BETTS HYDRO
CONSULTING ENGINEERS

OXFORD ROAD
BODICOTE

FLOOD RISK ASSESSMENT AND DRAINAGE MANAGEMENT STRATEGY

For

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EXECUTIVE SUMMARY

This Flood Risk Assessment and Drainage Management Strategy was commissioned by Hollins Strategic Land referred to hereafter as 'the client'. This report has been prepared to support an outline planning application for the construction of a residential development on land adjacent to Oxford Road in Bodicote.

Flood Risk

The site lies solely within Flood Zone 1 based on the Environment Agency Flood Map for Planning and is 2.204ha in size. Residential development is classified as 'more vulnerable' within the Planning Practice Guidance which supports the National Planning Policy Framework. The Planning Practice Guidance confirms that 'more vulnerable' development is appropriate to be located within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

This report has reviewed all sources of flood risk both to and resulting from the proposed development site. Consultations with the Environment Agency, Oxfordshire County Council, Cherwell District Council and Thames Water have been undertaken and did not identified any historical incidents of flooding to the site.

The proposals are considered to be at 'very low' flood risk from the majority of flood sources. The nearest watercourse to site is Sor Brook located approximately 1km south of site, the Oxford Canal is also located approximately 1.5km north with the River Cherwell located beyond. The primary flood risk however, is considered to be from 'very low' surface water run-off, which is closely associated with the existing topography on site. The risk associated with surface water flooding will be reduced and sustainably managed post-development, following the implementation of mitigation measures proposed within this assessment.

Drainage Strategy

Due to the relatively low flood risks identified, the principle focus of this assessment is on sustainable management of surface water run-off in accordance with national and local policy. Surface water discharge options have been assessed in accordance with the sustainable drainage hierarchy and based on the ground conditions identified by the online datasets, infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. The mapping however, is considered to be large scale and infiltration rates vary on a site by site basis, it would therefore be recommended that further investigation (onsite testing) takes place upon planning approval as infiltration would be the primary means of discharging surface water run-off.

At this time the planning layout has allowed for an area of open space, this area could be used for an infiltration based approach such as an infiltration basin, soakaway or trench. Conditional on the outcome of the onsite soakaway testing and detailed design requirements upon planning approval. It would also be recommended that the specific infiltration methods to be used are discussed with the key stakeholders, including the Local Planning Authority and Thames Water at an early stage. Infiltration method(s) and any adoption design standards used will need to be to BRE365 standard and designed in accordance with the CIRIA Sustainable Drainage System Manual.

In terms of discharge rates, in accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. The proposals are therefore discharge at greenfield rates, the discharge rate will not exceed that of the existing onsite percolation rate(s) based on testing at the proposed depths of drainage infrastructure proposed.

The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with overland run-off from storm events up to and including the 1 in 100yr return period event with a 40% allowance for climate change being contained onsite. It would be beneficial to implement SuDS features including permeable surfaces, bio-filtration and infiltration basin (or similar), to assist with this requirement.

Should infiltration be proven not be a feasible surface water drainage method for all the site following onsite testing, then the next outfall in the hierarchical approach is to discharge to the watercourse however, there are no watercourses suitable for outfall within close proximity of the site. The alternative would therefore be to discharge to the sewer network; subject to the relevant consents and agreements from Thames Water.

The Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

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Specialist Software

- MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability
BGL	Below Ground Level
BGS	British Geological Survey
CDC	Cherwell District Council
CC	Climate Change
CSAI	Cranfield Soil and Agrifood Institute
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FZ	Flood Zone
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	Metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSRI	National Soil Resources Institute
OS	Ordnance Survey
OCC	Oxfordshire County Council
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
QSE	Quick Storage Estimate
QBAR	Mean Annual Flood
SfA	Sewers For Adoption
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
TW	Thames Water
TWL	Top Water Level

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1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Planning Practice Guidance (PPG) (refer to extracts in **Appendix A**).

1.1.2 A Flood Risk Assessment and Drainage Management Strategy (FRA&DMS) has been completed in accordance with NPPF/PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with the recent changes to national policy.

1.1.3 The proposals are considered to be solely 'residential' in nature and as such is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification, within the Planning Practice Guidance. The PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

1.2 Site Context

1.2.1 This FRA&DMS has been prepared to support an outline planning application for a residential development on land off Oxford Road in Bodicote. The proposals will be complete with access, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultations with the Environment Agency (EA), Oxfordshire County Council (OCC), Cherwell District Council (CDC) and Thames Water (TW). Consultation responses can be seen in **Appendix B, C** and **D** respectively. The NPPF advises that CDC as the Local Planning Authority (LPA) should consult with the EA who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The proposed development site is located adjacent to Oxford Road in Bodicote. The Ordnance Survey National Grid Reference (OS NGR) for the site is E: 446170, N: 238398 and the nearest postcode is OX15 4QL. The total site covers 2.204ha and is edged in red in **Figure 1** (see location plan in **Appendix E**).

2.1.2 Adjacent to the north-eastern boundary of site is Oxford Road with existing residential dwellings with further residential development being undertaken. To the south-east of site is Park End Close residential estate and Cherwell District Council Offices. Further west of the council offices is Bishop Loveday C of E Primary School with White Post Road to the north-west of site. White Post Road is bounded by recreational land, residential dwellings, and Saltway Day Nursey (as illustrated in **Figure 1**).

Figure 1: Aerial Photograph of site (Bing Maps, 2018)

2.2 Existing and Historical Land Use

2.2.1 This assessment has identified that the site was historically used as the former Bodicote Flyover Farm Shop. There are numerous buildings onsite located within the south-west corner adjacent to the Bishop Loveday C of E Primary School. The undeveloped land located north of the Farm Shop compromises of low density vegetation, several trees, and taller shrubs along the site boundaries. No other historical uses of the site has been identified as part of this assessment.

2.3 Topography

2.3.1 The site is reasonably flat however, there is a gentle fall from 123.04mAOD in the north-eastern corner that slopes towards the south-western boundary of site, to a level of 120.51mAOD. A full topographical survey has been carried out and is included in **Appendix B**.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This assessment is to support an outline planning application for a residential development on land off Oxford Road. The application also includes demolition of the former Bodicote Flyover Farm Shop buildings. The proposals will be complete with access, car parking, external works and lighting, landscaping, ponds, boundary walls and fencing, external services and drainage as show on the illustrative masterplan in **Figure 2** (**Appendix G**).

Figure 2: Illustrative Masterplan (HSL, 2018)

3.1.2 The total site covers 2.204ha and the proposed development area however excludes those areas that will remain undeveloped and equates to 1.806ha. The site is partly developed and the pre-development area is 20% impermeable at present. Due to the nature of the proposals the impermeable area post-development is assumed to increase to approximately 49% of the development site (0.878ha).

3.1.3 National and local policy identifies that Sustainable Drainage Systems (SuDS) should be incorporated into new development where at all feasible. There is likely to be scope to incorporate some SuDS features within the proposed open space/amenity areas on the site. Although detailed design will be required to confirm the specific types, subject to ground investigations and detailed levels review (refer to Section 5.0 for the proposed outline drainage strategy).

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency and from the Gov.uk website. An extract of the EA's Flood Zone Map for Planning is shown in **Figure 3**, which illustrates that the proposed development site is located solely within Flood Zone 1. Flood Zone 1 is an area considered to be at little or no flood risk from rivers and/or the sea (as defined by the EA).

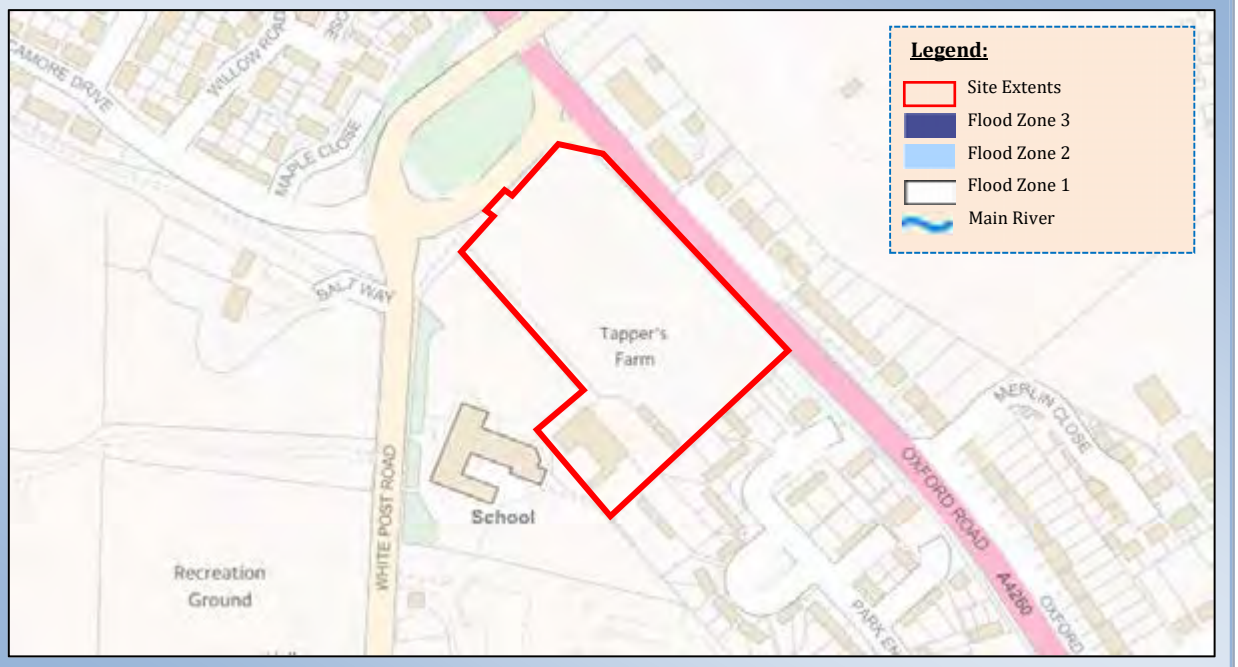

Figure 3: Fluvial/Tidal Flood Zone Map for Planning Extract (GOV.UK 2018)

4.1.2 The nearest Main River to the site is Sor Brook located approximately 1km south of site, the River Cherwell and the Oxford Canal are also located approximately 1.5km to the north-east. The risk to the site from these potential flood sources is considered to be 'very low' due to their proximity from the site and the existing surrounding topography.

4.1.3 There are also Ordinary Watercourses (land drainage) located approximately 1km to the west of site. The flood risk from these features is also considered to be 'very low' due to the proximity and the surrounding topography, this can be seen in the Governments Long-Term Flood Risk Mapping, see **Appendix B**.

Safe Access and Egress

4.1.4 The proposed access road for the site will be via White Post Road adjacent to the north-eastern site boundary. This is shown on the EA's Flood Zone Map for Planning, to also be located within Flood Zone 1 and is therefore at very low risk from fluvial/tidal flooding. Safe access and egress will therefore be maintained via the new proposed access road onto Oxford Road.

4.2 Tidal Flood Risk

4.2.1 The Bristol Channel is located approximately 100km of the development site and the Severn Estuary is also located approximately 90km south-west of site. Due to the distance from the coast, the associated flood risk from these sources is considered to be very low. This is supported by the EA's Fluvial/Tidal Flood Zone Map for Planning as the site is located within Flood Zone 1 (**Figure 3**).

4.3 Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.3.1 The proposals are solely 'residential' in nature and as such is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification within the PPG. Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

4.4 Surface Water Flood Risk

4.4.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. The risk associated with surface water run-off is indicated by the long term flood mapping (extract shown in **Figure 4**).

Figure 4: Surface Water Flood Map Extract (GOV.UK, 2018)

4.4.2 As indicated in **Figure 4**, the site is considered to predominantly be at 'very low' risk from surface water flooding. There is an area onsite shown to be at 'low' risk from surface water, located on existing hardstanding areas associated with the former Bodicote Flyover Farm Shop. The ground has been identified as low-lying gravel (120.86mAOD) in comparison to the surrounding ground levels (121.15mAOD). Run-off naturally falling onsite would direct to the low-lying areas and is unable to direct elsewhere due to the surrounding higher land and therefore may be susceptible to ponding in the extreme storm events.

4.4.3 There could be potential for surface water exceedance from the adjacent highway to flow towards the site along the Oxford Road boundary, an interception method could be implemented if deemed necessary along this boundary to mitigate for any associated residual risks.

4.4.4 The risk to the proposals from surface water flooding will be inherently reduced, post-development through appropriate levels design and implementation of a sustainable surface water drainage regime. In order to further mitigate for any residual risks it is advised that (following any re-grade of the site) finished floor levels are elevated above the external levels to provide safe overland flood routes for excess surface water run-off.

Pluvial (Overland run-off) Flood Risk

4.4.5 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. The topography of the development and surrounding area means there is little likelihood of significant flows impacting on the proposed development or on land/ property adjacent to the development. The only flows that are likely to be present on site are from direct rainfall on areas of hard-standing.

4.4.6 The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area. Any overland flows generated by the development must be carefully controlled, safe avenues directing overland flow away from adjacent proposed development being advised.

Sewer Flood Risk

4.4.7 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away.

4.4.8 Thames Water sewer records identify there to be limited public surface water sewer infrastructure within the vicinity of the site however, the nearest public surface water sewer is located within Sycamore Drive approximately 118m north-west of site. We have contacted TW regarding the possibility of sewer flooding in the vicinity of the site, they have confirmed there has been no recorded of historical sewer flooding issues, refer to **Appendix C**.

4.5 Groundwater Flood Risk

4.5.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe.

4.5.2 In general terms groundwater flooding can occur from three main sources:

- If groundwater levels are naturally close to the surface then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified

during review of the Oxfordshire County Council Strategic Flood Risk Assessment (SFRA).

- Seepage and percolation occur where embankments above ground level hold water. In these cases water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.
- Groundwater recovery/rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.

4.5.3 The EA mapping data for groundwater shows that the site is underlain by a Secondary A Bedrock Aquifer with no superficial deposits (**Appendix B**). The site is located within a High Groundwater Vulnerability Zone to a Minor Aquifer. No historical groundwater flooding of the site has been identified during consultation with interested parties. Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flow route.

4.6 Artificial Sources of Flood Risk

4.6.1 National policy states that a FRA should consider the potential risks from a variety of other flood sources including artificial sources (such as risks from reservoirs and canals).

Reservoirs

4.6.2 The EA recognises reservoirs as bodies of water over 25,000cu.m and the long term flood mapping is included in **Appendix B** which shows the extents of flooding associated with reservoirs does not impact upon or near to the proposed development site.

4.6.3 There is a small body of water (less than 25,000cu.m) 1km south-west of the proposed development site which has been identified as an existing reservoir. This feature is understood to aid in supplying water to the neighbouring areas, due to the distance and the surrounding natural topography the risk it poses to site is minimal.

Canals

4.6.3 The nearest canal to site is the Oxford Canal located approximately 1.5km north-east of the proposed development site. Consultation with the Canal & Rivers Trust did not identify any historical flooding to site during the preparation of this assessment as a result of canal flood sources. Due to the distance from site the risk of flooding associated with canals is considered to be 'very low'.

4.6.4 Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flood flow route in the event of a breach or any other source of flooding that could lead to overland flows including reservoir or canal flooding.

4.7 Historical and Anecdotal Flooding Information

4.7.1 An internet based search for flooding events did not recall any historical flooding to the immediate development site area. There has been instances of flooding recorded to the wider Oxford area associated with the River Cherwell and surface water run-off. However, due to the distance from the River Cherwell to site and the surrounding natural topography the risk to the proposals from the future events would be minimal.

4.7.2 Review of the Oxfordshire County Council Preliminary Flood Risk Assessment (PFRA) and the Cherwell District Council's Strategic Flood Risk Assessment (SFRA) did not highlight any historic flooding pertinent to this FRA (general mapping data is included in **Appendix H**). Consultation with EA, OCC, CDC and TW failed to highlight any historical flooding directly to the site (see correspondence in **Appendix B, C and D** respectively).

4.8 Flood Risk Mitigation Measures & Residual Risks

4.8.1 The site is located within Flood Zone 1 and considered to be at little risk of fluvial/tidal flooding. To observe a conservative approach, mitigation measures have been proposed below to safeguard the development with regards to other potentials residual sources of flood risk and to consider the uncertainties of climate change in accordance with the NPPF and PPG.

Mitigation Measures

4.8.2 For 'more vulnerable' development located within Flood Zone 1, it is typical to set the Finished Floor Levels (FFL) of residential dwellings to a minimum of 150mm above the existing ground levels. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

4.8.3 Any overland flows generated by the development must be carefully controlled. Safe avenues directing overland flow way from any existing and proposed buildings are advised.

4.8.4 To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation (with betterment where required).

4.8.5 The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

4.8.6 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

Residual Risks

4.8.7 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the development site in the event that the capacity of the drainage system is exceeded.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The total site covers 2.204ha, however the proposed development area excludes areas which will remain undeveloped and covers a smaller portion at approximately 1.806ha. At present the development area is approximately 20% impermeable and it is assumed to have existing positive surface water drainage infrastructure to cater for the existing run-off generated; further investigation would be required to confirm the presence of these existing assets. Furthermore, the undeveloped areas located onsite are considered to discharge naturally to ground over an extended time.

5.1.2 As the existing method of surface water management is unconfirmed and national planning policy states new development should endeavour to achieve greenfield equivalent rates. The peak rates and volumes of run-off for the development area have therefore been calculated based on a greenfield scenario. The IH214 greenfield method has been utilised to calculate the figures noted in **Table 1** (full details **Appendix I**).

Site Area	Run-Off Rates				Run-Off Volumes	
	1 In 1 Year	1 In 30 Year	1 In 100 Year	QBar	1 In 1 Year	1 In 100 Year
1.806ha	0.6l/s	1.7l/s	2.3l/s	0.7l/s	19.3cu.m	97.8cu.m

Table 1: Pre-Development Surface Water Run-Off Rates (Betts Hydro, 2018)

5.2 Post Development Surface Water Run-Off

5.2.1 At present the indicative proposals show the development area to cover 1.806ha of the wider site. Based on the planning layout we have estimated that the post-development impermeable areas will increase to approximately 49% of the development area. The unrestricted post-development run-off rates have been detailed in **Table 2**.

Site Area	Run-Off Rates		
	1 In 1 Yr	1 In 30 Yr	1 In 100 Yr +CC
0.878ha	34.0l/s	75.2l/s	126.9l/s

Table 2: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2018)

5.2.2 The proposals however will be to restrict the rate of discharge from the development to mimic a pre-development greenfield situation (**Table 1**), betterment in the form of permeable surfaces will also be considered as part of detailed design where feasible to reduce surface water run-off rates. Permeable surfaces will also be considered as part of detailed design where feasible to reduce surface water run-off rates.

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 Sustainable Drainage Systems (SuDS) have the ability to address four core objectives; water quantity, water quality, amenity and biodiversity. In accordance with the NPPF, SuDS should be specified wherever possible to manage surface water run-off generated onsite. With the appropriate system specified, all core objectives can be satisfied, this in turn reduces the burden downstream on both watercourses and sewerage systems.

5.3.2 Where possible, peak surface water discharge rates to watercourses and sewers should be appropriately managed and where possible reduced. Preference should always be given to SuDS over the traditional methods within green spaces (POS) areas, where SuDS features can be implemented. Given the indicative layout there may be the opportunity to incorporate methods such as swales and basins to provide a degree of treatment before flows are carried offsite. The photographs in **Figure 7** illustrate similar residential schemes which have utilised SuDS as part of the surface water management strategy.

Figure 5: SuDS Photographs (SusDrain, 2012)

5.3.3 Should the ground conditions onsite prove favourable, it would also be recommended that permeable paving, swales or tree pits be utilised in non-adopted areas where at all feasible; if infiltration is proven not feasible then the permeable paving should be lined with a positive connection into the proposed main drainage for the site. Detailed design should confirm which SuDS method would be suitable for incorporation into the development proposals following more detailed analysis of levels, ground conditions, and attenuation requirements.

5.4 Methods of Surface Water Management

5.4.1 At present the proposed development site is 2.204ha and the proposed impermeable area is set to increase to 49% of the development area (1.806ha). There are three methods that have been reviewed for the management and discharge of surface water. These may be applied individually or collectively to form a complete strategy and should be applied in the order of priority listed below:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

5.5 Discharge via Infiltration

5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.

5.5.2 The Cranfield Soil and AgriFood Institute (CSAI), Soilscapes viewer identifies the soils to be freely draining, slightly acid, but base-rich. The British Geology Survey (BGS) mapping data indicates that ground conditions are as follows:-

- *Bedrock Geology: Marlstone Rock Formation - Ferruginous Limestone and Ironstone.*
- *Superficial Deposits: None Recorded.*

5.5.3 Based on the ground conditions identified by the online datasets it can be considered that infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. The mapping however, is considered to be large scale and infiltration rates vary on a site by site basis. It would therefore be recommended further investigation in the form of Soakaway Testing to BRE365, takes place upon planning approval as infiltration is the primary proposed means of discharging surface water run-off.

5.5.4 The proposals are therefore to manage surface water run-off generated by the development via an infiltration based approach. At this time the planning layout has allowed for an area of open space; this area could incorporate an infiltration method such as a basin or below ground cellular crate(s) depending on the engineering constraints and onsite testing results.

5.5.5 It would be recommended that the specific infiltration method(s) to be used are designed to BRE365 standards in accordance with the CIRIA SuDS Manual. Discussion with the LLFA, the LPA and TW will also be required as part of detailed design to ensure the infiltration methods conform to their standards of design.

Figure 6: Surface Water Constraints Drainage Strategy Plan extract (Betts Hydro, 2018)

5.6.6 In terms of discharge rates, these will be in accordance with the SuDS Manual and Non-Statutory Technical Standard for SuDS. The proposed discharge will not exceed that of the

pre-development greenfield equivalent (existing onsite percolation rate determined during onsite testing). The proposed surface water drainage systems will be designed to cater for the storm events up to and including the 1 in 100 year return period event with 40% allowance for climate change.

5.6 Discharge to Watercourse

5.6.1 Should infiltration not be feasible then the next outfall in the hierarchical approach should be discharge to the watercourse. However, there are no watercourses suitable for outfall within close proximity of the site therefore, discharge to the sewer network would be the alternative approach; subject to the relevant consents and agreements.

5.7 Discharge to Public Sewer Network

5.7.1 Should infiltration not offer feasible solution for surface water management at the site, then the alternative option would be to discharge to the nearest Thames Water public surface water sewer. Thames Water have identified a public surface water sewers in proximity to site; the 225mm public surface water sewer is located approximately 118m north-west of site within Sycamore Drive (as illustrated in **Figure 6** previously). Presently, it is not clear whether a gravity solution to this sewer would be feasible therefore, a pumped solution may be required during detailed design.

5.7.2 Relevant consents and approaches for works to the public sewer network will be required from TW and early discussion will be needed to identify any additional capacity constraints and their preferred point(s) for connection. Any offsite works will need to be discussed and agreed with the relevant parties (including Highways Authority) during detailed design process.

5.7.3 At present the soil factor onsite is 0.150 (favourable to infiltration) however, if further testing identifies infiltration will not work onsite; then the proposals are to discharge to the public sewer network at a pre-development greenfield rate (QBar). The pre-development greenfield rate has been calculated using an increased soil factor (0.450) to reflect a more accurate representation of the surface water run-off onsite, should percolation rates onsite actually not favour an infiltration based approach. This approach has been agreed with the EA and the other LLFA on other schemes and is anticipated to be acceptable in this occasion.

5.7.4 The proposed discharge rate (using a higher soil factor) is 7.9l/s (QBar) (**Appendix I**). The restricted discharge rate will generate a storage requirement during the extreme storm events. The stormwater storage figures quoted in **Table 4** are estimates only for the site. Detailed drainage design will determine with accuracy the stormwater storage requirements.

Impermeable Area (0.878ha)	1 In 1 Year	1 In 30 Year	1 In 100 Year + 40% CC
Restricted Run-Off Rate	7.9l/s	7.9l/s	7.9l/s
Estimated Stormwater Storage Volume	65cu.m-108cu.m	215cu.m-305cu.m	469cu.m-636cu.m

Table 4: Estimated Stormwater Storage Requirements (Betts Hydro, 2017)

5.8 Climate Change

5.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall. It is believed that the impact of climate change means there is likely to be a long term increase in the average sea levels, with an expectation that sea levels will rise gradually. An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact.

5.8.2 In light of the future uncertainties Climate Change should be accounted for within the design of all new developments. The recently published Environment Agency document '*Adapting to Climate Change : Advice for Flood and Coastal Erosion Risk Management Authorities*' supersedes Defra's policy statement on Flood Risk and Coastal Erosion Risk Management (2009) and should be used for future proposals. Climate change factors have been considered and any increase in the level of flood risk (to the site) from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

5.8.3 In accordance with the updated Climate Change projections provides estimated changes to rainfall intensity (**Table 4**) and based on the design life of the development (100yrs) the "total potential change figures for the 2080's has been utilised.

PROJECTIONS	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE 2080'S
Upper End Estimate	40%
Central Change Factor	20%

Table 5: Change to Extreme Rainfall Intensity Compared to 1961-1990 Baseline (Environment Agency, 2016)

6.0 FOUL WATER MANAGEMENT

6.1 Review of the TW sewer records identify there to be limited public sewer infrastructure in proximity to the site however, the nearest foul water sewer (150mm dia.) is located adjacent to the north-eastern site boundary within Oxford Road (refer to sewer records within **Appendix C**). Due to the site being brownfield there is a possibility there is an existing connection, however further investigation is required to confirm the condition and capacity of the existing sewer network.

6.2 The proposals are to connect into the nearest fowl water sewer within Oxford Road adjacent to the north-eastern site boundary, the exact location of the proposed connection point is subject to early discussions with TW. Based on the proposals for the construction of 52 no. residential units the approximate peak foul water flows generated by the development will be 2.4l/s. This figure is calculated based on 4000 litres per dwelling per 24 hours; the guidance contained within Sewers for Adoption (SfA).

6.3 Detailed design will be required to confirm feasibility based on the topographic levels following further detailed investigation. It is not clear whether a full site gravity connection will be achievable onsite as further investigation as part of detailed design of the TW public sewer system is required to ascertain the existing invert levels.

6.4 Consents and relevant agreements will be required from TW prior to commencement of works. Early consultation with TW is recommended to identify any additional constraints and their preferred point(s) of connection. It is possible that offsite works would be required for a connection to the public sewer network. Any offsite asset routing works will also need to be considered in terms of consents with the relevant land owners (Highways Authority).

7.0 SUMMARY AND CONCLUSIONS

7.1 This Flood Risk Assessment and Drainage Management Strategy was commissioned by Hollins Strategic Land referred to hereafter as 'the client'. This report has been prepared to support an outline planning application for the construction of a residential development on land adjacent to Oxford Road in Bodicote.

Flood Risk

7.2 The site lies solely within Flood Zone 1 based on the Environment Agency Flood Map for Planning and is 2.204ha in size. Residential development is classified as 'more vulnerable' within the Planning Practice Guidance which supports the National Planning Policy Framework. The Planning Practice Guidance confirms that 'more vulnerable' development is appropriate to be located within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

7.3 This report has reviewed all sources of flood risk both to and resulting from the proposed development site. Consultations with the Environment Agency Oxfordshire County Council, Cherwell District Council and Thames Water, have been undertaken and did not identified any historical incidents of flooding to the site.

7.4 The proposals are considered to be at 'very low' flood risk from the majority of flood sources. The nearest watercourse to site is Sor Brook located approximately 1km south of site, the Oxford Canal is also located approximately 1.5km north with the River Cherwell located beyond. The primary flood risk however, is considered to be from 'very low' surface water run-off, which is closely associated with the existing topography on site. The risk associated with surface water flooding will be reduced and sustainably managed post-development, following the implementation of mitigation measures proposed within this assessment.

Drainage Strategy

7.5 Due to the relatively low flood risks identified, the principle focus of this assessment is on sustainable management of surface water run-off in accordance with national and local policy. Surface water discharge options have been assessed in accordance with the sustainable drainage hierarchy and based on the ground conditions identified by the online datasets, infiltration may offer a part or fully viable drainage solution for the development site due to the permeable strata. The mapping however, is considered to be large scale and infiltration rates vary on a site by site basis, it would therefore be recommended that further investigation (onsite testing) takes place upon planning approval as infiltration would be the primary means of discharging surface water run-off.

7.6 At this time the planning layout has allowed for an area of open space, this area could be used for an infiltration based approach such as an infiltration basin, soakaway or trench. Depending on the outcome of the onsite soakaway testing and detailed design requirements. It would also be recommended that the specific infiltration methods to be used are discussed with the key stakeholders, including the Local Planning Authority and Thames Water at an early stage. Infiltration method(s) and any adoption design standards used will need to be to BRE365 standard and designed in accordance with the CIRIA Sustainable Drainage System Manual.

7.7 In terms of discharge rates, in accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. As the existing method of surface water management is unconfirmed and national planning policy states new development should endeavour to achieve greenfield equivalent rates. The peak rates and volumes of run-off for the development area have therefore been calculated based on a greenfield scenario.

7.8 The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with overland run-off from storm events up to and including the 1 in 100yr return period event with a 40% allowance for climate change being contained onsite. It would be beneficial to implement SuDS features including permeable surfaces, bio-filtration and infiltration basin (or similar), to assist with this requirement.

7.9 Should infiltration not be feasible for all of the site due to other constraints then the next outfall in the hierarchical approach is to discharge to the watercourse. At present, there are no watercourses suitable for outfall within close proximity of the site, therefore discharge to the sewer network would be required. Thames Water surface water sewer. Thames Water have identified a 225mm public surface water sewer located approximately 118m north-west of site within Sycamore Drive.

7.10 Consents for works to the public sewer network will be required from TW and early discussion will be needed to identify any additional capacity constraints and preferred point(s) for connection. Detailed design will be required to confirm the possibility of a site wide gravity connection following further investigations. If a gravity system is not feasible a pumped surface water system may be required to cater for the proposals. Any offsite works will need to be discussed and agreed with the relevant parties (including Highways Authority) during detailed design process.

7.11 The Flood Risk Assessment and Drainage Management Strategy has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

8.0 RECOMMENDATIONS

8.1 For 'more vulnerable' development located within Flood Zone 1, it is typical to set the Finished Floor Levels (FFL) of residential dwellings to a minimum of 150mm above the existing ground levels. By ensuring the FFLs are raised sufficiently above the external levels (following any re-grade) should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

8.2 To minimise the flood risk to the neighbouring property and proposed dwellings it is proposed that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted in accordance with the NPPF and Non-Technical Standards for SuDS.

8.3 In accordance with LPA's and TW requirements, Soakaway Testing to BRE365 may be required to be undertaken upon planning approval to evidence that discharge to ground will not be a viable solution, this can be via a standard condition (prior to commencement of work).

8.4 Detailed design will refine the drainage strategy once an outfall point is determined, along with confirming whether a full site gravity system can be achieved; it is likely that a pumped solution in part would be required for foul water connection to the public sewer network.

8.5 Early discussion with TW for any proposed works to the public sewer network is advised and will identify any additional considerations including access, points of connection and capacity constraints. Furthermore, consents with other land owners including Highway Authority will be required for any offsite works.

8.6 Consideration is recommended into the stormwater attenuation requirements due to restricting the surface water discharge from the site. The proposed onsite surface water drainage system will need to be sized to contain the 30yr return period event wholly below ground with overland run-off from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite; the estimate of between 215m^3 and 305m^3 is required to store in the 1 in 30yr event.

8.7 It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

BIBLIOGRAPHY & REFERENCES

Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities – Environment Agency/DEFRA 2016
CIRIA 522: Sustainable urban drainage systems – design manual for England and Wales (2000).
CIRIA 523: Sustainable urban drainage systems – best practice manual (2001).
CIRIA 609: Sustainable drainage systems. Hydraulic, structural and water quality advice (2004).
CIRIA 624: Development and flood risk – guidance for the construction industry (2004).
CIRIA 635: Designing for Exceedance in urban drainage: Good practice (2006).
CIRIA 644: Building Greener (2007).
CIRIA 753: The SUDS manual (2015).
Flood Risk to People – Phase 2 (FD2321/TR2), DEFRA and the Environment Agency (2006).
Flood estimation for small catchments: Institute of Hydrology Report No.124, NERC (1994).
Flood Estimation Handbook, Centre for Ecology and Hydrology (1999).
Planning Policy Statement 25: Development and Flood Risk (2006).
Sewers for Adoption 7th Edition, WRc (2012).
Technical Guidance to the National Planning Policy Framework, CLG (2012).

Web-based References

Anglian Water - http://www.anglianwater.co.uk/
Bingmaps – http://www.bing.com/Maps/
British Geological Survey – http://www.bgs.ac.uk/opengeoscience/home.html
Chronology of British Hydrological Events – www.dundee.ac.uk/
CIRIA – http://www.ciria.org/
Cranfield University – http://www.landis.org.uk/soilscapes/
Environment Agency – www.environment-agency.gov.uk/
FloodProBE – http://www.floodprobe.eu/
Flood Forum – http://www.floodforum.org.uk/
Flood London – http://www.floodlondon.com/
Google Maps – http://maps.google.co.uk/
Streetmap – http://www.streetmap.co.uk/
Thames Water - https://www.thameswater.co.uk/

APPENDIX A: NPPF EXTRACTS

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Table 1: Flood zones

(Note. These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - low probability

Definition
This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

Appropriate uses
All uses of land are appropriate in this zone.

Flood risk assessment requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention.

Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems[2].

Zone 2 - medium probability

Definition
This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Appropriate uses
Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are *only* appropriate in this zone if the Exception Test is passed.

Flood risk assessment requirements
All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage systems.

Zone 3a - high probability

Definition
This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Appropriate uses
The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone.

The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

Flood risk assessment requirements
All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims
In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;

- relocate existing development to land in zones with a lower probability of flooding; and
- create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b - the functional floodplain

Definition
This zone comprises land where water *has* to flow or be stored in times of flood.

Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses
Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

Flood risk assessment requirements
All development proposals in this zone should be accompanied by a flood risk assessment.

Policy aims
In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;
- relocate existing development to land with a lower probability of flooding

Table 2: Flood risk vulnerability classification

Essential infrastructure

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood
- Wind turbines.

Highly vulnerable

- Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding.
- Emergency dispersal points
- Basement dwellings
- Caravans, mobile homes and park homes intended for permanent residential use[3].
- Installations requiring hazardous substances consent[4]. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure")[5]

More vulnerable

- Hospitals.
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste[6].
- Sites used for holiday or short let caravans and camping, *subject to a specific warning and evacuation plan.*[7]

Less vulnerable

- Police, ambulance and fire stations which are *not* required to be operational during flooding.
- Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working)
- Water treatment works which do *not* need to remain operational during times of flood.
- Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

Water-compatible development

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations
- Sand and gravel working
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan.*

APPENDIX B: EA INFORMATION & CORRESPONDENCE

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Megan Berry

From: Enquiries_THM <enquiries_THM@environment-agency.gov.uk>
Sent: 26 March 2018 12:30
To: Megan Berry
Subject: THM 79766 Flood Risk Advice
Attachments: flood map.pdf; surface water flood map.pdf

Dear Megan

Thank you for your email.

We are unable to supply any modelled flood levels as the site is located in Flood Zone 1. Please find attached an extract from our flood map and surface water flood map.

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

Please be aware that many of our datasets are now 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).

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

Yours sincerely

Dawn Cooper
Customers & Engagement Officer
Direct Dial: 020 302 59465

Environment Planning & Engagement Team
Environment Agency
Thames Area

Did you know that the Environment Agency publishes most of its data via www.data.gov.uk? Using this site you can search for our data alongside other environmental data providers from the Defra Network and local authorities.

Follow us on:-

From: Megan Berry [mailto:meganberry@betts-associates.co.uk]
Sent: 20 March 2018 09:30
To: Enquiries_THM <enquiries_THM@environment-agency.gov.uk>
Subject: Flood Risk Advice

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

To whom it may concern,

Oxford Road, Bodicote.

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons)
Graduate Flood Risk Analyst

BETTS HYDRO
Specialists in Drainage and Flood Risk
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY

CHESTER OFFICE - 01244 289041

meganberry@betts-associates.co.uk
www.betts-associates.co.uk

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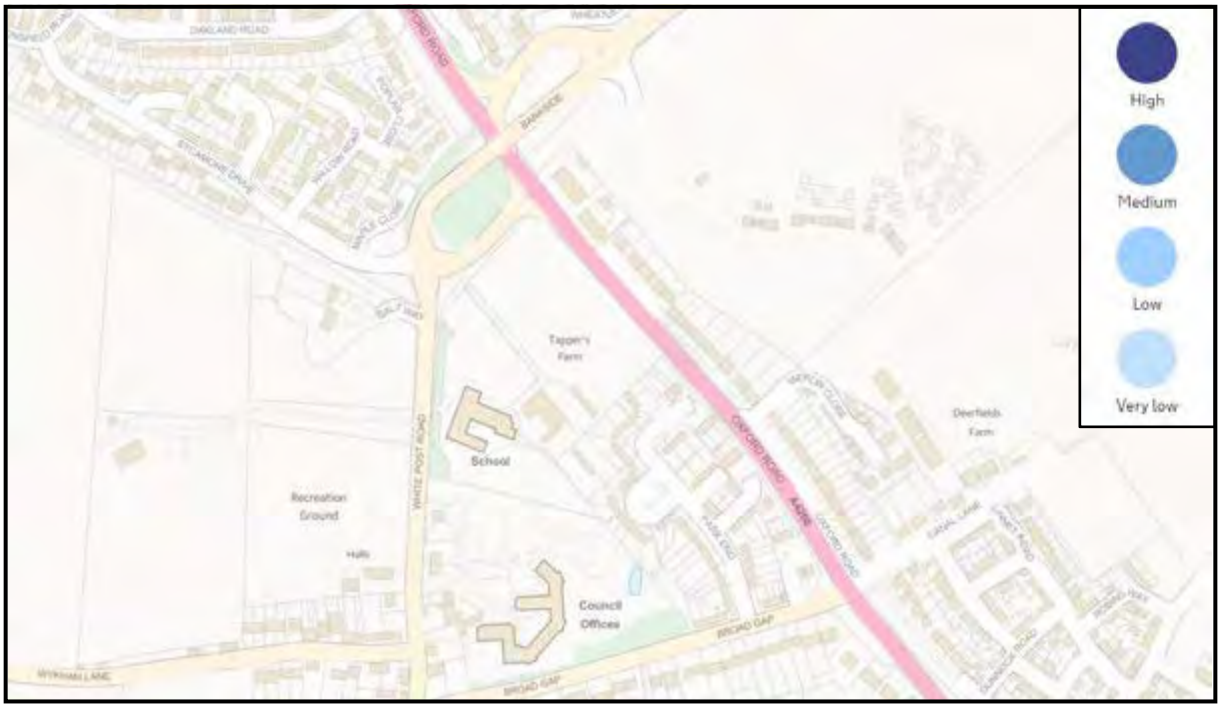
SUDS | STRUCTURAL SURVEYS | PARTY WALL DUTIES | INFILTRATION | GEO-TECHNICAL

NATIONAL FLOOD MAPPING

BETTS HYDRO
CONSULTING ENGINEERS

Flood Map for Planning

Long Term Flood Risk – Rivers or Sea



NATIONAL FLOOD MAPPING

BETTS HYDRO
CONSULTING ENGINEERS

Long Term Flood Risk – Surface Water

Long Term Flood Risk - Reservoirs

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APPENDIX C: TW CORRESPONDENCE

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Megan Berry

From: Megan Berry
Sent: 20 March 2018 09:30
To: 'DEVELOPER.SERVICES@THAMESWATER.CO.UK'
Subject: Flood Risk Advice
Attachments: LOCATION PLAN.pdf

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

To whom it may concern,

Oxford Road, Bodicote.

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons)
Graduate Flood Risk Analyst

BETTS HYDRO
Specialists in Drainage and Flood Risk
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY

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meganberry@betts-associates.co.uk
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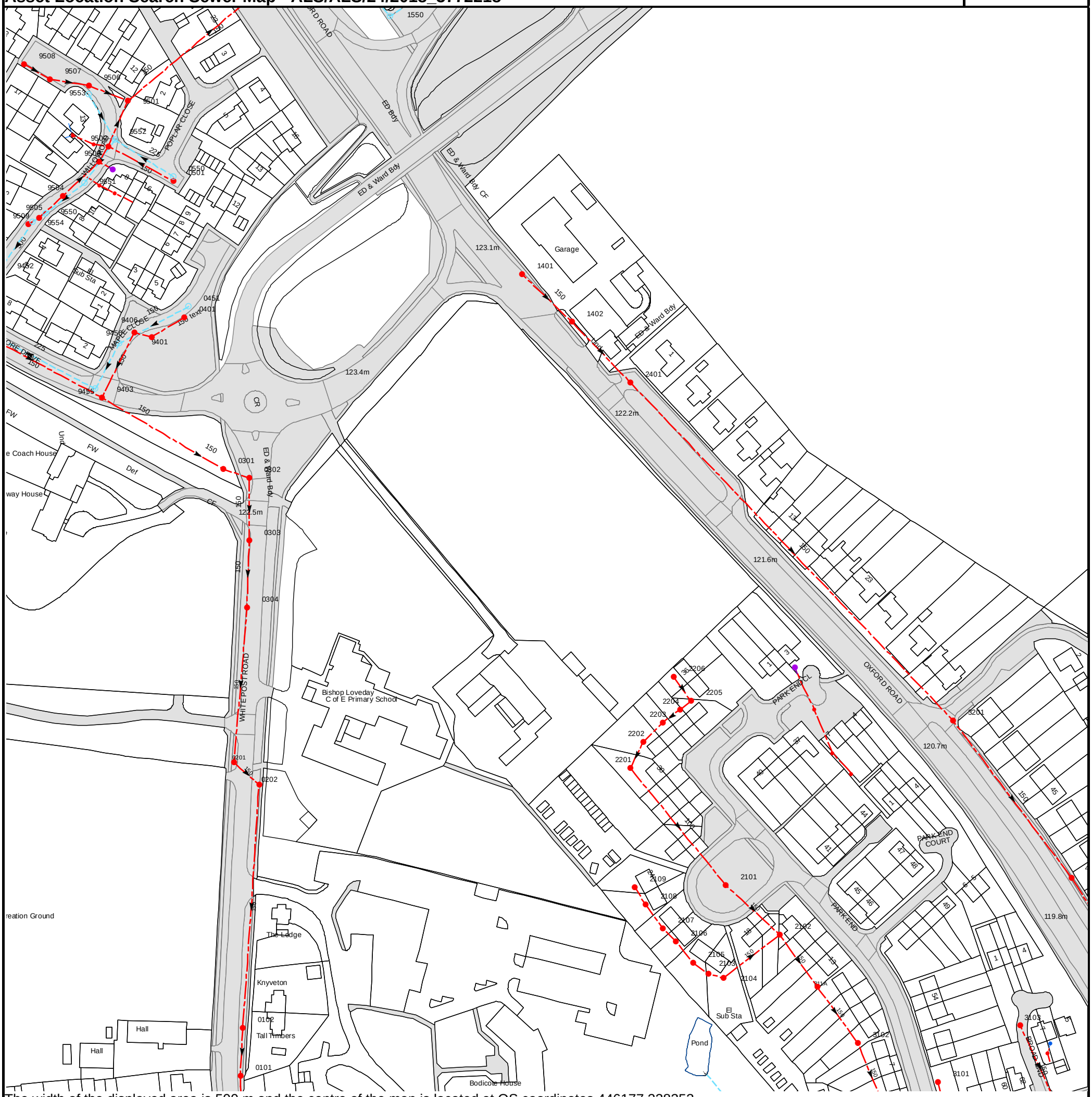
Asset Location Search Sewer Map - ALS/ALS/24/2018_3772218



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 446177,238353

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.

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APPENDIX D: LPA/LLFA CORRESPONDENCE

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Megan Berry

From: John Kearsey <John.Kearsey@canalrivertrust.org.uk>
Sent: 28 March 2018 09:26
To: Megan Berry
Cc: enquiries southeast
Subject: RE: Flood Risk Advice

Dear Megan
The site in question is remote from the South Oxford Canal which will not present any flood risk.

Regards
John

John Kearsey
Principal Water Engineer - South
Canal & River Trust

M 07710 796354

From: enquiries southeast
Sent: 22 March 2018 11:37
To: John Kearsey <John.Kearsey@canalrivertrust.org.uk>
Subject: FW: Flood Risk Advice

Hi John,

Please see below, can I leave this with you to respond to?

Many thanks

Lou

From: Megan Berry [mailto:meganberry@betts-associates.co.uk]
Sent: 20 March 2018 16:50
To: enquiries southeast <enquiries.southeast@canalrivertrust.org.uk>
Subject: Flood Risk Advice

F.A.O Flood Risk, Drainage and/or Planning department

Please forward to the correct department/ office

To whom it may concern,

Oxford Road, Bodicote.

Please could you confirm whether you have any information that you feel would be valuable to a Flood Risk Assessment and Drainage Management Strategy for the site above (see location plan attached), including details of historical flooding and any predicted flood water levels; this would be greatly appreciated. If there are any specific requirements that you require in a scope of works for this site please can you advise at this stage so that it can be fully incorporated into the proposals at an early stage.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind Regards

Megan Berry BSc(Hons)
Graduate Flood Risk Analyst

BETTS HYDRO
Specialists in Drainage and Flood Risk
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY

CHESTER OFFICE - 01244 289041

meganberry@betts-associates.co.uk
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Megan Berry

From: Tony Brummell <Tony.Brummell@cherwellandsouthnorthants.gov.uk>
Sent: 03 April 2018 09:24
To: Megan Berry
Subject: Site off Oxford Road Bodicote - Flood Risk (nearest post code OX15 4QL)

Hello, I have received your emailed enquiry of 20th March.

You are probably aware that the site is shown to be in Flood Zone 1. Reference to the surface water flood risk maps show there may be a small risk of surface water flooding within the site.

We are not aware that the site has been affected by flooding. However, because of its current use and nature, we may not necessarily have been notified if it has.

Tony Brummell CEng FICE
Building Control Manager

Cherwell and South Northants Building Control Service
Place and Growth Directorate
Cherwell and South Northants Councils

Direct Tel: 01327 322273
tony.brummell@cherwellandsouthnorthants.gov.uk
www.cherwell.gov.uk | www.southnorthants.gov.uk

Megan Berry

From: FOI - E&E <FOI-E&E@Oxfordshire.gov.uk>
Sent: 28 March 2018 15:53
To: Megan Berry
Cc: FOI - E&E
Subject: 13380 EIR Acknowledgement

Dear Ms Berry,

Thank you for your request of 20 March 2018 in which you asked for the flood risk assessment and drainage management strategy for Oxford Road, Bodicote.

Your request is being considered and Oxfordshire County Council will respond within 20 working days in compliance with the Freedom of Information Act 2000. This means that the council will send a response to you by 19 April 2018.

Please note that there will be a fee payable for this information and we would be grateful if you notify us if you wish to proceed with your request.

If appropriate, the information requested can be made available in alternative formats, including other languages, Braille, large print, and audiocassette. If you require any of these formats then please let us know.

Please contact us if you have any have further enquiries about your request. We would be grateful if you could quote the reference number given at the top of this email.

Kind regards
Renata Malinowski

E&E Freedom of Information and Complaints Support Officer
Joint Commissioning and E&E
Email: E&E-FOI@oxfordshire.gov.uk and JointCommissioningFOI@oxfordshire.gov.uk

Save money and paper - do you really need to print this email.

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APPENDIX E: LOCATION PLAN

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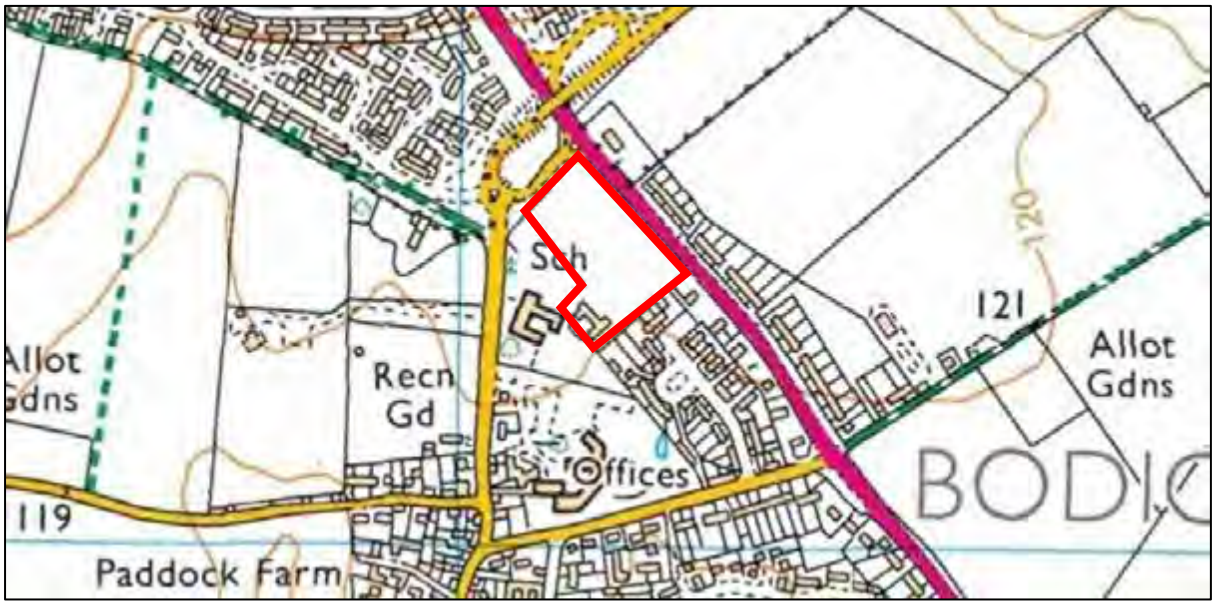
LOCATION PLAN

Oxford Road, Bodicote.



OS X (Eastings)	446170
OS Y (Northings)	238398
Nearest Post Code	OX15 4QL
Lat (WGS84)	N52:02:31 (52.042065)
Long (WGS84)	W1:19:42 (-1.328260)
Lat,Long	52.042065,-1.328260
Nat Grid	SP461383 / SP4617038398
mX	-147861
mY	6774022

APPENDIX F: TOPOGRAPHIC SURVEY

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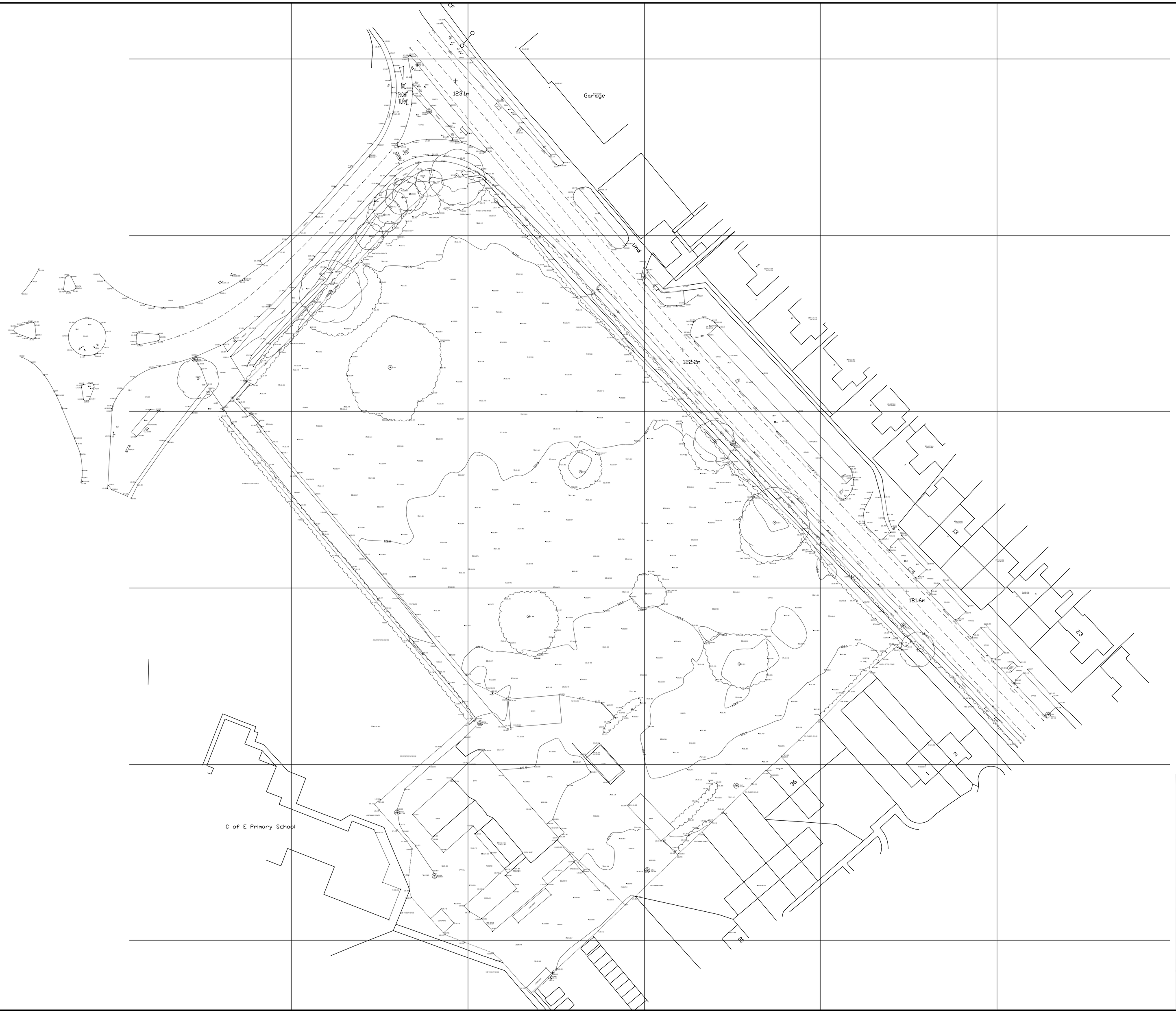

N

SURVEY ORIENTATED TO REAL TIME GPS

0m 10m 20m 30m 40m

SCALE BAR 1:500

NOTES AND AMENDMENTS

ONLY MANHOLES AND SERVICES VISIBLE AT TIME OF SURVEY SHOWN

DRAINAGE INFORMATION MUST BE CHECKED AND VERIFIED WITH LOCAL AUTHORITY RECORDS PRIOR TO WORK COMMENCING

Levels defining edge of carriageway are observed at channel (bottom of kerb). Unless otherwise stated.

TREE SPREADS ARE SYMBOLIC ONLY AND ARE REPRESENTATIVE OF THE THE AVERAGE SPREAD.

THE DRIP LINE LAYER DENOTES THE TREES EXTREMITY

REVISIONS

REV.	DESCRIPTION	DRAWN	CHKD.	DATE

Topographical Survey Legend

Bin	Litter bin	TL	Tie line
BH	Bore Hole	TP	Telegraph pole
Bol	Bollard	TPS	Tactile paving slabs
BS	Bus stop	TS	Traffic signal light
BT	British telecom ic	TV	Television cover
CPS	Concrete paving slabs	VP	Vent pipe
DR	Drain	WM	Water meter
Elec	Electrical ic	WO	Wash Out
EP	Elec. pole	UTL	Unable to lft
ER	Earth rod		Fence annotation
FH	Fire Hydrant	B/W	Barbed wire
FP	Flagpole	C/B	Closed boarded
FT	Floodlight	C/I	Corrugated iron
G	Gully	C/L	Chain link
GP	Gate post	C/P	Concrete panel
GV	Gas valve	H/R	Hand rail
IC	Inspection cover	I/R	Iron railings
JB	Junction box	O/B	Open boarded
KO	Kerb outlet	P/C	Post & chain
LB	Letter box	P/R	Post & rail
LP	Lamp post	P/W	Post & wire
Mkr	Utility marker	W/M	Wire mesh
MP	Mile post		Level prefix descriptions
MW	Monitoring Well	AL	Arch level
NP	Name plate	BL	Bed level
P	Post	CL	Cover level
PM	Parking meter	EH	Eaves level
RE	Rodding eye	FL	Floor level
RS	Road sign	IL	Invert level
rwp	Rain water pipe	PL	Parapet level
SP	Sign post	RH	Roofridge level
ST	Stop tap	SL	Soffit level
SB	Service Box	Spr	Arch springing level
SV	Stop valve	Top	Top of pipe/culvert
TCB	Telephone call box	WH	Wall height
TH	Trial Hole	WL	Water level

BENCH MARK INFORMATION

All levels relate to OSBM Newylln

Datum Generated by VRS GPS

SURVEY STATIONS

STN1	446273.464	238339.336	121.522
STN1A	446314.538	238314.097	121.185
STN2	446225.133	238391.042	122.053
STN3	446138.958	238485.152	123.485
STN4	446072.531	238414.824	123.760
STN5	446153.437	238311.660	121.501
STN5A	446129.903	238286.325	121.244
STN5B	446140.552	238268.390	120.863
STN6	446200.834	238269.951	120.858
STN7	446226.057	238293.961	121.145

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Suite 25 Rodney House,
King Street,
Wigan
WN1 1BT
Tel - 01942 243313
Fax - 01942 492230
Mobile - 07710 428498
EMAIL:- peterhouston@jlpsurveys.com

PROJECT

OXFORD ROAD,
BODICOTE

DRAWING TITLE

Topographical Land Survey

SCALE	SHEET SIZE	No. of SHEETS	DATE	REVISION
1:500	A1	1	04.04.18	

DRAWING NUMBER

S18-225

APPENDIX G: PROPOSED PLANNING LAYOUT

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Drawing Title:	Illustrative Masterplan	Revision:	B
Drawing Number:	UG1732 - URB - UD - XX - XX - GA - (90) - 001	Scale:	1:500 @ A2
Project:	Bodicote, Banbury	Date:	30.04.18

the urbanists
planning & design

APPENDIX H: PFRA/SFRA PLANNING EXTRACTS

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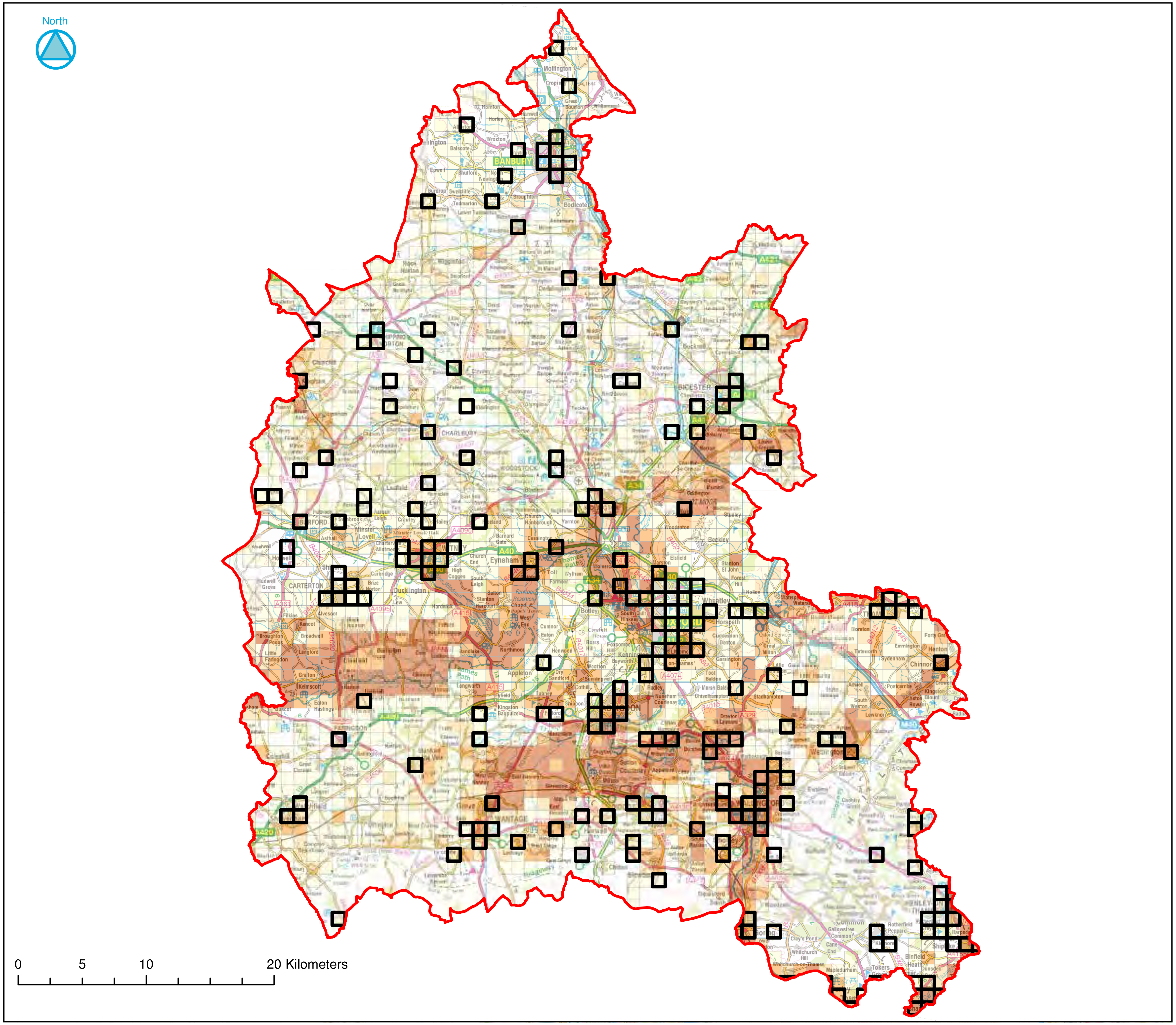

Legend

Surface water hotspots

Areas Susceptible to Groundwater Flooding

- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Proportion of each 1km square that is susceptible to groundwater emergence

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for

OXFORDSHIRE COUNTY COUNCIL

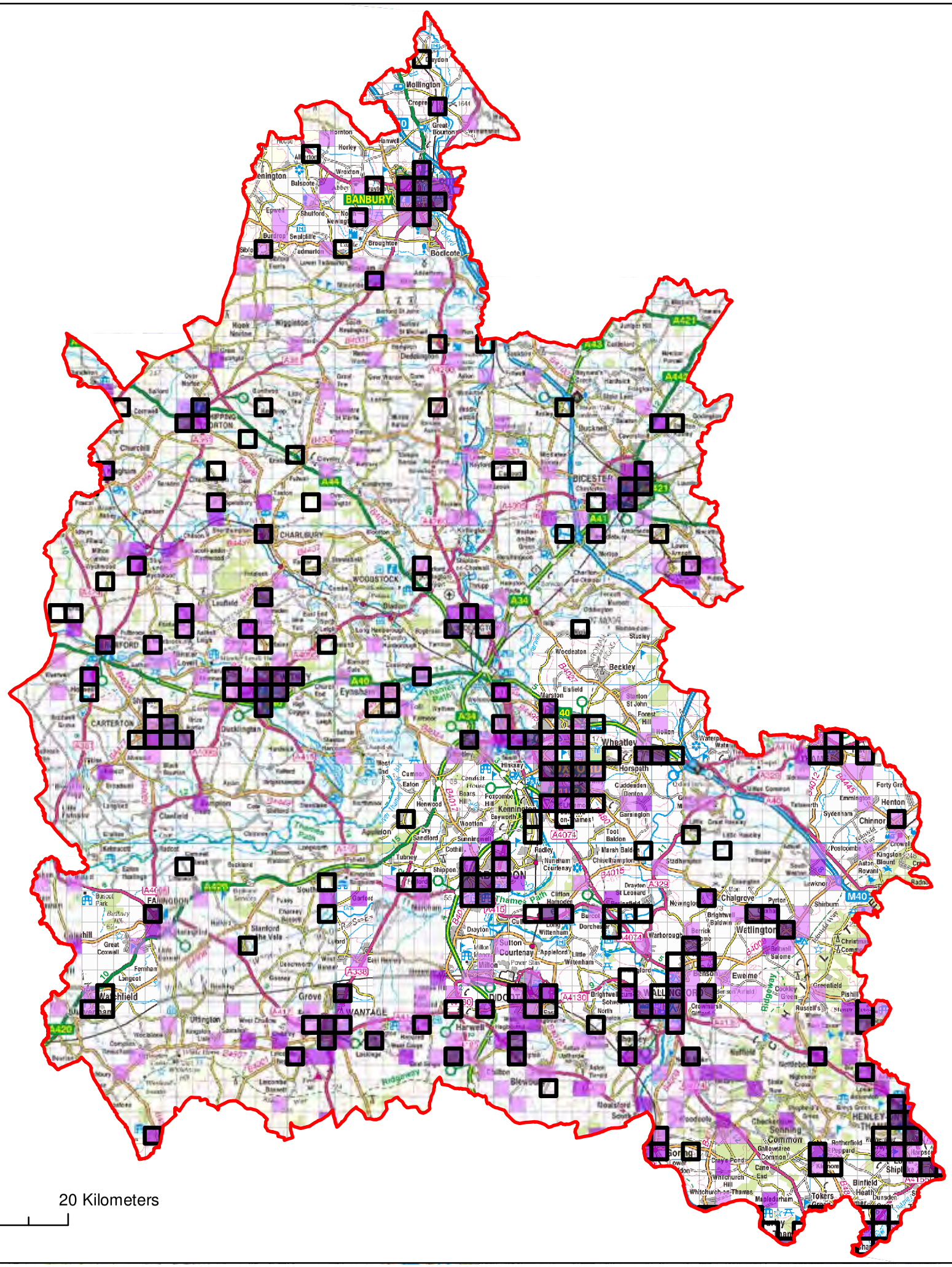
PRELIMINARY FLOOD RISK ASSESSMENT

Map 7: Areas Susceptible to Groundwater Flooding

Drawn by: AB	Scale:
Date: 09/06/2011	Not to scale
Status: FINAL	
File Name: N/A	
Drawing Number: Map 7	

Original @ A3

North



0 5 10 20 Kilometers

Explanatory note:
Maps 6a to 6c show the spatial distribution of three receptors (people, critical services and non-residential properties) that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year.
This map shows the number of non-residential properties affected, which can be considered an indicator of the consequences of flooding for economic activity. Non-residential properties are defined in the Environment Agency's PFRA and property count guidance, and include all industrial, commercial, retail, public buildings etc.
Calculations for each 1km square were carried out using the Flood Map for Surface Water (1 in 200 >0.3m), Environment Agency's detailed method of counting (based on property outlines) and the National Receptors Database v1.1.
The 1km squares are shaded from light to dark purple as the number of non-residential properties affected in each square increases.
Also overlaid on the map are surface water flooding 'hot spots', or areas where the consequences of a surface water event are likely to be more severe. These have been defined as 1km grid squares where at least one of the three indicators is above the threshold given below (thresholds defined by Defra guidance):
•More than 200 people affected
•One or more critical services affected
•More than 20 non-residential properties affected
The maps show that:
•The main hotpots are in more urban locations due to the concentration of population, industrial and commercial buildings, and critical services.
•Several more rural communities have less people affected but will still experience an adverse impact, particularly those where local critical services are affected.
More detail is given in the main report.

Legend

Hotspots

Non-residential properties

< 5	Number of non-residential properties affected per 1km grid square
5 - 10	
10 - 20	
> 20	

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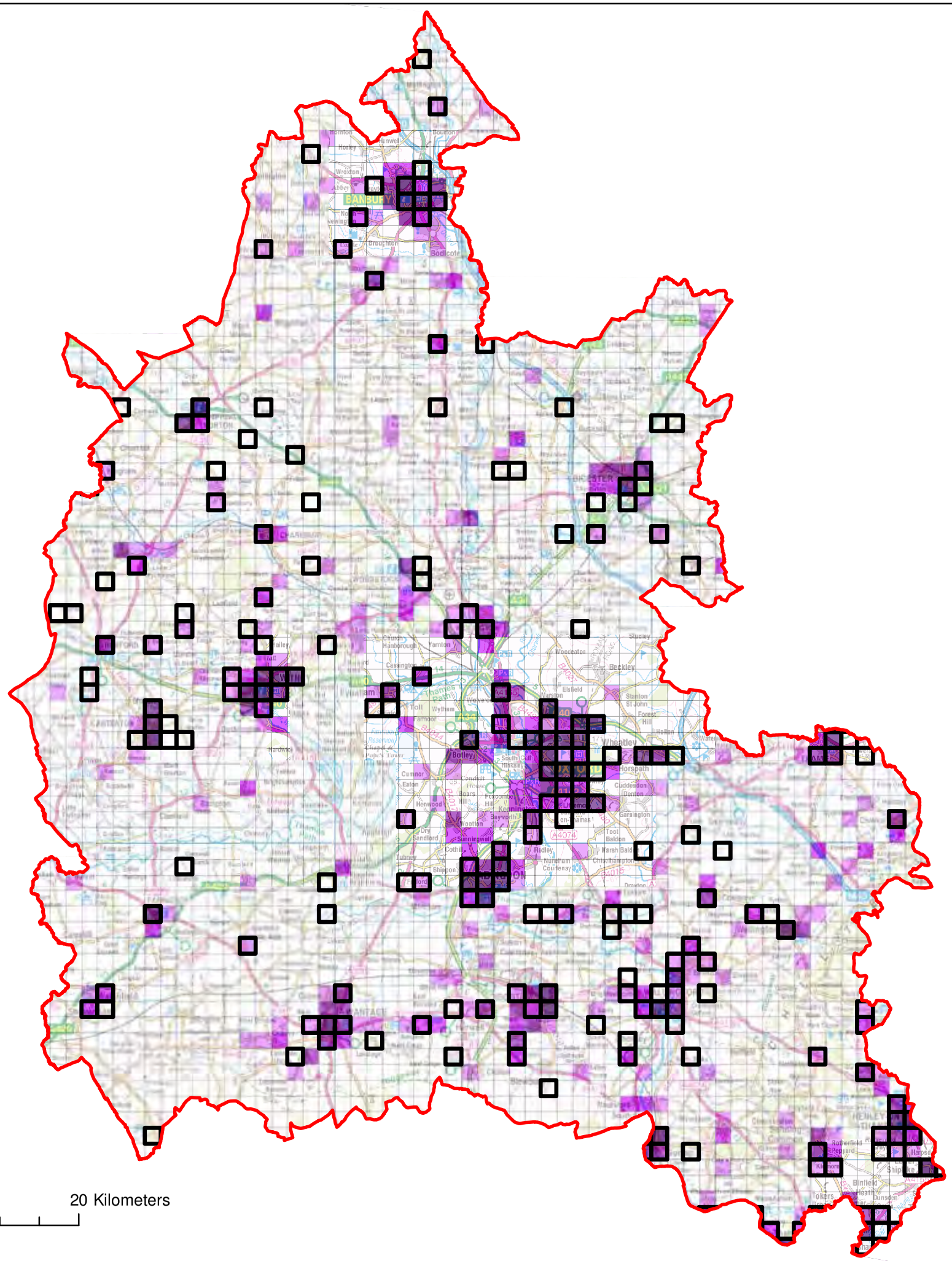
PRELIMINARY FLOOD RISK ASSESSMENT
Map 6c: Non-residential properties affected by flooding in a rainfall event with a 1 in 200 chance of occurring in any given year

Drawn by: AC	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 6c	

Original @ A3

North



0 5 10 20 Kilometers

Explanatory note:
Maps 6a to 6c show the spatial distribution of three receptors (people, critical services and non-residential properties) that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year.
This map shows the number of people affected, which can be considered an indicator of the consequences of flooding for human health. The number of people is defined by the Environment Agency guidance as the number of residential (housing) properties multiplied by 2.34.
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Legend

Hotspots

Number of people

< 20	Number of people affected per 1km grid square
20 - 50	
50 - 100	
100 - 200	
> 200	

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PRELIMINARY FLOOD RISK ASSESSMENT
Map 6a: People affected by flooding in a rainfall event with a 1 in 200 chance of occurring in any given year

Drawn by: AC	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 6a	

Original @ A3

North

0 5 10 20 Kilometers

Legend

- Breach location
- Overtopping location
- Oxford Canal

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PRELIMINARY FLOOD RISK ASSESSMENT

Map 4: Past flooding - Canal flooding in July 2007

Drawn by:	AB	Scale:	Not to scale
Date:	09/06/2011		
Status:	FINAL		
File Name:	N/A		
Drawing Number:	Map 4		

Original @ A3

North

July 2007

February 2001

February 2001

0 5 10 20 Kilometers

Legend

Past flooding from groundwater

Number of properties

- 0 to 10
- 11 to 20
- 21 to 200

Groundwater flooding locations (2001)

Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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PRELIMINARY FLOOD RISK ASSESSMENT

Map 3: Past flooding - Ground water

Drawn by: AB	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 3	

Original @ A3

North

January 2007

October 2006

0 5 10 20 Kilometers

Legend

June 2008

Number of properties flooded by parish

- Less than 2
- 2 to 5
- 5 to 10
- 10 to 15
- 15 to 20

Number of properties flooded by other events

- 20
- 25

Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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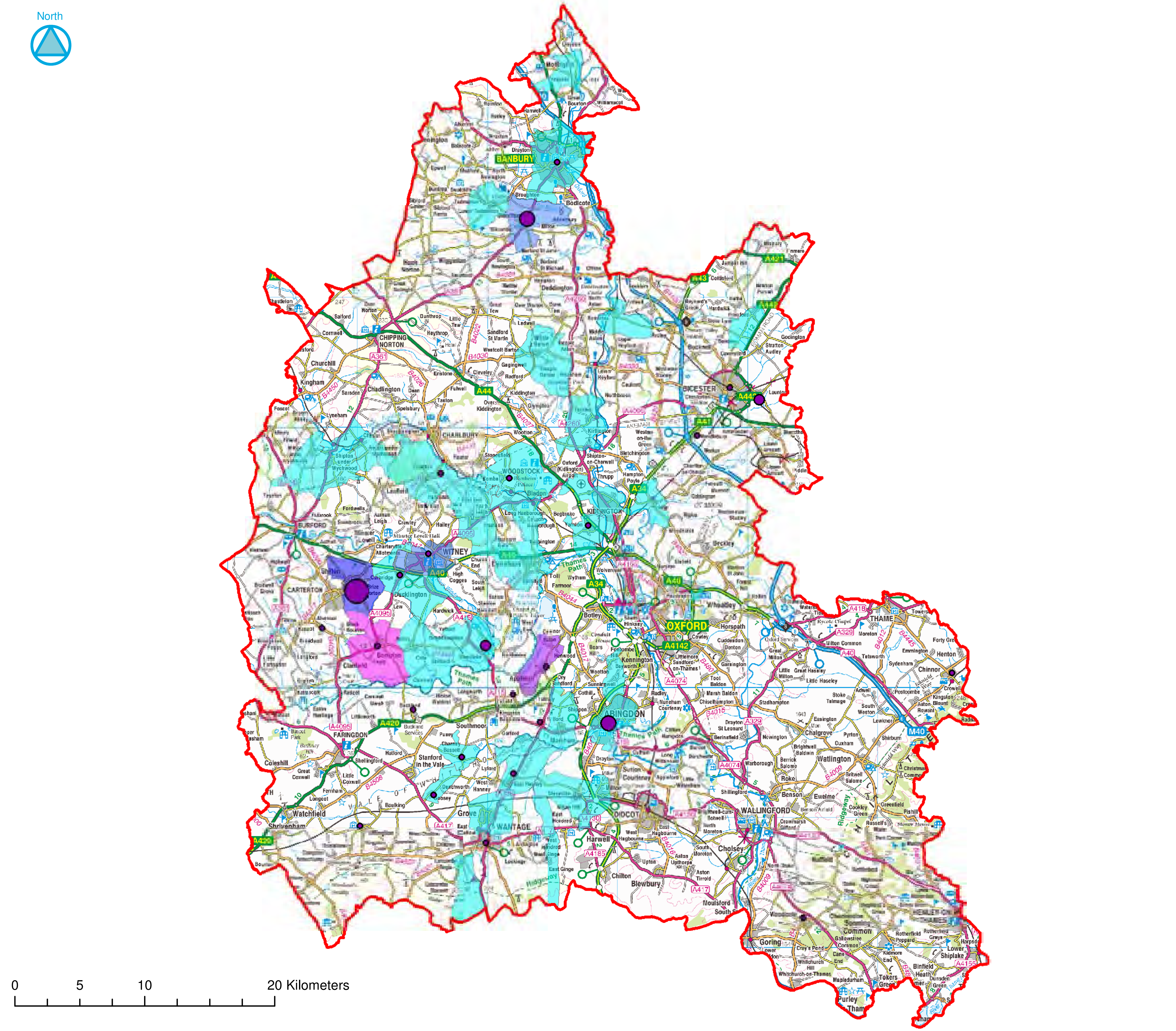
PRELIMINARY FLOOD RISK ASSESSMENT

Map 2: Past flooding - Surface water in other events

Drawn by: AB	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 2	

Original @ A3



Legend

July 2007 (Environment Agency)

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 24

Number of properties flooded internally by 'surface water' (by settlement). Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

July 2007 (Fire and Rescue Service)

- 1-5
- 6-10
- 11-20
- 21-50
- 51-125

Number of properties flooded internally by 'drainage' and 'ordinary watercourse' (by parish)

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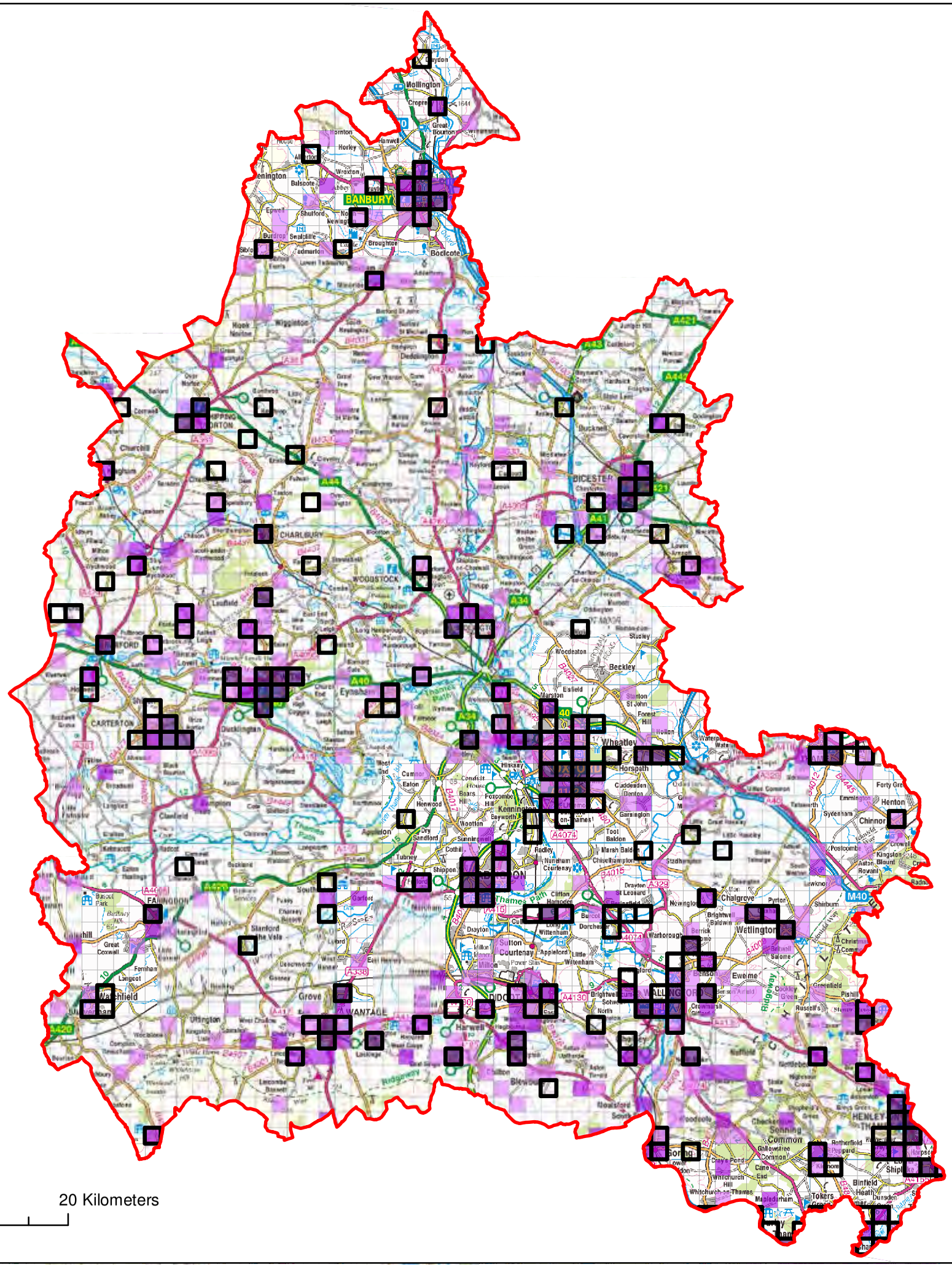
PRELIMINARY FLOOD RISK ASSESSMENT

Map 1: Past flooding - Surface water in July 2007

Drawn by: AB	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 1	

Original @ A3

North



0 5 10 20 Kilometers

Explanatory note:
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Also overlaid on the map are surface water flooding 'hot spots', or areas where the consequences of a surface water event are likely to be more severe. These have been defined as 1km grid squares where at least one of the three indicators is above the threshold given below (thresholds defined by Defra guidance):
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•More than 20 non-residential properties affected
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•Several more rural communities have less people affected but will still experience an adverse impact, particularly those where local critical services are affected.
More detail is given in the main report.

Legend

Hotspots

Non-residential properties

< 5	Number of non-residential properties affected per 1km grid square
5 - 10	
10 - 20	
> 20	

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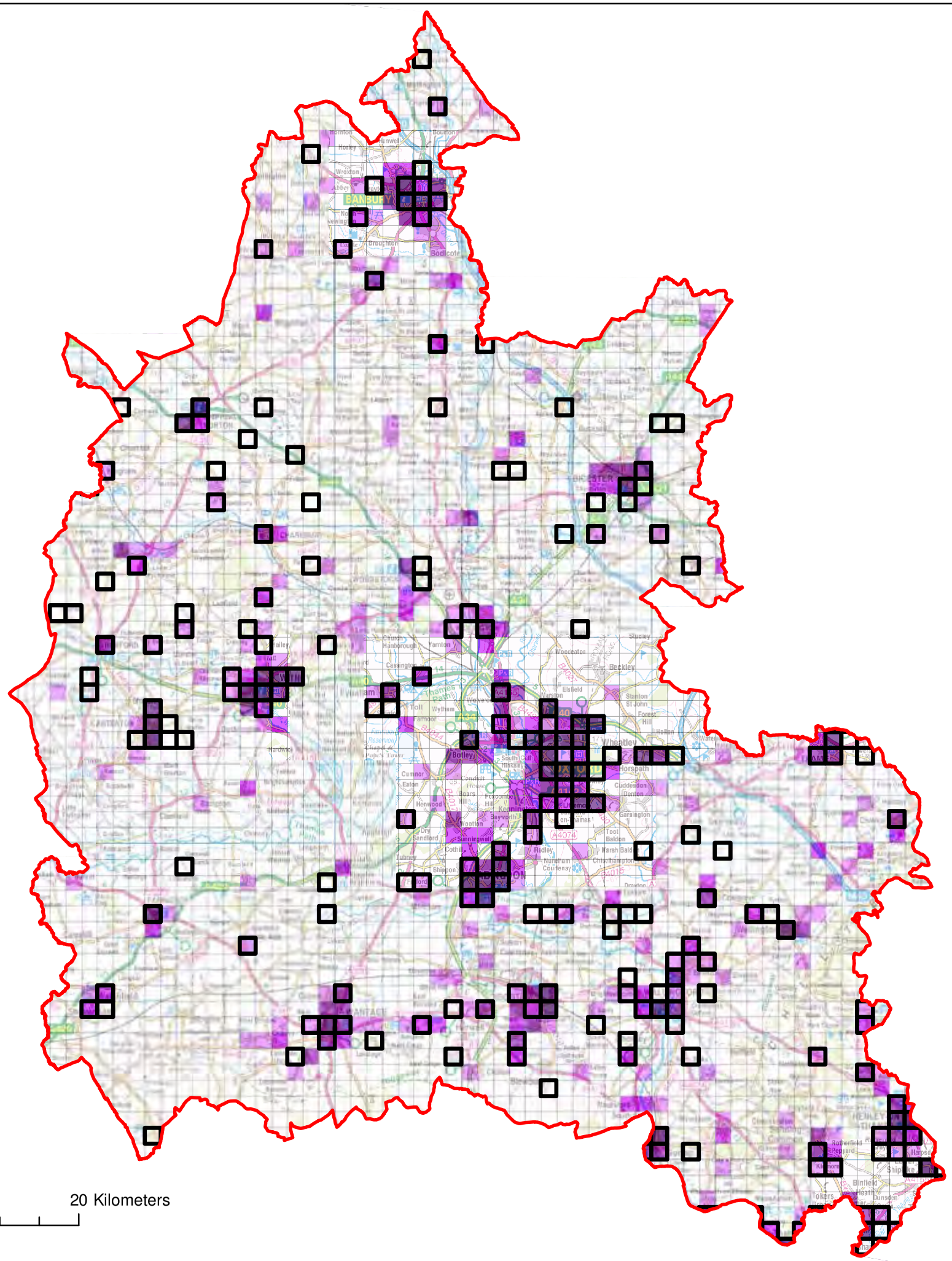
PRELIMINARY FLOOD RISK ASSESSMENT
Map 6c: Non-residential properties affected by flooding in a rainfall event with a 1 in 200 chance of occurring in any given year

Drawn by: AC	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 6c	

Original @ A3

North



0 5 10 20 Kilometers

Explanatory note:
Maps 6a to 6c show the spatial distribution of three receptors (people, critical services and non-residential properties) that may be affected by future surface water flooding in an event with a 1 in 200 chance of occurring in any given year.
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•Several more rural communities have less people affected but will still experience an adverse impact, particularly those where local critical services are affected. More detail is given in the main report.

Legend

Hotspots

Number of people

< 20	Number of people affected per 1km grid square
20 - 50	
50 - 100	
100 - 200	
> 200	

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PRELIMINARY FLOOD RISK ASSESSMENT
Map 6a: People affected by flooding in a rainfall event with a 1 in 200 chance of occurring in any given year

Drawn by: AC	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 6a	

Original @ A3

North

0 5 10 20 Kilometers

Legend

- Breach location
- Overtopping location
- Oxford Canal

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PRELIMINARY FLOOD RISK ASSESSMENT

Map 4: Past flooding - Canal flooding in July 2007

Drawn by:	AB	Scale:	Not to scale
Date:	09/06/2011		
Status:	FINAL		
File Name:	N/A		
Drawing Number:	Map 4		

Original @ A3

North

July 2007

February 2001

February 2001

0 5 10 20 Kilometers

Legend

Past flooding from groundwater

Number of properties

- 0 to 10
- 11 to 20
- 21 to 200

Groundwater flooding locations (2001)

Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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PRELIMINARY FLOOD RISK ASSESSMENT

Map 3: Past flooding - Ground water

Drawn by: AB	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 3	

Original @ A3

North

January 2007

October 2006

0 5 10 20 Kilometers

Legend

June 2008

Number of properties flooded by parish

- Less than 2
- 2 to 5
- 5 to 10
- 10 to 15
- 15 to 20

Number of properties flooded by other events

- 20
- 25

Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

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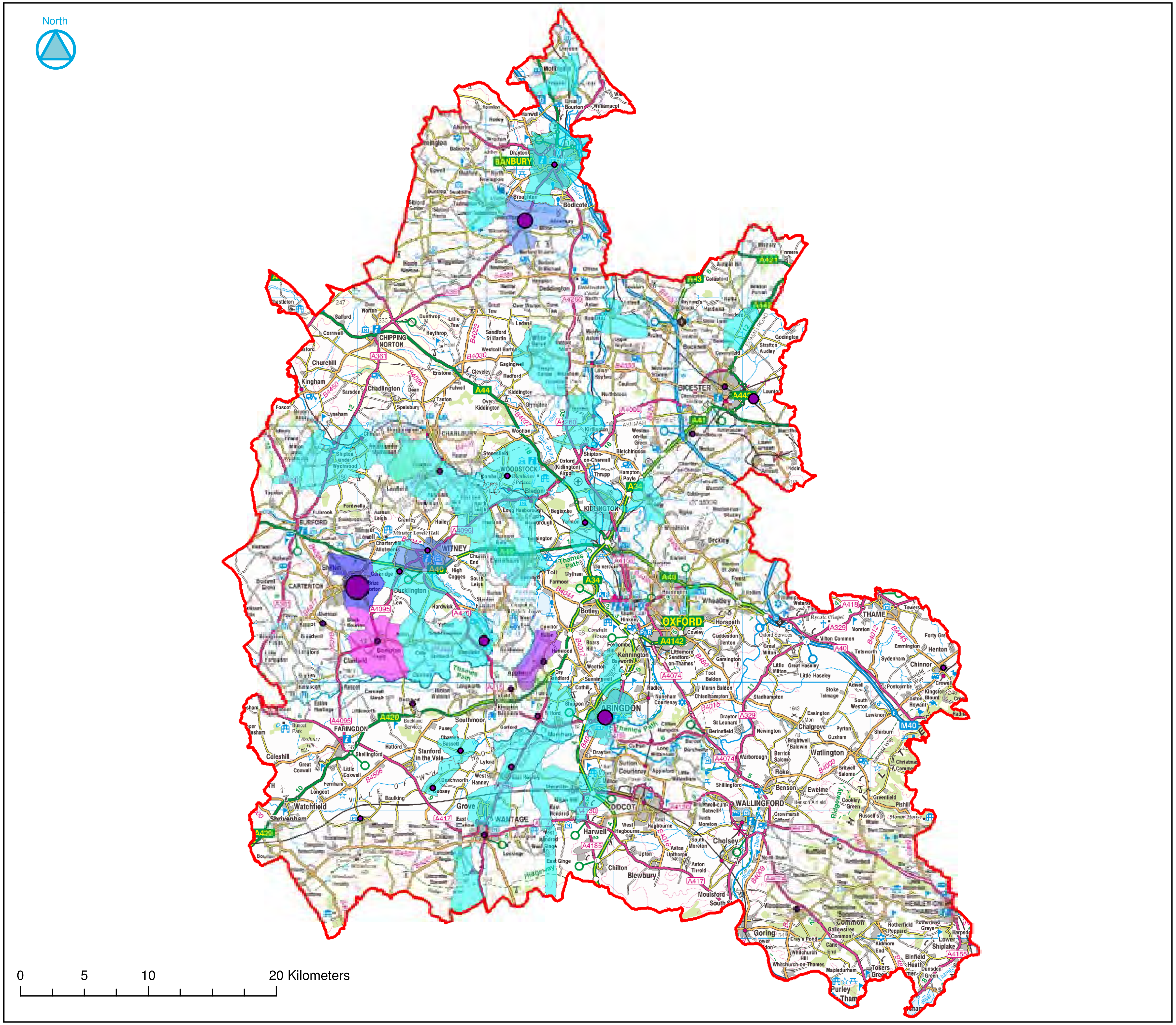
PRELIMINARY FLOOD RISK ASSESSMENT

Map 2: Past flooding - Surface water in other events

Drawn by: AB	Scale: Not to scale
Date: 09/06/2011	
Status: FINAL	
File Name: N/A	
Drawing Number: Map 2	

Original @ A3



Legend

July 2007 (Environment Agency)

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 24

Number of properties flooded internally by 'surface water' (by settlement). Note: Points are an indication of the approximate location of the settlement affected, NOT the location of individual properties flooded.

July 2007 (Fire and Rescue Service)

- 1-5
- 6-10
- 11-20
- 21-50
- 51-125

Number of properties flooded internally by 'drainage' and 'ordinary watercourse' (by parish)

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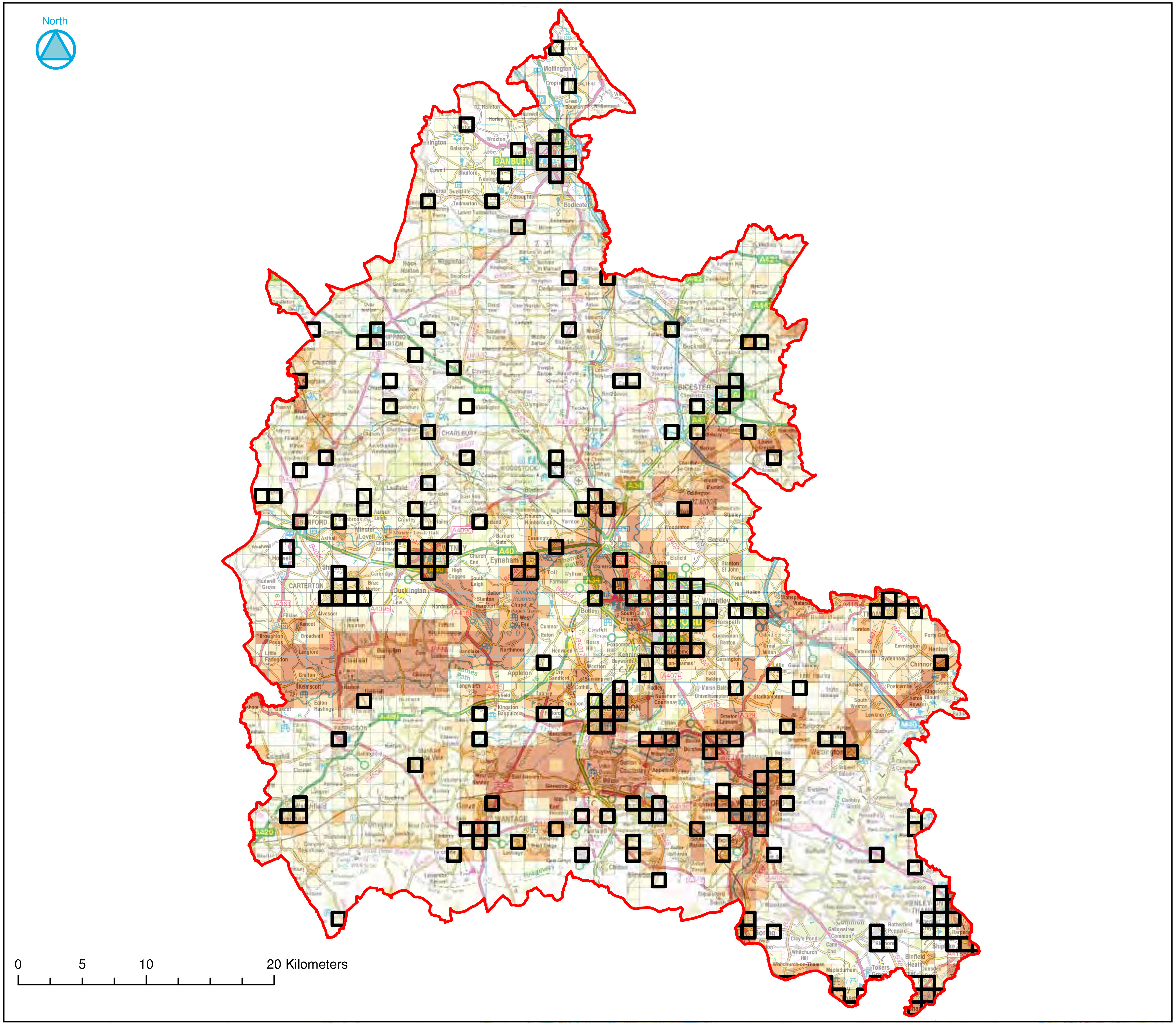
PRELIMINARY FLOOD RISK ASSESSMENT

Map 1: Past flooding - Surface water in July 2007

Drawn by: AB	Scale:
Date: 09/06/2011	Not to scale
Status: FINAL	
File Name: N/A	
Drawing Number: Map 1	

Original @ A3



Legend

Surface water hotspots

Areas Susceptible to Groundwater Flooding

- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Proportion of each 1km square that is susceptible to groundwater emergence

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PRELIMINARY FLOOD RISK ASSESSMENT

Map 7: Areas Susceptible to Groundwater Flooding

Drawn by: AB
Date: 09/06/2011
Status: FINAL
File Name: N/A
Drawing Number: Map 7
Scale: Not to scale

Original @ A3

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APPENDIX I: SURFACE WATER RUN-OFF CALCULATIONS

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SURFACE WATER RUN-OFF CALCULATION SHEET

Development	OXFORD ROAD BODICOTE
Project No.	HYD317

Revision	1.0	**Completed by**	MB
Date	13/04/2018	**Checked by**	DK

Areas			**Catchment Charateristics**		
Total Site	2.204	ha	SAAR	700	mm
Development Area (for SW Strategy)	1.806	ha	SPR	0.1	%
Existing Impermeable	0.430	ha	i_1	13.9	mm/hr
Existing Impermeable (for SW Strategy)	0.430	ha	i_{30}	30.8	mm/hr
Existing Pervious	1.774	ha	i_{100}	40.0	mm/hr
Existing Pervious (for SW Strategy)	1.376	ha			
Proposed Impermeable (total)	0.878	ha			
Proposed Impermeable (domestic only)	0.878	ha			

Run-off Rates

Pre-development

Impermeable	1yr	16.6	l/s
	30yr	36.8	l/s
	100yr	47.8	l/s
	50mm/hr	59.7	l/s
Pervious	1yr	0.6	l/s
	30yr	1.7	l/s
	100yr	2.3	l/s
	QBar	0.7	l/s
Total	1yr	17.2	l/s
	30yr	38.5	l/s
	100yr	50.1	l/s

Post-development

Impermeable (total)	1yr	34.0	l/s
	30yr	75.2	l/s
	100yr+CC	126.9	l/s
Impermeable (domestic only)	1yr		l/s
	30yr		l/s
	100yr+CC		l/s

Volumes

Pre-development

Impermeable	1yr	0.0	cu.m
	100yr	0.0	cu.m
Pervious	1yr	19.3	cu.m
	100yr	97.8	cu.m
Total	1yr	19.3	cu.m
	100yr	97.8	cu.m

Post-development

Impermeable (total)	1yr	0.0	cu.m
	100yr+CC	0.0	cu.m

Quick storage Estimates

		low	high	mean	Imp. Area (ha)	Max. Discharge (l/s)		Rainfall	CC
Return Period	1yr	65	108	86.5	0.878	7.9	*	FEH	0
Return Period	30yr	215	305	260	0.878	7.9	*	FEH	0
Return Period	100yr+CC	387	526	456.5	0.878	7.9	*	FEH	20%
Return Period	100yr+CC	469	636	552.5	0.878	7.9	*	FEH	40%

* Based on a soil factor of 0.45

SURFACE WATER RUN-OFF CALCULATION SHEET

Development	OXFORD ROAD BODICOTE
Project No.	HYD317

Revision	0.0	**Completed by**	MB
Date	13/04/2018	**Checked by**	DK

Areas			**Catchment Charateristics**		
Total Site	2.184	ha	SAAR	700	mm
Development Area (for SW Strategy)	1.807	ha	SPR	0.1	%
Existing Impermeable	0.044	ha	i_1	13.9	mm/hr
Existing Impermeable (for SW Strategy)	0.044	ha	i_{30}	30.8	mm/hr
Existing Pervious	2.140	ha	i_{100}	40.0	mm/hr
Existing Pervious (for SW Strategy)	1.763	ha			
Proposed Impermeable (total)	0.904	ha			
Proposed Impermeable (domestic only)	0.904	ha			

Run-off Rates

Pre-development

Impermeable	1yr	1.7	l/s
	30yr	3.8	l/s
	100yr	4.9	l/s
	50mm/hr	6.1	l/s
Pervious	1yr	0.6	l/s
	30yr	1.7	l/s
	100yr	2.3	l/s
	QBar	0.7	l/s
Total	1yr	2.3	l/s
	30yr	5.5	l/s
	100yr	7.2	l/s

Post-development

Impermeable (total)	1yr	35.0	l/s
	30yr	77.4	l/s
	100yr+CC	130.6	l/s
Impermeable (domestic only)	1yr		l/s
	30yr		l/s
	100yr+CC		l/s

Volumes

Pre-development

Impermeable	1yr	0.0	cu.m
	100yr	0.0	cu.m
Pervious	1yr	19.3	cu.m
	100yr	97.8	cu.m
Total	1yr	19.3	cu.m
	100yr	97.8	cu.m

Post-development

Impermeable (total)	1yr	0.0	cu.m
	100yr+CC	0.0	cu.m

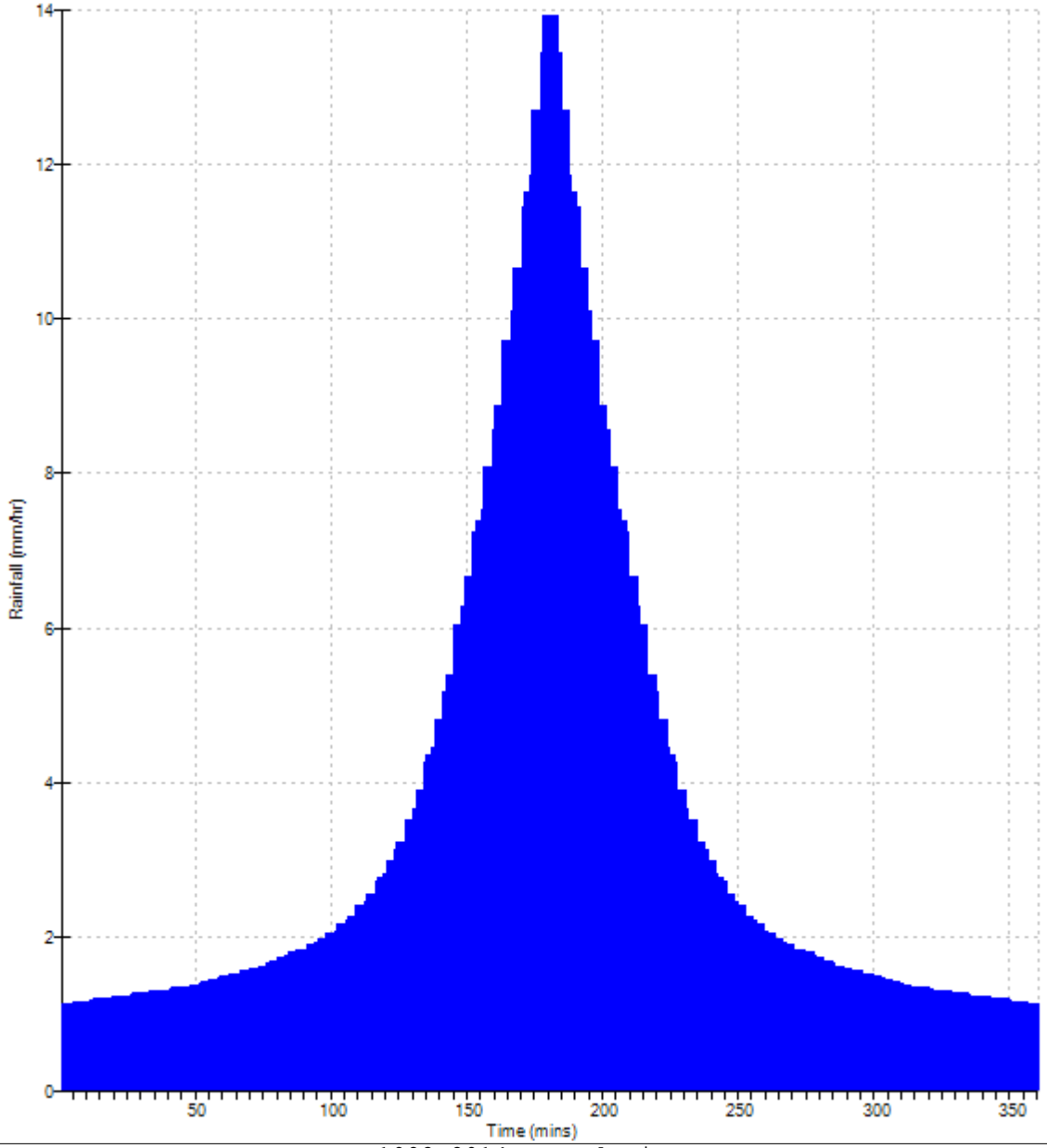
Quick storage Estimates

		low	high	mean	Imp. Area (ha)	Max. Discharge (l/s)		Rainfall	CC
Return Period	1yr	174	268	221	0.904	0.7	*	FEH	0
Return Period	30yr	437	589	513	0.904	0.7	*	FEH	0
Return Period	100yr+CC	724	923	824	0.904	0.7	*	FEH	20%
Return Period	100yr+CC	874	1097	986	0.904	0.7	*	FEH	40%

Rainfall profile

Storm duration (mins) 360

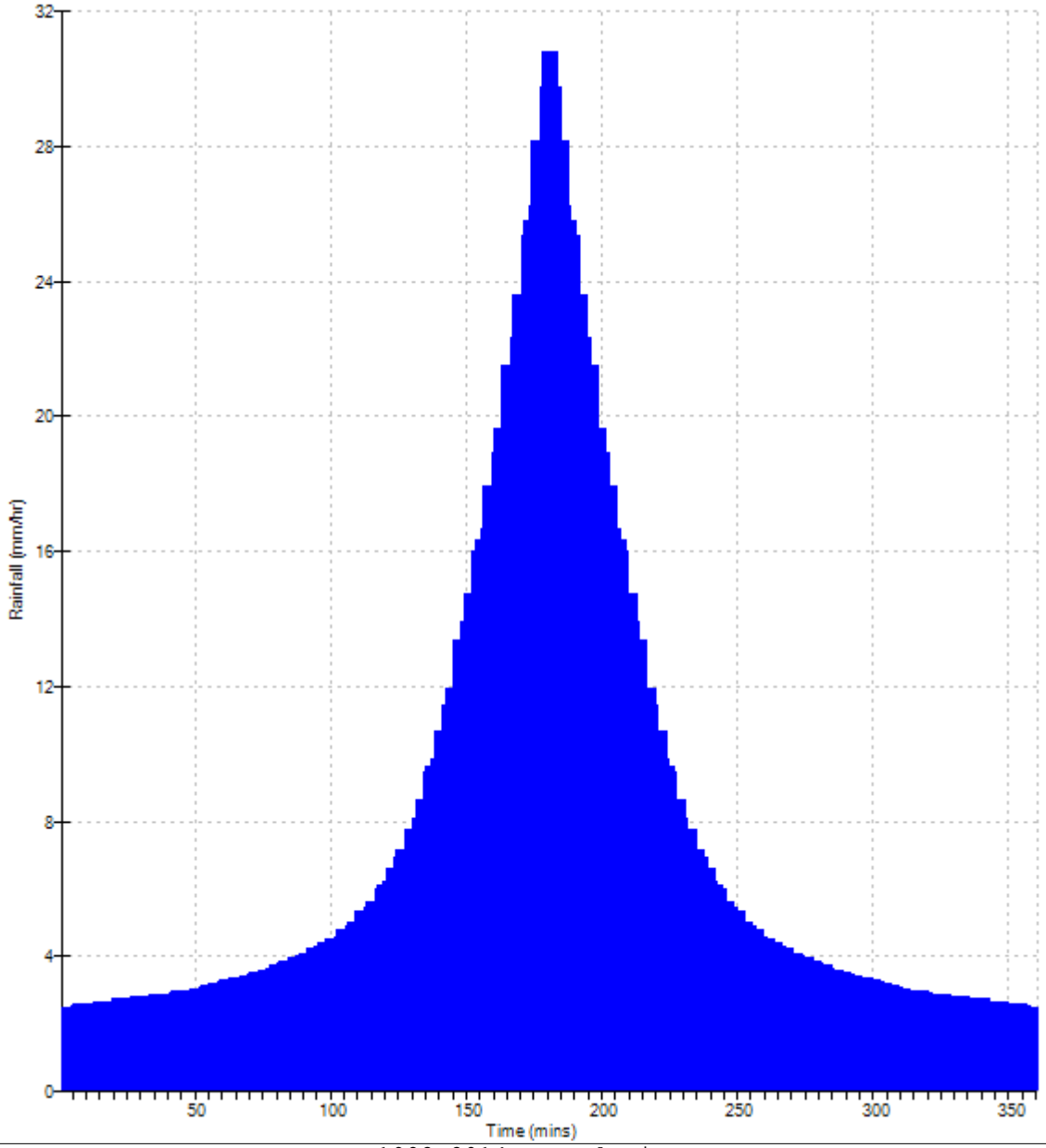
FSR Data	
Region	England and Wales
M5-60 (mm)	19.800
Ratio R	0.412
Peak Intensity (mm/hr)	13.930
Ave. Intensity (mm/hr)	3.553
Return Period (years)	1



Rainfall profile

Storm duration (mins) 360

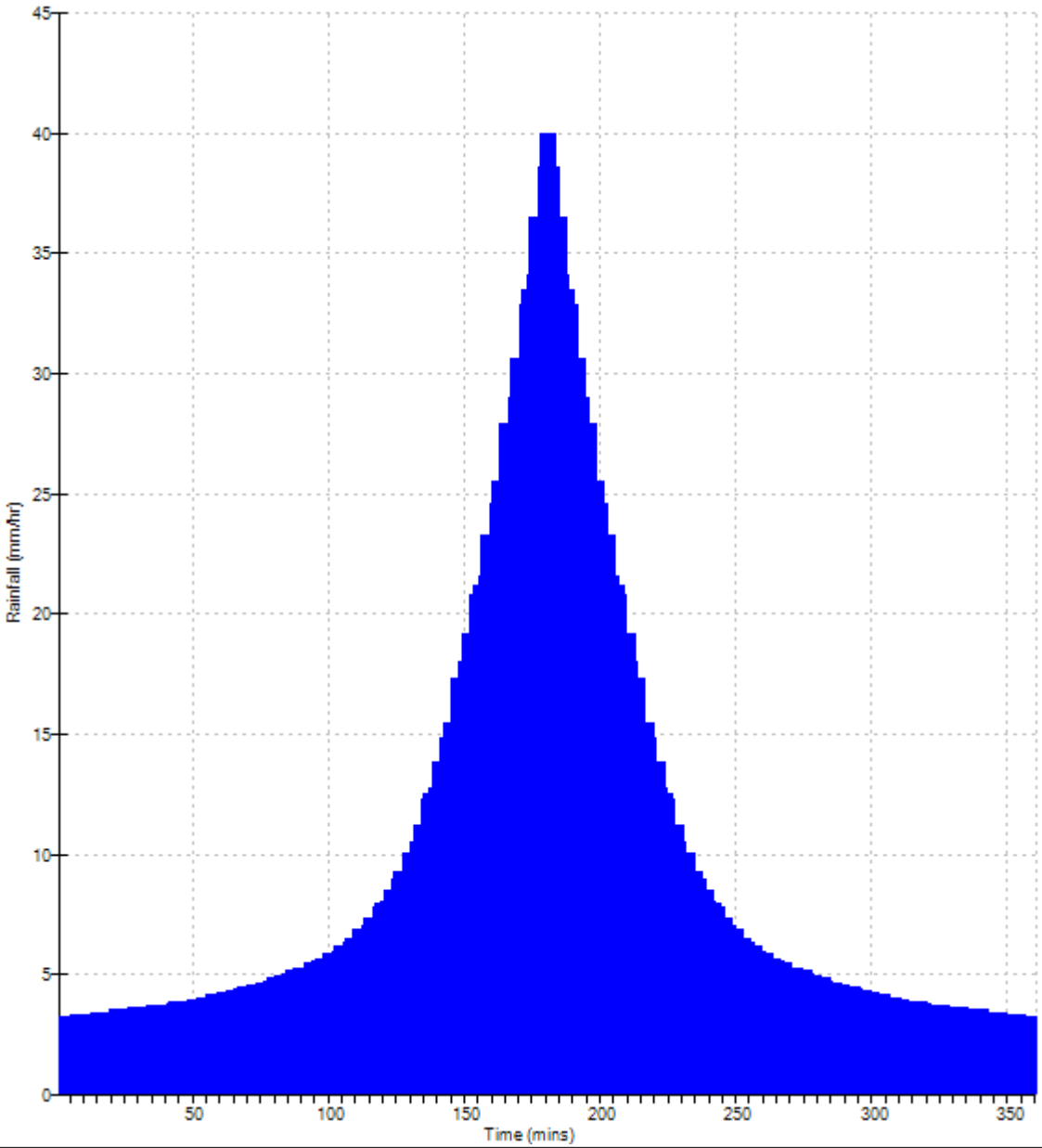
FSR Data	
Region	England and Wales
M5-60 (mm)	19.800
Ratio R	0.412
Peak Intensity (mm/hr)	30.824
Ave. Intensity (mm/hr)	7.863
Return Period (years)	30



Rainfall profile

Storm duration (mins) 360

FSR Data	
Region	England and Wales
M5-60 (mm)	19.800
Ratio R	0.412
Peak Intensity (mm/hr)	40.019
Ave. Intensity (mm/hr)	10.209
Return Period (years)	100



ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.150
Area (ha)	1.807	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results l/s

QBAR Rural	0.7
QBAR Urban	0.7
Q1 year	0.6
Q1 year	0.6
Q30 years	1.7
Q100 years	2.3

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	1.807	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results l/s

QBAR Rural	7.9
QBAR Urban	7.9
Q1 year	6.7
Q1 year	6.7
Q30 years	18.0
Q100 years	25.3

Greenfield Runoff Volume

FSR Data

Return Period (years)	1
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.800
Ratio R	0.411
Areal Reduction Factor	1.00
Area (ha)	1.807
SAAR (mm)	700
CWI	105.000
Urban	0.000
SPR	10.000

Results

Percentage Runoff (%)	5.00
Greenfield Runoff Volume (m^3)	19.287

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.800
Ratio R	0.411
Areal Reduction Factor	1.00
Area (ha)	1.807
SAAR (mm)	700
CWI	105.000
Urban	0.000
SPR	10.000

Results

Percentage Runoff (%)	8.83
Greenfield Runoff Volume (m^3)	97.833

APPENDIX J: IMPERMEABLE AREAS PLANS

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DO NOT SCALE

LEGEND

TOTAL SITE AREA- 2.204ha
DEVELOPMENT AREA- 1.806ha

PRE-DEVELOPMENT IMPERMEABLE AREAS- 0.430ha

REV	DATE	BY	DESCRIPTION	CHK
A	05.04.18	MB	PRELIMINARY FOR ISSUE	KW

DRAWING STATUS: PRELIMINARY

BETTS HYDRO
CONSULTING ENGINEERS
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

HSL | HOLLINS STRATEGIC LAND

PROJECT:
OXFORD ROAD
BODICOTE

TITLE:
PRE-DEVELOPMENT
IMPERMEABLE AREAS PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
05.04.18	1:1@A1	MB	DK

PROJECT No:	DRAWING No:	REV:
HYD317	101	A

DO NOT SCALE

LEGEND

TOTAL SITE AREA- 2.204ha
DEVELOPMENT AREA- 1.806ha

POST-DEVELOPMENT IMPERMEABLE AREAS- 0.878ha

BUILDINGS- 0.328ha
ROADS- 0.403ha
DRIVES - 0.147ha

REV	DATE	BY	DESCRIPTION	CHK
A	05.04.18	MB	PRELIMINARY FOR ISSUE	KW

DRAWING STATUS: PRELIMINARY

BETTS HYDRO CONSULTING ENGINEERS
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

HSL | HOLLINS STRATEGIC LAND

PROJECT:
OXFORD ROAD
BODICOTE

TITLE:
POST DEVELOPMENT
IMPERMABLE AREAS PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
05.04.18	1:1@A1	MB	DK

PROJECT No:	DRAWING No:	REV:
HYD317	201	A

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APPENDIX K: PRELIMINARY PROPOSED DRAINAGE PLANS

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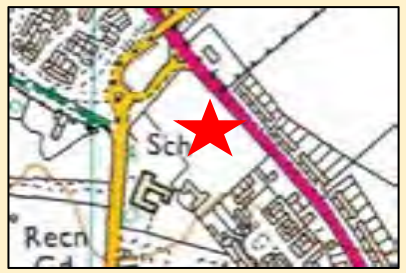
SITE: OXFORD ROAD, BODICOTE

REF: HYD317
REV: 0
DATE: 06.04.18

BETTS HYDRO CONSULTING ENGINEERS

EXISTING DRAINAGE SITUATION PLAN



LEGEND

Site Extents

Existing Land Features

General Topographic Fall

Existing Drainage Features

TBC

Existing Sewer Infrastructure

Surface Water Sewer (public)

Foul Water Sewer (public)

FURTHER NOTES:

This drawing is not a drainage 'design' it is a preliminary drainage strategy showing existing sewer locations.

No hydraulic simulation or assessment of these proposals has been undertaken.

Proposed points of connection to the existing watercourse and sewer require invert levels to be accurately established. Refer to proposed drainage plan.

Surcharging of the proposed outfall will require modelling to satisfy the requirements of united utilities along with full hydraulic analysis.

Foul Water:

Review of the TW sewer records identify there to be limited public sewer infrastructure in proximity to the site however, the nearest foul water sewer (150mm dia.) is located north-east of site within Oxford Road. Due to the site being brownfield there is a possibility there is an existing connection, however further investigation is required to confirm the condition and capacity of the existing sewer network. Detailed design will be required to confirm feasibility based on the topographic levels following further detailed investigation. Consents and relevant agreements will be required from TW prior to commencement of works. Early consultation with TW is recommended to identify any additional constraints and their preferred point(s) of connection.

Surface Water:

Based on the ground conditions identified by the online datasets it can be considered that infiltration may be likely offer a part or fully viable drainage solution for the development site due to the permeable strata. Further investigation is recommended to take place promptly as infiltration would be the primary means of discharging surface water run-off. Should infiltration not be feasible for all of the site due to other constraints then the next outfall in the hierarchical approach is to discharge to the watercourse. At present, there are no watercourses suitable for outfall within close proximity of the site, therefore discharge to the sewer network (subject to the relevant consents/agreements), would be required to be explored. Detailed design will be required to confirm the possibility of a site wide gravity connection following further investigations. If a gravity system is not feasible a pumped surface water system may be required to cater for the proposals.

SITE: OXFORD ROAD, BODICOTE

REF: HYD317
REV: 0
DATE: 06.04.18

BETTS HYDRO CONSULTING ENGINEERS

PRELIMINARY
PROPOSED DRAINAGE PLAN

LEGEND

Site Extents

Existing Drainage Features

TBC

Existing Sewer Infrastructure

Surface Water Sewer (public)

Foul Water Sewer (public)

Proposed Drainage Route/Connection(s)

Infiltration (1)

Surface Water (2)

Foul Water

FURTHER NOTES:

This drawing is not a drainage 'design' it is a preliminary drainage strategy showing existing sewer locations.

No hydraulic simulation or assessment of these proposals has been undertaken.

Proposed points of connection to the existing watercourse and sewer require invert levels to be accurately established. Refer to proposed drainage plan.

Surcharging of the proposed outfall will require modelling to satisfy the requirements of united utilities along with full hydraulic analysis.

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APPENDIX L: STORMWATER STORAGE ESTIMATES

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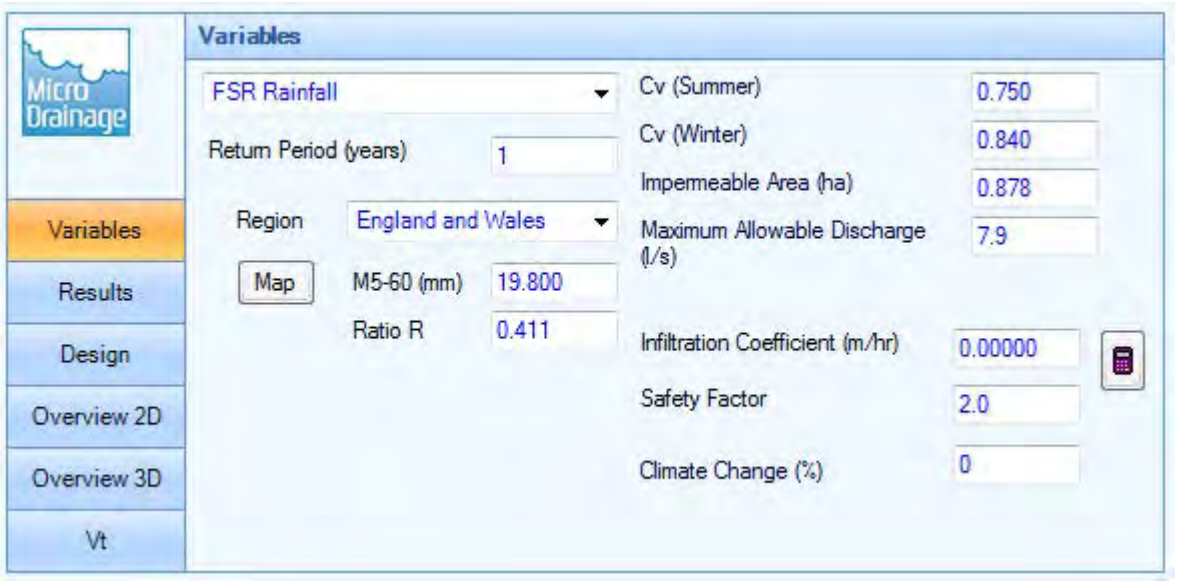
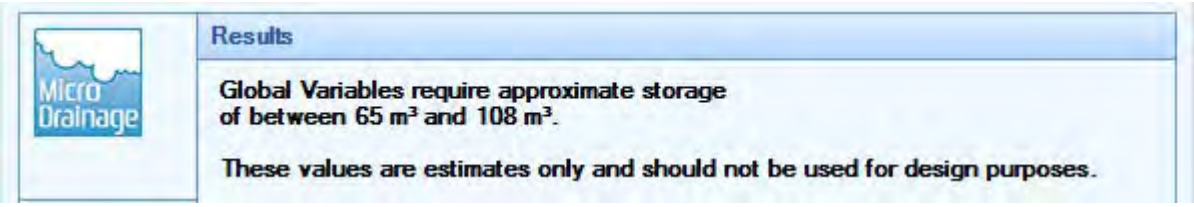
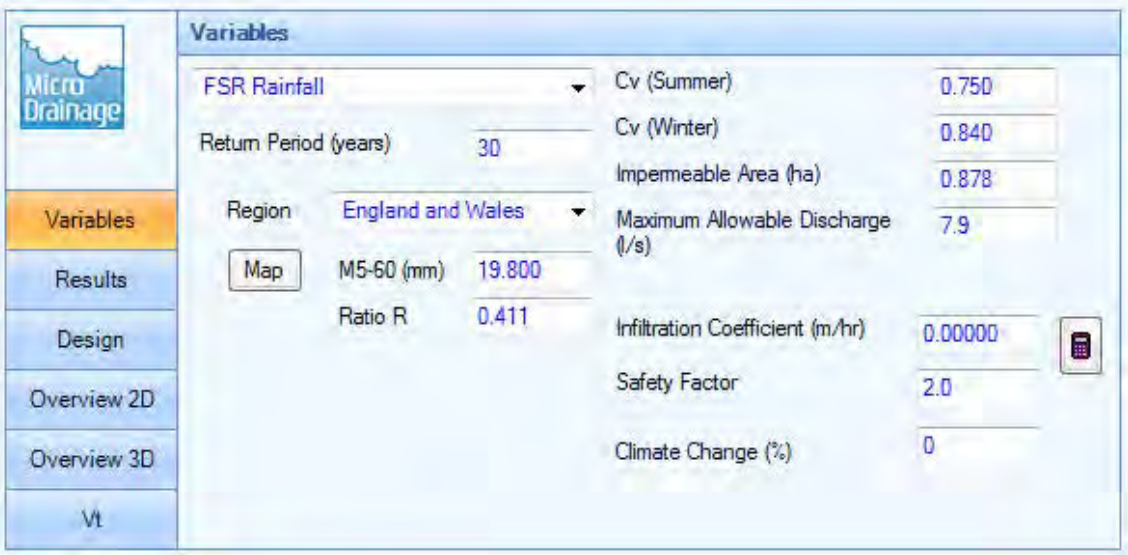
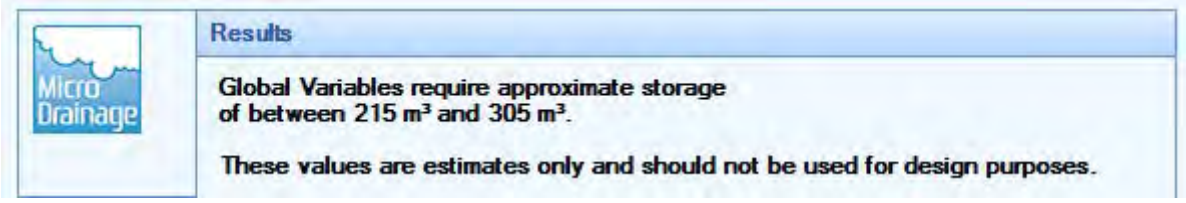
1 YEAR RETURN PERIOD STORM EVENT



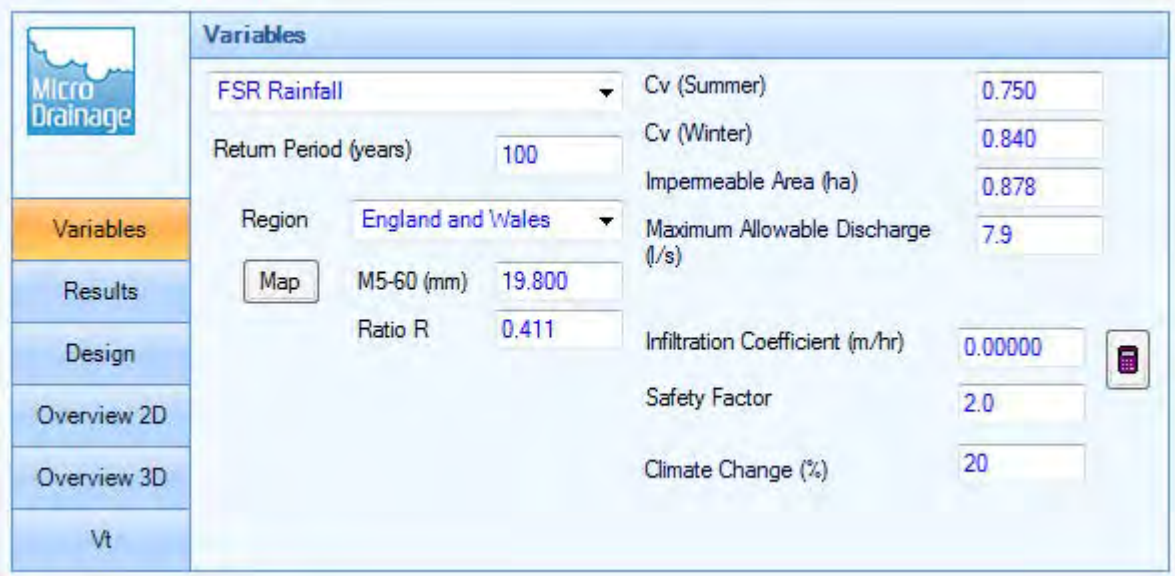


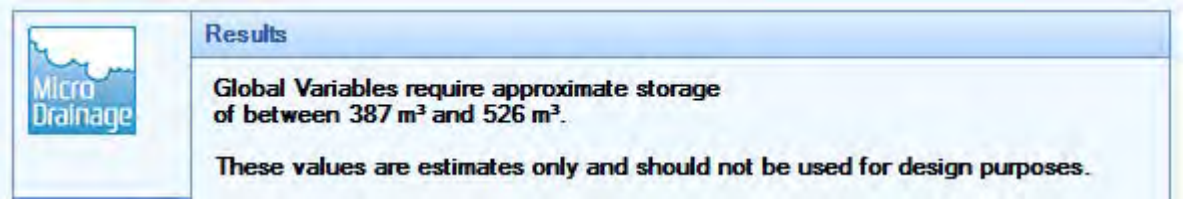
30 YEAR RETURN PERIOD STORM EVENT



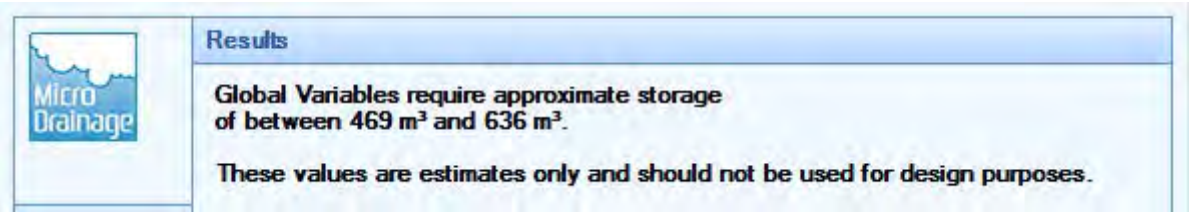


100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE

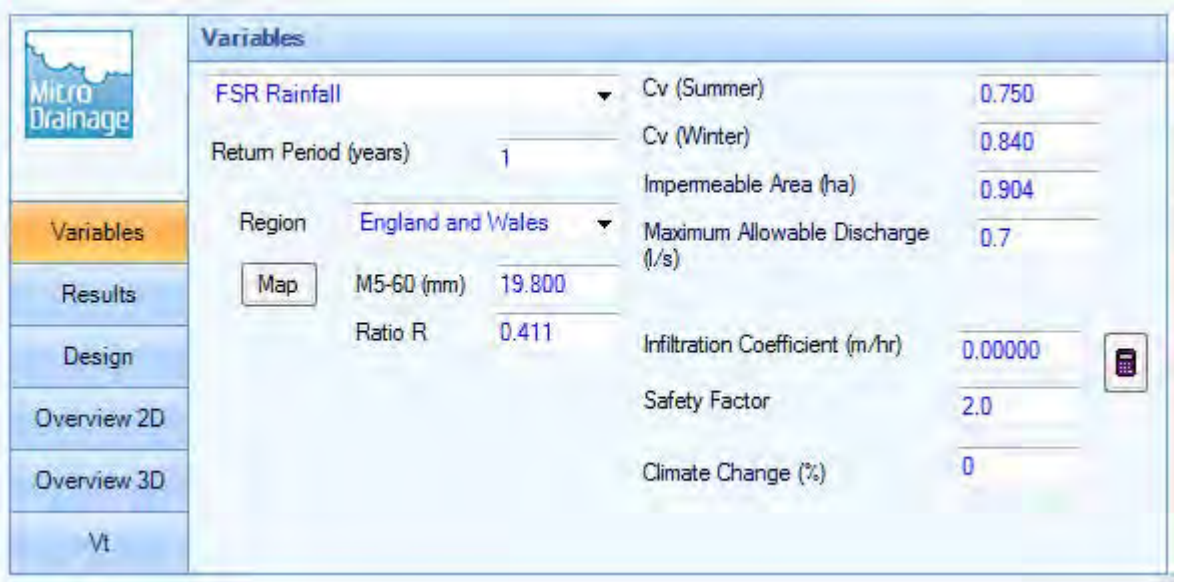


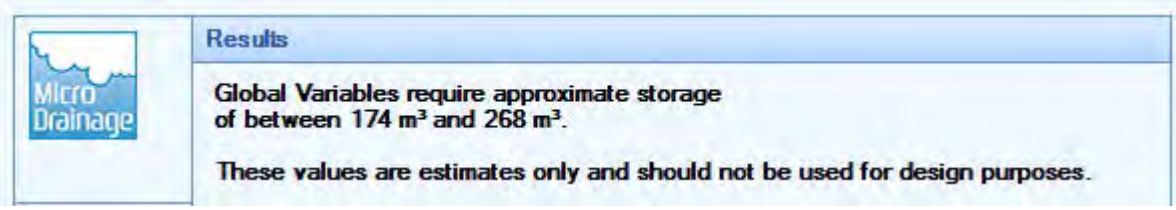


100 YEAR RETURN PERIOD STORM EVENT + 40% CLIMATE CHANGE

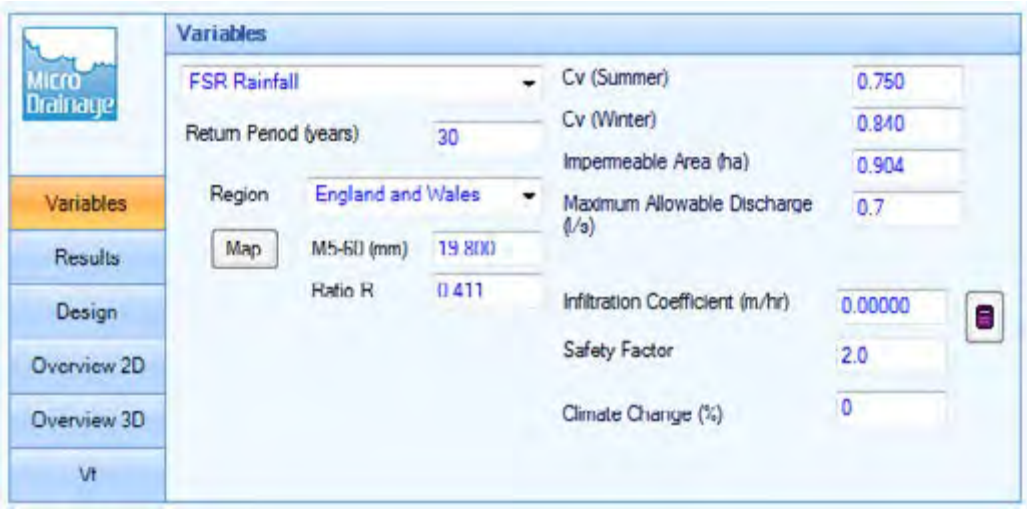


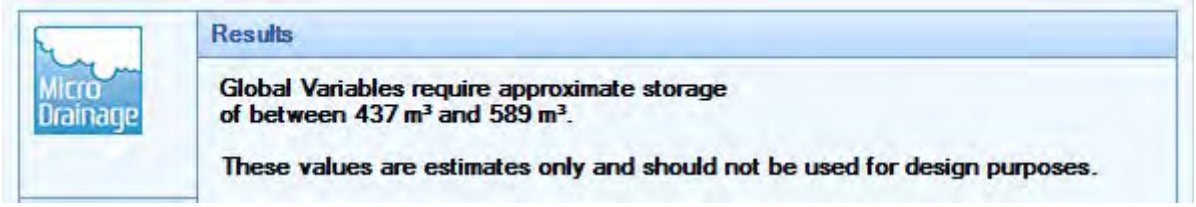
1 YEAR RETURN PERIOD STORM EVENT



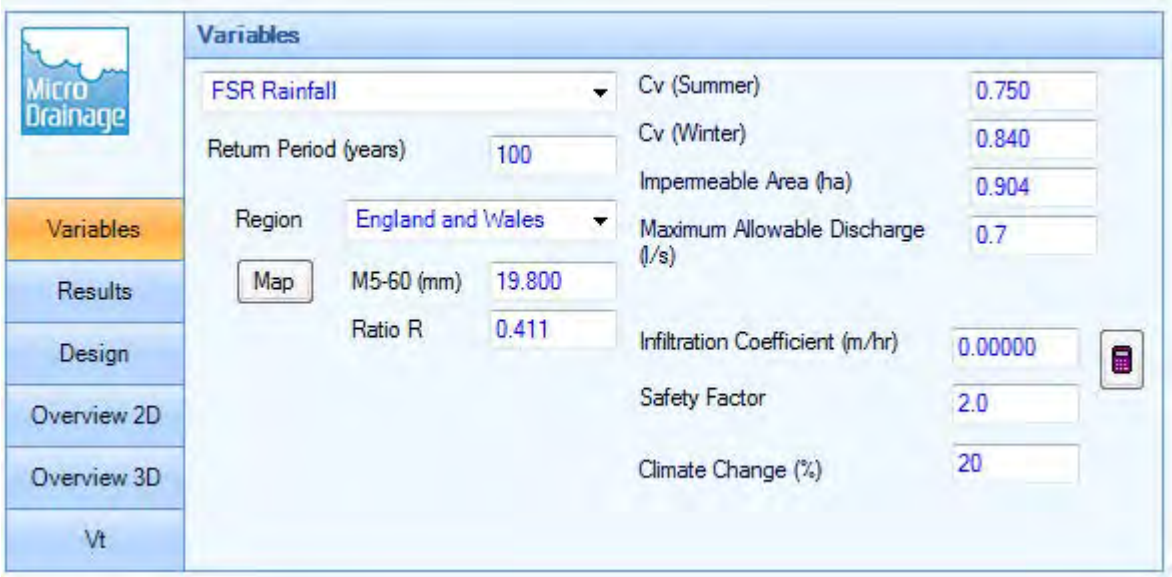


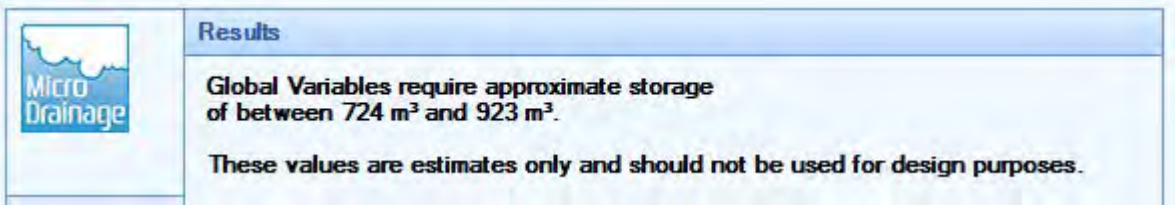
30 YEAR RETURN PERIOD STORM EVENT



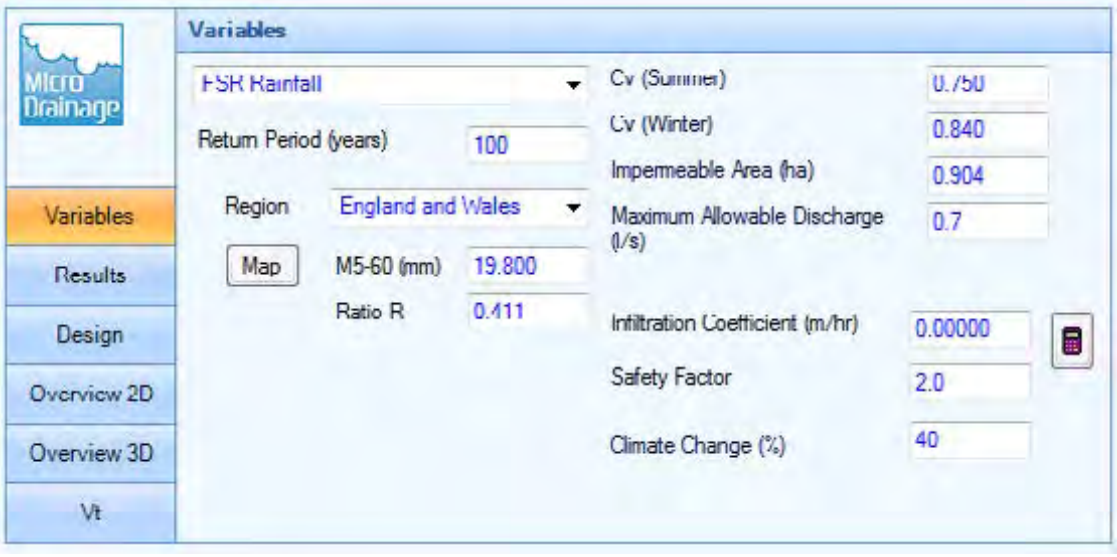


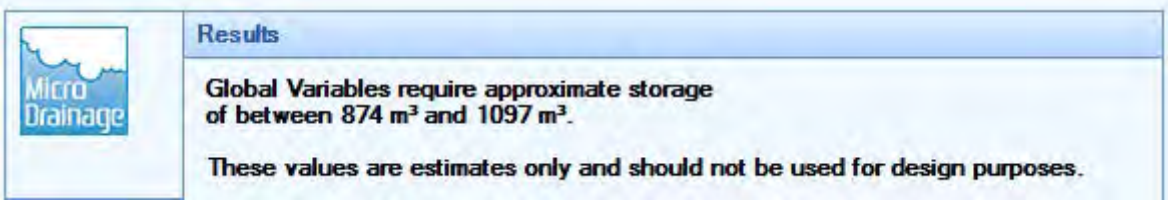
100 YEAR RETURN PERIOD STORM EVENT + 20% CLIMATE CHANGE





100 YEAR RETURN PERIOD STORM EVENT + 40% CLIMATE CHANGE





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APPENDIX M: OVERLAND FLOOD FLOW ROUTING PLANS

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DO NOT SCALE

REV	DATE	BY	DESCRIPTION	CHK
A	05.04.18	MB	PRELIMINARY FOR ISSUE	KW

DRAWING STATUS:
PRELIMINARY

BETTS HYDRO CONSULTING ENGINEERS
Old Main Farm Barns, Main Road, Sandoe, Filkirkve, CH5 2LY
Tel: 01244 288178 enquiries@betts-consodtes.co.uk

HSL | HOLLINS STRATEGIC LAND

PROJECT:
OXFORD ROAD
BODICOTE

TITLE:
PRE-DEVELOPMENT
OVERLAND FLOW PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
05.04.18	1:1@A1	MB	DK

PROJECT No:	DRAWING No:	REV:
HYD317	102	A

DO NOT SCALE

LEGEND

TOTAL SITE AREA- 2.204ha
DEVELOPMENT AREA- 1.806ha

OVERLAND FLOW ROUTES

REV	DATE	BY	DESCRIPTION	CHK
A	05.04.18	MB	PRELIMINARY FOR ISSUE	KW

DRAWING STATUS: PRELIMINARY

BETTS HYDRO CONSULTING ENGINEERS
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
Tel: 01244 288178 enquiries@betts-associates.co.uk

HSL | HOLLINS STRATEGIC LAND

PROJECT:
OXFORD ROAD
BODICOTE

TITLE:
POST-DEVELOPMENT
OVERLAND FLOW PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
05.04.18	1:1@A1	MB	DK

PROJECT No:	DRAWING No:	REV:
HYD317	202	A

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APPENDIX N: TYPICAL SUDS DETAILS

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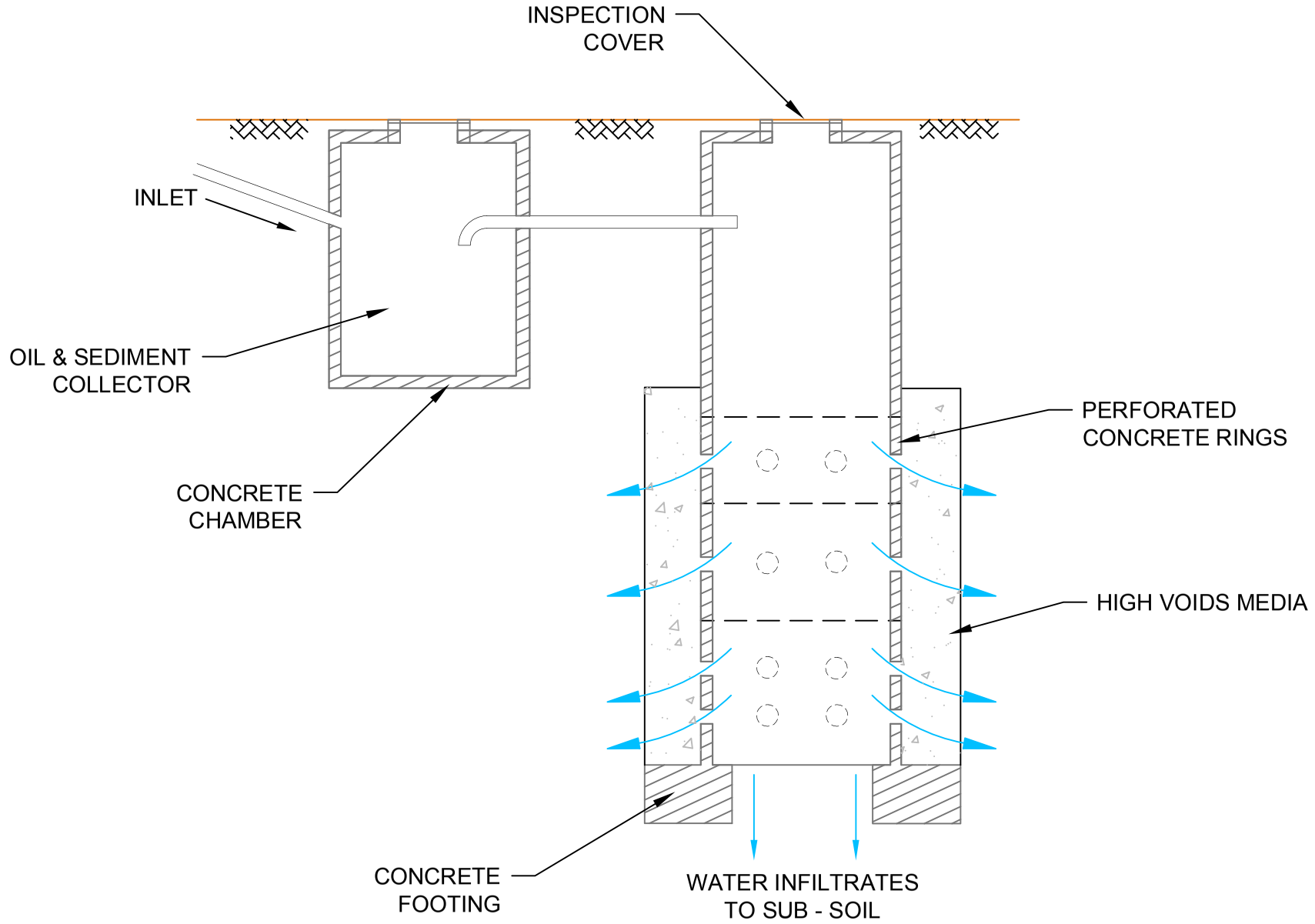
DO NOT SCALE



SOAKAWAY DETAILS (INCLUDING PRE-TREATMENT DEVICE)

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

BETTS ASSOCIATES
CIVIL AND STRUCTURAL ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 Fax: 01244 288516 enquiries@betts-associates.co.uk

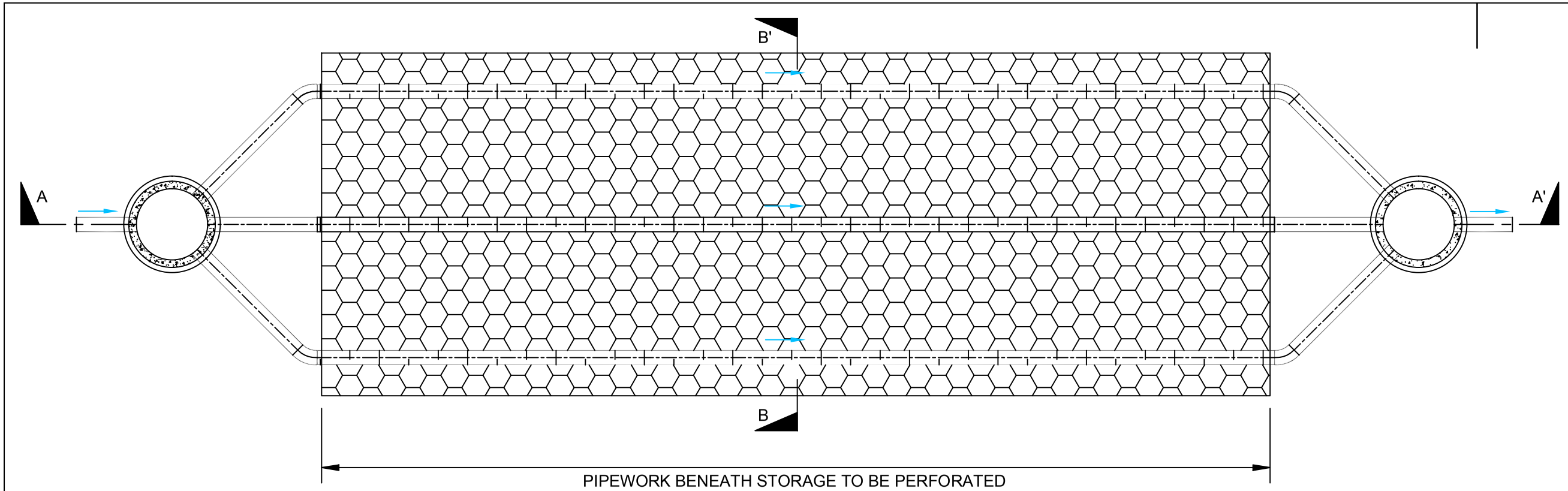
PROJECT: TYPICAL SUDS DETAIL

TITLE: SOAKAWAYS

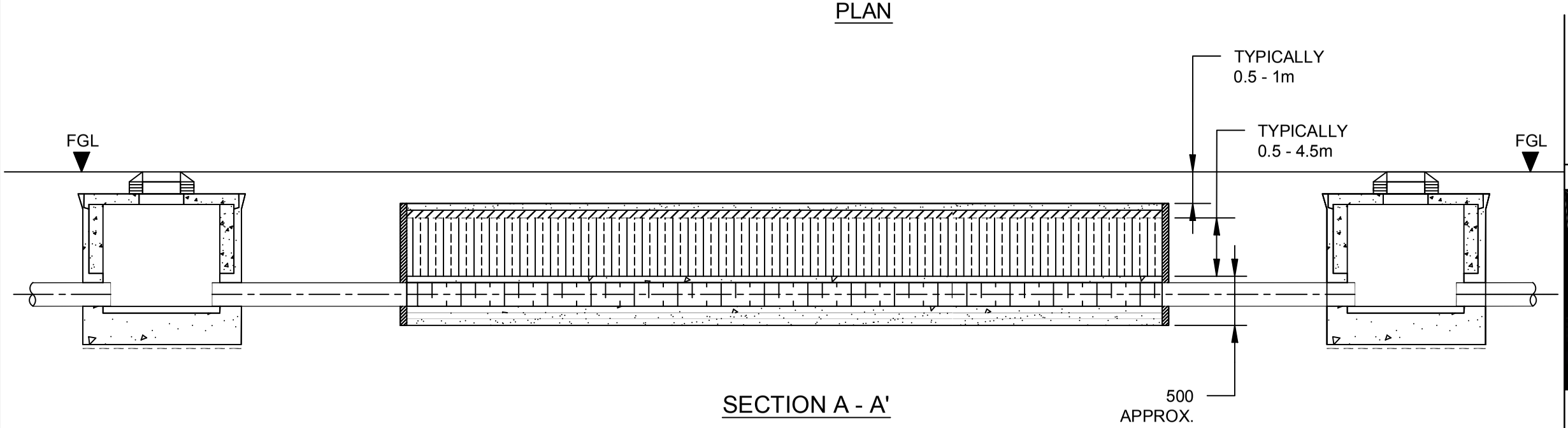
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	108	A

DO NOT SCALE

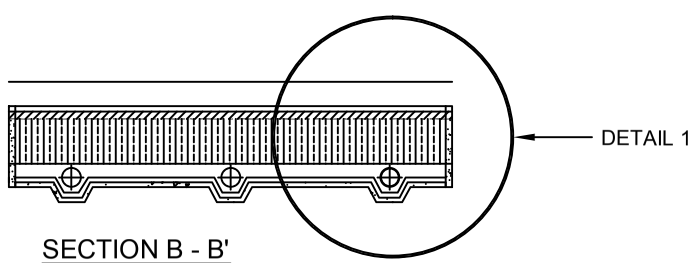


PLAN



SECTION A - A'

ALL DIMENSIONS AND DEPTHS DEPENDENT ON REQUIRED VOLUME AND LOCAL GROUND CONDITIONS



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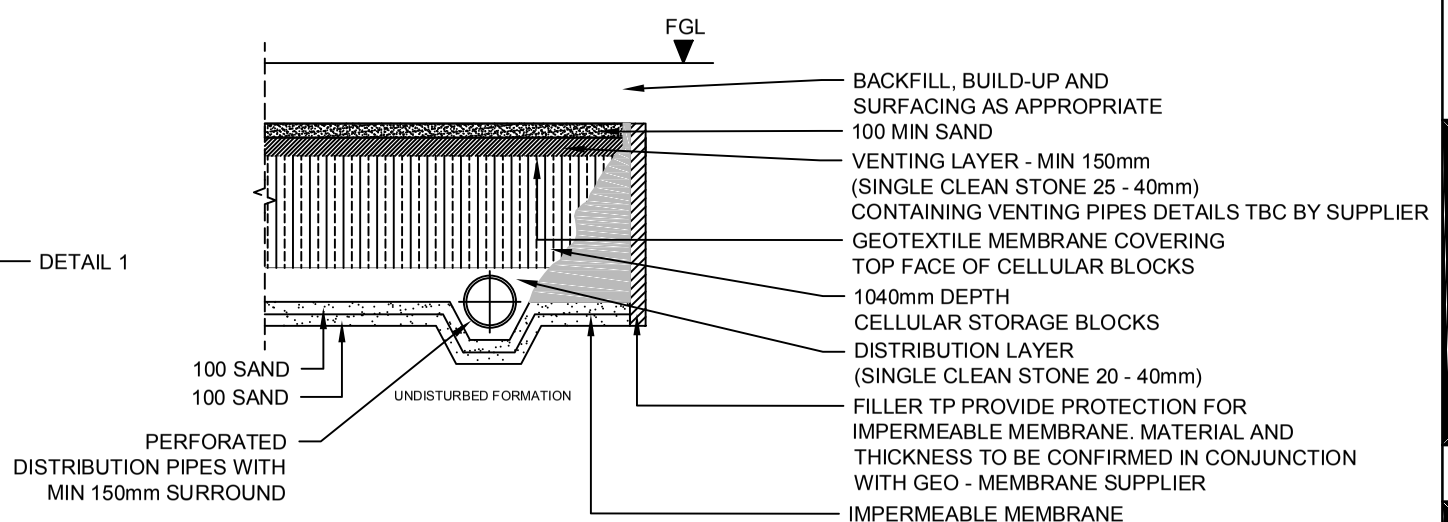


DETAIL 1

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

BETTS ASSOCIATES
CIVIL AND STRUCTURAL ENGINEERS
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 Fax: 01244 288516 enquiries@betts-associates.co.uk

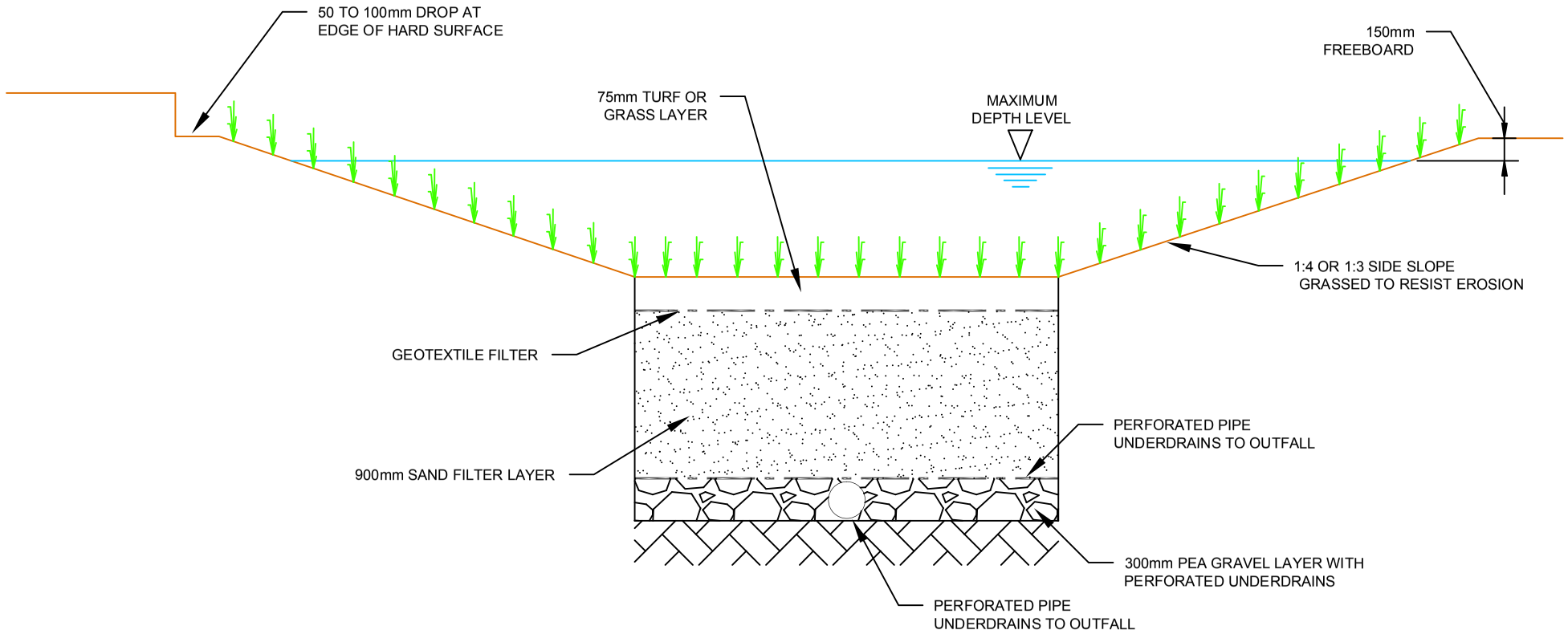
PROJECT: TYPICAL SUDS DETAIL

TITLE: CELLULAR STORAGE

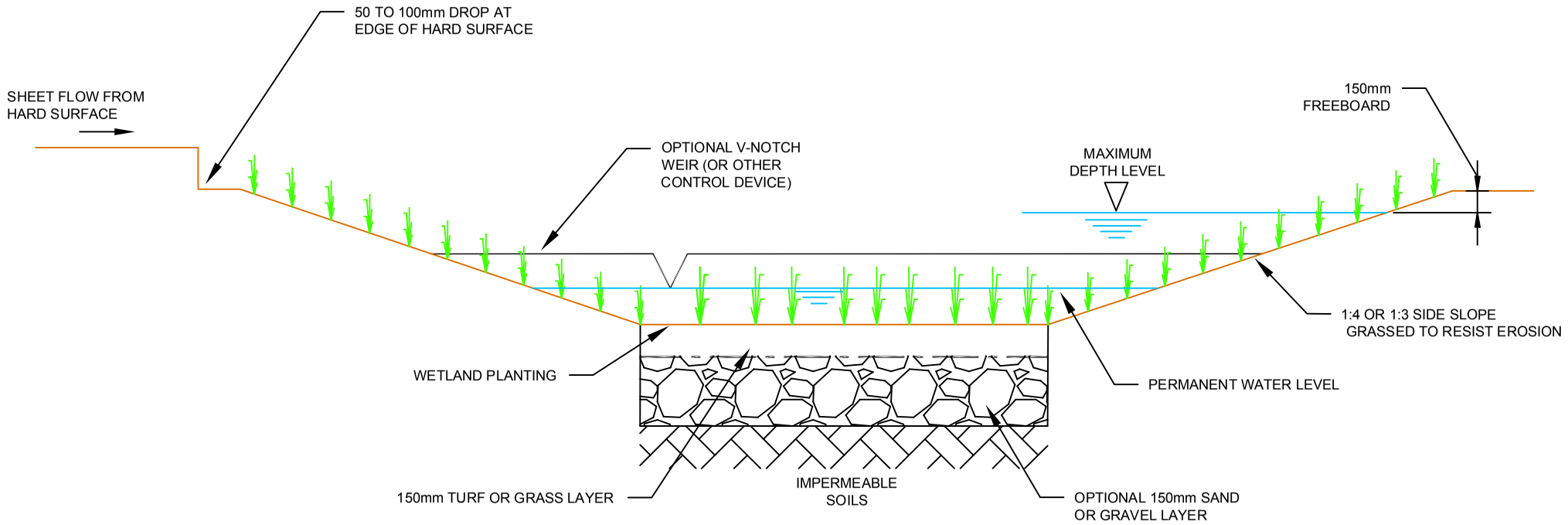
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	113	A

DO NOT SCALE



DRY SWALE



WET SWALE

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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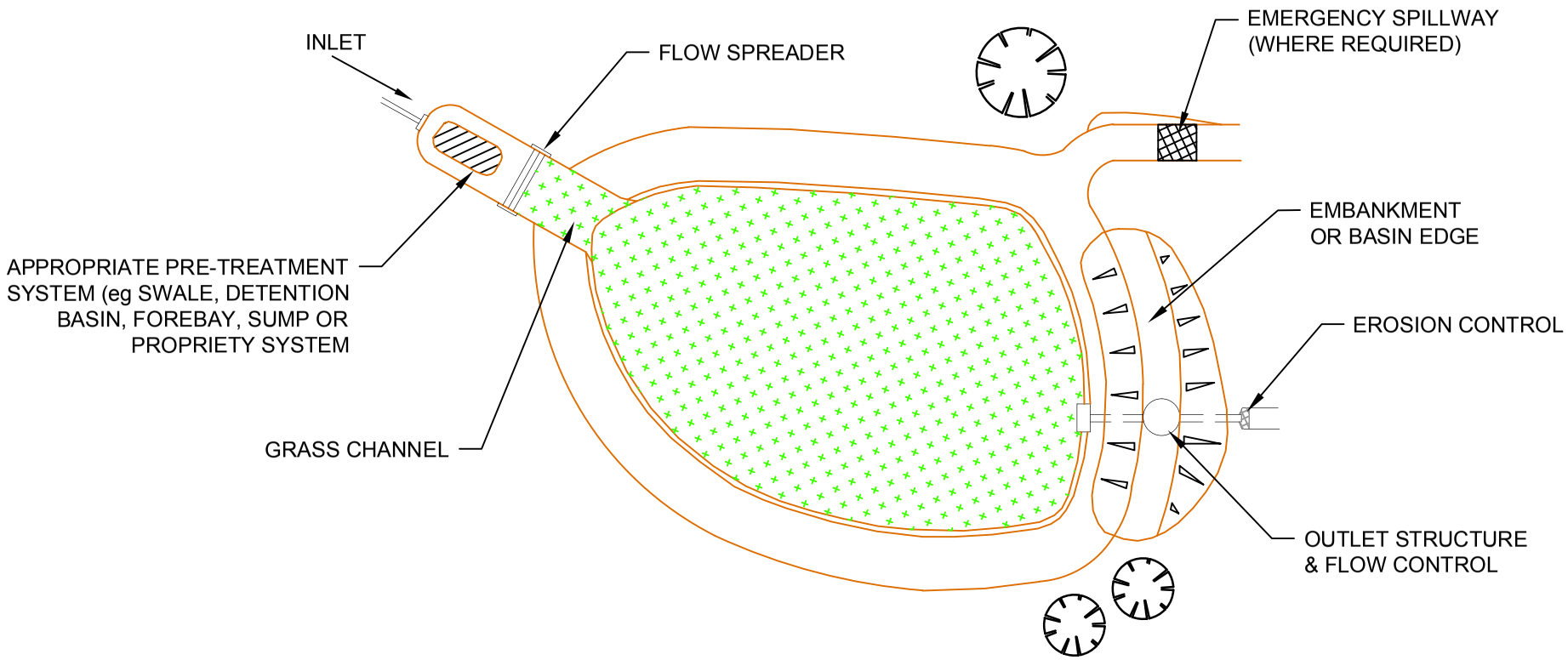
PROJECT: TYPICAL SUDS DETAIL

TITLE: SWALES (1 of 2)

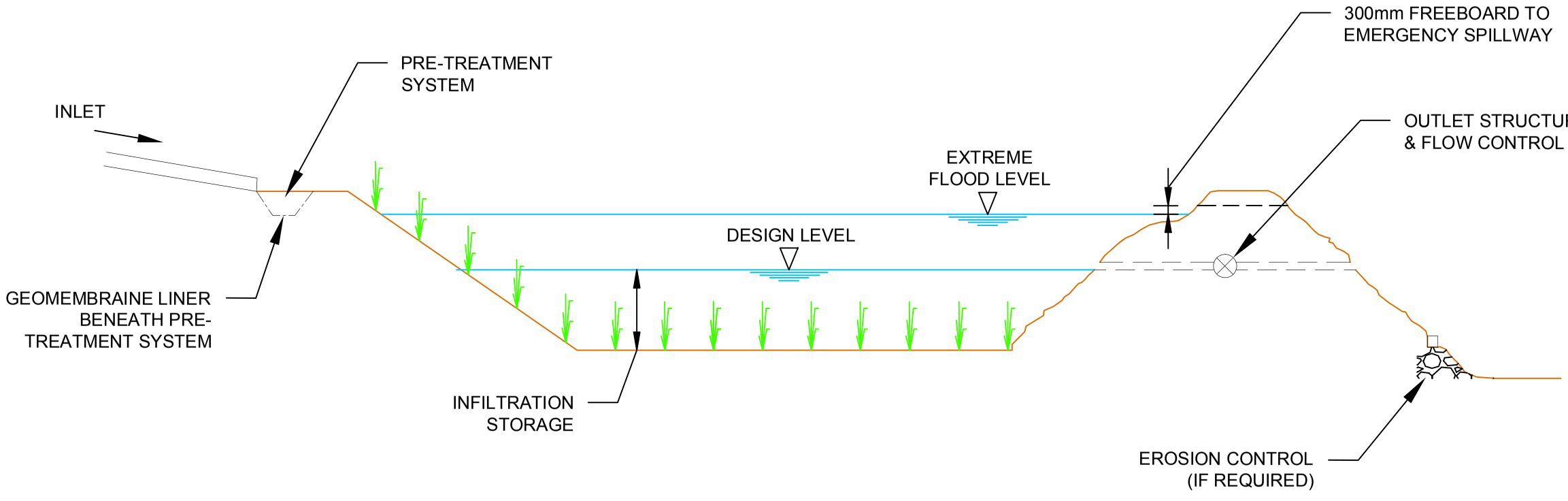
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	103	A

DO NOT SCALE



PLAN VIEW



ELEVATION

REV	DATE	BY	DESCRIPTION	CHK

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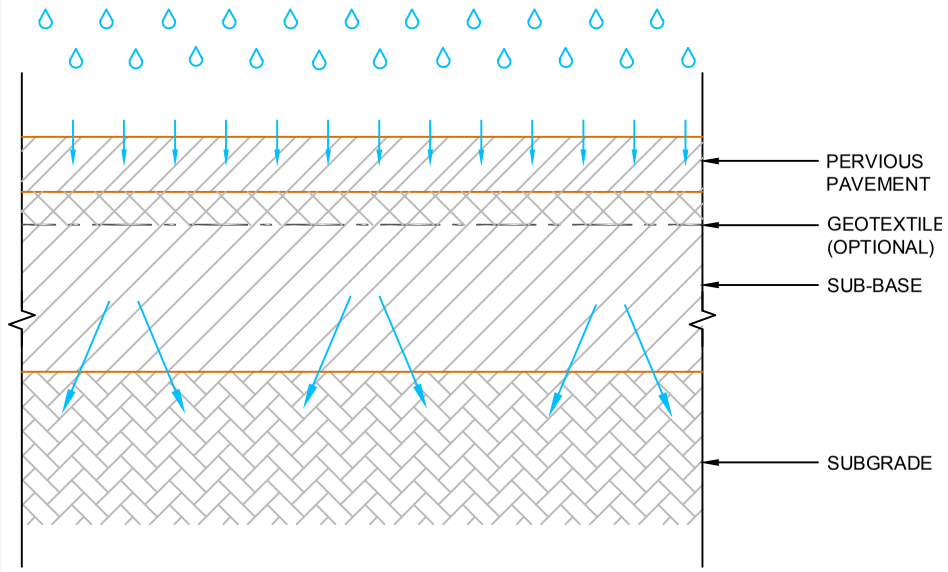
PROJECT: TYPICAL SUDS DETAIL

TITLE: INFILTRATION BASINS

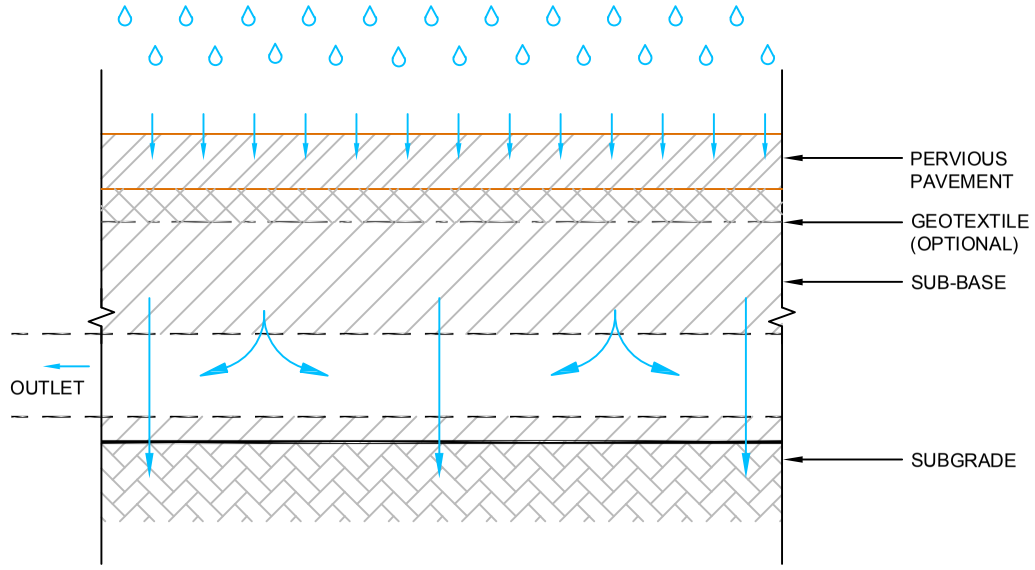
DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	109	A

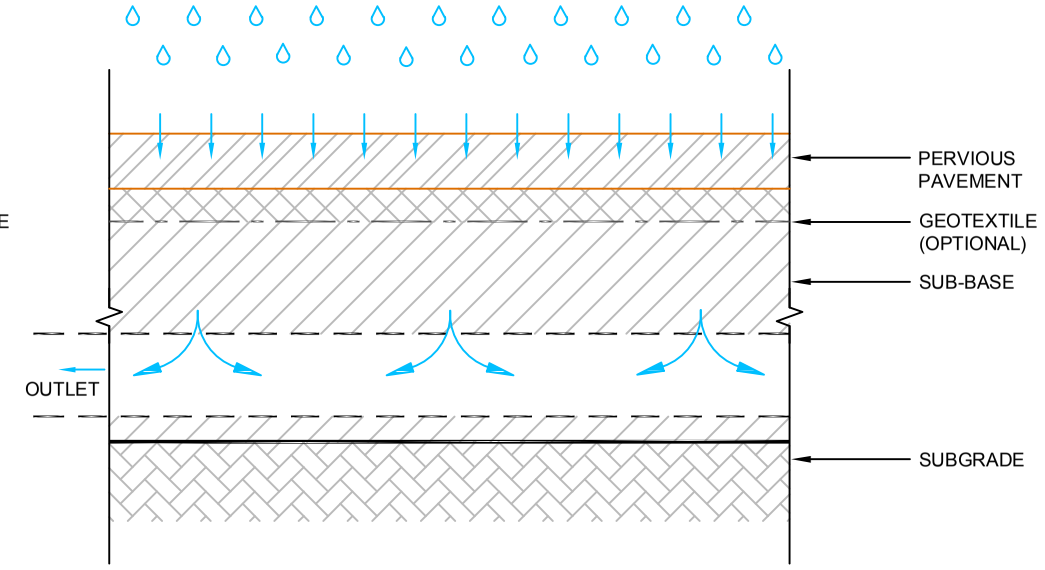
DO NOT SCALE



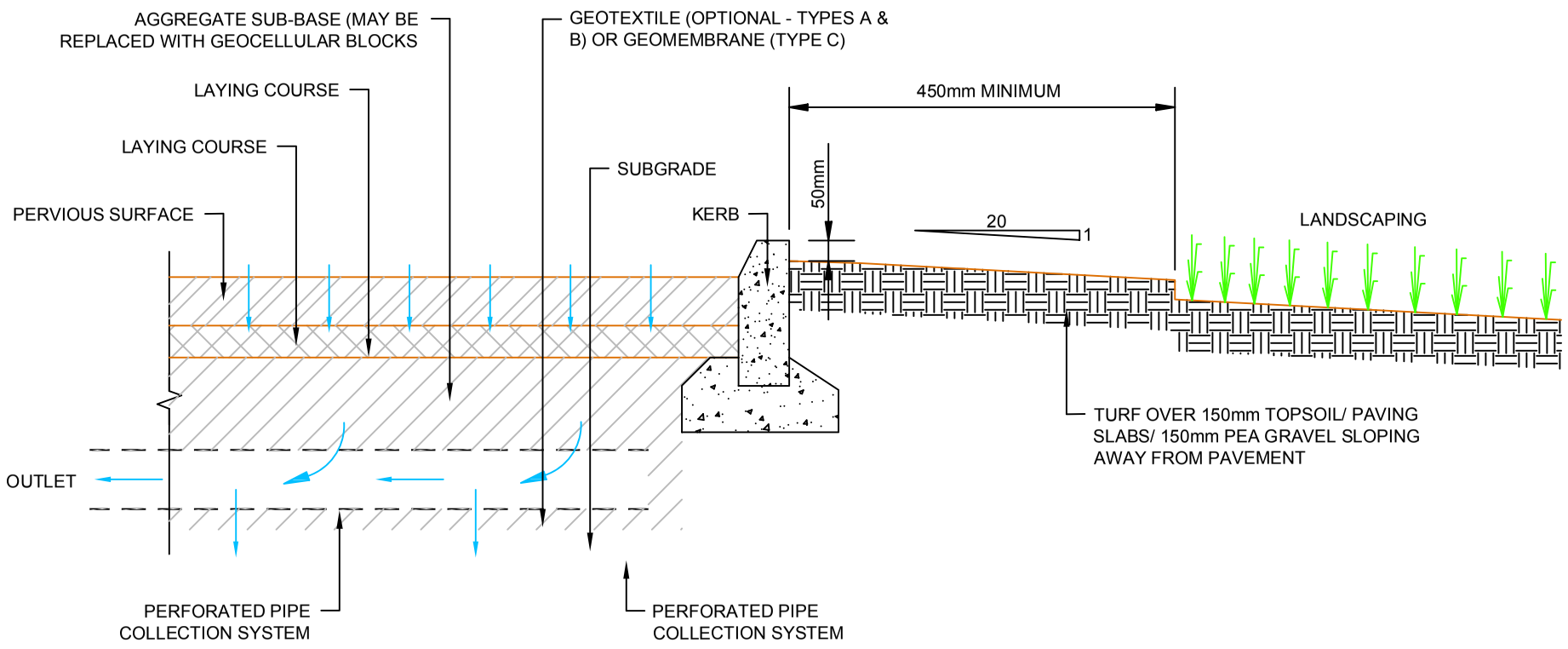
TYPE A: TOTAL INFILTRATIPN



TYPE B: PARTIAL INFILTRATION



TYPE C: NO INFILTRATION



LANDSCAPING DETAIL

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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PROJECT: TYPICAL SUDS DETAIL

TITLE: PERVIOUS PAVEMENTS

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
SEP 2014	@ A3	CP	RDN

PROJECT No:	DRAWING No:	REV:
BETTS	105	A

APPENDIX O: NOTES OF LIMITATIONS

The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns, and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information.

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