surface Water Flooding	Very low risk of surface water flooding across the majority of the site. There are two areas of higher risk, the first is adjacent to the western boundary where a high risk is associated with the watercourse that is to the west of the boundary. The other is associated with the culverted watercourse in the northeast corner where the land is lower and is partially dammed by the railway embankment.
	Flooding from reservoirs	No risk from reservoirs.
	Groundwater Source Protection Zone	Not within Source Protection Zone.
Oxfordshire Council	Possible or known incidents of highway flooding	Unaware of any current flooding problems associated with South Newington Road.
Thames Water	Likely conditions for connecting into their sewerage system	They would request conditions for a separate system with only foul draining to foul / combined sewers and surface water draining to soakaway/SuDS, watercourse or surface water sewer.
	Sewer map	Combined sewer (300mm diameter) running parallel to the site's boundary along Colesbourne Road, Brookside Way and the adjacent disused railway. A surface water culvert runs along Hyde Grove and Colesbourne Road before discharging into the Water course north of the site, adjacent to Brookside Way.
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA[3]	The site has no history of flooding from any source.
	Level 2 SFRA[4]	The site has no history of flooding from any source.
Preliminary Flood Risk Assessment (PFRA)[5]	The Preliminary Flood Risk Assessment (PFRA)[3] for the area indicates that there is a history of flooding within Bloxham in July 2007, although there are no records within the immediate vicinity of the site. The risk of groundwater flooding is recorded at less than 25%. Bloxham is recorded as a surface water hotspot.	

Table 3-1: Summary of available information

[3] Strategic Flood Risk Assessment Level 1: Cherwell District Council and West Oxfordshire District Council; 2009, Scott Wilson.
[4] Strategic Flood Risk Assessment Level 2: Cherwell District Council; 2012, URS.
[5] Preliminary Flood Risk Assessment: Oxfordshire County Council; 2011, JBA Consulting

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4 ASSESSMENT OF FLOOD RISK

4.1 Flood Zones

The detailed flood map provided by the EA indicates that the site is in Flood Zones 1, 2 & 3 (see Appendix C).

A direct comparison was made between the provided EA flood level extents at this location and the topographical levels.

The EA did not provide any modelled levels for the stretch of the Bloxham Brook closest to the site. Therefore the level data was extracted by comparison with the flood map extents and the available topographical data provided for this site to provide the 100-year and 1000-year plus climate change levels.

Comparison of the flood map and the topographical survey indicates that the 1% (100-year) flood level would be coincident with the 112.0m AOD contour.

The extents of the 0.1% (1000-year) flood level on the map would be coincident with the 112.5m AOD contour.

4.2 Sources of flooding

The risk of flooding from the following flood sources has been considered:

Fluvial – The EA has confirmed that part of the study area is within Flood Zones 2 and 3 and has a Low to Medium risk in this area. However, the majority of the site is in Flood Zone 1 Very Low Risk. The EA has confirmed that there are no records of flooding in the vicinity. Therefore, the flood risk associated with this source is considered Low.

Tidal – The study area is remote from the sea and tidally influenced water bodies; therefore, the flood risk associated with this source is considered Negligible.

Pluvial (Rainfall) – The surface water flood risk maps show a significant area within the north of the site that has the potential to flood during prolonged heavy rainfall. This area is associated with the disused railway embankment at the northern boundary. This area needs consideration within the detailed design or there is the potential to have areas of standing water in gardens and landscaped areas not positively drained if overland flow routes are not considered. No areas of shallow standing water were observed during the site visit. The risk to property and life will be Low, but there is the potential to have areas of standing water in gardens and landscaped areas not positively drained if overland flow routes are not considered. Therefore, the risk of flooding from surface water flooding should be considered further during the detailed design.

Surface Water (Overland flow) – There is no impermeable area at a level above the site within the immediate vicinity. If there was a drainage failure causing overland flow it would flow towards the northern boundary. There have been anecdotal records of flooding adjacent to the railway embankment within the adjacent recreation ground There are two separate land drains flowing through the site that may overtop if their onwards route is blocked allowing water to collect in the northeast corner of the site. The flood risk from this source is considered Low.

Groundwater – The BGS has groundwater records for the study area in the form of borehole records. The records show the water table is recorded at 6.5m below the surface. There are no potential sources of Artesian Pressure to force the water to spring in the area. The risk is recorded at less than 25% on the flood susceptibility mapping. The clay based soils make it unlikely for groundwater flooding to occur. No evidence of shallow groundwater was observed during the walkover. Therefore, the flood risk associated with this source is considered Very Low.

Sewers – Thames Water sewer records show 300mm diameter combined sewers adjacent to the site, within Colesbourne Road, Brookside Way and within the adjacent disused railway bed. Surface water drains run along Hyde Grove, Colesbourne Road and Cherrys Close, and discharge into the watercourse adjacent to Brookside Way. The ground falls away to the north from the railway. The Drainage and Water Enquiry states that there are no records of sewer flooding at the site location. Therefore, the flood risk associated with this source is considered Very Low.

Artificial sources – According to the EA online maps, the study area is not at risk from reservoir flooding. The flood risk associated with artificial sources is therefore considered Very Low.

4.3 Summary of Flood Risk

Source of Flooding	Risk assessment Level
Fluvial	Low
Tidal	Negligible
Pluvial (Rainfall)	Low
Surface Water	Low
Groundwater	Very Low
Sewers	Very Low
Artificial Sources	Very Low

Table 4-1 Summary of Existing Risk Level

The site is located within Flood Zones 1, 2 and 3, and a low risk of flooding from all sources has been identified for the site. LKC consider that a strategy for surface water management will be required at the site to mitigate the risk. The assessments of a range of measures that are feasible for the site are outlined in Section 5.

5 SURFACE WATER MANAGEMENT

The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface run-off from development sites through the use of Sustainable Drainage Systems (SuDS), this being complementary to the control of development within the floodplain.

SuDS will not alleviate flooding in an area prone to flooding; however, properly designed SuDS have the potential to prevent the surface water runoff from new development worsening the flood risk. The effective disposal of surface water from development is a material planning consideration in determining proposals for the development and use of land.

The accepted principles are that surface water arising from a developed area should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

The Building Regulations Requirement H3[6] stipulates that rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following, listed in order of priority:

a) an adequate soakaway or other adequate infiltration system,
b) a watercourse or, where that is not practicable,
c) a sewer.

The concept of a sustainable drainage system has been incorporated into the outline drainage strategy for the study area in order to comply with the Flood and Water Management Act 2010[7].

5.1 Infiltration

The Groundwater Source Protection Zone mapping from the EA website shows that the site is not within any identified protection zones.

A summary of British Geological Society superficial soils and bedrock aquifer classification supplemented by local records is summarised in Table 5-1 below:

Classification	Description	Aquifer Description	Recorded Water Table Depth	Soakaway Potential
None recorded	Brown clayey sand with weathered sand stone.	N/A	6.5m	Limited
Western site: Whitby Mudstone Formation	Mudstone	Secondary A	N/A	Poor
Eastern site: Marlstone Rock Formation	Limestone and Ironstone	Secondary A	N/A	Poor

Table 5-1 – Geological and Hydrogeological Setting

[6] UK Government – Building Regulations (2010)
[7] UK Government – Flood and Water Management Act (2010)

Infiltration methods such as soakaways are unlikely to be feasible, but this may be investigated further at the detailed design stage if required.

There is a slope over the site and surrounding area which indicates that groundwater in the vicinity of the site would drain towards the north.

There is a partially culverted watercourse running adjacent to the site that currently collects the surface water. This is culverted under the former railway embankment. The culvert then flows north from the site below Hyde Grove, before discharging into Bloxham Brook.

There are surface water pipes within the roads to the north of the former railway. These are not classified as adopted by Thames Water and are shown as gully connections to the 300mm diameter the culverted watercourse. There are also the 300mm diameter combined sewers within the adjacent disused railway and housing development.

5.2 Surface Water Drainage Strategy

The drainage options relating to the final discharge of surface water for this section of the site are listed in Table 5-2 in order of priority within the NPPF:

Option No:	Drainage Solution	Most feasible solution	Comments
a	Soakaway/Infiltration	3	Low permeability – due to the clays and weathered mudstones.
b	Connection to Watercourse.	1	There is a culverted watercourse that flows north from the site there are also open sections of the watercourse where it passes through the site.
c	Discharge into a sewer.	2	The depth of the sewers to the north of the former railway, indicate that a connection is possible – subject to approval from Thames Water.

Table 5-2: Drainage options for land

Table 5-3 provides a summary of the SuDS options appraisal with consideration of CIRIA C697 (The SUDS Manual)[8] for the development:

SuDS Option	Appropriate to Development	Comments
Soakaways	X	Due to the nature of the ground conditions, the use of infiltration systems is unlikely be feasible.
Infiltration basin	X	Depressions that store and dispose of water via infiltration. May not be appropriate given the ground conditions.
Sand filter	X	Treatment devices using sand beds as filter media.
Filter strip	*	Engineered filters that use vegetation to remove and treat runoff. The filter strip is sloped to allow sheet flow across the vegetated strip. A filter strip offers no storage and is used solely to remove pollutants from surface water.
Filter drains	*	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.
Detention basin	✓	Dry depressions designed to hold water for a specific retention time.
Swales	✓	Swales are shallow grass-lined channels that provide capacity for conveying flows at a controlled rate into ponds and watercourses.
Rain water harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use. When required, the water is pumped to the point of use, thus displacing what would otherwise be a demand for mains-water. In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks. Rainwater harvesting systems are currently not included in the development proposals.
Green roofs	*	Green roof installations can help to reduce surface water runoff from roof areas depending on the system specified. Green roofs are not currently included in the development proposals.
Geo-cellular storage systems	✓	Modular block systems can be used to provide an underground storage facility. Any geo-cellular storage systems should be lined with a geo-membrane to provide attenuation storage.
Permeable Pavements – with granular and geo-cellular storage systems	✓	Permeable pavements allow inflow of rainwater into underlying construction. Any geo-cellular storage systems would have to be lined with an impermeable membrane to provide storage rather than infiltration for runoff from highways.
Ponds	✓	Attenuation ponds can be used to offset the increase in surface water flows attributable to increased area of hard standing, in order to minimise the risk of flooding to and from the proposed development. Ponds will attenuate the surface water flow prior to discharging to the public surface water sewers. The storage volume afforded by these features should not include any permanent water in the pond.
Oversized Pipes	✓	Oversizing the pipes that make up the on-site drainage network is a cost effective method for providing attenuation storage within the network. Such systems could be considered on the parts of the development where gradients are relatively flat.
Tanks	✓	Prefabricated underground tanks could be considered at the detailed design stage in order to provide storage to attenuate surface water runoff.
Flow control devices	✓	The peak flow rates will be controlled by flow control devices e.g. hydrobrake style flow control systems, and restricted orifices. Flow control devices enable the discharge to be restricted to a constant rate from the development.

Table 5-3: Summary of the SuDS options appraisal.

Notes

✓ Suitable for use given the nature and scale of the development

* Possibly suitable for use – not included in the client and architect design proposal at present

X Not suitable

[8] CIRIA C697 - The SUDS Manual. London 2015

5.3 Surface Water Attenuation Requirements

From correspondence with the EA that the flow should be limited to a 'greenfield scenario' for estimating the attenuation volumes required. It is estimated from the supplied plan (see Appendix A) that the site will have the following designated areas (Table 5-4).

Designated Areas	Plot Area
Total area (ha)	6.00
Catchment Area (ha)	3.96
Development Area (ha)	2.75
Impermeable Split (ha)	1.51
Permeable Split (ha)	1.24
Catchment Greenspace (ha)	1.21

Table 5-4: Assumed plot areas

Table 5-4 shows the assumed split in area included within the calculations.

5.3.1 Attenuation Estimate

Surface water storage and Greenfield Runoff estimations based on the HR Wallingford procedure (IH 124[9]) and the ADAS 345 method[10] have been undertaken for the development and the output report is presented in Appendix 'E'.

The methods of calculation use different variables and parameters to estimate Q_{bar}. The IH124 method which is commonly used for these calculations does not take into account the slope of the site or vegetation coverage. It can often underestimate the value for Greenfield runoff, if these are particularly relevant to the plot. The ADAS method was used for many years as the basis for the Greenfield runoff calculations, and was tested mostly for calculating flows from sloping sites; but it had a lower database of test sites.

For the contributing catchment of 3.96ha an estimate has been produced assuming a developable area of 2.75ha. Assuming conservatively that 55% of the developed area comprises roofs and hard surfacing with an allowance for urban creep, the resulting impermeable area would be 1.51ha. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford IH 124 method:

- Q_{bar}: **13.70 l/s**
- 1 in 1 year greenfield runoff rate: **11.64 l/s**
- 1 in 30 year greenfield runoff rate: **30.55 l/s**
- 1 in 100 year greenfield runoff rate: **43.15 l/s**

Alternatively, the ADAS 345 Report provides increased estimations from the IH 124 method below:

- Q_{bar}: **19.60 l/s**
- 1 in 1 year greenfield runoff rate: **15.85 l/s**
- 1 in 30 year greenfield runoff rate: **34.02 l/s**
- 1 in 100 year greenfield runoff rate: **44.02 l/s**

All Greenfield runoff estimates and subsequent storage estimates are included in Appendix E.

[9] IH124 Flood Estimation of Small Catchments
[10] The Agriculture and Development Advisory Service report 345

The following attenuation has been estimated for the development using greenfield runoff rates and utilises the FSR methodology[11] as:

- Attenuation storage volume: **375.0 m^3** (1 in 30 year event)
- Retention on site volume: **617.2 m^3** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **761.5 m^3** (1 in 100 year + 40% Climate Change)

The following attenuation has been estimated for the development using ADAS 345 Greenfield runoff rates and utilises the FSR methodology as:

- Attenuation storage volume: **359.5 m^3** (1 in 30 year event)
- Retention on site volume: **612.7 m^3** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **756.1 m^3** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the corresponding greenfield runoff for a range of annual flow rate probabilities before discharge to watercourse. As the flow from the development would be restricted to the greenfield equivalent there should be little change in the flows that enter the unnamed watercourse and thus the risk of flooding and the level of erosion created as a result from the development should be negligible.

The attenuation required for a 1 in 30 year storm event, requires a storage volume of between **359.5 m^3** and **375.0 m^3** and for the 1 in 100 year event, a storage capacity of between **612.7 m^3** and **761.5 m^3** will be required from on-site storage as well as SuDS systems. All volumes can be stored within the site boundary and discharges will be limited by flow control devices to the on-site culverted watercourse.

The use of permeable paving may be viable dependant on the detailed design of the proposed development. If this drainage technique is considered to be feasible then it will reduce the requirement for attenuation as it will reduce the contributing area.

Assuming that the outline drainage strategy is acceptable to the Local Authority, a more detailed design can be presented and agreed with the appropriate regulatory bodies during the detailed design phase.

A preliminary drainage strategy (shown in Appendix F) has been developed based on an indicative development plan.

5.4 Foul Drainage

The potential foul drainage strategy is considered elsewhere.

[11] Flood Studies Report Wallingford NERC 1975

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6 MITIGATION MEASURES

6.1 Proposed Site levels and Development Level

Current Environment Agency guidance recommends that the minimum ground floor levels of residential developments are set at a minimum of 600mm above the 1% annual probability (1 in 100 year) flood level including an additional fluvial allowance for climate change. It is generally accepted that vehicle parking can be accommodated within the flood zone with suitable safeguards. The 'design' flood level for the site should therefore be the 1% annual probability event with allowance for climate change plus an allowance for freeboard.

On the basis of the information provided, the 1 in 100 year flood level has been estimated as 112.0m AOD. Normal Environment Agency recommendation is to set ground floor level for the development at a minimum of 600mm above the 'design' level, or 112.0m AOD plus an allowance for climate change. As the modelling information is not available to predict the climate change increase the assessment utilised the estimated 1 in 1000 year flood level of 112.5m AOD as the design level. Thus, the recommended minimum finished floor level should be taken as the 1 in 1000 year flood level plus 600mm; this is 113.1m AOD. The lowest levels on site have an approximate level of 111.2m AOD which is below this level but the area to be utilised for housing is outside of the area designated as Flood Zones 2 & 3.

6.2 Safe Access

Safe and dry access is available via South Newington Road (114.2m AOD) to the southeast at 2.2m above the 1% annual probability event (112.0m AOD). Therefore no mitigation is proposed.

6.3 Flood Resistance and Resilience

The development proposed may be subject to flooding at more extreme events than those considered. Flood resilience measures should be included into ground floor construction to aid recovery after any event in the lower areas of the site. If utilised, typical measures would include solid floors, use of suitable materials and services fed from upper floors with outlets at high level. The need can be discussed and agreed with building control officers during detailed design.

6.4 Residual Risks

It is impossible to completely guard against flooding since extreme events greater than the design standard event are always possible. However, ground floor levels should be set above proposed levels across the site and provide a nominal freeboard to allow overland flow under exceptional conditions. Overland flow routes should be considered in case of drainage failure and the extreme events.

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7 CONCLUSIONS

The site is shown on published mapping to be located within the Environment Agency's Flood Zones 1, 2 & 3. Comparison of topographical data with the estimated flood levels indicates that the majority of the site is in Flood Zone 1 – Very Low Risk of flooding. There is a small area at the northeast boundary is within Flood Zones 2 & 3 that will not be used for residential accommodation.

Low risks of flooding from all sources have been identified from information provided by Oxfordshire County Council and Thames Water.

An assessment of these risks in conjunction with the development proposals have resulted in the following recommendations for the safe development of the site:

- The recommended minimum finished floor level is 113.1m. This is 600mm above the 0.1% flood level.
- Above this topographical level, the finished floor level should be set at a nominal height above the finished ground levels to allow for overland flow routes in extreme events and drainage failures.
- Pedestrian and vehicular safe access to and from the site is achievable under all conditions via the access road off South Newington Road.
- Potential for soakaway use for rainwater disposal is low; however this could be investigated further at the detailed design phase if required.
- Surface water flow will probably need to be attenuated to the greenfield runoff rate or a rate agreed with the LLFA.
- Surface water arising from the site could potentially discharge into the culverted watercourse that discharges into Bloxham Brook, adjacent to the northern site boundary.
- A formal evacuation plan is not considered to be required.

Further details on the proposed mitigation measures are provided in Section 6. All proposed measures should be agreed with the Local Authority prior to commencement of the development.

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APPENDIX A

FIGURES, PLANS, AND DRAWINGS

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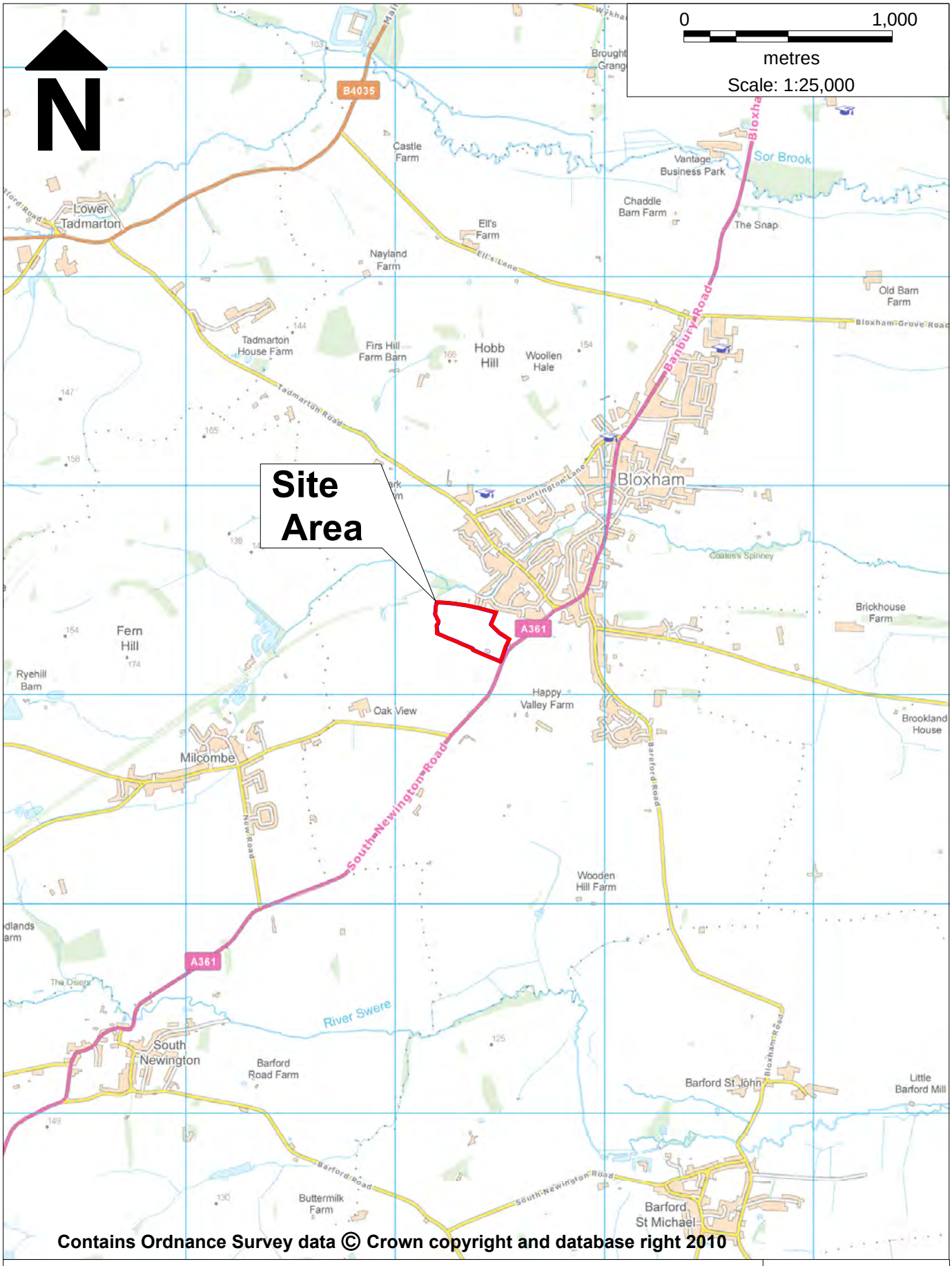
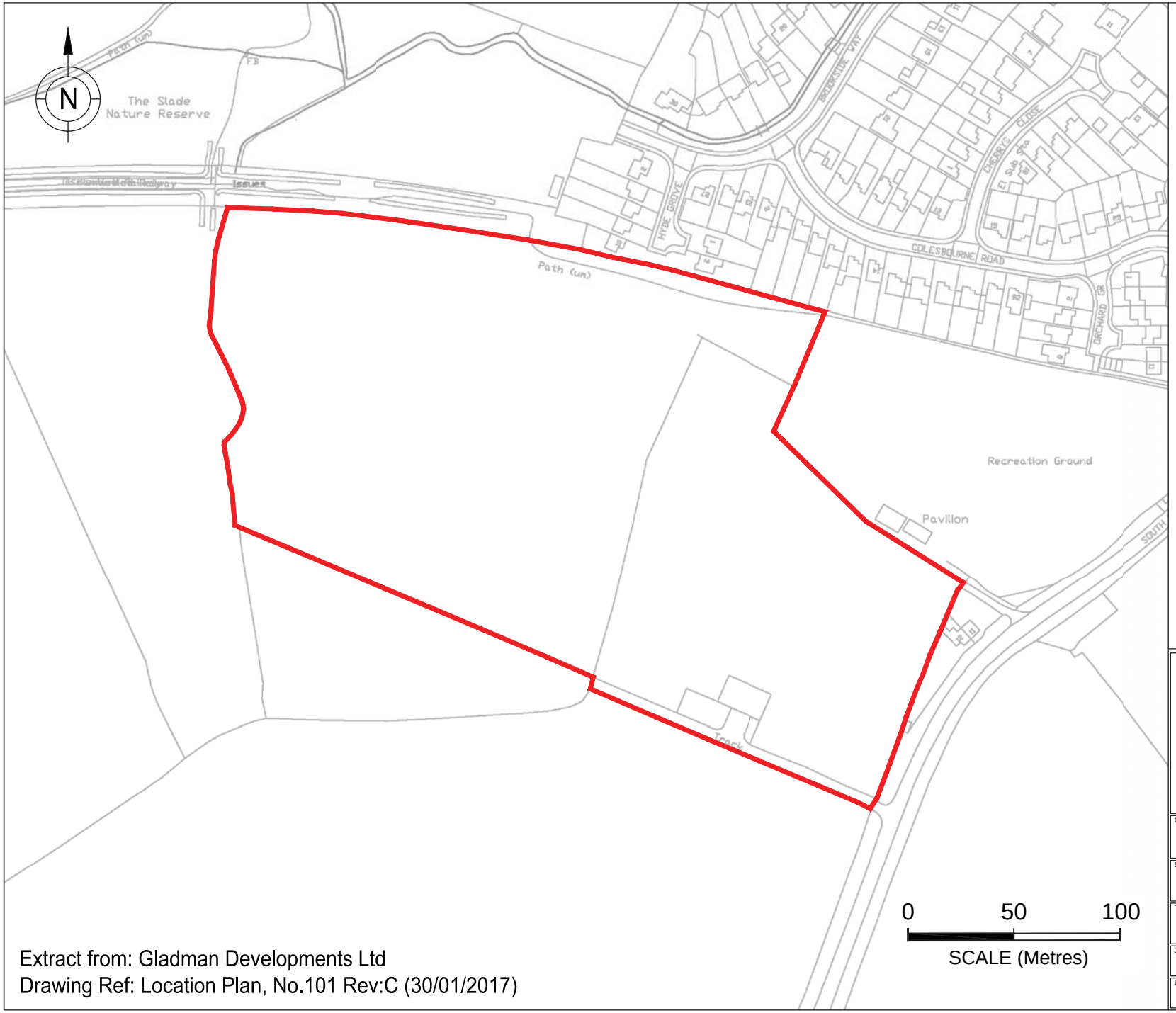


Figure 1: Site Area Location Plan, Land off South Newington Road, Bloxham

Drawn: February 2017 Scale: 1:25,000 @ A4 (see scale bar)

LK CONSULT LIMITED



Extract from: Gladman Developments Ltd
Drawing Ref: Location Plan, No.101 Rev:C (30/01/2017)

KEY

Site Area Boundary

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

LK CONSULT LIMITED

Client: Gladman Developments Ltd

Site: Land off South Newington Road, Bloxham

Title: Site Area Boundary Plan

Job No.:	Scale (See Scale Bar):	Figure:	Revision:
LKC 16 1314	1:2500 @ A4	2	

Drawn By:	Checked By:	Drawn:
AC	PP	Feb 2017

APPENDIX B

SITE INFORMATION

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N

NOTES

THIS SURVEY IS ORIENTATED TO ORDNANCE SURVEY GRID NORTH. THE SURVEY IS TO A PLANE GRID. HORIZONTAL MEASUREMENTS TAKEN FROM THIS SURVEY WILL BE GROUND DISTANCES.

ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM GENERATED BY ACTIVE GPS NETWORK.

LEGEND

- 30.29 SPOT LEVEL
- SURVEY STATION
- SAPLING
- BUSHES/SHRUB
- TREE (INDICATIVE ONLY)
- HEDGE/AREA OF UNDERGROWTH
- 99.90 CONTOUR
- GATE
- OVERHEAD CABLE
- FENCE

ABBREVIATIONS

ArL	ARCH LEVEL	LB	LETTER BOX
AV	AIR VALVE	LP	LAMPOST
B	BOLLARD	MH	MANHOLE
BB	BELISHA BEACON	MKR	MARKER
BH	BOREHOLE	OHC	OVERHEAD CABLE
BL	BED LEVEL	OpL	OPENING LEVEL
BS	BUS STOP	OSBM	OS BENCHMARK
BT	BT COVER	P	POST
C/B	CLOSED BOARD FENCE	P/R	POST AND RAIL FENCE
C/L	CHAIN LINK FENCE	P/W	POST AND WIRE FENCE
CATV	CABLE TELEVISION COVER	PEC	PEDESTRIAN CROSSING
CC	CONTROL CABIN	PM	PARKING METER
COL	COLUMN	RE	RODDING EYE
Conc/p	CONCRETE PANEL FENCE	RWL	RETAINING WALL
CPY	CANOPY	SAP	SAPLING
CrL	CROWN LEVEL	SEC	SECURITY CAMERA
Csty	CABLE STAY	SGY	STRIP GULLY
CTV	CABLE TELEVISION POINT	SoL	SOFFIT LEVEL
CYR	CYCLE RACK	SP	SIGNPOST
DK	DROPPED KERB	SpL	SPRINGING LEVEL
DP	DOWNPIPE	SV	STOP VALVE
EiP	ELECTRIC INLET POINT	T/Pit	TRIAL PIT
EL	ELECTRIC INSPECTION COVER	TCB	TELEPHONE BOX
EP	ELECTRICITY SUPPLY POLE	TE/?	TREE + NUMBER
ER	EARTH ROD	THL	THRESHOLD LEVEL
FH	FIRE HYDRANT	TL	TRAFFIC LIGHT
G	GULLY	ToF	TOP OF FENCE
G/DP	GULLY AND DOWNPIPE	ToW	TOP OF WALL
GP	GATE POST	TP	TELEPHONE POLE
Gpi	GAS PIPE	W/M	WIRE MESH FENCE
GV	GAS VALVE	W/P	WOODEN PANEL FENCE
IC	INSPECTION CHAMBER	WLV	WATER LEVEL
IL	INVERT LEVEL	WM	WATER METER
I/R	IRON RAILING FENCE	WO	WASH OUT
KO	KERB OUTLET		

STATION CO-ORDINATES

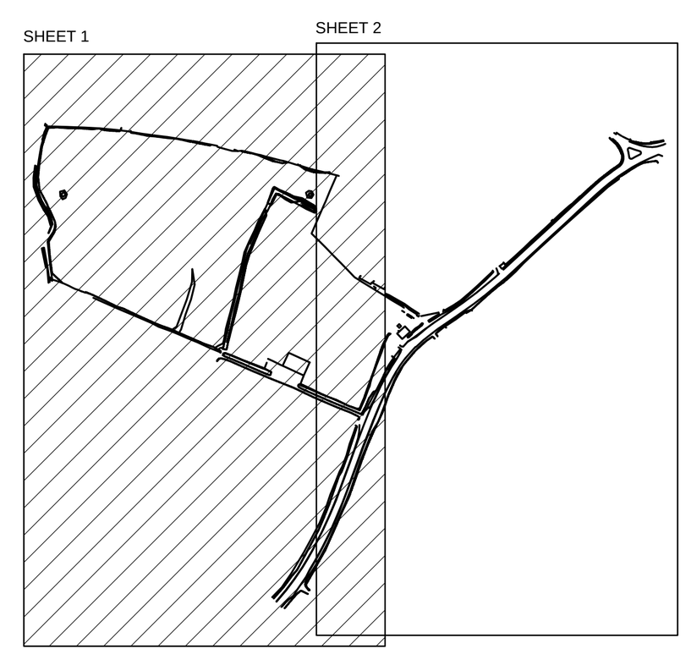
STATION	EASTING	NORTHING	LEVEL	DESCRIPTION
STN/1	442776.61	235413.54	115.56	Survey Nail
STN/2	442706.55	235358.60	117.68	Survey Nail
STN/3	442637.88	235295.59	114.31	Survey Nail
STN/4	442513.26	235165.03	114.17	Survey Nail
STN/9	442570.46	235246.32	113.60	Survey Nail
STN/13	442445.43	234988.02	118.21	Survey Nail

TREE SCHEDULE

No.	DIAM.	SPREAD Ø	HEIGHT
TE/1	0.75	20	21
TE/2	1.50	22	24
TE/3	0.70	12	12
TE/4	0.45	12	12
TE/5	0.30	8	5
TE/6	0.30	8	5
TE/7	0.45	8	8
TE/8	0.45	8	8
TE/9	0.55	10	10
TE/10	0.50	10	12
TE/11	0.50	10	12
TE/12	0.60	12	12
TE/13	0.40	10	10
TE/14	0.40	10	10
TE/15	0.45	10	10
TE/16	0.55	12	12
TE/17	1.20	12	8
TE/18	0.70	6	29
TE/19	0.60	6	29
TE/20	0.60	6	29
TE/21	0.60	6	29
TE/22	0.60	6	29
TE/23	0.60	6	29
TE/24	0.60	12	10
TE/25	0.40	10	10
TE/26	0.20	6	6
TE/27	0.30	8	8
TE/28	0.25	5	5
TE/29	0.45	7	7
TE/30	0.35	8	8
TE/31	0.40	10	8
TE/32	0.30	6	8
TE/33	0.25	4	5
TE/34	0.40	10	10
TE/35	0.90	16	16
TE/36	0.55	8	10
TE/37	1.00	16	16
TE/38	1.30	12	16
TE/39	1.50	18	16
TE/40	1.50	22	16
TE/41	1.50	12	16

TREE DIAMETER MEASURED APPROXIMATELY 1.5M ABOVE GROUND LEVEL. TREE SPREADS ARE SYMBOLIC ONLY AND ARE REPRESENTATIVE OF THE GENERALISED CANOPY SIZE. TREE BOLE MAY NOT SIT CENTRALLY TO THE CANOPY. TREE HEIGHT ESTIMATED FROM GROUND LEVEL.

PLOT LOCATIONS



Rev	Date	Revision notes	By
*	*	*	*
A	08/11/16	ADDITIONAL MANHOLE ADDED	JH

DO NOT SCALE

Status

INFORMATION

Project

BLOXHAM 3, SOUTH NEWINGTON ROAD.

Title

TOPOGRAPHICAL SURVEY AS OF 28.09.16 SHEET 1 OF 2

GLADMAN
Gladman House, Alexandria Way
Congleton Business Park
Congleton, Cheshire
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Tel: 01260 288800
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Drawn By	Publish Date	Scale(s)	Sheet Size
JW	07.10.16	1:500	A0

Project no.	Drawing no.	Revision
2016-104	Topo_01_2D	A

NOTES

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TE/21	0.60	6	29
TE/22	0.60	6	29
TE/23	0.60	6	29
TE/24	0.60	12	10
TE/25	0.40	10	10
TE/26	0.20	6	6
TE/27	0.30	8	8
TE/28	0.25	5	5
TE/29	0.45	7	7
TE/30	0.35	8	8
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TE/32	0.30	6	8
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PLOT LOCATIONS

Rev	Date	Revision notes	By
*	*	*	*
A	08/11/16	ADDITIONAL MANHOLE ADDED	JH

DO NOT SCALE

Status: **INFORMATION**

Project: **BLOXHAM 3, SOUTH NEWINGTON ROAD.**

Title: **TOPOGRAPHICAL SURVEY AS OF 28.09.16 SHEET 2 OF 2**

GLADMAN
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Drawn By	Publish Date	Scale(s)	Sheet Size
JW	07.10.16	1:500	A0

Project no.	Drawing no.	Revision
2016-104	Topo_02_2D	A

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Flandrian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	CNL	Chipping Norton Limestone Formation	Limestone, Ooidal	Bathonian - Bathonian
	NS	Northampton Sand Formation	Sandstone, Limestone and Ironstone	Aalenian - Aalenian
	WHM	Whitby Mudstone Formation	Mudstone	Toarcian - Toarcian
	MRB	Marlstone Rock Formation	Ferruginous Limestone and Ironstone	Toarcian - Pliensbachian
	DYS	Dyrham Formation	Siltstone and Mudstone, Interbedded	Pliensbachian - Pliensbachian
	CHAM	Charmouth Mudstone Formation	Mudstone	Pliensbachian - Sinemurian
		Faults		

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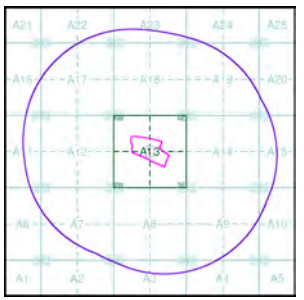
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**218**
Map Name:	**Chipping Norton**
Map Date:	**1968**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Not Supplied**
Landslip:	**Available**
Rock Segments:	**Not Supplied**

Geology 1:50,000 Maps - Slice A



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Order Number:	112367251_1_1
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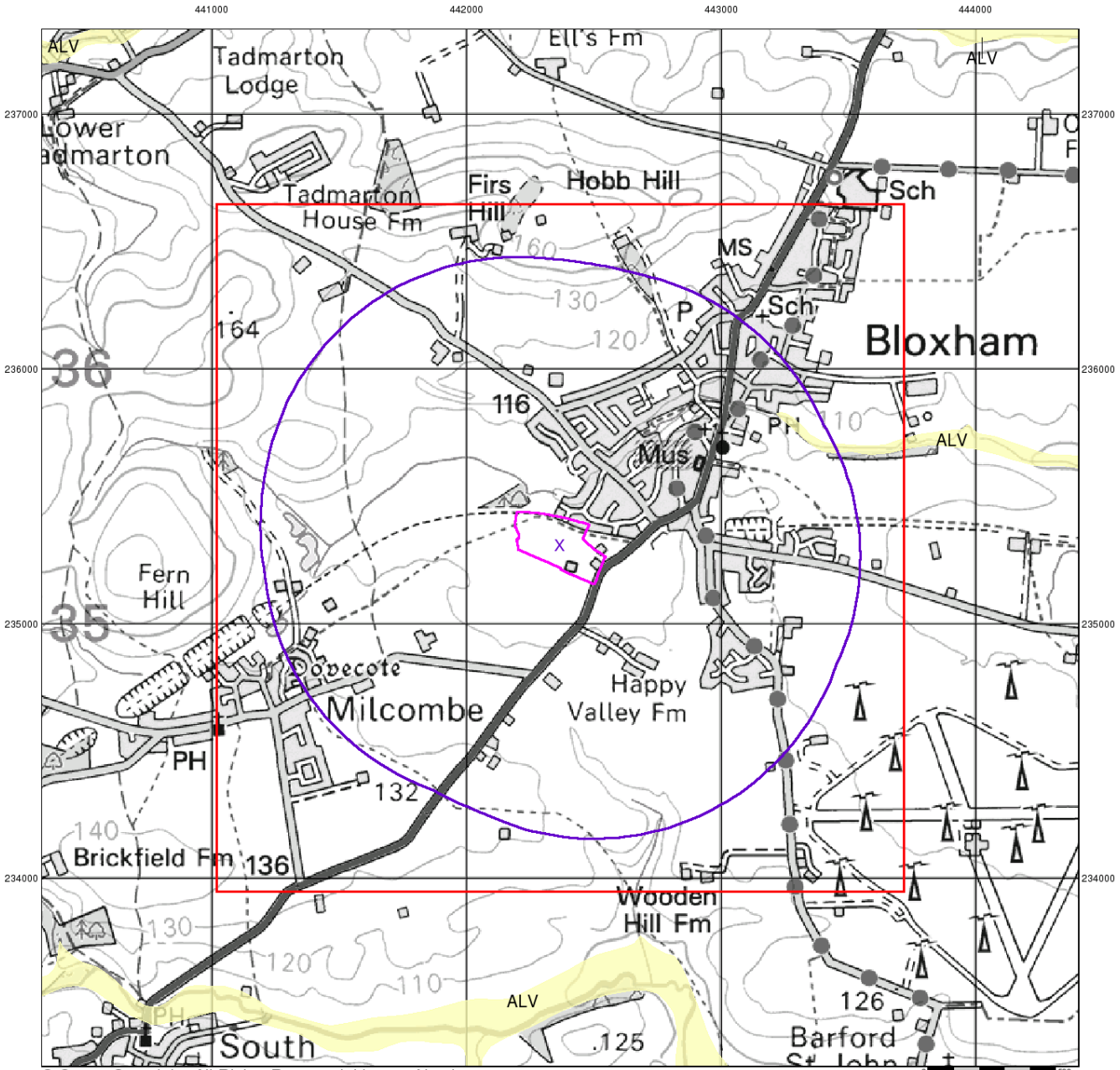
National Grid Reference:	442370, 235310
Slice:	A
Site Area (Ha):	5.92
Search Buffer (m):	1000

Site Details:

Site at 442387,235301



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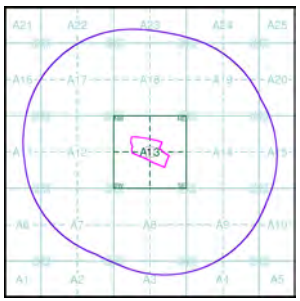
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details:

Order Number:	112367251_1_1
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Slice:	A
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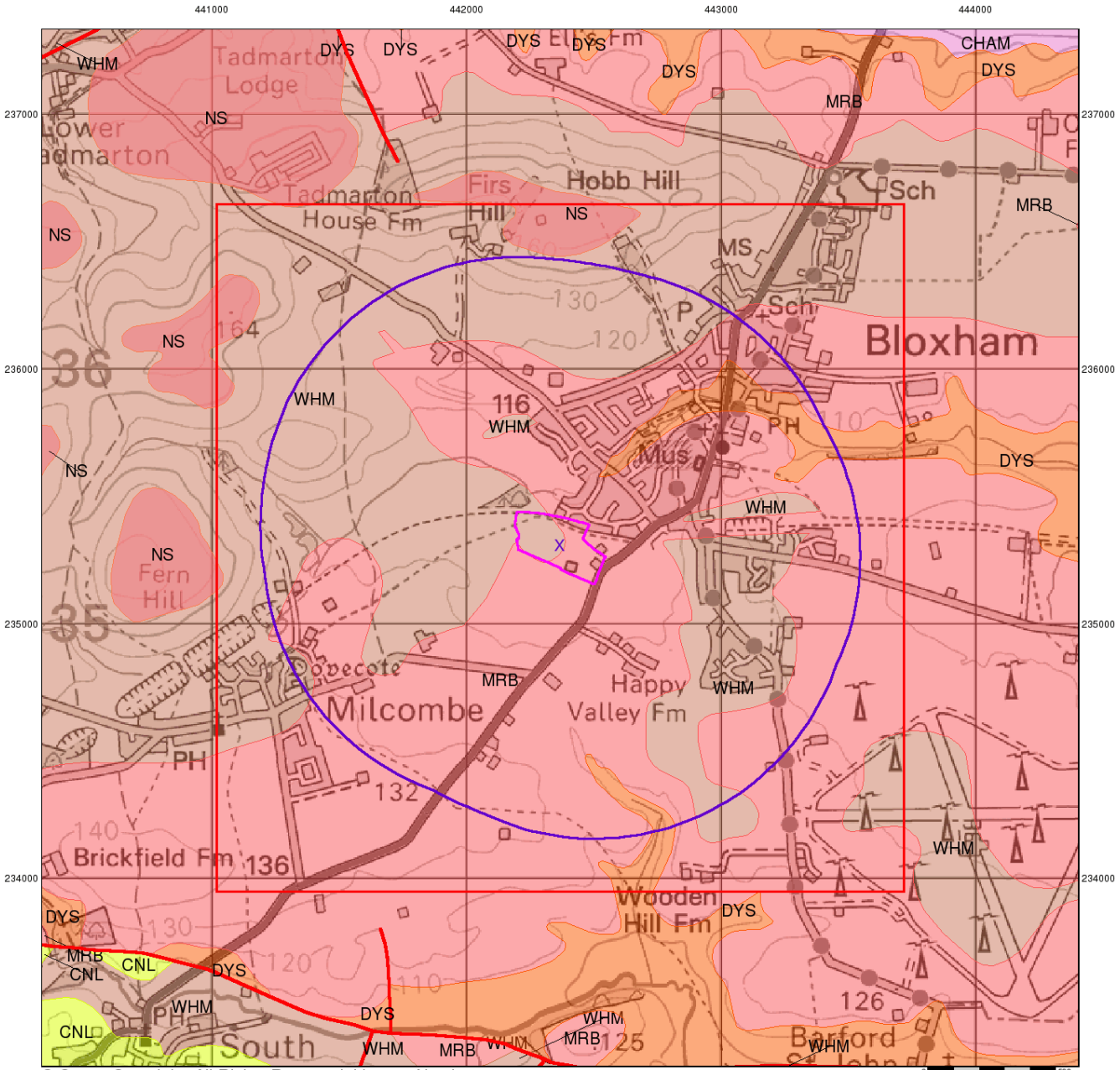
Site Details:

Site at 442387,235301

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Bedrock and Faults

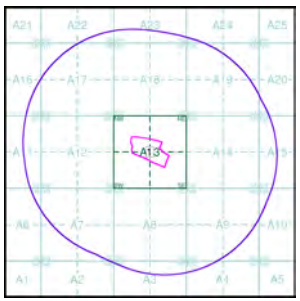
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



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Order Number:	112367251_1_1
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Site Details:

Site at 442387,235301

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

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BOREHOLE No. Seven

Location Cherry's Close,Bloxham,Oxon. Date 30.05.1980

STRATA DESCRIPTION	Strata Change: Legend	Strata Change: Depth m	Strata Change: Reduced Level m	Samples: No.	Samples: Depth m	Samples: Type	Water Level	Depth of Casing
Marlstone Rock Beds loose brown rubbly sandstone - very loose - brown clayey sand - becoming moist - loose rubbly - becoming medium hard - becoming hard		3.00 5.75						
MIDDLE LIAS - SILTS AND CLAYS Mudstone Grey silty CLAY - clayey SILT - grey silty CLAY		6.50 9.00					▼	

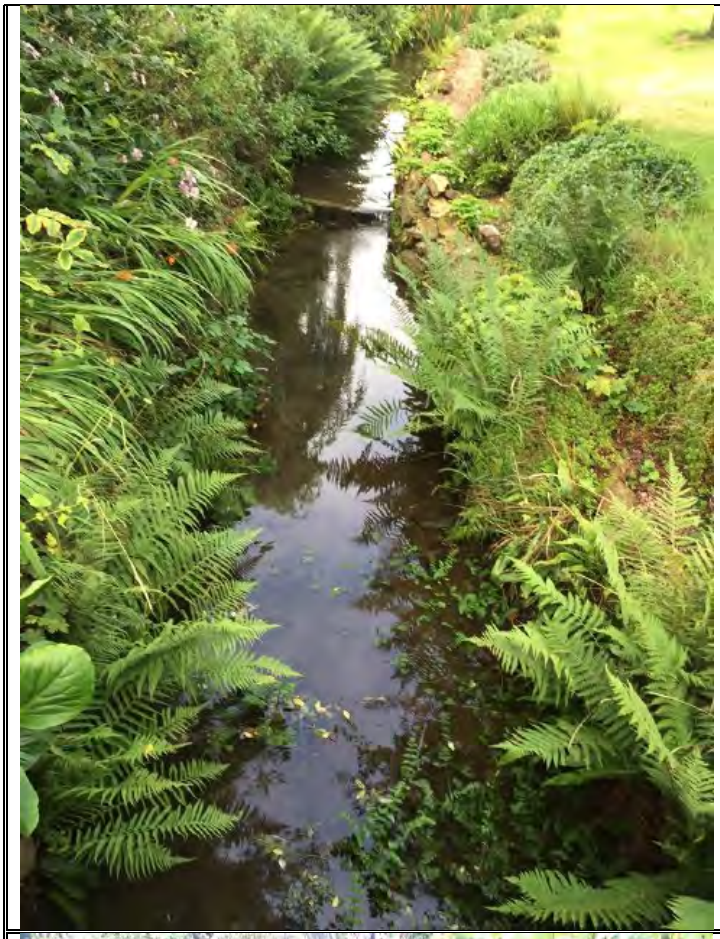
Borehole Diameter : 75mm.
Ground Level O.D. : 385.19
Rig : Rotary Auger
Scale of Legend : 2.0cm. to 1.0m.
Weather : Warm
Remarks : Borehole drilled from existing ground level.

B - Bulk Sample
D - Disturbed Sample
U - Undisturbed Sample
S - Standard Penetration Test
W - Water Sample

Report No. S.275 | BOREHOLE LOG | Date June 1980

TYRONE

	**Photograph 1 (facing S):** Hyde Grove showing culverted drainage passing through housing area.
	**Photograph 2 (facing W):** Bloxham Brook crossing beneath road.

		**Photograph 3 (facing E):** Bloxham Brook.
		**Photograph 4 (facing S):** Outfall from culverted watercourse to Bloxham Brook.

		**Photograph 5 (facing SW):** Highway Drainage on South Newington Road.
		**Photograph 6 (facing W):** Culverted watercourse entering Recreation Ground.

		**Photograph 7 (facing E):** Culverted watercourse opening out on the boundary between the recreation ground and the site.
		**Photograph 8 (facing W):** Watercourse entering culvert behind changing rooms.

		**Photograph 9 (facing NW):** View towards western boundary from the northern boundary.
		**Photograph 10 (facing N):** Culvert exiting recreation ground area.

	**Photograph 11 (facing NW):** Culvert headwall where culvert turns northwards towards the railway.
	**Photograph 12 (facing E):** Northeast corner of the site shown as Flood Zone 3.

	**Photograph 13 (facing E):** Northern boundary adjacent to former railway line.
	**Photograph 14 (facing W):** Northern boundary adjacent to former railway line.

	**Photograph 15 (facing S):** Clay type soils encountered by hand augering.
	**Photograph 16 (facing N):** Watercourse on the western boundary.

	**Photograph 17 (facing E):** View from western boundary towards east showing ridge within the site.
	**Photograph 18 (facing N):** Southwest corner towards northern boundary.

		**Photograph 19 (facing E):** View from the southern boundary towards the east.
		**Photograph 20 (facing SW):** Land drain pipe entering the site on the southern boundary. Flowing towards the central ditch..

	**Photograph 21 (facing NE):** View towards current access adjacent to the Recreation Ground.
	**Photograph 15 (facing E):** View towards central field boundary.

APPENDIX C

ENVIRONMENT AGENCY DATA

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Mark Jones

From: WT Enquiries <WTenquiries@environment-agency.gov.uk>
Sent: 10 October 2016 14:04
To: Matthew Craig
Subject: RE: Ref: THM25442 Flood Risk Assessment - South Newington Road, Bloxham
Attachments: Flood Map.pdf; Surface Water Map.pdf

Dear Matthew

Thank you for your request for modelled flood levels.

The Bloxham Brook is classed as a main river but we have not carried out flood level modelling of this Brook. We have no plans to model the river in the near future. There are no Environment Agency flood defence schemes or structural defences on the river. We hold no records of previous flooding in the area. I have attached a flood zone map for your information.

I have also attached a surface water map although the Lead Local Flood Authority, Oxfordshire County Council, will hold more information on surface water, ground water flooding and drainage.
You may be interested in the following guidance / information publically available:

- **'Planning Practice Guidance'** - provides information about planning considerations in areas at risk of flooding. http://planningguidance.planningportal.gov.uk/
- **'Planning applications: assessing flood risk'** - information about completing Flood Risk Assessments. https://www.gov.uk/planning-applications-assessing-flood-risk
- **'Site specific flood risk assessment: Checklist'** – a checklist to help ensure you have considered all the relevant factors in your flood risk assessment. http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/site-specific-flood-risk-assessment-checklist/

We recommend that you discuss your proposals with the Local Planning Authority at the earliest opportunity. They will be able to advise you on a wide range of planning matters in addition to flood risk.

I hope that we have correctly interpreted your request. Please refer to our Open Government Licence to see how you may use the supplied data: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Did you know that many of our datasets are available online? Simply visit environment.data.gov.uk

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

We are committed to providing a professional customer service. Please help us understand more about what is important to you by completing on line survey:
http://www.smartsurvey.co.uk/s/EnvironmentAgencyCustomerSurvey/?a=WT

Please get in touch if you have any further queries or contact us within two months if you would like us to review the information we have sent.

Kind regards

Julia Hewitt
Customers and Engagement Officer

Customers and Engagement
Environment Planning and Engagement
Environment Agency
Thames Area
Red Kite House, Howbery Park, Wallingford, OX10 8BD

Telephone: 020302 59673

You can follow us on Twitter at @EnvAgencySE

From: Matthew Craig [mailto:m.craig@thelkgroup.com]
Sent: 29 September 2016 16:29
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: Ref 161006/JC06 Flood Risk Assessment - South Newington Road, Bloxham

Dear Sir/Madam

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), of a site located off South Newington Road, Bloxham, Oxfordshire**.** Nearest Postcode OX15 4HJ.

Centred at approximate National Grid Reference 442500E, 235240N. The area of interest appears to be within Flood Zone 1.

The site plans are attached to this email.

To complete the FRA we would be grateful if you could supply us with the following, if available, for the vicinity of the site:

- The modelled 1% and 0.1% annual probability fluvial flood level, the 1% annual probability plus climate change flood level and any lower order flood levels, in particular the modelled 5% fluvial flood level if relevant for functional floodplain, (with confirmation of the reference datum used for the levels – i.e. Local OSBM or OSGPS) if available.
- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics.
- Proposed defence levels and timescale for implementation.
- Results of any breach analyses for defences in the area which may be relevant.
- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area.
- Any restrictions to infiltration and discharge to the watercourse.
- A copy of your detailed flood zone map and the modelled flood extent plans for the area.

If you have any queries please get in touch with me.

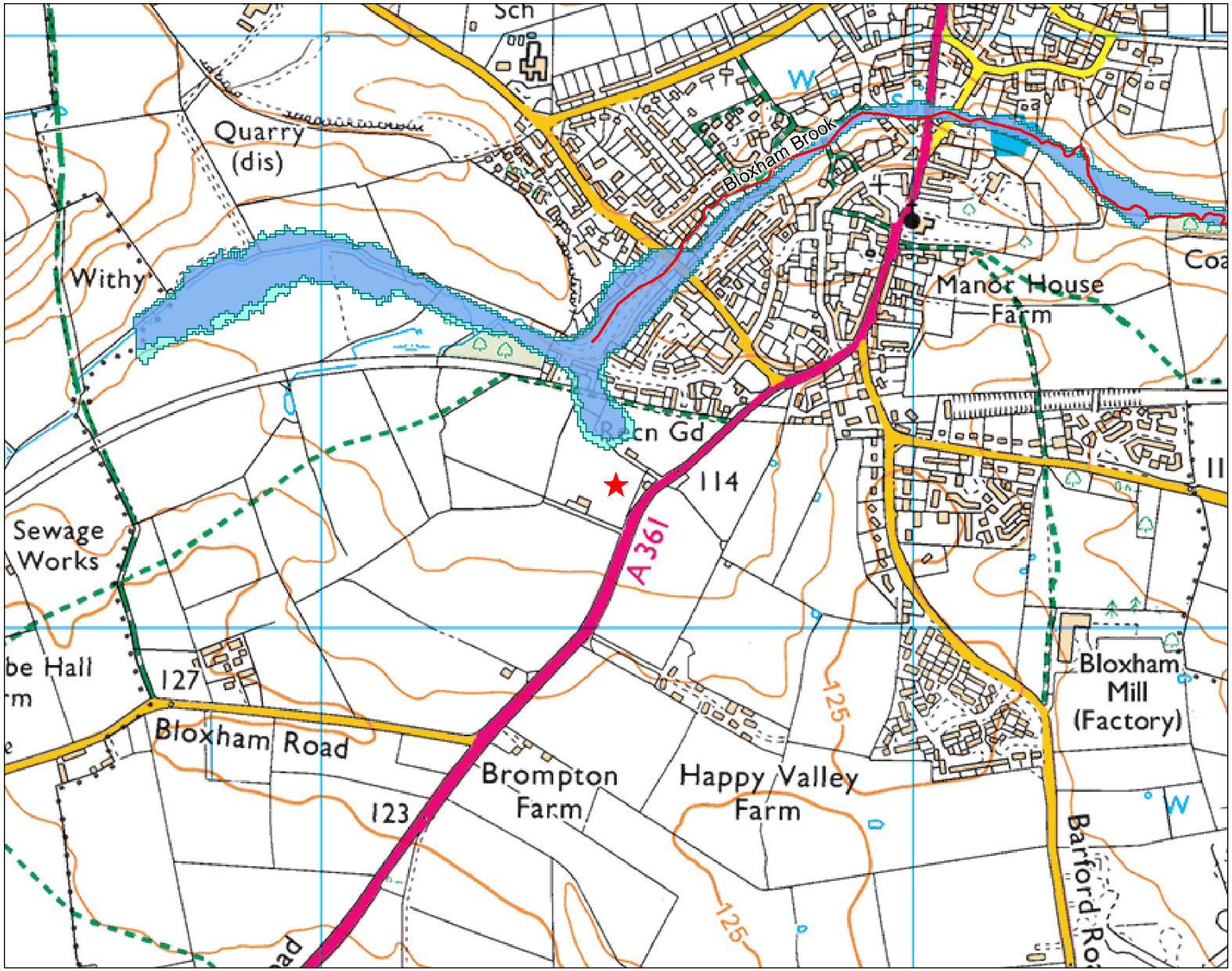
We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available and what the charge will be and we will pay the relevant fees by debit card as soon as possible.

Any advice or recommendations you may have regarding the potential discharges from the development of this site?
With reference to the attached site plans, there appear to be extensive drainage ditches in the vicinity. Do you have any information that may be relevant to the FRA?

Regards

Matthew Craig

Map centred on land south of Bloxham



Environment Agency

Scale 1:10,001

N
W E
S

Flood Map for Planning (Rivers and Sea)

- Sealed Main Rivers
- Flood Map - Defences
- Areas Benefiting from Flood Defences
- Flood Map - Flood Storage Areas
- Flood Map - Flood Zone 3
- Flood Map - Flood Zone 2

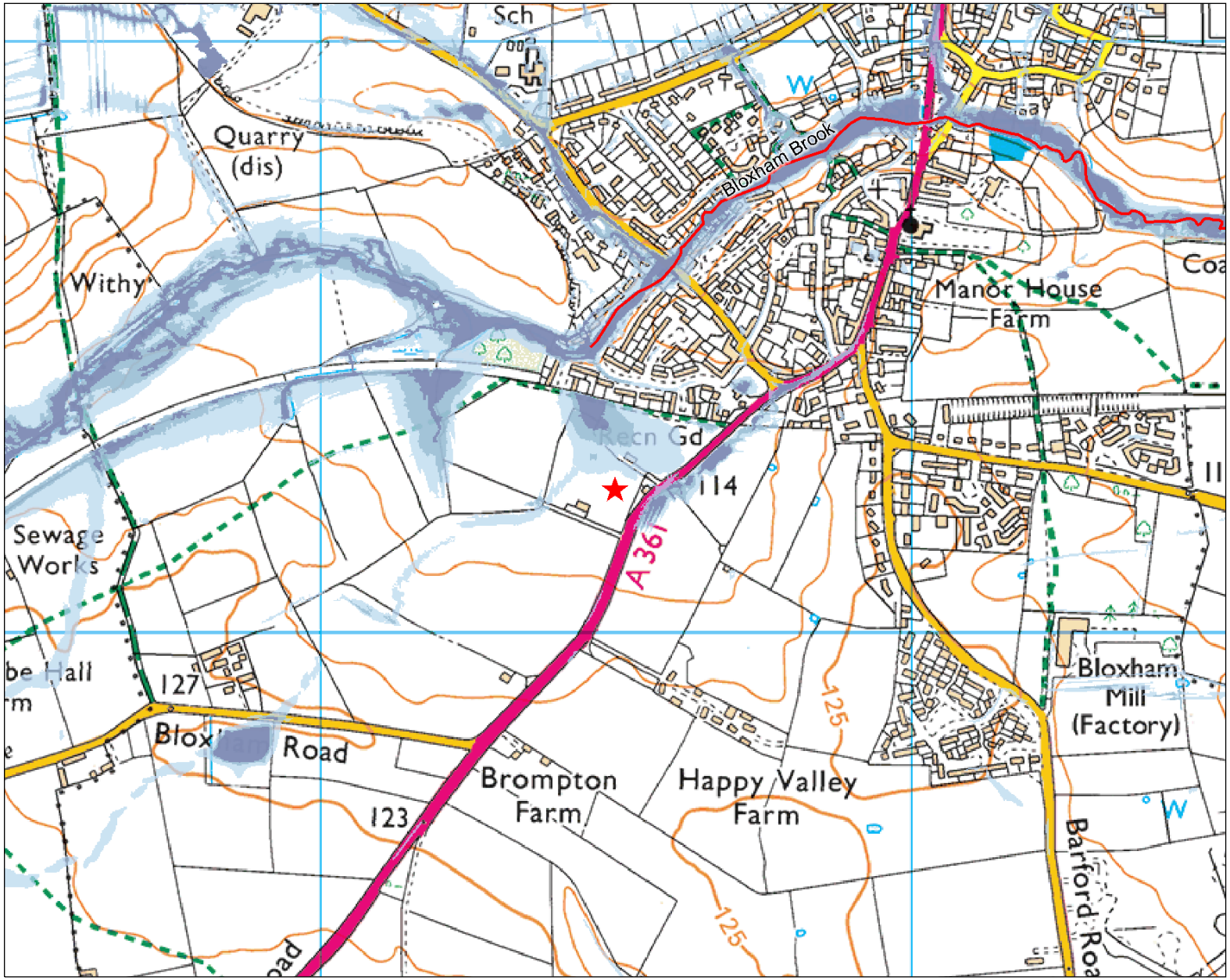
Flood Map for Planning (Rivers and Sea)
(assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Risk of flooding from Surface Water



Environment Agency

Scale 1:10,001

N
W E
S

Likelihood of flooding from Surface Water

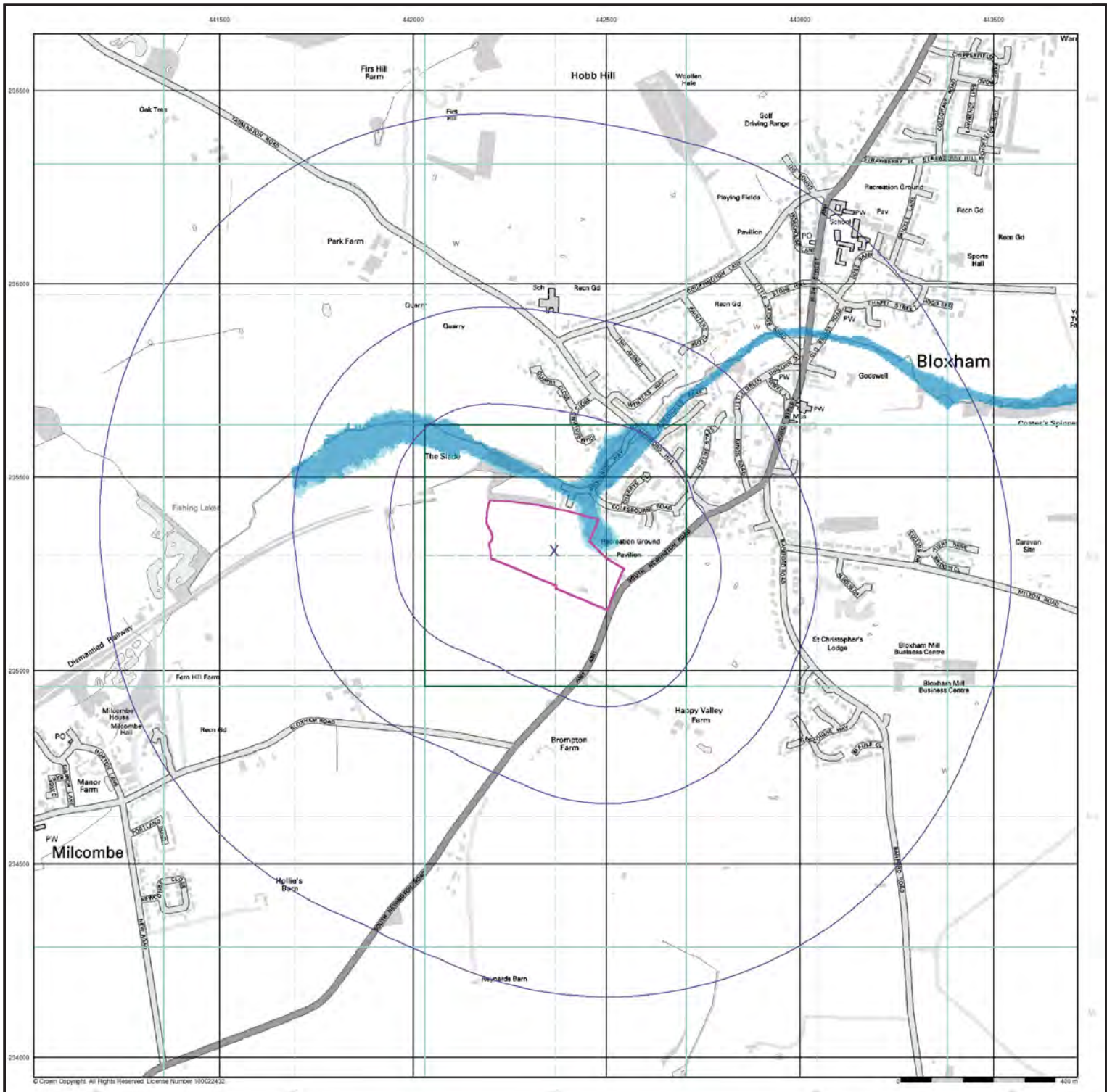
- High
- Medium
- Low
- Very Low

Likelihood of flooding from Surface Water

High:	Greater than or equal to 1 in 30 (3.3%) chance in any given year
Medium:	Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
Low:	Less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year
Very Low:	Less than 1 in 1,000 (0.1%) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on our website.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



LK CONSULT LIMITED

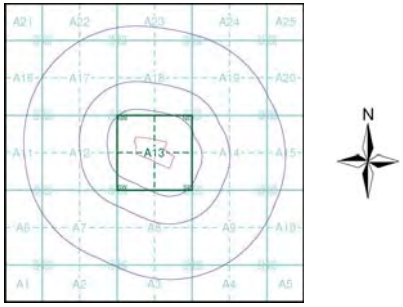
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A

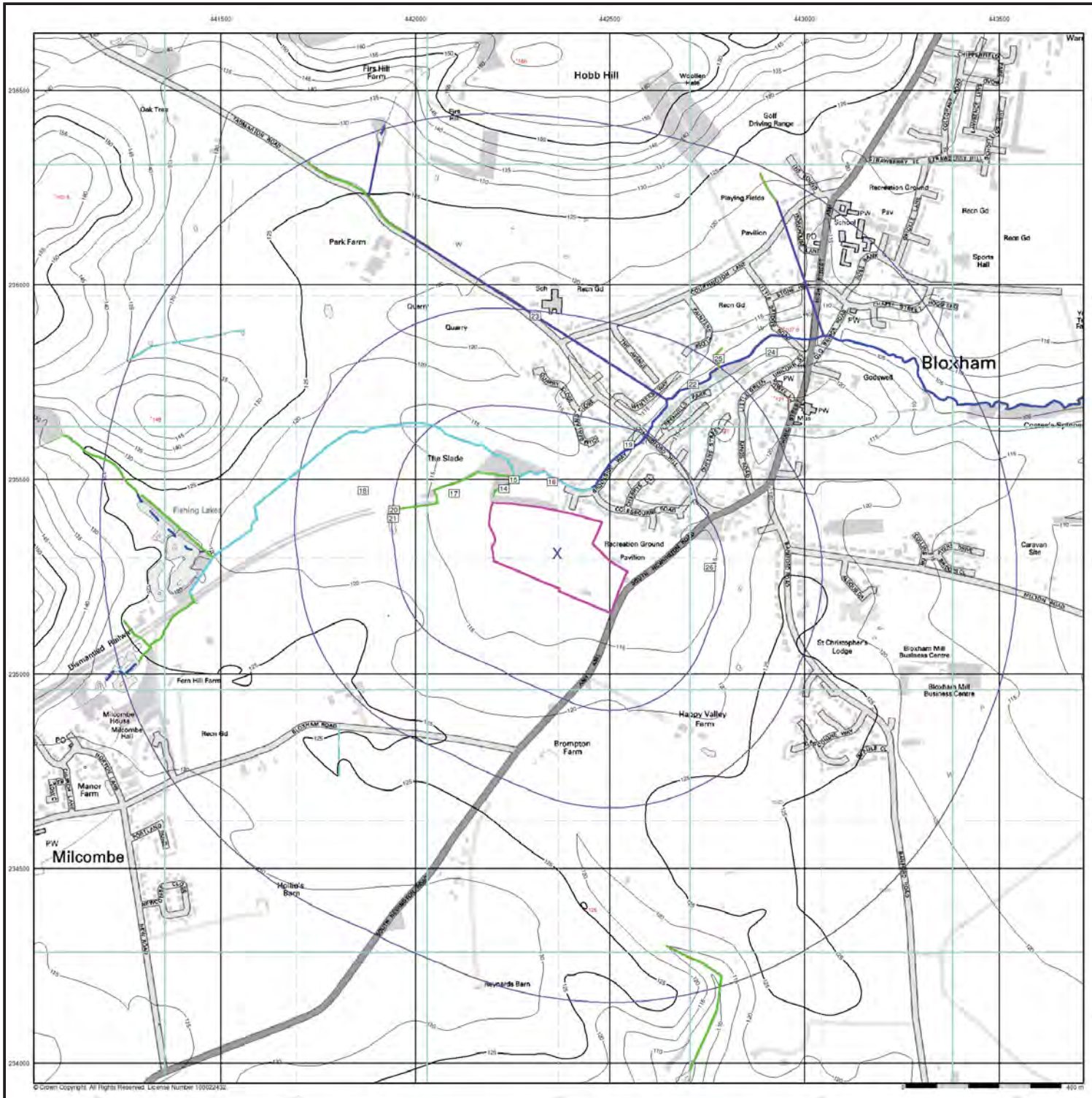


Order Details

Order Number:	112367251_1_1
Customer Ref:	LKC 16 1314
National Grid Reference:	442370, 235310
Slice:	A
Site Area (Ha):	5.92
Search Buffer (m):	1000

Site Details

Site at 442387,235301



LK CONSULT LIMITED

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- Map ID

Detailed River Network Data

- Primary River
- Secondary River
- Tertiary River
- Canal
- Canal Tunnel
- Undefined River
- Lake/Reservoir
- Offline Drainage Feature
- Extended Culvert (greater than 50m)
- Underground River (inferred)
- Underground River (local knowledge)
- Downstream of High Water Mark
- Downstream of Seaward Extension
- Not assigned River feature

Contours (height in metres)

Standard Contour — 105

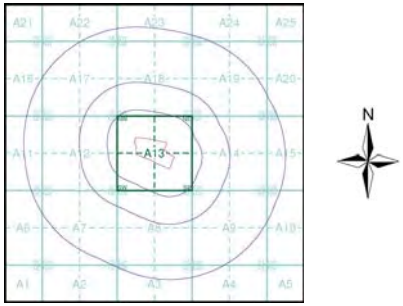
Master Contour — 100 — 95

Spot Height — *167.3

MLW Mean Low Water

MHW Mean High Water

EA/NRW Detailed River Network Map - Slice A



Order Details

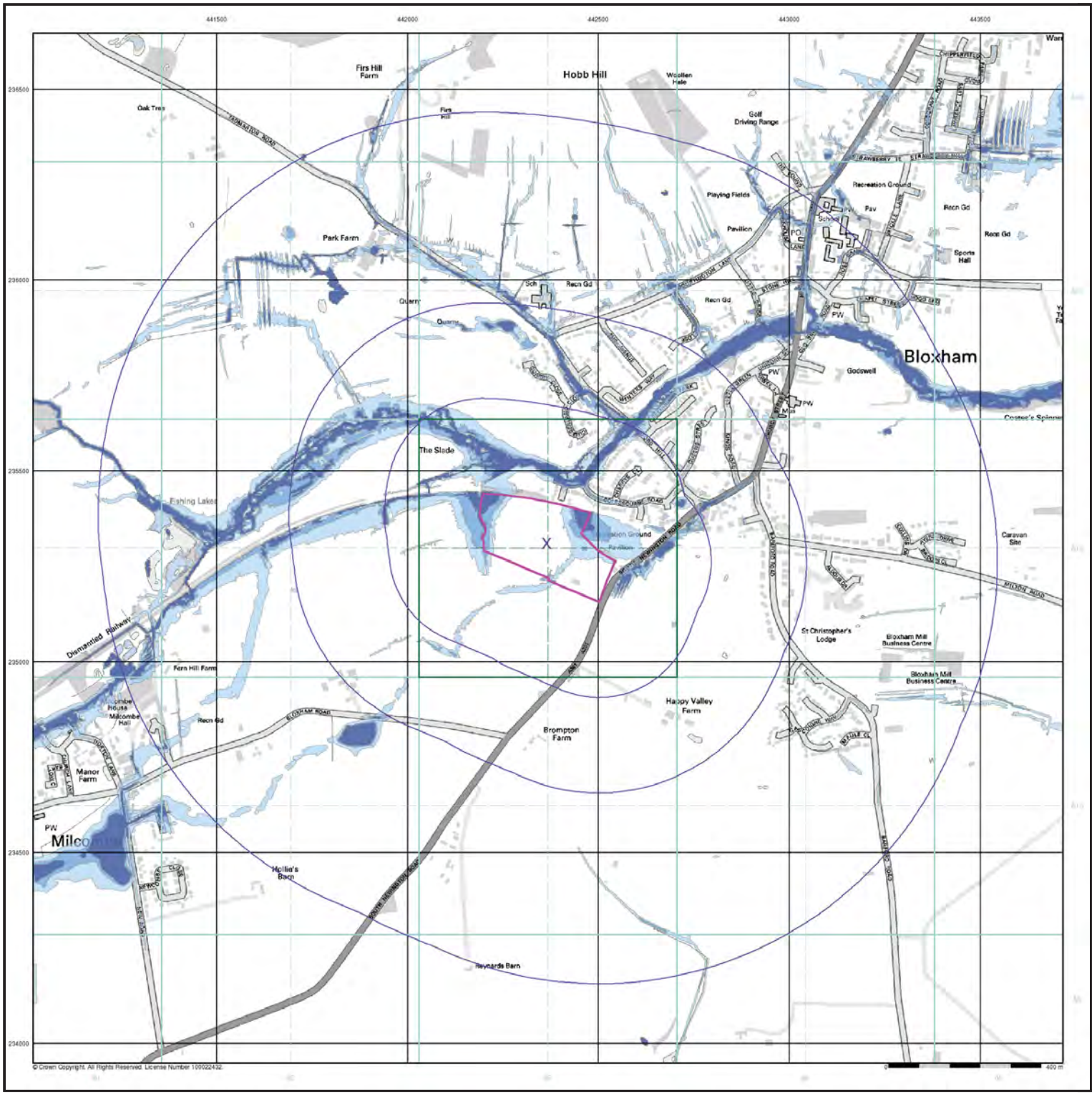
Order Number:	112367251_1_1
Customer Ref:	LKC 16 1314
National Grid Reference:	442370, 235310
Slice:	A
Site Area (Ha):	5.92
Search Buffer (m):	1000

Site Details

Site at 442387,235301

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LK CONSULT LIMITED

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Risk of Flooding from Surface Water

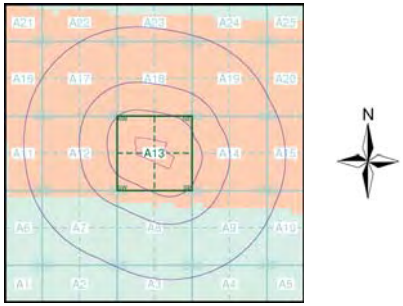
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



Order Details

Order Number:	112367251_1_1
Customer Ref:	LKC 16 1314
National Grid Reference:	442370, 235310
Slice:	A
Site Area (Ha):	5.92
Search Buffer (m):	1000

Site Details

Site at 442387,235301

APPENDIX D

CONSULTEE CORRESPONDENCE

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Mark Jones

From: Flood Management <floodmanagement@Oxfordshire.gov.uk>
Sent: 20 October 2016 17:08
To: Matthew Craig
Cc: lewis.purbrick@environment-agency.gov.uk
Subject: RE: Flood Risk Assessment - Newington Road, Bloxham

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Mathew
Sorry for the delay in replying
I have no information on flooding of this site, but as you intend to discharge to the Sorr Brook and the EA are at the present time in the process of designing a scheme to reduce the flooding of the Sorr brook through Bloxham it would be useful if you contacted Lewis Purbrick of the EA.
Regards
Gordon

Gordon Hunt
County Drainage Engineer
07774 835434

From: Matthew Craig [mailto:m.craig@thelkgroup.com]
Sent: 07 October 2016 15:31
To: Drainage - E&E; Flood Management
Subject: Flood Risk Assessment - Newington Road, Bloxham

Dear Sir/Madam,

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), of a site located off South Newington Road, Bloxham, Oxfordshire**.** Nearest Postcode OX15 4HJ.

Centred at approximate National Grid Reference 442500E, 235240N. The area of interest appears to be within Flood Zone 1.

The site plan is attached to this email

To complete the FRA we would be grateful if you could supply us with the following, if available, for the vicinity of the site:

- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics.
- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area.
- Any restrictions to infiltration and discharge to the watercourse.

If you have any queries please get in touch with me.

We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available and what the charge will be and we will pay the relevant fees by debit card as soon as possible.

We will also contact the EA and Thames Water as well for their information and requirements.

Any advice or recommendations you may have regarding the potential discharges from the development of this site?

With reference to the attached site plans, there appear to be a number of historical watercourses in the vicinity
We will be in contact with all other relevant authorities to get a more complete understanding of the issues in the area.

Regards

Matthew Craig

Sewer Flooding
History Enquiry

LK Group

Eton Hill Road Radcliffe

Search address supplied

South Newington Road
Bloxham
Oxfordshire
OX15 4HJ

Your reference N/A

Our reference SFH/SFH Standard/2016_3422413

Received date **30 September 2016**

Search date **30 September 2016**

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Sewer Flooding

History Enquiry

Search address supplied: South Newington Road,Bloxham,Oxfordshire,OX15 4HJ

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched;

(ii) any negligent or incorrect interpretation of the records searched;

(iii) and any negligent or incorrect recording of that interpretation in the search report

(iv) compensation payments

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Clearwater Court, Vastern Road
Reading RG1 8DB

Sewer Flooding

History Enquiry

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

For your guidance:

- A sewer is “overloaded” when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- “Internal flooding” from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- “At Risk” properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company’s reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk

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No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

CommercialDW
Drainage & Water Enquiry

Thames Water Property Searches

Gladman Developments Limited
Gladman House
Alexandria Way
Congleton
CW12 1LB

Search address supplied	St Helen's Avenue, South Newington Road, Cumberford Hill and Barford Road, Bloxham, Banbury, Oxfordshire, OX15 4QH
Your reference	LKs/Bloxham 3 2016-104
Our reference	CDWS/CDWS Standard/2016_3416079
Received date	22 September 2016
Search date	26 September 2016

Notification of Price Changes…

From 1 September 2016 Thames Water Property Searches will be increasing the prices of its CON29DW, CommercialDW Drainage & Water Enquiries and Asset Location Searches.

This will be the first price rise in three years and is in line with the RPI at 1.84%. The increase follows significant capital investment in improving our systems and infrastructure, including the recent updates to the content of the Law Society's CON29DW and the CommercialDW Enquiries.

Enquiries received with a higher payment prior to 1 September 2016 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

CON29DW
DRAINAGE AND WATER ENQUIRY

SearchCode™

CommercialDW
Drainage & Water Enquiry

Thames Water Property Searches

Question		Summary Answer
Maps, Wayleaves, Easements, Manhole Cover and Invert levels		
1.1	Where relevant, please include a copy of an extract from the public sewer map.	Map Provided
1.2	Where relevant, please include a copy of an extract from the map of waterworks.	Map Provided
1.3	Is there a wayleave/easement agreement giving Thames Water the right to lay or maintain assets or right of access to pass through private land in order to reach the Company's assets?	No
1.4	On the copy extract from the public sewer map, please show manhole cover, depth and invert levels where the information is available.	See Details
Drainage		
2.1	Does foul water from the property drain to a public sewer?	See Details
2.2	Does surface water from the property drain to a public sewer?	See Details
2.3	Is a surface water drainage charge payable?	See Details
2.4	Does the public sewer map indicate any public sewer, disposal main or lateral drain within the boundaries of the property?	Yes
2.4.1	Does the public sewer map indicate any public pumping station or any other ancillary apparatus within the boundaries of the property?	No
2.5	Does the public sewer map indicate any public sewer within 30.48 metres (100 feet) of any buildings within the property?	See Details
2.5.1	Does the public sewer map indicate any public pumping station or any other ancillary apparatus within the 50metres of any buildings within the property?	No
2.6	Are any sewers or lateral drains serving, or which are proposed to serve the property, the subject of an existing adoption agreement or an application for such an agreement?	No
2.7	Has a sewerage undertaker approved or been consulted about any plans to erect a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain?	No
2.8	Is the building which is or forms part of the property, at risk of internal flooding due to overloaded public sewers?	Not At Risk
2.9	Please state the distance from the property to the nearest boundary of the nearest sewage treatment works.	1.065 Kilometres
Water		
3.1	Is the property connected to mains water supply?	See Details
3.2	Are there any water mains, resource mains or discharge pipes within the boundaries of the property?	Yes
3.3	Is any water main or service pipe serving or which is proposed to serve the property, the subject of an existing adoption agreement or an application for such an agreement?	No
3.4	Is the property at risk of receiving low water pressure or flow?	See Details
3.5	What is the classification of the water supply for the property?	See Details
3.6	Please include details of the location of any water meter serving the property.	See Details

CommercialDW
Drainage & Water Enquiry

Thames Water Property Searches

Question		Summary Answer
Charging		
4.1.1	Who are the sewerage undertakers for the area?	Thames Water
4.1.2	Who are the water undertakers for the area?	Thames Water
4.2	Who bills the property for sewerage services?	Not Billed
4.3	Who bills the property for water services?	Not Billed
4.4	What is the current basis for charging for sewerage and/or water services at the property?	No Charge
4.5	Are there any trade effluent consents relating to this site/property for disposal of chemically enhanced waste?	No

CommercialDW
Drainage & Water Enquiry

Thames Water Property Searches

Search address supplied: St Helen's Avenue, South Newington Road, Cumberford Hill and Barford Road, Bloxham, Banbury, Oxfordshire, OX15 4QH

Any new owner or occupier will need to contact Thames Water on 0800 316 9800 or log onto our website www.thameswater.co.uk and complete our online form to change the water and drainage services bills to their name.

The following records were searched in compiling this report: - the map of public sewers, the map of waterworks, water and sewer billing records, adoption of public sewer records, building over public sewer records, the register of properties subject to internal foul flooding, the register of properties subject to poor water pressure and the drinking water register. Thames Water Utilities Ltd (TWUL) holds all of these.

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched

(ii) any negligent or incorrect interpretation of the records searched

(iii) any negligent or incorrect recording of that interpretation in the search report

(iv) and compensation payments

Please refer to the attached Terms & Conditions. Customers and clients are asked to note these terms, which govern the basis on which this Commercial Drainage and Water search is supplied.

COPSO EXECUTIVE MEMBER

Thames Water Property Searches is an Executive member of CoPSO (Council of Property Search Organisations).

Maps, Wayleaves, Easements, Manhole Cover and Invert levels

1.1 Where relevant, please include a copy of an extract from the public sewer map.

A copy of an extract of the public sewer map is included, showing the public sewers, disposal mains and lateral drains in the vicinity of the property.

1.2 Where relevant, please include a copy of an extract from the map of waterworks.

A copy of an extract of the map of waterworks is included, showing water mains, resource mains or discharge pipes in the vicinity of the property.

1.3 Wayleaves & Easements

Is there a wayleave/easement agreement giving Thames Water the right to lay or maintain assets or right of access to pass through private land in order to reach the Company's assets?

No.

1.4 Manhole

On the copy extract from the public sewer map, please show manhole cover, depth and invert levels where the information is available.

Details of any manhole cover and invert levels applicable to this site are enclosed.

Drainage

2.1 Does foul water from the property drain to a public sewer?

The enquiry appears to relate to a plot of land or a recently built property. It is recommended that drainage proposals are checked with the developer.

2.2 Does surface water from the property drain to a public sewer?

Records indicate that this enquiry relates to a plot of land or a recently built property. It is recommended that the drainage proposals are checked with the developer. If the property was constructed after 6th April 2015 the Surface Water drainage may be served by a Sustainable Drainage System (SuDS). Further information may be available from the Developer.

2.3 Is a surface water drainage charge payable?

This enquiry appears to relate to a plot of land or a recently built property. It is recommended that charging proposals are checked with the developer. If the property was constructed after 6th April 2015 the Surface Water drainage may be served by a Sustainable Drainage System (SuDS). Further information may be available from the Developer.

2.4 Does the public sewer map indicate any public sewer, disposal main or lateral drain within the boundary of the property?

The public sewer map included indicates that there is a public sewer, disposal main or lateral drain within the boundaries of the property. However, from the 1st October 2011 there may be additional public sewers, disposal mains or lateral drains which are not recorded on the public sewer map but which may further prevent or restrict development of the property.

2.4.1 Does the public sewer map indicate any public pumping station or any other ancillary apparatus within the boundaries of the property?

The public sewer map included indicates that there is no public pumping station within the boundaries of the property.

2.5 Does the public sewer map indicate any public sewer within 30.48 metres (100 feet) of any buildings within the property?

The public sewer map indicates that there are no public sewers within 30.48 metres (100 feet) of any buildings within the property.
However, from the 1st October 2011 many private sewers were transferred into public ownership and may not be recorded on the public sewer map and it is our professional opinion that if the property is connected to a foul sewer it is likely that there will be a public sewer within 30.48 metres (100 feet) of any buildings within the property.

2.5.1 Does the public sewer map indicate any public pumping station or any other ancillary apparatus within 50 metres of any buildings within the property?

The public sewer map included indicates that there is no public pumping station within 50 metres of any buildings within the property.

2.6 Are any sewers or lateral drains serving, or which are proposed to serve, the property the subject of an existing adoption agreement or an application for such an agreement?

Records confirm that Foul sewers serving the development, of which the property forms part are not the subject of an existing adoption agreement or an application for such an agreement.

The Surface Water sewer(s) and/or Surface Water lateral drain(s) are not the subject of an adoption agreement.

2.7 Has a sewerage undertaker approved or been consulted about any plans to erect a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain?

There are no records in relation to any approval or consultation about plans to erect a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain. However, the sewerage undertaker might not be aware of a building or extension on the property over or in the vicinity of a public sewer, disposal main or drain.

2.8 Is the building which is or forms part of the property, at risk of internal flooding due to overloaded public sewers?

The property is not recorded as being at risk of internal flooding due to overloaded public sewers.

From the 1st October 2011 most private sewers, disposal mains and lateral drains were transferred into public ownership It is therefore possible that a property may be at risk of internal flooding due to an overloaded public sewer which the sewerage undertaker is not aware of. For further information it is recommended that enquiries are made of the vendor.

2.9 Please state the distance from the property to the nearest boundary of the nearest sewage treatment works.

The nearest sewage treatment works is Bloxham STW which is 1.065 kilometres to the east of the property.

Water

3.1 Is the property connected to mains water supply?

The enquiry appears to relate to a plot of land or a recently built property. It is recommended that the water proposals are checked with the developer.

3.2 Are there any water mains, resource mains or discharge pipes within the boundary of the property?

The map of waterworks indicates that there are water mains, resource mains or discharge pipes within the boundaries of the property.

3.3 Is any water main or service pipe serving, or which is proposed to serve, the property the subject of an existing adoption agreement or an application for such an agreement?

Records confirm that water mains or service pipes serving the property are not the subject of an existing adoption agreement or an application for such an agreement.

3.4 Is the property at risk of receiving low water pressure or flow?

Records confirm that the property is not recorded on a register kept by the water undertaker as being at risk of receiving low water pressure or flow.

3.5 What is the classification of the water supply for the property?

The water supplied to the property has an average water hardness of 100.6mg/l calcium which is defined as Hard by Thames Water.

3.6 Please include details of the location of any water meter serving the property.

This enquiry appears to relate to a plot of land or a recently built property. It is recommended that drainage proposals are checked with the developer.

Charging

4.1.1 – Who is responsible for providing the sewerage services for the property?

Thames Water Utilities Limited, Clearwater Court, Reading, RG1 8DB is the sewerage undertaker for the area.

4.1.2 – Who is responsible for providing the water services for the property?

Thames Water Utilities Limited, Clearwater Court, Reading, RG1 8DB is the water undertaker for the area.

4.2 Who bills the property for sewerage services?

The property is not billed for sewerage services.

4.3 Who bills the property for water services?

The property is not billed for water services.

4.4 What is the current basis for charging for sewerage and / or water services at the property?

This enquiry appears to relate to a plot of land or a recently built property.

4.5 Trade Effluent Consent

Are there any trade effluent consents relating to this site/property for disposal of chemically enhanced waste?

No.

Payment for this Search

A charge will be added to your suppliers account.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information.

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2016_3416079

The width of the displayed area is 500m

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no survey information is available.

Manhole Reference	Manhole Cover Level	Manhole Invert Level
6601	109.845	107.235
6604	109.87	108.95
6602	108.99	106.42
6605	109.97	108.63
6606	110.13	107.32
6652	n/a	108.58
6607	109.46	107.48
6653	n/a	109.68
6608	109.19	107.59
6609	108.95	107.7
6696	n/a	n/a
5452	113.1	111.44
5402	113.14	111.18
5453	114.78	112.98
5501	110.71	108.34
551B	n/a	n/a
5502	110.2	107.99
551A	n/a	n/a
5503	110.06	107.89
5602	109.99	107.44
5661	109.71	108.58
5654	109.88	109.25
6301	115.05	113.71
6453	113.64	112.2
6401	113.73	112.02
6402	113.73	112.02
7492	115.83	113.78
6491	114.73	113.53
6452	114.89	113.84
6451	114.21	113.27
8491	115.61	114.39
7491	n/a	n/a
7451	115.98	115
8401	116.36	114.88
7401	116.833	112.973
8502	117.9	116.51
6503	116.77	112.44
8503	118.56	117.16
7591	n/a	n/a
6502	113.21	110.58
6501	110.83	108.89
8501	119.52	117.84
6551	111.01	109.84
651A	n/a	n/a
7601	119.15	117.84
661A	n/a	n/a
6603	110.04	109.39
661B	n/a	n/a
6693	109.9	107.64
861A	n/a	n/a
9492	117.15	n/a
9452	119.48	118.9
9451	120.11	119.67
9401	119.89	118.53
941G	n/a	n/a
9301	121.09	119.66
9501	119.18	117.69
941F	n/a	n/a
951A	n/a	n/a
9302	122.67	121.46
941A	n/a	n/a
941B	n/a	n/a
941H	n/a	n/a
9652	120.51	119.51
9651	120.16	119.38
9601	120.49	118.99
941C	n/a	n/a
941D	n/a	n/a
9201	n/a	n/a
7603	n/a	n/a
8651	119.21	118.38
8601	119.67	118.39
8691	n/a	n/a
5601	112.02	110.36
5651	111.71	109.91
5652	111.58	109.6
5603	109.63	107.66
5653	109.86	109.27

Sewer Key - Commercial Drainage and Water Enquiry

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

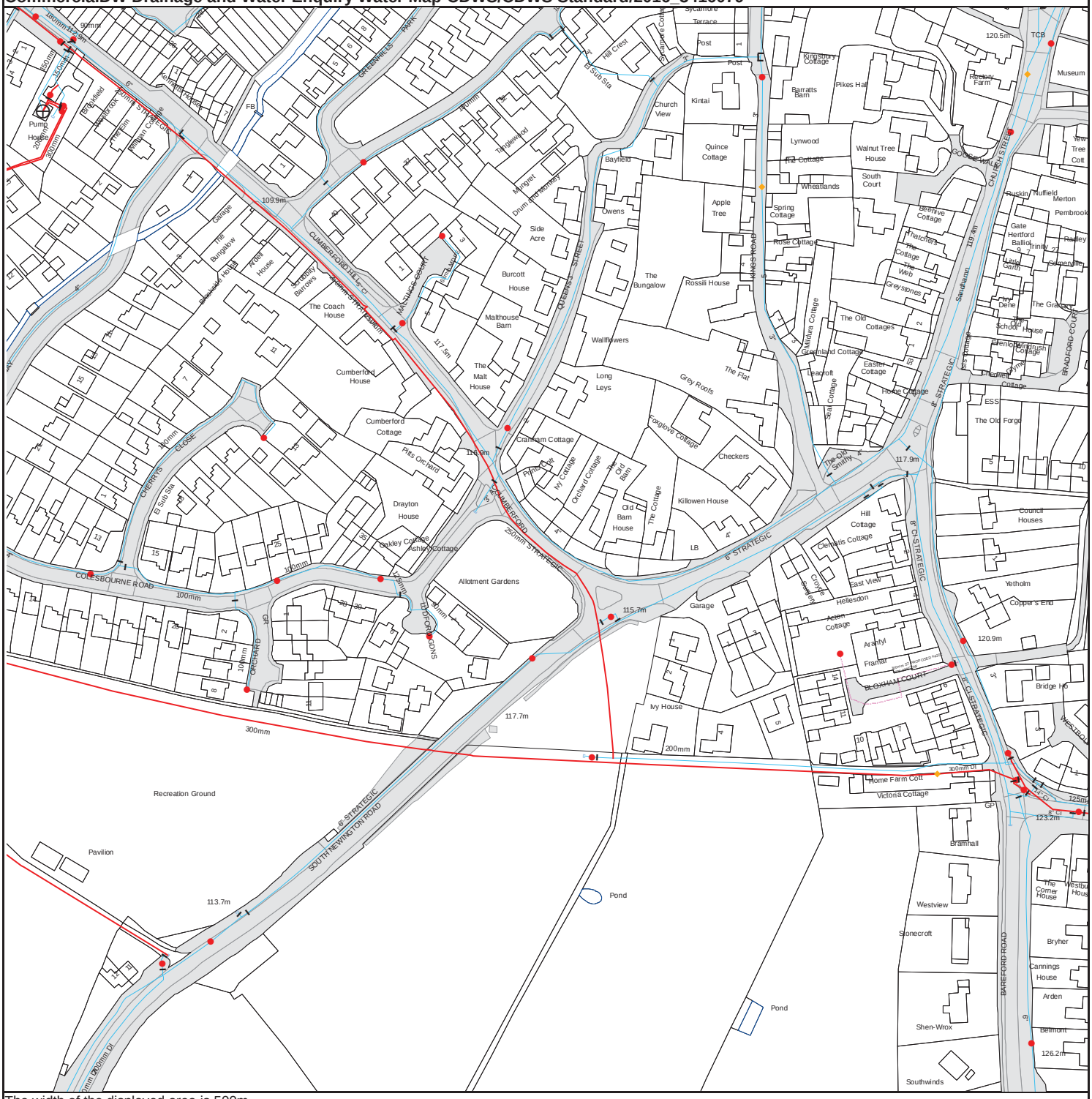
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0118 925 1504.

CommercialDW Drainage and Water Enquiry Water Map-CDWS/CDWS Standard/2016_3416079



The width of the displayed area is 500m

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

Waterworks Key - Commercial Drainage and Water Enquiry

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

For your guidance:

- Thames Water Property Searches Complaints Procedure:
  - Thames Water Property Searches offers a robust complaints procedure. Complaints can be made by telephone, in writing, by email (searches@thameswater.co.uk) or through our website (www.thameswater-propertysearches.co.uk)

As a minimum standard Thames Water Property Searches will:

- endeavour to resolve any contact or complaint at the time of receipt. If this isn't possible, we will advise of timescales;
- investigate and research the matter in detail to identify the issue raised (in some cases third party consultation will be required);
- provide a response to the customer within 10 working days of receipt of the complaint;
- provide compensation, if no response or acknowledgment that we are investigating the case is given within 10 working days of receipt of the complaint;
- keep you informed of the progress and, depending on the scale of investigation required, update with new timescales as necessary;
- provide an amended search, free of charge, if required;
- provide a refund if we find your complaint to be justified; take the necessary action within our power to put things right.

If you want us to liaise with a third party on your behalf, just let us know.

If you are still not satisfied with the outcome provided, we will refer the matter to a Senior Manager, for resolution, who will respond again within 5 working days.

If you remain dissatisfied with our final response you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). Please refer to the final page of the search for further details.

Question 1.1

For your guidance:

- The Water Industry Act 1991 defines Public Sewers as those which Thames Water have responsibility for. Other assets and rivers, watercourses, ponds, culverts or highway drains may be shown for information purposes only.
- The company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.
- Assets other than public sewers may be shown on the copy extract, for information.

Question 1.2

For your guidance:

- The “water mains” in this context are those, which are vested in and maintainable by the water company under statute.
- Assets other than public water mains may be shown on the plan, for information only.
- Water companies are not responsible for private supply pipes connecting the property to the public water main and do not hold details of these. These may pass through land outside of the control of the seller, or may be shared with adjacent properties. The buyer may wish to investigate whether separate rights or easements are needed for their inspection, repair or renewal.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Question 2.1

For your guidance:

- Water companies are not responsible for any private drains that connect the property to the public sewerage system and do not hold details of these. The property owner will normally have sole responsibility for private drains serving the property. These may pass through land outside the control of the seller and the buyer may wish to investigate whether separate rights or easements are needed for their inspection, repair or renewal.
- If foul water does not drain to the public sewerage system, the property may have private facilities in the form of a cesspit, septic tank or other type of treatment plant.
- An extract from the public sewer map is enclosed. This will show known public sewers in the vicinity of the property and it should be possible to estimate the likely length and route of any private drains and/or sewers connecting the property to the public sewerage system.

Question 2.2

For your guidance:

- Sewerage Undertakers are not responsible for any private drains that connect the property to the public sewerage system, and do not hold details of these.
- The property owner will normally have sole responsibility for private drains serving the property. These private drains may pass through land outside of the control of the seller and the buyer may wish to investigate whether separate rights or easements are needed for their inspection, repair or renewal.
- In some cases, 'Sewerage Undertakers' records do not distinguish between foul and surface water connections to the public sewerage system.
- At the time of privatisation in 1989, Sewerage Undertakers were sold with poorly-kept records of sewerage infrastructure. The records did not always show which properties were connected for surface water drainage purposes. Accordingly, billing records have been used to provide an answer for this element of the drainage and water search.
- Due to the potential inadequacy of 'Sewerage Undertakers' infrastructure records with respect to surface water drainage, it is the customer's responsibility to inform the Sewerage Undertaker that they do not receive the surface water drainage service. If on inspection, the buyer finds that surface water from the property does not drain to a public sewer, then the property may be eligible for a rebate of the surface water drainage charge. For further information, please contact Thames Water on Tel: 0800 316 9800, or refer to the website at www.thameswater.co.uk.
- If surface water from the property does not drain to the public sewerage system, the property may have private facilities in the form of a soakaway or private connection to a watercourse.
- An extract from the public sewer map is enclosed. This will show known public sewers in the vicinity of the property and it should be possible to estimate the likely length and route of any private drains and/or sewers connecting the property to the public sewerage system.

Question 2.3

For your guidance:

- If surface water from the property drains to a public sewer, then a surface water drainage charge is payable.
- Where a surface water drainage charge is currently included in the property's water and sewerage bill but, on inspection, the buyer finds that surface water from the property does not drain to a public sewer, then the property may be eligible for a rebate of the surface water drainage charge. For further information, please contact Thames Water on Tel: 0800 316 9800 or refer to the website www.thameswater.co.uk.

Question 2.4

For your guidance:

- Thames Water has a statutory right of access to carry out work on its assets. Employees of Thames Water or its contractors may, therefore, need to enter the property to carry out work.
- Please note if the property was constructed after 1st July 2011 any sewers and/or lateral drain within the boundary of the property are the responsibility of the householder.
- The approximate boundary of the property has been determined by reference to the Ordnance Survey Record or the map supplied.
- The presence of a public sewer running within the boundary of the property may restrict further development. The Company has a statutory right of access to carry out work on its assets, subject to notice. This may result in employees of the Company, or its contractors, needing to enter the property to carry out work.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Question 2.4.1

For your guidance:

- Private pumping stations installed before 1 July 2011 will be transferred into the ownership of the sewerage undertaker.
- The approximate boundary of the property has been determined by reference to the Ordnance Survey Record or the map supplied.
- The presence of a public Pumping station running within the boundary of the property may restrict further development. The company has a statutory right of access to carry out work on its assets, subject to notice. This may result in employees of the company, or its contractors, needing to enter the property to carry out work.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Question 2.5

For your guidance:

- This is because there are no buildings from which to measure the distance to any public sewers.
- The presence of a public sewer within 30.48 metres (100 feet) of the building(s) within the property can result in the local authority requiring a property to be connected to the public sewer.
- The measurement is estimated from the Ordnance Survey record, between the building(s) within the boundary of the property and the nearest public sewer.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Question 2.5.1

For your guidance:

- Private pumping stations installed before 1 July 2011 will be transferred into the ownership of the sewerage undertaker.
- The presence of a public pumping station within 50 metres of the building(s) within the property can result in the local authority requiring a property to be connected to the public sewer.
- The measurement is estimated from the Ordnance Survey record, between the building(s) within the boundary of the property and the nearest public sewer.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Question 2.6

For your guidance:

- Any sewers and/or lateral drains within the boundary of the property are not the subject of an adoption agreement and remain the responsibility of the householder. Adoptable sewers are normally those situated in the public highway.
- This enquiry is of interest to purchasers who will want to know whether or not the property will be linked to a public sewer.
- Where the property is part of a very recent or ongoing development and the sewers are not the subject of an adoption application, buyers should consult with the developer to ascertain the extent of private drains and sewers for which they will hold maintenance and renewal liabilities.
- Final adoption is subject to the developer complying with the terms of the adoption agreement under Section 104 of the Water Industry Act 1991 and meeting the requirements of 'Sewers for Adoption' 6th Edition.

Question 2.7

For your guidance:

- From the 1st October 2011 most private sewers, disposal mains and lateral drains were transferred into public ownership and the sewerage undertaker may not have been approved or consulted about any plans to erect a building or extension on the property over or in the vicinity of these.
- Buildings or extensions erected over a sewer in contravention of building controls may have to be removed or altered.

Question 2.8

For your guidance:

- For reporting purposes buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- A sewer is "overloaded" when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- "Internal flooding" from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- "At Risk" properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company's reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk

Question 2.9

For your guidance:

- The nearest sewage treatment works will not always be the sewage treatment works serving the catchment within which the property is situated.
- The sewerage undertaker's records were inspected to determine the nearest sewage treatment works.
- It should be noted that there may be a private sewage treatment works closer than the one detailed above that has not been identified.
- As a responsible utility operator, Thames Water Utilities seeks to manage the impact of odour from operational sewage works on the surrounding area. This is done in accordance with the Code of Practice on Odour Nuisance from Sewage Treatment Works issued via the Department of Environment, Food and Rural Affairs (DEFRA). This Code recognises that odour from sewage treatment works can have a detrimental impact on the quality of the local environment for those living close to works. However DEFRA also recognises that sewage treatment works provide important services to communities and are essential for maintaining standards in water quality and protecting aquatic based environments. For more information visit www.thameswater.co.uk

Question 3.2

For your guidance:

- The boundary of the property has been determined by reference to the plan supplied. Where a plan was not supplied, the Ordnance Survey Record was used.
- The presence of a public water main within the boundary of the property may restrict further development within it. Water companies have a statutory right of access to carry out work on their assets, subject to notice. This may result in employees of the Company, or its contractors, needing to enter the property to carry out work.

Question 3.3

For your guidance:

- This enquiry is of interest to purchasers who will want to know whether or not the property will be linked to the mains water supply.

Question 3.4

For your guidance:

- The boundary of the property has been determined by reference to the plan supplied. Where a plan was not supplied the Ordnance Survey Record was used.
- “Low water pressure” means water pressure below the regulatory reference level, which is the minimum pressure when demand on the system is not abnormal.
- Water Companies are required to include in the Regulatory Register that is presented annually to the Director General of Water Services, properties receiving pressure below the reference level, provided that allowable exclusions do not apply (i.e. events which can cause pressure to temporarily fall below the reference level)
- The reference level of service is a flow of 9 litres/minute at a pressure of 10metres / head on the customer's side of the outside stop valve (osv). The reference level of service must be applied on the customer's side of a meter or any other company fittings that are on the customer's side of the main stop tap. The reference level applies to a single property. Where more than one property is served by a common service pipe, the flow assumed in the reference level must be appropriately increased to take account of the total number of properties served. For two properties, a flow of 18 litres/minute at a pressure of 10metres/head on the customers' side of the osv is appropriate. For three or more properties the appropriate flow should be calculated from the standard loadings provided in BS6700 or the Institute of Plumbing handbook.
- Allowable exclusions The Company is required to include in the Regulatory Register properties receiving pressure below the reference level, provided that allowable exclusions listed below do not apply.
- Abnormal demand: This exclusion is intended to cover abnormal peaks in demand and not the daily, weekly or monthly peaks in demand, which are normally expected. Companies should exclude from the reported figures properties which are affected by low pressure only on those days with the highest peak demands. During the report year companies may exclude, for each property, up to five days of low pressure caused by peak demand.
- Planned maintenance: Companies should not report low pressures caused by planned maintenance. It is not intended that companies identify the number of properties affected in each instance. However, companies must maintain sufficiently accurate records to verify that low-pressure incidents that are excluded because of planned maintenance are actually caused by maintenance.
- One-off incidents: This exclusion covers a number of causes of low pressure; mains bursts; failures of company equipment (such as pressure reducing valves or booster pumps); firefighting; and action by a third party. However, if problems of this type affect a property frequently, they cannot be classed as one-off events and further investigation will be required before they can be excluded
- Low-pressure incidents of short duration: Properties affected by low pressures, which only occur for a short period, and for which there is evidence that incidents of a longer duration would not occur during the course of the year, may be excluded from the reported figures.
- Please contact your water company mentioned in Question 4.1.2 if you require further information on water pressure.

Question 3.5

For your guidance:

- Water hardness can be expressed in various indices for example the hardness settings for dishwashers are commonly expressed in Clark's degrees, but check with the manufacturer as there are also other units. The following table shows the normal ranges of hardness.
- Sample table for information only:
-

Hardness category	Calcium (mg/l)	Calcium carbonate (mg/l)	English Clarke degrees	French degrees	General/ German degrees
Soft	0 to 20	0 to 50	0 to 3.5	0 to 5	0 to 2.8
Moderately soft	21 to 40	51 to 100	3.6 to 7	6 to 10	2.9 to 5.6
Slightly hard	41 to 60	101 to 150	8 to 10.5	11 to 15	5.7 to 8.4
Moderately hard	61 to 80	151 to 200	10.6 to 14	16 to 20	8.5 to 11.2
Hard	81 to 120	201 to 300	15 to 21	21 to 30	11.3 to 16.8
Very hard	Over 120	Over 300	Over 21	Over 30	Over 16.8

Question 3.6

For your guidance:

- Where a meter does not serve the property and the customer wishes to consider this method of charging, they should contact the water undertakers mentioned in Question 4.1.2.

.

Question 4.4

For your guidance:

-
- Records indicate that the Water Company does not levy charges to the property.Water and sewerage companies' full charges are set out in their charges schemes which are available from the company free of charge upon request.
- The Water Industry Act 1991 Section 150, The Water Resale Order 2001 provides protection for people who buy their water or sewerage services from a person or company instead of directly from a water or sewerage company. Details are available from the Office of Water Services (OFWAT) website is www.ofwat.gov.uk.
- Where charges are given, these are based on the data available at the time of the report.
- The Company may install a meter at the premises where a buyer makes a change of use of the property or where the buyer uses water for:
  - Watering the garden other than by hand (this includes the use of sprinklers).
  - Automatically replenishing a pond or swimming pool with a capacity greater than 10,000 litres.
  - A bath with a capacity in excess of 230 litres.
  - A reverse osmosis unit

Question 4.5

For your guidance:

- If a Trade effluent consent applies to the premises which are the subject of this search, it is for the applicant to satisfy itself as to the suitability of the consent for its client's requirements. The occupier of any trade premises in the area of a sewerage undertaker may discharge any trade effluent proceeding from those premises into the undertaker's public sewers if he does so with the undertaker's consent. If, in the case of any trade premises, any trade effluent is discharged without such consent or other authorisation, the occupier of the premises shall be guilty of an offence.
- Please note any existing consent is dependent on the business being carried out at the property and will not transfer automatically upon change of ownership.
- For further information regarding Trade Effluent consents please contact: Trade Effluent Control, Crossness STW, Belvedere Road, Abbey Wood London SE2 9AQ.

CommercialDW Drainage and Water Enquiry Terms and Conditions

Customer and Clients are asked to note these terms, which govern the basis on which this CommercialDW Drainage & Water Enquiry is supplied

Definitions

'Client' means the person, company or body who is the intended recipient of the Report with an actual or potential interest in the Property.
'Company' means a water service company or their data service provider producing the Report.
'Customer' means the person, company, firm or other legal body placing the Order, either on their own behalf as Client, or, as an agent for a Client.
'Order' means any request completed by the Customer requesting the Report.
'Property' means the address or location supplied by the Customer in the Order.
'Report' means the drainage and/or water report prepared by The Company in respect of the Property.
'Thames Water" means Thames Water Utilities Limited registered in England and Wales under number 2366661 whose registered office is at Clearwater Court, Vastern Road, Reading, Berks, RG1 8DB;

Agreement

1 Thames Water agrees to supply the Report to the Customer and the Client subject to these terms. The scope and limitations of the Report are described in paragraph 2 of these terms. Where the Customer is acting as an agent for the Client then the Customer shall be responsible for bringing these terms to the attention of the Client. The Customer and Client agree that the placing of an Order for a Report indicates their acceptance of these terms.

The Report

2. Whilst Thames Water will use reasonable care and skill in producing the Report, it is provided to the Customer and the Client on the basis that they acknowledge and agree to the following:-

2.1 The information contained in the Report can change on a regular basis so Thames Water cannot be responsible to the Customer and the Client for any change in the information contained in the Report after the date on which the Report was produced and sent to the Client.

2.2 The Report does not give details about the actual state or condition of the Property nor should it be used or taken to indicate or exclude actual suitability or unsuitability of the Property for any particular purpose, or relied upon for determining saleability or value, or used as substitute for any physical investigation or inspection. Further advice and information from appropriate experts and professionals should always be obtained.

2.3 The information contained in the Report is based upon the accuracy, completeness and legibility of the address and other information supplied by the Customer or Client.

2.4 The Report provides information as to the location and connection of existing services and should not be relied on for any other purpose. The Report may contain opinions or general advice to the Customer and the Client and Thames Water cannot ensure that any such opinion or general advice is accurate, complete or valid and accepts no liability therefore.

2.5 The position and depth of apparatus shown on any maps attached to the Report are approximate, and are furnished as a general guide only, and no warranty as to its correctness is given or implied. The exact positions and depths should be obtained by excavation trial holes and the maps must not be relied on in the event of excavation or other works made in the vicinity of apparatus shown on any maps.

Liability

3 Thames Water shall not be liable to the Client for any failure, defect or non-performance of its obligations arising from any failure of, or defect in any machine, processing system or transmission link or anything beyond Thames Water's reasonable control or the acts or omissions of any party for whom Thames Water are not responsible.

3.1 Where the Customer sells this report to a Client (other than in the case of a bona fide legal adviser recharging the cost of the Report as a disbursement) Thames Water shall not in any circumstances (whether for breach of contract, negligence or any other tort, under statute or statutory duty or otherwise at all) be liable for any loss or damage whatsoever and the Customer shall indemnify Thames Water in respect of any claim by the Client.

3.2 Where a report is requested for an address falling within a geographical area where Thames Water and another Company separately provide Water and Sewerage Services, then it shall be deemed that liability for the information given by Thames Water or the Company as the case may be will remain with Thames Water or the Company as the case may be in respect of the accuracy of the information supplied. Where Thames Water is supplying information which has been provided to it by another Company for the purposes outlined in this agreement Thames Water will therefore not be liable in any way for the accuracy of that information and will supply that information as agent for the Company from which the information was obtained.

3.3 Except in respect of death or personal injury caused by negligence, or as expressly provided in these Terms:

3.3.1 The entire liability of Thames Water or the Company as the case may be in respect of all causes of action arising under or in connection with the Report (whether for breach of contract, negligence or any other tort, under statute or statutory duty or otherwise at all) shall not exceed £2,000,000 (two million pounds); and

3.3.2 Thames Water shall not in any circumstances (whether for breach of contract, negligence or any other tort, under statute or statutory duty or otherwise at all) be liable for any loss of profit, loss of goodwill, loss of reputation, loss of business or any indirect, special or consequential loss, damage or other claims, costs or expenses;

Copyright and Confidentiality

4. The Customer and the Client acknowledge that the Report is confidential and is intended for the personal use of the Client. The copyright and any other intellectual property rights in the Report shall remain the property of Thames Water or the Company as the case may be. No intellectual or other property rights are transferred or licensed to the Customer or the Client except to the extent expressly provided

4.1 The Customer or Client is entitled to make copies of the Report but is not permitted to copy any maps contained in, or attached to the Report

4.2 The maps contained in the Report are protected by Crown Copyright and must not be used for any purpose outside the context of the Report.

4.3 The Customer and Client agree (in respect of both the original and any copies made) to respect and not to alter any trademark, copyright notice or other property marking which appears on the Report.

Payment

5. Unless otherwise stated all prices are inclusive of VAT. The Customer shall pay for the price of the Report specified by Thames Water, without any set off, deduction or counterclaim.

5.1 Unless payment has been received in advance, Customers shall be invoiced for the agreed fee once their request has been processed. Any such invoice must be paid within 14 days. Where the Customer has an account with Thames Water, payment terms will be as agreed with Thames Water.

5.2 No payment shall be deemed to have been received until Thames Water has received cleared funds.

5.3 If the Customer fails to pay Thames Water any sum due Thames Water shall be entitled but not obliged to charge the Customer interest on the sum from the due date for payment at the annual rate of 2% above the base lending rate from time to time of Natwest Bank, accruing on a daily basis until payment is made. Thames Water reserves the right to claim interest under the Late Payment of Commercial Debts (Interest) Act 1998.

5.4 Thames Water reserves the right to increase fees on reasonable prior written notice at any time.

Cancellations or Alterations

6. Once an Order is placed, Thames Water shall not be under any obligation to accept any request to cancel that Order and payment for the Order shall still be due upon completion of the Report. In cases where an error has been made in the original Order (e.g. the Customer has supplied an incorrect address), the Customer will need to place a second Order, detailing the correct information, and shall be liable to pay a second charge in accordance with clause 5 above.

Delivery

7. On receiving your order the reports will be posted to you within 10 working days from receipt.

7.1 Delivery is subject to local post conditions and regulations. All items should arrive within 12 working days, but Thames Water cannot be held responsible should delays be caused by local post conditions, postal strikes or other causes beyond the control of Thames Water.

General

8. If any provision of these terms is or becomes invalid or unenforceable, it will be taken to be removed from the rest of these terms to the extent that it is invalid or unenforceable. No other provision of these terms shall be affected.

8.1 These terms shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts.

8.2 Nothing in this notice shall in any way restrict the Customer or Clients statutory or any other rights of access to the information contained in the Report.

These Terms & Conditions are available in larger print for those with impaired vision.

APPENDIX E

CALCULATIONS

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HY 9.36

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Job No.			
Sheet no.	1		
Date	03/02/17		
Project	IH greenfield	By	Checked	Reviewed
Title	IoH 124 Runoff calcs for BLOXHAM			

Hydrological Data:-

FSR Hydrology:-

Location = BLOXHAM
Grid reference = SP4235
M5-60 (mm) = 19.7
r = 0.40
Soil runoff = 0.40
SAAR (mm/yr) = 710
WRAP = 3
Area = England & Wales
Hydrological area = 6
Hydrological zone = 8

Soil classification for WRAP type 3
i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Design data:-

Area = 0.0396 Km² - 3.96 Ha - 39600 m²

Calculation method:-

Runoff is calculated from:-

$$Q_{BAR(rural)} = 0.00108\ AREA^{0.89} \cdot SAAR^{1.17} \cdot SOIL^{2.17}$$

where

AREA = Site area in Km²
SAAR = Standard Average Annual Rainfall (mm/yr)
SOIL = Soil value derived from Winter Rainfall Acceptance Potential
$Q_{BAR(rural)}$ = Runoff (cumecs)

$Q_{BAR(rural)}$ is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.

Calculated data:-

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.079

Mean Annual Peak Flow $Q_{BAR(rural)}$ = 13.70 l/s

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Job No.	
Sheet no.	2
Date	03/02/17

By	Checked	Reviewed

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Project IH greenfield

Title IoH 124 Runoff calcs for BLOXHAM

Values for $Q_{BAR(rural)}$

Ret. per.	m³/hr	l/s	l/s/ha	Ret. per.	m³/hr	l/s	l/s/ha
1yr	41.918	11.644	2.940	100yr	155.342	43.150	10.897
2yr	43.397	12.055	3.044	100yr+20%	186.410	51.781	13.076
5yr	63.123	17.534	4.428	100yr+30%	201.944	56.096	14.166
10yr	79.890	22.192	5.604	200yr	182.465	50.685	12.799
30yr	109.972	30.548	7.714	200yr + 30%	237.204	65.890	16.639
50yr	129.205	35.890	9.063	500yr	221.423	61.506	15.532
				1000yr	254.464	70.685	17.850

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.88	1.28	1.62	2.23	2.62	3.15	3.70	4.49	5.16

The above is based on the Institute of Hydrology Report 124
to which you are referred for further details (see Sect 7).
Note that the 200 and above year growth curves were taken from W5-074.

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Job No.			
Sheet no.	1		
Date	03/02/17		
Project	ADAS greenfield 1 in 1yr	By	Checked / Reviewed
Title	ADAS runoff calculations for BLOXHAM		

Data:-

Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	SAAR (mm/yr)	= 710
r	= 0.40	Soil	= 0.40
Return period	= 1	Area	= England and Wales

Soil classification for WRAP type 3

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;

ii) Permeable soils with shallow ground water in low-lying areas;

iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Site values used in design:-

Catchment area	= 3.96 Ha	Catchment length	= 205 m
Catchment height	= 2.55 m		

Calculations :-

Formula used: $Q = 2.78 \times Sm^2 \times Fa \times A \times \text{Rainfall rate} \times Mf$ l/s

where

Time of Concentration for rainfall is $ToC = 6.09 \times Lc^{0.39}$

Lc = 0.0001 x (Catchment length²/Height over outfall)

Mf= 4.938 x Sm² (Soil modification value(Sm) =fractional value of the WRAP)

Fa= dimensionless annual rainfall factor (Fa={0.00127 * SAAR}-0.321)

A= Catchment Area (Ha)

Results :-

Characteristic length Lc	= 1.648
Catchment ToC	= 7.40 hrs
Soil modification factor	= 0.790
Catchment Intensity at ToC	= 3.14 mm/hr
Flow off site	= 15.85 l/s
Catchment flow	= 4.00 l/s/Ha

Calculations derived from formulae in ADAS Land Drainage Service report 5 (1980)
For further information, you are directed to the above document.

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

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Job No.			
Sheet no.	1		
Date	03/02/17		
Project	ADAS greenfield 1 in 30yr	By	Checked / Reviewed
Title	ADAS runoff calculations for BLOXHAM		

Data:-

Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	SAAR (mm/yr)	= 710
r	= 0.40	Soil	= 0.40
Return period	= 30	Area	= England and Wales

Soil classification for WRAP type 3

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;

ii) Permeable soils with shallow ground water in low-lying areas;

iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Site values used in design:-

Catchment area	= 3.96 Ha	Catchment length	= 205 m
Catchment height	= 2.55 m		

Calculations :-

Formula used: $Q = 2.78 \times Sm^2 \times Fa \times A \times \text{Rainfall rate} \times Mf$ l/s

where

Time of Concentration for rainfall is $ToC = 6.09 \times Lc^{0.39}$

Lc = 0.0001 x (Catchment length²/Height over outfall)

Mf= 4.938 x Sm² (Soil modification value(Sm) =fractional value of the WRAP)

Fa= dimensionless annual rainfall factor (Fa={0.00127 * SAAR}-0.321)

A= Catchment Area (Ha)

Results :-

Characteristic length Lc	= 1.648
Catchment ToC	= 7.40 hrs
Soil modification factor	= 0.790
Catchment Intensity at ToC	= 6.74 mm/hr
Flow off site	= 34.02 l/s
Catchment flow	= 8.59 l/s/Ha

Calculations derived from formulae in ADAS Land Drainage Service report 5 (1980)
For further information, you are directed to the above document.

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

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HY 9.36

Job No.			
Sheet no.	1		
Date	03/02/17		
Project	ADAS greenfield 1 in 100yr	By	Checked / Reviewed
Title	ADAS runoff calculations for BLOXHAM		

Data:-

Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	SAAR (mm/yr)	= 710
r	= 0.40	Soil	= 0.40
Return period	= 100	Area	= England and Wales

Soil classification for WRAP type 3

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;

ii) Permeable soils with shallow ground water in low-lying areas;

iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Site values used in design:-

Catchment area	= 3.96 Ha	Catchment length	= 205 m
Catchment height	= 2.55 m		

Calculations :-

Formula used: $Q = 2.78 \times Sm^2 \times Fa \times A \times \text{Rainfall rate} \times Mf$ l/s

where

Time of Concentration for rainfall is ToC=6.09 x Lc^0.39

Lc = 0.0001 x (Catchment length²/Height over outfall)

Mf= 4.938 x Sm² (Soil modification value(Sm) =fractional value of the WRAP)

Fa= dimensionless annual rainfall factor (Fa={0.00127 * SAAR}-0.321)

A= Catchment Area (Ha)

Results :-

Characteristic length Lc	= 1.648
Catchment ToC	= 7.40 hrs
Soil modification factor	= 0.790
Catchment Intensity at ToC	= 8.72 mm/hr
Flow off site	= 44.02 l/s
Catchment flow	= 11.12 l/s/Ha

Calculations derived from formulae in ADAS Land Drainage Service report 5 (1980)
For further information, you are directed to the above document.

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

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Job No.			
Sheet no.	1		
Date	06/02/17		
Project	IH 30yr event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

FSR Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	r	= 0.40
Soil index	= 0.40	SAAR (mm/yr)	= 710
Return period	= 30	WRAP	= 3
UCWI	= 75.7	Climate change	= 0

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 27.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area	= 15100 m²	Pervious area	= 24500 m²
Total area (TA)	= 39600 m²	Equiv area	= 10692 m² (TA x RF).
Allowed discharge rate	= 30.550 l/s	Areal reduction factor	= 1.000
Additional flow	= 0.00 l/s	Climate change factor	= 0

Calculated data:-

Time to max	= 79.0 mins	Calculated storage volume	= 375.0 m³
Rainfall at max	= 24.92 mm/hr	Allowed discharge rate	= 30.550 l/s
Pipeline storage	= 0.0 m³	Available MH storage	= 0.0 m³
Offline storage	= 0.0 m³		

Fixed 6 hour data:-

Rainfall event	= 6 hours	Calculated storage volume	= 79.6 m³
Rainfall rate	= 8.00 mm/hr	Allowed discharge rate	= 30.550 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	47749.2	1125	377.3
150	21221.9	1200	331.6
225	9431.9	1275	293.7
300	5305.5	1350	262.0
375	3395.5	1425	235.1
450	2358.0	1500	212.2
525	1732.4	1575	192.5
600	1326.4	1650	175.4
675	1048.0	1725	160.5
750	848.9	1800	147.4
825	701.5	1875	135.8
900	589.5	1950	125.6
975	502.3	2025	116.4
1050	433.1	2100	108.3

Ovoid	Len
400 x 600	2083.1
600 x 900	907.0
800 x 1200	510.1

Box culvert	Len
500 x 500	1499.8
500 x 750	999.9
500 x 1000	749.9
750 x 1000	499.9
750 x 1200	416.6
750 x 1500	333.3
1000 x 1000	375.0
1000 x 1200	312.5
1000 x 1500	250.0
1000 x 1800	208.3
1000 x 2000	187.5
1500 x 1500	166.6
1500 x 1800	138.9
1500 x 2000	125.0

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Job No.	
Sheet no.	2
Date	06/02/17

MasterDrain SW

Project	IH 30yr event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	93.0	246.631	18.330	228.301
20	63.0	332.863	36.660	296.203
30	49.0	385.880	54.990	330.890
40	40.0	424.535	73.320	351.215
50	34.0	455.146	91.650	363.496
60	30.0	480.590	109.980	370.610
70	27.0	502.420	128.310	374.110
80	25.0	521.571	146.640	374.931
90	23.0	538.653	164.970	373.683
100	21.0	554.083	183.300	370.783
110	20.0	568.163	201.630	366.533
120	18.0	581.115	219.960	361.155
130	17.0	593.112	238.290	354.822
140	16.0	604.287	256.620	347.667
150	16.0	614.747	274.950	339.797
160	15.0	624.579	293.280	331.299
170	14.0	633.855	311.610	322.245
180	14.0	642.634	329.940	312.694
190	13.0	650.965	348.270	302.695
200	12.0	658.894	366.600	292.294
210	12.0	666.455	384.930	281.525
220	12.0	673.681	403.260	270.421
230	11.0	680.599	421.590	259.009
240	11.0	687.235	439.920	247.315
250	11.0	693.609	458.250	235.359
260	10.0	699.740	476.580	223.160
270	10.0	705.646	494.910	210.736
280	10.0	711.342	513.240	198.102
290	9.0	716.842	531.570	185.272
300	9.0	722.478	549.900	172.578
310	9.0	727.916	568.230	159.686
320	9.0	733.210	586.560	146.650
330	8.0	738.370	604.890	133.479
340	8.0	743.401	623.220	120.181
350	8.0	748.311	641.550	106.761
360	8.0	753.107	659.880	93.227
370	8.0	757.793	678.210	79.583
380	8.0	762.377	696.540	65.837
390	7.0	766.861	714.870	51.991
400	7.0	771.252	733.200	38.052
410	7.0	775.553	751.530	24.023
420	7.0	779.768	769.860	9.908
430	7.0	783.902	788.190	0.000
440	7.0	787.957	806.520	0.000
450	7.0	791.937	824.850	0.000
460	7.0	795.844	843.180	0.000
470	6.0	799.683	861.510	0.000
480	6.0	803.454	879.840	0.000
490	6.0	807.162	898.170	0.000
500	6.0	810.808	916.500	0.000
510	6.0	814.394	934.830	0.000
520	6.0	817.923	953.160	0.000
530	6.0	821.397	971.490	0.000
540	6.0	824.817	989.820	0.000
550	6.0	828.185	1008.150	0.000
560	6.0	831.504	1026.480	0.000
570	6.0	834.774	1044.810	0.000
580	5.0	837.998	1063.140	0.000
590	5.0	841.176	1081.470	0.000
600	5.0	844.310	1099.800	0.000

Storage volume (m³) = 375.0 m³

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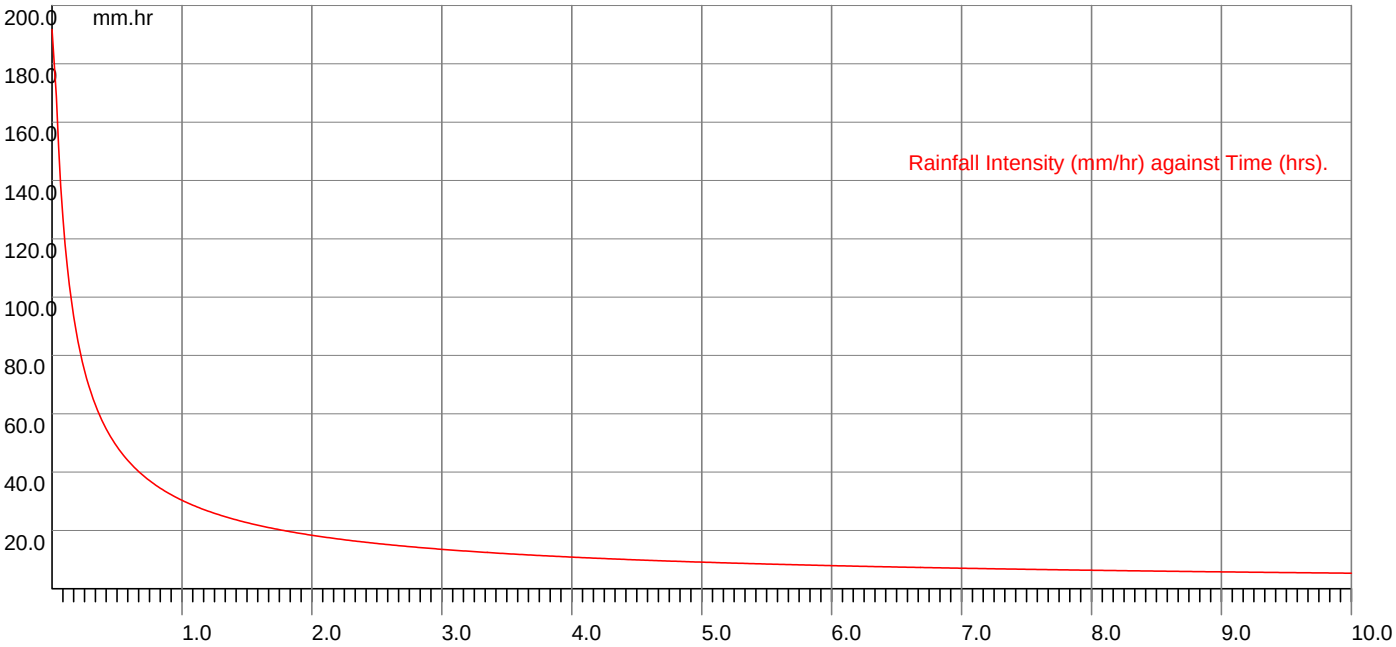
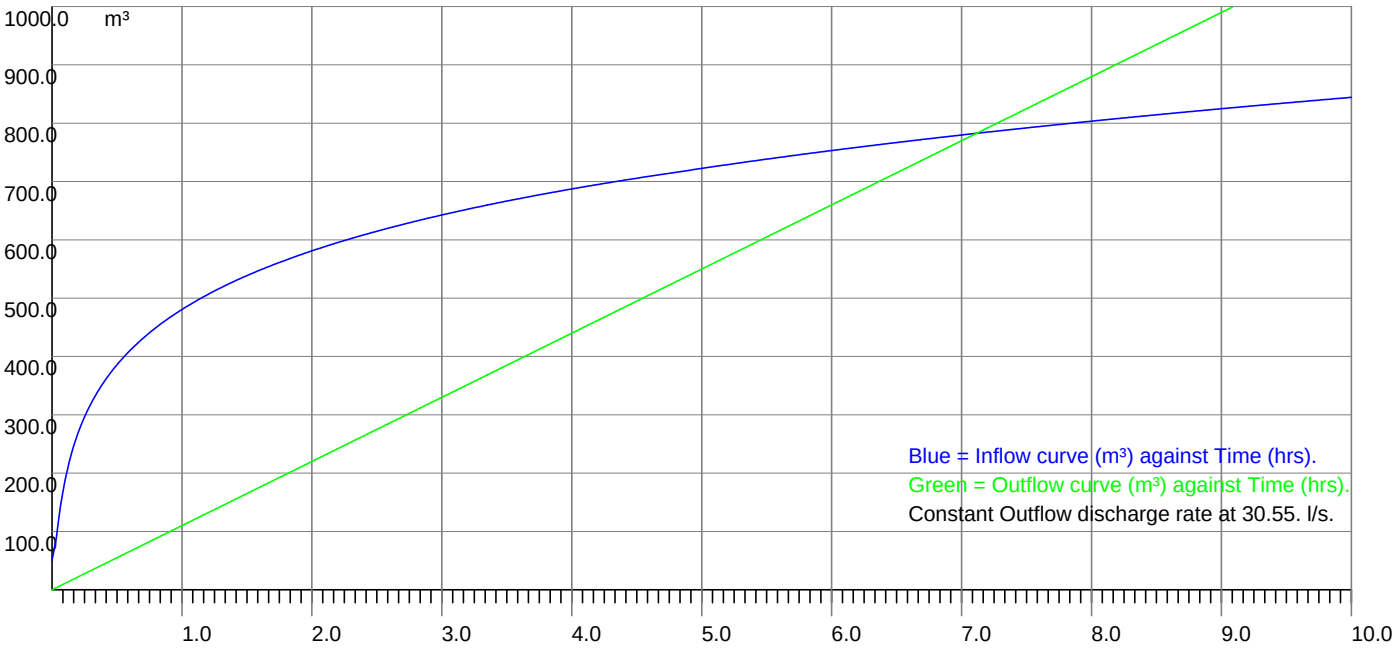
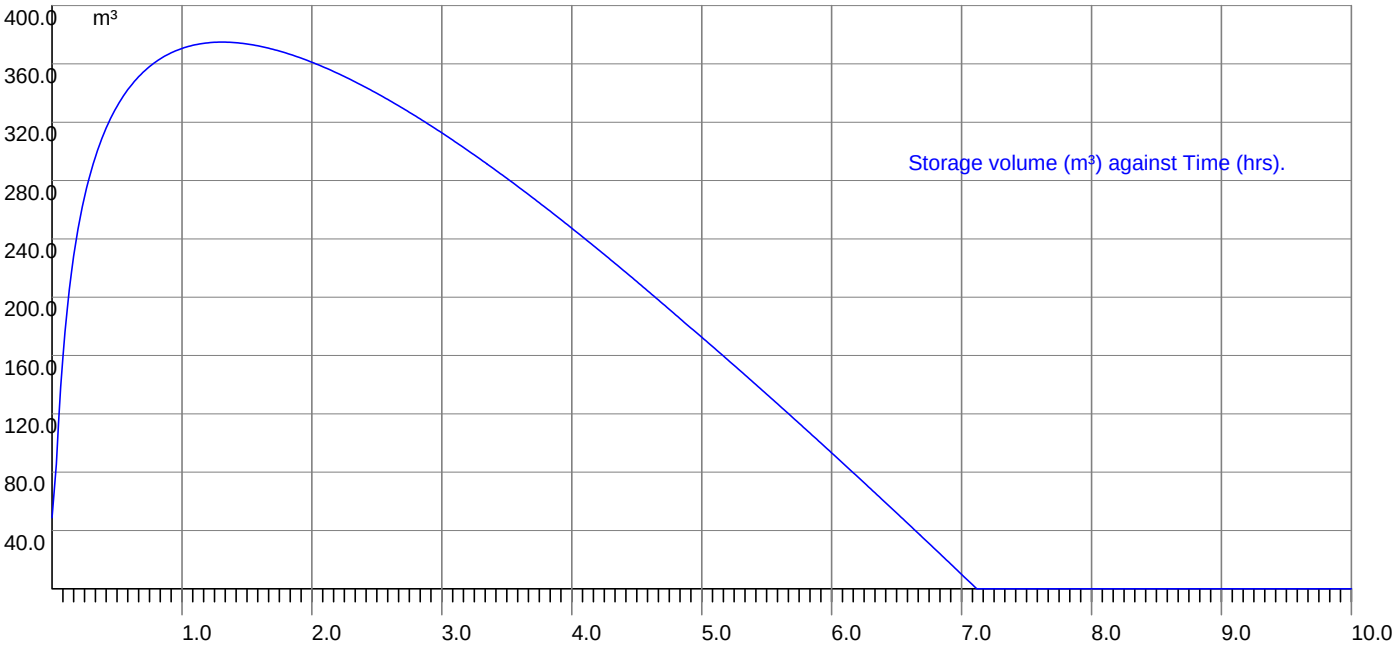
Job No.	
Sheet no.	3
Date	06/02/17

MasterDrain SW

	By	Checked	Reviewed
Project: IH 30yr event			
Title: Peak flow storage calcs for BLOXHAM			







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Job No.			
Sheet no.	1		
Date	06/02/17		
Project	ADAS 30 yr event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

FSR Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	r	= 0.40
Soil index	= 0.40	SAAR (mm/yr)	= 710
Return period	= 30	WRAP	= 3
UCWI	= 75.7	Climate change	= 0

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 27.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area	= 15100 m²	Pervious area	= 24500 m²
Total area (TA)	= 39600 m²	Equiv area	= 10692 m² (TA x RF).
Allowed discharge rate	= 34.020 l/s	Areal reduction factor	= 1.000
Additional flow	= 0.00 l/s	Climate change factor	= 0

Calculated data:-

Time to max	= 70.0 mins	Calculated storage volume	= 359.5 m³
Rainfall at max	= 27.19 mm/hr	Allowed discharge rate	= 34.020 l/s
Pipeline storage	= 0.0 m³	Available MH storage	= 0.0 m³
Offline storage	= 0.0 m³		

Fixed 6 hour data:-

Rainfall event	= 6 hours	Calculated storage volume	= 2.5 m³
Rainfall rate	= 8.00 mm/hr	Allowed discharge rate	= 34.020 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	45786.1	1125	361.8
150	20349.4	1200	318.0
225	9044.2	1275	281.7
300	5087.3	1350	251.2
375	3255.9	1425	225.5
450	2261.0	1500	203.5
525	1661.2	1575	184.6
600	1271.8	1650	168.2
675	1004.9	1725	153.9
750	814.0	1800	141.3
825	672.7	1875	130.2
900	565.3	1950	120.4
975	481.6	2025	111.7
1050	415.3	2100	103.8

Ovoid	Len
400 x 600	1997.4
600 x 900	869.7
800 x 1200	489.1

Box culvert	Len
500 x 500	1438.1
500 x 750	958.8
500 x 1000	719.1
750 x 1000	479.4
750 x 1200	399.5
750 x 1500	319.6
1000 x 1000	359.5
1000 x 1200	299.6
1000 x 1500	239.7
1000 x 1800	199.7
1000 x 2000	179.8
1500 x 1500	159.8
1500 x 1800	133.2
1500 x 2000	119.8

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Job No.	
Sheet no.	2
Date	06/02/17
By	
Checked	
Reviewed	

MasterDrain SW

Project: ADAS 30 yr event

Title: Peak flow storage calcs for BLOXHAM

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	93.0	246.631	20.412	226.219
20	63.0	332.863	40.824	292.039
30	49.0	385.880	61.236	324.644
40	40.0	424.535	81.648	342.887
50	34.0	455.146	102.060	353.086
60	30.0	480.590	122.472	358.118
70	27.0	502.420	142.884	359.536
80	25.0	521.571	163.296	358.275
90	23.0	538.653	183.708	354.945
100	21.0	554.083	204.120	349.963
110	20.0	568.163	224.532	343.631
120	18.0	581.115	244.944	336.171
130	17.0	593.112	265.356	327.756
140	16.0	604.287	285.768	318.519
150	16.0	614.747	306.180	308.567
160	15.0	624.579	326.592	297.987
170	14.0	633.855	347.004	286.851
180	14.0	642.634	367.416	275.218
190	13.0	650.965	387.828	263.137
200	12.0	658.894	408.240	250.654
210	12.0	666.455	428.652	237.803
220	12.0	673.681	449.064	224.617
230	11.0	680.599	469.476	211.123
240	11.0	687.235	489.888	197.347
250	11.0	693.609	510.300	183.309
260	10.0	699.740	530.712	169.028
270	10.0	705.646	551.124	154.522
280	10.0	711.342	571.536	139.806
290	9.0	716.842	591.948	124.894
300	9.0	722.478	612.360	110.118
310	9.0	727.916	632.772	95.144
320	9.0	733.210	653.184	80.026
330	8.0	738.370	673.596	64.773
340	8.0	743.401	694.008	49.393
350	8.0	748.311	714.420	33.891
360	8.0	753.107	734.832	18.275
370	8.0	757.793	755.244	2.549
380	8.0	762.377	775.656	0.000
390	7.0	766.861	796.068	0.000
400	7.0	771.252	816.480	0.000
410	7.0	775.553	836.892	0.000
420	7.0	779.768	857.304	0.000
430	7.0	783.902	877.716	0.000
440	7.0	787.957	898.128	0.000
450	7.0	791.937	918.540	0.000
460	7.0	795.844	938.952	0.000
470	6.0	799.683	959.364	0.000
480	6.0	803.454	979.776	0.000
490	6.0	807.162	1000.188	0.000
500	6.0	810.808	1020.600	0.000
510	6.0	814.394	1041.012	0.000
520	6.0	817.923	1061.424	0.000
530	6.0	821.397	1081.836	0.000
540	6.0	824.817	1102.248	0.000
550	6.0	828.185	1122.660	0.000
560	6.0	831.504	1143.072	0.000
570	6.0	834.774	1163.484	0.000
580	5.0	837.998	1183.896	0.000
590	5.0	841.176	1204.308	0.000
600	5.0	844.310	1224.720	0.000

Storage volume (m^3) = 359.5 m^3

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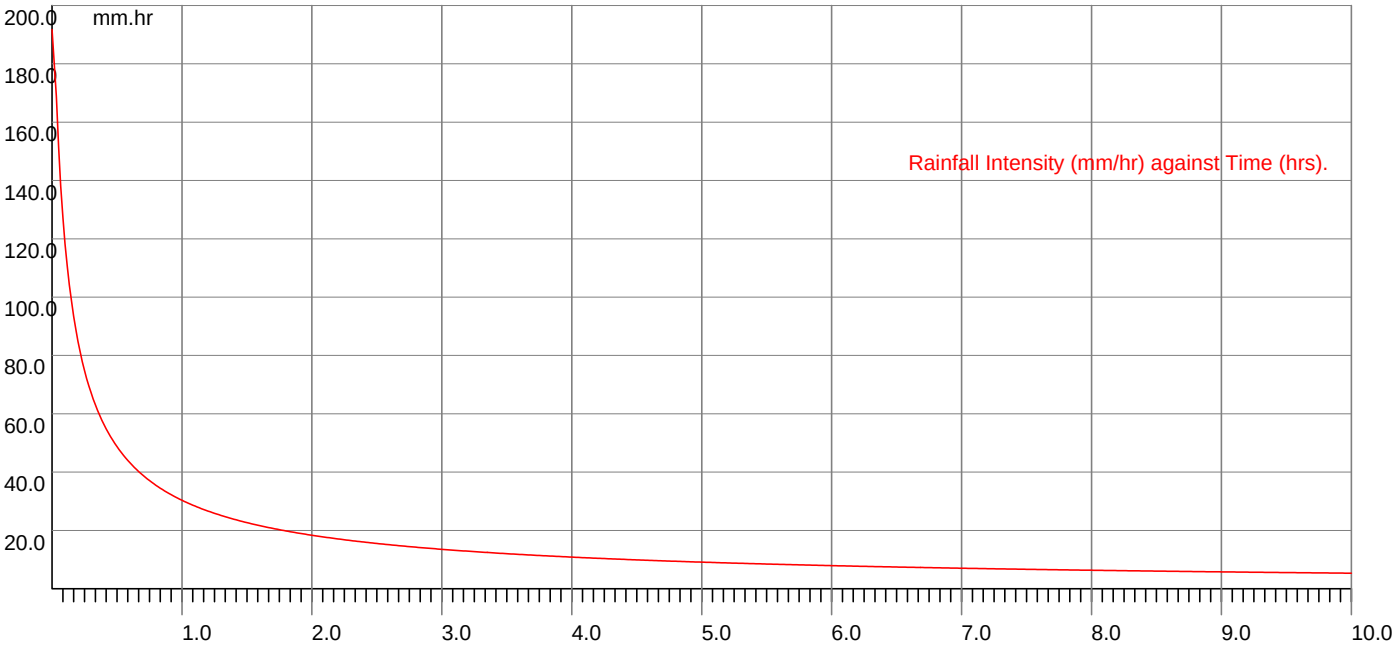
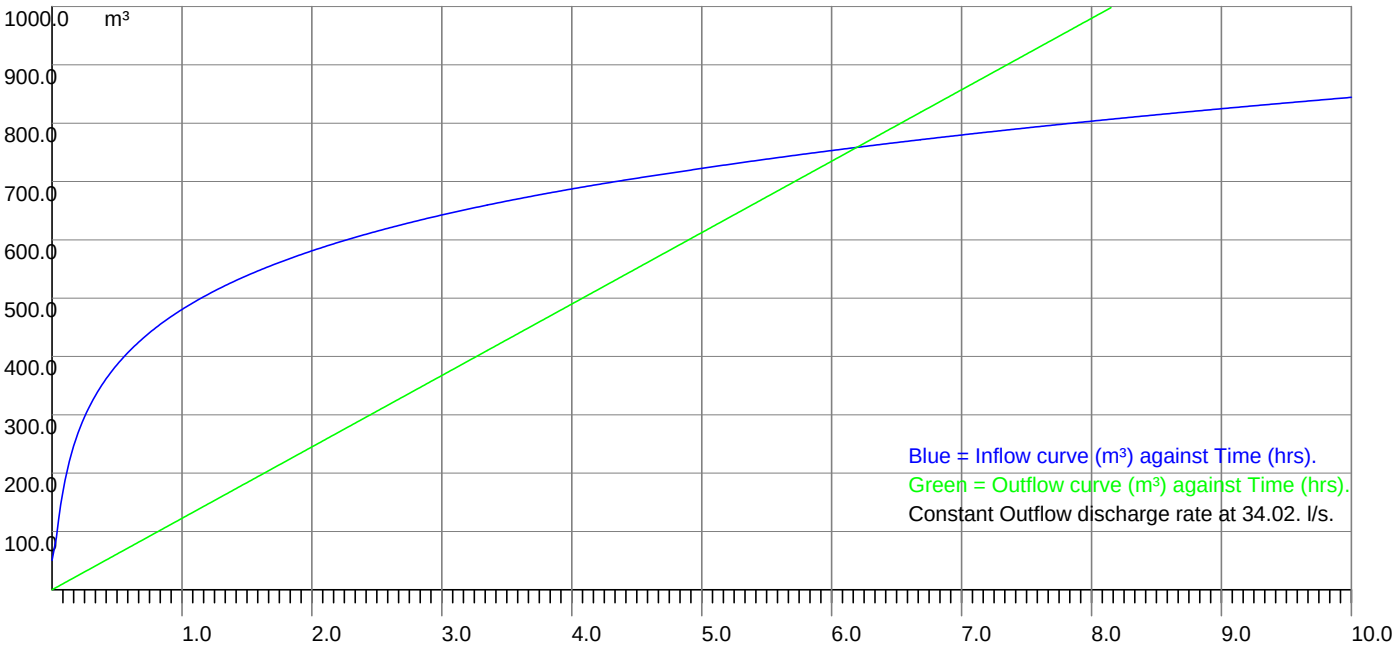
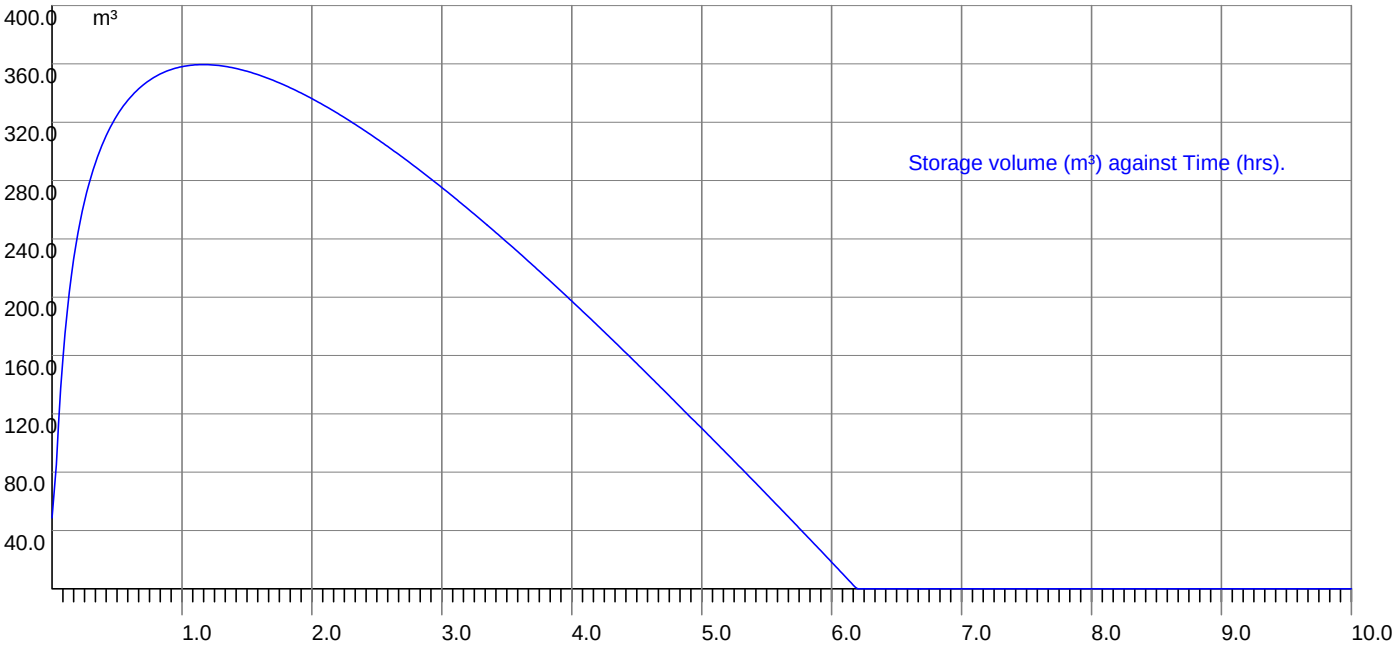
Job No.	
Sheet no.	3
Date	06/02/17

MasterDrain SW

Project	ADAS 30 yr event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		







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Job No.	
Sheet no.	1
Date	06/02/17
Project	IH 100yr +20% event
Title	Peak flow storage calcs for BLOXHAM

By	Checked	Reviewed

Data:-

FSR Hydrology:-

Location = BLOXHAM
M5-60 (mm) = 19.7
Soil index = 0.40
Return period = 100
UCWI = 75.7

Grid reference = SP4235
r = 0.40
SAAR (mm/yr) = 710
WRAP = 3
Climate change = 20

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 27.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 15100 m²
Total area (TA) = 39600 m²
Allowed discharge rate = 43.150 l/s
Additional flow = 0.00 l/s

Pervious area = 24500 m²
Equiv area = 10692 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 89.0 mins
Rainfall at max = 36.08 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 617.2 m³
Allowed discharge rate = 43.150 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 12.00 mm/hr

Calculated storage volume = 221.7 m³
Allowed discharge rate = 43.150 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	78605.0	1125	621.1
150	34935.6	1200	545.9
225	15526.9	1275	483.5
300	8733.9	1350	431.3
375	5589.7	1425	387.1
450	3881.7	1500	349.4
525	2851.9	1575	316.9
600	2183.5	1650	288.7
675	1725.2	1725	264.2
750	1397.4	1800	242.6
825	1154.9	1875	223.6
900	970.4	1950	206.7
975	826.9	2025	191.7
1050	713.0	2100	178.2

Ovoid	Len
400 x 600	3429.1
600 x 900	1493.1
800 x 1200	839.7

Box culvert	Len
500 x 500	2469.0
500 x 750	1646.0
500 x 1000	1234.5
750 x 1000	823.0
750 x 1200	685.8
750 x 1500	548.7
1000 x 1000	617.2
1000 x 1200	514.4
1000 x 1500	411.5
1000 x 1800	342.9
1000 x 2000	308.6
1500 x 1500	274.3
1500 x 1800	228.6
1500 x 2000	205.7

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Job No.	
Sheet no.	2
Date	06/02/17

MasterDrain SW

Project	IH 100yr +20% event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	144.0	381.378	25.890	355.488
20	99.0	520.190	51.780	468.410
30	76.0	605.827	77.670	528.157
40	63.0	668.168	103.560	564.608
50	54.0	717.371	129.450	587.921
60	48.0	758.103	155.340	602.763
70	43.0	792.892	181.230	611.662
80	39.0	823.269	207.120	616.149
90	36.0	850.231	233.010	617.221
100	33.0	874.467	258.900	615.567
110	31.0	896.470	284.790	611.680
120	29.0	916.611	310.680	605.931
130	27.0	935.171	336.570	598.601
140	26.0	952.372	362.460	589.912
150	24.0	968.391	388.350	580.041
160	23.0	983.371	414.240	569.131
170	22.0	997.431	440.130	557.301
180	21.0	1010.670	466.020	544.650
190	20.0	1023.172	491.910	531.262
200	20.0	1035.007	517.800	517.207
210	19.0	1046.236	543.690	502.546
220	18.0	1056.913	569.580	487.333
230	18.0	1067.083	595.470	471.613
240	17.0	1076.787	621.360	455.427
250	16.0	1086.060	647.250	438.810
260	16.0	1094.935	673.140	421.795
270	15.0	1103.439	699.030	404.409
280	15.0	1111.599	724.920	386.679
290	15.0	1119.436	750.810	368.626
300	14.0	1127.789	776.700	351.089
310	14.0	1135.794	802.590	333.204
320	14.0	1143.582	828.480	315.102
330	13.0	1151.164	854.370	296.794
340	13.0	1158.551	880.260	278.291
350	13.0	1165.755	906.150	259.605
360	12.0	1172.786	932.040	240.746
370	12.0	1179.651	957.930	221.721
380	12.0	1186.359	983.820	202.539
390	12.0	1192.919	1009.710	183.209
400	11.0	1199.336	1035.600	163.736
410	11.0	1205.618	1061.490	144.128
420	11.0	1211.771	1087.380	124.391
430	11.0	1217.800	1113.270	104.530
440	11.0	1223.710	1139.160	84.550
450	10.0	1229.507	1165.050	64.457
460	10.0	1235.195	1190.940	44.255
470	10.0	1240.778	1216.830	23.948
480	10.0	1246.262	1242.720	3.542
490	10.0	1251.648	1268.610	0.000
500	10.0	1256.942	1294.500	0.000
510	9.0	1262.147	1320.390	0.000
520	9.0	1267.265	1346.280	0.000
530	9.0	1272.300	1372.170	0.000
540	9.0	1277.255	1398.060	0.000
550	9.0	1282.132	1423.950	0.000
560	9.0	1286.934	1449.840	0.000
570	9.0	1291.664	1475.730	0.000
580	8.0	1296.323	1501.620	0.000
590	8.0	1300.915	1527.510	0.000
600	8.0	1305.441	1553.400	0.000

Storage volume (m³) = 617.2 m³

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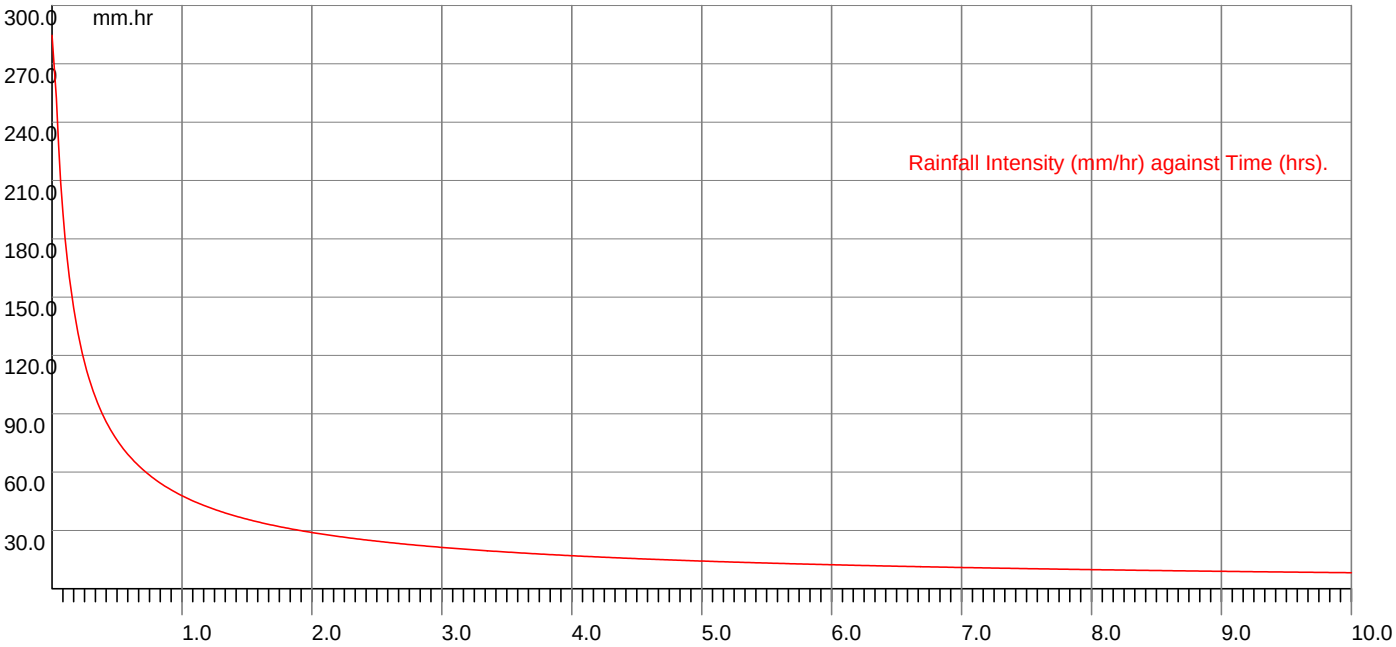
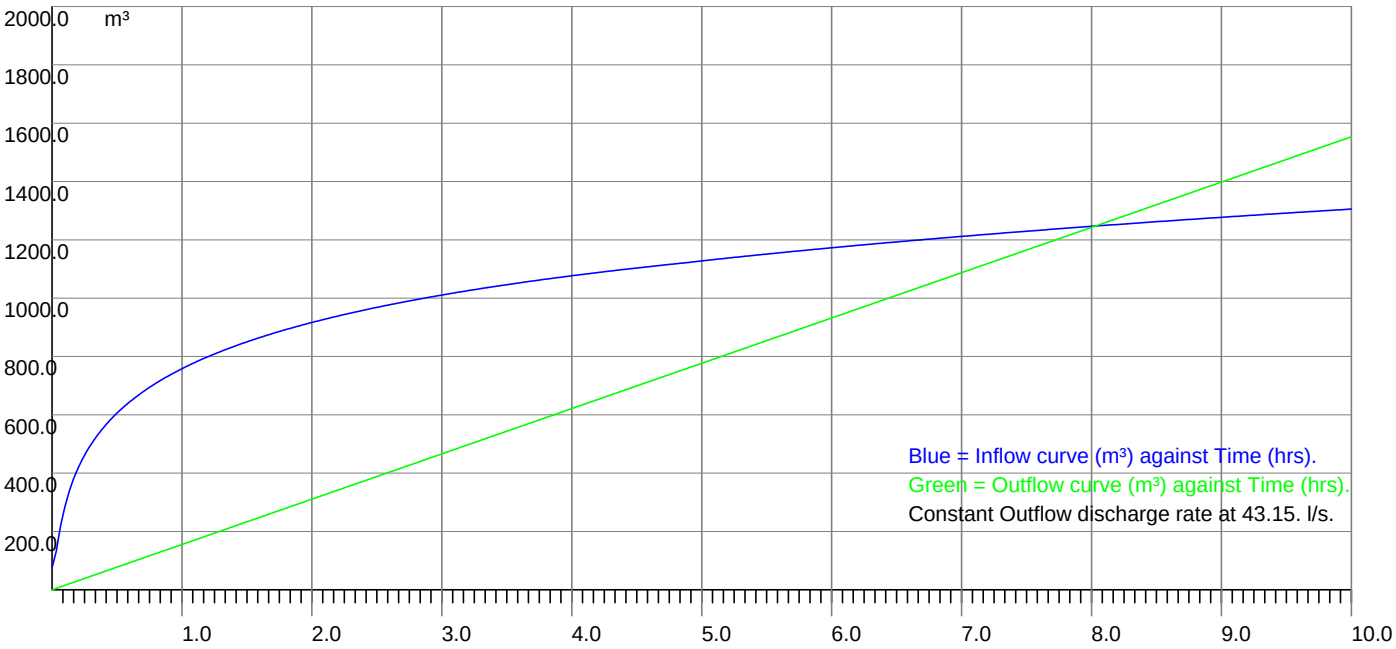
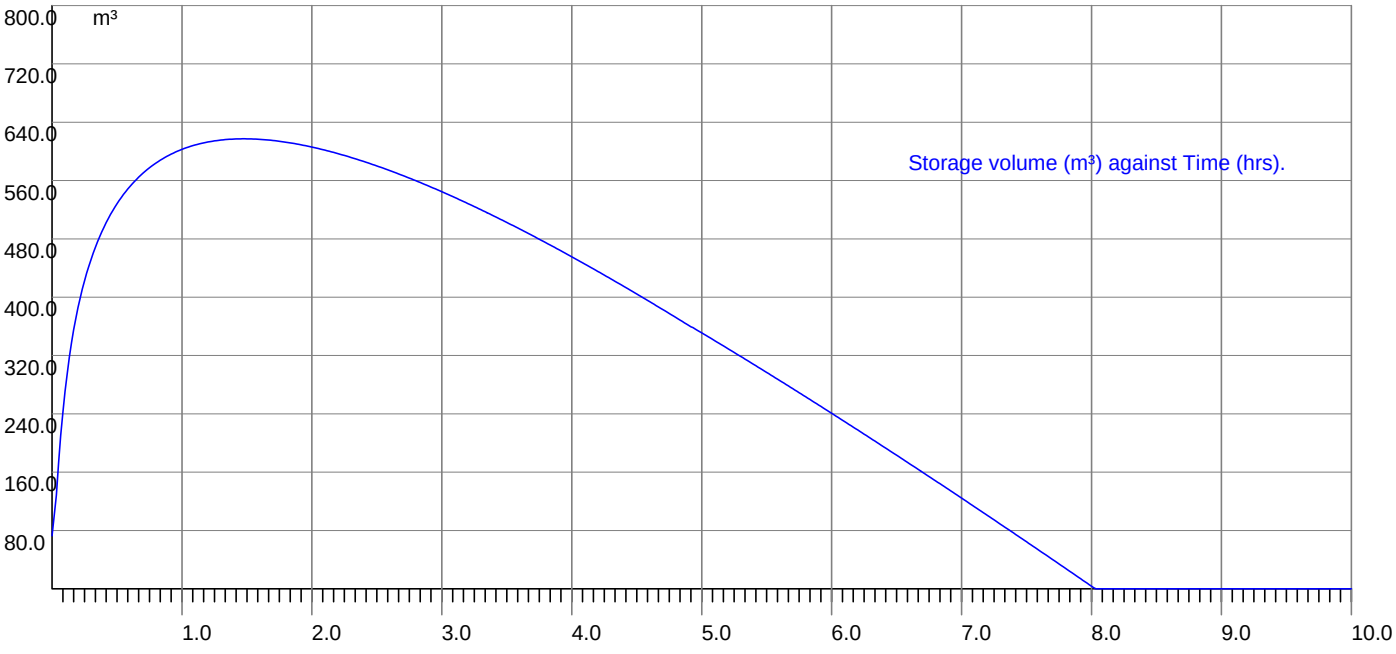
Job No.	
Sheet no.	3
Date	06/02/17

MasterDrain SW

Project	IH 100yr +20% event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		







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Job No.			
Sheet no.	1		
Date	06/02/17		
Project	IH 100yr +40% event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

FSR Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	r	= 0.40
Soil index	= 0.40	SAAR (mm/yr)	= 710
Return period	= 100	WRAP	= 3
UCWI	= 75.7	Climate change	= 40

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 27.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area	= 15100 m²	Pervious area	= 24500 m²
Total area (TA)	= 39600 m²	Equiv area	= 10692 m² (TA x RF).
Allowed discharge rate	= 43.150 l/s	Areal reduction factor	= 1.000
Additional flow	= 0.00 l/s	Climate change factor	= 40

Calculated data:-

Time to max	= 104.0 mins	Calculated storage volume	= 761.5 m³
Rainfall at max	= 37.54 mm/hr	Allowed discharge rate	= 43.150 l/s
Pipeline storage	= 0.0 m³	Available MH storage	= 0.0 m³
Offline storage	= 0.0 m³		

Fixed 6 hour data:-

Rainfall event	= 6 hours	Calculated storage volume	= 418.3 m³
Rainfall rate	= 14.00 mm/hr	Allowed discharge rate	= 43.150 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	96976.6	1125	766.2
150	43100.7	1200	673.4
225	19155.9	1275	596.5
300	10775.2	1350	532.1
375	6896.1	1425	477.6
450	4789.0	1500	431.0
525	3518.4	1575	390.9
600	2693.8	1650	356.2
675	2128.4	1725	325.9
750	1724.0	1800	299.3
825	1424.8	1875	275.8
900	1197.2	1950	255.0
975	1020.1	2025	236.5
1050	879.6	2100	219.9

Ovoid	Len
400 x 600	4230.6
600 x 900	1842.1
800 x 1200	1036.0

Box culvert	Len
500 x 500	3046.0
500 x 750	2030.7
500 x 1000	1523.0
750 x 1000	1015.3
750 x 1200	846.1
750 x 1500	676.9
1000 x 1000	761.5
1000 x 1200	634.6
1000 x 1500	507.7
1000 x 1800	423.1
1000 x 2000	380.8
1500 x 1500	338.4
1500 x 1800	282.0
1500 x 2000	253.8

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Job No.	
Sheet no.	2
Date	06/02/17

MasterDrain SW

Project	IH 100yr +40% event	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	169.0	444.941	25.890	419.051
20	115.0	606.889	51.780	555.109
30	89.0	706.798	77.670	629.128
40	74.0	779.529	103.560	675.969
50	63.0	836.933	129.450	707.483
60	56.0	884.453	155.340	729.113
70	50.0	925.040	181.230	743.810
80	45.0	960.480	207.120	753.360
90	42.0	991.936	233.010	758.926
100	39.0	1020.211	258.900	761.311
110	36.0	1045.882	284.790	761.092
120	34.0	1069.380	310.680	758.699
130	32.0	1091.033	336.570	754.463
140	30.0	1111.101	362.460	748.641
150	29.0	1129.789	388.350	741.439
160	27.0	1147.266	414.240	733.026
170	26.0	1163.670	440.130	723.540
180	25.0	1179.116	466.020	713.096
190	24.0	1193.701	491.910	701.791
200	23.0	1207.508	517.800	689.708
210	22.0	1220.609	543.690	676.919
220	21.0	1233.065	569.580	663.485
230	21.0	1244.930	595.470	649.460
240	20.0	1256.251	621.360	634.891
250	19.0	1267.070	647.250	619.820
260	19.0	1277.424	673.140	604.284
270	18.0	1287.346	699.030	588.316
280	18.0	1296.865	724.920	571.945
290	17.0	1306.008	750.810	555.198
300	17.0	1315.753	776.700	539.053
310	16.0	1325.094	802.590	522.503
320	16.0	1334.179	828.480	505.699
330	15.0	1343.024	854.370	488.654
340	15.0	1351.643	880.260	471.383
350	15.0	1360.048	906.150	453.898
360	14.0	1368.250	932.040	436.210
370	14.0	1376.260	957.930	418.329
380	14.0	1384.086	983.820	400.266
390	14.0	1391.739	1009.710	382.029
400	13.0	1399.226	1035.600	363.626
410	13.0	1406.555	1061.490	345.065
420	13.0	1413.733	1087.380	326.353
430	13.0	1420.766	1113.270	307.496
440	12.0	1427.662	1139.160	288.502
450	12.0	1434.424	1165.050	269.374
460	12.0	1441.061	1190.940	250.120
470	12.0	1447.575	1216.830	230.745
480	11.0	1453.972	1242.720	211.252
490	11.0	1460.256	1268.610	191.646
500	11.0	1466.433	1294.500	171.933
510	11.0	1472.505	1320.390	152.115
520	11.0	1478.476	1346.280	132.196
530	11.0	1484.350	1372.170	112.180
540	10.0	1490.130	1398.060	92.070
550	10.0	1495.820	1423.950	71.870
560	10.0	1501.423	1449.840	51.583
570	10.0	1506.941	1475.730	31.211
580	10.0	1512.377	1501.620	10.757
590	10.0	1517.734	1527.510	0.000
600	10.0	1523.014	1553.400	0.000

Storage volume (m^3) = 761.5 m^3

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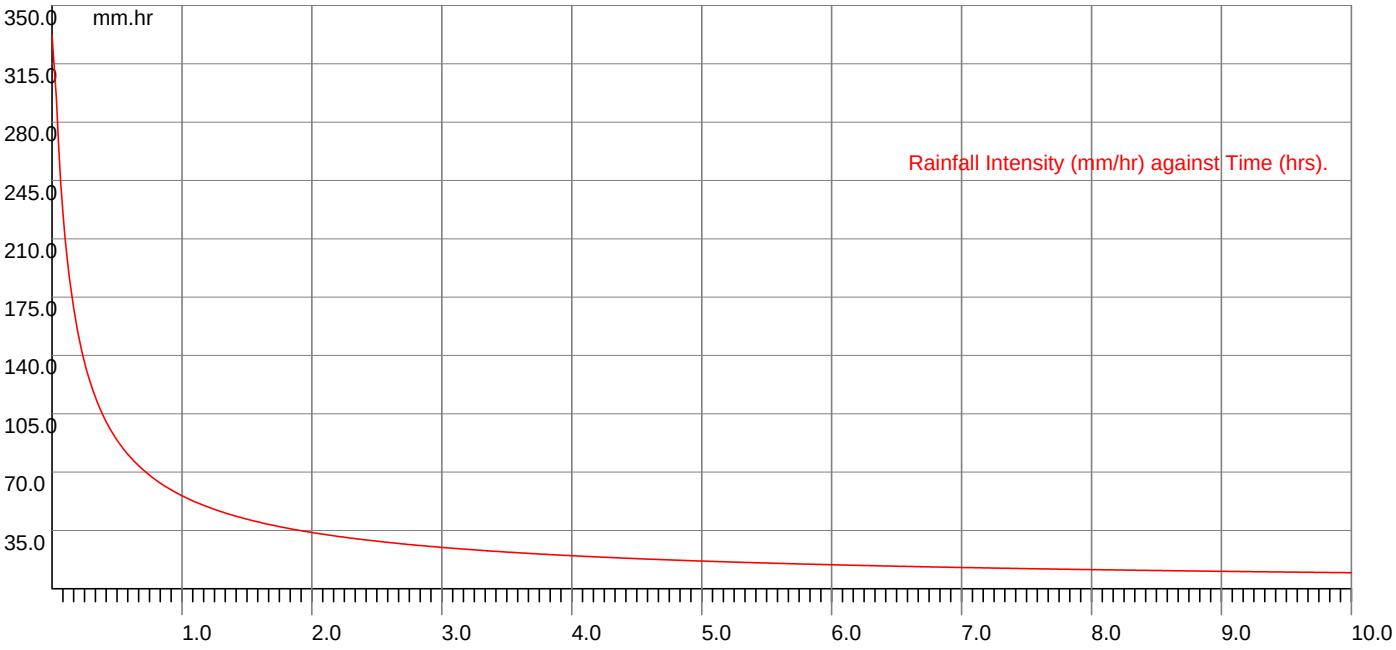
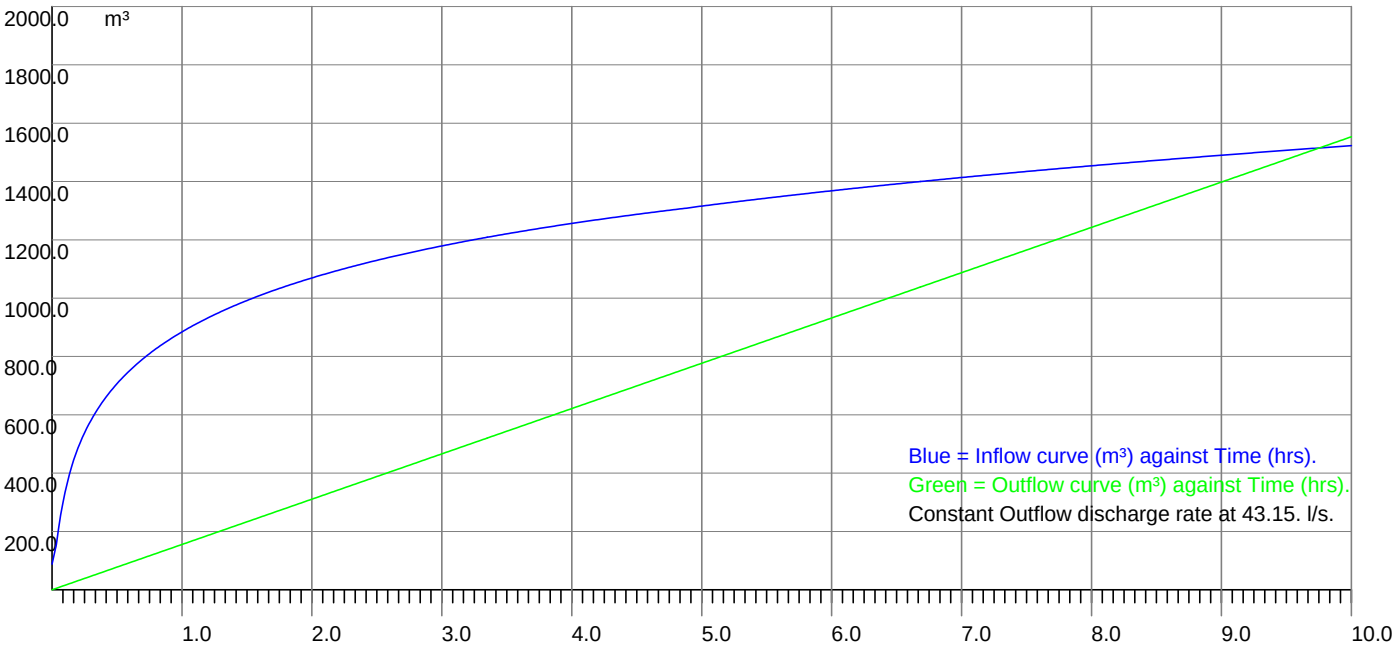
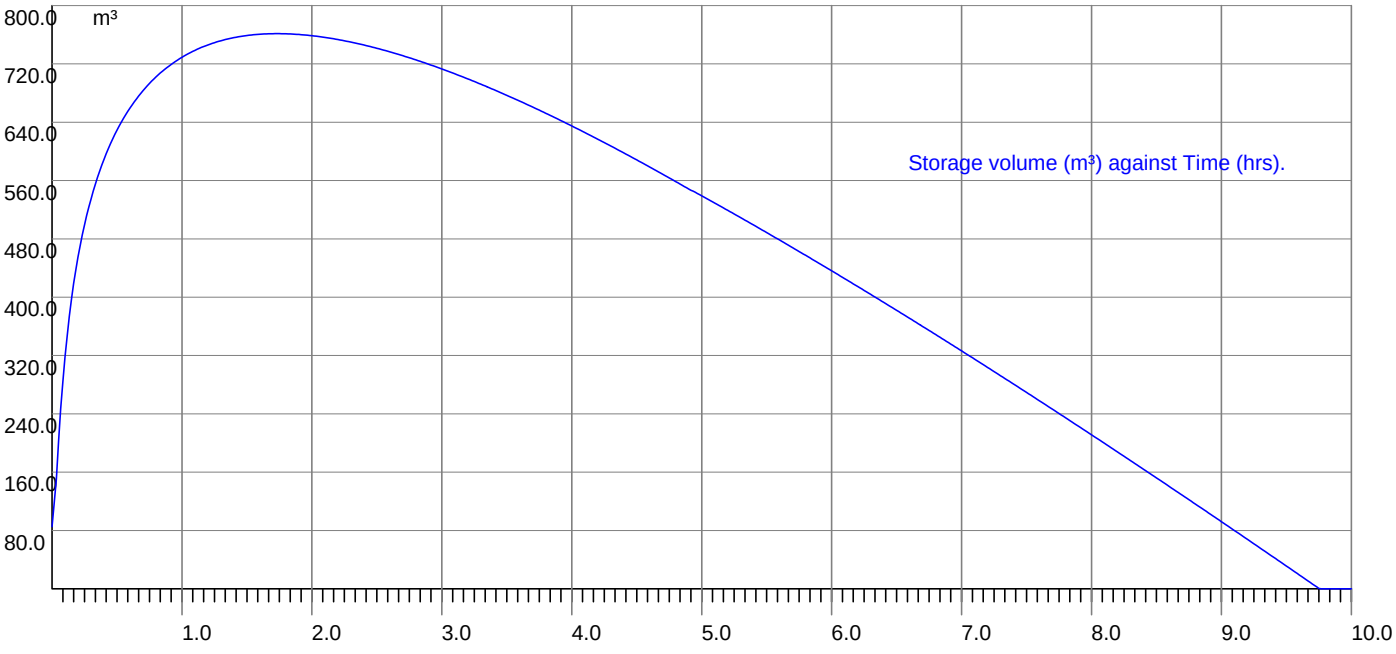
Job No.	
Sheet no.	3
Date	06/02/17

MasterDrain SW

	By	Checked	Reviewed
Project: IH 100yr +40% event			
Title: Peak flow storage calcs for BLOXHAM			







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Job No.	
Sheet no.	1
Date	06/02/17

MasterDrain SW

	By	Checked	Reviewed
Project: ADAS 100 yr +20%			
Title: Peak flow storage calcs for BLOXHAM			

Data:-

FSR Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	r	= 0.40
Soil index	= 0.40	SAAR (mm/yr)	= 710
Return period	= 100	WRAP	= 3
UCWI	= 75.7	Climate change	= 20

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 27.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area	= 15100 m²	Pervious area	= 24500 m²
Total area (TA)	= 39600 m²	Equiv area	= 10692 m² (TA x RF).
Allowed discharge rate	= 44.020 l/s	Areal reduction factor	= 1.000
Additional flow	= 0.00 l/s	Climate change factor	= 20

Calculated data:-

Time to max	= 87.0 mins	Calculated storage volume	= 612.7 m³
Rainfall at max	= 36.68 mm/hr	Allowed discharge rate	= 44.020 l/s
Pipeline storage	= 0.0 m³	Available MH storage	= 0.0 m³
Offline storage	= 0.0 m³		

Fixed 6 hour data:-

Rainfall event	= 6 hours	Calculated storage volume	= 202.4 m³
Rainfall rate	= 12.00 mm/hr	Allowed discharge rate	= 44.020 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	78022.4	1125	616.5
150	34676.6	1200	541.8
225	15411.8	1275	480.0
300	8669.2	1350	428.1
375	5548.3	1425	384.2
450	3853.0	1500	346.8
525	2830.7	1575	314.5
600	2167.3	1650	286.6
675	1712.4	1725	262.2
750	1387.1	1800	240.8
825	1146.3	1875	221.9
900	963.2	1950	205.2
975	820.7	2025	190.3
1050	707.7	2100	176.9

Ovoid	Len
400 x 600	3403.7
600 x 900	1482.0
800 x 1200	833.5

Box culvert	Len
500 x 500	2450.7
500 x 750	1633.8
500 x 1000	1225.3
750 x 1000	816.9
750 x 1200	680.7
750 x 1500	544.6
1000 x 1000	612.7
1000 x 1200	510.6
1000 x 1500	408.4
1000 x 1800	340.4
1000 x 2000	306.3
1500 x 1500	272.3
1500 x 1800	226.9
1500 x 2000	204.2

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Job No.	
Sheet no.	2
Date	06/02/17

MasterDrain SW

Project	ADAS 100 yr +20%	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	144.0	381.378	26.412	354.966
20	99.0	520.190	52.824	467.366
30	76.0	605.827	79.236	526.591
40	63.0	668.168	105.648	562.520
50	54.0	717.371	132.060	585.311
60	48.0	758.103	158.472	599.631
70	43.0	792.892	184.884	608.008
80	39.0	823.269	211.296	611.973
90	36.0	850.231	237.708	612.523
100	33.0	874.467	264.120	610.347
110	31.0	896.470	290.532	605.938
120	29.0	916.611	316.944	599.667
130	27.0	935.171	343.356	591.815
140	26.0	952.372	369.768	582.604
150	24.0	968.391	396.180	572.211
160	23.0	983.371	422.592	560.779
170	22.0	997.431	449.004	548.427
180	21.0	1010.670	475.416	535.254
190	20.0	1023.172	501.828	521.344
200	20.0	1035.007	528.240	506.767
210	19.0	1046.236	554.652	491.584
220	18.0	1056.913	581.064	475.849
230	18.0	1067.083	607.476	459.607
240	17.0	1076.787	633.888	442.899
250	16.0	1086.060	660.300	425.760
260	16.0	1094.935	686.712	408.223
270	15.0	1103.439	713.124	390.315
280	15.0	1111.599	739.536	372.063
290	15.0	1119.436	765.948	353.488
300	14.0	1127.789	792.360	335.429
310	14.0	1135.794	818.772	317.022
320	14.0	1143.582	845.184	298.398
330	13.0	1151.164	871.596	279.568
340	13.0	1158.551	898.008	260.543
350	13.0	1165.755	924.420	241.335
360	12.0	1172.786	950.832	221.954
370	12.0	1179.651	977.244	202.407
380	12.0	1186.359	1003.656	182.703
390	12.0	1192.919	1030.068	162.851
400	11.0	1199.336	1056.480	142.856
410	11.0	1205.618	1082.892	122.726
420	11.0	1211.771	1109.304	102.467
430	11.0	1217.800	1135.716	82.084
440	11.0	1223.710	1162.128	61.582
450	10.0	1229.507	1188.540	40.967
460	10.0	1235.195	1214.952	20.243
470	10.0	1240.778	1241.364	0.000
480	10.0	1246.262	1267.776	0.000
490	10.0	1251.648	1294.188	0.000
500	10.0	1256.942	1320.600	0.000
510	9.0	1262.147	1347.012	0.000
520	9.0	1267.265	1373.424	0.000
530	9.0	1272.300	1399.836	0.000
540	9.0	1277.255	1426.248	0.000
550	9.0	1282.132	1452.660	0.000
560	9.0	1286.934	1479.072	0.000
570	9.0	1291.664	1505.484	0.000
580	8.0	1296.323	1531.896	0.000
590	8.0	1300.915	1558.308	0.000
600	8.0	1305.441	1584.720	0.000

Storage volume (m^3) = 612.7 m^3

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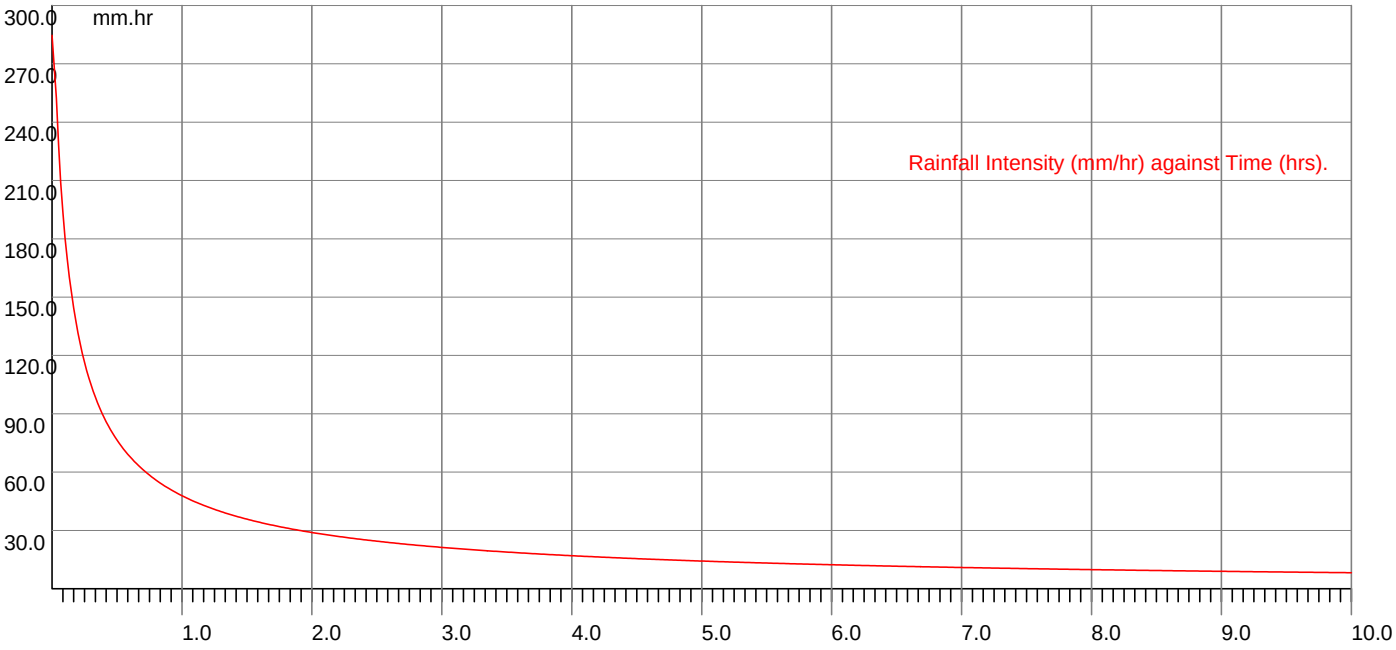
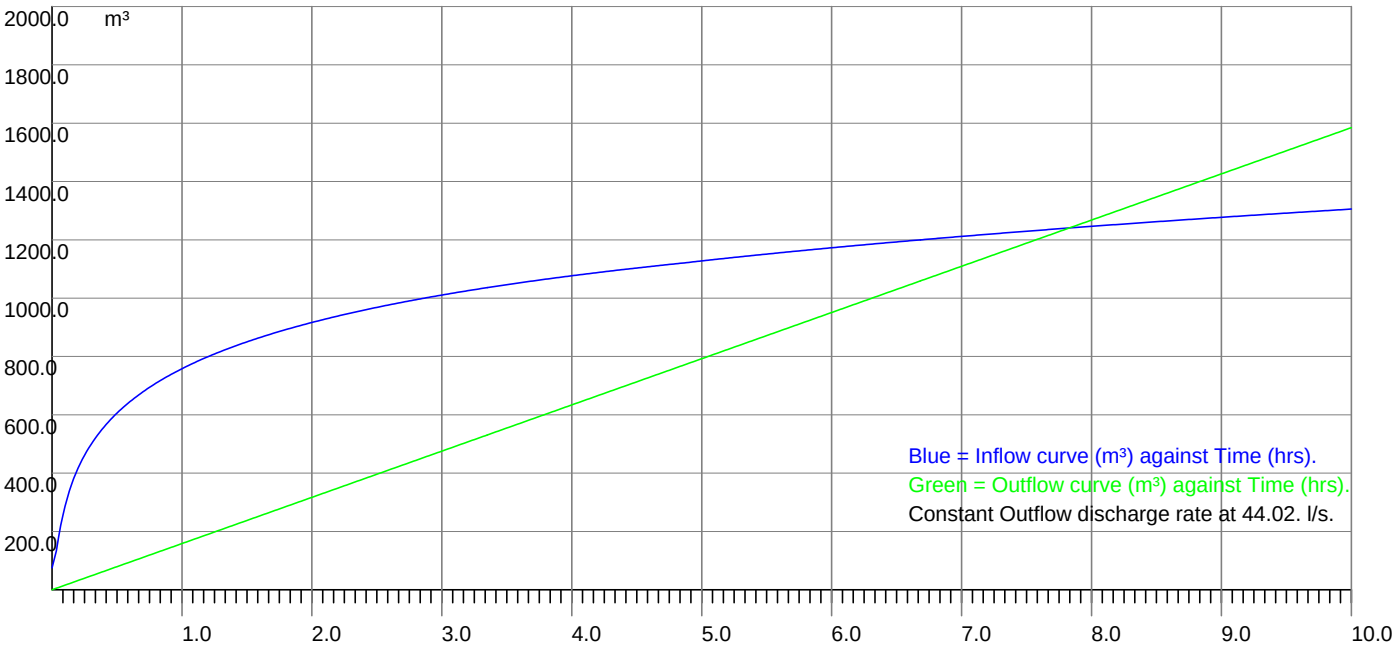
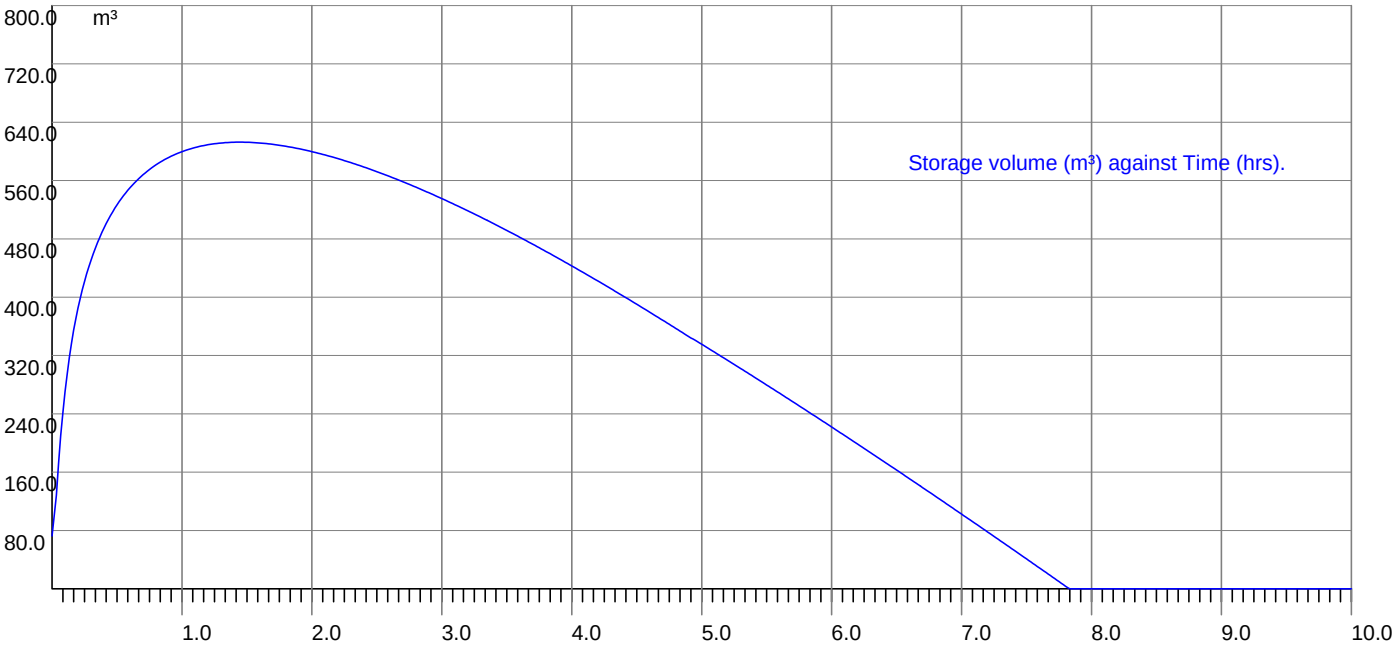
Job No.	
Sheet no.	3
Date	06/02/17

MasterDrain SW

Project	ADAS 100 yr +20%	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		







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Job No.	
Sheet no.	1
Date	06/02/17

MasterDrain SW

	By	Checked	Reviewed
Project: ADAS 100 yr +40%			
Title: Peak flow storage calcs for BLOXHAM			

Data:-

FSR Hydrology:-

Location	= BLOXHAM	Grid reference	= SP4235
M5-60 (mm)	= 19.7	r	= 0.40
Soil index	= 0.40	SAAR (mm/yr)	= 710
Return period	= 100	WRAP	= 3
UCWI	= 75.7	Climate change	= 40

i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
ii) Permeable soils with shallow ground water in low-lying areas;
iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 27.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area	= 15100 m²	Pervious area	= 24500 m²
Total area (TA)	= 39600 m²	Equiv area	= 10692 m² (TA x RF).
Allowed discharge rate	= 44.020 l/s	Areal reduction factor	= 1.000
Additional flow	= 0.00 l/s	Climate change factor	= 40

Calculated data:-

Time to max	= 102.0 mins	Calculated storage volume	= 756.1 m³
Rainfall at max	= 38.08 mm/hr	Allowed discharge rate	= 44.020 l/s
Pipeline storage	= 0.0 m³	Available MH storage	= 0.0 m³
Offline storage	= 0.0 m³		

Fixed 6 hour data:-

Rainfall event	= 6 hours	Calculated storage volume	= 399.0 m³
Rainfall rate	= 14.00 mm/hr	Allowed discharge rate	= 44.020 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len
100	96292.4	1125	760.8
150	42796.6	1200	668.7
225	19020.7	1275	592.3
300	10699.2	1350	528.4
375	6847.5	1425	474.2
450	4755.2	1500	428.0
525	3493.6	1575	388.2
600	2674.8	1650	353.7
675	2113.4	1725	323.6
750	1711.9	1800	297.2
825	1414.8	1875	273.9
900	1188.8	1950	253.2
975	1012.9	2025	234.8
1050	873.4	2100	218.4

Ovoid	Len
400 x 600	4200.8
600 x 900	1829.1
800 x 1200	1028.7

Box culvert	Len
500 x 500	3024.5
500 x 750	2016.4
500 x 1000	1512.3
750 x 1000	1008.2
750 x 1200	840.2
750 x 1500	672.1
1000 x 1000	756.1
1000 x 1200	630.1
1000 x 1500	504.1
1000 x 1800	420.1
1000 x 2000	378.1
1500 x 1500	336.1
1500 x 1800	280.1
1500 x 2000	252.0

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Job No.	
Sheet no.	2
Date	06/02/17

MasterDrain SW

Project	ADAS 100 yr +40%	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	169.0	444.941	26.412	418.529
20	115.0	606.889	52.824	554.065
30	89.0	706.798	79.236	627.562
40	74.0	779.529	105.648	673.881
50	63.0	836.933	132.060	704.873
60	56.0	884.453	158.472	725.981
70	50.0	925.040	184.884	740.156
80	45.0	960.480	211.296	749.184
90	42.0	991.936	237.708	754.228
100	39.0	1020.211	264.120	756.091
110	36.0	1045.882	290.532	755.350
120	34.0	1069.380	316.944	752.436
130	32.0	1091.033	343.356	747.677
140	30.0	1111.101	369.768	741.333
150	29.0	1129.789	396.180	733.609
160	27.0	1147.266	422.592	724.674
170	26.0	1163.670	449.004	714.666
180	25.0	1179.116	475.416	703.700
190	24.0	1193.701	501.828	691.873
200	23.0	1207.508	528.240	679.268
210	22.0	1220.609	554.652	665.957
220	21.0	1233.065	581.064	652.001
230	21.0	1244.930	607.476	637.454
240	20.0	1256.251	633.888	622.363
250	19.0	1267.070	660.300	606.770
260	19.0	1277.424	686.712	590.712
270	18.0	1287.346	713.124	574.222
280	18.0	1296.865	739.536	557.329
290	17.0	1306.008	765.948	540.060
300	17.0	1315.753	792.360	523.393
310	16.0	1325.094	818.772	506.321
320	16.0	1334.179	845.184	488.995
330	15.0	1343.024	871.596	471.428
340	15.0	1351.643	898.008	453.635
350	15.0	1360.048	924.420	435.628
360	14.0	1368.250	950.832	417.418
370	14.0	1376.260	977.244	399.016
380	14.0	1384.086	1003.656	380.430
390	14.0	1391.739	1030.068	361.671
400	13.0	1399.226	1056.480	342.746
410	13.0	1406.555	1082.892	323.663
420	13.0	1413.733	1109.304	304.429
430	13.0	1420.766	1135.716	285.050
440	12.0	1427.662	1162.128	265.534
450	12.0	1434.424	1188.540	245.884
460	12.0	1441.061	1214.952	226.109
470	12.0	1447.575	1241.364	206.211
480	11.0	1453.972	1267.776	186.196
490	11.0	1460.256	1294.188	166.068
500	11.0	1466.433	1320.600	145.833
510	11.0	1472.505	1347.012	125.493
520	11.0	1478.476	1373.424	105.052
530	11.0	1484.350	1399.836	84.514
540	10.0	1490.130	1426.248	63.882
550	10.0	1495.820	1452.660	43.160
560	10.0	1501.423	1479.072	22.351
570	10.0	1506.941	1505.484	1.457
580	10.0	1512.377	1531.896	0.000
590	10.0	1517.734	1558.308	0.000
600	10.0	1523.014	1584.720	0.000

Storage volume (m³) = 756.1 m³

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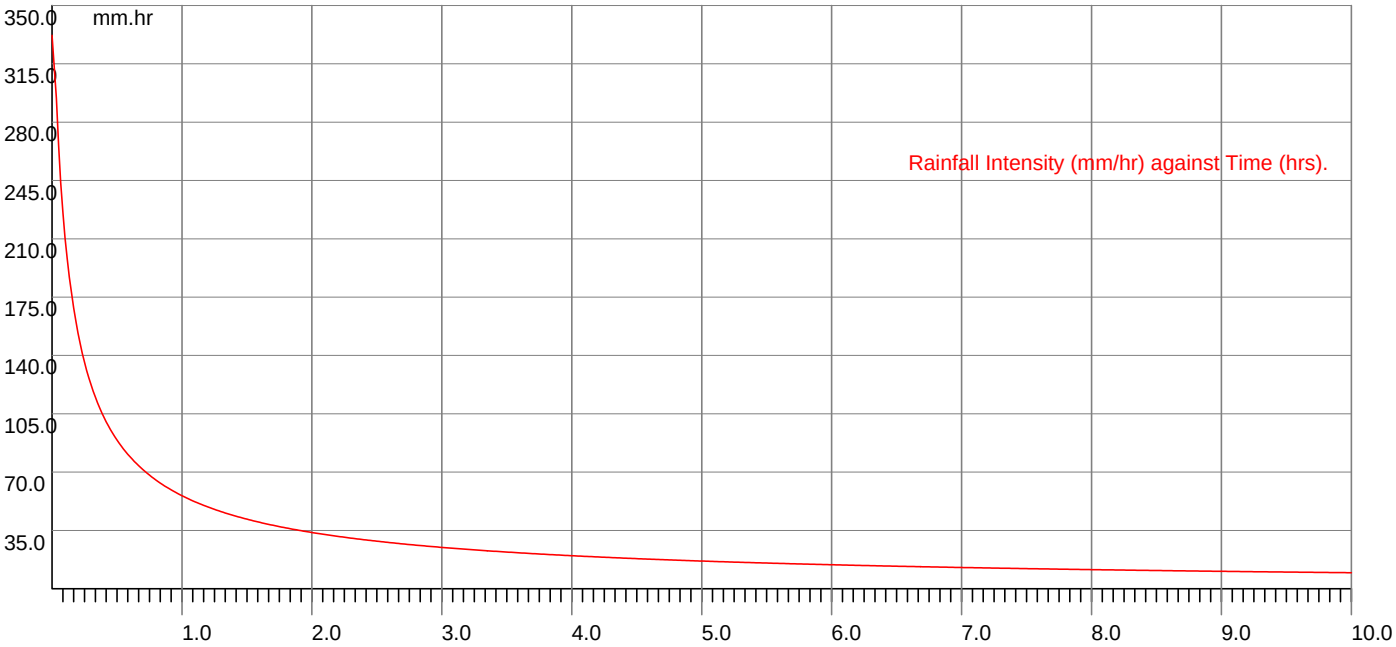
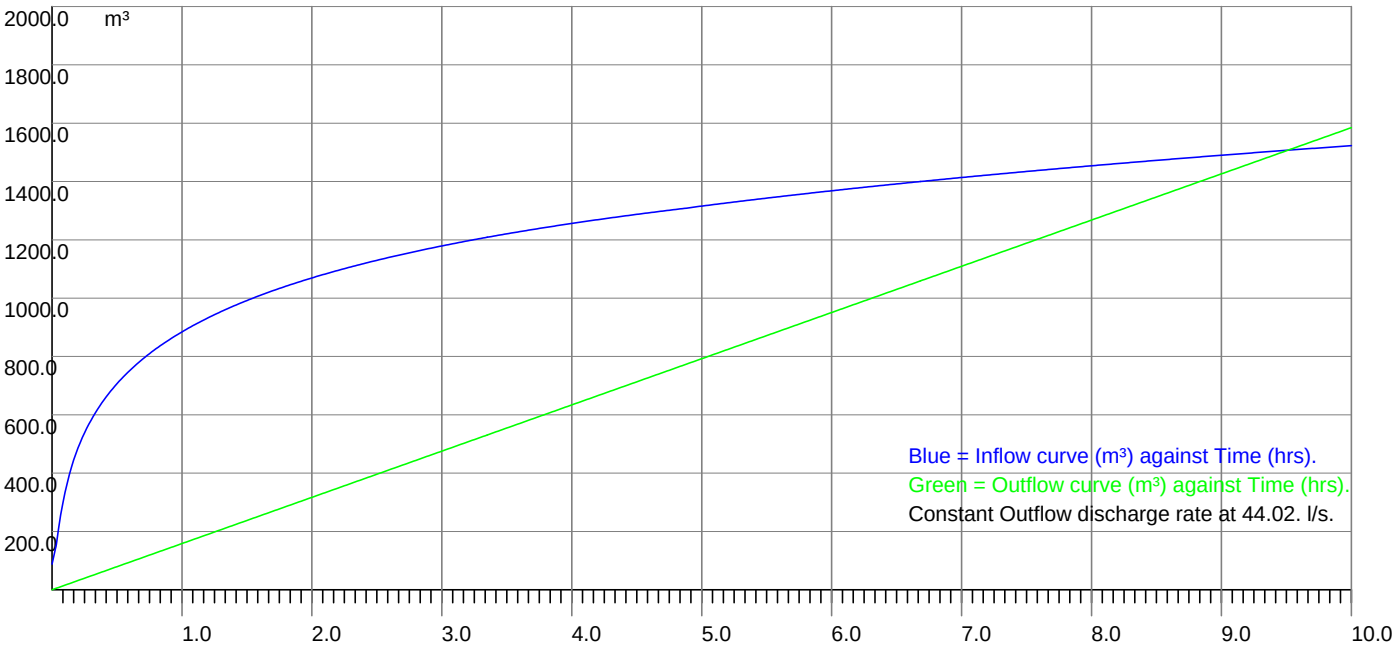
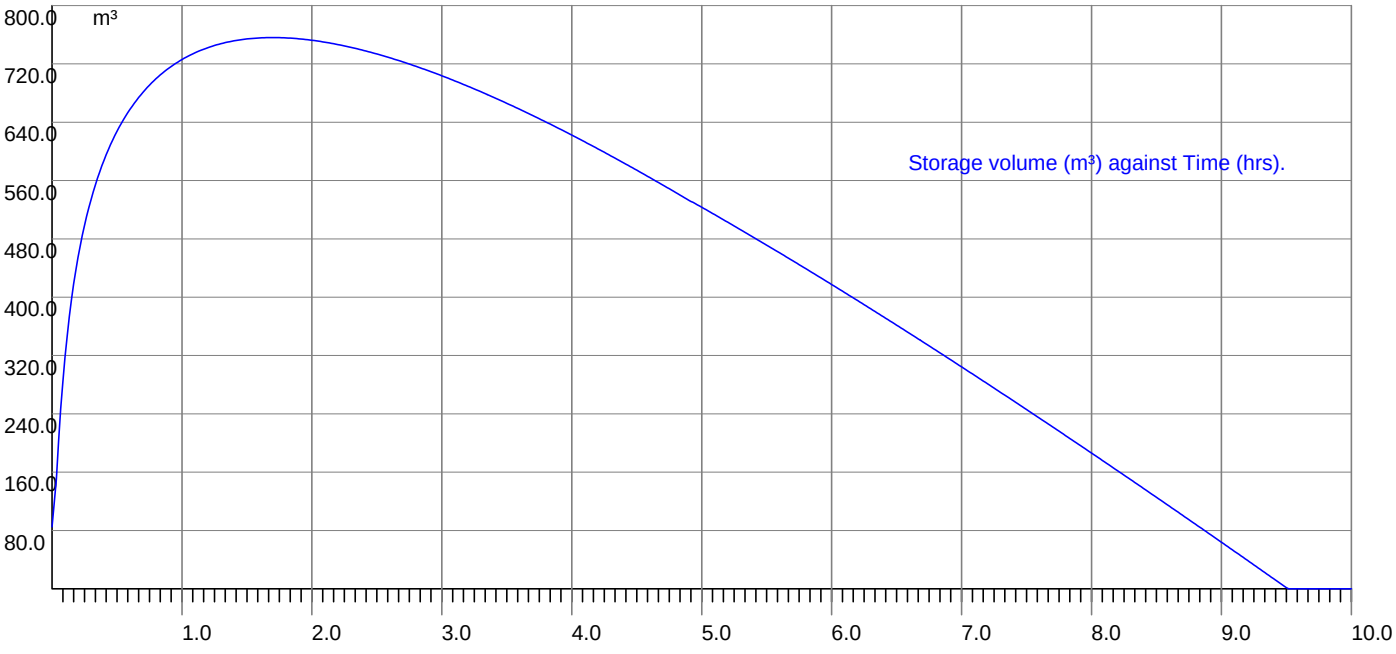
Job No.	
Sheet no.	3
Date	06/02/17

MasterDrain SW

Project	ADAS 100 yr +40%	By	Checked / Reviewed
Title	Peak flow storage calcs for BLOXHAM		







Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

APPENDIX F

DRAINAGE STRATEGY PLAN

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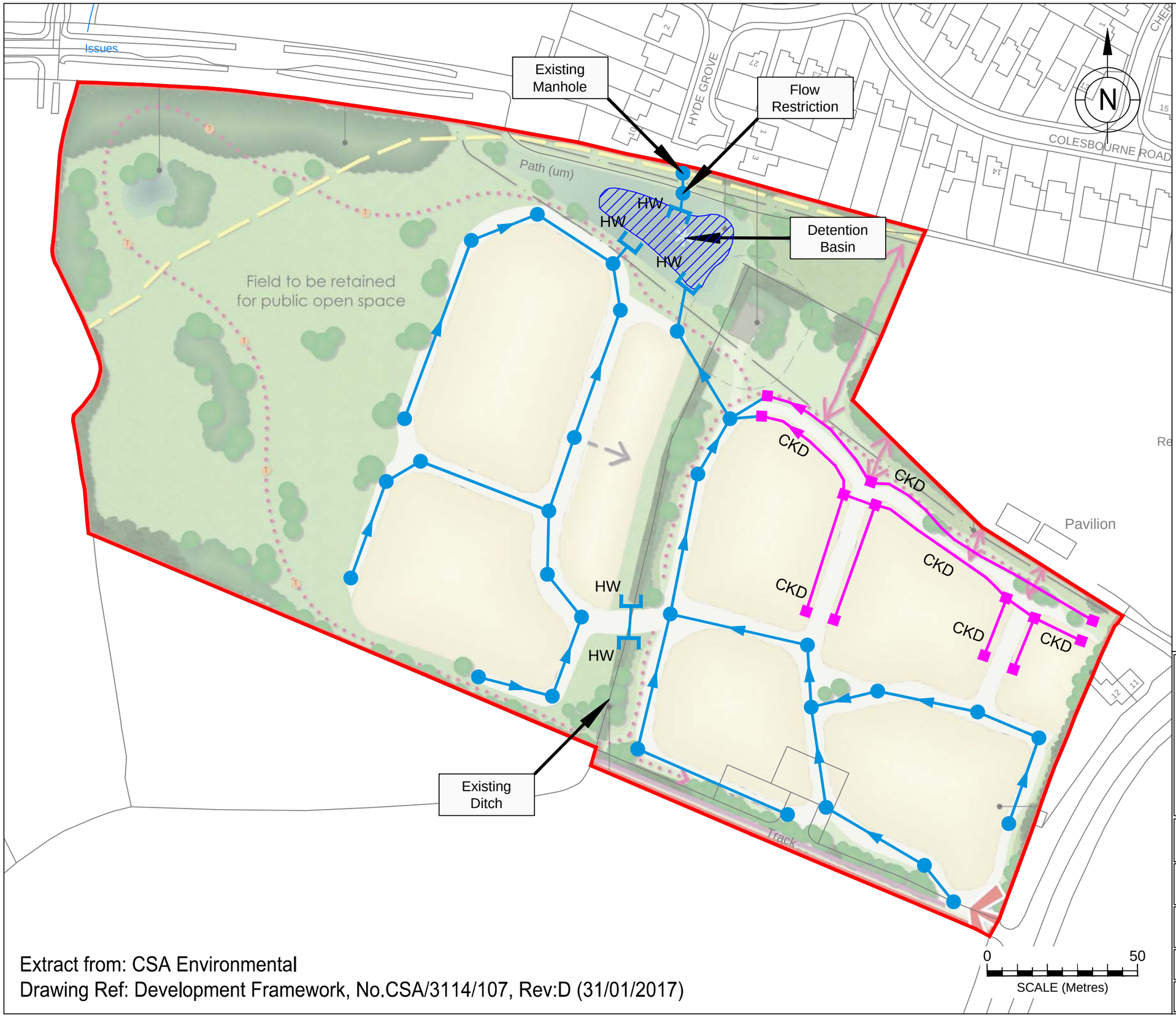

Extract from: CSA Environmental
Drawing Ref: Development Framework, No.CSA/3114/107, Rev:D (31/01/2017)

KEY

- Site Boundary
- Chamber
- Direction of Flow
- Detention Basin
- Headwall (HW)
- Combined Kerb Drain (CKD)

Attenuation storage volume: **359.5 m^3 - 375.0 m^3**
(1 in 30 year event)
Retention on site volume: **612.7 m^3 - 761.5 m^3**
(1 in 100 year event + Climate Change)

LK CONSULT LIMITED

Client: Gladmans Developments Ltd

Site: South Newington Road, Bloxham

Title: Drainage Strategy

Job No.:	Scale (See Scale Bar):	Figure:	Revision:
FRA 16 1075	1:1250 @ A3	3	

Drawn By:	Checked By:	Drawn:
AC	MJ	Feb 2017