

Submission ID: [REDACTED]

Further to OFH1 on 16 September I am attaching a copy of the statement I made at the Hearing plus the Flood Risk Assessment that I referred to.

Saxlingham Nethergate Parish Council

Statement for Open Floor Hearing 1 on 16 September 2026

- 1. Good morning and thank you for the opportunity to speak here today. My name is [REDACTED] and I am a member of the Saxlingham Nethergate Parish Council and I am speaking on their behalf to raise their main concerns here today. The totality of our objections is contained in our Relevant Representations and in our forthcoming Written Representations that will be submitted before 6 October.**
- 2. The Saxlingham Nethergate Parish Council strongly objects to this proposal that will, if approved, industrialise a large part of our parish but we are supportive of the need for the country to move towards green energy but in a sensible and planned way. Our main concerns are set out in the following paragraphs.**
- 3. The way in which the consultation has been conducted and the methods used have caused considerable distress and anxiety among some of our residents, rather than enabling them to engage with the proposals in a meaningful and accessible way. A consultation process should facilitate informed participation, not create additional barriers for those least able to navigate a highly technical process. The unnecessarily complex and voluminous documents and the absence of any hard copies that could be viewed by the many of our elderly residents who do not have access to computers has led to them being frozen out of the process. For a scheme of this size a responsible developer should do more than the statutory minimum to engage with the local population.**
- 4. The applicant's solicitor said yesterday (15 September) that the complex and layered application plans, that are so difficult to download and read, were needed for accuracy. This sits uncomfortably with the absence of**

any realistic details for many of the components of the scheme and the generalisations in so much of the draft DCO.

5. We are pleased that the developer's solicitor made it clear yesterday that the applicant was now not seeking to acquire any land from our War Memorial and the frontage of the Old Rectory alongside Church Hill because of the serious harm this would have caused to both the conservation area and the curtilages of the listed buildings. For the avoidance of doubt I wish to make it clear that the footpath alongside our War Memorial is not part of the public highway.
6. We object to the AIL haul route and to the use of the narrow village roads as routes for delivery vehicles. We are concerned that such use will damage the many pipes under the road, the culvert wall alongside The Street and those listed buildings that are close to the roads and have no foundations.
7. We object to the impact of the proposals on the character and appearance of both the Saxlingham Nethergate and Saxlingham Green Conservations Areas and the proximity of the panels to existing houses on the Green.
8. We are concerned that the proposals will increase flooding along The Street and some frontage houses that were flooded in the December 2020 floods. The applicant's response on page 141 to our relevant representations is factually incorrect. Sites 7D and 7F are within the watercourse catchment that a specialist engineer prepared in 2012 in connection with a Flood Risk Assessment (FRA) in respect of properties near the junction of The Street with Cargate Lane and Shotesham Lane. I am attaching an extract from the FRA that shows the extent of the watercourse catchment as an appendix to this statement that I will append to our forthcoming written representations.

- 9. We object to the loss of BMV agricultural land at a time when the impacts of climate change are causing huge reductions in crop yields and food shortages are expected when “El Nino” arrives later this autumn.**
- 10. We are concerned that the applicants have submitted this application without first having properly consulted with and incorporated into their proposals the formal views of National Gas Transmission. This really is quite extraordinary given the obvious risk from electricity meeting gas.**
- 11. We respectfully ask that you recommend that sites 7 be excluded from the Order.**



SAXLINGHAM NETHERGATE, NORFOLK

FLOOD MODELLING ASSESSMENT

AUGUST 2012

REPORT REF: 1113/RE/07-12/01

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CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Saxlingham Flood Association to carry out a flood modelling assessment which includes residential properties adjacent to the watercourse which flows in a westerly direction through Saxlingham Nethergate, Norfolk.

QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

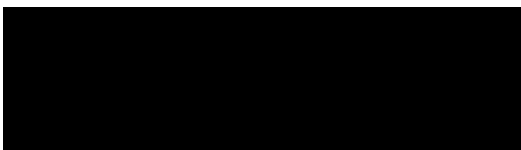
Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; depth analysis; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by providing specifications to third parties such as surveyors; initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a "designers risk assessment".

Report carried out by:



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EXECUTIVE SUMMARY

A watercourse flows in a westerly direction through the village of Saxlingham Nethergate and drains a small rural catchment. The watercourse, in its present form, is understood to have been established through the village in 1969 to alleviate flooding in the area. The watercourse is a tributary of the River Tas, which flows in a north easterly direction through the village of Newton Flotman approximately 1.3 km west of Saxlingham Nethergate.

The Environment Agency's Flood Map indicates that there are 18 properties (i.e. buildings or gardens) located within the floodplain of the watercourse and at risk of flooding during the 1 in 100 year return period event (1% annual probability event and extent of the Flood Zone 3a). Additionally, the Association of British Insurers (ABI) have published a guidance document in 2012, which suggests that properties in flood risk areas should be protected for flood events up to the 1 in 100 year event in order to access insurance at a competitive price.

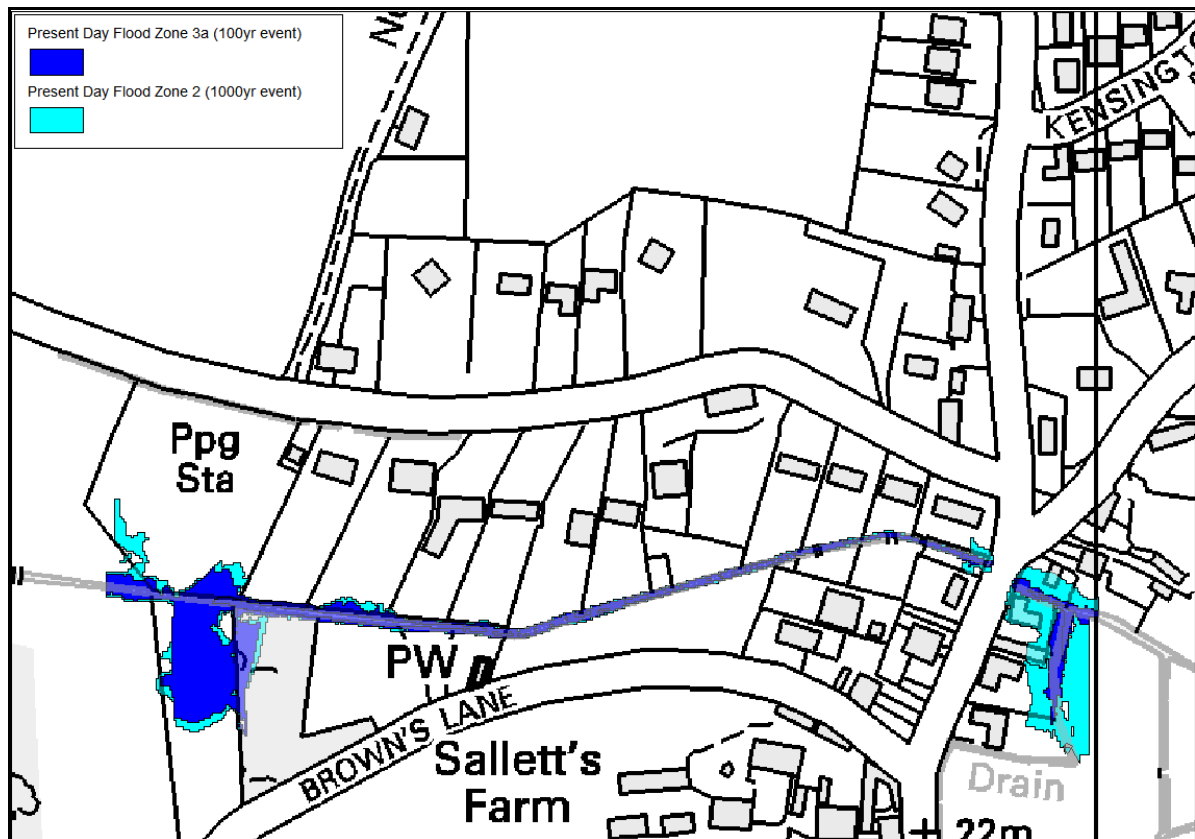
Evans Rivers and Coastal Ltd has been commissioned by Saxlingham Flood Association to carry out a flood modelling assessment which will provide them with up-to-date, comprehensive and detailed flood mapping of the Saxlingham area, and also enable them to assess whether or not there is a basis for challenging the Environment Agency's Flood Map for the village.

It is understood that the Environment Agency's Flood Map is based on a study carried out in 2005, however, there have been various improvements to flood flow methodology since then. This assessment includes site-specific flood modelling which incorporates recent flow methodology guidance and detailed ground level survey data. It is considered that the approach adopted in this study will provide more accurate and reliable results.

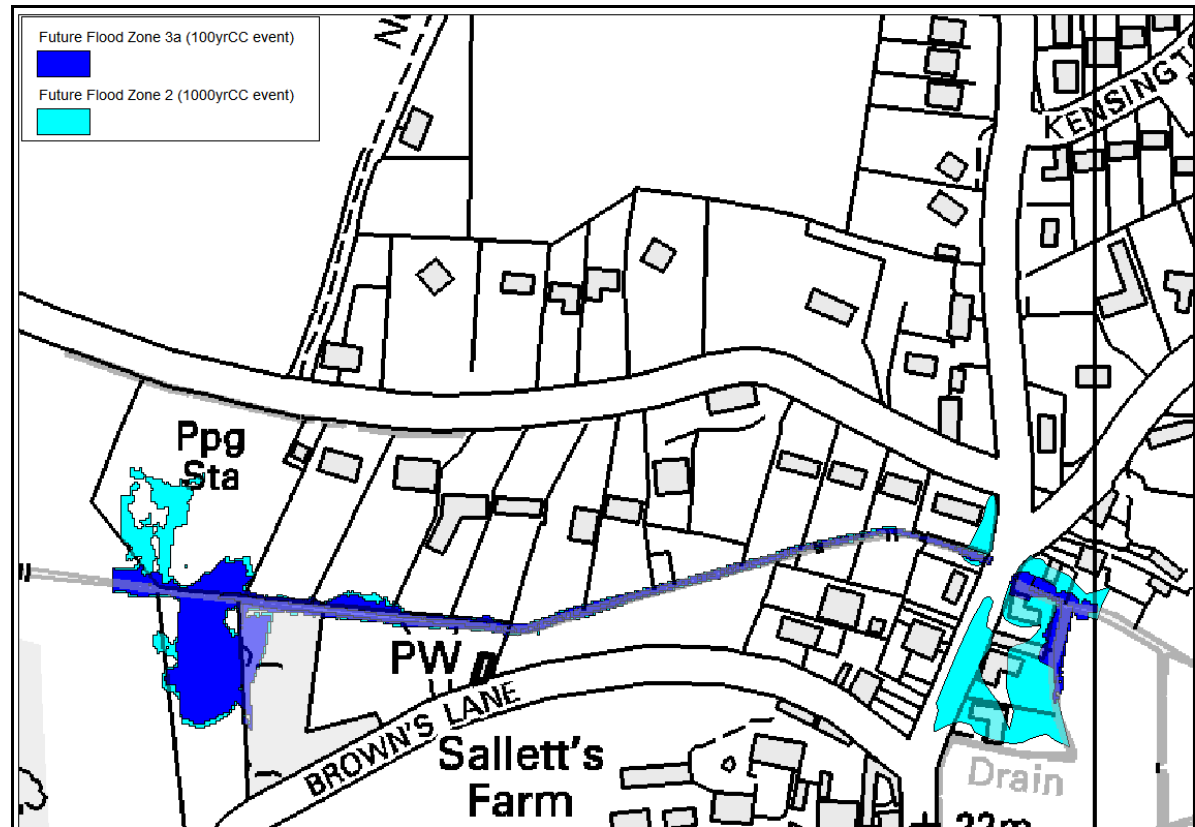
A hydraulic flood model was carried out as part of this assessment using well-established techniques and software. The model was run for a variety of flood events and also assessed the impacts of climate change on flood levels.

The results of this study has shown that in contrast to the Environment Agency's Flood Map, the number of properties (i.e. buildings or gardens) affected during the 1 in 100 year event and climate change 1 in 100 year event has reduced to 4. With the exception of one property, the affected properties are mainly situated upstream of the bridge under The Street, in which the bridge arch restricts flow which causes backing up and out-of-bank flooding. Furthermore, the watercourse channel at this location has a different geometry to the downstream section and this is likely to increase the flood risk. The flood maps using the results from this study can be seen overleaf.

The results also show that during the 1 in 1000 year event (0.1% annual probability flood event and extent of the Flood Zone 2), and climate change 1 in 1000 year event, 7 properties are affected.



Present day Flood Zones using results from the InfoWorks model



Future (climate change) Flood Zones using results from the InfoWorks model

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APPENDIX A CORRESPONDENCE

DRAWINGS	BBS/RE/SAX1	EXISTING GROUND LEVEL SURVEY SHEET LAYOUT
	BBS/RE/SAX2	EXISTING GROUND LEVEL SURVEY SHEET 1 OF 9
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	BBS/RE/SAX5	EXISTING GROUND LEVEL SURVEY SHEET 4 OF 9
	BBS/RE/SAX6	EXISTING GROUND LEVEL SURVEY SHEET 5 OF 9
	BBS/RE/SAX7	EXISTING GROUND LEVEL SURVEY SHEET 6 OF 9
	1113/RE/01	FLOOD EXTENTS SHEET 1 OF 2
	1113/RE/02	FLOOD EXTENTS SHEET 2 OF 2

1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Saxlingham Flood Association to carry out a flood modelling assessment which includes residential properties adjacent to the watercourse which flows in a westerly direction through Saxlingham Nethergate, Norfolk.

1.1.2 Specifically, this assessment intends to:

- a) Determine the fluvial flood flows within the watercourse using appropriate and up-to-date Flood Estimation Handbook methods for a range of return periods in accordance with NPPF.
- b) Develop an InfoWorks flood model of the watercourse to determine the extent, depth and velocity of the flood water during the critical return period flood events.
- c) Confirm the extent of the floodplain across the area using the topographical survey/LIDAR.
- d) Compare the results with the EA flood level data and discuss.
- e) Compile report and any drawings for submission.

1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) and associated Technical Guidance, both dated March 2012. Other documents which have been consulted include:

- Science Report (SC050050/SR) entitled *Improving the FEH statistical procedures for flood frequency estimation*, carried out by the Centre for Ecology and Hydrology and published in 2008 by DEFRA and the EA.
- EA guidance document entitled *Flood Estimation Guidelines Operational Instruction (197_08)* dated June 2012.
- DEFRA/EA document entitled *Estimating flood peaks and hydrographs for small catchments: Phase 1 (SC090031)* dated May 2012.
- EA guidance document entitled *Requirements for completing computer river modelling for flood risk assessments (2009)*.

1.1.4 The purpose of this assessment is to provide the Saxlingham Flood Association with up-to-date, comprehensive and detailed flood mapping of the Saxlingham area to enable them to assess whether or not there is a basis for challenging the Environment Agency's Flood Map for the village.

1.1.5 This assessment includes site-specific modelling which incorporates recent flow methodology guidance and detailed ground level survey data.

2. DATA COLLECTION

2.1 To assist with this report, the data collected included:

- Ordnance Survey 1:10,000 street view map (Evans Rivers and Coastal Ltd OS licence number 100049458).
- Filtered LIDAR data at 2m resolution covering the study area obtained from Promap but surveyed by the Environment Agency.
- Topographical Survey of the site carried out by BB Surveys Ltd (shown on Drawing Number BBS/RE/SAX 1-7).
- 1:250,000 *Soil Map of Eastern England* (Sheet 4) published by Cranfield University and Soil Survey of England and Wales 1983.
- Flood level data provided by the Agency in their response dated 9th May 2012 (Appendix A).

2.2 All third party data used in this study has been checked and verified prior to use in accordance with Evans Rivers and Coastal Ltd Quality Assurance procedures.

3. STUDY AREA AND LOCATION

- 3.1 The study area encompasses properties and land located adjacent to the watercourse which flows in a westerly direction through Saxlingham Nethergate. The approximate Ordnance Survey (OS) grid reference for the area is 622800 297530 and the location of the study area is shown on Figure 1.

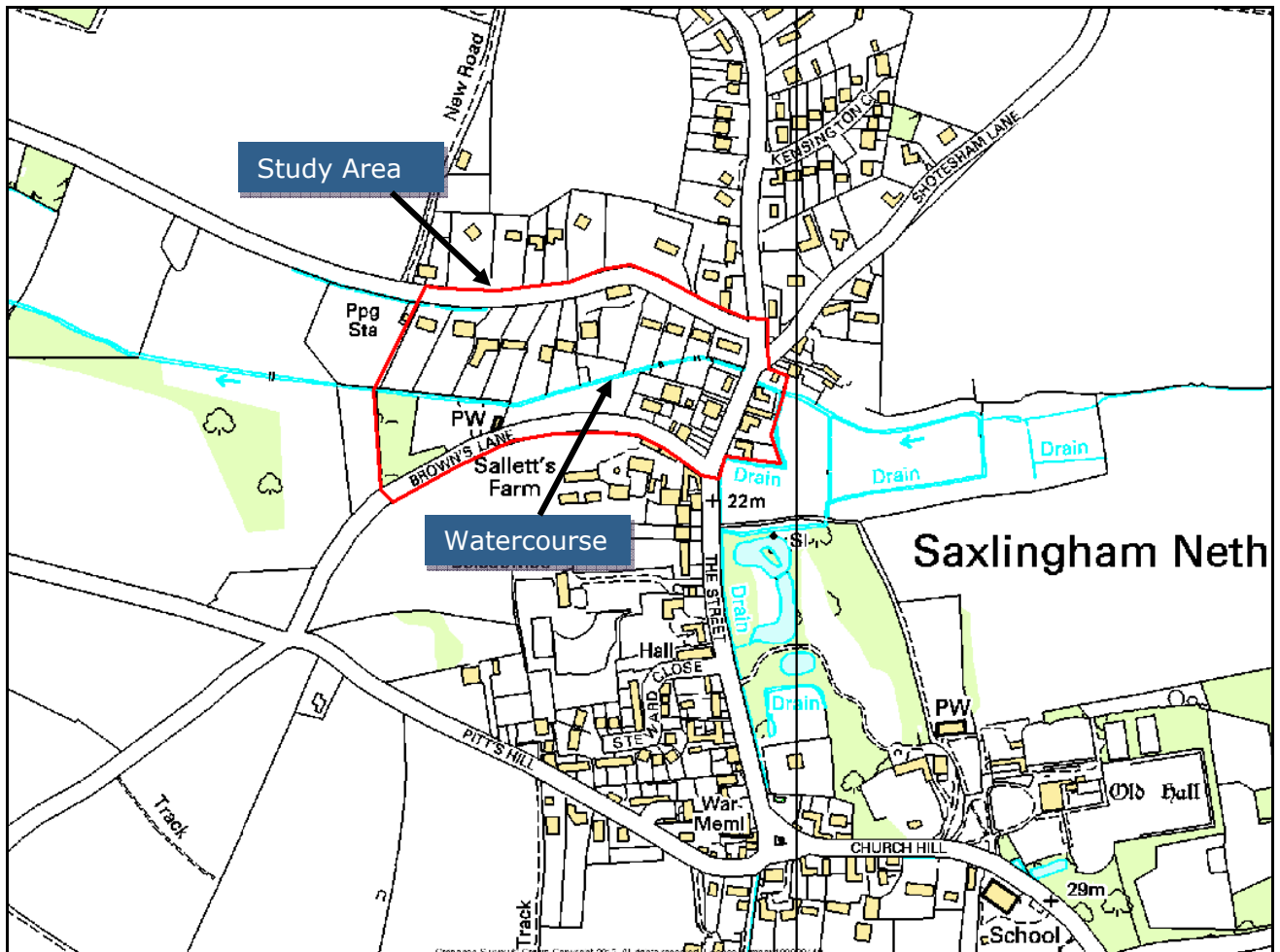


Figure 1: Site location plan (Source: Ordnance Survey, 2012)

- 3.2 The study area includes numerous properties and private gardens which are accessed from Cargate Lane to the north and The Street/Brown's Lane to the east/south. The study area also includes an area of undeveloped land to the south of the watercourse and a place of worship adjacent to Brown's Lane.
- 3.3 The watercourse flows in a westerly direction through the study area and is understood to have been established in 1969 to alleviate flooding in the area.



**Figure 2: View of watercourse looking downstream from bridge (at The Street)
(Source: Evans Rivers and Coastal taken 3/5/2012)**



**Figure 3: View of watercourse at Place of Worship looking upstream from left bank
(Source: Evans Rivers and Coastal taken 3/5/2012)**

- 3.4 A GPS topographical survey of the study area has been carried out by BB Surveys Ltd and can be seen on Drawing Number BBS/RE/SAX 1-7. Ground levels are in metres above Ordnance Datum (m AOD).
- 3.5 Inspection of the topographical survey and LIDAR data (Figures 4 and 5), together with observations during a site visit on the 3rd May 2012, indicates that the study area lies at a lower level in comparison to areas north and south of the study area. Ground levels across the study area fall towards the watercourse and range from a maximum of 21.67m AOD to a minimum of 18.08m AOD.
- 3.6 The bed of the watercourse channel at the eastern part of the study area is as low as 16.33m AOD. The watercourse is 7m wide and 1.7m deep in places and has a channel width of around 1.7m. The watercourse bed was generally free from vegetation at the time of the site visit and comprised mainly of silt with occasional pebbles and cobbles (see Figure 2 and 3).

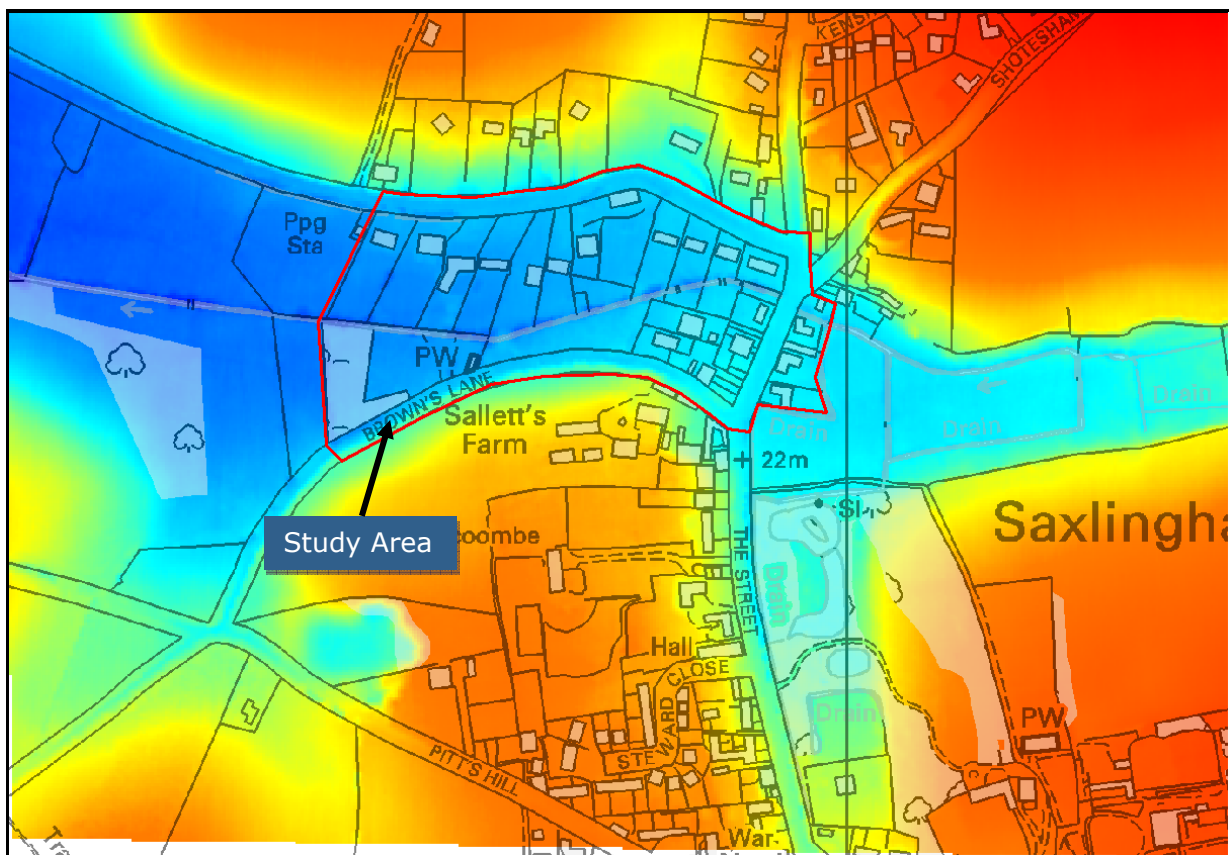


Figure 4: Filtered LIDAR survey of the study area combined with OS, where higher ground is represented by red and orange colours (Source: Environment Agency/Promap, 2012)

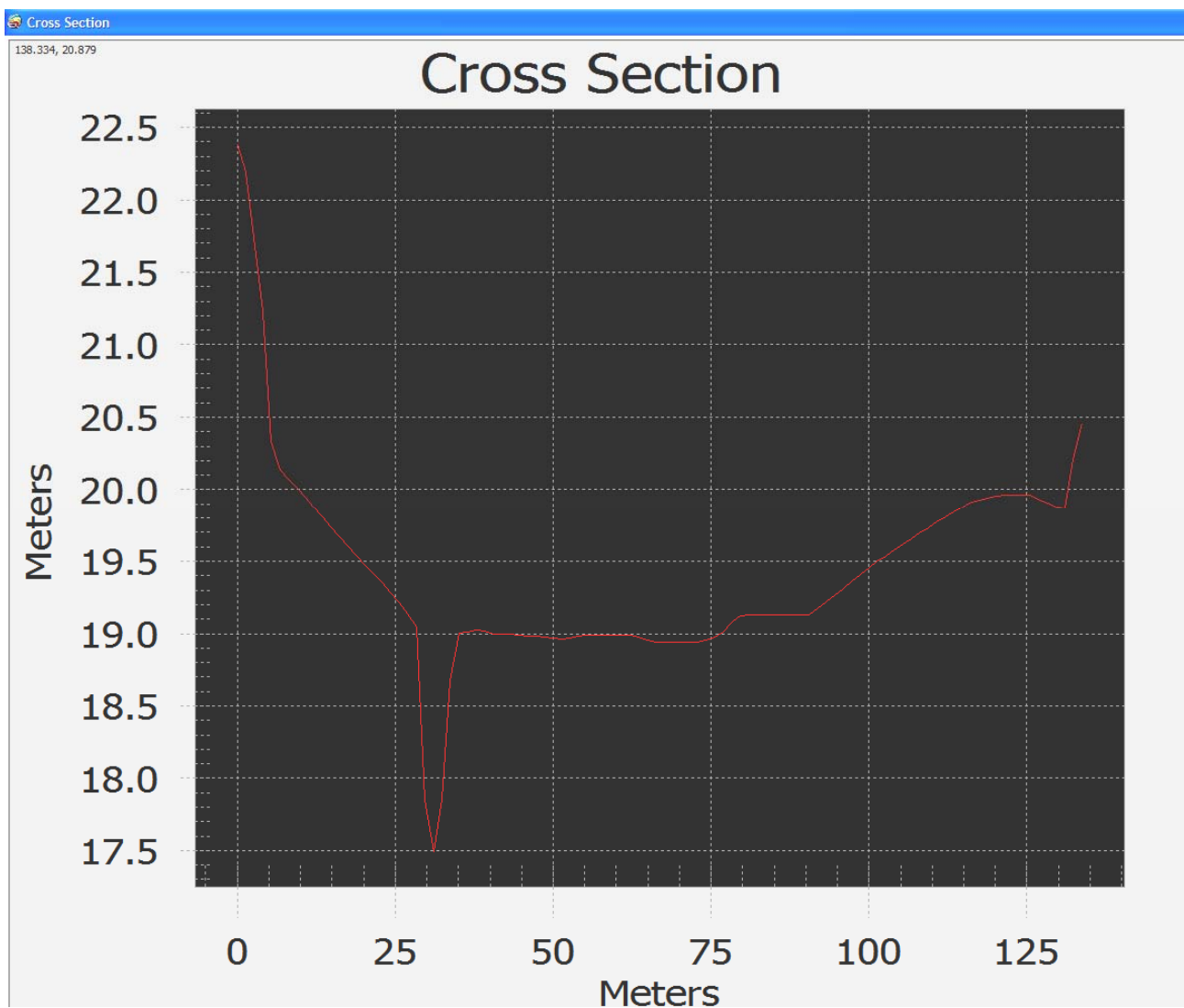


Figure 5: Cross section north/south through filtered LIDAR survey of the study area

4. BASELINE INFORMATION

4.1 Environment Agency Flood Zone Map

- 4.1.1 The Environment Agency's Flood Zone Map (Figure 6) shows that many of the properties adjacent to the watercourse and within the study area are located within the NPPF defined Flood Zone 3.
- 4.1.2 The Flood Zone 3 is divided into two sub-categories, the Flood Zone 3a and Flood Zone 3b. The extent of the Flood Zone 3a 'High Probability' is defined as the 1 in 100 year return period fluvial event in this case. Flood Zone 3b functional floodplain is defined in Table 1 of the NPPF Technical Guidance as the area where water flows or is stored during flood events. The functional floodplain is generally defined by the limit of the 1 in 20 year flood envelope.
- 4.1.3 The extent of the flood zones do not take into account the presence of any formal flood defences, or other features which also act as informal flood defences. It should be noted that the Environment Agency website maps are "indicative only", and the disclaimer associated with the maps says: "...maps only show the predicted likelihood of flooding from rivers or the sea for defined areas, and are not detailed enough to account for precise addresses...".

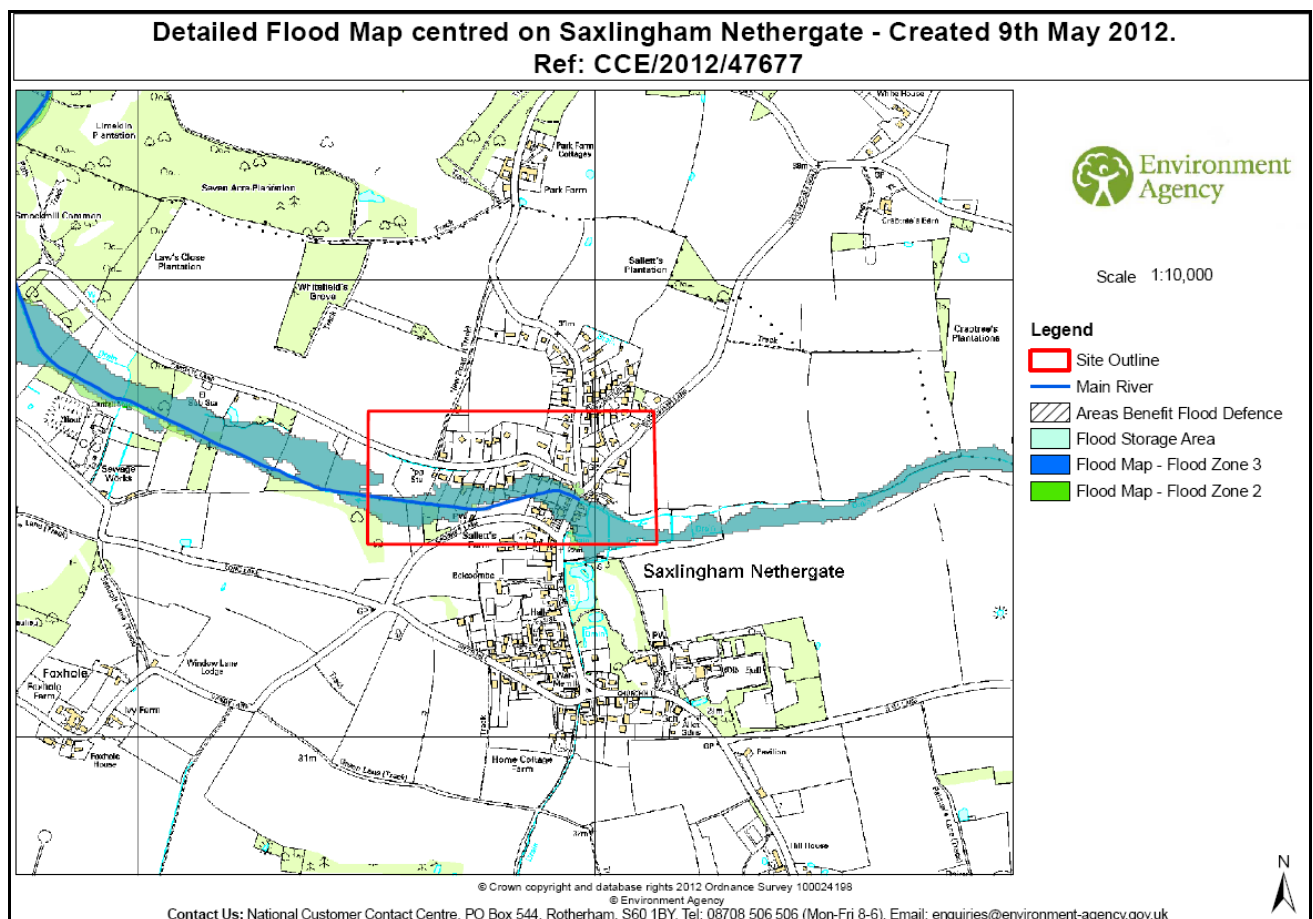


Figure 6: Environment Agency Flood Zone Map (Source: Environment Agency, 2012)

4.2 Environment Agency Flood Levels

- 4.2.1 The Agency has provided modelled flood levels for the watercourse as part of their response dated 9th May 2012 (Appendix A) and are summarised in Table 1. The source of the levels is from the River Yare Flood Risk Study carried out by Babbie Brown and Root in 2005, however, there have been various improvements to flood flow methodology since then (which are incorporated in this assessment). It is also possible that the flood levels were derived using LIDAR ground survey only and not a more detailed GPS topographical survey.

Table 1: Fluvial flood level data

Location	1 in 25 year (mAOD)	1 in 100 year (mAOD)	1 in 100 year plus climate change (mAOD)	1 in 1000 year (mAOD)
SAXL1_1710	21.02	21.12	21.17	21.33
SAXL1_1680	20.99	21.08	21.11	21.24
SAXL1_1630	19.72	19.89	20.01	20.49
SAXL1_1530	18.57	18.72	18.81	19.19
SAXL1_1500	18.40	18.55	18.65	19.07
SAXL1_1250	17.10	17.25	17.35	17.77

4.3 Climate Change

- 4.3.1 NPPF requires that the effects of climate change for the next 100 years be considered in any assessment of flood risk. It is usual to enhance present day flood levels by an appropriate increment to account for the expected effects of sea level rise and the increase in rainfall expected on fluvial catchments. NPPF recommends that a 20% increase in fluvial flood flows is required to account for climate change effects over the next 100 years.

5. HYDROLOGICAL SETTING AND CATCHMENT DESCRIPTORS

5.1 Introduction

- 5.1.1 The extent of the upstream catchment associated with the watercourse is shown on the FEH CD-ROM (Figure 7).
- 5.1.2 Reference to the catchment descriptors extracted from the FEH CD-ROM Version 3 (Figure 8) shows that the watercourse drains an upstream catchment of 7.15 sq km. The catchment receives a standard average annual rainfall (SAAR) of 602mm and there is little attenuation by small ponds and lakes which is denoted by a FARL value of 0.991. The catchment has a moderate gradient (DPSBAR = 18.2m/km) and is of a moderate elevation (ALTBAR = 37m).
- 5.1.3 The new FEH catchment descriptor $URBEXT_{2000}$, in which its development is discussed in the DEFRA/EA report entitled *URBEXT₂₀₀₀ – A New FEH Catchment Descriptor*, indicates that the catchment is essentially rural (i.e. an $URBEXT_{2000}$ value of 0.0204).

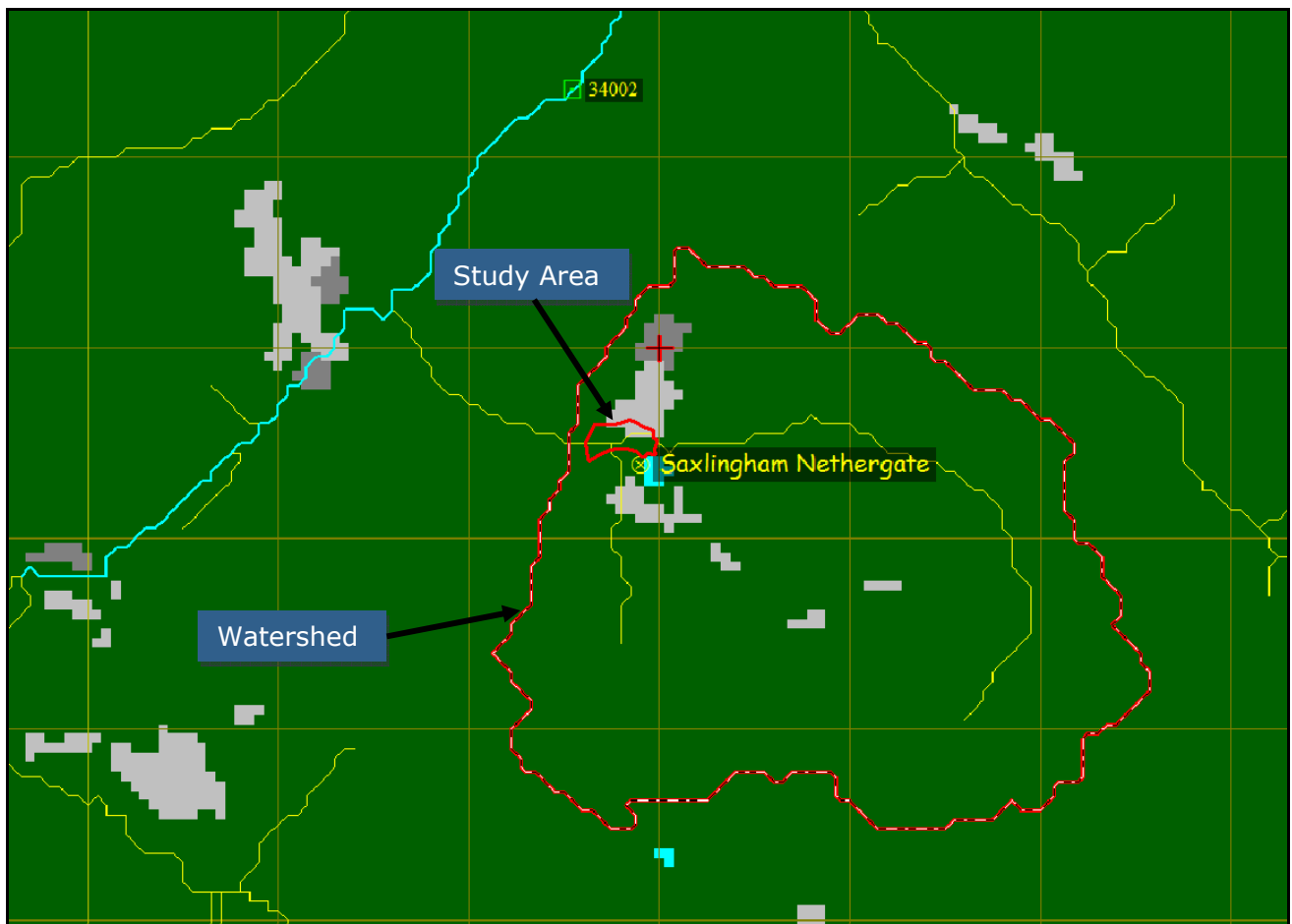


Figure 7: Watercourse catchment at a point immediately downstream of the study area (Source: FEH CD-ROM Version 3)

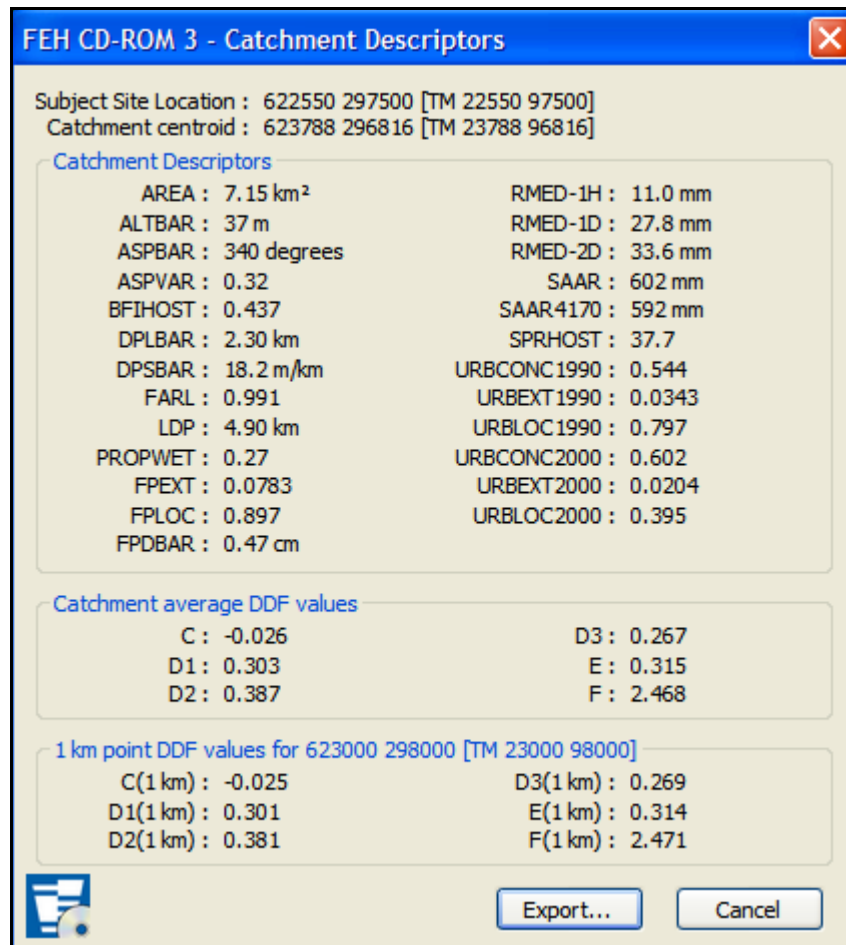


Figure 8: Catchment descriptors for the watercourse catchment (Source: FEH CD-ROM Version 3)

5.2 SPRHOST

- 5.2.1 The SPRHOST value has been confirmed by Figure 8 as 37.7, however it is generally recommended that such values are verified by the user. Therefore, the value of SPRHOST has been verified using the Soil Map of Eastern England (Sheet 4) published by the Soil Survey of England and Wales (1983), together with Volume 4 of the FEH Handbook.
- 5.2.2 Figure 9 shows that the catchment soil types comprise loamy over clayey soils together with sandy and peaty soils.

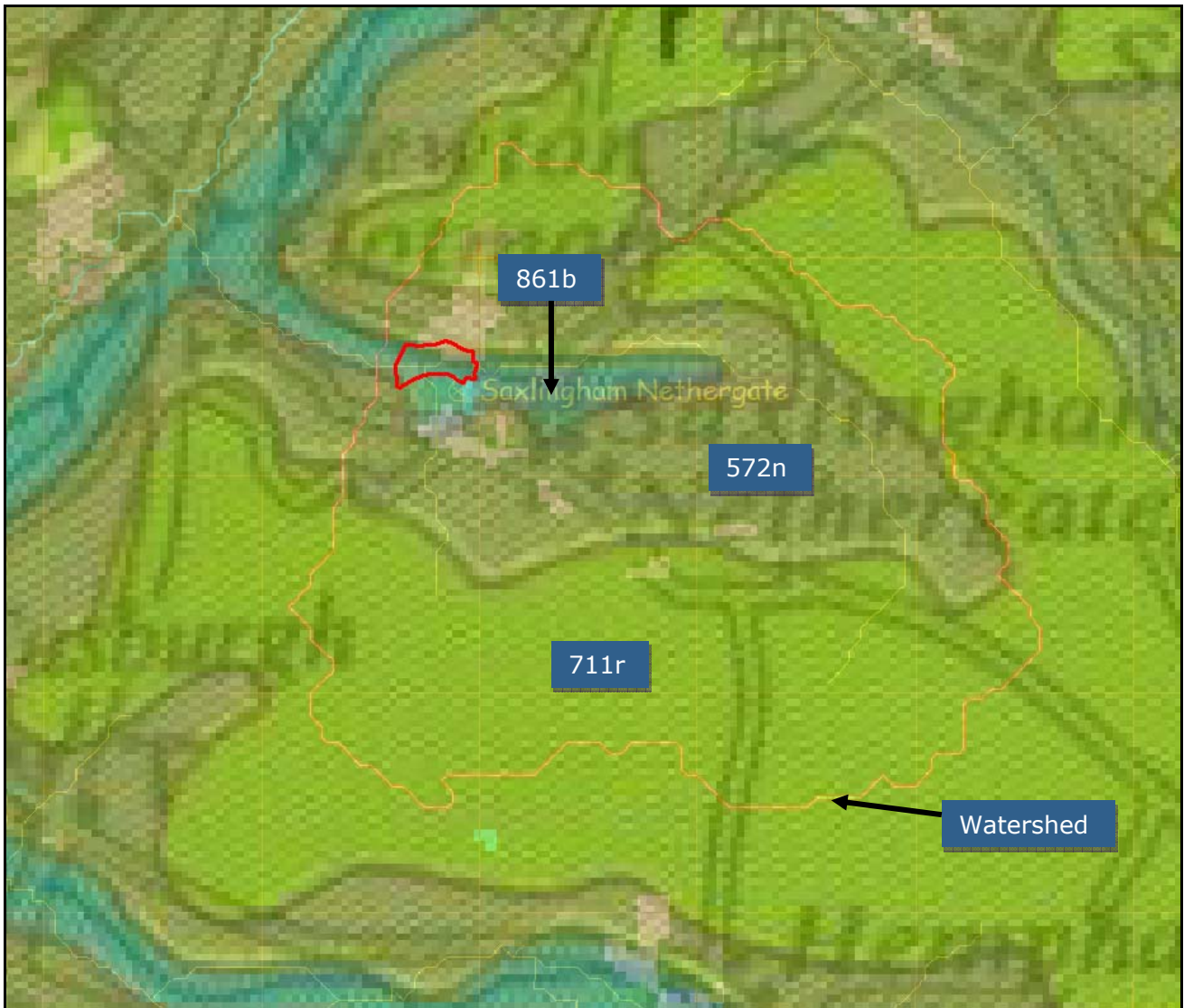


Figure 9: Soil map and catchment (Source: Soil Map of Eastern England and FEH CD-ROM Version 3)

- 5.2.3 Using the FEH Handbook to translate the soil type code into a HOST classification and subsequently to give an SPR that applies to each HOST value, the SPRHOST value for the catchment has been calculated as 36.5 (see Table 2). This indicates that the permeability is moderate to poor overall.
- 5.2.4 The variance in SPRHOST between the FEH CD-ROM and the user-defined values does not represent a significant change in the permeability of the catchment. The information on the FEH CD-ROM should always be checked especially for small catchments (< 25 sq km) as the FEH CD-ROM does contain some inaccuracies. Therefore it is considered that the user-defined derived SPRHOST value in Table 2 will be more reliable in this instance.

Table 2: Calculation of SPRHOST for catchment

Map Unit	Fraction of catchment (%)	Component Host Classes (fraction in map unit) [See Table C.3 of FEH Vol 4]	
711r	56	24 (100)	
572n	36	5 (37.50), 18 (62.50)	
861b	8	7 (20), 10 (50), 11 (30)	
Total	100		
HOST Class	Components (fraction of HOST class in map unit x fraction of map unit in catchment)	Fraction of catchment (%)	SPRHOST (%) (fraction of catchment x SPR decimal value for corresponding HOST class [See Table 2.2 of FEH Vol 4])
5	37.50 x (0.36)	13.5	1.95
7	20 x (0.08)	1.6	0.70
10	50 x (0.08)	4	1.01
11	30 x (0.08)	2.4	0.04
18	62.50 x (0.36)	22.5	10.6
24	100 x (0.56)	56	22.2
Total		100	36.5

5.3 URBEXT

- 5.3.1 The new FEH catchment descriptor URBEXT₂₀₀₀ indicates that the catchment is essentially rural. URBEXT₂₀₀₀ is based on a different methodology than URBEXT₁₉₉₀ and therefore results in a separate set of FEH categories of urbanisation. For example, an essentially rural catchment will have an URBEXT₂₀₀₀ value of up to 0.030 as opposed to 0.025 if using the former URBEXT₁₉₉₀ value.
- 5.3.2 Urbanisation of the catchment since 2000 has been checked against the FEH CD-ROM values using OS mapping. The urban extent shown from the FEH CD-ROM (URBEXT₂₀₀₀) is similar to the extent shown on the OS map. Therefore, as there has been no substantial development since 2000, the updating of URBEXT₂₀₀₀ to 2012 using the national average model of urban growth in WINFAP-FEH Version 3 is acceptable. URBEXT has therefore increased from 0.0204 to 0.0210 and the catchment remains essentially rural.

Table 3: Summary table of key catchment descriptors

Catchment	AREA (km ²)	SAAR (mm)	FARL	DPLBAR (km)	DPSBAR (m/km)	SPRHOST (%)	URBEXT ₂₀₀₀ updated to 2012
Saxlingham Nethergate	7.15	602	0.991	2.30	18.2	36.5	0.0210

6. ESTIMATION OF FLUVIAL FLOWS

6.1 Choice of Method

- 6.1.1 In order to determine the most suitable flow estimation method, the guidance outlined in the FEH Handbook and the Environment Agency's Operational Instruction entitled *Flood estimation guidelines* (2008), has been referred to, together with the EA guidance document entitled *Flood Estimation Guidelines Operational Instruction (197_08)* dated June 2012, and DEFRA/EA document entitled *Estimating flood peaks and hydrographs for small catchments: Phase 1 (SC090031)* dated May 2012.
- 6.1.2 There are two main accepted approaches for estimating flood flows for a catchment of this size; the FEH Statistical Method (pooled analysis) and the Revitalised Flood Hydrograph Method (ReFH).
- 6.1.3 The FEH Statistical Method is based on a larger dataset of gauged flow records across the UK than the ReFH Method. The catchment area is above 5 km² and therefore the FEH pooled dataset should comprise a suitable amount of similar sized catchments.
- 6.1.4 The FEH Statistical Method uses flow records from either a single reliable gauged site located within the catchment or several other gauged sites which are located in other hydrologically similar catchments. The method is based on a large flood event dataset in the UK and is more directly calibrated to reproduce flood frequency for UK catchments.
- 6.1.5 The FEH Rainfall Runoff Method was largely superseded by the Revitalised Flood Hydrograph Method (ReFH) in 2006. The ReFH Method is intended to update and address several constraints of the FEH Rainfall-Runoff method. The key changes are that in the ReFH Method baseflow varies throughout the event and the ReFH method uses a new (kinked) unit hydrograph shape. Furthermore, additional calibration data has been used within the ReFH which includes a larger number of flood events across the UK.
- 6.1.6 In earlier guidance for small catchments below 25 km² the methodology outlined within the Institute of Hydrology Report 124 (IoH 124) was considered suitable, in which the mean annual flood flow QBAR is calculated. The recently published operational instruction 197_08 and science report SC090031 discourages the use of the IoH 124 method for estimating flood flows in small catchments. The guidance recommends that FEH methods should be used in preference.
- 6.1.7 Although the FEH Statistical Method is preferred for estimating peak flows in the catchment, flow estimates have also been derived using the ReFH Method for comparison.

6.2 Improved Statistical Method

- 6.2.1 The FEH Statistical Method has been improved with the release of the Science Report (SC050050/SR) entitled *Improving the FEH statistical procedures for flood frequency estimation*, carried out by the Centre for Ecology and Hydrology and published in 2008 by DEFRA and the EA.
- 6.2.2 As stated by the research document, the improved features include a new QMED equation; an improved procedure for the formation of pooled growth curves; and a revised procedure for the use of donor catchments in the data transfer process. A new catchment descriptor which describes the floodplain extent (FPEXT) was also developed as part of the study to assist in the derivation of pooling groups.

- 6.2.3 The WINFAP-FEH Version 3 software incorporates all of these changes to the FEH Statistical Method and has therefore been used to assist in the flood estimation process.
- 6.2.4 There are no observed flow or level records available as the watercourse is ungauged and the Agency has no spot gauging records. Therefore FEH Statistical Method single-site analysis of the catchment is not possible. Estimation of the flood flows has been carried out using the catchment descriptor method and pooled analysis as no flow records are available for the catchment.

6.3 Estimation of QMED

- 6.3.1 To estimate QMED, the catchment descriptor method has been used as the catchment is ungauged and essentially rural. This method is described in Volume 3, Chapter 13, of the FEH and has been updated in the Science Report. The method produces the mean annual flood QMED, which is the flood flow along the river that is statistically exceeded on average every other year.
- 6.3.2 The exercise can be done by hand using the catchment descriptors taken from the FEH CD-ROM and using the following improved QMED equation:

$$QMED = 8.3062 AREA^{0.8510} 0.1536 \left(\frac{1000}{SAAR} \right) FARL^{3.4451} 0.0460 BFIHOST^2$$

- 6.3.3 The QMED equation only applies to rural catchments ($URBEXT_{2000} < 0.030$) and as the catchment remains essentially rural (i.e. $URBEXT = 0.0210$ in 2012), an urban adjustment to the QMED (rural) formula is not required.
- 6.3.4 The calculation using WINFAP-FEH based on updated catchment descriptors for the watercourse catchment gives a value for $QMED_{s,cds}$ of 1.062 cu m/sec for QMED rural.

6.4 Revised Data Transfer Process

- 6.4.1 In order to make the ungauged rural estimate of $QMED_{s,cds}$ at the site more accurate, it is necessary to use flow data from a similar (rural) donor site either within the catchment, or in another catchment with similar hydrological characteristics, and where gauged information does exist for an adequate number of years. The suitability of the donor catchment will depend on how similar its catchment descriptors are to the subject catchment. For example, AREA should not differ by more than a factor of 5 and SAAR a factor of 1.1. Additional guidance is offered in the FEH Handbook.
- 6.4.2 A local correction or adjustment factor to the estimate of $QMED_{s,cds}$ at the subject site can then be applied. The procedure involves deriving QMED from the observed annual maximum record at a gauged site ($QMED_{g,obs}$), and also from the catchment descriptors at a gauged site ($QMED_{g,cds}$) and using the ratio of these two estimates to adjust the catchment descriptor estimate of $QMED_{s,cds}$ at the subject site.
- 6.4.3 The Science Report and Operational Instruction 197_08 also states that in addition to catchment similarity, the geographical proximity is important when considering the suitability of a donor site for the data transfer process, and the chosen donor should be the closest to the subject site. A new equation has therefore been developed and documented in the Science Report:

$$QMED_{s,adj} = QMED_{s,cds} \left(\frac{QMED_{g,obs}}{QMED_{g,cds}} \right)^{a_{sg}}$$

$$a_{sg} = 0.4598 \exp(-0.0200d_{sg}) + (1 - 0.4598) \exp(-0.4785d_{sg})$$

- 6.4.4 The subscript *s* refers to the ungauged subject site and *g* refers to the gauged donor site. The subscript *cds* refer to catchment descriptors and *obs* refers to the observed value at the donor site. The subscript *d_{sg}* refers to the geographical distance between the centroid of the subject site and donor site. The subscript *adj* refers to the adjusted value of QMED at the ungauged subject site.
- 6.4.5 A list of suitable donor sites (ranked by geographical proximity) for the data transfer process has been determined using the WINFAP-FEH software by following the *Pooled Analysis/Flood Frequency Curve Development* options and selecting *Donor Station* as the method to calculate QMED. The software uses the latest HiFlows-UK data (version 3.1.2) and a link to the HiFlows-UK website is also available to allow the user to further scrutinise the donor site's suitability. Table 4 shows the list of suitable donor catchments as generated by the WINFAP-FEH software.

Table 4: List of potential donor sites to be used in the data transfer process

Station	QMED donor	Centroid X	Centroid Y	Centroid distance (km)	AREA	SAAR	BFIHOST	FARL	URBEXT	Years of data	QMED AM	QMED cds
999200 (gb 622550 297500 (tm 22550 97500) @ Saxlingham)		623788	296816		7.15	602	0.437	0.991	0.021			
34001 (Yare @ Colney)	0.927	606922	304371	18.48	228.81	635	0.528	0.971	0.019	50	11.064	16.952
33045 (Wittle @ Quidenham)	0.846	605154	287146	20.99	27.55	608	0.534	0.974	0.01	41	1.147	2.432
33046 (Thet @ Red Bridge)	1.06	602298	295014	21.57	143.43	624	0.581	0.944	0.016	42	8.141	8.189
34005 (Tud @ Costessey Park)	0.912	605697	311919	23.57	72.12	649	0.598	0.973	0.029	48	3.144	5.343
33044 (Thet @ Bridgham)	1.012	600029	291906	24.26	274.99	620	0.681	0.942	0.013	42	7.932	9.407
33019 (Thet @ Melford Bridge)	1.022	599012	291010	25.45	311.37	620	0.707	0.932	0.014	49	7.845	9.018
33063 (Little Ouse @ Knettishall)	0.956	601051	277607	29.77	103.32	595	0.596	0.982	0.01	29	3.843	5.806
33011 (Little Ouse @ County Bridge Euston)	0.96	599445	278215	30.64	130.1	596	0.653	0.985	0.008	48	3.855	5.764
33034 (Little Ouse @ Abbey Heath)	1.029	596477	281368	31.38	707.72	607	0.694	0.959	0.017	40	17.465	19.841
33048 (Larling Brook @ Stonebridge)	0.798	592750	290650	31.64	21.99	635	0.694	0.907	0.003	32	0.303	0.978

- 6.4.6 Although Station 34001, Yare at Colney is ranked the highest as a suitable donor and is the closest to the subject catchment, its catchment area is much greater than the recommended limit as discussed in paragraph 6.4.1 when compared to the subject catchment (by a factor of 32). The next highest ranked station, Station 33045, Wittle at Quidenham, is more acceptable in terms of its similarity to the subject catchment, and the HiFlows-UK website indicates that this station is suitable for QMED.

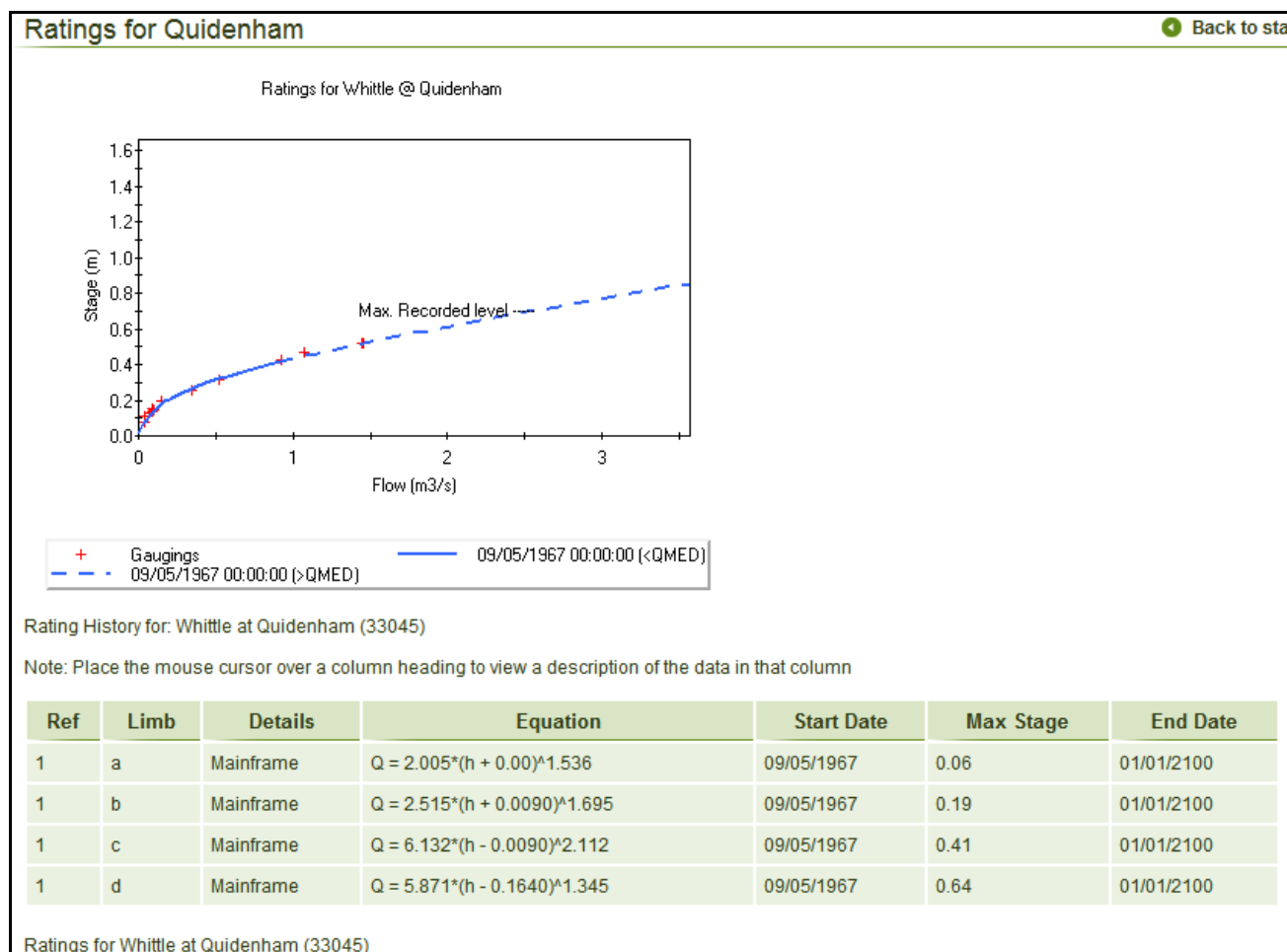


Figure 10: Rating Curve for Station 33045 (Source: HiFlows website, accessed July 2012)

6.4.7 Reference to Table 4 shows that QMED for the gauged site based on observed records ($QMED_{g,obs}$) equates to 1.147 cu m/sec. QMED from catchment descriptors at the gauged site ($QMED_{g,cds}$) equates to 2.432 cu m/sec. The geographical distance between the sites (d_{sg}) equates to 20.99 km. The Science Report suggests that influence of the donor site reduces when the geographical distance between the centroids increases (typically above 75km). Therefore, by using a geographically closer donor site, there will be more of an influence on QMED at the subject site. Table 4 shows that the adjusted QMED value at the subject site, $QMED_{s,adj}$ using the new data transfer equation is 0.846 cu m/sec.

6.5 Pooled Analysis and Flood Growth Curve

6.5.1 In order to estimate a range of statistical flood return period events which will occur in the catchment, it is necessary to determine a flood growth curve and a flood frequency curve. This is done by forming a pooling group, which involves a group of gauged rural catchments across the UK which have very similar catchment characteristics such as AREA and SAAR.

6.5.2 The catchment output from the FEH CD-ROM is entered as a data file to the WINFAP-FEH software, which sorts a pooling group of similar catchments. The FEH states that the pooling group should contain 5 times as many station-years as the target return period (57); however the Science Report recommends that a fixed pooling group size of at least

500 AMAX events for all required return periods should be used. The WINFAP-FEH Version 3 software incorporates the information and data gathered by the Agency's HiFlows-UK program.

- 6.5.3 The recommended generalised logistic (GL) technique has been applied in the statistical analysis. The updated Statistical Method uses an enhanced procedure which no longer relies on pooling group ranking, but calculates separate weighting equations of the L-moment ratios within the pooling group based on record length. Weight is also applied to each catchment depending on distance in catchment space from the subject site, with more weight assigned to available "at site" data than the FEH procedure.
- 6.5.4 Stations that had been identified in the WINFAP-FEH software as not being suitable for pooling (as indicated by the HiFlows-UK program), were removed from the pooling group and other more suitable stations added at the end of the pooling group to ensure that the total record length was at least 500 years.

Table 5: Pooling Group

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
27051 (Crimple @ Burn Bridge)	1.007	37	4.514	0.22	0.133	1.502
44009 (Wey @ Broadway)	1.045	32	1.688	0.34	0.241	0.117
26802 (Gypsey Race @ Kirby Grindalythe)	1.311	10	0.127	0.233	0.25	0.641
25019 (Leven @ Easby)	1.378	31	6.088	0.355	0.396	0.539
44006 (Sydling Water @ Sydling st Nicholas)	1.469	35	0.853	0.227	0.087	0.431
45816 (Haddeo @ Upton)	1.532	16	3.539	0.331	0.427	0.748
28033 (Dove @ Hollinsclough)	1.736	30	4.654	0.257	0.403	0.943
27073 (Brompton Beck @ Snainton Ings)	1.819	29	0.743	0.205	0.011	0.666
27010 (Hodge Beck @ Bransdale Weir)	1.823	41	9.42	0.224	0.293	0.606
36009 (Brett @ Cockfield)	1.826	39	3.661	0.26	-0.113	1.794
44008 (Sth Winterbourne @ W'bourne Steepleton)	1.895	30	0.413	0.382	0.325	0.364
20002 (West Peffer Burn @ Luffness)	1.904	41	3.299	0.292	0.015	1.562
203046 (Rathmore Burn @ Rathmore Bridge)	1.918	27	10.996	0.126	0.125	1.776
36010 (Bumpstead Brook @ Broad Green)	1.925	42	6.795	0.428	0.223	1.497
41023 (Lavant @ Graylingwell)	3.609	31	1.327	0.497	0.401	2.302
21027 (Blackadder Water @ Mouth Bridge)	4.331	32	40.298	0.321	0.268	0.51
Total		503				
Weighted means				0.29	0.211	

- 6.5.5 The WINFAP-FEH software indicates that the pooling group is strongly heterogeneous and a review of the pooling group is essential. All of the sites which are ranked are satisfactory in terms of their hydrological similarity with the subject site and the pooling group distribution provides an acceptable statistical fit. Removal or addition of extra sites was not justifiable and a representative, but heterogeneous, pooling group generally gives better flood frequency estimates, than either single site data or a pooling group that has been made homogeneous by inappropriately removing sites. The FEH also states that a significant proportion of pooling groups remain heterogeneous, even after a review and adapting a heterogeneous pooling group to make it homogeneous is not advised.

Institute of Hydrology - Flood Peaks Database Printed : 23 July 2012 Station : 999200 (gb 622550 297500 (tm 22550 97500))				
Growth Curve Fittings				
Standardised by median				
<u>Pooled L-moments</u>				
L-CV: 0.290				
L-skewness: 0.211				
<u>Fitted parameters</u>				
	Location	Scale	Shape	Bound
GL	1.000	0.299	-0.211	-0.414
<u>Return periods</u>				
	GL			
2	1.000			
5	1.481			
10	1.835			
20	2.220			
50	2.804			
100	3.320			
200	3.913			
500	4.841			
1000	5.671			

Figure 11: Flood Growth Curve Fittings

6.6 Flood Frequency Curve

- 6.6.1 The WINFAP-FEH software allows the user to generate a flood frequency curve for the specified return period based on the adjusted QMED_{s,adj} value and growth curve fittings established during the pooling group stage and statistical analysis. The results can be seen on Figure 12.

Institute of Hydrology - Flood Peaks Database Printed : 23 July 2012 Station : 999200 (gb 622550 297500 (tm 22550 97500))	
Fittings for FFC	
Standardised by median	
<u>Return periods</u>	
	GL
2	0.846
5	1.253
10	1.553
20	1.878
50	2.372
100	2.808
200	3.310
500	4.095
1000	4.797

Figure 12: Flood Frequency Curve Fittings (cu m/sec)

- 6.6.2 Applying 20% to the flows to accommodate the expected climate change effect over the next 100 years, as recommended by the Environment Agency and NPPF, the resultant flood flows can be seen in Table 6.

Table 6: Flood Flows (cu m/sec)

Flood Frequency	Q20	Q100	Q1000
Flood Flow	1.878	2.808	4.797
Flood Flow including climate change	2.253	3.369	5.756

6.7 Revitalised Flood Hydrograph Method (ReFH)

- 6.7.1 The FEH Rainfall-Runoff method is detailed within Volume 4 of the Flood Estimation Handbook and consists of determining the parameters of the unit hydrograph based on a depth-duration-frequency (DDF) model; determining a percentage runoff to convert total rainfall to effective rainfall; constructing a design storm by determining its duration, depth and profile; combining the effective rainfall profile with the unit hydrograph by convolution to give the flood hydrograph and adding a baseflow increment to the flood hydrograph.
- 6.7.2 The method uses a loss model, routing model and baseflow model to generate a flood hydrograph. The method has been summarised by Environment Agency's Operational Instruction and can be seen below:

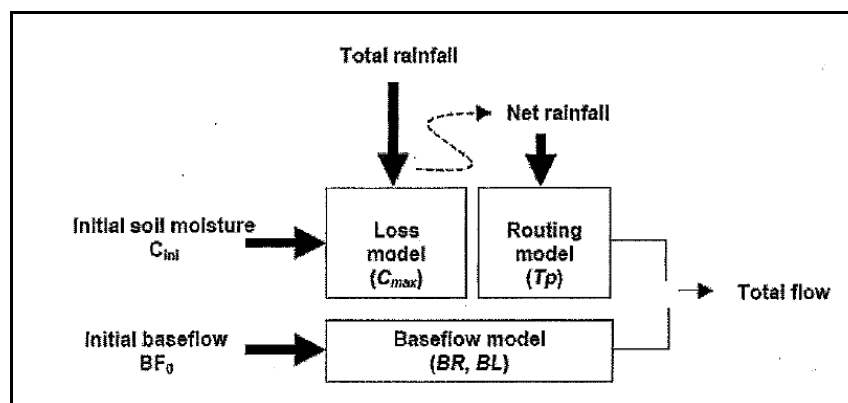


Figure 13: Summary of ReFH method

- 6.7.3 The catchment descriptors were imported into Version 11.5 of the InfoWorks RS modelling software. The updated URBEXT value of 0.0210 was used and an appropriate flood return period, storm duration and data interval was set, as discussed below, to enable appropriate flows to be estimated.
- 6.7.4 The model parameters for the ReFH Method (time-to-peak, baseflow, and standard percentage runoff) should ideally be based on actual flood event data comprising rainfall and flow records rather than catchment descriptors alone. However, due to the lack of available rainfall and flow data for the catchment, the catchment descriptor method and ReFH design standards has been adopted in this instance based on the relevant technical guidance.
- 6.7.5 The critical storm duration was calculated as 7.120 hours from the time-to-peak (T_p) from catchment descriptors (4.445 hours) using the equation provided in Volume 4 of FEH:

$$D = T_p (1 + \text{SAAR}/1000)$$

Where:

D is the critical storm duration

T_p is the time-to-peak

SAAR is the standard average annual rainfall

- 6.7.6 In addition to the storm duration it is necessary to select an appropriate data interval. According to the FEH handbook (Volume 4) a data interval of 10-20% of the time-to-peak (T_p) is usually suitable so that the design flood hydrograph is well defined. A data interval of 1 hour was selected as a convenient and appropriate value which produced a smooth hydrograph for the catchment.
- 6.7.7 The ReFH requires the user to have a design storm duration divided by the data interval which is an odd integer to ensure the use of an odd number of rainfall blocks in the storm profile. Therefore the design storm duration was reduced to 7 hours for the catchment. The results are summarised in Table 7.
- 6.7.8 A 75% winter storm profile was used as the catchment is rural (N.B. urban catchments are defined as those with URBEXT >0.125 in the ReFH Method).

Table 7: Results from ReFH using catchment descriptors (winter profile)

Catchment	Data Interval (hours)	Design Storm Duration (hours)	20 year event (cu m/sec)	100 year event (cu m/sec)	1000 year event (cu m/sec)
Saxlingham Nethergate	1	7	2.921	4.233	7.833

6.8 Estimating Long Return Period Floods

- 6.8.1 The Agency's Operational Instruction indicates that there is no preferred method for calculating long return periods (i.e. between 150 and 1000 years), however there has been a tendency to estimate these flows using the FEH Statistical Method. There are some concerns about using the ReFH method to determine such flows as the seasonal correction factors used for design rainfalls may not be applicable for extreme events.
- 6.8.2 However, the study by Faulkner and Barber (2009) suggests that as rainfall is a more spatially consistent variable than flood flow, the ReFH could be preferred over the FEH statistical method for estimation of design floods for long return periods.
- 6.8.3 For consistency and continuity in the results, only one FEH method will be used for all calculated return period events (see Section 6.10).

6.9 Flow Method Comparison

- 6.9.1 Reference to Table 8 indicates that the flow estimates using the ReFH Method are much higher than those derived from the FEH Statistical Method. The ReFH Method is known to overestimate flows for longer return periods which are outside of its calibration range, hence why the 1000 year event results are shown to be significantly higher when using the ReFH Method.

Table 8: Comparison of Flood Flows (cu m/sec)

Catchment	ReFH			Statistical		
	20	100	1000	20	100	1000
Saxlingham Nethergate	2.921	4.233	7.833	1.878	2.808	4.797

6.10 Final Choice of Method

6.10.1 Although all of the above methods are considered appropriate for flow estimation, the FEH Statistical Method is likely to be more appropriate in this instance as it is based on a larger dataset across the UK and uses good quality donor site data.

Table 9: Final Flood Flow Estimates using the FEH Statistical Method (cu m/sec)

Catchment	20 year event (cu m/sec)	20 year event plus climate change (cu m/sec)	100 year event (cu m/sec)	100 year event plus climate change (cu m/sec)	1000 year event (cu m/sec)	1000 year event plus climate change (cu m/sec)
Saxlingham Nethergate	1.878	2.253	2.808	3.369	4.797	5.756

6.11 Hybrid Method

6.11.1 Having determined that the FEH Statistical Method is preferred for estimating flood flows, a flow hydrograph is required for input into the hydraulic model, with a peak flow that matches the corresponding flood frequency estimate.

6.11.2 It is common to generate a hydrograph using the ReFH Method, then scaling it to match the FEH statistical estimates shown in Table 9.

6.11.3 The critical duration was determined using the equation outlined in Volume 4 of the FEH Handbook and data interval was determined as 10-20% of the T_p calculated from catchment descriptors (as discussed in Section 6.7). Therefore, using the Infoworks software, the critical duration of 7 hours and the data interval of 1 hour has been entered.

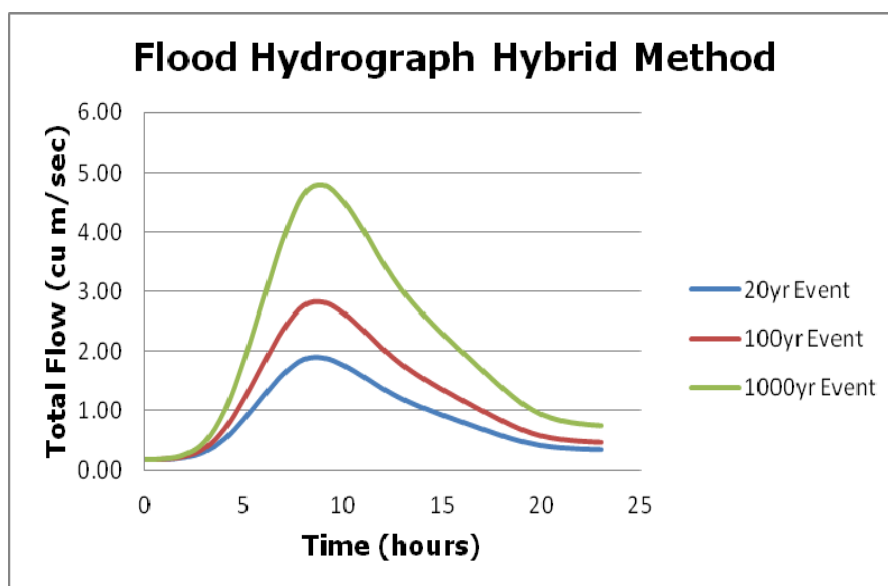


Figure 14: Flood hydrograph using the hybrid method (without climate change)

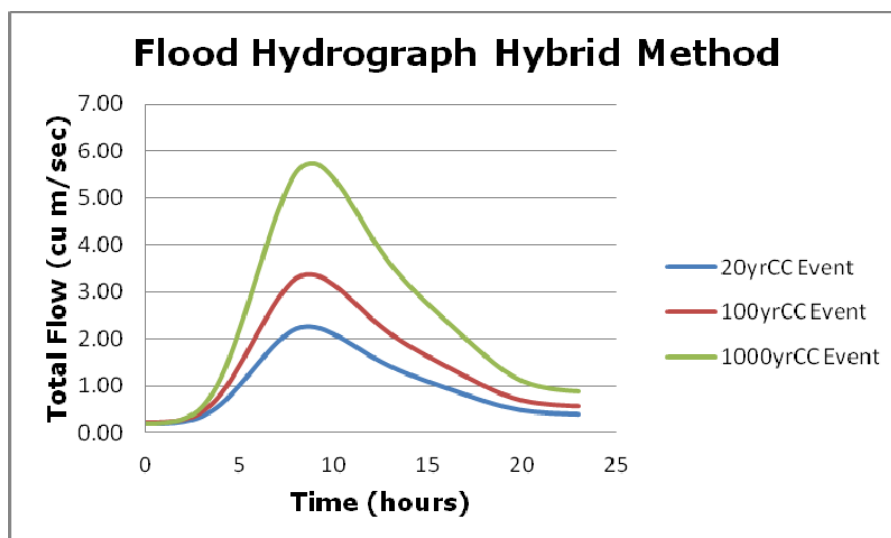


Figure 15: Flood hydrograph using the hybrid method (with climate change)

7. HYDRAULIC ANALYSIS

7.1 Introduction

- 7.1.1 A site specific assessment of the probability and consequences of the site flooding from the watercourse has been undertaken using well established hydraulic modelling and flood mapping techniques. The Agency's guidance document entitled *Requirements for completing computer river modelling for flood risk assessments (2009)*, has been consulted.

7.2 InfoWorks Model Development

- 7.2.1 One-dimensional (1D) unsteady hydrodynamic modelling of the watercourse and the study area was undertaken using the hydraulic modelling package InfoWorks RS Version 11.5. This software package combines the advanced ISIS Flow simulation engine, GIS functionality within a single environment.
- 7.2.2 In these types of model which use a GIS interface, the study area can be represented as a Digital Terrain Model (DTM) and the properties of the model, such as ground elevation, surface roughness, and inflows are all assigned within the software.
- 7.2.3 The 3D GPS topographical survey carried out by BB Surveys Ltd was used to provide a more accurate and detailed representation of the site and watercourse. The survey was imported into MapInfo GIS software and a ground model was generated which allowed the interpolation of ground levels between available elevation points. Filtered LIDAR survey data of 2m resolution (Figure 4) was obtained from the Environment Agency via Promap and used to supplement areas not covered by the topographical survey (e.g. due to access restrictions). The combined ground model was then exported in a suitable format which could then be read by the InfoWorks software. The final ground model as it appears in the InfoWorks model is shown on Figure 16.

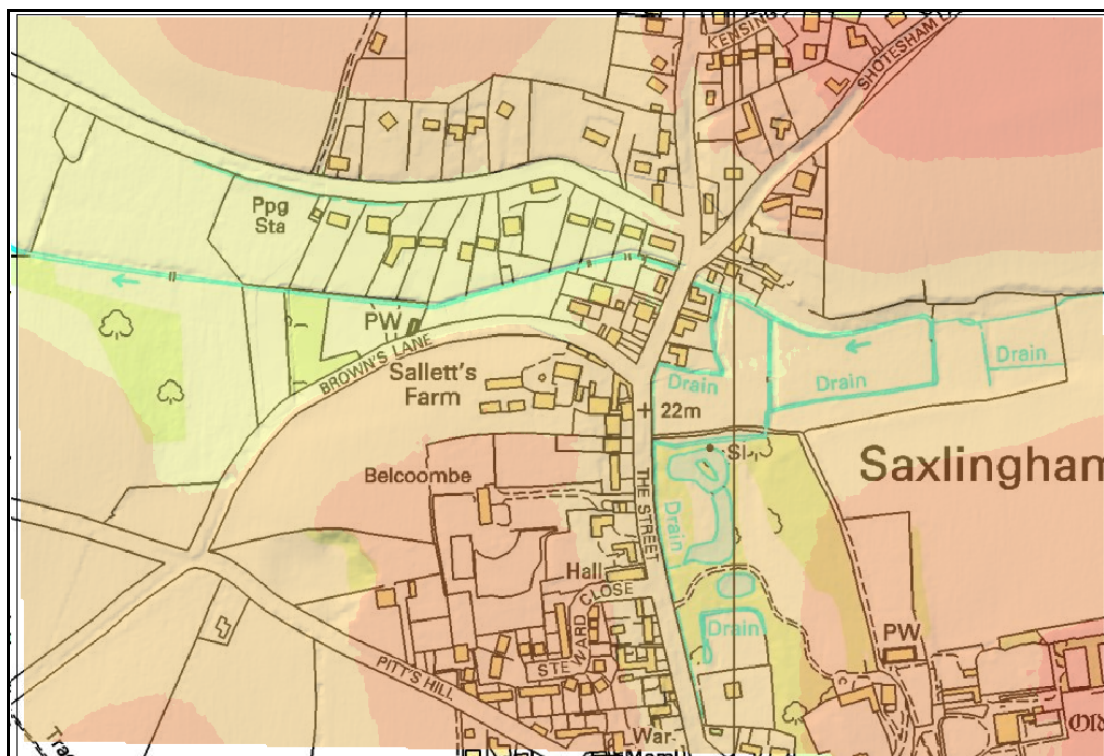


Figure 16: Representation of DTM with OS as presented in InfoWorks RS



Figure 17: 3D representation of DTM with OS as presented in InfoWorks RS

- 7.2.4 Figure 18 shows that by forming a ground model which includes the topographical survey information, a more accurate and representative ground model can be generated in contrast to LIDAR alone.

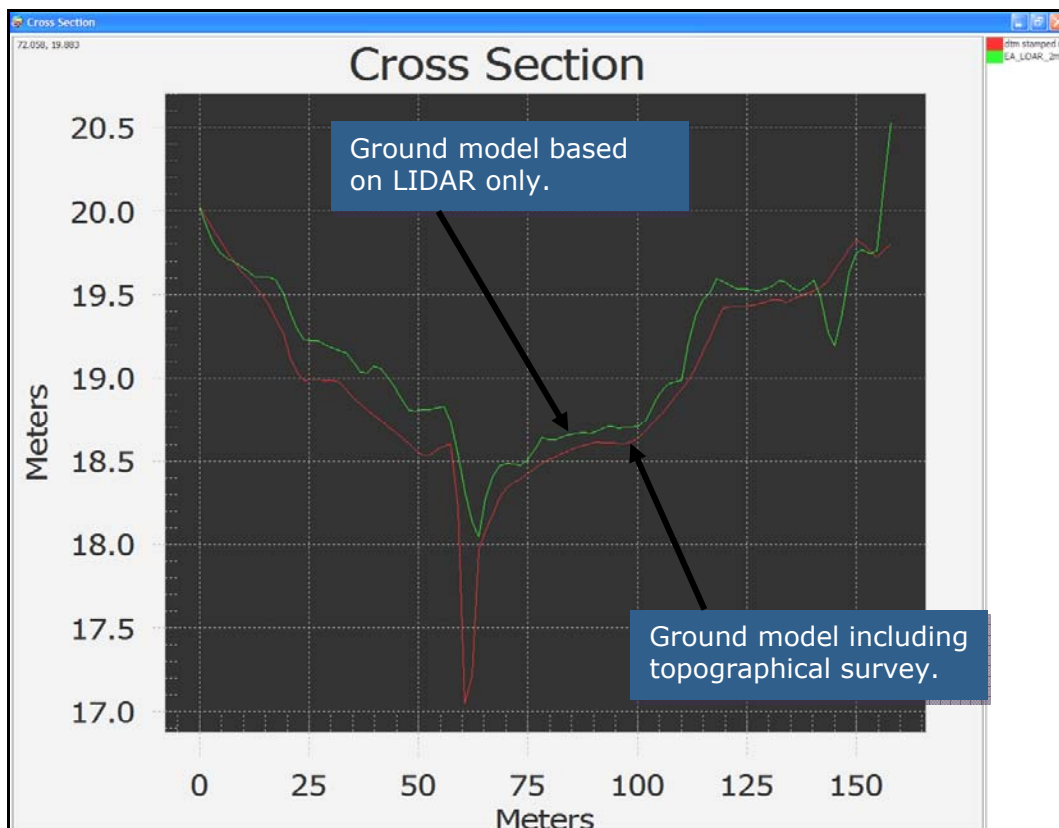


Figure 18: Comparison between LIDAR survey and topographical survey when creating a ground model

- 7.2.5 The in-channel structure consisting of the concrete bridge under The Street (Figure 19 and 20) was included in the model and a Spill Unit was used to allow floodwater to overtop the road deck above this structure if it reached a level high enough. The geometry of this structure was extracted from the topographical survey and site observations. As there is a relatively steep drop in bed level downstream of the bridge invert, additional cross sections were added, together with a Spill Unit in order to improve model stability.
- 7.2.6 The model was started at an appropriate hour before the peak of the hydrograph in order to prevent the channel from “drying out” in the model. This has not affected the results as it is only the peak of the event and the maximum flood level that is of interest.



Figure 19: View of concrete bridge under The Street looking upstream (Source: [REDACTED] 3/8/2012)



Figure 20: View of concrete bridge under The Street looking downstream (Source: [REDACTED] 3/8/2012)

7.3 Surface Roughness

- 7.3.1 Surface roughness varies across the study area as a result of different land uses, such as short and long grass, overgrown areas of vegetation, concrete and buildings. To ensure an accurate representation of the impact of different surface roughness values on the flood flows, information from the OS map and site observations was used. The anticipated roughness values were checked with the CES Roughness Advisor created by Wallingford Software and resultant Manning's "n" values were entered for each cross section.

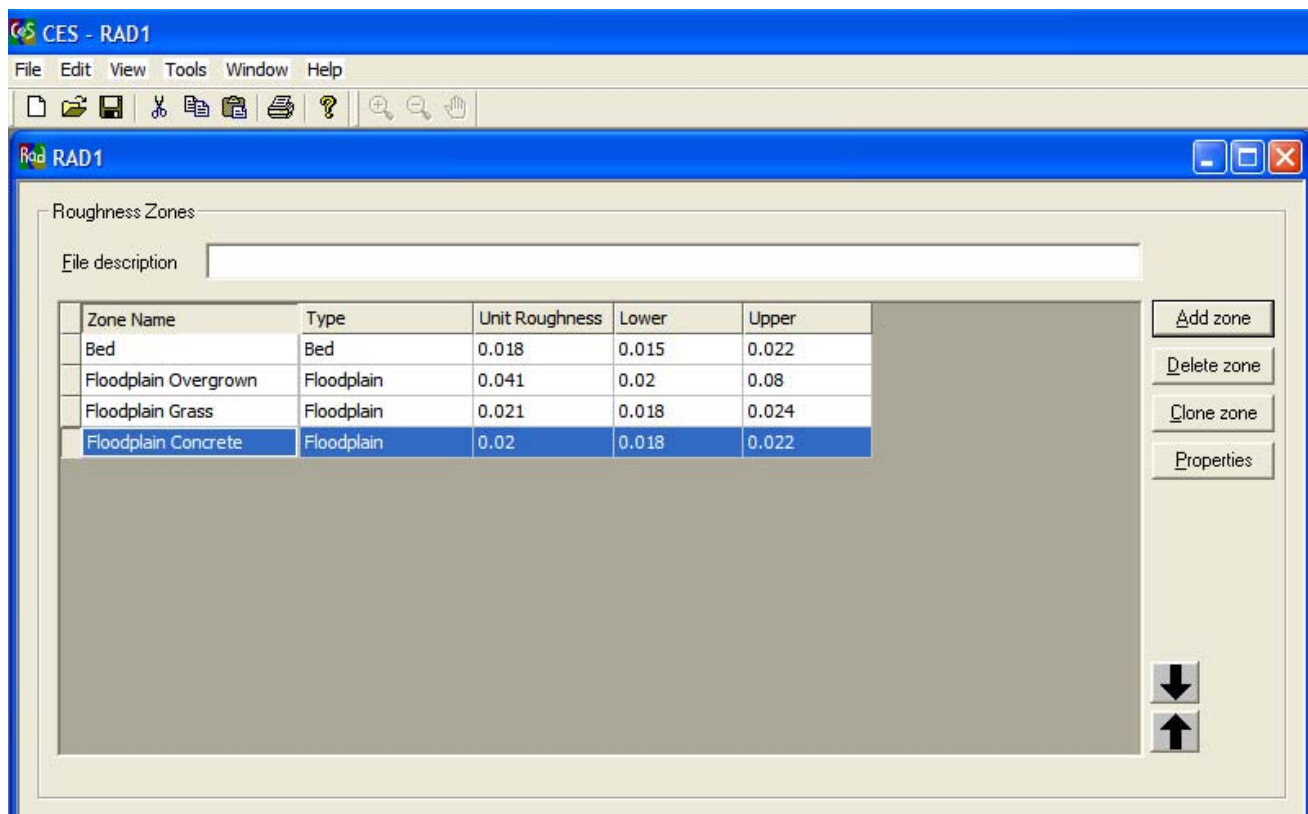


Figure 21: Manning's "n" roughness values derived from the CES Roughness Advisor

- 7.3.2 The watercourse bed was generally free from vegetation at the time of the site visit (May 2012) and comprised mainly of silt with occasional pebbles and cobbles (see Figure 2 and 3). Despite this, a channel roughness of 0.035 has been used in the model to consider possible vegetation growth during the summer months, or fallen bank vegetation.
- 7.3.3 To represent the existing buildings within the model, the building footprints were included in the model however the external walls were not modelled. Instead, a Manning's roughness of 0.3 was applied to the building footprint along the cross section. This essentially allows floodwater to be deflected around the structures, whilst still allowing the potential for floodwater to propagate across them via doorways and other openings.

7.4 Model Boundary Conditions

7.4.1 The following flood event scenarios have been carried out within the model and will allow the extent of the fluvial floodplain across the study area to be determined and appraised in terms of NPPF.

1. 20yr event
2. 100yr event
3. 1000yr event
4. 20yr plus climate change event
5. 100yr plus climate change event
6. 1000yr plus climate change event

Upstream Boundary

7.4.2 Having determined that the FEH Statistical Method is preferred for estimating flood flows, a flow hydrograph is required for input into the hydraulic model, with a peak flow that matches the corresponding flood frequency estimate.

7.4.3 It is common to generate a hydrograph using the ReFH Method, then scaling it to match the statistical flow estimate as discussed in Section 6.11. This hydrograph then forms the upstream inflow boundary condition. It was ensured that the hydrograph parameters, shape, duration, data interval and results for each return period determined in Section 6.7 were reproduced in the InfoWorks RS software.

Downstream Boundary

7.4.4 For the downstream boundary, the InfoWorks software allows the user to define a Normal/Critical Depth downstream boundary which generates a flow-head relationship based on the downstream slope (approximately 1:250).

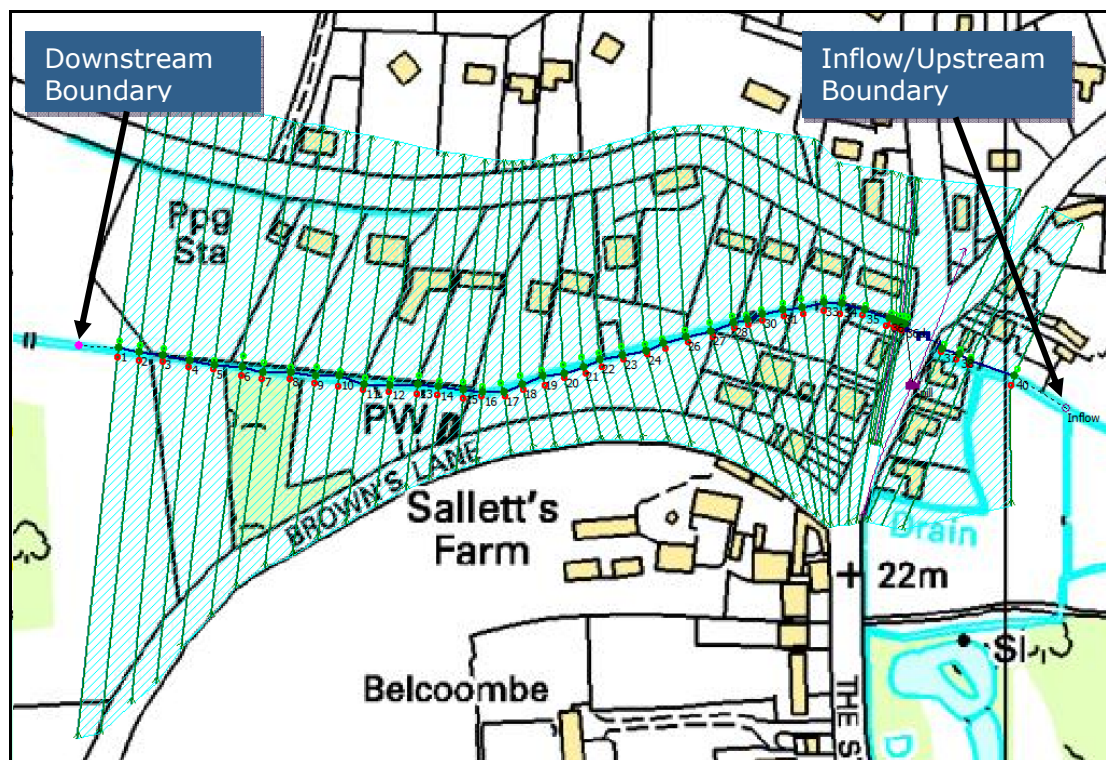


Figure 22: Model schematic as it appears in the Infoworks software

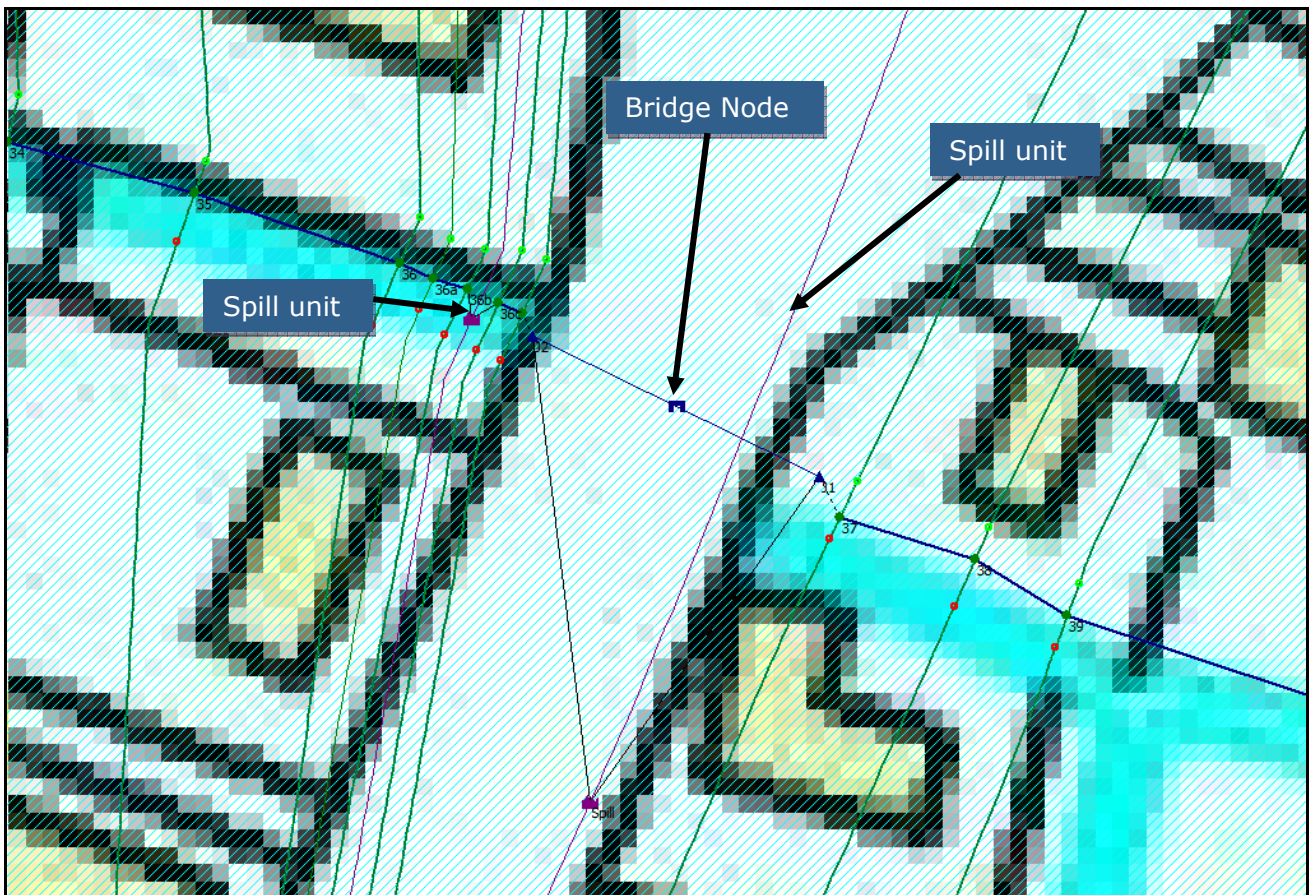


Figure 23: Close-up of bridge node and spill units

7.5 Results

20yr and 20yr plus climate change event

- 7.5.1 During these events, all of the floodwater is contained within the watercourse channel, and there is no out-of-bank flooding at all cross sections.
- 7.5.2 The results also show that all of the flood flow is permitted downstream by the bridge opening under The Street and there is no overtopping of the bridge deck. Flood flow conveyance along the river is typically uniform (i.e. the outflow rate from the model is similar to the inflow rate) and there is little attenuation of the overall flood flows along this reach caused by the bridge and channel roughness.
- 7.5.3 The results for all modelled return period events have been plotted on the topographical survey and can be seen on Drawing Number 1113/RE/01 and 1113/RE/02. The flood extents have been mapped without the consideration of the existing buildings in order to show the extent of the flood zones.

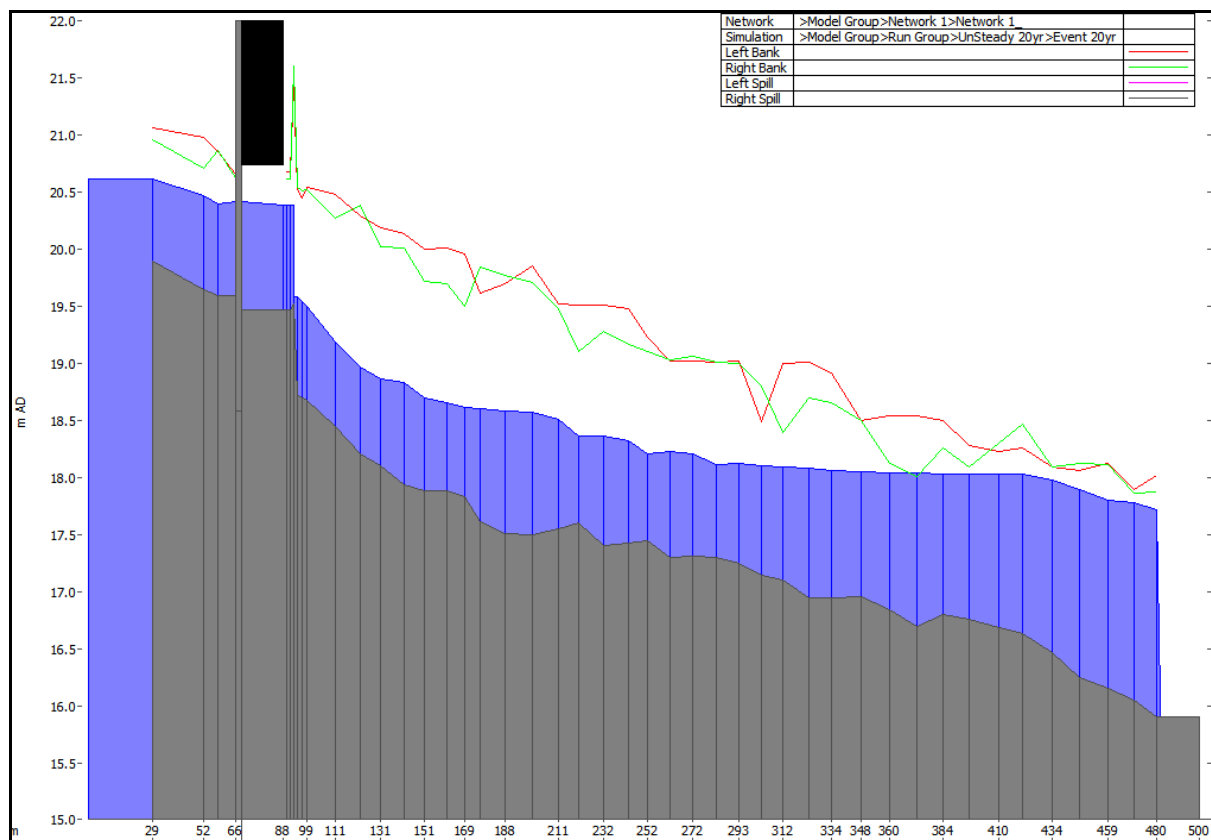


Figure 24: Long section of model showing flood level during 1 in 20 year event

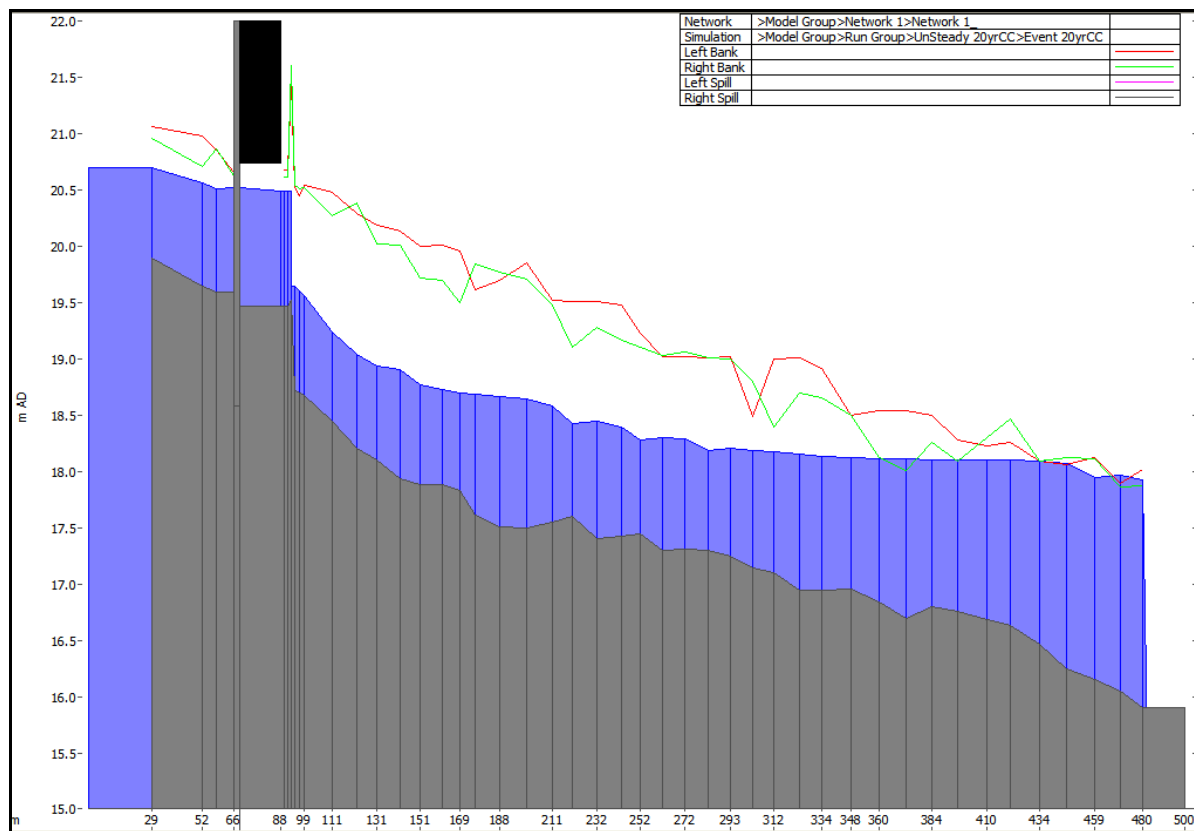


Figure 25: Long section of model showing flood level during climate change 1 in 20 year event

Table 10: Results for 1 in 20 year event

Cross Section	Results - 20yr		
	Max Stage (m AD)	Max Velocity (m/s)	Max Flow (m3/s)
40	20.618	1.084	1.878
39	20.471	1.232	1.878
38	20.397	1.682	1.878
37	20.415	0.895	1.878
36d	20.39	0.723	1.878
36c	20.392	0.661	1.878
36b	19.586	1.036	1.878
36a	19.548	1.279	1.878
36	19.506	2.373	1.878
35	19.185	1.938	1.878
34	18.971	2.032	1.878
33	18.862	1.199	1.878
32	18.83	1.078	1.878
31	18.698	1.886	1.878
30	18.653	1.087	1.878
29	18.618	1.134	1.877
28	18.608	0.984	1.877
27	18.584	0.928	1.877
26	18.571	0.792	1.877
25	18.508	1.109	1.877
24	18.359	1.754	1.877
23	18.367	0.946	1.877
22	18.319	1.07	1.877
21	18.205	1.712	1.877
20	18.224	0.844	1.877
19	18.208	0.808	1.877
18	18.109	1.445	1.877
17	18.124	0.984	1.877
16	18.104	0.828	1.876
15	18.097	0.737	1.876
14	18.081	0.719	1.876
13	18.063	0.791	1.876
12	18.053	0.685	1.876
11	18.044	0.627	1.875
10	18.043	0.47	1.875
9	18.035	0.522	1.875
8	18.028	0.515	1.875
7	18.029	0.372	1.874
6	18.033	0.349	1.874
5	17.977	0.923	1.873
4	17.898	1.138	1.873
3	17.804	1.266	1.873
2	17.782	0.985	1.873
1	17.721	1.038	1.873

Table 11: Results for climate change 1 in 20 year event

Cross Section	Results - 20yrCC		
	Max Stage (m AD)	Max Velocity (m/s)	Max Flow (m3/s)
40	20.698	1.106	2.253
39	20.563	1.262	2.253
38	20.51	1.621	2.253
37	20.524	0.932	2.252
36d	20.488	0.76	2.252
36c	20.49	0.702	2.252
36b	19.652	1.129	2.252
36a	19.608	1.388	2.252
36	19.566	2.483	2.252
35	19.243	2.036	2.252
34	19.039	2.113	2.252
33	18.937	1.262	2.252
32	18.905	1.148	2.252
31	18.768	1.961	2.252
30	18.735	1.144	2.252
29	18.698	1.192	2.252
28	18.689	1.047	2.252
27	18.663	0.997	2.252
26	18.649	0.862	2.252
25	18.582	1.183	2.252
24	18.43	1.832	2.252
23	18.443	1.015	2.252
22	18.392	1.145	2.252
21	18.281	1.759	2.252
20	18.303	0.9	2.252
19	18.287	0.849	2.252
18	18.184	1.431	2.252
17	18.204	0.963	2.252
16	18.183	0.842	2.252
15	18.176	0.735	2.252
14	18.159	0.742	2.252
13	18.139	0.804	2.252
12	18.128	0.706	2.252
11	18.118	0.654	2.252
10	18.118	0.499	2.252
9	18.108	0.551	2.251
8	18.101	0.547	2.251
7	18.101	0.409	2.251
6	18.107	0.349	2.251
5	18.088	0.914	2.25
4	18.076	1.139	2.25
3	17.95	1.286	2.25
2	17.967	0.987	2.25
1	17.924	1.04	2.25

100yr and 100yr plus climate change event

- 7.5.4 During the 1 in 100 year event all floodwater is permitted downstream by the bridge opening without backing up and overtopping of the road deck. There is out-of-bank flooding across downstream parts of the study area and upstream of the bridge.
- 7.5.5 During the climate change 1 in 100 year event the floodwater reaches a level which is 0.05m above the soffit of the bridge opening. Although most of the floodwater is permitted downstream by the bridge opening, there is a small amount of out-of-bank flooding upstream of the bridge, which mainly affects the garden area of Grays Cottage and White Cottage. There is also out-of-bank flooding at downstream sections which affects a small area of garden associated with the property Cardell.

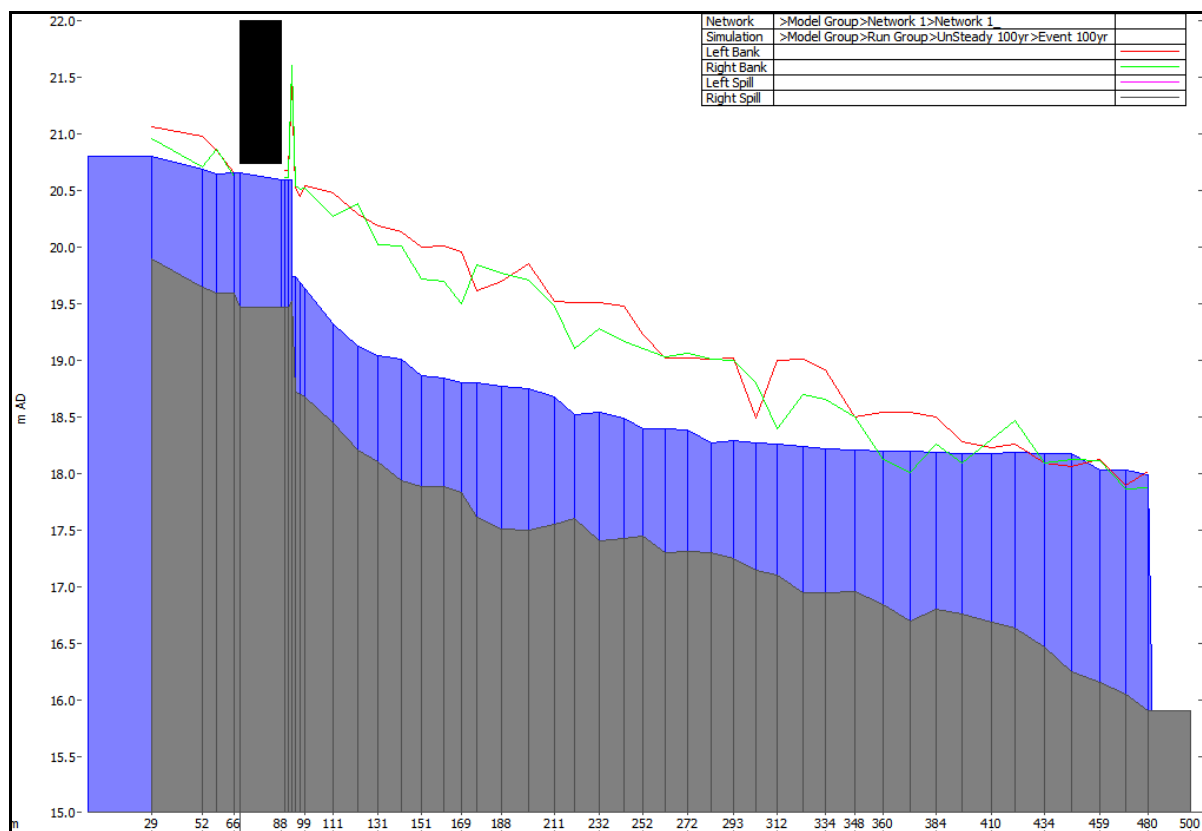


Figure 26: Long section of model showing flood level during 1 in 100 year event

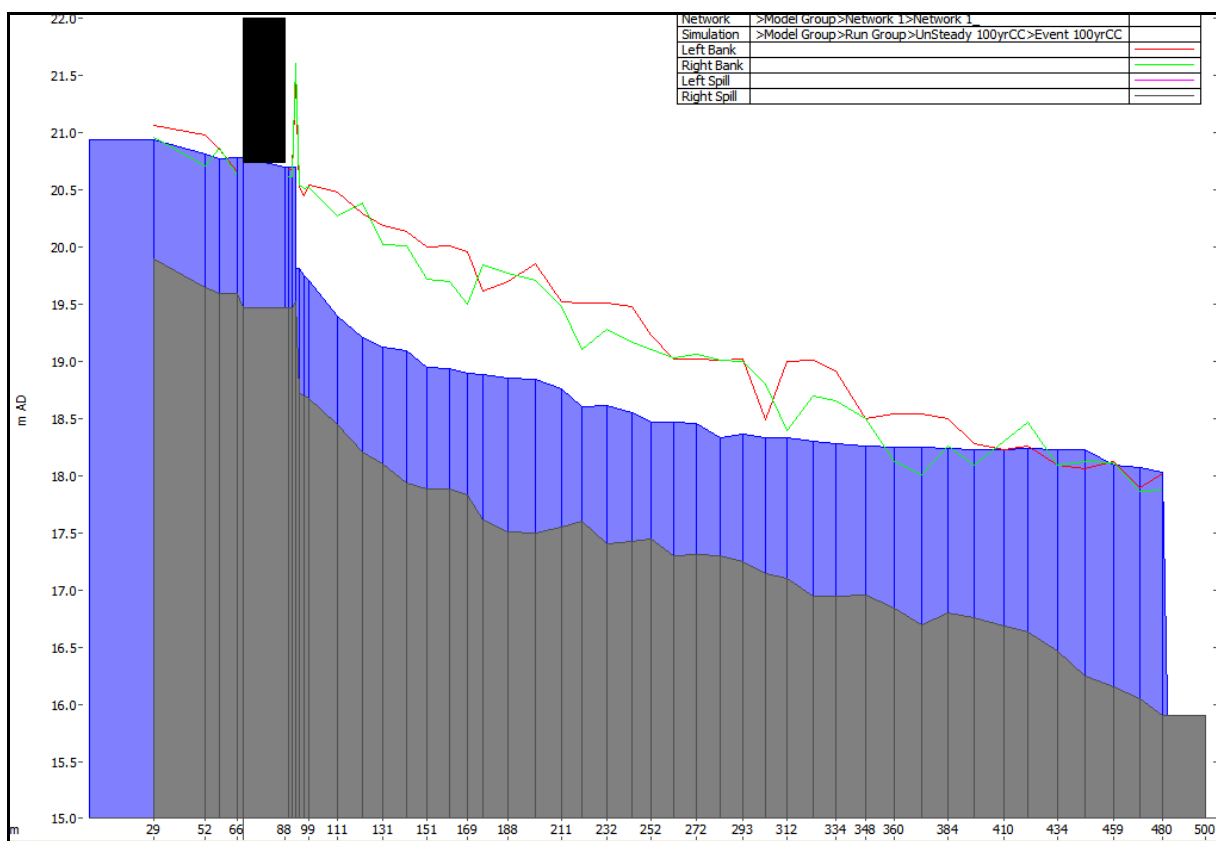


Figure 27: Long section of model showing flood level during climate change 1 in 100 year event

Table 12: Results for 1 in 100 year event

Cross Section	Results - 100yr		
	Max Stage (m AD)	Max Velocity (m/s)	Max Flow (m ³ /s)
40	20.81	1.092	2.808
39	20.689	1.254	2.808
38	20.649	1.532	2.808
37	20.658	0.949	2.807
36d	20.599	0.774	2.807
36c	20.6	0.725	2.807
36b	19.738	1.251	2.807
36a	19.684	1.542	2.807
36	19.642	2.612	2.807
35	19.323	2.147	2.807
34	19.127	2.17	2.807
33	19.041	1.342	2.807
32	19.007	1.233	2.807
31	18.865	2.023	2.807
30	18.843	1.218	2.807
29	18.806	1.27	2.807
28	18.798	1.122	2.807
27	18.769	1.08	2.807
26	18.754	0.95	2.806
25	18.68	1.28	2.806
24	18.525	1.895	2.806
23	18.54	1.11	2.806
22	18.485	1.24	2.806
21	18.395	1.66	2.806
20	18.397	0.991	2.806
19	18.382	0.914	2.806
18	18.267	1.468	2.806
17	18.293	0.964	2.806
16	18.269	0.928	2.806
15	18.264	0.794	2.806
14	18.243	0.823	2.805
13	18.22	0.889	2.805
12	18.206	0.792	2.805
11	18.196	0.727	2.805
10	18.198	0.541	2.805
9	18.185	0.621	2.805
8	18.176	0.61	2.805
7	18.176	0.469	2.805
6	18.184	0.349	2.804
5	18.177	0.911	2.804
4	18.173	1.111	2.804
3	18.028	1.333	2.804
2	18.026	0.985	2.805
1	17.985	1.021	2.805

Table 13: Results for the climate change 1 in 100 year event

Cross Section	Results - 100yrCC		
	Max Stage (m)	Max Velocity (m/s)	Max Flow (m3/s)
40	20.942	1.077	3.369
39	20.812	1.26	3.366
38	20.779	1.533	3.366
37	20.788	0.955	3.366
36d	20.697	0.784	3.366
36c	20.698	0.739	3.366
36b	19.817	1.356	3.366
36a	19.756	1.665	3.366
36	19.713	2.713	3.366
35	19.397	2.243	3.366
34	19.206	2.255	3.365
33	19.131	1.415	3.365
32	19.097	1.311	3.365
31	18.952	2.093	3.365
30	18.937	1.29	3.365
29	18.897	1.352	3.365
28	18.889	1.198	3.365
27	18.858	1.164	3.365
26	18.841	1.038	3.365
25	18.76	1.376	3.365
24	18.604	1.983	3.365
23	18.615	1.207	3.365
22	18.551	1.359	3.365
21	18.474	1.699	3.365
20	18.473	1.08	3.366
19	18.46	0.979	3.366
18	18.337	1.539	3.366
17	18.362	0.964	3.366
16	18.334	1.021	3.366
15	18.331	0.854	3.366
14	18.304	0.909	3.366
13	18.276	0.986	3.366
12	18.26	0.884	3.366
11	18.252	0.769	3.366
10	18.253	0.586	3.366
9	18.236	0.69	3.366
8	18.225	0.679	3.366
7	18.225	0.532	3.366
6	18.235	0.349	3.365
5	18.23	0.911	3.365
4	18.227	1.119	3.364
3	18.096	1.333	3.364
2	18.069	0.986	3.364
1	18.029	1.029	3.364

1000yr and 1000yr plus climate change event

- 7.5.7 During these events there is backing up of floodwater upstream of the bridge opening, as the capacity of the bridge is exceeded (i.e. the flood level reaches 0.389m higher than the bridge soffit). The floodwater also reaches a level higher than part of the road deck to the left of the bridge opening, however, the flood level does not reach a level high enough to fully spill across the road and onto downstream areas.
- 7.5.8 Upstream of the bridge, properties White Cottage, Prince of Wales House, The Willows and Grays Cottage will directly be affected by the floodwater. There is also some flooding of gardens associated with properties Funnels Corner and Number 1 Cargate Lane located immediately downstream of the bridge.
- 7.5.9 There is also out-of-bank flooding at downstream cross sections which affects a small area of garden associated with the property Cardell.

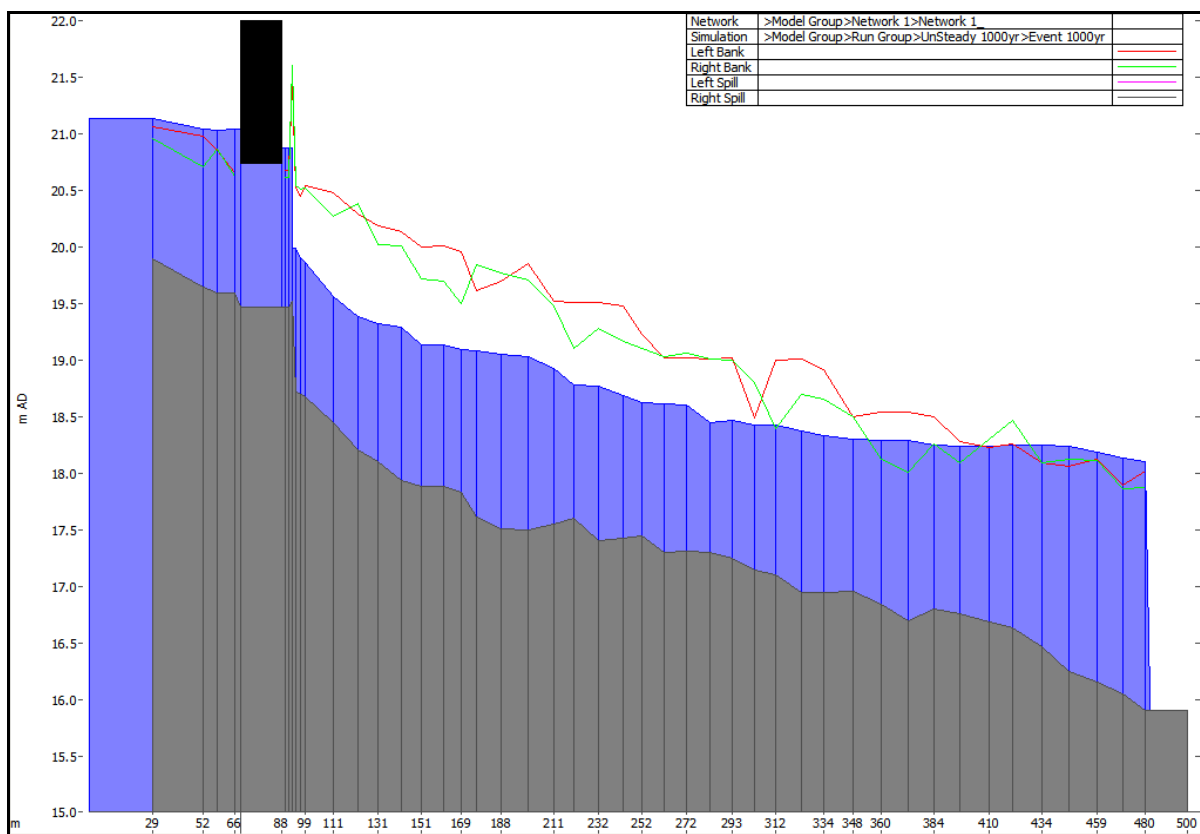


Figure 28: Long section of model showing flood level during 1 in 1000 year event

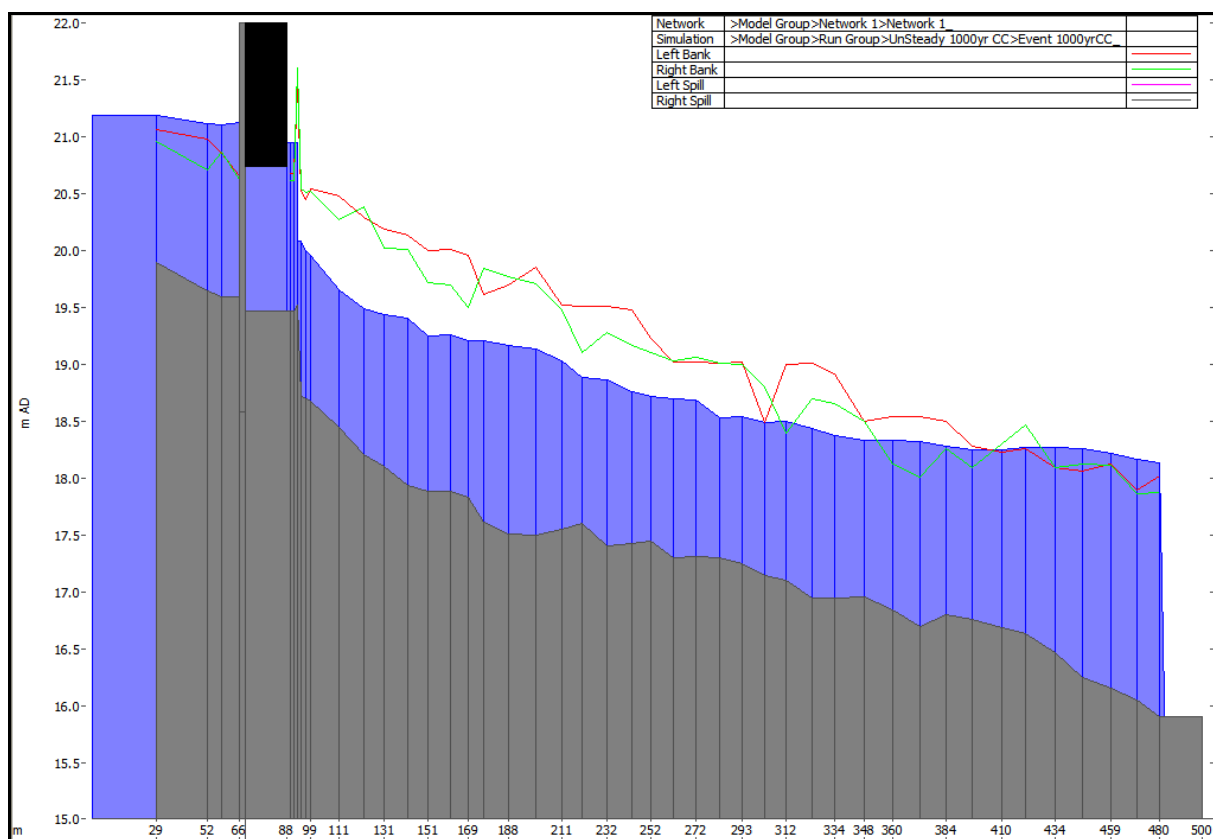


Figure 29: Long section of model showing flood level during climate change 1 in 1000 year event

Table 14: Results for the 1 in 1000 year event

Cross Section	Results - 1000yr		
	Max Stage (m AD)	Max Velocity (m/s)	Max Flow (m3/s)
40	21.136	1.078	4.797
39	21.046	1.261	4.793
38	21.035	1.658	4.793
37	21.047	0.968	4.793
36d	20.875	0.799	4.793
36c	20.875	0.753	4.793
36b	19.988	1.582	4.793
36a	19.909	1.938	4.793
36	19.865	2.905	4.793
35	19.563	2.428	4.793
34	19.383	2.213	4.794
33	19.328	1.578	4.794
32	19.293	1.475	4.794
31	19.141	2.044	4.794
30	19.14	1.448	4.794
29	19.095	1.523	4.794
28	19.089	1.36	4.794
27	19.052	1.341	4.794
26	19.03	1.225	4.795
25	18.931	1.591	4.795
24	18.786	2.11	4.795
23	18.772	1.431	4.795
22	18.685	1.628	4.795
21	18.63	1.63	4.795
20	18.619	1.302	4.795
19	18.609	1.131	4.795
18	18.45	1.764	4.795
17	18.47	1.194	4.795
16	18.424	1.298	4.795
15	18.427	1.044	4.795
14	18.38	1.175	4.795
13	18.331	1.3	4.795
12	18.298	1.197	4.795
11	18.288	1.009	4.795
10	18.289	0.781	4.795
9	18.254	0.959	4.795
8	18.24	0.959	4.795
7	18.239	0.754	4.795
6	18.251	0.35	4.795
5	18.247	0.917	4.795
4	18.244	1.141	4.794
3	18.191	1.329	4.794
2	18.138	0.986	4.793
1	18.1	1.037	4.793

Table 15: Results for the climate change 1 in 1000 year event

Cross Section	Results - 1000yrCC		
	Max Stage (m)	Max Velocity (m/s)	Max Flow (m3/s)
40	21.196	1.08	5.756
39	21.121	1.26	5.753
38	21.105	1.679	5.753
37	21.129	0.967	5.754
36d	20.952	0.798	5.754
36c	20.952	0.751	5.755
36b	20.087	1.709	5.755
36a	19.999	2.078	5.755
36	19.956	2.993	5.755
35	19.663	2.524	5.755
34	19.488	2.293	5.755
33	19.442	1.67	5.755
32	19.406	1.565	5.755
31	19.252	2.1	5.755
30	19.257	1.538	5.755
29	19.208	1.625	5.755
28	19.205	1.446	5.755
27	19.163	1.442	5.756
26	19.138	1.334	5.756
25	19.028	1.717	5.756
24	18.889	2.196	5.756
23	18.861	1.557	5.756
22	18.758	1.789	5.756
21	18.715	1.695	5.756
20	18.695	1.44	5.756
19	18.69	1.214	5.756
18	18.526	1.851	5.756
17	18.544	1.31	5.756
16	18.488	1.446	5.756
15	18.501	1.106	5.756
14	18.441	1.309	5.756
13	18.378	1.466	5.756
12	18.332	1.375	5.756
11	18.328	1.097	5.756
10	18.327	0.875	5.755
9	18.279	1.106	5.755
8	18.248	1.109	5.755
7	18.246	0.883	5.755
6	18.275	0.336	5.754
5	18.266	0.921	5.752
4	18.26	1.139	5.75
3	18.218	1.332	5.749
2	18.171	0.988	5.748
1	18.132	1.038	5.748

7.6 Sensitivity Analysis

- 7.6.1 The Agency's guidance document entitled *Requirements for completing computer river modelling for flood risk assessments (2009)*, suggests that the model should be tested for sensitivity by adjusting key parameters such as the channel roughness values.
- 7.6.2 The channel Manning's roughness has been increased by 10% (from 0.035 to 0.039 in order to consider a higher density of channel vegetation. The sensitivity analysis has been carried out for the 1 in 1000 year plus climate change event within the watercourse as this would represent a worst-case scenario.
- 7.6.3 The results in Table 16 show that when compared to the above modelling results, flood levels are marginally higher when considering an increase in channel roughness. It can be concluded that the model is not particularly sensitive to an increase in channel roughness and does not cause a significant increase in the flood extent.

Table 16: Results comparison for increased "n" during climate change 1 in 1000 year event

Channel Manning's n = 0.039			Event			
Node	Max Stage (m AD)	Max Velocity (m/s)	Node	Max Stage (m AD)	Max Velocity (m/s)	Stage Difference (m)
40	21.202	0.988	40	21.196	1.08	0.006
39	21.13	1.246	39	21.121	1.26	0.009
38	21.11	1.612	38	21.105	1.679	0.005
37	21.129	0.979	37	21.129	0.967	0
36d	20.952	0.812	36d	20.952	0.798	0
36c	20.952	0.767	36c	20.952	0.751	0
36b	20.127	1.638	36b	20.087	1.709	0.04
36a	20.049	1.962	36a	19.999	2.078	0.05
36	20.005	2.763	36	19.956	2.993	0.049
35	19.705	2.379	35	19.663	2.524	0.042
34	19.526	2.179	34	19.488	2.293	0.038
33	19.517	1.543	33	19.442	1.67	0.075
32	19.475	1.457	32	19.406	1.565	0.069
31	19.329	1.9	31	19.252	2.1	0.077
30	19.331	1.431	30	19.257	1.538	0.074
29	19.283	1.508	29	19.208	1.625	0.075
28	19.274	1.351	28	19.205	1.446	0.069
27	19.228	1.356	27	19.163	1.442	0.065
26	19.197	1.266	26	19.138	1.334	0.059
25	19.096	1.599	25	19.028	1.717	0.068
24	18.926	2.087	24	18.889	2.196	0.037
23	18.917	1.467	23	18.861	1.557	0.056
22	18.818	1.666	22	18.758	1.789	0.06
21	18.781	1.53	21	18.715	1.695	0.066
20	18.747	1.361	20	18.695	1.44	0.052
19	18.736	1.14	19	18.69	1.214	0.046
18	18.593	1.667	18	18.526	1.851	0.067
17	18.595	1.235	17	18.544	1.31	0.051
16	18.541	1.357	16	18.488	1.446	0.053
15	18.55	1.02	15	18.501	1.106	0.049
14	18.489	1.234	14	18.441	1.309	0.048
13	18.428	1.37	13	18.378	1.466	0.05
12	18.373	1.307	12	18.332	1.375	0.041
11	18.368	0.997	11	18.328	1.097	0.04
10	18.36	0.825	10	18.327	0.875	0.033
9	18.313	1.048	9	18.279	1.106	0.034
8	18.28	1.034	8	18.248	1.109	0.032
7	18.275	0.811	7	18.246	0.883	0.029
6	18.297	0.283	6	18.275	0.336	0.022
5	18.29	0.832	5	18.266	0.921	0.024
4	18.286	1.016	4	18.26	1.139	0.026
3	18.228	1.168	3	18.218	1.332	0.01
2	18.183	0.884	2	18.171	0.988	0.012
1	18.145	0.932	1	18.132	1.038	0.013

7.7 Comparison with EA Flood Levels and Flood Map

- 7.7.1 In order to provide context, the flood levels provided by the Agency have been compared with the results of the equivalent cross section determined in this study. The 1 in 25 year return period has not been modelled in this study, however it is considered that for the purposes of this exercise the use of the 1 in 20 year event results will suffice.

Table 17: Comparison between EA flood data and flood data generated in this report

	Cross Section	1 in 25/20 year (mAOD)	1 in 100 year (mAOD)	1 in 100 year plus climate change (mAOD)	1 in 1000 year (mAOD)
EA Flood Levels (2005)	SAXL1_1710	21.02	21.12	21.17	21.33
	SAXL1_1680	20.99	21.08	21.11	21.24
	SAXL1_1630	19.72	19.89	20.01	20.49
	SAXL1_1530	18.57	18.72	18.81	19.19
	SAXL1_1500	18.40	18.55	18.65	19.07
	SAXL1_1250	17.10	17.25	17.35	17.77
Evans Rivers and Coastal Flood Levels (2012)	39	20.471	20.689	20.812	21.046
	37	20.415	20.658	20.788	21.047
	33	18.862	19.041	19.131	19.328
	22	18.319	18.485	18.551	18.685
	19	18.208	18.382	18.460	18.609
	1	17.721	17.985	18.029	18.100

- 7.7.2 Table 17 shows that the flood levels provided by the Agency are higher than those derived in this report. For example, during the 1 in 100 year event at cross sections 39 and SAXL1_1710, the modelled flood level in this report is 0.431m lower than the level provided by the Agency. In general, the difference is greater at cross section 33, particularly for the 1 in 1000 year event, in which the Agency's flood level is 1.162m higher.
- 7.7.3 Whilst it is useful to compare the results of this study with previous studies, it is considered that the difference in flood levels is attributed to a multitude of factors, such as the modelling techniques used and the accuracy of the model/input data across this area. Site-specific modelling also tends to produce more reliable results as more detail can be applied to a specific area which improves the model's accuracy.
- 7.7.4 In order to map the flood zones across the study area, the results were exported from the InfoWorks model as MIF files and imported into MapInfo. When mapping the flood zones, the presence of dwellings were ignored in order to be consistent with flood zone mapping techniques carried out by the Agency.
- 7.7.5 Figures 30 and 31 show the present day flood zones and future climate change flood zones as determined by this study. In comparison to the Agency's flood map shown on Figure 2, the flood zone extents established by this study show a smaller flood zone 3a and 2 across the study area.

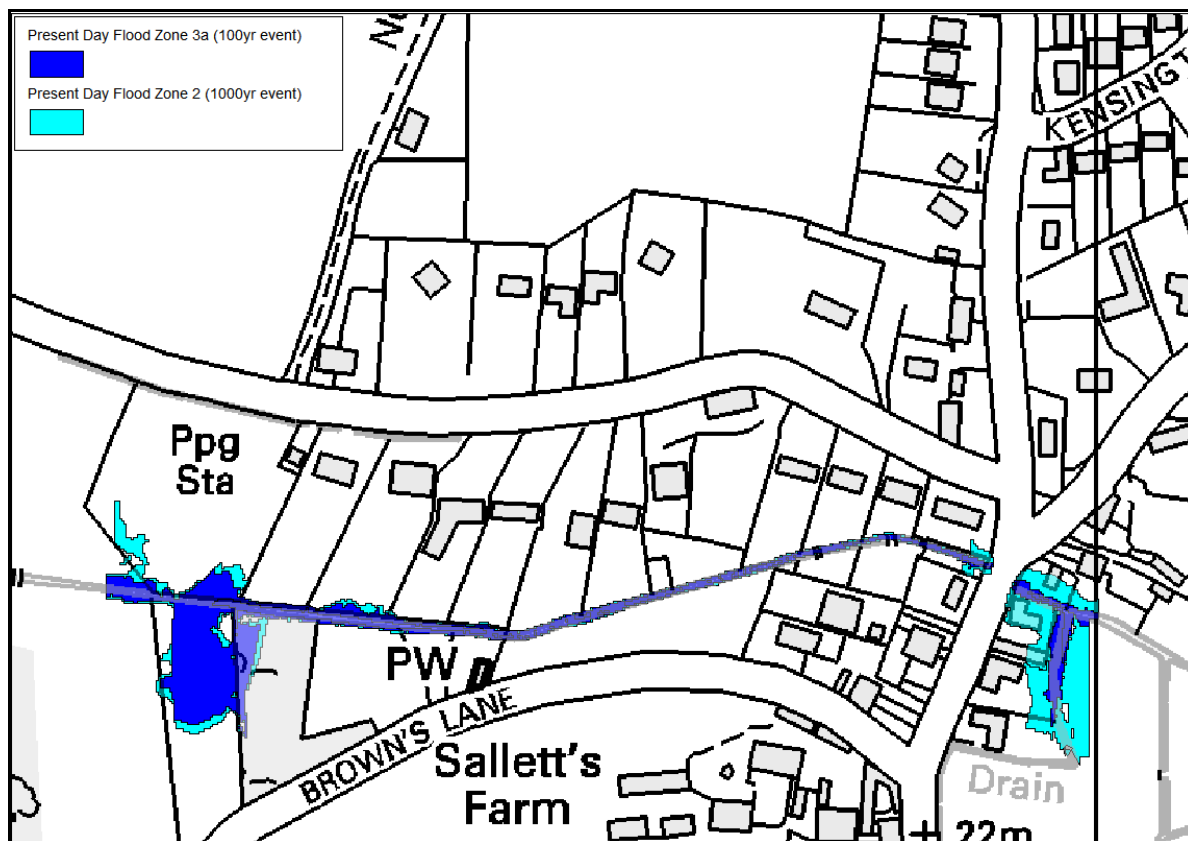


Figure 30: Present day Flood Zones using results from the InfoWorks model

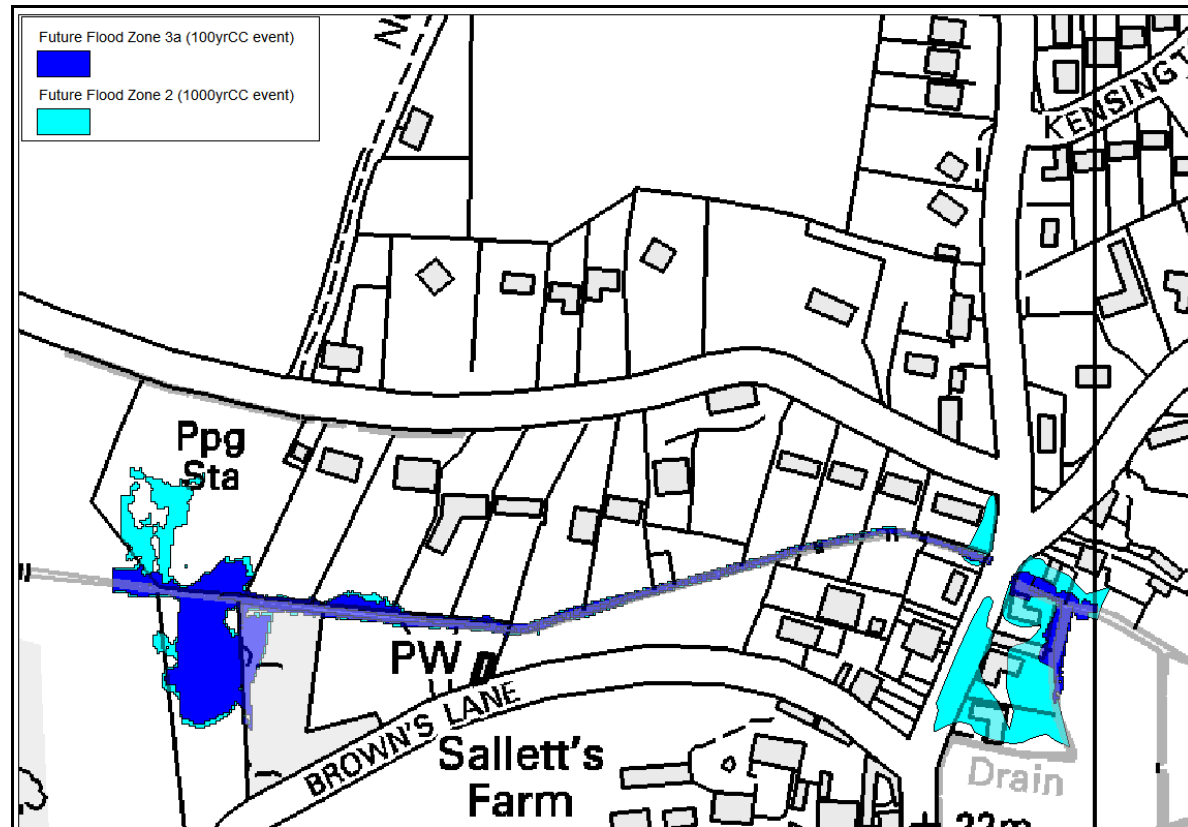


Figure 31: Future (climate change) Flood Zones using results from the InfoWorks model

8. CONCLUSIONS

- 8.1 The development of a fluvial flood model, which uses the latest flood flow methodology, has enabled a full assessment of the floodplain extents across the study area to be quantified.
- 8.2 An InfoWorks RS model has been developed to establish flood levels during the various NPPF return period events. The flood model has used ground level data from a GPS topographical survey, commissioned specifically for this study, together with LIDAR data to supplement areas which were not covered by the topographical survey. A sensitivity analysis has demonstrated that the model is not significantly sensitive to changes in channel Manning's roughness values.
- 8.3 The results have shown that, in general, most of the floodwater remains within the channel banks during all modelled return period events. There is no out-of-bank flooding during the 1 in 20 year and climate change 1 in 20 year event. However, during the 1 in 100 year, 1 in 100 year plus climate change, 1 in 1000 year and 1 in 1000 year plus climate change events, there is out-of-bank flooding upstream of the bridge at The Street, which affects residents situated adjacent to the watercourse. There is also a small area of flooding during these events downstream of the bridge and further downstream.
- 8.4 Therefore properties and associated land which are located within the floodplain area include; Grays Cottage, White Cottage, Prince of Wales House, The Willows, Funnels Corner, 1 Cargate Lane and Cardell.
- 8.5 The purpose of this assessment is to provide the Saxlingham Flood Association with up-to-date, comprehensive and detailed flood mapping of the Saxlingham area to enable them to assess whether or not there is a basis for challenging the Environment Agency's Flood Map for the village.
- 8.6 This assessment includes site-specific modelling which incorporates recent flow methodology guidance and detailed ground level survey data.

9. BIBLIOGRAPHY

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- xiii. WinDes 2009. *Micro Drainage*. Version 12.6.

APPENDIX A – CORRESPONDENCE

██████████
Evans Rivers and Coastal
██

Our ref CCE/2012/47677

Date 9 May 2012

Dear ██████████

Saxlingham, Nethergate

Thank you for your enquiry which was received on 16 April and subsequent payment of ██████████. Following internal consultations we are able to reply to your enquiry as below.

This area falls within Flood Zone 3 Fluvial.

Please find attached to my email;

- A map showing the Flood Zones (outlines) for the area of the site;
- Modelled flood levels; and
- A map showing where the modelled flood level nodes are located.

Flood Zone 1 means a less than 0.1% annual probability of flooding.

The Flood Zone 2 outline shows a 1 in 1000 chance of flooding at a location in any one given year (i.e., a 0.1% annual probability of flooding).

The Flood Zone 3 fluvial outline shows a 1 in 100 chance of flooding at a location in any one given year (i.e., a 1% annual probability of flooding).

The Flood Zone 3 tidal outline shows a 1 in 200 chance of flooding at a location in any one given year (i.e., a 0.5% annual probability of flooding).

The flood outlines show areas of potential flooding as a direct result of floodwater coming from a watercourse. No direct effects of surface runoff or surface flooding are included. The Flood Maps show areas at risk of flooding, and not the risk to individual properties. This is because we do not hold data on individual properties.

We have checked our historic flooding database and have found no record of flooding in this area. This does not mean that the site has never flooded, only that no flooding has been reported to us in this location.

Eastern Area - Icen House

Cobham Road, Ipswich, Suffolk, IP3 9JD

General Enquiries: 03708 506506 Fax: 01473 724205

Weekday Daytime calls cost 8p plus up to 6p per minute from BT Weekend Unlimited.

Mobile and other providers' charges may vary

Email: enquiries@environment-agency.gov.uk

Website: www.environment-agency.gov.uk

There are no Environment Agency maintained flood defences in this area.

The purpose of the Flood Risk Assessment (FRA) is to demonstrate that any development will be safe and sustainable. The requirements and level of information required within a FRA depends on the development vulnerability and Flood Zone.

Further guidance on any development type within any of the Flood Zones can be found at the following website. Here you will find PDF documents detailing the information you will need to include in your Flood Risk Assessment. Just click on the relevant link for your proposal. <http://www.environment-agency.gov.uk/research/planning/93498.aspx>

If you would like to discuss the content of the FRA in more detail, including the requirements for floor levels and safe access/egress, please call [REDACTED] on [REDACTED] or email [REDACTED] -

Please see the attached notice for details of the permitted use of the information provided.

If we can be of any further assistance, please do contact the Corporate Services Team at the number below.



External Relations Officer

Corporate Services Team
01473 706720

Eastern Area - Icen House

Cobham Road, Ipswich, Suffolk, IP3 9JD

General Enquiries: 03708 506506 Fax: 01473 724205

Weekday Daytime calls cost 8p plus up to 6p per minute from BT Weekend Unlimited.

Mobile and other providers' charges may vary

Email: enquiries@environment-agency.gov.uk

Website: www.environment-agency.gov.uk

Datasheet Reference CCE/2012/47677

Fluvial flood levels (mAODN)



Node	10% (1:10)	4% (1:25)	2% (1:50)	1% (1:100)	1% (1:100)+CC	0.1% (1:1000)
SAXL1_1250	17.00	17.10	17.18	17.25	17.35	17.77
SAXL1_1500	18.30	18.40	18.48	18.55	18.65	19.07
SAXL1_1710	20.81	21.02	21.08	21.12	21.17	21.33
SAXL1_1680	20.78	20.99	21.05	21.08	21.11	21.24
SAXL1_1630	19.61	19.72	19.81	19.89	20.01	20.49
SAXL1_1530	18.48	18.57	18.65	18.72	18.81	19.19

CC = Climate Change

Source Of Information: River Yare Flood Risk Study 2005 By Babbie Brown & Root

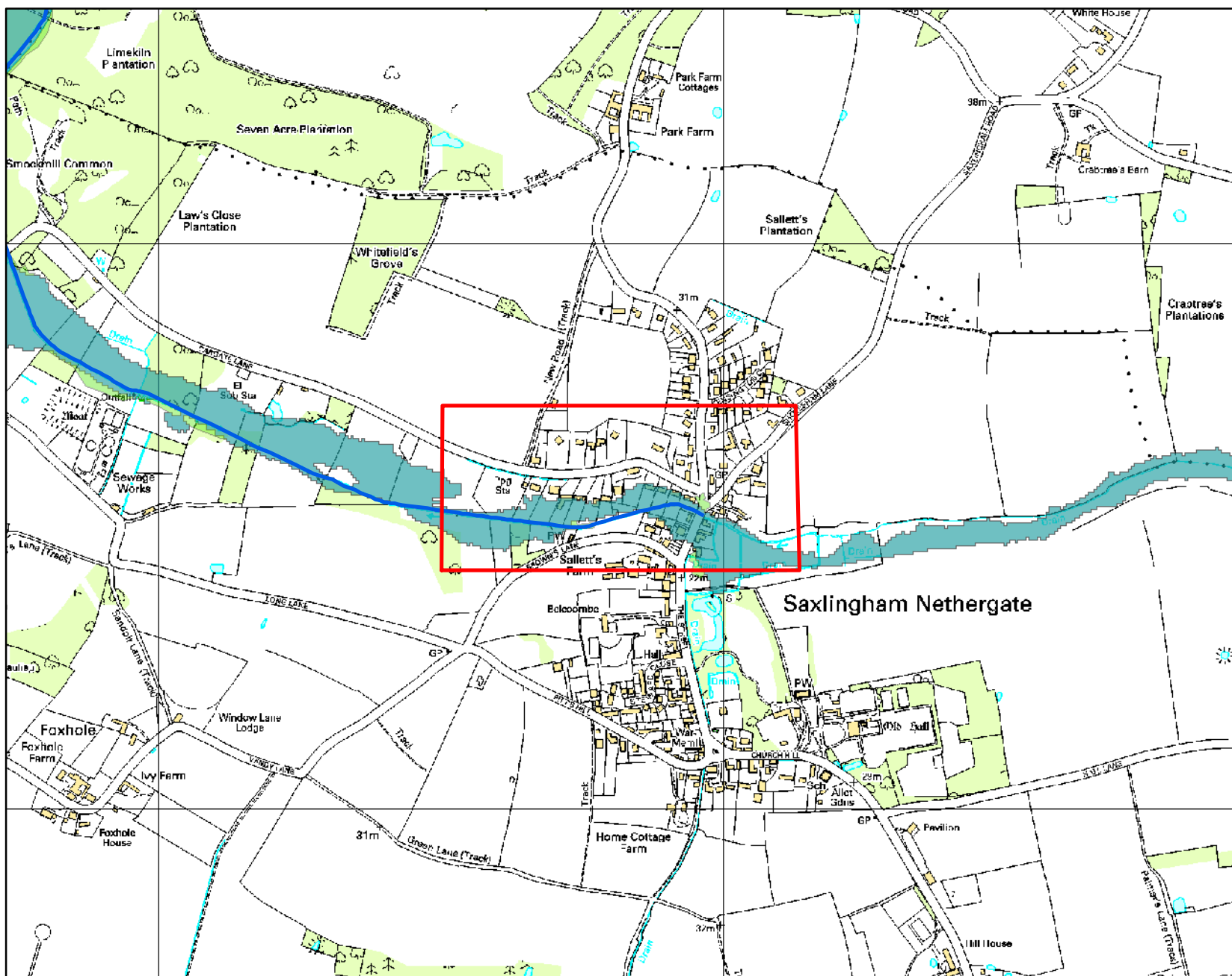
Ref: CCE/2012/47677



Scale 1:10,000

Legend

-  Site Outline
-  Main River
-  Areas Benefit Flood Defence
-  Flood Storage Area
-  Flood Map - Flood Zone 3
-  Flood Map - Flood Zone 2



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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Detailed Flood Map centred on Saxlingham Nethergate - Created 9th May 2012.

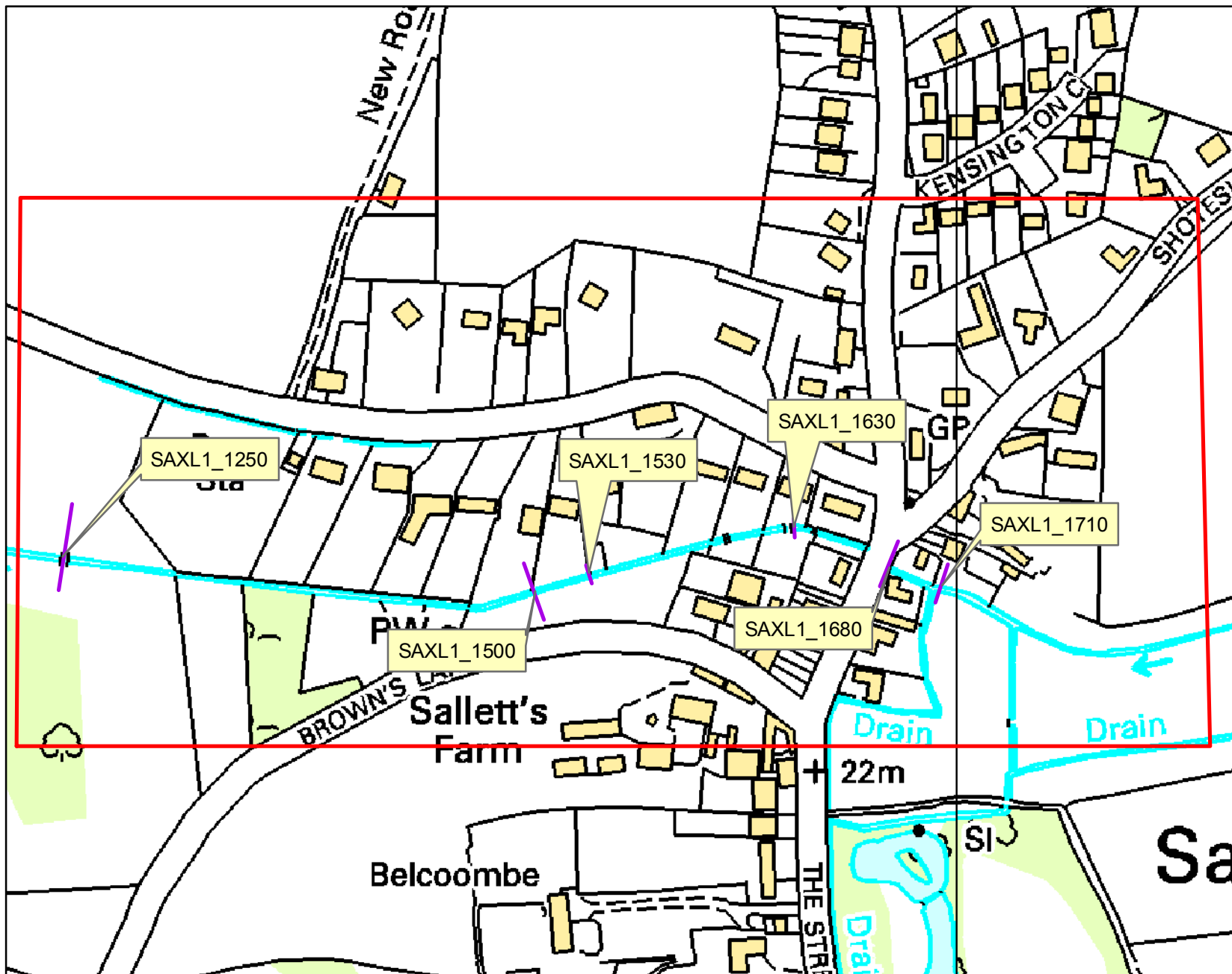
Ref: CCE/2012/47677



Scale 1:3,000

Legend

- Modelled Flood Level Cross Sections
- Site Outline



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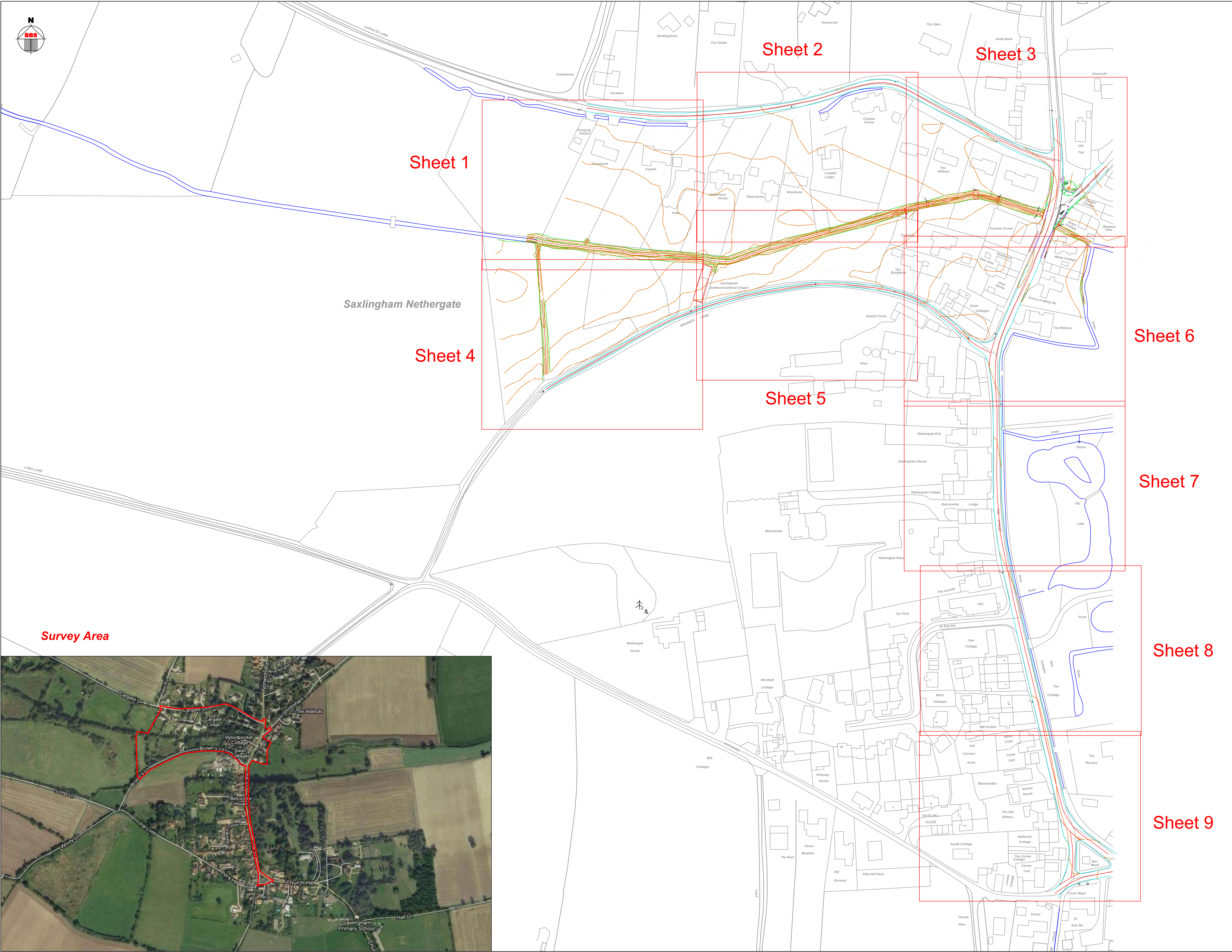
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DRAWINGS



DRAWING NUMBER:
BBS/RE/SAX1

NOTES:

AV

Air Valve

BB

Bottom Bank

BS

Bore Hole

BL

Li-Bolard

BOL

Bollard

BN

Bin

BS

Bus Stop

BUSH

Bush

BOX

Box (Mileage)

CAB

Cabinet

CHNL

Channel

CL

Control Line

CONC

Concrete

COL

Column

DB

Ditch Bottom

SCNC

Drainage Canal

DR

Door

EEB

Electric MH Cover

EP

Electric Pole

ER

Earth Road

ET

EP Transformer

FEED

Feeder Pipe

FCB

Close Boarded

FCL

Chain Line

FHD

Hoarding

FHW

Home Fence

FPL

Palisade

FPR

Post & Rail

PPW

Post & Wire

RAL

Railings

FM

Flow Hydrant

FP

Footpath

G

Gully Grate

GV

Gas Valve

HEDGE

Hedge

IC

Inspection Cover

IL

Invert Level

KO

Kiosk Outlet

LP

Lamp Post

BN

Manhole

MP

Marker Post

NB

Neave Board

PPW

Partition Wall

PB

Post Box

PD

Post

RE

Rodding Eye

RL

Ridge Level

RP

Reflector Post

RS

Road Sign

SETTS

Setts

SP

Sign Post

STAY

Stay

SV

Stake Valve

TAC

Traffic Parking

TB

Top Bank

TBOX

Traffic Light

TOK

Top Of Kerb

TP

Telephone Pole

TRK

Track

TS

Traffic Sign

VENT

Vent

W

Wear Cover

WL

White Line

WO

Wash Out

YL

Yellow Line

Features

Fence

Walls

Hedges

Overhead Line

FCB 1.0m

FCB 1.5m

FCB 2.0m

FCB 2.5m

FCB 1.0m

FCB 1.5m

FCB 2.0m

FCB 2.5m

FCB 1.0m

FCB 1.5m

FCB 2.0m

FCB 2.5m

FCB 1.0m

FCB 1.5m

FCB 2.0m

FCB 2.5m

Average road line shown.

Indicative position of cables.

Services

Foul Sewers

Storm Sewers

1.0m

1.5m

2.0m

2.5m

1.0m

1.5m

2.0m

2.5m

1.0m

1.5m

2.0m

2.5m

Pipe position and alignment is indicative only.

Trees

Decision

Contour

Decision

Contour

Decision

Contour

Traces are drawn to scale on the survey.

All dimensions are in metres unless otherwise stated.
Any critical dimensions and measurements should be based on the original digital data and checked by BBS Surveys Ltd.
Any errors should be notified to BBS Surveys Ltd.

SURVEY STATIONS			
Name	Easting	Northing	Height
STNBS1	622048.593	297594.782	19.720
STNBS2	622170.296	297588.882	19.955
STNBS3	622788.502	297596.777	20.110
STNBS4	622856.127	297513.360	20.396
STNBS5	622903.388	297573.912	20.523
STNBS6	622960.022	297594.903	22.309
STNBS7	622956.807	297528.011	21.120
STNBS8	622922.890	297447.395	21.412
STNBS9	622904.862	297444.487	21.540
STNBS10	622856.312	297475.089	20.807
STNBS11	622804.271	297480.109	20.332
STNBS12	622722.292	297462.345	20.252
STNBS13	622625.126	297469.432	20.442
STNBS14	622626.343	297401.147	21.602
STNBS15	622627.228	297290.029	22.738
STNBS16	622646.908	297205.002	23.208
STNBS17	622675.581	297116.187	23.032

DATE:	REF:	REVISIONS

CLIENT:

PROJECT:

Saxlingham Nethergate

TITLE:

Existing Ground
Level Survey
Sheet Layout

SHEET SIZE:

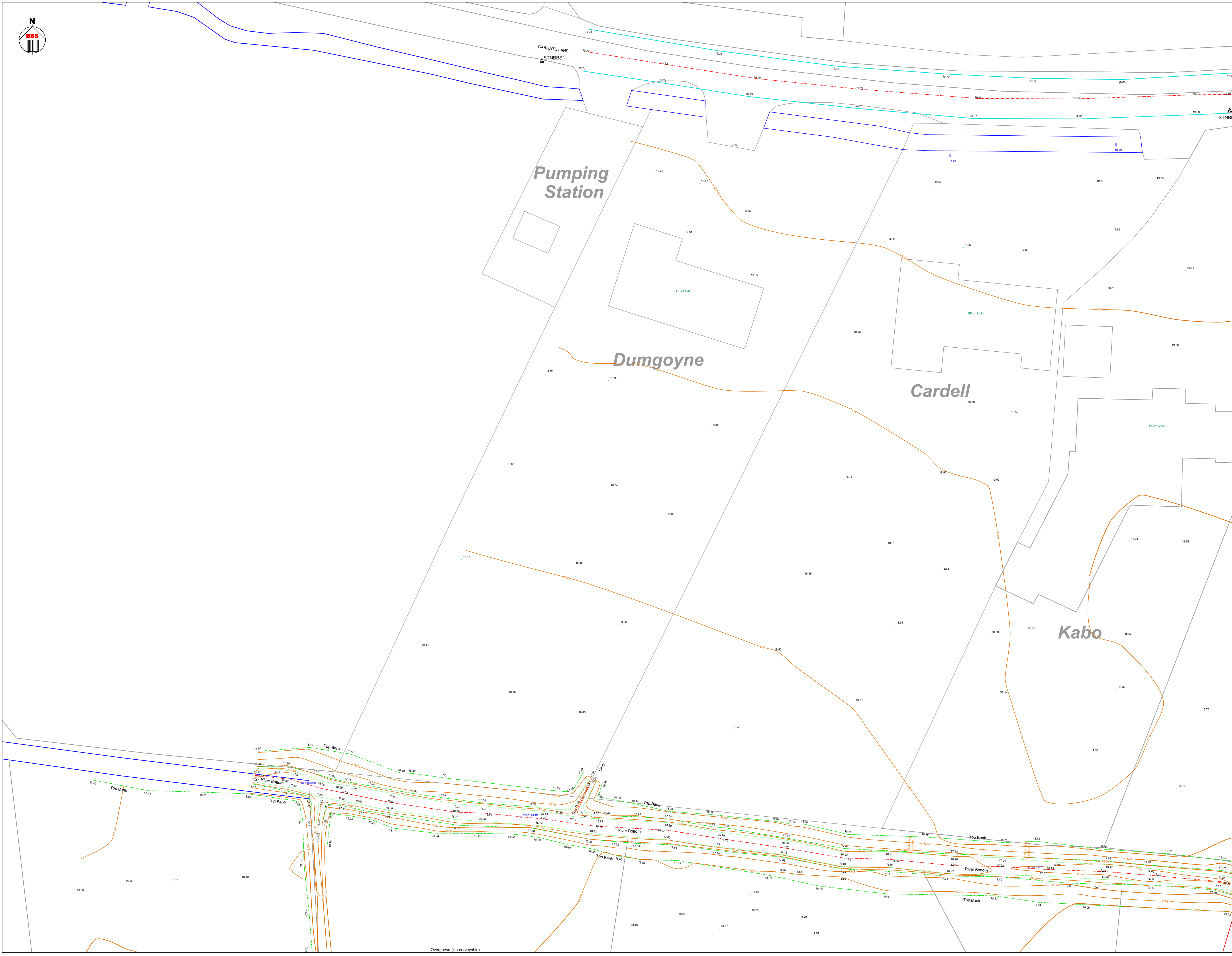
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CAD FILE:

SCALE:	DRAWN:	CHECKED:	DATE:
NTS	B.B.	B.B.	30.07.2012

DRAWING NUMBER:

BBS/RE/SAX1



DRAWING NUMBER:
BBS/RE/SAX2

NOTES:

AV	Air Valve	FH	Flow Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BB	Bore Hole	G	Gully Grate	SV	Stake Valve
BL	Li-Bulldoz	GV	Gas Valve	TAC	Traffic Parking
BOL	Bulldoz	HEDGE	Hedge	TB	Top Bank
BOL	Bulldoz	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Inset Level	TL	Traffic Light
BUSH	Bush	KO	Kiosk Outlet	TOK	Top Of Kiosk
BOX	Box (Utilities)	LP	Lamp Post	TP	Telephone Pole
CAB	Cabinet	MB	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Nearest Board	VENT	Vent
CONC	Concrete	PM	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHE	Drainage Channel	PO	Post	YL	Yellow Line
DR	Door	RE	Rodding Eye		
EEB	Electric MH Cover	RL	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Road	RS	Road Sign		
ET	EPH Transformer	SETTS	Setts		
FEED	Feeder Pole	SF	Safety Fence		
FCL	Chain Link				
FHD	Hoarding				
FHW	Home Fence				
FPL	Fallside				
FPR	Post & Rail				
FPW	Post & Wire				
RAL	Railings				

Control Station
Column
Floor to Ceiling Height
Floor to False Ceiling Height

Features

Fences
Walls
Hedges
Overhead Line

Services

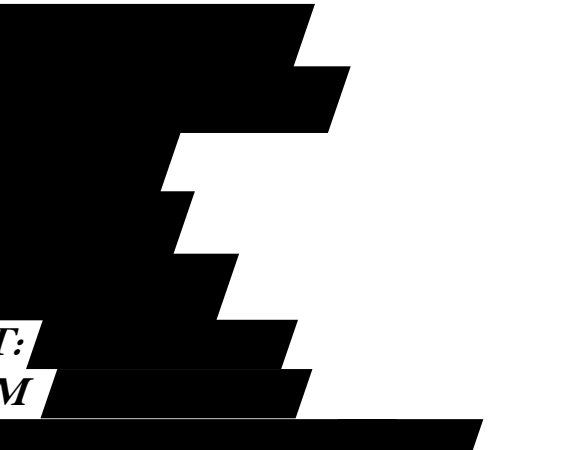
Foul Sewers
Storm Sewers

Trees

Deciduous
Coniferous

All dimensions are in metres unless otherwise stated.
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DATE:	REF:	REVISIONS



CLIENT:
[Redacted]

PROJECT:
Saxlingham Nethergate

TITLE:
**Existing Ground
Level Survey
Sheet 1 of 9**

SHEET SIZE:
A1

CAD FILE: [Redacted]

SCALE:	DRAWN:	CHECKED:	DATE:
1:500	B.B.	B.B.	30.07.2012

DRAWING NUMBER:
BBS/RE/SAX2

BBS/RE/SAX3

AV	Air Valve	FH	Fly Hydrant	SP	Sign Post
BS	Bottom Basin	FP	Footpath	STAY	STAY
BH	Bolt Hole	G	Grully Gully	SV	Slack Valve
BSL	Bolt	TA	Tar	TAC	Tarbit Pipe
BOL	Bolford	HEDGE	Hedge	TB	Ton
BUN	Bun	IC	Imperial Cover	TBOX	Talbot
BS	BS	IS	Inset Strip	TO	Ton
BUSH	Bush	KO	Kerb Outlet	TOOK	Ton Of Ground
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph
CAB	Cabinet	MH	Manhole	TRK	Track
CB	Cable	MP	Man Pit	TS	Ton
CL	Control Line	NB	Name Board	VENT	VENT
CONC	Concrete	PW	Partition Wall	W	Water
COOL	Cool	PS	Post Box	WL	White Line
COOL	Cool	PM	Parking Meter	W	Water
CDNL	Drainage Cannel	PO	Post	YL	Yellow Line
DR	Door	RE	Redding Eye		
EDB	Electricity Cover	RL	Ridge Line		
EP	Electric Pole	RP	Roller Post		
ER	Earth Road	RS	Road Sign		
ET	ET-Transformer	SETS	Gravette Sets		
GP	Gravel	SS	Gravel		

Features

Fences	FCB 1.6h	
Walls	Wall 1.2h	
Hedges	Hedge 1.3h	
Overhead Line	OHL	

Average root line shown.
Indicative position of cable

Trees

Trees are drawn to scale on the survey,



The diagram shows a circular cross-section of a tree. A diagonal line runs from the top-left to the bottom-right. The area above the line is labeled 'Deciduous' and the area below is labeled 'Coniferous'. The tree is drawn with green outlines and a brown center.

All dimensions are in metres unless otherwise stated.

Any critical dimensions and measurements should be based on the original digital data and checked by BB Surveys Ltd.

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DATE:	REF:	REVISIONS



T: [REDACTED]
M: [REDACTED]
e [REDACTED]

CLIENT: [REDACTED]

PROJECT: Saxlingham Netherga

TITLE:
Existing Ground
Level Survey
Sheet 2 of 9

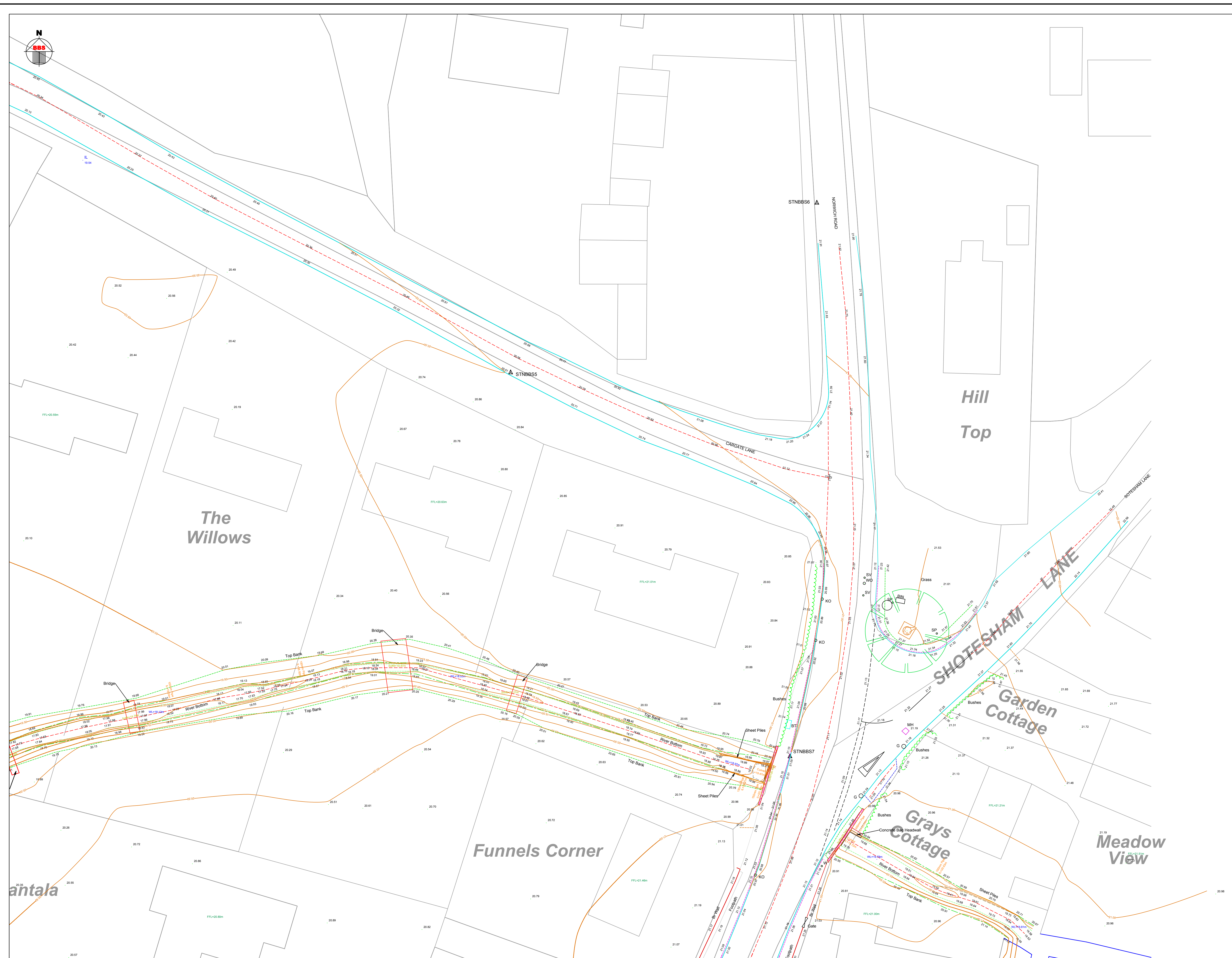
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BBS/RE/SAX3



DRAWING NUMBER:
BBS/RE/SAX4

NOTES:

AV	Air Valve	FW	Flow Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BR	Bore Hole	G	Gully Grate	SV	Stake Valve
BL	Li-Bulford	GV	Gas Valve	TAC	Traffic Parking
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kurb Outlet	TOK	Top Of Kurb
BOX	Box (Mileage)	LP	Lamp Post	TP	Telephone Pole
CAB	Cabinet	BN	Bench	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Neave Board	VENT	Vent
CONC	Concrete	PP	Partition Wall	WP	Wear Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCNL	Drainage Canal	PO	Post	YL	Yellow Line
DR	Door	RE	Rodding Eye		
EBB	Electric MH Cover	RL	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Road	RS	Road Sign		
ET	EPH Transformer	SETTS	Gravel Setts		
FEED	Feeder Pole	SF	Safety Fence		

FCL	Close Boarded Chain Link	CS	Control Station
FHD	Hoarding	COL	Column
FHW	Heavy Fence	FLH	Floor to Ceiling Height
FPL	Palisade	FLC	Floor to False Ceiling Height
FPR	Post & Rail		
FPW	Post & Wire		
RAL	Railings		

Features

Fences	1.5m
Walls	1.5m
Hedges	1.5m
Overhead Line	1.5m

Services

Foul Sewers	1.5m
Storm Sewers	1.5m

Trees

Trees are drawn to scale on the survey.

Deciduous

Coniferous

All dimensions are in metres unless otherwise stated.

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DATE:	REF:	REVISIONS

CLIENT:

PROJECT:

Saxlingham Nethergate

TITLE:

Existing Ground Level Survey Sheet 3 of 9

SHEET SIZE:

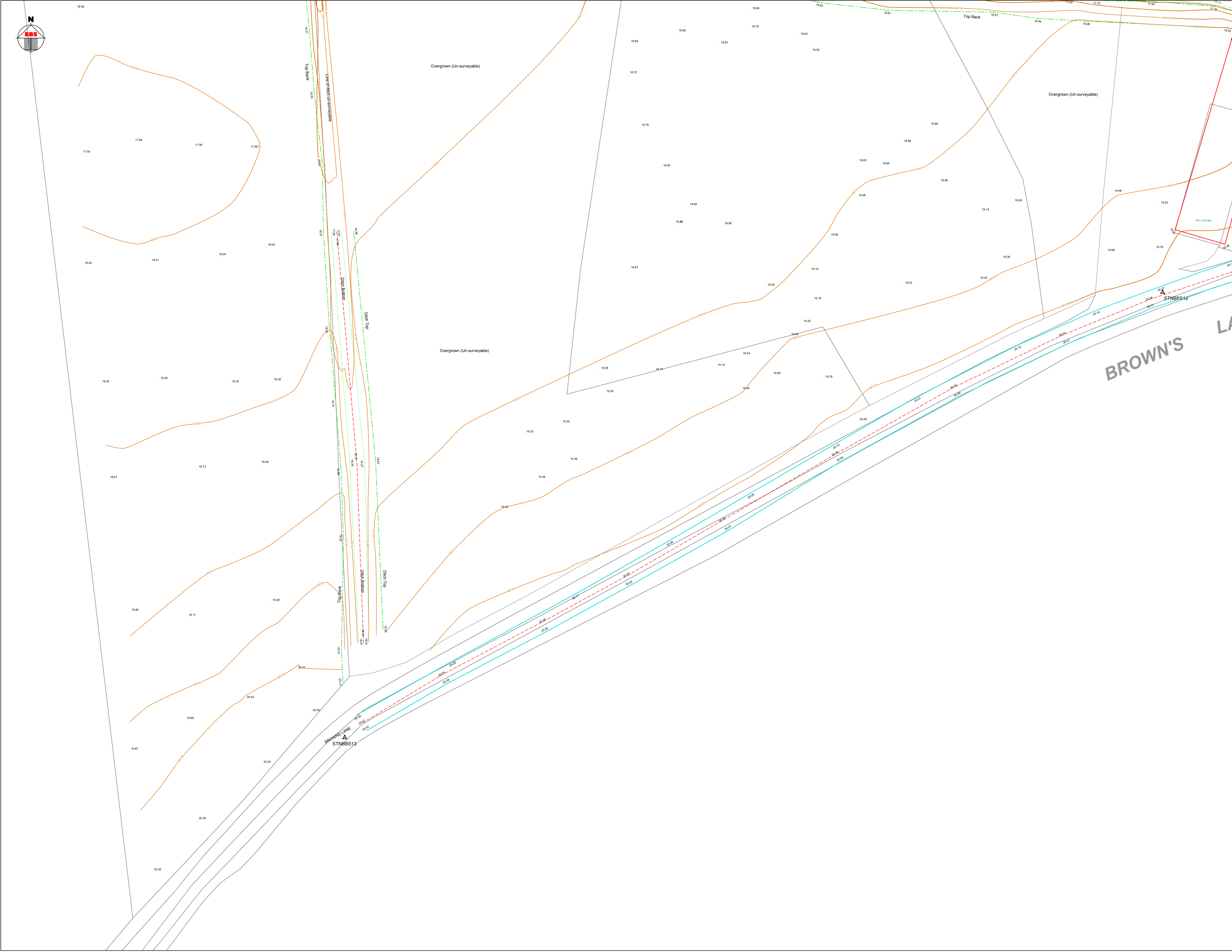
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CAD FILE:

SCALE:	DRAWN:	CHECKED:	DATE:
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DRAWING NUMBER:

BBS/RE/SAX4



DRAWING NUMBER:

BBS/RE/SAX5

NOTES:

AV	Air Valve	FH	Flow Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BB	Bore Hole	G	Gully Grate	SV	Stake Valve
BL	LiLi Bulb	GV	Gas Valve	TAC	Traffic Parking
BOL	Bulldoz	HEDGE	Hedge	TB	Top Bank
BN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kurb Outlet	TOK	Top Of Kurb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telephone Pole
CAB	Cabinet	BN	Bench	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Control Line	NB	Home Board	VENT	Vent
CONC	Concrete	PM	Partition Wall	WP	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCNK	Drainage Canal	PO	Post	YL	Yellow Line
DR	Door	RE	Rodding Eye		
EBB	Electric MH Cover	RL	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Road	RS	Road Sign		
ET	EPH Transformer	SETTS	Gravel Setts		
FED	Fender Pole	SF	Safety Fence		

FCL	Close Boarded	CS	Control Station
FCL	Chain Link	C	Column
FHD	Hoarding	FLH	Floor to Ceiling Height
FHW	Heavy Fence	FLH	Floor to Ceiling Height
FPL	Palisade	FLH	Floor to Ceiling Height
FPR	Post & Rail	FLH	Floor to Ceiling Height
FPW	Post & Wire	FLH	Floor to Ceiling Height
RAI	Railings	FLH	Floor to Ceiling Height

Features

Fences	FLH	FLH
Walls	FLH	FLH
Hedges	FLH	FLH
Overhead Line	FLH	FLH

Services

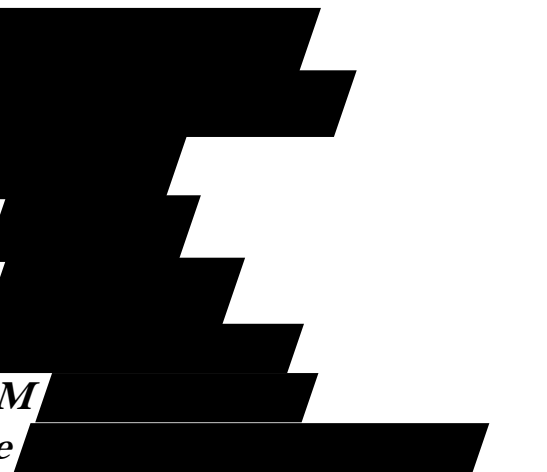
Foul Sewers	FLH	FLH
Storm Sewers	FLH	FLH

Trees

Trees are drawn to scale on the survey.	Deciduous
	Coniferous

All dimensions are in metres unless otherwise stated.
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DATE: REF: REVISIONS



CLIENT:

PROJECT:

Saxlingham Nethergate

TITLE:

Existing Ground
Level Survey
Sheet 4 of 9

SHEET SIZE:

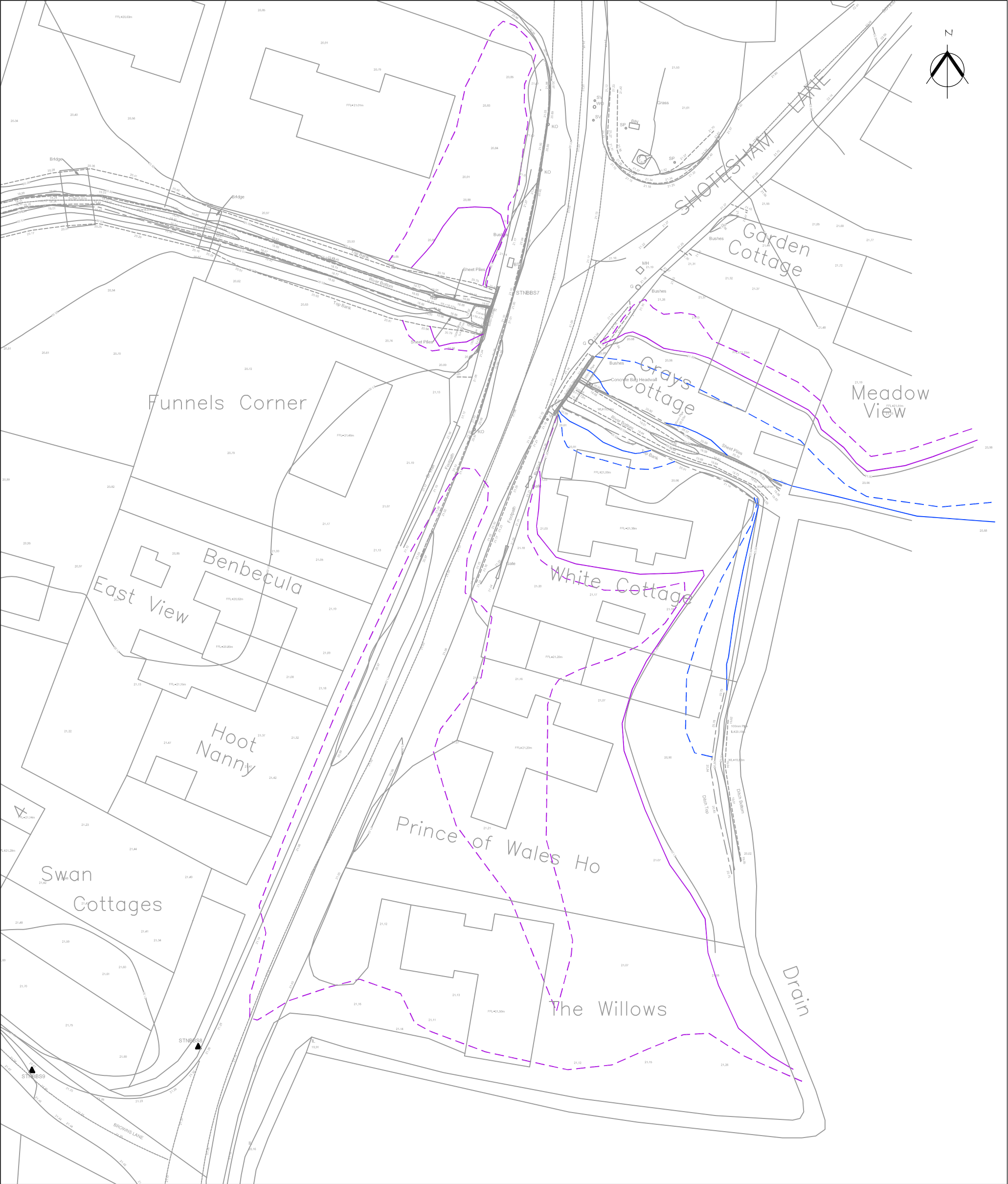
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CAD FILE:

SCALE:	DRAWN:	CHECKED:	DATE:
1:500	B.B.	B.B.	30.07.2012

DRAWING NUMBER:

BBS/RE/SAX5



LEGEND

- MODELLED 1 IN 100 YEAR FLOOD EXTENT
- MODELLED 1 IN 1000 YEAR FLOOD EXTENT
- MODELLED 1 IN 100 YEAR PLUS CLIMATE CHANGE FLOOD EXTENT
- MODELLED 1 IN 1000 YEAR PLUS CLIMATE CHANGE FLOOD EXTENT

NOTES

SITE SURVEY TAKEN FROM BB SURVEYS
DRAWING NUMBER BBS/RE/SAX1-7.
FLOOD EXTENTS PRODUCED FROM
INFOWORKS MODEL AUGUST 2012.

PROJECT
SAXLINGHAM NETHERGATE

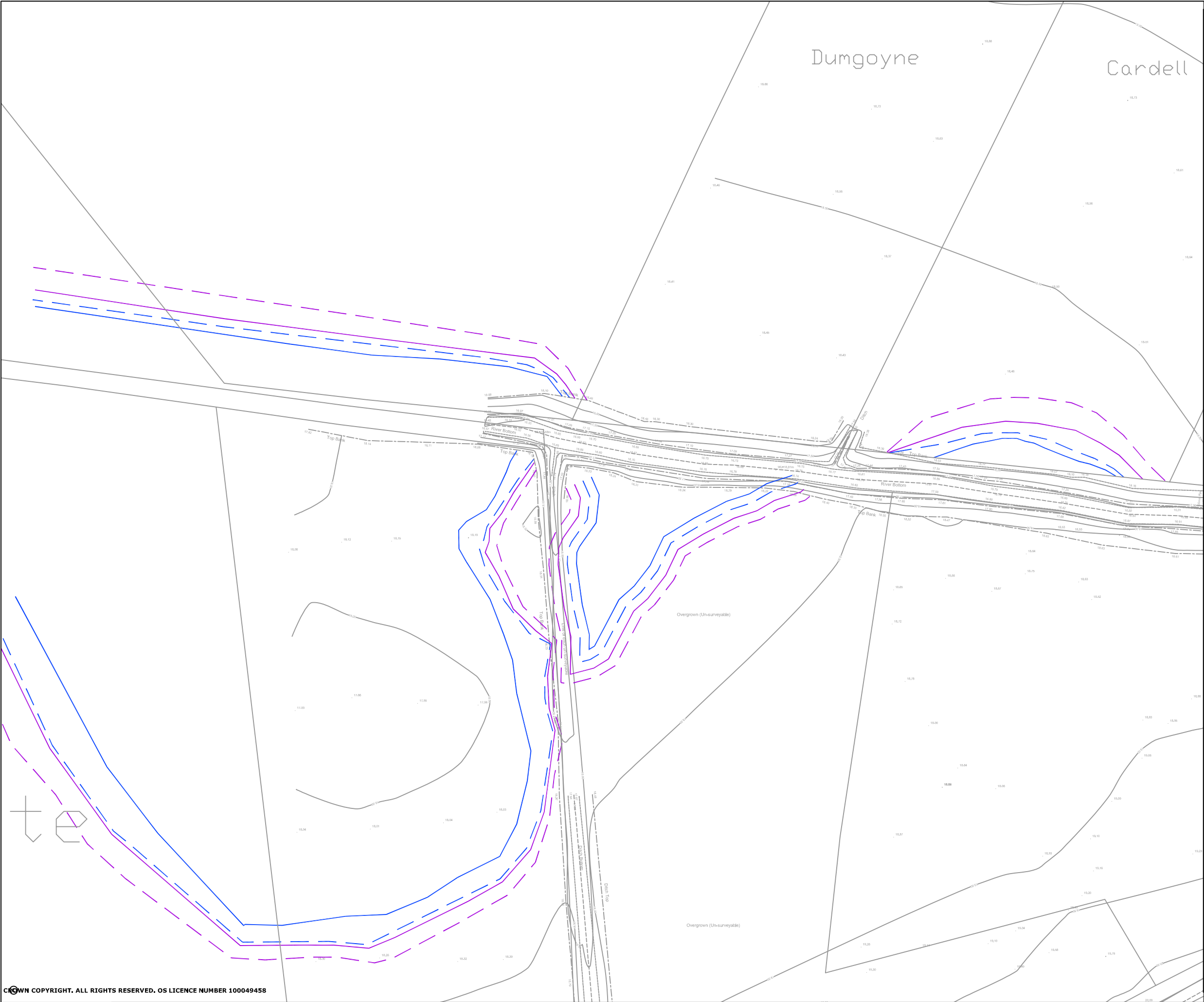
DRAWING TITLE
FLOOD EXTENTS SHEET 1 OF 2

CLIENT
SAXLINGHAM FLOOD ASSOCIATION



EVANS RIVERS AND COASTAL LIMITED
PO BOX 3494
NORWICH NORFOLK NR7 7PY
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F 01603 611923
E enquires@evansriversandcoastal.co.uk
W www.evansriversandcoastal.co.uk

DESIGNED RE	DRAWN RE	SCALE 1:400	DATE 08/08/2012
DRAWING NUMBER 1113/RE/01	REVISION	DRAWING STATUS FINAL	



LEGEND

- MODELLED 1 IN 100 YEAR FLOOD EXTENT
- MODELLED 1 IN 1000 YEAR FLOOD EXTENT
- MODELLED 1 IN 100 YEAR PLUS CLIMATE CHANGE FLOOD EXTENT
- MODELLED 1 IN 1000 YEAR PLUS CLIMATE CHANGE FLOOD EXTENT

NOTES

SITE SURVEY TAKEN FROM BB SURVEYS
DRAWING NUMBER BBS/RE/SAX1-7.

FLOOD EXTENTS PRODUCED FROM
INFOWORKS MODEL AUGUST 2012.

DESIGNED RE	DRAWN RE	SCALE 1:400	DATE 08/08/2012
DRAWING NUMBER 1113/RE/02	REVISION -	DRAWING STATUS FINAL	

PROJECT
SAXLINGHAM NETHERGATE

DRAWING TITLE
FLOOD EXTENTS SHEET 2 OF 2

CLIENT
SAXLINGHAM FLOOD ASSOCIATION



EVANS RIVERS AND COASTAL LIMITED
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W www.evansriversandcoastal.co.uk

