Rossi Long Consulting

Flood Risk Assessment and Surface Water Drainage Strategy on:

Proposed Development

Norwich Road

Dickleburgh

Norfolk

RLC Ref. 151492

March 2018

Prepared for

Chapel Farm Partnership

Revision Schedule

RLC Ref. 151492

March 2018

Rev	Date	Details	Reviewed by
00	28 March 2018	Flood Risk Assessment & Drainage Strategy	**Mike Lloyd** BEng(Hons), CEng, MIStructE Director

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Table of Contents

1 Introduction and Client's Brief

1.1 We were instructed by La Ronde Wright Ltd, on behalf of Chapel Farm Partnership, to undertake a Flood Risk Assessment and Surface Water Drainage Strategy for a proposed development on land at Norwich Road, Dickleburgh.

1.2 The proposal for the site is for a development of up to 14 residential dwellings, 8 retirement units and a community facility.

1.3 When determining planning applications, the Local Planning Authority should ensure flood risk is not increased as a result of the development. A site-specific Flood Risk Assessment is required for proposals of one hectare or greater in Flood Zone 1 and all proposals for new development in Flood Zones 2 and 3.

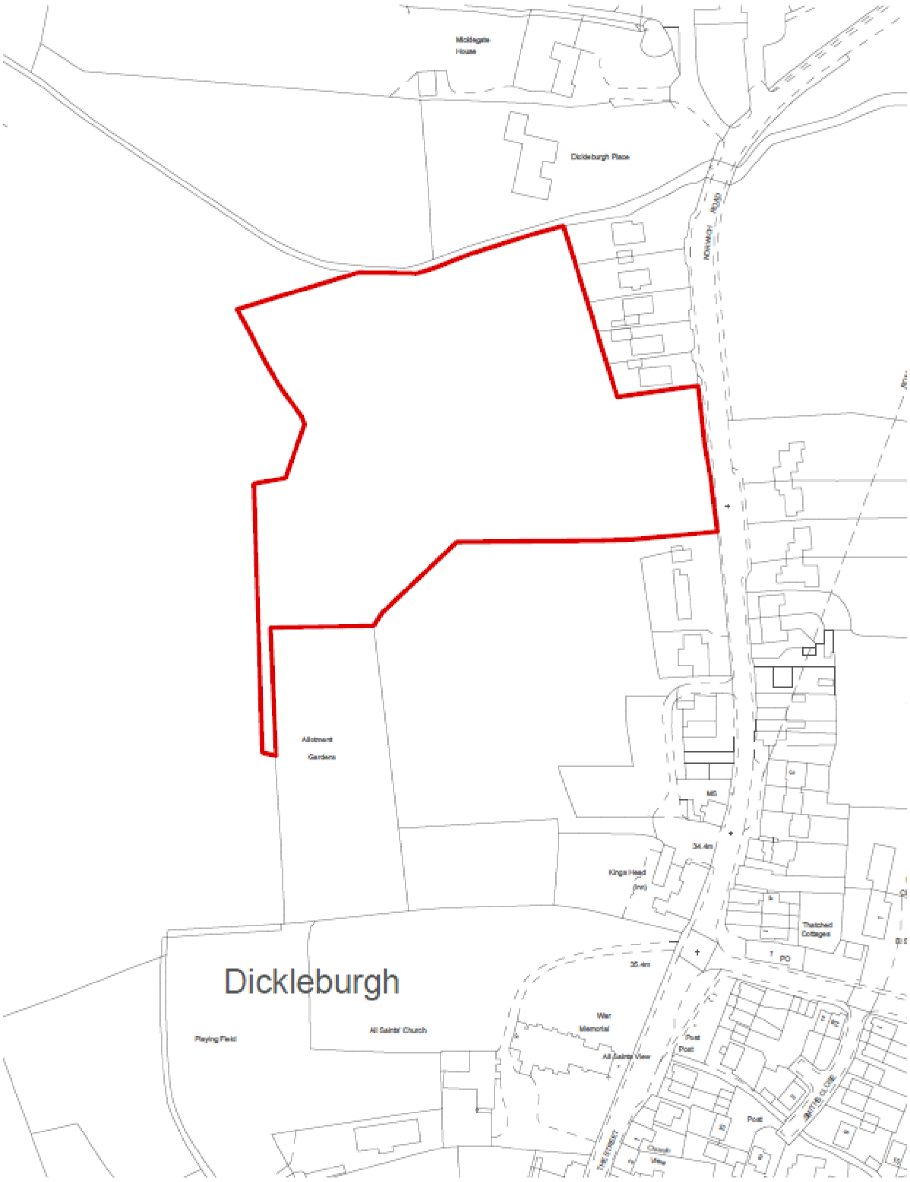
For major development greater than 0.5 hectares, the Lead Local Flood Authority is a statutory consultee and will comment on surface water flood risk and surface water drainage proposals.

1.4 An indicative layout is shown on the drawing included at Appendix A.

1.5 This report is compiled with the benefit of our findings from local research, topographical survey and walk-over survey, and with reference to data from the Environment Agency and river modelling by Evans Rivers & Coastal Ltd.

2 Site Description

2.1 The site is located to the west of Norwich Road, Dickleburgh using the existing vehicular access taken from Norwich Road. The site area is 1.6 hectares. A location plan is shown below:



Location Plan

2.2 The site is agricultural land with boundaries comprising a mixture of hedgerows and trees. The site is bounded by residential housing to the south and east. The site boundary extends to the Dickleburgh Stream to the north and is bounded by a land drainage stream on its western boundary.

2.3 Ground levels on the site are falling towards the north boundary. On the south boundary ground levels are at about 31.2m AOD, falling to 29.0m along the north boundary at Dickleburgh Stream. A site survey drawing is included in Appendix B.

2.4 The site is immediately north of the recent residential development by Saffron Housing Trust.

3 Planning Policy and Flood Risk

3.1 The National Planning Policy Framework (NPPF) was published by the Department for Communities and Local Government in March 2012. The NPPF requires that flood risk is taken into account in the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. The aim should be to steer new development towards Flood Zone 1.

3.2 Flood Zone 1 is a low probability zone that comprises land assessed as having a less than 1 in 1000 annual probability of river flooding in any year.

Flood Zone 2 is a medium probability flood zone that comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding in any year.

Flood Zone 3 is a high probability flood zone that comprises land assessed as having a 1 in 100 or greater annual probability of river flooding in any year.

3.3 From Environment Agency flood zone mapping it is confirmed that the majority of the site is situated in Flood Zone 1. The area of land close to the northern boundary at Dickleburgh Stream is situated in Flood Zone 3.

3.4 There are no restrictions to the type of development permitted within Flood Zone 1.

3.5 The NPPF permits certain types of developments within the other two higher probability zones, Zone 2 (medium) and Zone 3 (high), subject to the type of development and mitigation measures being put in place.

The NPPF “Flood Risk Vulnerability Classification” sets out these development types and categorises them as follows:

a) Essential Infrastructure

b) High Vulnerability

c) More Vulnerable

d) Less Vulnerable

e) Water Compatible Development

The NPPF defines “Buildings used for dwelling houses” as ‘more vulnerable’ development. Community Centre usage is not specifically defined but is also likely to be considered as ‘more vulnerable’ development.

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	x	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	x	x	x

Key: ✓ Development is appropriate x Development should not be permitted

'More vulnerable' development is appropriate in Flood Zone 1 and the Exception Test is not required.

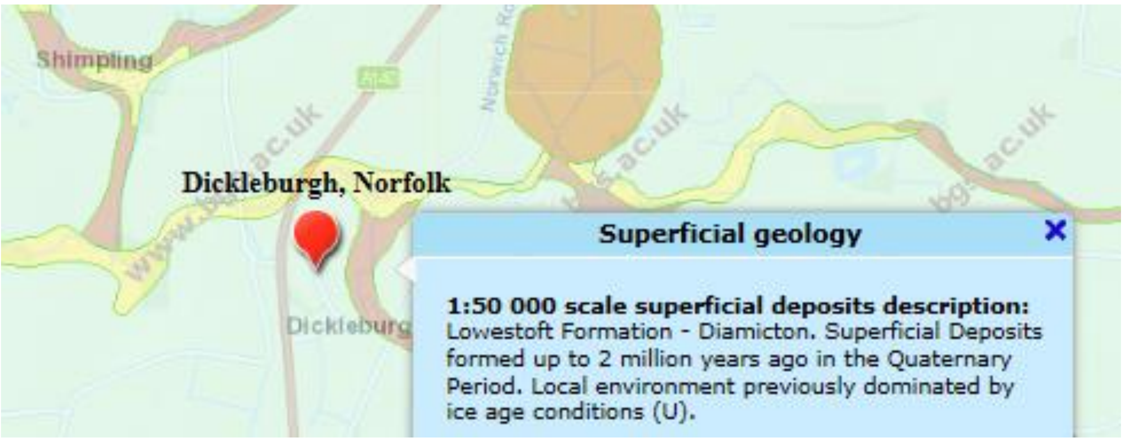
Properly prepared assessments of flood risk will inform the decision-making process at all stages of development planning. A Strategic Flood Risk Assessment is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that changes or development in the area will have on flood risk. It may also identify, particularly at more local levels, how to manage those changes to ensure that flood risk is not increased. A site-specific Flood Risk Assessment is carried out by, or on behalf of, a developer to assess the risk to a development site and demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others will be managed now, and taking climate change into account.

3.6 For site-specific Flood Risk Assessments the main study requirement is to identify the flood zone and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions. A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

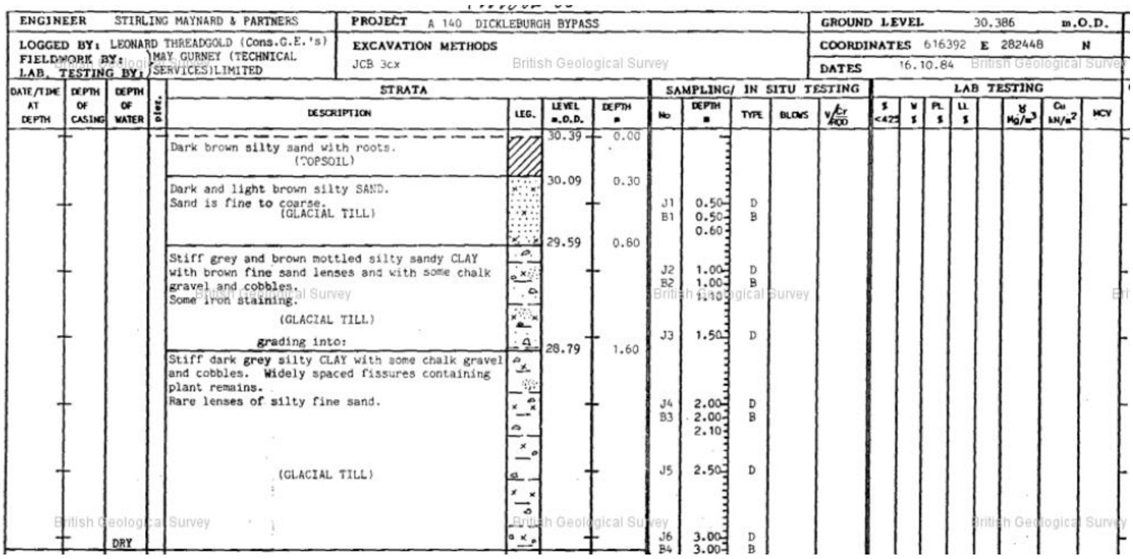
3.7 For sites in Flood Zone 1, the Flood Risk Assessment is principally required to consider the management of surface water run-off together with flood risk from sources other than rivers and the sea. Surface water arising from a developed site should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

4 Ground Conditions

4.1 British Geological Survey (BGS) mapping shows that the site is situated upon superficial deposits of Lowestoft Formation – Diamicton (Glacial Till). The underlying bedrock is Lewes Chalk and other Chalk Formations:



4.2 Although no on-site site investigation has been completed, BGS records indicate that the superficial deposits are cohesive soils described as 'Glacial Till – Boulder Clay'. BGS records include a series of boreholes for the nearby Dickleburgh Bypass. An extract of one of the boreholes is shown below, confirming shallow soils comprising silty, sandy CLAY (Glacial Till):



ENGINEER: STIRLING MAYNARD & PARTNERS
PROJECT: A 140 DICKLEBURGH BYPASS
GROUND LEVEL: 30.386 m.O.D.
LOGGED BY: LEONARD THREADGOLD (Cons.G.E.'s)
FIELDWORK BY: / LAB. TESTING BY: MAY GURNEY (TECHNICAL SERVICES) LIMITED
EXCAVATION METHODS: JCB 3cx
COORDINATES: 616392 E 282448 N
DATES: 16.10.84

Strata: Description	Level m.O.D.	Depth m
	30.39	0.00
Dark brown silty sand with roots. (TOPSOIL)	30.09	0.30
Dark and light brown silty SAND. Sand is fine to coarse. (GLACIAL TILL)	29.59	0.60
Stiff grey and brown mottled silty sandy CLAY with brown fine sand lenses and with some chalk gravel and cobbles. Some iron staining. (GLACIAL TILL) grading into:	28.79	1.60
Stiff dark grey silty CLAY with some chalk gravel and cobbles. Widely spaced fissures containing plant remains. Rare lenses of silty fine sand. (GLACIAL TILL)		

Sampling No	Depth m	Type
J1	0.50	D
B1	0.50–0.60	B
J2	1.00	D
B2	1.00–1.10	B
J3	1.50	D
J4	2.00	D
B3	2.00–2.10	B
J5	2.50	D
J6	3.00	D
B4	3.00	B

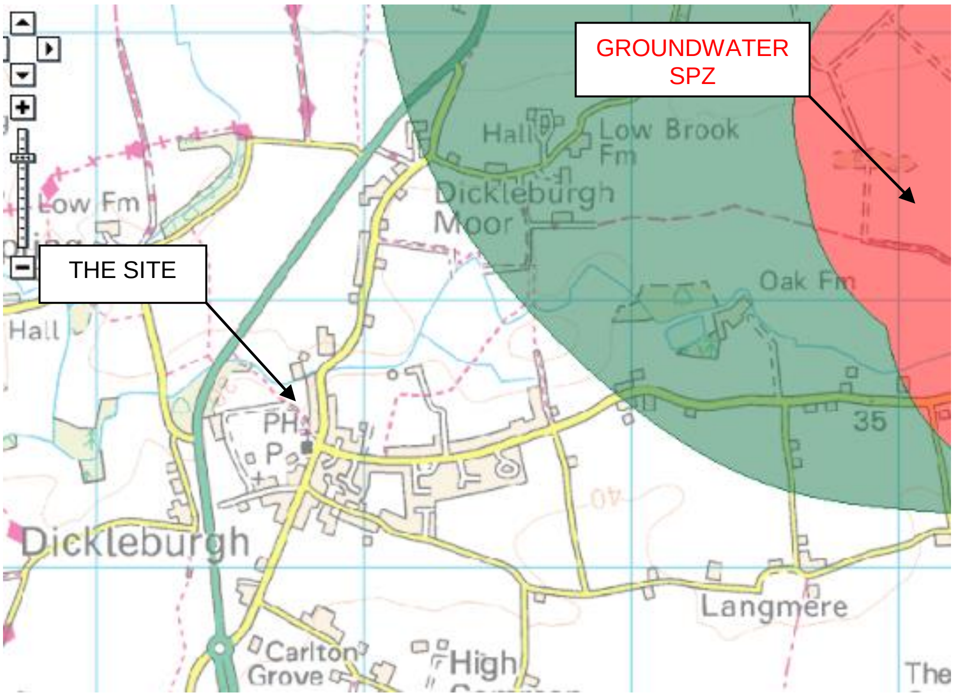
Depth of water: DRY

4.3 BRE365 infiltration tests have not been completed in the Glacial Till but, by reference to Table 25.1 of CIRIA C753, The SuDS Manual 2015, for 'clay' and 'till' typical infiltration rates are given as < 3.0 x 10^{-8} m/sec. This represents very poor infiltration media:

TABLE 25.1 Typical infiltration coefficients based on soil texture (after Bettess, 1996)

Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)
Good infiltration media		
• gravel	Sandy GRAVEL	$3 \times 10^{-4} – 3 \times 10^{-2}$
• sand	Slightly silty slightly clayey SAND	$1 \times 10^{-5} – 5 \times 10^{-5}$
• loamy sand	Silty slightly clayey SAND	$1 \times 10^{-4} – 3 \times 10^{-5}$
• sandy loam	Silty clayey SAND	$1 \times 10^{-7} – 1 \times 10^{-5}$
Poor infiltration media		
• loam	Very silty clayey SAND	$1 \times 10^{-7} – 5 \times 10^{-6}$
• silt loam	Very sandy clayey SILT	$1 \times 10^{-7} – 1 \times 10^{-5}$
• chalk (structureless)	N/A	$3 \times 10^{-8} – 3 \times 10^{-6}$
• sandy clay loam	Very clayey silty SAND	$3 \times 10^{-10} – 3 \times 10^{-7}$
Very poor infiltration media	–	
• silty clay loam	–	$1 \times 10^{-8} – 1 \times 10^{-6}$
• clay	Can be any texture of soil described above	$< 3 \times 10^{-8}$
• till		$3 \times 10^{-9} – 3 \times 10^{-6}$
Other		
• rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} – 3 \times 10^{-5}$

4.4 The Environment Agency website shows the site is not within a Groundwater Source Protection Zone (see below):

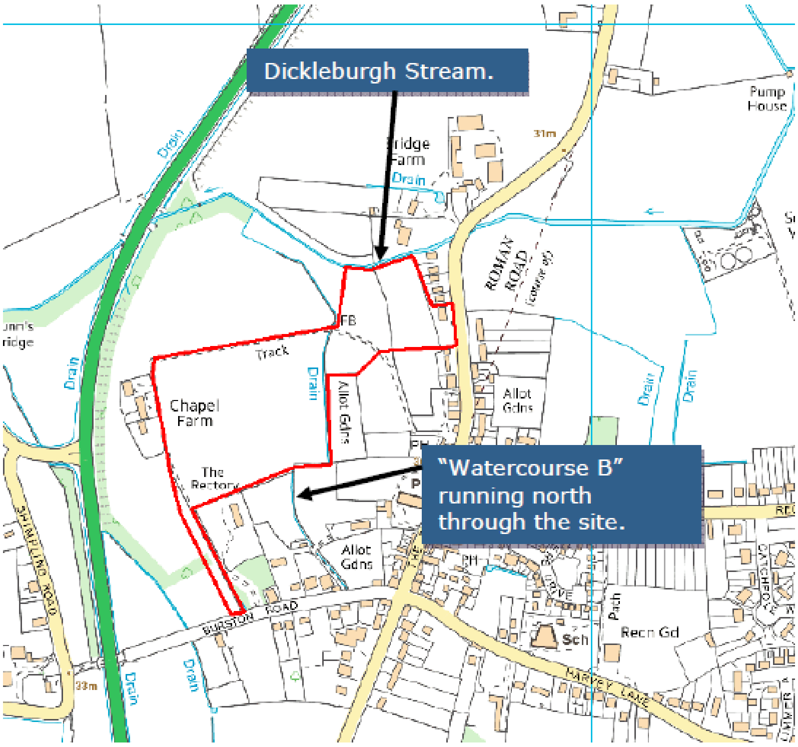


Extract of Groundwater Map

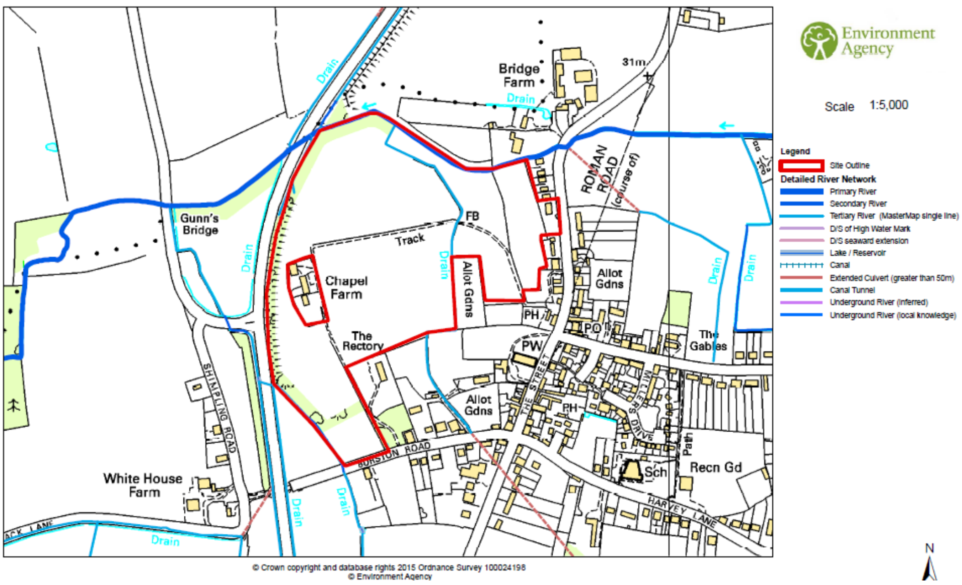
4.5 The superficial deposits aquifer designation is Secondary (undifferentiated). The bedrock aquifer designation is ‘principal’.

5 Existing Drainage

5.1 We are not aware of any formal provision of land drainage serving the site. For surface water run-off, the fall of land in the area is to the north where the Dickleburgh Stream is located on the northern site boundary. A shallow ditch runs through the centre of the site, with another ditch located on the western site boundary flowing north and converging with the Dickleburgh Stream (see below):



5.2 The Dickleburgh Stream is a Primary River not a designated Main River (see below):



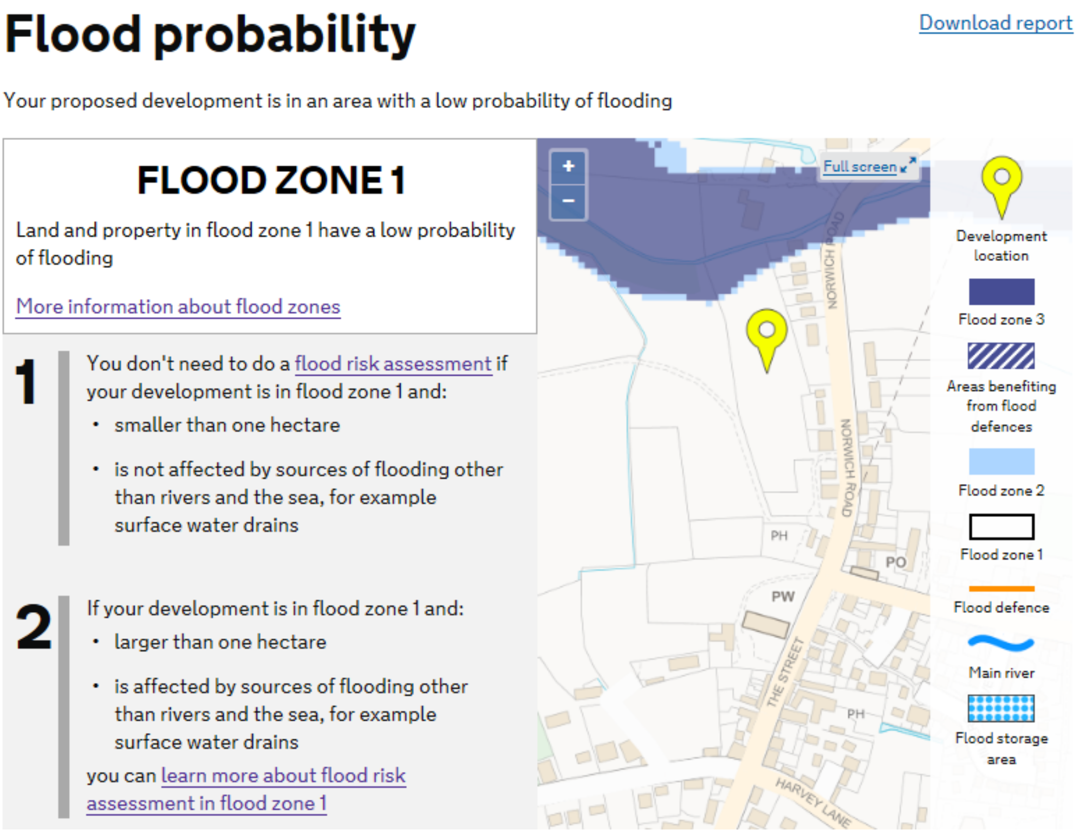
5.3 A plan showing the location of public sewers is shown on the Anglian Water drawing included in Appendix C, with an extract shown below:

Extract of Anglian Water Plan

The above plan shows foul sewers only in the vicinity of the development. There are no public surface water sewers available for the development.

6 Flood Risk Sources

6.1 River Flooding: The site is situated in Flood Zone 1, as shown on Environment Agency flood zone mapping. Flood Zone 1 is a low probability flood zone and comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (< 0.1%).



The northern area of the site adjacent to Dickleburgh Stream is situated in Flood Zone 3. The development has been sequentially sited to be within Flood Zone 1 with Flood Zone 3 land retained as open space.

6.2 Due to the proximity of the Dickleburgh Stream, an enquiry was made to the Environment Agency for modelled river flood levels. Although it is proposed to place all housing in the area of the site at the lowest risk of fluvial flooding (i.e. Flood Zone 1), information was required to assess the effects of climate change on flood levels. The Environment Agency advised that the Dickleburgh Stream has not been modelled and flood levels were not available.

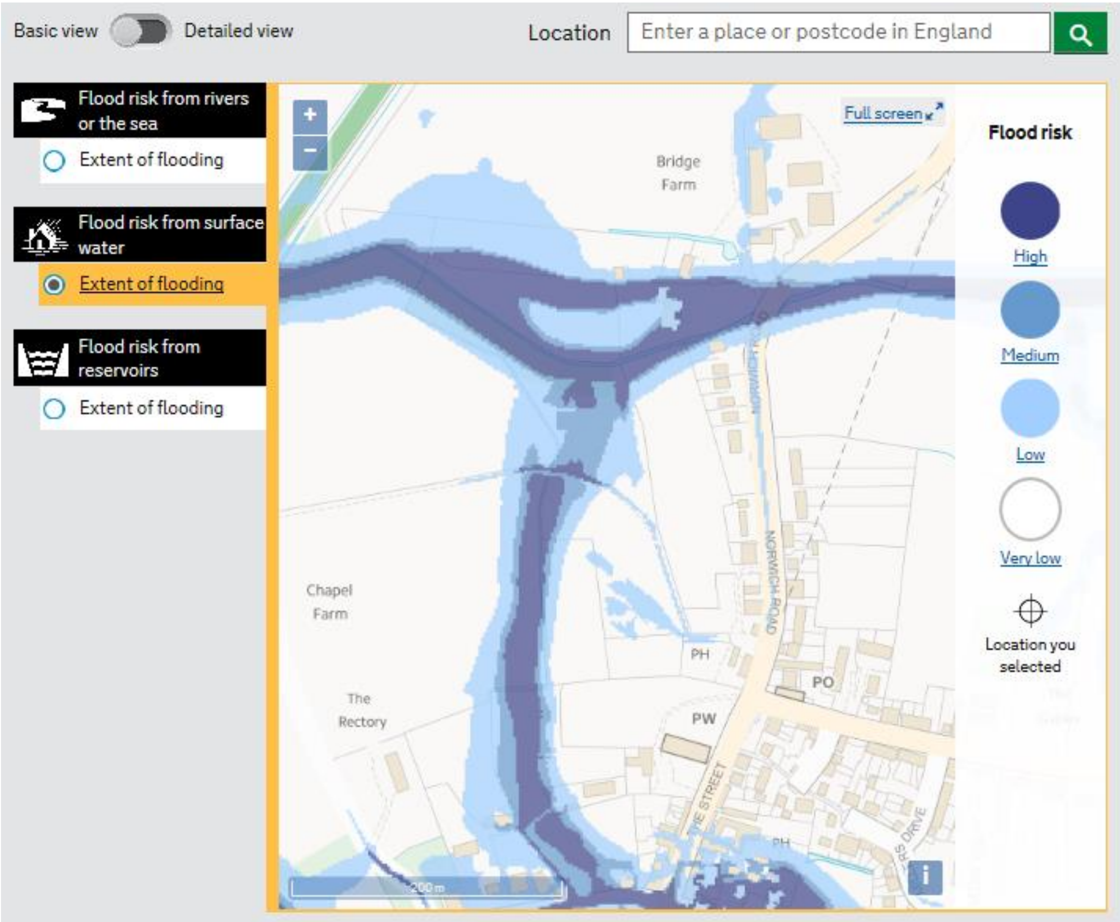
In order to assess the climate change effect on flood levels, Evans Rivers & Coastal was commissioned to undertake a hydraulic analysis to determine the extent of the future NPPF Flood Zones across the site. The model included the stream that runs north along the west boundary. The results show that during all modelled return period events, up to and including the worst case climate change 1 in 1000 year event, there is flooding across the northern part of the site. The results show that the main flood risk to the site is from the Dickleburgh Stream and, although there is flooding from Watercourse B around its confluence with the Dickleburgh Stream, there is no flooding across the site directly from Watercourse B. A copy of the Evans Rivers & Coastal report is included in Appendix D.

The extent of 1 in 1000 year flooding with an allowance for future climate change is illustrated on the site plan extract below:

The drawing shows that all housing is located in Flood Zone 1, both now and when future climate change allowances are considered.

6.3 Groundwater flooding occurs when water levels in the ground rise above surface elevations. BGS records for a nearby borehole confirmed a groundwater level at 6.4m below ground level (m bgl). The ground conditions and topography are such that the risk of flooding from groundwater is 'low'.

6.4 Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter drainage systems but lies on or flows over the ground instead. The Environment Agency publishes mapping showing the risk of flooding from surface water. An extract of this mapping is shown below and confirms that the site is generally at 'very low' risk from surface water flooding. 'Very low' risk means that each year this area has a chance of flooding of less than 0.1% (< 1 in 1000):



An area around Watercourse B shows out of bank 'low' and 'medium' risk flooding; however, the Evans Rivers & Coastal report has modelled the flows to this watercourse and concluded that there is no flooding of the site up to the 1 in 1000 year plus climate change event.

The risk of flooding from surface water is 'low'.

6.5 From our review of Ordnance Survey mapping of the site and the surrounding area, our assessment is that there are no significant flood risks to the site from reservoirs, canals or other artificial sources. This is confirmed by reference to Environment Agency online mapping.

6.6 As far as we have been able to establish, there has been no history of flooding in the area of the site. All sources of flooding listed in paragraph 2 of the Technical Guidance to the NPPF have been considered. The site is at 'low' risk of flooding from all sources.

7 Surface Water Drainage

7.1 The Building Regulations Approved Document H3 requires that rainwater from buildings and paved areas shall discharge to one of the following, listed in order of priority:

a) An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,

b) A watercourse; or where that is not reasonably practicable,

c) A sewer.

The Building Regulations therefore adopt a design philosophy that accords with sustainable drainage systems (SuDS).

7.2 The National Planning Policy also requires that, for planning applications relating to major development (development of 10 dwellings or more) or equivalent non-residential or mixed development, sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate. Sustainable drainage is an approach to managing surface water run-off which seeks to mimic natural drainage systems and retain water on or near the site, as opposed to traditional drainage approaches which involve piping water off-site as quickly as possible. SuDS involves a range of techniques including soakaways, infiltration trenches, permeable pavements, grassed swales, ponds and wetlands. SuDS offers significant advantages over conventional pipe drainage systems in reducing flood risk by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge and improving water quality and amenity.

Planning Practice Guidance considers what sort of sustainable drainage system should be considered. Generally, the aim should be to discharge surface run-off as high up the following hierarchy of drainage options as reasonably practicable:

1) Into the ground (infiltration);

2) To a surface water body;

3) To a surface water sewer, highway drain or another drainage system;

4) To a combined sewer.

Particular types of sustainable drainage systems may not be practicable in all locations.

This hierarchy follows the same order of priority of Approved Document H3 of the Building Regulations.

7.3 Norfolk County Council (NCC) is the Lead Local Flood Authority (LLFA) for this area and the Local Planning Authority (LPA) should consult with the LLFA on surface water drainage. CIRIA has published guidance on the use of sustainable drainage systems, which is an approach to managing surface water run-off which seeks to mimic natural drainage systems and retain water on or near the site, as opposed to traditional drainage approaches which involve piping water off-site as quickly as possible. SuDS involves a range of techniques including soakaways, infiltration trenches, permeable pavements, grassed swales, ponds and wetlands. SuDS offers significant advantages over conventional pipe drainage systems in reducing flood risk by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge and improving water quality and amenity.

7.4 BGS mapping and nearby boreholes have confirmed predominantly fine grained cohesive soils in this area. From CIRIA guidance a soil infiltration rate of less than 3.0×10^{-8} m/sec can be expected. This confirms that a reliance on infiltration drainage would not be suitable for this site.

7.5 The site naturally drains to the local watercourse at 'greenfield' run-off rates that are calculated as follows:

Return Period	Pre-development 'Greenfield' Run-off Rate
1 year	4.0 l/sec
30 years	10.9 l/sec
100 years	16.2 l/sec

QBAR = 4.5 l/sec

The total development area of 1.6ha comprises approximately 0.152ha of roads and 0.279ha of roofs / hardstanding. The total impermeable area is 0.4174ha, which represents an impermeable area of run-off of 38%. Equivalent 'greenfield' run-off rates for the proposed impermeable area are as follows:

Return Period	Impermeable Area 'Greenfield' Run-off Rate
1 year	1.0 l/sec
30 years	2.9 l/sec
100 years	4.2 l/sec

QBAR = 1.2 l/sec

7.6 It is a requirement of the NPPF that the development does not increase flood risk elsewhere. Regulators will normally require that, for the range of annual flow rate probabilities up to and including the 1% annual probability (1 in 100 year event), the developed rate of run-off should be no greater than the undeveloped rate of run-off for the same event. Exceptions only apply where it is not practical to achieve this due to the size of the hydraulic control unit.

7.7 Non-statutory technical standards for sustainable drainage require that for:

(i) Peak Flow Control
S2 *For 'greenfield' developments, the peak run-off rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak 'greenfield' run-off rate for the same event.*

(ii) Volume Control
S4 *Where reasonably practicable, for 'greenfield' development, the run-off volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the 'greenfield' run-off volume for the same event.*
S6 *Where it is not reasonably practicable to constrain the volume of run-off to any drain, sewer or surface water body in accordance with **S4** above, the run-off volume must be discharged at a rate that does not adversely affect flood risk.*

7.8 The pre and post development run-off volumes are calculated as follows:

Return Period	Pre-development Run-off Volume	Post Development Run-off Volume
1 year	91. 482 m^3	140.370 m^3
30 years	215.166 m^3	319.860 m^3
100 years	299.457 m^3	408.870 m^3

7.9 It would not be reasonably practicable to constrain the volume of run-off to the 'greenfield' run-off volume and, in these circumstances, any additional volume should be stored and released at a low rate that will not increase downstream flood risk. To achieve this, BS8582:2013 requires that all of the run-off from the site should be discharged at a rate of 2.0 l/sec per hectare or QBAR (whichever is the greater) for all storms up to and including the 1 in 100 year plus climate change event.

7.10 Accordingly, the following surface water drainage strategy is proposed for the site:

- Private driveways will be constructed using permeable paving. This will be a Type B system that allows for any partial infiltration to occur into the subsoil. A series of perforated pipes at formation level will convey the proportion of the rainfall that exceeds the infiltration capacity of the subsoil to the receiving drainage system;

- Roof water run-off will be directed to the receiving drainage system. Wherever possible this will be via the permeable driveways. This will delay any discharge to the receiving drainage system and provide water quality benefits. Rainwater butts will be provided to rear elevations of the dwellings;

- Adoptable estate roads will drain to the receiving drainage system via trapped road gullies. During the detailed design stage, alternative SuDS techniques will be considered for estate road drainage to reduce the volume of storage and to provide pollution treatment stages. Options include:

  - Filter strips;
  - Swales;
  - Rain gardens.

  All to comply with Highway Authority adoption requirements.

- The receiving drainage system will discharge to the off-site watercourse via a detention basin and flow control device. The detention basin will store all peak storms up to and including the 1 in 100 year event +40% allowance for climate change. A maximum discharge rate of 1.2 l/sec (QBAR) is proposed. The detention basin will provide water quality benefits by allowing settlement and delaying the rate of discharge to the wider are network.

7.11 Surface water calculations are included in Appendix F and a drainage strategy drawing is included in Appendix G.

7.12 Permeable driveways will be maintained by individual householders / occupiers. The receiving drainage system and detention basin will be offered for adoption by Anglian Water. A management and maintenance plan will be prepared in conjunction with the detailed designs. A preliminary copy is included in Appendix H.

8 Conclusions and Recommendations

8.1 The proposal for the site is for a development of 14 residential dwellings, 8 retirement units and a community facility.

8.2 From examination of site levels and by reference to Environment Agency flood zone mapping, it is demonstrated that the development area of the site is situated in Flood Zone 1. This is a low probability flood zone with a less than 1 in 1000 annual probability of flooding. Hydraulic modelling of the Dickleburgh Stream and the local watercourse has defined potential areas at risk of flooding and the dwellings have been sequentially positioned on the site to be located in Flood Zone 1 for the lifetime of the development.

8.3 The site is at 'low' risk of flooding from all sources.

8.4 The ground conditions are not suitable for infiltration drainage due to clay soils and a poor ground infiltration rate. A sustainable approach is proposed for surface water drainage incorporating source control using permeable paving and attenuation storage of peak flows and discharge to the local watercourse at a maximum controlled rate of 1.2 l/sec for a 1 in 100 year storm, including an allowance for climate change. Additional SuDS features will be considered at the detailed design stage that will provide water quality benefits to the receiving watercourse.

9 Appendices

Appendix A – Indicative Layout

N

KEY

- Application boundary
- 1-bedroom house
- 2-bedroom house
- 3-bedroom house
- 4-bedroom house
- 1-bedroom flat

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

Rev	Init	Date	Revision
F	MM	12.03.18	Updated to client requirements
E	MM	08.03.18	Updated to client requirements
D	RB	09.05.17	Updated to client requirements
C	RB	05.05.17	Updated to client requirements
B	RB	27.04.17	Updated to client requirements
A	RB	26.04.17	Updated to client requirements

0m 10 20 30

Scale 1:500

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Client
La Ronde Wright

Project
Dickleburgh - New Housing Masterplan

Title
1700 Site
Application Site Plan

Scale @ A1	Date	Drawn
1:500	30.08.16	MM

15229-1721 | F

Appendix B – Site Survey Drawing


Overgrown Bushes / Trees
Field
Ditch Top
Ditch Bottom
Foot Bridge
Fence P/R
Bushes / Trees

Appendix C – Anglian Water Drawing

(c) Crown copyright and database rights 2018 Ordnance Survey 100022432 | Date: 22/03/18 | Scale: 1:1250 | Map Centre: 616502,282421 | Data updated: 03/02/18 | Our Ref: 258110 - 1 | Wastewater Plan A2

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

robert.chapman@digdat.co.uk

257666

love every drop
anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
6201	F	32.79	32.1	0.69
6202	F	32.34	31.57	0.77
7201	F	33.47	31.6	1.87
7202	F	32.86	31.01	1.85
7301	F	32.83	30.94	1.89
7302	F	32.45	31.21	1.24
7303	F	34.37	30.17	4.2
8201	F	32.98	31.69	1.29
8202	F	32.79	31.35	1.44
8401	F	35.34	29.59	5.75
8402	F	-	-	-
8404	F	35.7	31.98	3.72
8405	F	35.19	31.74	3.45
8406	F	35.38	31.88	3.5
8501	F	33.97	29.31	4.66
8502	F	33.38	29.1	4.28
8601	F	31.15	28.65	2.5

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix D – Evans Rivers & Coastal Report

PROPOSED RESIDENTIAL DEVELOPMENT OFF NORWICH ROAD, DICKLEBURGH, NORFOLK

FLOOD MODELLING ASSESSMENT

JULY 2016

REPORT REF: 1650/RE/07-16/01

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CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Chapel Farm Partnership to carry out a Flood Modelling Assessment for a proposed residential development off Norwich Road, Dickleburgh, 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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1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Chapel Farm Partnership to carry out a Flood Modelling Assessment for a proposed residential development off Norwich Road, Dickleburgh, Norfolk.

1.1.2 Specifically, this assessment intends to:

a) Estimate the fluvial flood flows within the adjacent watercourse using appropriate and up-to-date Flood Estimation Handbook methods for a range of return period events and updated climate change allowances.

b) Develop an InfoWorks flood model of the watercourse to determine the likely extent, depth and velocity of the floodwater.

c) Carry out a sensitivity analysis;

d) Determine the extents of the NPPF Flood Zones across the site together with depths of floodwater and hazard;

e) Report findings.

1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) 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.
- National Planning Practice Guidance – Flood Risk and Coastal Change.
- UK Government's climate change allowances guidance dated February 2016.

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 NEXTMAP data at 5m resolution covering the site and surrounding area.
- Topographical survey of the site and watercourse carried out by BB Surveys Ltd (Drawing Numbers 2219-244-S01 to 2219-244-S21).
- 1:250,000 *Soil Map of Eastern England* (Sheet 4) published by Cranfield University and Soil Survey of England and Wales 1983.
- 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
- 1:125,000 *Hydrogeological Map of Northern East Anglia* published in 1976 by the Institute of Geological Sciences (now the British Geological Survey).

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. SITE CHARACTERISTICS

3.1 Existing Site Characteristics and Location

3.1.1 The site is located off Norwich Road, Dickleburgh, Norfolk. The approximate Ordnance Survey (OS) grid reference for the site is 616640 282560 and the location of the site is shown on Figure 1.

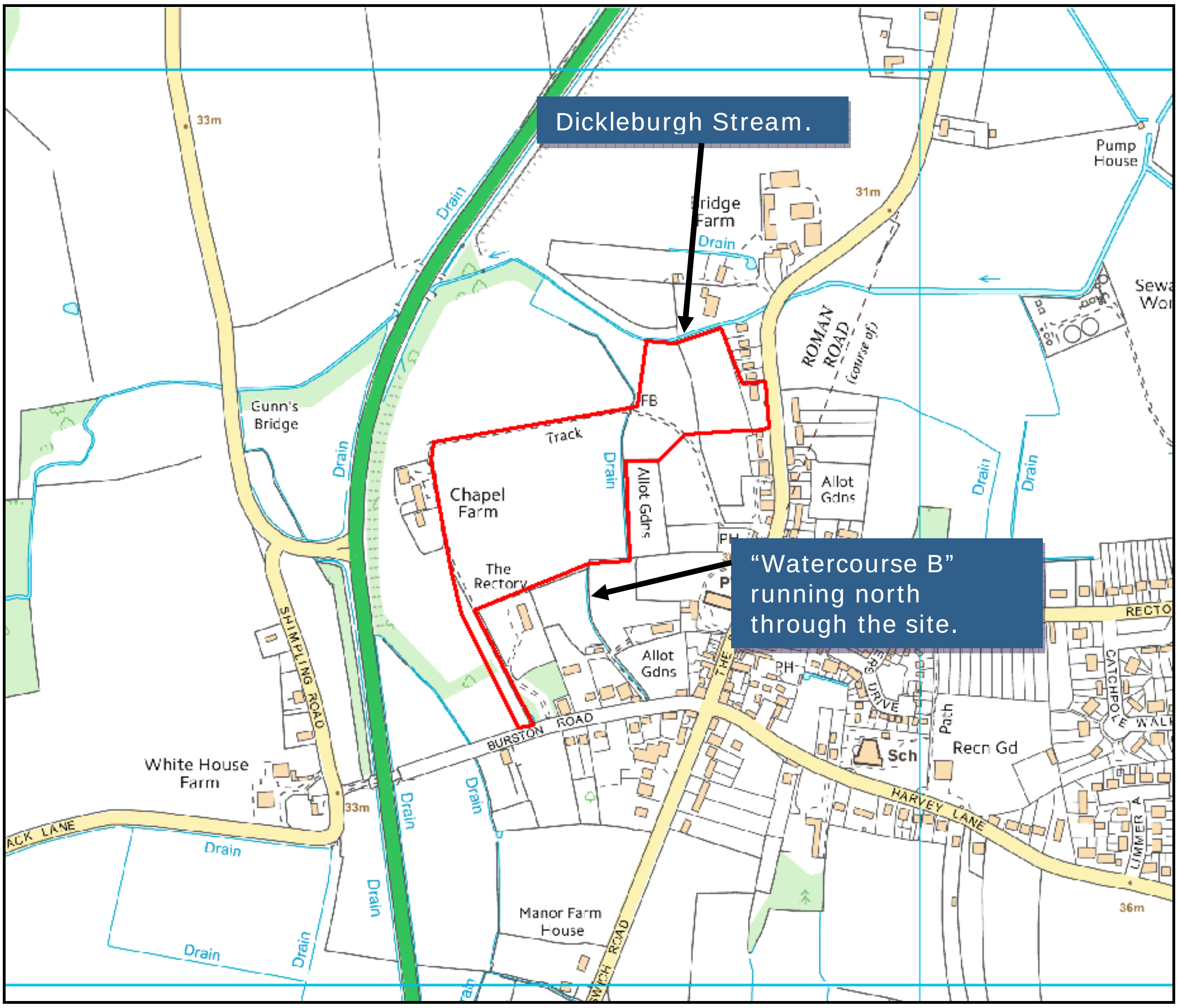


Figure 1: Site location (Source: Ordnance Survey)

3.1.2 The site currently comprises arable farmland and Chapel Farm occupies an area adjacent to the site. Figure 1 shows a watercourse flowing in a northerly direction through the central part of the site and converging with Dickleburgh Stream which flows in a westerly direction along the north frontage of the site.

3.1.3 A GPS topographical survey of the study area and watercourses has been carried out by BB Surveys Ltd and can be seen on Drawing Numbers 2219-244-S01 to 2219-244-S21. It should be noted that parts of the site and watercourse were inaccessible due to heavily overgrown vegetation. The topographical survey shows other smaller drainage ditches across the study area, however, these are not considered significant in terms of hydrology and are likely to be draining localised parts of the field and not a large catchment area in comparison to the aforementioned watercourses which flow through the site.

3.1.4 Filtered NEXTMAP data at 5m resolution (i.e. LIDAR data not available at this location) has also been obtained to determine and illustrate the topography across the surrounding area (Figure 2) and to supplement the topographical survey.

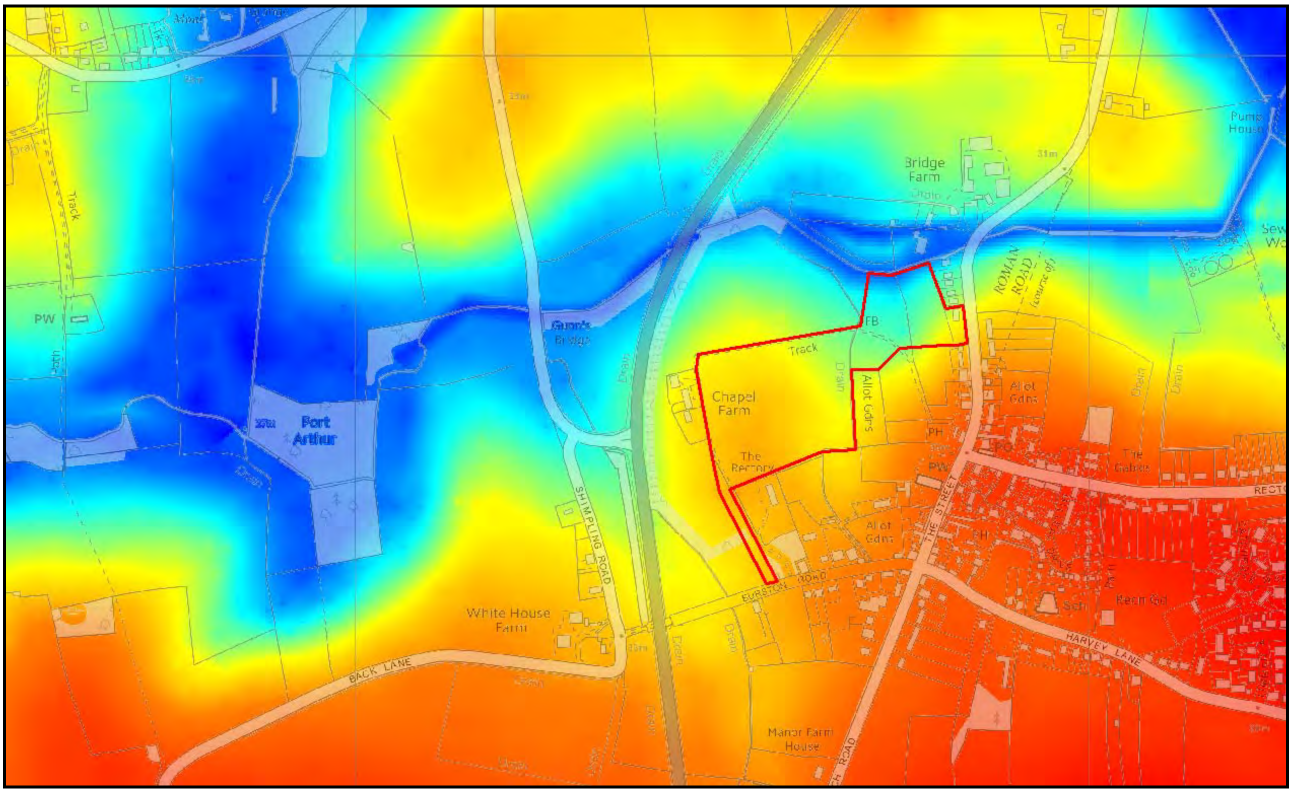


Figure 2: Filtered NEXTMAP survey of the site and surrounding area combined with OS (where low ground is denoted by blue colours and higher ground is denoted by green and yellow colours)

4. BASELINE INFORMATION

4.1 Environment Agency Flood Zone Map

4.1.1 As discussed earlier, Figure 1 shows a watercourse flowing in a northerly direction through the central part of the site and converging with Dickleburgh Stream which flows in a westerly direction along the north frontage of the site.

4.1.2 The Environment Agency Flood Map (Figure 3) shows that the site is largely located within the NPPF Flood Zone 1, 'Low Probability' which comprises land as having less than a 1 in 1000 year annual probability of fluvial or tidal flooding (i.e. an event more severe than the extreme 1 in 1000 year event). NPPF states that all uses of land are appropriate in this zone.

4.1.3 The Environment Agency Flood Map also show that the northern frontage of the site is partially located within the Flood Zone 3 and 2.

4.1.4 The Agency has indicated in their response dated 4th December 2015 (ref: CCE/2015/56288) that the watercourses which flow through the site have not been modelled by them.

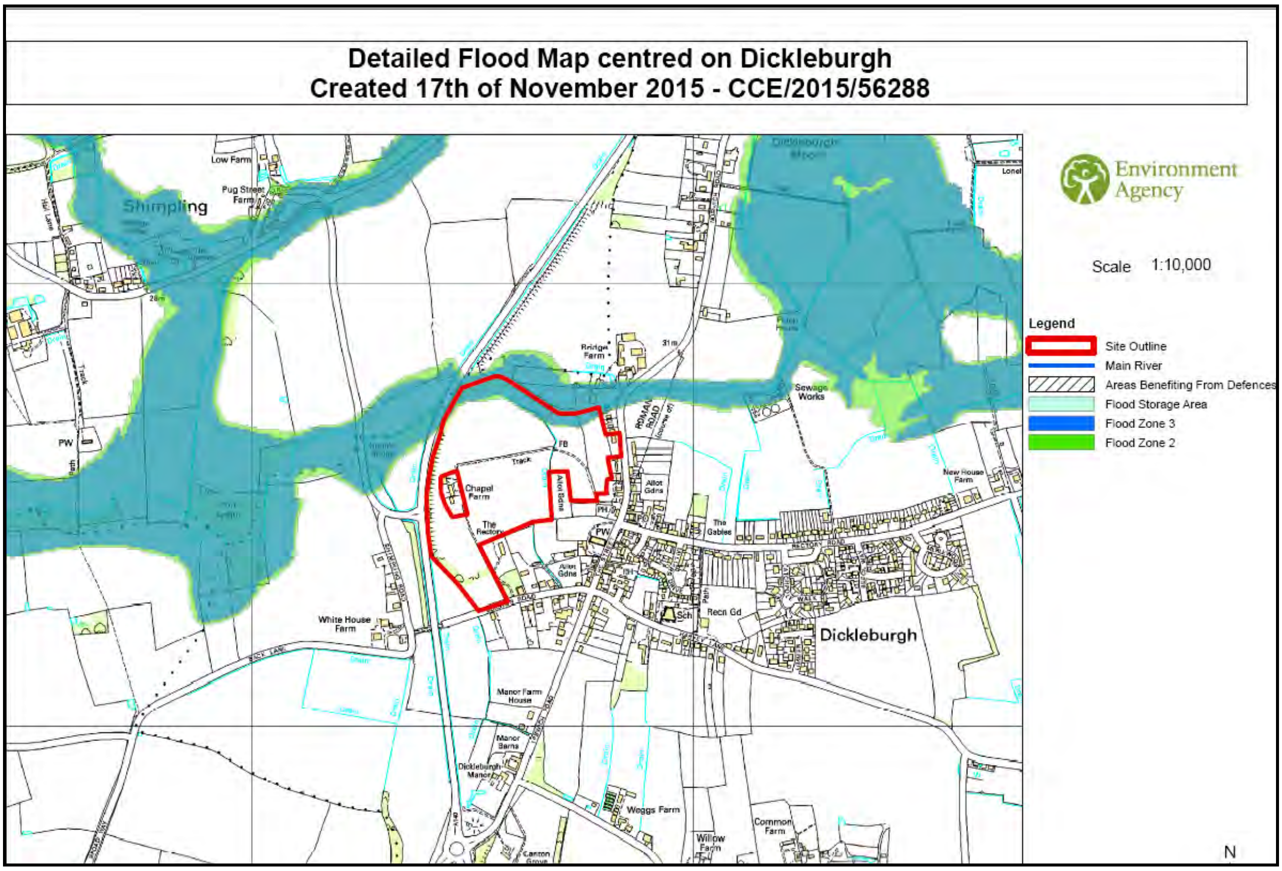


Figure 3: Environment Agency Flood Map (Source: Environment Agency)

5. HYDROLOGICAL SETTING AND CATCHMENT DESCRIPTORS

5.1.1 The watercourse which flows through the site in a northerly direction is a tributary of the Dickleburgh Stream which flows in a westerly direction adjacent to the northern frontage of the site. The OS maps and FEH CD-ROM show that the two watercourses converge at a point 130m downstream of the site, however, this is not shown on the topographical survey due to the dense vegetation restricting access. The extent of the upstream catchments (selected up to the confluence) associated with the watercourses is shown on the FEH CD-ROM (Figure 4).

5.1.2 Reference to the catchment descriptors extracted from the FEH CD-ROM Version 3 (Figure 5) shows that the Dickleburgh Stream drains an upstream catchment of 12.57 sq km. The catchment receives a standard average annual rainfall (SAAR) of 609mm and there is little attenuation from lakes and reservoirs which is denoted by a FARL value of 1. The catchment has a moderate gradient (DPSBAR = 10.5m/km) and is of a moderate elevation (ALTBAR = 40m).

5.1.3 Reference to Figure 6 indicates that "Watercourse B" drains an upstream catchment of 0.91 sq km. The catchment receives a standard average annual rainfall (SAAR) of 611mm and there is no significant attenuation from lakes and reservoirs which is denoted by a FARL value of 1. The catchment has a moderate gradient (DPSBAR = 9.8m/km) and is of a moderate elevation (ALTBAR = 41m).

5.1.4 The new FEH catchment descriptor $URBEXT_{2000}$, the development of which is discussed in the DEFRA/EA report entitled *$URBEXT_{2000}$ – A New FEH Catchment Descriptor*, indicates that the Dickleburgh Stream catchment is essentially rural, and the Watercourse B catchment is moderately urbanised (i.e. an $URBEXT_{2000}$ value of 0.0068 and 0.0671 respectively).

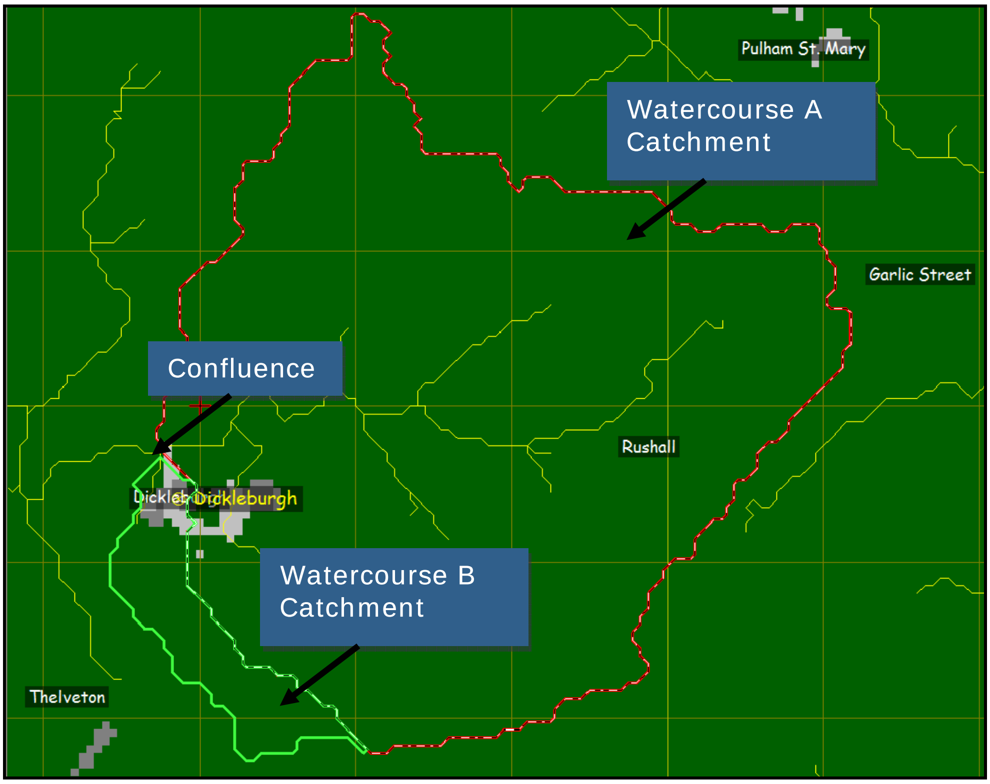


Figure 4: Location of site in relation to catchment watershed (Source: FEH CD-ROM Version 3)

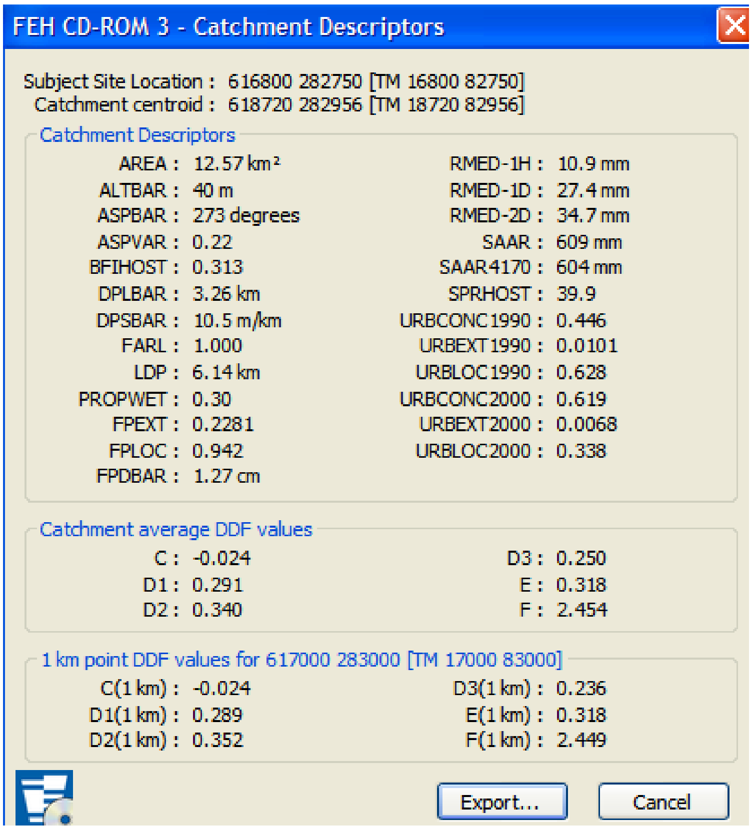


Figure 5: Catchment descriptors Dickleburgh Stream (Source: FEH CD-ROM Version 3)

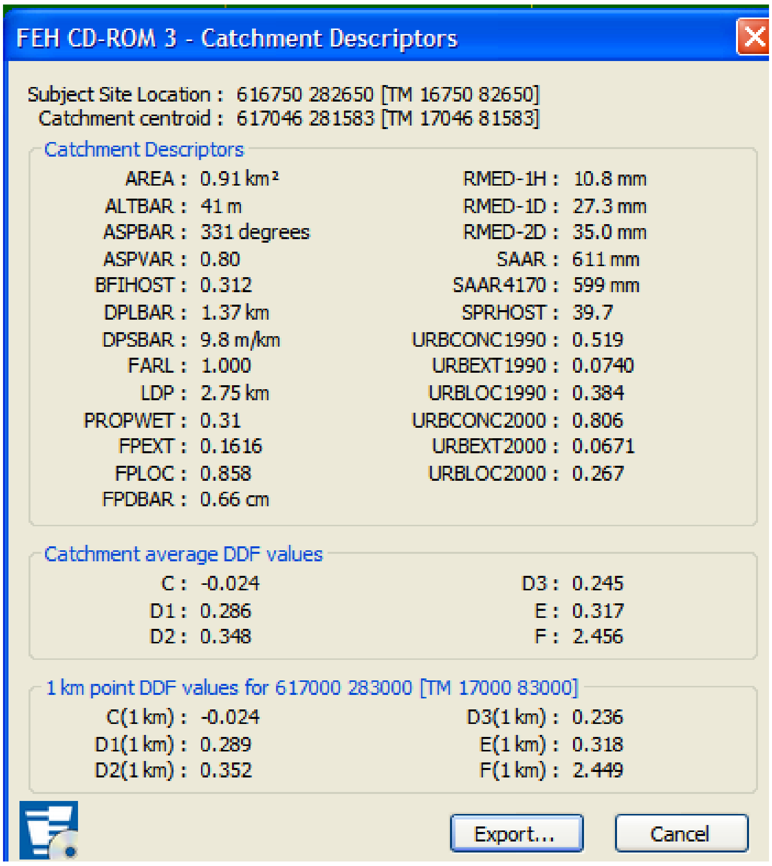


Figure 6: Catchment descriptors Watercourse B (Source: FEH CD-ROM Version 3)

5.1.5 $URBEXT_{2000}$ is based on a different methodology than $URBEXT_{1990}$ and therefore results in a separate set of FEH categories of urbanisation. For example, a moderately urbanised catchment will have an $URBEXT_{2000}$ value of up to 0.150 as opposed to 0.125 if using the former $URBEXT_{1990}$ value.

5.1.6 Urbanisation of the catchments since 2000 has been checked against the FEH CD-ROM values using OS mapping. The urban extent shown from the FEH CD-ROM ($URBEXT_{2000}$) is similar to the extent shown on the OS map. Therefore, as there has been no substantial development since 2000, the updating of $URBEXT_{2000}$ to 2016 using the national average model of urban growth in WINFAP-FEH Version 3 is acceptable. URBEXT for the Dickleburgh Stream catchment has therefore increased from 0.0068 to 0.0070, and URBEXT for the Watercourse B catchment has increased from 0.0671 to 0.0694 and the catchments remain essentially rural and moderately urbanised respectively.

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 approaches for estimating flood flows for catchments of this size; the FEH Statistical Method (pooled analysis) and the Revitalised Flood Hydrograph Method (ReFH). The FEH Statistical Method is based on a larger dataset of gauged flow records across the UK than the ReFH Method.

6.1.3 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.

6.1.4 The original 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.

6.1.5 **Note:** In earlier guidance for small catchments below 25 km^2 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.

6.1.6 Although both 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.

6.1.7 However, flow estimates have also been derived using the ReFH Method for comparison later in this Chapter.

6.2 Improved Statistical Method - Introduction

6.2.1 The original 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 (median annual flood) 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 is no observed flow or level records available as the watercourse is ungauged at this location and the Agency has no spot gauging records. Therefore FEH Statistical Method single-site analysis is not possible. Consequently, estimation of the flood flows has been carried out using the catchment descriptor method and pooled analysis.

6.3 Improved Statistical Method - Estimation of QMED

6.3.1 To estimate QMED for the catchment, the catchment descriptor method has been used. 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 Dickleburgh Stream catchment remains essentially rural, an urban adjustment to the QMED (rural) formula is not required.

6.3.4 The calculation using WINFAP-FEH based on catchment descriptors gives a value for $QMED_{s,cds}$/QMED rural of 2.443 cu m/sec for the Dickleburgh Stream catchment.

6.3.5 As the Watercourse B catchment is moderately urbanised, an urban adjustment to the QMED (rural) formula is required. To adjust for urbanisation, an Urban Adjustment Factor (UAF) based on the urbanisation (URBEXT) and soil type (SPRHOST) of the catchment is applied to the QMED (rural) value.

$$QMED = UAF \times QMED_{rural}$$

6.3.6 The UAF is calculated automatically by WINFAP-FEH Version 3 and applied to QMED (rural) to give the final QMED value.

6.3.7 The calculation using WINFAP-FEH based on catchment descriptors for the Watercourse B catchment gives a value for $QMED_{s,cds}$/QMED rural of 0.265 cu m/sec and UAF adjusted QMED value of 0.286 cu m/sec.

6.4 Improved Statistical Method - Revised Data Transfer Process

Dickleburgh Stream

6.4.1 In order to make the ungauged rural estimate of $QMED_{s,cds}$ 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:

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

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

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 NRFA Peak Flow Data (version 4.1) which is suitable for WINFAP-FEH (Note: HiFlows-UK data is now integrated with the National River Flow Archive on the CEH website). Table 1 shows the list of suitable donor catchments as generated by the WINFAP-FEH software.

Table 1: List of potential donor sites to be used in the data transfer process for the catchment

Station	QMED donor	Centroid X	Centroid Y	Centroid distance (km)	AREA	SAAR	BFIHOST	FARL	URBEXT	Years of data	QMED AM	QMED cds
Watercourse A		618720	282956		12.57	609	0.313	1	0.007			
34006 (Waveney @ Needham Mill)	2.178	613458	275350	9.25	376.05	594	0.422	0.998	0.014	50	23.524	31.629
33045 (Wittle @ Quidenham)	1.889	605154	287146	14.2	27.55	608	0.534	0.974	0.01	46	1.158	2.432
33011 (Little Ouse @ County Bridge Euston)	2.163	599445	278215	19.85	130.1	596	0.653	0.985	0.008	53	3.89	5.764
33046 (Thet @ Redbridge)	2.466	602298	295014	20.37	143.43	624	0.581	0.944	0.016	47	8.44	8.189
33044 (Thet @ Bridgham)	2.319	600029	291906	20.72	274.99	620	0.681	0.942	0.013	47	7.92	9.407
35003 (Alde @ Farnham)	2.601	631314	266280	20.9	62.9	592	0.365	0.988	0.008	53	9.32	7.577
33019 (Thet @ Melford Bridge)	2.309	599012	291010	21.29	311.37	620	0.707	0.932	0.014	54	7.472	9.018
33034 (Little Ouse @ Abbey Heath)	2.326	596477	281368	22.3	707.72	607	0.694	0.959	0.017	45	16.781	19.841
34001 (Yare @ Colney)	2.281	606922	304371	24.45	228.81	635	0.528	0.971	0.019	56	13.29	16.952
33048 (Larling Brook @ Stonebridge)	1.787	592750	290650	27.09	21.99	635	0.694	0.907	0.003	32	0.303	0.978

6.4.6 Reference to Table 1 shows that almost all suitable potential donor sites have catchment areas which are higher than the subject site (some significantly higher) and typically greater than the recommended limit as discussed in paragraph 6.4.1. Therefore, in this instance the chosen donor site should be the closest to the subject site, and Station 34006, Waveney at Needham Mill, which is ranked first in Table 1, is most acceptable in terms of its similarity and proximity to the subject catchment. The NRFA/CEH website also indicates that this station is suitable for QMED.

6.4.7 Reference to Table 1 shows that QMED for the gauged site based on observed records ($QMED_{g,obs}$) equates to 22.674 cu m/sec. QMED from catchment descriptors at the gauged site ($QMED_{g,cds}$) equates to 31.629 cu m/sec. The geographical distance between the sites (d_{sg}) equates to 9.25 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 1 shows that the adjusted QMED value at the subject site, $QMED_{s,adj}$ using the new data transfer equation is 2.178 cu m/sec.

Watercourse B

6.4.8 The original Flood Estimation Handbook states that particular caution is required when proposing a transfer to or from a catchment affected by urbanisation and the guidance notes associated with WINFAP-FEH Version 3 state that when a catchment is urbanised the use of data transfer methods to improve the estimate of QMED is not recommended. Therefore, the UAF adjusted QMED value of 0.286 cu m/sec will not be subjected to the data transfer procedure.

6.5 Improved Statistical Method - 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 (*5T*); 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 latest download of NRFA Peak Flow Data (version 4.1).

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 NRFA Peak Flow Data), 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 2: Pooling Group for Dickleburgh Stream catchment

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
27073 (Brompton Beck @ Snainton Ings)	0.707	33	0.82	0.192	0.052	0.721
20002 (West Peffer Burn @ Luffness)	1.524	41	3.299	0.292	0.015	2.095
203046 (Rathmore Burn @ Rathmore Bridge)	2.178	32	10.821	0.133	0.1	1.642
26802 (Gypsey Race @ Kirby Grindalythe)	2.271	15	0.109	0.284	0.27	0.659
33054 (Babingley @ Castle Rising)	2.292	38	1.132	0.208	0.06	0.385
36010 (Bumpstead Brook @ Broad Green)	2.327	47	7.5	0.375	0.186	1.436
41020 (Bevern Stream @ Clappers Bridge)	2.348	45	13.66	0.21	0.189	1.164
72014 (Conder @ Galgate)	2.379	47	17.703	0.196	0.049	0.326
25019 (Leven @ Easby)	2.421	36	5.538	0.345	0.383	2.032
73015 (Keer @ High Keer Weir)	2.442	24	12.187	0.164	0.008	0.704
33032 (Heacham @ Heacham)	2.452	46	0.461	0.31	0.099	1.141
27051 (Crimple @ Burn Bridge)	2.56	42	4.539	0.221	0.149	0.751
34005 (Tud @ Costessey Park)	2.573	53	3.146	0.275	0.17	0.315
26003 (Foston Beck @ Foston Mill)	2.58	54	1.739	0.248	0.002	0.629
Total		553				
Weighted means				**0.25**	**0.121**	

Table 3: Pooling Group for Watercourse B catchment

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
76011 (Coal Burn @ Coalburn)	1.697	37	1.84	0.168	0.337	1.141
27073 (Brompton Beck @ Snainton Ings)	3.179	33	0.82	0.192	0.052	1.232
45816 (Haddeo @ Upton)	3.527	21	3.522	0.313	0.404	0.949
27051 (Crimple @ Burn Bridge)	3.542	42	4.539	0.221	0.149	0.578
28033 (Dove @ Hollinsclough)	3.795	35	4.666	0.259	0.417	0.73
91802 (Allt Leachdach @ Intake)	4.265	34	6.35	0.153	0.257	1.059
25019 (Leven @ Easby)	4.273	36	5.538	0.345	0.383	1.622
26802 (Gypsey Race @ Kirby Grindalythe)	4.274	15	0.109	0.284	0.27	0.467
25003 (Trout Beck @ Moor House)	4.366	41	15.164	0.174	0.285	0.507
25011 (Langdon Beck @ Langdon)	4.383	28	15.878	0.238	0.318	1.403
47022 (Tory Brook @ Newnham Park)	4.384	21	7.331	0.255	0.072	1.398
54022 (Severn @ Plynlimon Flume)	4.473	38	14.988	0.156	0.171	1.049
206006 (Annalong @ Recorder)	4.543	48	15.33	0.189	0.052	1.99
27010 (Hodge Beck @ Bransdale Weir)	4.655	41	9.42	0.224	0.293	0.084
203046 (Rathmore Burn @ Rathmore Bridge)	4.705	32	10.821	0.133	0.1	0.791
Total		502				
Weighted means				0.219	0.236	

6.5.5 The WINFAP-FEH software indicates that the Dickleburgh Stream pooling group is strongly heterogeneous and a review of the pooling group is desirable. The WINFAP-FEH software indicates that the Watercourse B pooling group is possibly heterogeneous and a review of the pooling group is optional.

6.5.6 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 group remains heterogeneous, even after a review and adapting a heterogeneous pooling group to make it homogeneous is not advised.

6.6 Improved Statistical Method - Flood Frequency Curve

6.6.1 When considering the Dickleburgh Stream, 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 7.

6.6.2 When considering Watercourse B, the WINFAP-FEH software allows the user to construct a flood frequency curve for the specified return period and choose whether to apply the UAF to the QMED rural value and as-rural growth curve.

Institute of Hydrology - Flood Peaks Database
Printed : 4 July 2016
Station : 999200 (gb 616800 282750 (tm 16800 82750))

Fittings for FFC

Standardised by median

Return periods

	GL
2	2.178
5	3.004
10	3.556
20	4.115
50	4.900
100	5.543
200	6.239
500	7.249
1000	8.089

Figure 7: Flood Frequency Curve Fittings for the Dickleburgh Stream catchment (cu m/sec)

Institute of Hydrology - Flood Peaks Database
Printed : 4 July 2016
Station : 999200 (gb 616750 282650 (tm 16750 82650))

Fittings for FFC

Standardised by median

Return periods

	GL
2	0.286
5	0.384
10	0.459
20	0.543
50	0.674
100	0.793
200	0.934
500	1.160
1000	1.369

Figure 8: Flood Frequency Curve Fittings for the Watercourse B catchment (cu m/sec)

6.7 Revitalised Flood Hydrograph Method (ReFH)

6.7.1 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. The method uses a loss model, routing model and baseflow model to generate a flood hydrograph.

6.7.2 The catchment descriptors were imported into Version 11.5 of the InfoWorks modelling software. The appropriate flood return period, storm duration and data interval was set, as discussed below, to enable appropriate flows to be estimated.

6.7.3 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.

6.7.4 For the Dickleburgh Stream catchment the critical storm duration was calculated as 9.503 hours from the time-to-peak (T_p) from catchment descriptors (5.906 hours) using the equation provided in Volume 4 of FEH:

$$D = T_p\,(1 + SAAR/1000)$$

Where:
D is the critical storm duration
T_p is the time-to-peak
SAAR is the standard average annual rainfall

6.7.5 Using the equation above for the Watercourse B catchment, the critical storm duration was calculated as 4.533 hours from the time-to-peak (T_p) from catchment descriptors (2.814 hours).

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.

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, for the Dickleburgh Stream catchment the design storm duration was rounded to 9 hours which is the nearest odd integer. For the Watercourse B catchment the design storm duration was rounded to 5 hours which is the nearest odd integer.

6.7.8 A 75% winter storm profile was used as the catchments are not considered to be urbanised according to the ReFH Method (N.B. urban catchments are defined as those with URBEXT >0.125 in the ReFH Method).

Table 4: Results from ReFH using catchment descriptors

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)
Dickleburgh Stream	1	9	5.476	8.011	15.032
Watercourse B	1	5	0.653	0.979	1.901

6.8 Flow Method Comparison

6.8.1 Reference to Table 5 indicates that the results from the FEH Statistical Method are lower than the ReFH Method. The ReFH Method is known to overestimate flows especially for longer return periods which are outside of its calibration range, hence why in particular the 1000 year event results are shown to be high when using the ReFH Method.

Table 5: Comparison of Flood Flows (cu m/sec)

Catchment	ReFH			Statistical		
	20	100	1000	20	100	1000
Dickleburgh Stream	5.476	8.011	15.032	4.115	5.543	8.089
Watercourse B	0.653	0.979	1.901	0.543	0.793	1.369

6.9 Flood History

6.9.1 There have been no known flood incidents across the site. There is no observed flow or level records available as the watercourse is ungauged at this location. There is a lack of available rainfall and flow data for the catchment, hence the reason for the catchment descriptor method being adopted based on the relevant technical guidance.

6.10 Final Choice of Method

6.10.1 Although the FEH Statistical Method and ReFH Method 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. Therefore, the results shown on Figures 7 and 8 have been taken forward in this assessment.

6.11 Estimating Long Return Period Floods

6.11.1 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.

6.11.2 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. For consistency, the FEH Statistical Method has been used to estimate the 1 in 1000 year flood flow.

6.12 Climate Change

6.12.1 The NPPF requires that the effects of climate change for the lifetime of the development 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.

6.12.2 Climate change levels should reflect the UK Government's climate change allowances guidance dated February 2016. By consulting the guidance and FEH CD-ROM it can be seen that the site and catchment fall within the Anglian river basin district.

6.12.3 It is understood that for future flood zones and general design purposes the "Higher Central" climate change allowance for the Anglian region of 35% as outlined in Table 1 of the guidance should be applied to the peak flow rate for "more-vulnerable" development in Flood Zone 3a.

6.12.4 According to the guidance, the "Upper End" increase in peak flow rate of 65% also needs to be considered, and it is understood that this should be applied to the 1 in 100 year event when determining the potential increase in flood risk to people, as this will also consider the scientific uncertainty in the climate change estimates.

6.12.5 The resultant flood flows when applying 35% to accommodate the expected climate change effect over the lifetime of the development can be seen in Tables 6 and 7 (also showing 65% allowance on 1 in 100 year flow).

Table 6: Final Flood Flows – Dickleburgh Stream (cu m/sec)

Flood Frequency	Q20	Q100	Q1000
Flood Flow	4.115	5.543	8.089
Flood Flow including (35%) climate change	5.560	7.483 ***9.146 (65%)***	10.920

Table 7: Final Flood Flows – Watercourse B (cu m/sec)

Flood Frequency	Q20	Q100	Q1000
Flood Flow	0.543	0.793	1.369
Flood Flow including (35%) climate change	0.733	1.071 ***1.308 (65%)***	1.848

6.13 Hybrid Method

6.13.1 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.

6.13.2 It is common to generate a hydrograph using the ReFH Method, then scaling it to match the FEH statistical estimates shown in Tables 6 and 7.

6.13.3 The parameters such as critical duration and data interval was determined as discussed in Section 6.7.

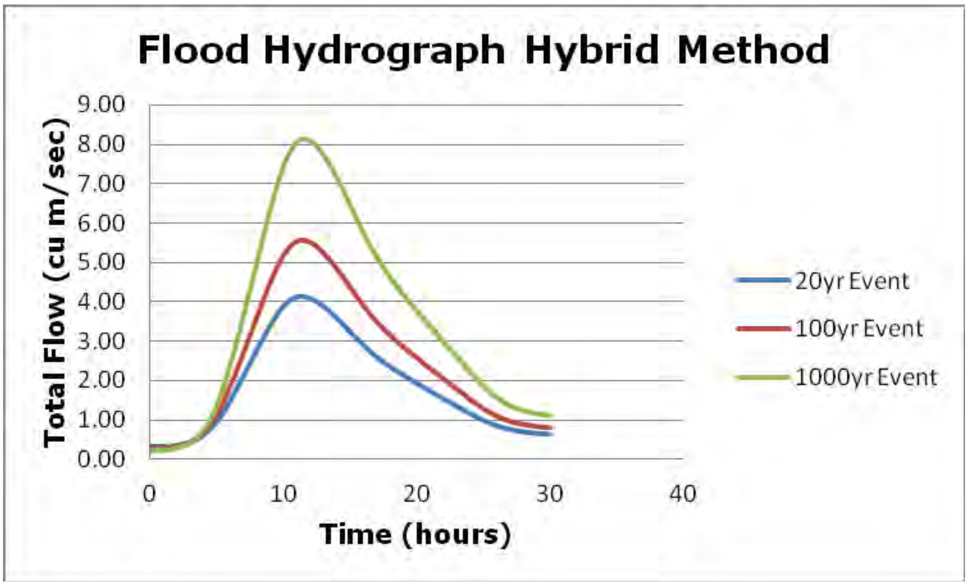


Figure 9: Flood hydrograph using the hybrid method without climate change (Dickleburgh Stream)

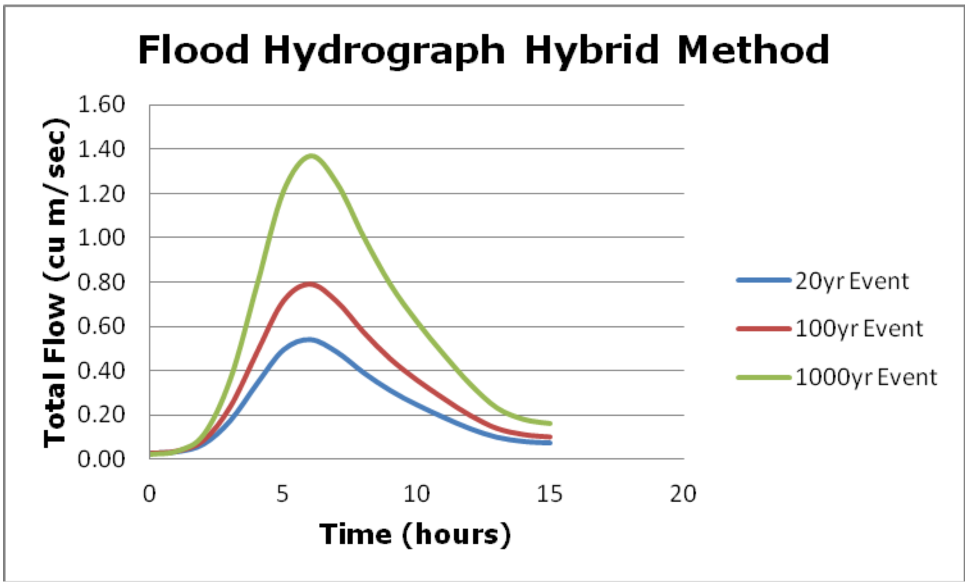


Figure 10: Flood hydrograph using the hybrid method without climate change (Watercourse B)

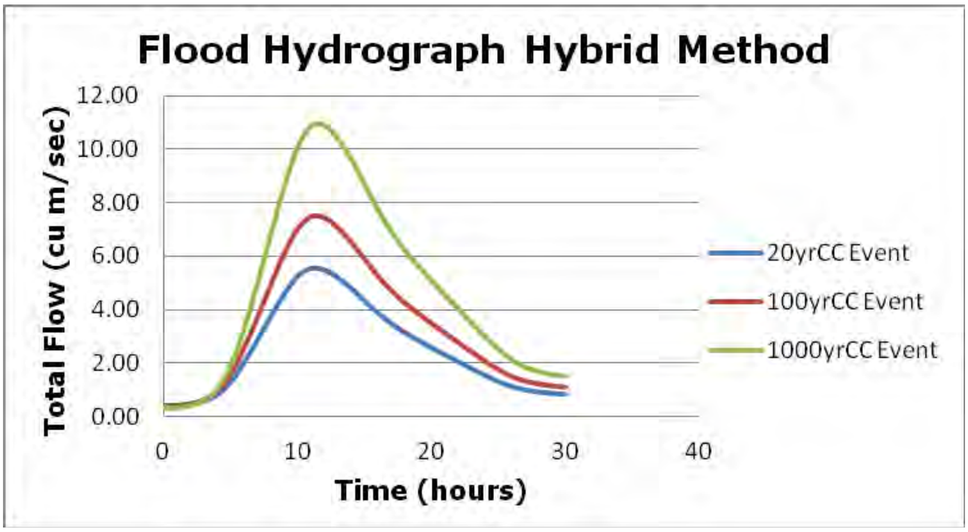


Figure 11: Flood hydrograph using the hybrid method with 35% climate change (Dickleburgh Stream)

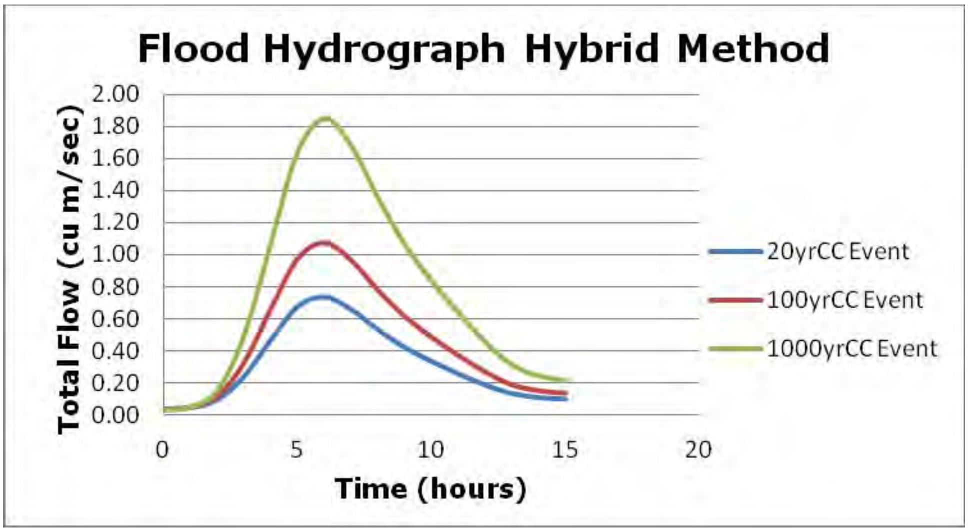


Figure 12: Flood hydrograph using the hybrid method with 35% climate change (Watercourse B)

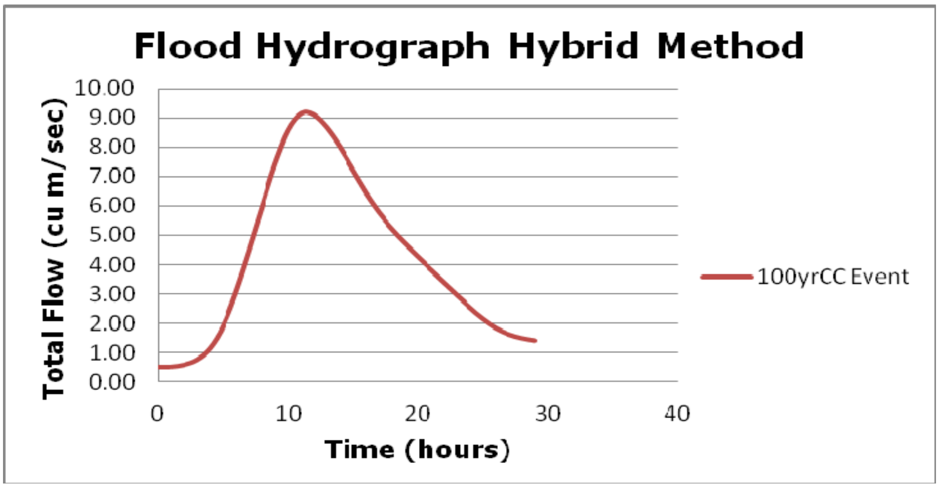


Figure 13: 1 in 100 year with Upper End climate change (Dickleburgh Stream)

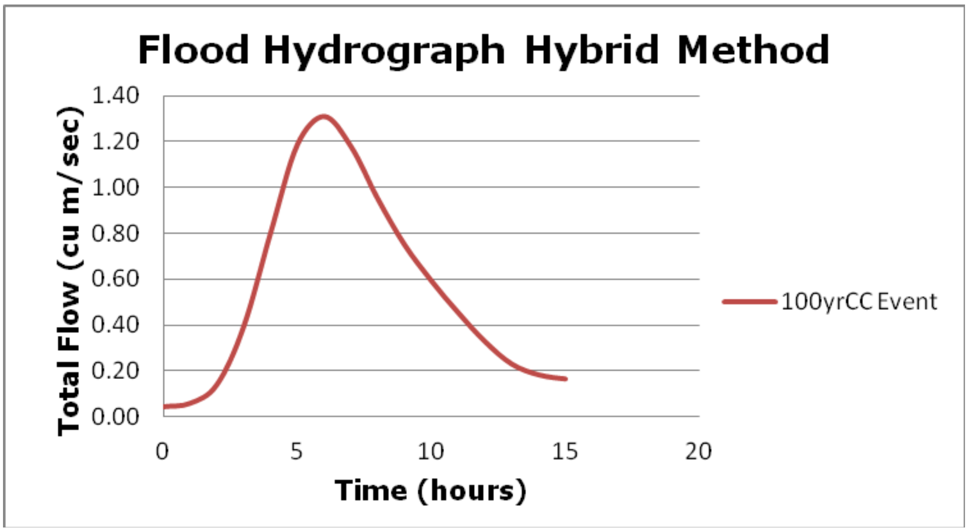


Figure 14: 1 in 100 year with Upper End climate change (Watercourse B)

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 *Fluvial Design Guide (2009)*, and Agency's Best Practice Guide dated 2006 entitled *Using Computer River Modelling as part of a flood risk assessment* have been consulted.

7.2 InfoWorks Model Development

7.2.1 One-dimensional (1D) unsteady hydrodynamic modelling of 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 and GIS functionality within a single environment.

7.2.2 The GPS topographical survey (3D and geo-referenced) was imported into the MapInfo GIS software and a ground model was generated which allowed the interpolation of ground levels between available elevation points. Filtered NEXTMAP survey data was used to supplement the ground model in areas outside of the site boundary and therefore not covered by the topographical survey (i.e. due to access restrictions as a result of heavily overgrown areas). The combined ground model (Figure 15) was then exported in a suitable format which could be read by the InfoWorks software. The final ground model as it appears in the InfoWorks model is shown on Figure 16.

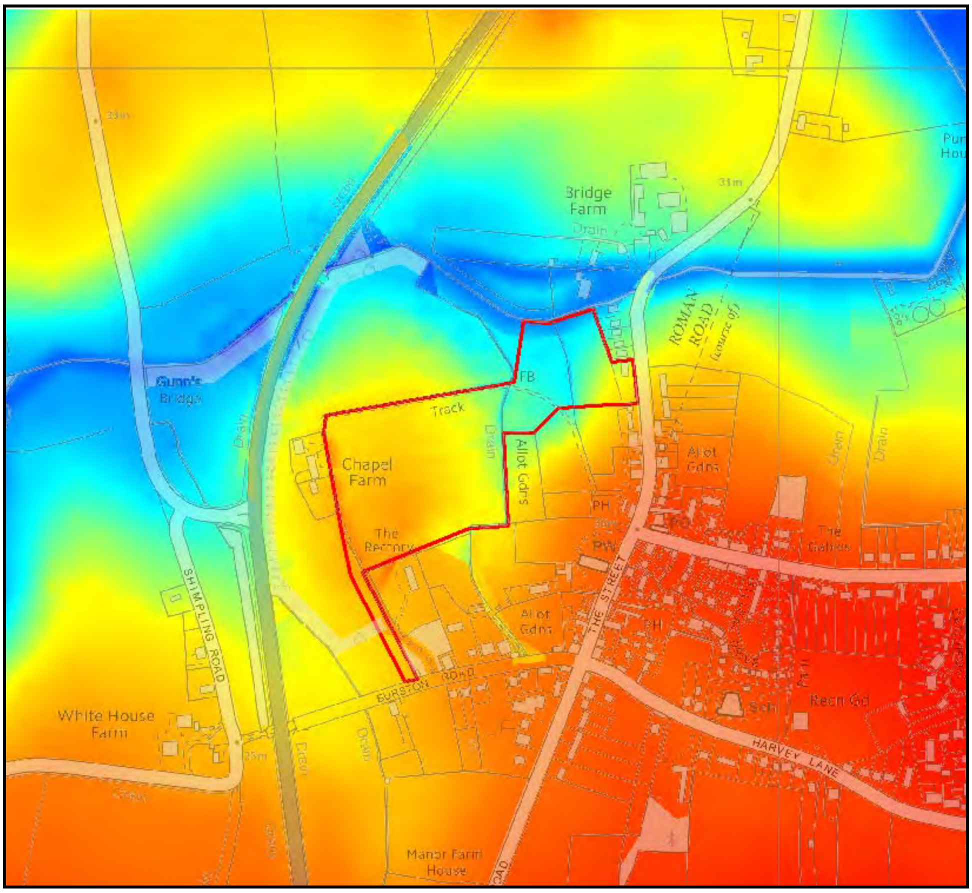


Figure 15: Combined NEXTMAP and topographical survey (where higher ground is represented by yellow and orange colours)

Figure 16: 3D representation of DTM with OS as presented in InfoWorks RS

7.2.3 Figure 17 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 NEXTMAP data alone.

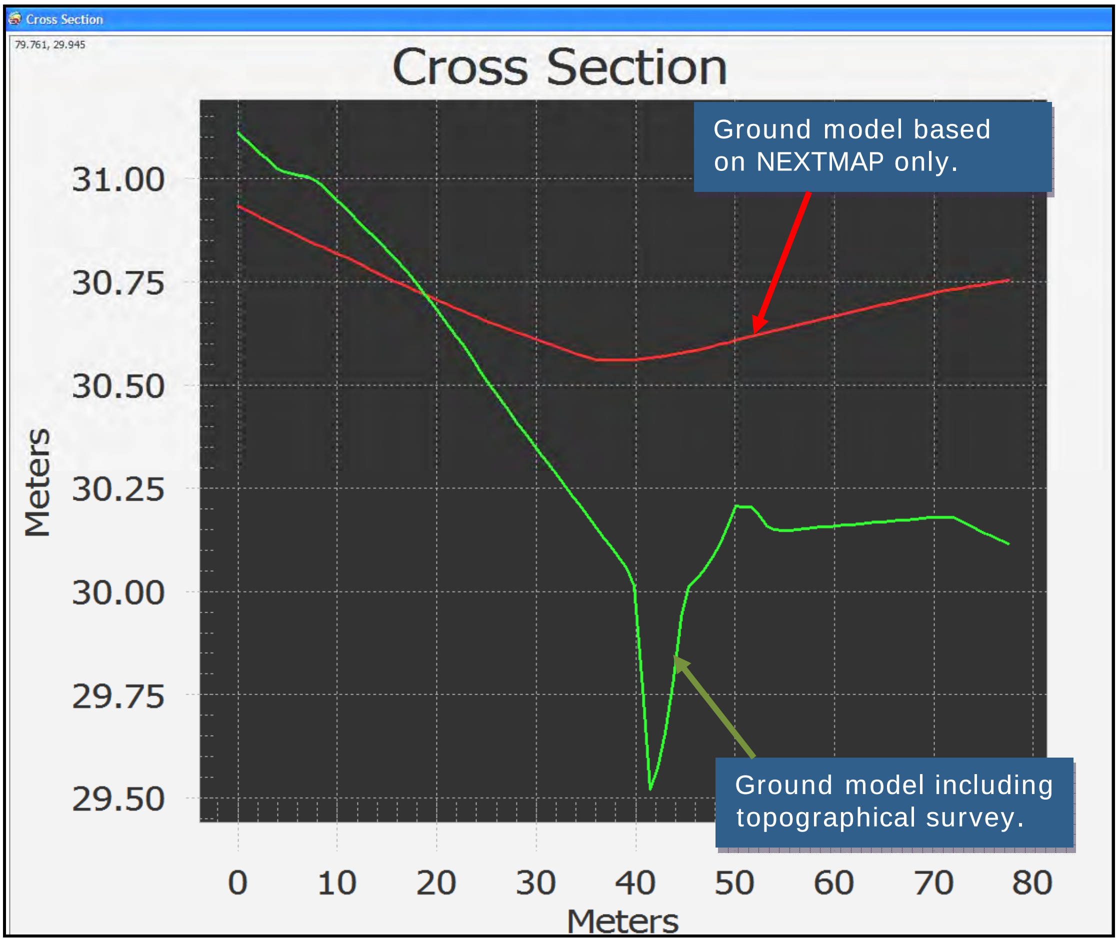
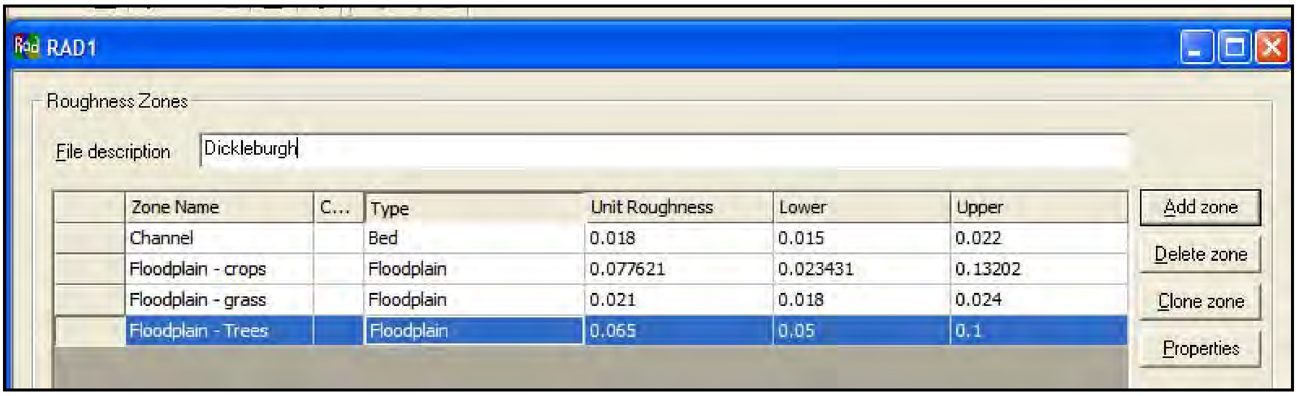


Figure 17: Comparison between NEXTMAP survey and topographical survey across the site when creating a ground model

7.3 Surface Roughness

7.3.1 Surface roughness varies across the study area as a result of different land uses. 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.

7.3.2 The watercourse channel is generally free from vegetation (Figure 19), however, the topographical survey indicates that some sections of the watercourse suffer from heavily overgrown bank vegetation which hangs over or into the channel. Therefore, despite the CES Roughness Advisor suggesting a channel roughness of 0.018 on Figure 18, a channel roughness of 0.035 has been used in the model instead of that shown on Figure 18 to consider vegetation growth during the summer months, or fallen bank vegetation.


RAD1

Roughness Zones

File description: Dickleburgh

Zone Name	C...	Type	Unit Roughness	Lower	Upper
Channel		Bed	0.018	0.015	0.022
Floodplain - crops		Floodplain	0.077621	0.023431	0.13202
Floodplain - grass		Floodplain	0.021	0.018	0.024
Floodplain - Trees		Floodplain	0.065	0.05	0.1

Add zone
Delete zone
Clone zone
Properties

Figure 18: Manning's "n" roughness values derived from the CES Roughness Advisor

Figure 19: Photo of surveyed section of watercourse

7.4 Structures

7.4.1 The topographical survey and OS map indicates that the Dickleburgh Stream flows through a large brick arch bridge upstream of the site to the east and beneath Norwich Road. Watercourse B flows through a small brick arch bridge beneath Burston Road to the south of the site (although the upstream extent is not clearly defined on the topographical survey or OS map).

7.4.2 In order to consider a more conservative scenario (and due to model instabilities), the upstream cross section on both watercourses was positioned immediately downstream of the aforementioned bridges located upstream of the site. This assumes that no flood flow is restricted by these structures and that all flood flow calculated in this report will reach the site immediately. (Although the inflow boundaries are shown on the model Geoplan to be located upstream of these bridges, this is for illustrative purposes only, and all flood flow will reach the cross sections downstream of the bridges without obstruction).

7.4.3 Approximately 60m downstream of the bridge beneath Burston Road (but still upstream of the site), Watercourse B flows through a 1m high, 10m long rectangular culvert as shown on the topographical survey (Figure 20). Despite restricted access to the culvert due to overgrown vegetation, some topographical information was obtained for this structure. The culvert was included in the model using a rectangular conduit unit and the dimensions of the culvert, including invert and soffit, were taken from the topographical survey. As the rectangular conduit unit does not model the potential overtopping of floodwater across the deck, a Spill unit was applied perpendicular to the culvert and levels were derived from the ground model and topographical survey.

Figure 20: Photo of rectangular culvert along Watercourse B upstream of the site

7.4.4 Approximately 300m downstream of the aforementioned culvert and along Watercourse B, the topographical survey shows that Watercourse B discontinues for a length of 7m. However, it is understood that Watercourse B is hydraulically connected at this point and that a buried/silted up culvert exists. Despite Watercourse B remaining dry at this location during the time of the topographical survey, it can be deduced that there remains a hydraulic connection (possibly by seeping through the soil and bed material). Due to the difficulty in accessing the culvert, there is little information such as size and invert/soffit level. Therefore, this structure has not been included in the model and it is assumed that there is sufficient hydraulic connectivity between upstream and downstream parts. However, in order to include a restriction in the model at this point, a Blockage link unit has been included in the model at this location and is set to consider a 50% blockage of the channel.

7.4.5 The topographical survey indicates that 10m downstream of the aforementioned buried culvert a wide spanning timber footbridge (i.e. simple planks of wood crossing Watercourse B) exists. However, due to the nature of the structure, in order to consider a more conservative scenario this bridge was not included in the model, as it is unlikely to limit flood flows significantly.

7.4.6 Approximately 300m west of the site, Dickleburgh Stream flows under the A140 and through a large rectangular concrete culvert (Figure 21). The culvert was included in the model using a rectangular conduit unit (i.e. as this structure could have an impact on upstream water levels at the site) and the dimensions of the culvert, including invert and soffit, were taken from the topographical survey. A Spill unit was applied perpendicular to the culvert and levels were derived from the ground model.

Figure 21: Concrete rectangular culvert under A140

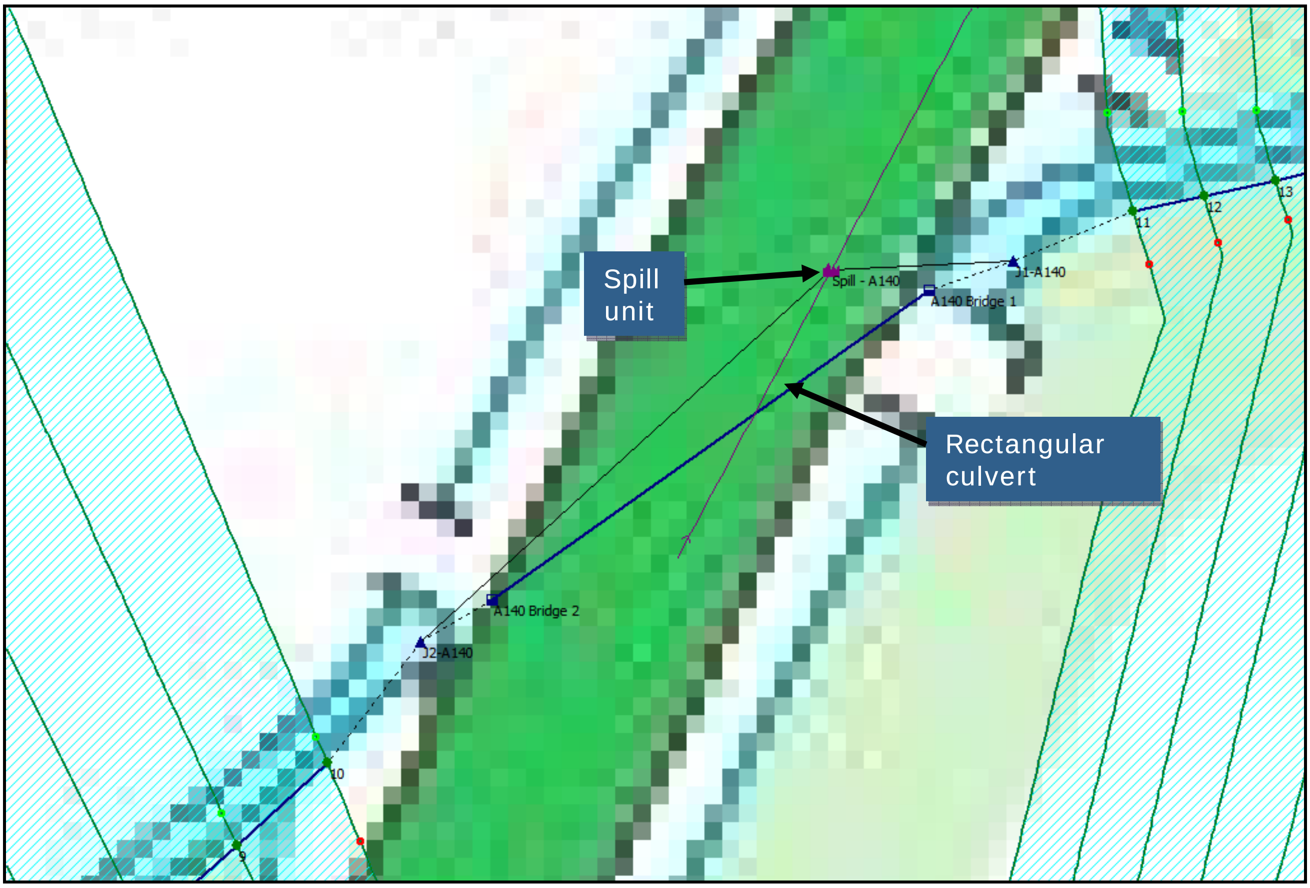


Figure 22: Culvert beneath A140 as it appears in the model

7.5 Model Boundary Conditions

7.5.1 The following flood event scenarios have been considered to allow the extent of the fluvial floodplain across the site to be determined and appraised in terms of NPPF:

1. 20yr event (present day Flood Zone 3b)
2. 20yr plus climate change event (future Flood Zone 3b)
3. 100yr event (present day Flood Zone 3a)
4. 100yr plus climate change event (future Flood Zone 3a)
5. 1000yr event (present day Flood Zone 2)
6. 1000yr plus climate change event (future Flood Zone 2)
7. 100yr plus climate change event (Upper End)

Upstream Boundary

7.5.2 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.

7.5.3 It is common to generate a hydrograph using the ReFH Method, then scale it to match the statistical flow estimate as discussed in Section 6.13. This hydrograph then forms the upstream inflow boundary condition and considers all of the catchment flow discussed in Chapter 5. It was ensured that the hydrograph parameters, shape, duration, data interval and results for each return period determined in Section 6.13 were reproduced in the InfoWorks RS software.

Downstream Boundary

7.5.4 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 at the end of the model (i.e. 1 in 880 based on the GPS topographical survey and NEXTMAP data).

7.5.5 In accordance with the EA Best Practice Guide dated 2006 entitled *Using Computer River Modelling as part of a flood risk assessment*, the downstream boundary should be located sufficiently downstream of the site so that any errors in the boundary will not significantly affect predicted water levels at the site. This is proven by carrying out a sensitivity analysis in Section 7.8 which indicates that when making the downstream slope shallower there is no change in upstream water level at the site.

7.5.6 The aforementioned EA guidance states that for a typical fluvial river, a rule of thumb is that a backwater effect extends a length L = 0.7D/s, where D = bankfull depth and s = river slope (as a decimal). Hence, if the downstream boundary is greater than L from the site, it is likely that any errors in the rating curve at the boundary will not affect flood levels at the site.

7.5.7 It has been calculated that the "L" value is 770m based on a river slope of 1 in 880 and downstream bankfull depth of 1.43m. However, as the topographical survey extends 430m downstream of the site and as only NEXTMAP data exists beyond this point, it is considered that the downstream boundary is set 430m downstream of the site (i.e. 130m downstream of the A140), as this will ensure that more reliable topographical survey defines this boundary. This will also improve the stability of the model and it is likely that the rectangular culvert beneath the A140 will have an overriding influence on upstream water levels.

7.5.8 Moreover, the sensitivity analysis in Section 7.8 confirms that the downstream boundary is sufficiently positioned downstream of the site. The results indicate that when making the downstream slope 20% shallower, the flood level within the channel adjacent to the site does not increase significantly during the climate change 1 in 100 year event. Therefore, the downstream boundary is sufficiently downstream of the site and the Agency's requirement outlined in paragraph 7.5.5 above will be met.

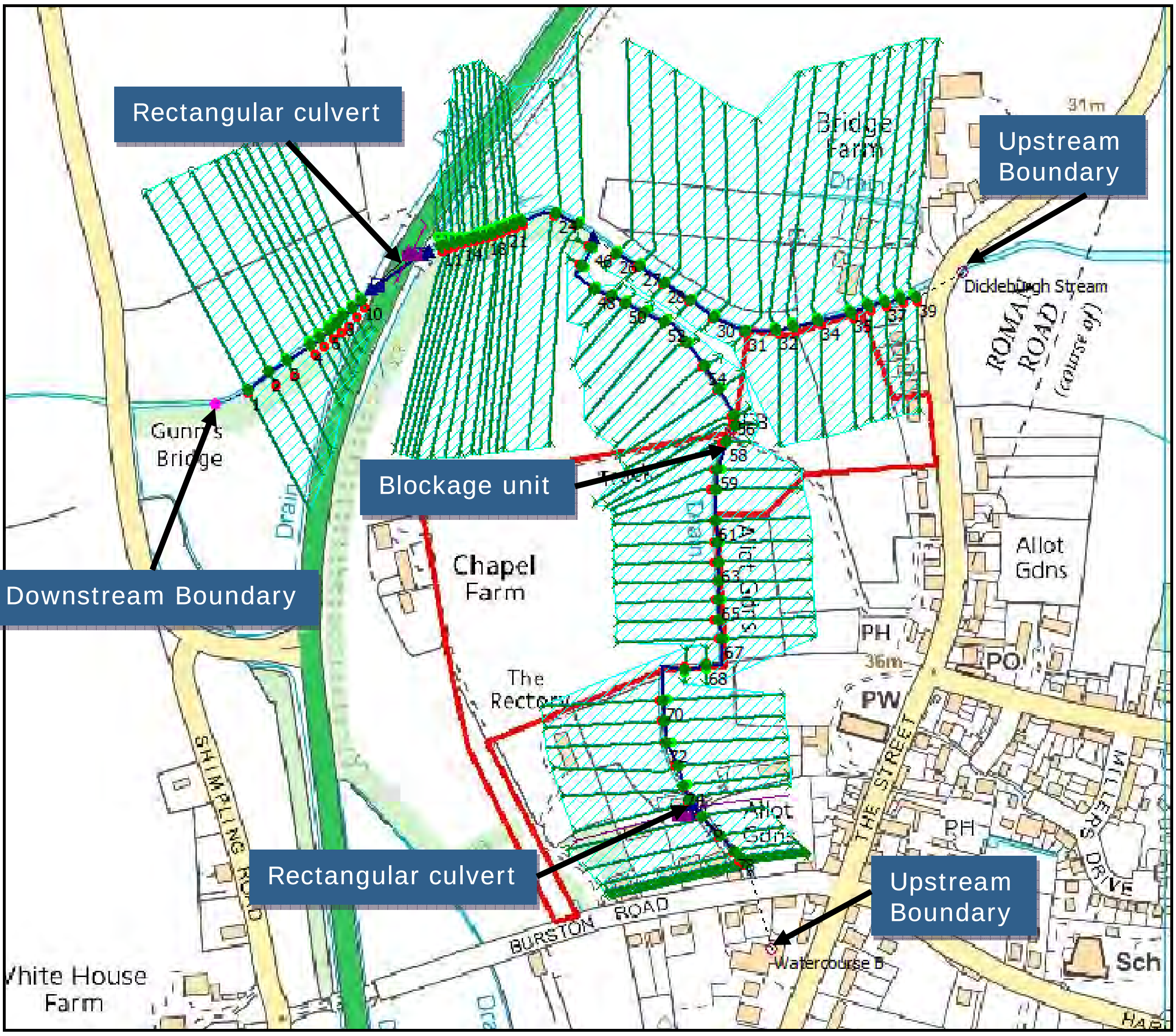


Figure 23: Model schematic as it appears in the InfoWorks software

7.6 Results

7.6.1 The model was initially run to consider the worst-case climate change 1 in 1000 year event, as this would allow the identification of any model instabilities and errors and the opportunity to correct them.

7.6.2 The results show that during all modelled return period events up to and including the worst-case climate change 1 in 1000 year event (extreme event), there is flooding across the northern part of the site.

7.6.3 The results also show that the main flood risk to the site is from the Dickleburgh Stream, and although there is flooding from Watercourse B within the vicinity of the confluence (and marginally upstream across lower lying land), there is no flooding across the site from Watercourse B. Therefore, the cross section results (as shown in the following tables) relevant to the affected part of the site are between 36 and 31.

7.6.4 Note: The "plan view" results as illustrated within the software have not been provided in this report, as a review of the tabulated results and cross sections indicate a mapping inaccuracy caused by the software (i.e. showing inaccurate flooding along Watercourse B). Long sections are provided instead and on Figures 24 and 25.

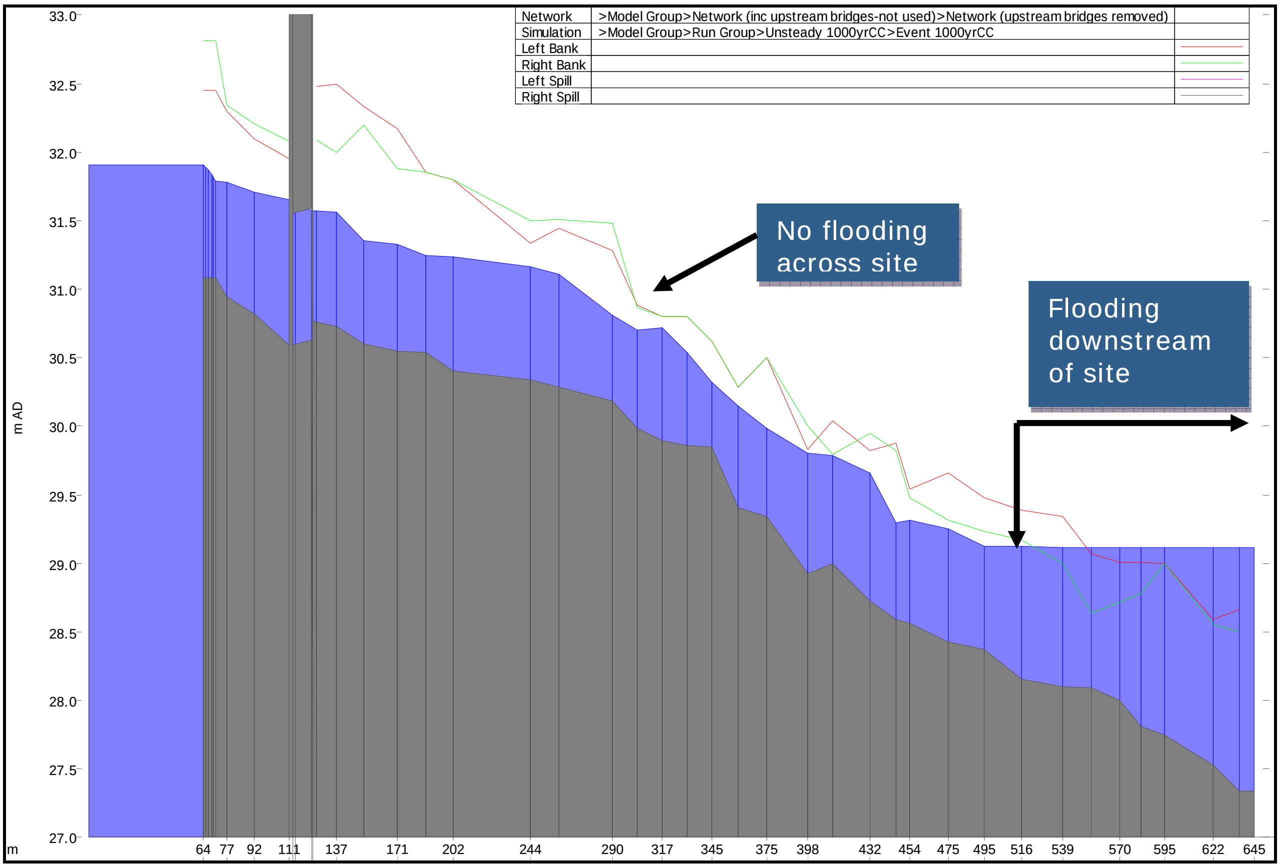


Figure 24: Long section along Watercourse B during worst-case climate change 1 in 1000 year event

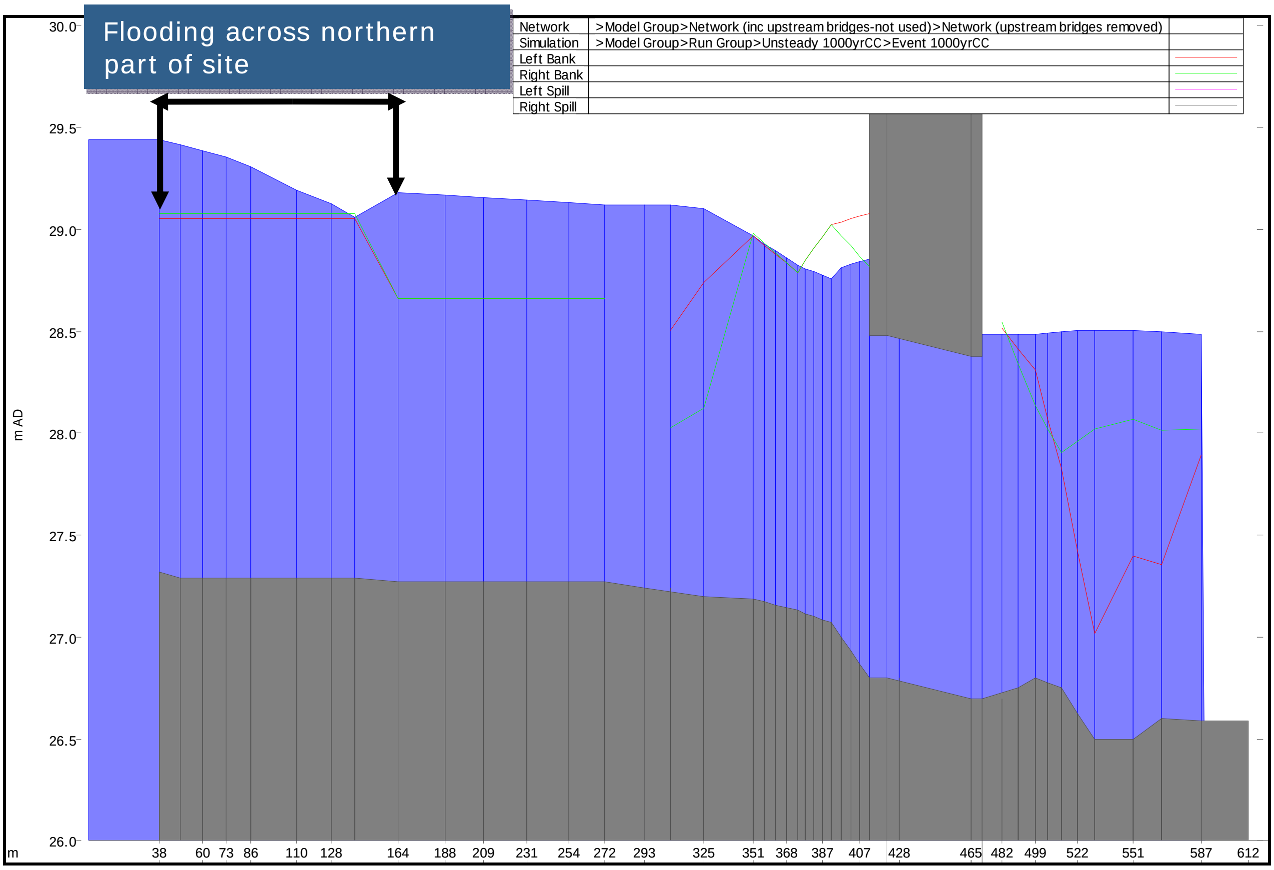


Figure 25: Long section along Dickleburgh Stream during worst-case climate change 1 in 1000 year event

Table 8: Results for 1 in 20 year event

	Results - 20yr		
Cross Section	Max Flow (m3/s)	Max Stage (m AD)	Max Velocity (m/s)
79	0.543	31.513	0.978
79a	0.543	31.499	1.016
79b	0.543	31.482	1.065
79c	0.543	31.454	1.162
79d	0.543	31.429	1.261
79e	0.543	31.409	1.356
78	0.543	31.352	1.043
77	0.543	31.263	0.918
76	0.543	31.216	0.6
75	0.542	31.189	1.009
74	0.542	31.143	0.801
73	0.542	31.045	0.96
72	0.542	30.969	0.735
71	0.542	30.894	0.798
70	0.541	30.871	0.453
69	0.541	30.811	0.529
68	0.541	30.789	0.519
67	0.541	30.509	1.247
66	0.541	30.403	0.867
65	0.541	30.362	0.673
64	0.541	30.299	0.839
63	0.541	30.064	1.427
62	0.542	29.835	0.787
61	0.542	29.648	1.382
60	0.542	29.454	0.389
59	0.542	29.328	1.07
58	0.542	29.208	0.789
57	0.542	28.991	1.019
56	0.542	28.969	0.781
55	0.542	28.893	0.706
54	0.542	28.728	1.1
53	0.541	28.64	0.574
52	0.541	28.567	0.592
51	0.54	28.533	0.666
50	0.54	28.529	1.206
49	0.54	28.528	0.862
48	0.54	28.527	1.076
47	0.537	28.527	0.691
46	0.535	28.526	0.433
39	4.115	28.898	0.762
38	4.115	28.889	0.756
37	4.114	28.877	0.764
36	4.114	28.865	0.773
35	4.113	28.852	0.782
34	4.113	28.828	0.801
33	4.112	28.808	0.816
32	4.112	28.794	0.826
31	4.107	28.816	0.798
30	4.101	28.788	0.862
29	4.1	28.76	0.928
28	4.099	28.711	1.027
27	4.1	28.633	1.16
26	4.1	28.526	1.32
25	4.277	28.526	0.788
24	4.277	28.478	0.898
23	4.277	28.301	1.481
22	4.277	28.273	1.48
21	4.277	28.245	1.474
20	4.277	28.22	1.451
19	4.277	28.198	1.416
18	4.277	28.193	1.316
17	4.277	28.19	1.22
16	4.277	28.186	1.148
15	4.277	28.181	1.099
14	4.277	28.194	0.872
13	4.277	28.2	0.737
12	4.277	28.202	0.647
11	4.277	28.204	0.577
10	4.277	28.161	0.776
9	4.277	28.159	0.676
8	4.277	28.156	0.608
7	4.277	28.157	0.511
6	4.277	28.16	0.394
5	4.277	28.163	0.265
4	4.277	28.164	0.175
3	4.276	28.162	0.253
2	4.277	28.161	0.242
1	4.276	28.142	0.588

Table 9: Results for climate change 1 in 20 year event

	Results - 20yrCC		
Cross Section	Max Flow (m3/s)	Max Stage (m AD)	Max Velocity (m/s)
79	0.733	31.588	1.08
79a	0.733	31.573	1.12
79b	0.733	31.556	1.172
79c	0.733	31.525	1.275
79d	0.733	31.5	1.369
79e	0.733	31.479	1.451
78	0.733	31.433	1.119
77	0.733	31.347	0.996
76	0.732	31.298	0.689
75	0.732	31.261	1.118
74	0.732	31.223	0.849
73	0.732	31.113	1.092
72	0.732	31.041	0.747
71	0.731	30.962	0.866
70	0.731	30.942	0.508
69	0.73	30.875	0.607
68	0.73	30.848	0.605
67	0.73	30.568	1.346
66	0.73	30.466	0.965
65	0.731	30.423	0.76
64	0.731	30.334	1.023
63	0.731	30.108	1.504
62	0.731	29.897	0.878
61	0.731	29.71	1.497
60	0.731	29.517	0.455
59	0.731	29.403	1.084
58	0.731	29.301	0.846
57	0.731	29.057	1.14
56	0.731	29.042	0.835
55	0.731	28.971	0.755
54	0.731	28.78	1.248
53	0.731	28.751	0.577
52	0.73	28.747	0.609
51	0.73	28.746	0.665
50	0.729	28.745	1.266
49	0.728	28.744	0.93
48	0.727	28.743	1.11
47	0.724	28.743	0.682
46	0.721	28.743	0.441
39	5.56	29.032	0.9
38	5.559	29.018	0.901
37	5.559	29	0.918
36	5.558	28.982	0.934
35	5.558	28.961	0.952
34	5.557	28.922	0.99
33	5.556	28.889	1.021
32	5.556	28.866	1.044
31	5.551	28.916	0.772
30	5.544	28.895	0.858
29	5.541	28.874	0.927
28	5.539	28.844	1.025
27	5.538	28.804	1.156
26	5.539	28.743	1.323
25	5.774	28.743	0.792
24	5.774	28.714	0.901
23	5.773	28.438	1.713
22	5.773	28.403	1.719
21	5.773	28.369	1.715
20	5.773	28.338	1.691
19	5.773	28.309	1.659
18	5.773	28.304	1.547
17	5.773	28.299	1.449
16	5.773	28.293	1.378
15	5.773	28.284	1.335
14	5.773	28.307	1.048
13	5.773	28.316	0.882
12	5.773	28.32	0.772
11	5.773	28.322	0.692
10	5.773	28.251	0.939
9	5.773	28.25	0.811
8	5.773	28.248	0.718
7	5.773	28.25	0.593
6	5.773	28.255	0.454
5	5.773	28.259	0.31
4	5.772	28.262	0.201
3	5.772	28.259	0.243
2	5.772	28.257	0.219
1	5.772	28.24	0.588

Table 10: Results for 1 in 100 year event

	Results - 100yr		
Cross Section	Max Flow (m3/s)	Max Stage (m AD)	Max Velocity (m/s)
79	0.793	31.61	1.11
79a	0.793	31.595	1.15
79b	0.793	31.577	1.201
79c	0.793	31.547	1.298
79d	0.793	31.521	1.393
79e	0.793	31.501	1.477
78	0.793	31.456	1.143
77	0.793	31.371	1.017
76	0.792	31.322	0.713
75	0.792	31.281	1.15
74	0.792	31.246	0.864
73	0.792	31.128	1.139
72	0.791	31.059	0.758
71	0.791	30.981	0.882
70	0.791	30.964	0.522
69	0.79	30.895	0.625
68	0.79	30.868	0.626
67	0.79	30.586	1.372
66	0.79	30.484	0.991
65	0.79	30.441	0.783
64	0.79	30.344	1.076
63	0.79	30.12	1.529
62	0.791	29.915	0.902
61	0.791	29.727	1.526
60	0.791	29.538	0.47
59	0.791	29.427	1.09
58	0.791	29.327	0.86
57	0.791	29.076	1.169
56	0.791	29.064	0.848
55	0.791	28.994	0.765
54	0.791	28.795	1.293
53	0.79	28.752	0.576
52	0.789	28.747	0.625
51	0.788	28.746	0.667
50	0.788	28.745	1.274
49	0.787	28.744	0.96
48	0.786	28.743	1.208
47	0.783	28.743	0.755
46	0.78	28.743	0.506
39	5.543	29.032	0.899
38	5.542	29.017	0.899
37	5.542	28.999	0.916
36	5.541	28.981	0.932
35	5.54	28.961	0.95
34	5.54	28.921	0.988
33	5.539	28.889	1.019
32	5.539	28.866	1.041
31	5.535	28.916	0.774
30	5.531	28.894	0.86
29	5.529	28.873	0.928
28	5.529	28.844	1.024
27	5.53	28.804	1.156
26	5.531	28.743	1.322
25	5.777	28.743	0.793
24	5.776	28.714	0.902
23	5.776	28.439	1.714
22	5.776	28.403	1.72
21	5.776	28.369	1.716
20	5.776	28.338	1.691
19	5.775	28.309	1.659
18	5.776	28.304	1.548
17	5.775	28.299	1.449
16	5.775	28.293	1.379
15	5.775	28.285	1.335
14	5.775	28.307	1.048
13	5.775	28.316	0.882
12	5.775	28.32	0.772
11	5.775	28.323	0.692
10	5.775	28.251	0.939
9	5.775	28.25	0.811
8	5.775	28.248	0.718
7	5.775	28.251	0.594
6	5.775	28.255	0.454
5	5.775	28.259	0.31
4	5.775	28.262	0.201
3	5.774	28.259	0.252
2	5.774	28.257	0.237
1	5.774	28.24	0.587

Table 11: Results for 1 in 100 year plus climate change (35%) event

	Results - 100yrCC		
Cross Section	Max Flow (m3/s)	Max Stage (m AD)	Max Velocity (m/s)
79	1.071	31.702	1.221
79a	1.071	31.686	1.263
79b	1.071	31.667	1.316
79c	1.071	31.635	1.414
79d	1.071	31.61	1.499
79e	1.071	31.589	1.575
78	1.071	31.556	1.223
77	1.07	31.474	1.096
76	1.07	31.425	0.806
75	1.07	31.369	1.271
74	1.07	31.341	0.926
73	1.069	31.2	1.309
72	1.069	31.142	0.796
71	1.069	31.066	0.955
70	1.068	31.052	0.582
69	1.067	30.977	0.705
68	1.066	30.946	0.715
67	1.067	30.66	1.472
66	1.067	30.564	1.088
65	1.067	30.522	0.859
64	1.067	30.394	1.274
63	1.067	30.178	1.6
62	1.068	29.993	0.993
61	1.068	29.804	1.642
60	1.068	29.622	0.536
59	1.068	29.523	1.096
58	1.068	29.434	0.927
57	1.068	29.15	1.318
56	1.068	29.147	0.917
55	1.068	29.077	0.84
54	1.068	28.984	1.445
53	1.068	28.984	0.579
52	1.067	28.982	0.671
51	1.067	28.981	0.668
50	1.064	28.981	1.276
49	1.062	28.981	1.018
48	1.06	28.98	1.235
47	1.056	28.98	0.709
46	1.053	28.98	0.523
39	7.483	29.215	0.972
38	7.481	29.198	0.984
37	7.48	29.177	1.013
36	7.479	29.153	1.048
35	7.478	29.125	1.082
34	7.476	29.066	1.159
33	7.475	29.015	1.224
32	7.475	28.978	1.27
31	7.465	29.052	0.701
30	7.459	29.039	0.745
29	7.46	29.026	0.79
28	7.463	29.012	0.849
27	7.467	28.995	1.132
26	7.471	28.98	1.317
25	7.775	28.98	0.795
24	7.774	28.967	0.906
23	7.773	28.596	1.965
22	7.773	28.554	1.969
21	7.773	28.512	1.965
20	7.773	28.474	1.944
19	7.774	28.439	1.916
18	7.773	28.432	1.798
17	7.774	28.425	1.703
16	7.774	28.415	1.642
15	7.773	28.401	1.61
14	7.773	28.438	1.246
13	7.773	28.453	1.04
12	7.773	28.46	0.909
11	7.773	28.463	0.816
10	7.773	28.342	1.126
9	7.773	28.341	0.973
8	7.773	28.34	0.851
7	7.773	28.347	0.674
6	7.773	28.355	0.5
5	7.773	28.361	0.335
4	7.773	28.364	0.22
3	7.772	28.361	0.243
2	7.772	28.359	0.228
1	7.772	28.341	0.588

Table 12: Results for 1 in 1000 year event

	Results - 1000yr		
Cross Section	**Max Flow (m3/s)**	**Max Stage (m AD)**	**Max Velocity (m/s)**
79	1.369	31.789	1.316
79a	1.369	31.772	1.359
79b	1.369	31.752	1.413
79c	1.369	31.72	1.508
79d	1.369	31.696	1.582
79e	1.369	31.674	1.656
78	1.369	31.652	1.286
77	1.368	31.575	1.157
76	1.367	31.526	0.881
75	1.367	31.453	1.37
74	1.367	31.433	0.978
73	1.367	31.268	1.461
72	1.366	31.22	0.832
71	1.365	31.145	1.019
70	1.365	31.136	0.636
69	1.363	31.056	0.762
68	1.363	31.021	0.791
67	1.364	30.731	1.56
66	1.364	30.637	1.177
65	1.364	30.612	0.879
64	1.364	30.442	1.445
63	1.364	30.231	1.67
62	1.364	30.058	1.082
61	1.364	29.87	1.766
60	1.364	29.699	0.613
59	1.363	29.624	1.101
58	1.362	29.53	0.989
57	1.362	29.214	1.456
56	1.362	29.22	0.983
55	1.362	29.148	0.914
54	1.361	29.019	1.557
53	1.361	29.019	0.58
52	1.361	29.015	0.724
51	1.36	29.014	0.668
50	1.359	29.013	1.276
49	1.357	29.012	1.031
48	1.355	29.01	1.415
47	1.35	29.01	0.882
46	1.347	29.01	0.652
39	8.089	29.243	1.046
38	8.089	29.225	1.066
37	8.089	29.203	1.104
36	8.089	29.179	1.15
35	8.089	29.151	1.197
34	8.089	29.091	1.301
33	8.089	29.036	1.392
32	8.089	28.996	1.463
31	8.09	29.074	0.665
30	8.284	29.061	0.699
29	8.511	29.05	0.736
28	8.717	29.037	0.786
27	8.959	29.023	0.991
26	9.312	29.01	1.311
25	10.133	29.01	0.798
24	10.365	28.998	0.907
23	10.212	28.791	1.99
22	10.177	28.753	2.034
21	10.163	28.712	2.091
20	10.155	28.682	2.042
19	10.147	28.655	1.981
18	10.143	28.649	1.876
17	10.14	28.64	1.81
16	10.139	28.626	1.772
15	10.139	28.609	1.764
14	10.14	28.658	1.348
13	10.144	28.678	1.117
12	10.15	28.688	0.97
11	10.158	28.693	0.856
10	10.158	28.41	1.285
9	10.126	28.412	1.08
8	10.1	28.413	0.913
7	10.073	28.422	0.697
6	10.039	28.429	0.531
5	9.987	28.435	0.36
4	9.93	28.438	0.235
3	9.807	28.435	0.255
2	9.722	28.432	0.244
1	9.681	28.415	0.589

Table 13: Results for climate change 1 in 1000 year event

	Results - 1000yrCC		
Cross Section	Max Flow (m3/s)	Max Stage (m AD)	Max Velocity (m/s)
79	1.848	31.911	1.44
79a	1.848	31.893	1.482
79b	1.848	31.872	1.536
79c	1.848	31.838	1.63
79d	1.848	31.814	1.698
79e	1.848	31.792	1.767
78	1.848	31.781	1.384
77	1.847	31.705	1.253
76	1.847	31.653	0.993
75	1.847	31.572	1.495
74	1.846	31.563	1.046
73	1.845	31.359	1.674
72	1.841	31.326	0.894
71	1.847	31.243	1.138
70	1.854	31.235	0.733
69	1.836	31.163	0.763
68	1.867	31.11	0.869
67	1.894	30.812	1.791
66	1.846	30.705	1.486
65	2.016	30.725	0.879
64	2.065	30.54	1.708
63	2.04	30.322	1.878
62	1.998	30.146	1.25
61	1.854	29.983	1.763
60	1.979	29.808	0.599
59	1.906	29.789	1.102
58	1.834	29.657	1.078
57	1.834	29.295	1.666
56	1.835	29.318	1.079
55	1.842	29.249	0.981
54	1.845	29.121	1.698
53	1.841	29.122	0.581
52	1.818	29.12	0.775
51	1.816	29.12	0.669
50	1.807	29.119	1.277
49	1.815	29.119	1.024
48	1.965	29.118	1.472
47	2.336	29.118	0.844
46	2.331	29.118	0.68
39	10.92	29.444	1.04
38	11.182	29.417	1.065
37	10.972	29.389	1.116
36	10.919	29.354	1.185
35	10.918	29.307	1.27
34	10.918	29.195	1.454
33	10.918	29.126	1.623
32	10.918	29.061	1.772
31	11.963	29.183	0.632
30	11.268	29.17	0.66
29	11.391	29.159	0.685
28	11.542	29.146	0.723
27	12.187	29.131	0.768
26	11.8	29.118	0.818
25	12.683	29.118	0.798
24	12.89	29.104	0.91
23	12.616	28.967	1.991
22	12.11	28.93	2.139
21	11.77	28.895	2.322
20	11.755	28.86	2.298
19	11.725	28.828	2.179
18	11.678	28.805	1.972
17	11.637	28.793	1.905
16	11.593	28.778	1.871
15	11.558	28.76	1.867
14	11.496	28.81	1.418
13	11.387	28.831	1.16
12	11.372	28.844	0.993
11	11.371	28.854	0.86
10	11.371	28.484	1.431
9	11.371	28.486	1.267
8	11.37	28.486	1.16
7	11.388	28.493	0.913
6	11.497	28.499	0.691
5	11.416	28.504	0.465
4	11.367	28.507	0.291
3	11.367	28.504	0.249
2	11.365	28.5	0.256
1	11.365	28.484	0.59

7.7 Flood Zones and Upper End climate change 1 in 100 year event

7.7.1 Due to the flood mapping inconsistencies produced by the model as discussed in paragraph 7.6.4, instead of exporting the flood contours directly from the model, the tabulated results have been mapped onto the topographical survey and the resultant flood zones exported into MapInfo software and mapped onto the OS map.

7.7.2 Reference to Figure 26 indicates that the site is located mainly within the Flood 1, with some northern parts of the site located within Flood Zones 3b, 3a and 2.

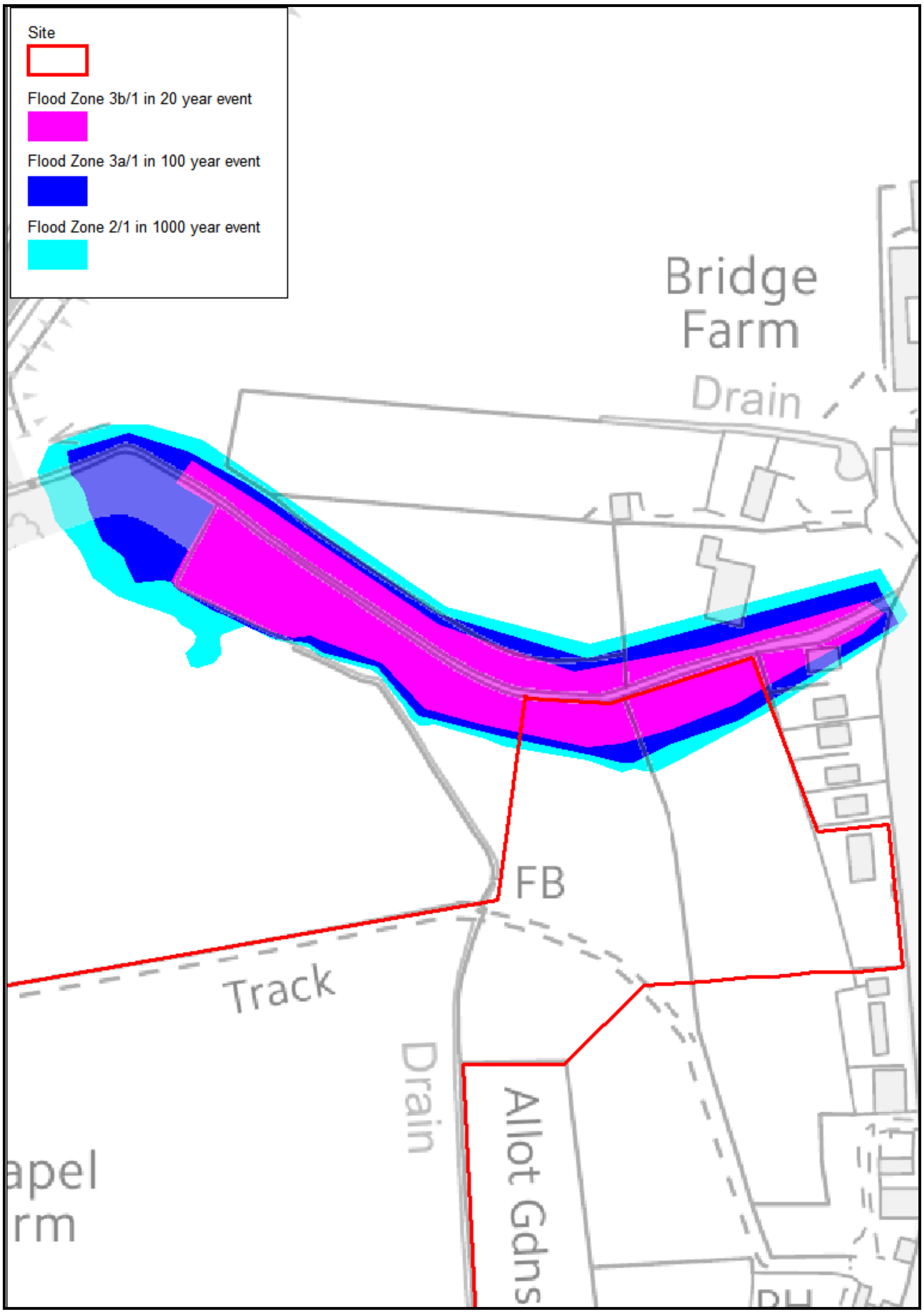


Figure 26: Present day flood extents and flood zones (note that only the southern floodplain of the Dickleburgh Stream has been mapped accurately)

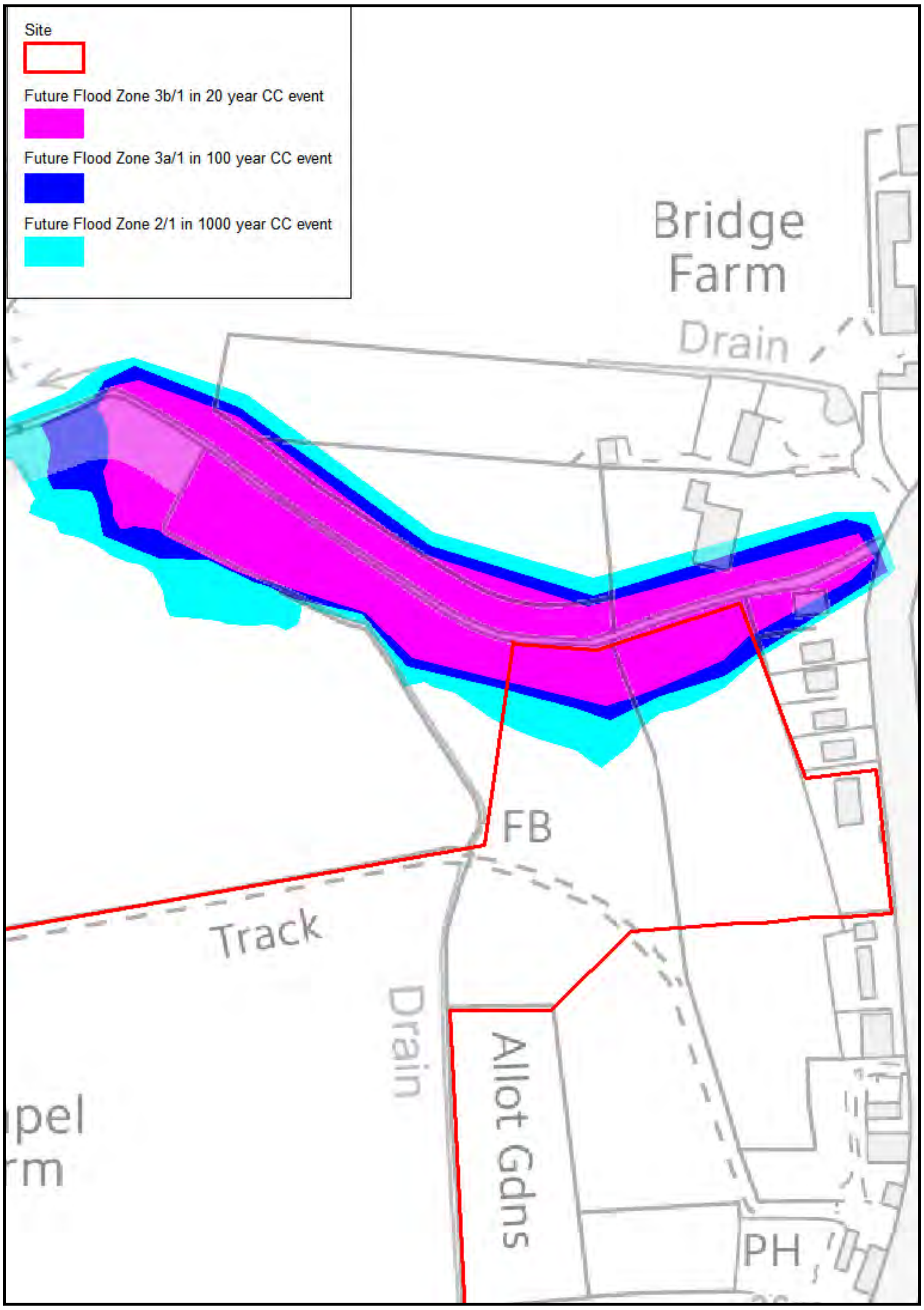


Figure 27: Future flood extents and flood zones (note that only the southern floodplain of the Dickleburgh Stream has been mapped accurately)

7.7.3 Figure 28 shows the flood extent when considering the Upper End climate change 1 in 100 year event. Figure 28 also shows that the Upper End flood extent lies between the present day and future Flood Zone 2/1 in 1000 year flood extent.

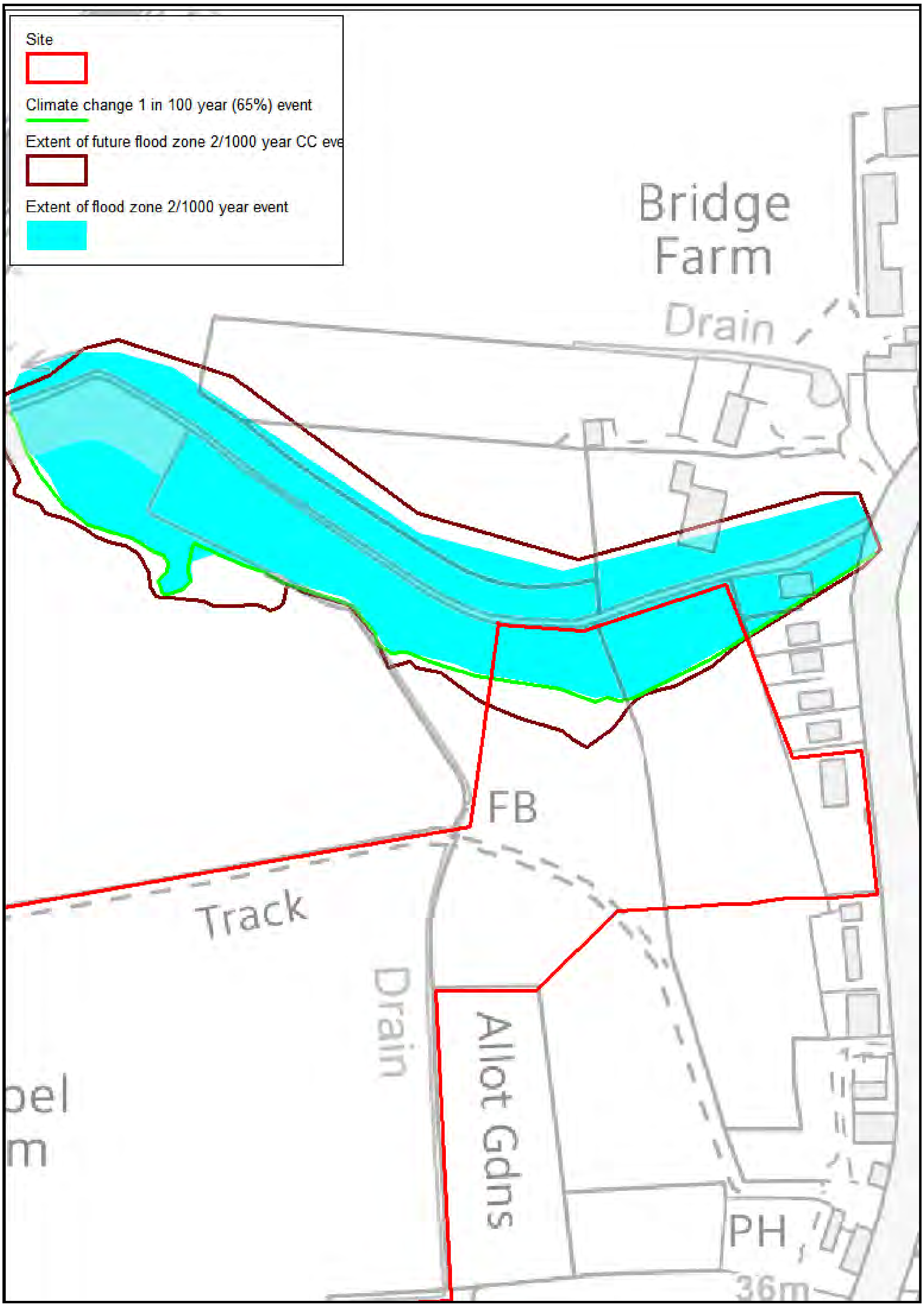


Figure 28: Extent of Upper End climate change 1 in 100 year event in relation to present day Flood Zone 2 and future Flood Zone 2

Table 14: Results for 1 in 100 year plus climate change event (Upper End)

	Results - 100yrCC (Upper End)		
Cross Section	Max Flow (m3/s)	Max Stage (m AD)	Max Velocity (m/s)
79	1.308	31.772	1.298
79a	1.308	31.755	1.342
79b	1.308	31.735	1.397
79c	1.308	31.703	1.489
79d	1.308	31.679	1.565
79e	1.308	31.657	1.642
78	1.308	31.633	1.274
77	1.307	31.555	1.145
76	1.307	31.506	0.868
75	1.307	31.437	1.353
74	1.306	31.416	0.967
73	1.306	31.255	1.433
72	1.306	31.205	0.825
71	1.305	31.13	1.005
70	1.305	31.12	0.624
69	1.303	31.041	0.754
68	1.302	31.007	0.776
67	1.302	30.718	1.544
66	1.303	30.623	1.158
65	1.303	30.592	0.88
64	1.303	30.432	1.416
63	1.303	30.223	1.652
62	1.305	30.054	1.061
61	1.307	29.862	1.738
60	1.316	29.697	0.588
59	1.334	29.621	1.1
58	1.349	29.526	0.989
57	1.349	29.211	1.453
56	1.349	29.218	0.981
55	1.352	29.146	0.913
54	1.354	29.026	1.554
53	1.349	29.025	0.579
52	1.335	29.019	0.708
51	1.323	29.015	0.666
50	1.308	29.018	1.27
49	1.307	29.024	1.024
48	1.306	29.015	1.261
47	1.529	29.003	0.682
46	1.991	29.002	0.536
39	9.146	29.295	1.043
38	9.142	29.27	1.068
37	9.142	29.237	1.123
36	9.141	29.203	1.189
35	9.141	29.165	1.252
34	9.14	29.093	1.395
33	9.14	29.035	1.525
32	9.14	28.992	1.624
31	9.134	29.077	0.683
30	9.13	29.059	0.719
29	9.128	29.049	0.761
28	9.129	29.046	0.814
27	9.129	29.02	0.915
26	11.554	29.002	1.228
25	13.545	29.002	0.795
24	14.087	28.99	0.906
23	11.916	28.808	1.991
22	11.725	28.77	2.233
21	11.668	28.722	2.376
20	11.643	28.688	2.355
19	11.652	28.66	2.346
18	11.689	28.653	2.247
17	11.742	28.643	2.186
16	11.774	28.629	2.158
15	11.726	28.611	2.136
14	11.534	28.66	1.542
13	11.186	28.696	1.214
12	10.711	28.72	0.996
11	10.152	28.734	0.854
10	10.152	28.412	1.301
9	10.141	28.414	1.092
8	10.136	28.416	0.933
7	10.144	28.425	0.712
6	10.16	28.431	0.536
5	10.181	28.437	0.366
4	10.186	28.441	0.241
3	10.088	28.437	0.245
2	9.933	28.434	0.247
1	9.752	28.417	0.589

7.8 Sensitivity Analysis

7.8.1 Chapter 7 of the Agency's guidance document entitled *Fluvial Design Guide (2009)*, and Section 4.3 of the EA *Using Computer River Modelling as part of a flood risk assessment* guide, suggests that the model should be tested for sensitivity by adjusting key parameters such as the channel roughness values, downstream slope, flow rate and blockage.

7.8.2 In order to determine whether the model is sensitive when considering a particular parameter, each sensitivity test was carried out individually and as a separate model run. The sensitivity analysis has been carried out for the design climate change (35%) 1 in 100 year event.

7.8.3 The channel Manning's roughness has been increased by 20% (i.e. from 0.035 to 0.042 in order to consider an even higher density of channel vegetation).

7.8.4 The gradient of the downstream boundary slope has also been made shallower by 20% (i.e. from 1:880 to 1:1056).

7.8.5 To model a 50% blockage of the downstream A140 concrete culvert caused by lack of maintenance, debris or vegetation growth, a Blockage unit was placed before the rectangular conduit unit in the model and the blockage proportion set at 0.5. It is considered that a blockage scenario of this culvert will have the most impact on upstream water levels and flood risk at the site.

7.8.6 When considering changes to inflows, it is considered that modelling of the climate change 1 in 1000 year event and climate change (Upper End) 1 in 100 year event in this assessment is sufficient.

Results

7.8.7 The results in Table 15 show that when considering an increase in channel roughness, flood levels are overall higher and typically by up to 0.088m. However, downstream of the site between cross sections 23 and 11 the level is up to 0.203m higher. There is not a significant increased risk to the site and it is considered that the previous conservative manning's value used in this assessment remains suitable.

7.8.8 Table 16 shows that there is a negligible increase in flood levels at the site when considering a shallower downstream slope, which is to be expected as the downstream boundary is sufficiently downstream of the site as discussed in Section 7.5.

7.8.9 Table 17 shows that when introducing a 50% blockage to the opening of the A140 rectangular culvert unit, the upstream flood levels increase significantly and by up to 1.198m (i.e. at cross section 15 upstream of the culvert). Floodwater is also shown not to flow over the A140 road deck/spill unit (i.e. the road deck is set higher than the flood level) which could explain why upstream flood levels are higher. Figure 29 shows that there would be an increase in flood extent across the site in relation to the baseline climate change (35%) 1 in 100 year flood event. The flood level across the northern part of the site would reach 29.617m AOD (i.e. at cross section 36).

Table 15: Results comparison for increased "n" during climate change 1 in 100 year event

Channel Manning's n = 0.042					Original Results		
Node	Max Stage (m AD)	Max Velocity (m/s)		Node	Max Stage (m AD)	Max Velocity (m/s)	Stage Difference (m)
79	31.756	1.098		79	31.702	1.221	0.054
79a	31.74	1.133		79a	31.686	1.263	0.054
79b	31.722	1.175		79b	31.667	1.316	0.055
79c	31.695	1.239		79c	31.635	1.414	0.06
79d	31.677	1.287		79d	31.61	1.499	0.067
79e	31.658	1.34		79e	31.589	1.575	0.069
78	31.627	1.057		78	31.556	1.223	0.071
77	31.541	0.962		77	31.474	1.096	0.067
76	31.479	0.74		76	31.425	0.806	0.054
75	31.436	1.109		75	31.369	1.271	0.067
74	31.398	0.82		74	31.341	0.926	0.057
73	31.267	1.145		73	31.2	1.309	0.067
72	31.198	0.686		72	31.142	0.796	0.056
71	31.131	0.822		71	31.066	0.955	0.065
70	31.111	0.52		70	31.052	0.582	0.059
69	31.035	0.626		69	30.977	0.705	0.058
68	31.002	0.642		68	30.946	0.715	0.056
67	30.712	1.283		67	30.66	1.472	0.052
66	30.616	0.963		66	30.564	1.088	0.052
65	30.564	0.769		65	30.522	0.859	0.042
64	30.437	1.147		64	30.394	1.274	0.043
63	30.219	1.378		63	30.178	1.6	0.041
62	30.081	0.802		62	29.993	0.993	0.088
61	29.83	1.536		61	29.804	1.642	0.026
60	29.663	0.494		60	29.622	0.536	0.041
59	29.575	0.951		59	29.523	1.096	0.052
58	29.469	0.864		58	29.434	0.927	0.035
57	29.212	1.143		57	29.15	1.318	0.062
56	29.197	0.814		56	29.147	0.917	0.05
55	29.118	0.763		55	29.077	0.84	0.041
54	29	1.255		54	28.984	1.445	0.016
53	28.996	0.494		53	28.984	0.579	0.012
52	28.992	0.6		52	28.982	0.671	0.01
51	28.991	0.609		51	28.981	0.668	0.01
50	28.991	1.052		50	28.981	1.276	0.01
49	28.99	0.872		49	28.981	1.018	0.009
48	28.989	1.045		48	28.98	1.235	0.009
47	28.988	0.682		47	28.98	0.709	0.008
46	28.988	0.463		46	28.98	0.523	0.008
39	29.302	0.841		39	29.215	0.972	0.087
38	29.281	0.874		38	29.198	0.984	0.083
37	29.256	0.93		37	29.177	1.013	0.079
36	29.23	0.977		36	29.153	1.048	0.077
35	29.199	1.023		35	29.125	1.082	0.074
34	29.134	1.126		34	29.066	1.159	0.068
33	29.069	1.216		33	29.015	1.224	0.054
32	29.018	1.282		32	28.978	1.27	0.04
31	29.063	0.6		31	29.052	0.701	0.011
30	29.049	0.638		30	29.039	0.745	0.01
29	29.037	0.68		29	29.026	0.79	0.011
28	29.021	0.735		28	29.012	0.849	0.009
27	29.004	0.858		27	28.995	1.132	0.009
26	28.988	1.196		26	28.98	1.317	0.008
25	28.988	0.701		25	28.98	0.795	0.008
24	28.975	0.808		24	28.967	0.906	0.008
23	28.798	1.852		23	28.596	1.965	0.202
22	28.75	1.913		22	28.554	1.969	0.196
21	28.709	1.977		21	28.512	1.965	0.197
20	28.677	1.94		20	28.474	1.944	0.203
19	28.634	1.926		19	28.439	1.916	0.195
18	28.621	1.851		18	28.432	1.798	0.189
17	28.614	1.793		17	28.425	1.703	0.189
16	28.603	1.765		16	28.415	1.642	0.188
15	28.585	1.772		15	28.401	1.61	0.184
14	28.619	1.374		14	28.438	1.246	0.181
13	28.635	1.148		13	28.453	1.04	0.182
12	28.642	1.006		12	28.46	0.909	0.182
11	28.645	0.908		11	28.463	0.816	0.182
10	28.419	1.34		10	28.342	1.126	0.077
9	28.415	1.174		9	28.341	0.973	0.074
8	28.413	1.02		8	28.34	0.851	0.073
7	28.418	0.769		7	28.347	0.674	0.071
6	28.422	0.559		6	28.355	0.5	0.067
5	28.427	0.369		5	28.361	0.335	0.066
4	28.429	0.232		4	28.364	0.22	0.065
3	28.426	0.241		3	28.361	0.243	0.065
2	28.422	0.224		2	28.359	0.228	0.063
1	28.406	0.509		1	28.341	0.588	0.065

Table 16: Results comparison for shallower downstream slope during climate change 1 in 100 year event

Channel slope = 1:1056					Original Results		
Node	Max Stage (m AD)	Max Velocity (m/s)		Node	Max Stage (m AD)	Max Velocity (m/s)	Stage Difference (m)
79	31.702	1.221		79	31.702	1.221	0
79a	31.686	1.263		79a	31.686	1.263	0
79b	31.667	1.316		79b	31.667	1.316	0
79c	31.635	1.414		79c	31.635	1.414	0
79d	31.61	1.499		79d	31.61	1.499	0
79e	31.589	1.575		79e	31.589	1.575	0
78	31.556	1.223		78	31.556	1.223	0
77	31.474	1.096		77	31.474	1.096	0
76	31.425	0.806		76	31.425	0.806	0
75	31.369	1.271		75	31.369	1.271	0
74	31.341	0.926		74	31.341	0.926	0
73	31.2	1.309		73	31.2	1.309	0
72	31.142	0.796		72	31.142	0.796	0
71	31.066	0.955		71	31.066	0.955	0
70	31.052	0.582		70	31.052	0.582	0
69	30.977	0.705		69	30.977	0.705	0
68	30.946	0.715		68	30.946	0.715	0
67	30.66	1.472		67	30.66	1.472	0
66	30.564	1.088		66	30.564	1.088	0
65	30.522	0.859		65	30.522	0.859	0
64	30.394	1.274		64	30.394	1.274	0
63	30.178	1.6		63	30.178	1.6	0
62	29.993	0.993		62	29.993	0.993	0
61	29.804	1.642		61	29.804	1.642	0
60	29.622	0.536		60	29.622	0.536	0
59	29.523	1.096		59	29.523	1.096	0
58	29.434	0.927		58	29.434	0.927	0
57	29.15	1.318		57	29.15	1.318	0
56	29.147	0.917		56	29.147	0.917	0
55	29.077	0.84		55	29.077	0.84	0
54	28.992	1.445		54	28.984	1.445	0.008
53	28.987	0.579		53	28.984	0.579	0.003
52	28.985	0.671		52	28.982	0.671	0.003
51	28.984	0.668		51	28.981	0.668	0.003
50	28.984	1.276		50	28.981	1.276	0.003
49	28.984	1.009		49	28.981	1.018	0.003
48	28.983	1.223		48	28.98	1.235	0.003
47	28.983	0.697		47	28.98	0.709	0.003
46	28.983	0.514		46	28.98	0.523	0.003
39	29.216	1.018		39	29.215	0.972	0.001
38	29.199	1.032		38	29.198	0.984	0.001
37	29.178	1.065		37	29.177	1.013	0.001
36	29.155	1.098		36	29.153	1.048	0.002
35	29.127	1.14		35	29.125	1.082	0.002
34	29.068	1.222		34	29.066	1.159	0.002
33	29.016	1.291		33	29.015	1.224	0.001
32	28.981	1.346		32	28.978	1.27	0.003
31	29.056	0.695		31	29.052	0.701	0.004
30	29.042	0.74		30	29.039	0.745	0.003
29	29.028	0.78		29	29.026	0.79	0.002
28	29.014	0.839		28	29.012	0.849	0.002
27	28.998	1.113		27	28.995	1.132	0.003
26	28.983	1.299		26	28.98	1.317	0.003
25	28.983	0.779		25	28.98	0.795	0.003
24	28.97	0.884		24	28.967	0.906	0.003
23	28.812	1.934		23	28.596	1.965	0.216
22	28.788	1.963		22	28.554	1.969	0.234
21	28.752	1.967		21	28.512	1.965	0.24
20	28.722	1.922		20	28.474	1.944	0.248
19	28.69	1.88		19	28.439	1.916	0.251
18	28.677	1.812		18	28.432	1.798	0.245
17	28.663	1.769		17	28.425	1.703	0.238
16	28.646	1.75		16	28.415	1.642	0.231
15	28.626	1.755		15	28.401	1.61	0.225
14	28.673	1.353		14	28.438	1.246	0.235
13	28.691	1.13		13	28.453	1.04	0.238
12	28.7	0.99		12	28.46	0.909	0.24
11	28.704	0.883		11	28.463	0.816	0.241
10	28.423	1.385		10	28.342	1.126	0.081
9	28.426	1.246		9	28.341	0.973	0.085
8	28.427	1.137		8	28.34	0.851	0.087
7	28.434	0.876		7	28.347	0.674	0.087
6	28.438	0.652		6	28.355	0.5	0.083
5	28.444	0.441		5	28.361	0.335	0.083
4	28.447	0.285		4	28.364	0.22	0.083
3	28.445	0.276		3	28.361	0.243	0.084
2	28.442	0.264		2	28.359	0.228	0.083
1	28.428	0.533		1	28.341	0.588	0.087

Table 17: Results comparison for 50% blockage of A140 culvert opening during climate change 1 in 100 year event

Blockage 50%					Original Results		
Node	Max Stage (m AD)	Max Velocity (m/s)		Node	Max Stage (m AD)	Max Velocity (m/s)	Stage Difference (m)
79	31.702	1.221		79	31.702	1.221	0
79a	31.686	1.263		79a	31.686	1.263	0
79b	31.667	1.316		79b	31.667	1.316	0
79c	31.635	1.414		79c	31.635	1.414	0
79d	31.61	1.499		79d	31.61	1.499	0
79e	31.589	1.575		79e	31.589	1.575	0
78	31.556	1.223		78	31.556	1.223	0
77	31.474	1.096		77	31.474	1.096	0
76	31.425	0.806		76	31.425	0.806	0
75	31.369	1.271		75	31.369	1.271	0
74	31.341	0.926		74	31.341	0.926	0
73	31.2	1.309		73	31.2	1.309	0
72	31.142	0.796		72	31.142	0.796	0
71	31.066	0.955		71	31.066	0.955	0
70	31.052	0.582		70	31.052	0.582	0
69	30.977	0.705		69	30.977	0.705	0
68	30.946	0.715		68	30.946	0.715	0
67	30.66	1.472		67	30.66	1.472	0
66	30.564	1.088		66	30.564	1.088	0
65	30.522	0.859		65	30.522	0.859	0
64	30.394	1.274		64	30.394	1.274	0
63	30.178	1.6		63	30.178	1.6	0
62	29.993	0.993		62	29.993	0.993	0
61	29.804	1.642		61	29.804	1.642	0
60	29.622	0.536		60	29.622	0.536	0
59	29.609	1.096		59	29.523	1.096	0.086
58	29.608	0.926		58	29.434	0.927	0.174
57	29.604	1.316		57	29.15	1.318	0.454
56	29.604	0.915		56	29.147	0.917	0.457
55	29.604	0.837		55	29.077	0.84	0.527
54	29.604	1.44		54	28.984	1.445	0.62
53	29.604	0.579		53	28.984	0.579	0.62
52	29.604	0.655		52	28.982	0.671	0.622
51	29.604	0.668		51	28.981	0.668	0.623
50	29.604	1.273		50	28.981	1.276	0.623
49	29.604	0.973		49	28.981	1.018	0.623
48	29.604	1.153		48	28.98	1.235	0.624
47	29.604	0.682		47	28.98	0.709	0.624
46	29.604	0.468		46	28.98	0.523	0.624
39	29.626	0.791		39	29.215	0.972	0.411
38	29.623	0.791		38	29.198	0.984	0.425
37	29.62	0.804		37	29.177	1.013	0.443
36	29.617	0.817		36	29.153	1.048	0.464
35	29.614	0.832		35	29.125	1.082	0.489
34	29.608	0.862		34	29.066	1.159	0.542
33	29.609	0.885		33	29.015	1.224	0.594
32	29.608	0.904		32	28.978	1.27	0.63
31	29.607	0.606		31	29.052	0.701	0.555
30	29.606	0.629		30	29.039	0.745	0.567
29	29.606	0.649		29	29.026	0.79	0.58
28	29.605	0.676		28	29.012	0.849	0.593
27	29.604	0.702		27	28.995	1.132	0.609
26	29.604	0.733		26	28.98	1.317	0.624
25	29.604	0.69		25	28.98	0.795	0.624
24	29.603	0.745		24	28.967	0.906	0.636
23	29.602	1.028		23	28.596	1.965	1.006
22	29.601	0.999		22	28.554	1.969	1.047
21	29.601	0.962		21	28.512	1.965	1.089
20	29.6	0.918		20	28.474	1.944	1.126
19	29.6	0.873		19	28.439	1.916	1.161
18	29.6	0.876		18	28.432	1.798	1.168
17	29.599	0.864		17	28.425	1.703	1.174
16	29.599	0.777		16	28.415	1.642	1.184
15	29.599	0.72		15	28.401	1.61	1.198
14	29.598	0.571		14	28.438	1.246	1.16
13	29.597	0.482		13	28.453	1.04	1.144
12	29.597	0.422		12	28.46	0.909	1.137
11	29.597	0.38		11	28.463	0.816	1.134
10	28.297	1.035		10	28.342	1.126	-0.045
9	28.297	0.889		9	28.341	0.973	-0.044
8	28.295	0.781		8	28.34	0.851	-0.045
7	28.3	0.638		7	28.347	0.674	-0.047
6	28.305	0.483		6	28.355	0.5	-0.05
5	28.311	0.325		5	28.361	0.335	-0.05
4	28.314	0.211		4	28.364	0.22	-0.05
3	28.311	0.245		3	28.361	0.243	-0.05
2	28.309	0.223		2	28.359	0.228	-0.05
1	28.291	0.59		1	28.341	0.588	-0.05

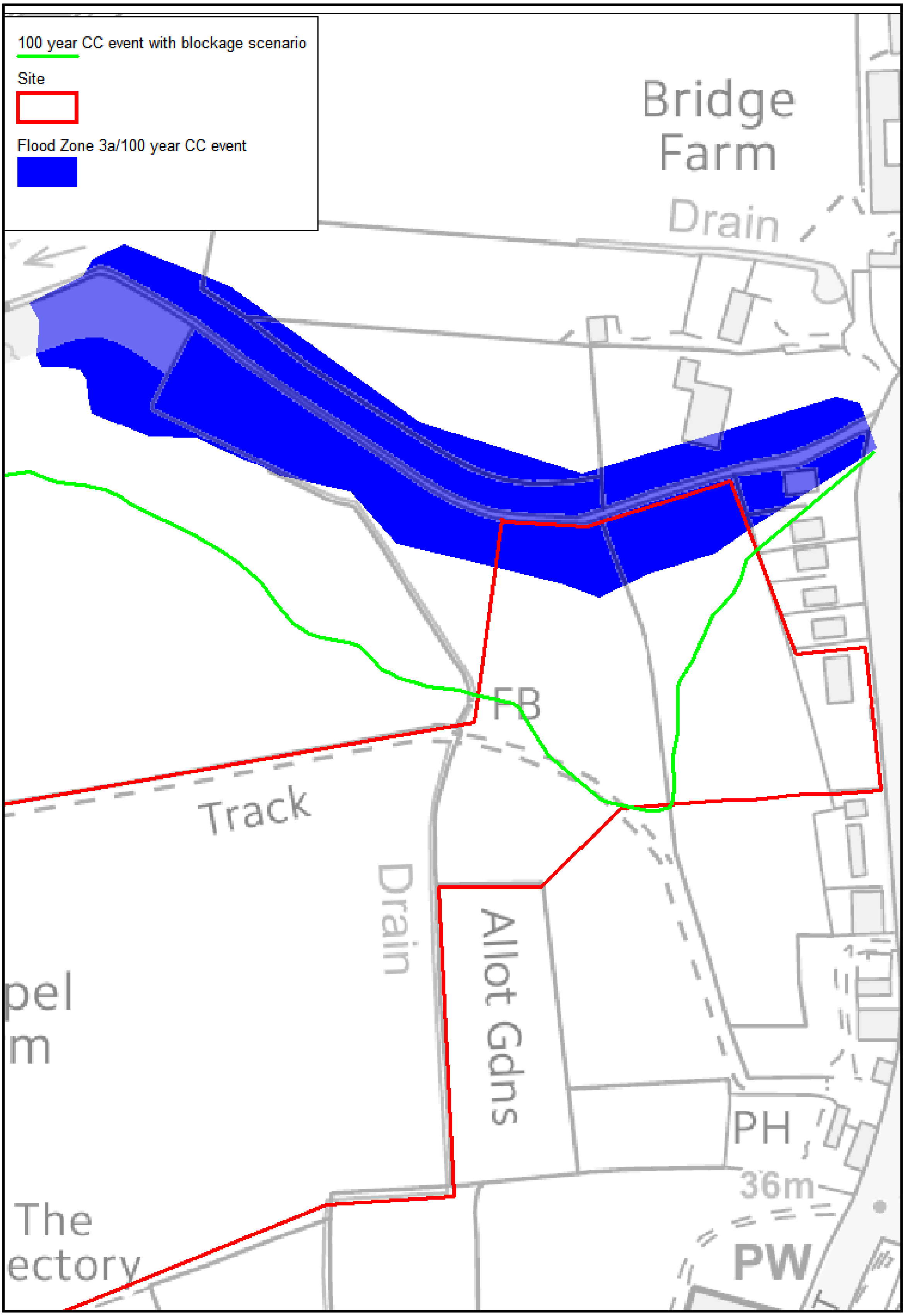


Figure 29: Extent of climate change (35%) 1 in 100 year flood extent with A140 blockage in relation to baseline climate change (35%) 1 in 100 year flood extent

8. CONCLUSIONS

- An InfoWorks RS model has been developed to determine the fluvial flood risk to the site from the watercourses.

- The results show that the site is mainly located within the present day and future Flood Zone 1, however, the northern part of the site is located within the Flood Zone 3b, 3a and 2.

- A sensitivity analysis has been carried out in which the model was tested for a change in channel roughness, change in downstream slope and partial blockage of the downstream A140 culvert. The results indicate that the model is not particularly sensitive and does not result in significant changes in flood extent. However, when considering the blockage scenario, there is a significant increase in flood level upstream and across the northern part of the site.

9. BIBLIOGRAPHY

i. Communities and Local Government 2012. *National Planning Policy Framework.*

ii. DEFRA/EA 2012. *Estimating flood peaks and hydrographs for small catchments: Phase 1 (SC090031).*

iii. DEFRA/EA 2008. *Improving the FEH statistical procedures for flood frequency estimation (SC050050/SR).*

iv. DEFRA/EA 2007. *Public Response to Flood Warning, Flood and Coastal Defence R&D Programme, R&D Technical Report SC020116.* Environment Agency.

v. DEFRA/EA 2005. *Framework and guidance for assessing and managing flood risk for new development, Phase 2, Flood and Coastal Defence R&D Programme, R&D Technical Report FD2320/TR2*. Water Research Council.

vi. Environment Agency 2012. *Flood Estimation Guidelines Operational Instruction (197_08).*

vii. Environment Agency 2009. *Requirements for completing computer river modelling for flood risk assessments.*

viii. Faulkner and Barber 2009. *Performance of the ReFH Method.* Journal of Flood Risk Management. Blackwell Publishing Ltd.

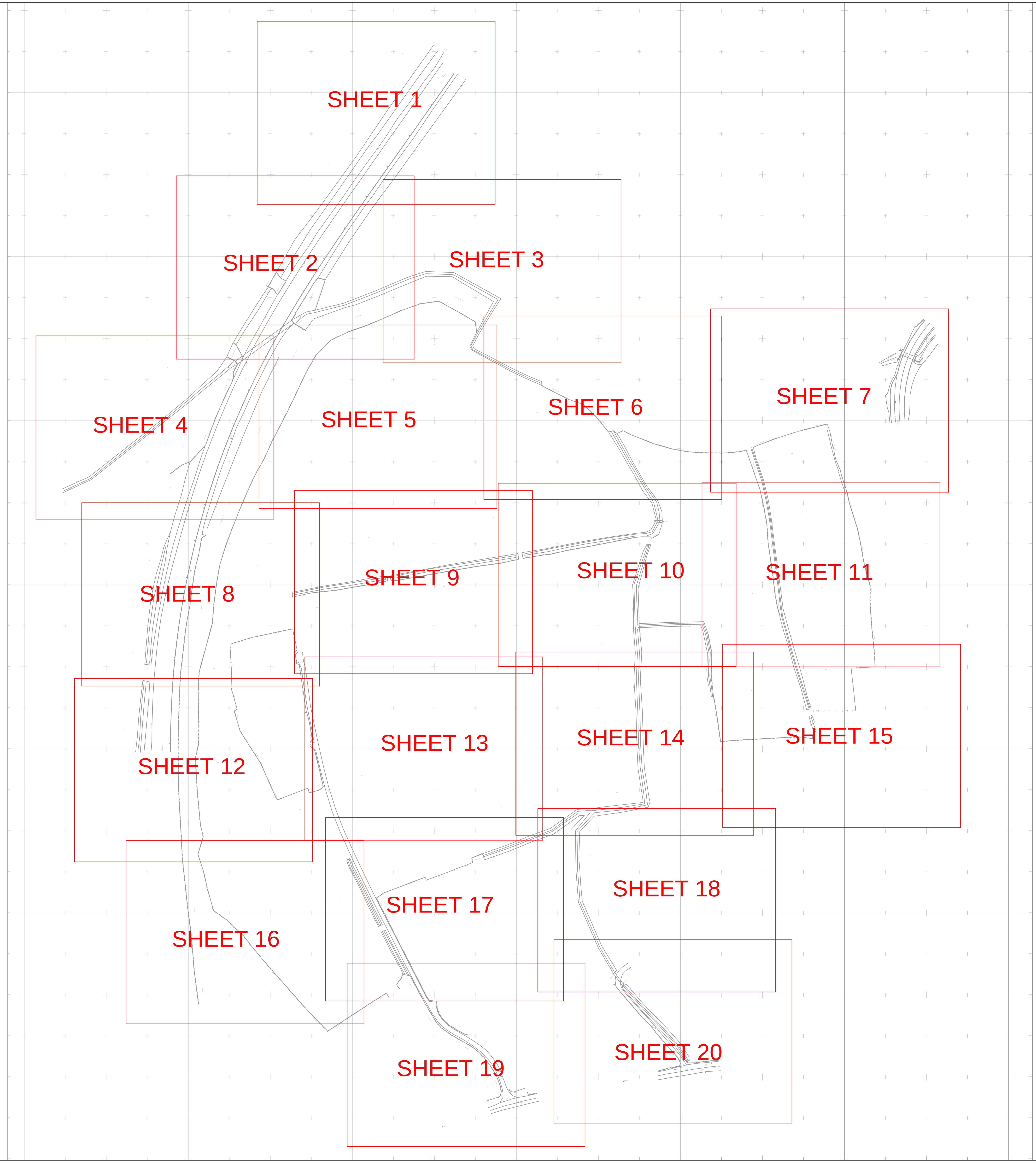
ix. NERC 2009. *Flood Estimation Handbook* [CD-ROM], Version 3. Institute of Hydrology.

x. NERC 1975. *Flood Studies Report (FSR)*. Institute of Hydrology.

xi. Wallingford Hydrosolutions Ltd 2009. *WINFAP-FEH Version 3*.

xii. Wallingford Software Ltd 2012*. InfoWorks RS*. Version 11.5.

DRAWINGS



DRAWING NUMBER:

2219-244-S01

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers — 0.225Ø FW MH
Storm Sewers — 0.375Ø SW MH
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey,
Deciduous
Coniferous

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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STATION TABLE

Code	Easting	Northing	Height
STNBBS1	616377.901	282515.227	30.813
STNBBS2	616400.063	282645.599	30.262
STNBBS3	616435.446	282735.731	30.381
STNBBS4	616470.805	282796.282	30.443
STNBBS5	616831.126	282699.498	29.836
STNBBS6	616842.146	282737.958	29.925
STNBBS7	616848.405	282761.489	30.124
STNBBS8	616665.627	282297.420	32.491
STNBBS9	616723.636	282306.322	32.250
STNBBS10	616684.813	282329.846	32.351
STNBBS11	616554.886	282269.681	32.004
STNBBS12	616601.275	282284.598	32.800

DATE:	REV:	REVISIONS
07.07.16	-	Survey Issued

BBS
BB SURVEYS LTD
38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

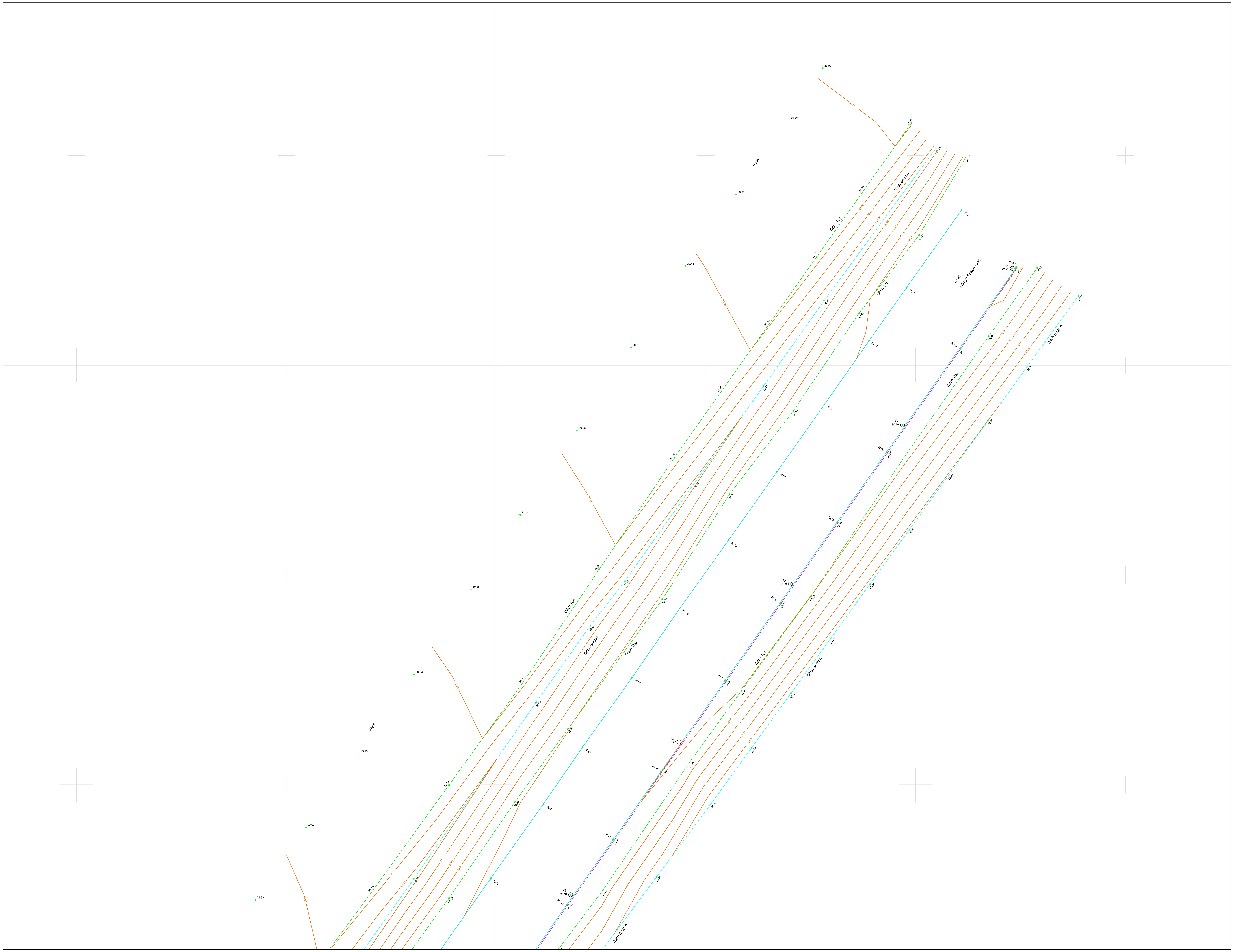
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Overview

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:1250	N.P.	A1	07.07.16

DRAWING NUMBER:

2219-244-S01



DRAWING NUMBER:

2219-244-S02

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
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CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	PO	Post	YL	Yellow Line
DR	Door	RE	Rodding Eye		
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Control Station
Column
X.XX Floor to Ceiling Height
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Features

Fences — FCB 1.6h
Walls — Wall 1.2h
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Services

Foul Sewers
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Trees

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Deciduous
Coniferous

Building Heights

RIDGE
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m: 07786 388175
e: barry@bbsurveys.co.uk

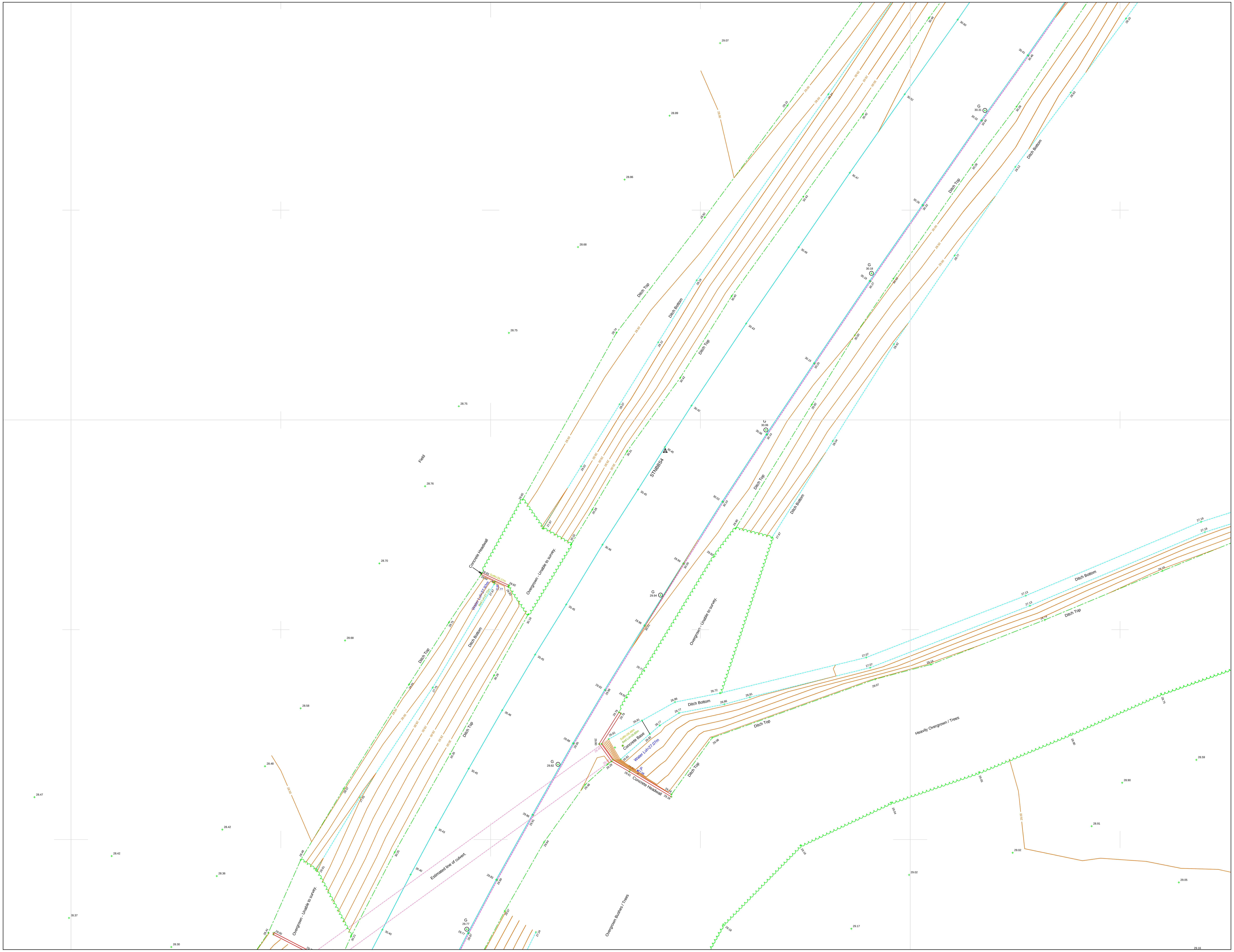
CLIENT:
La Ronde Wright
Tom Wright

PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 1

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S02



DRAWING NUMBER:

2219-244-S03

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
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Features

Fences — FCB 1.6h
Walls — Wall 1.2h
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Trees

Trees are drawn to scale on the survey,
Deciduous
Coniferous

Building Heights

RIDGE
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SOFFIT

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BBS
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38 Almond Drive
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t: 01603 507917
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e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

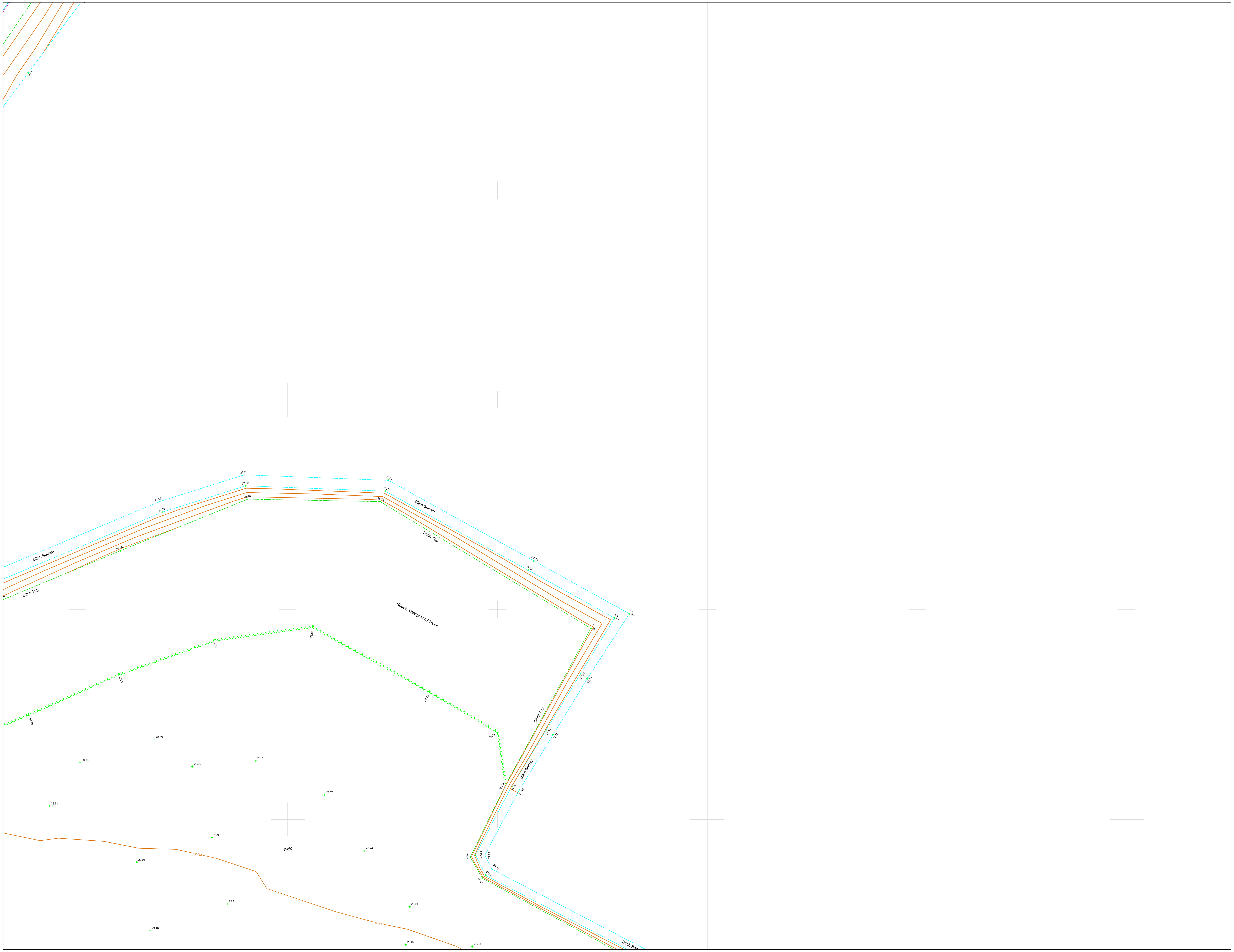
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 2

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S03



DRAWING NUMBER:

2219-244-S04

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
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FCL	Chain Link		Column
FHD	Hoarding	X.XX	Floor to Ceiling Height
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FPL	Pallisade		
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Features

Fences — FCB 1.6h

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Services

Foul Sewers

Storm Sewers

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Trees

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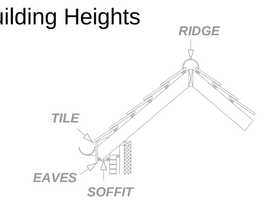
Deciduous

Coniferous

Building Heights



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Tom Wright

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Land off Norwich Road
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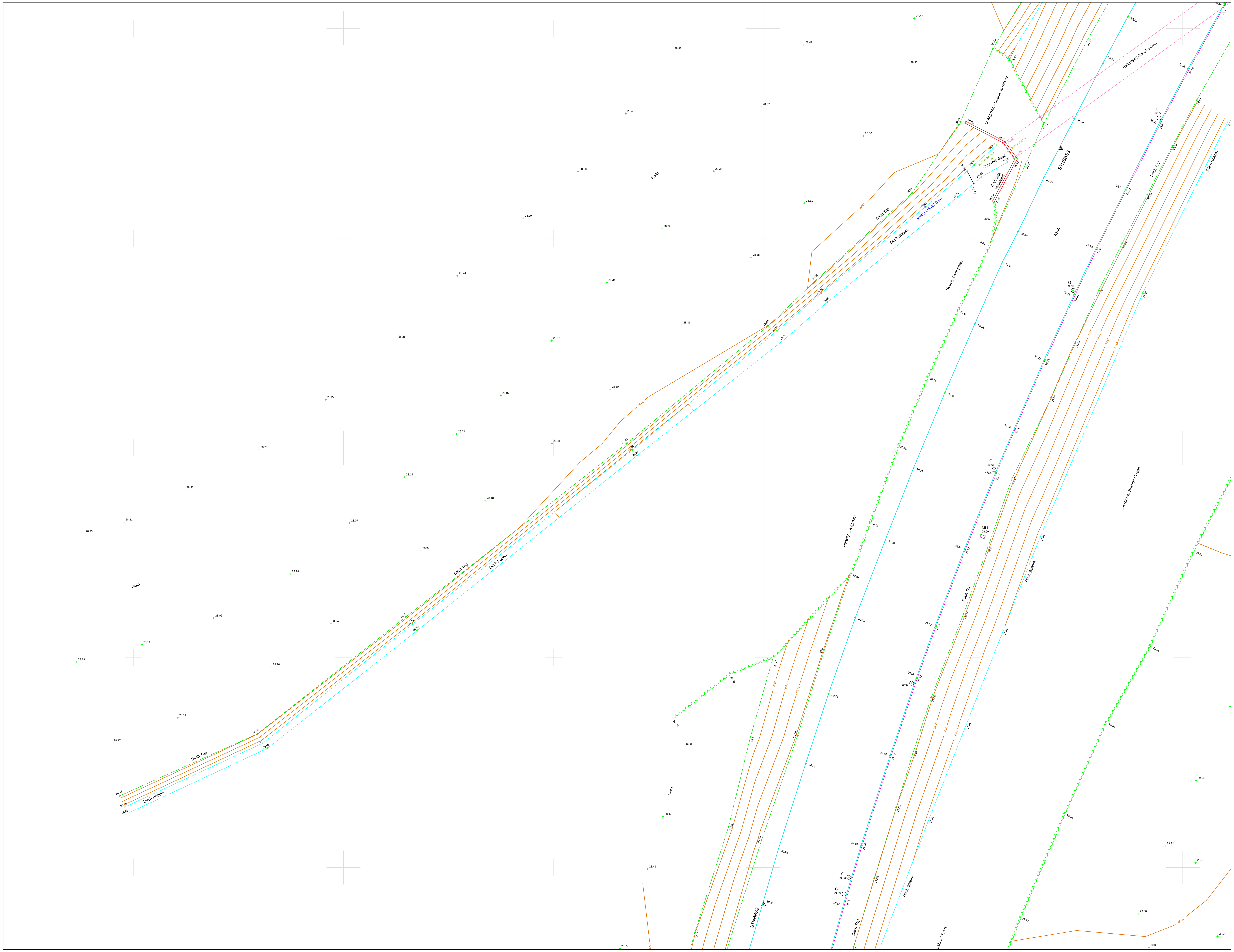
TITLE:
Existing Ground Level Survey
Sheet 3

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S04



DRAWING NUMBER:

2219-244-S05

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
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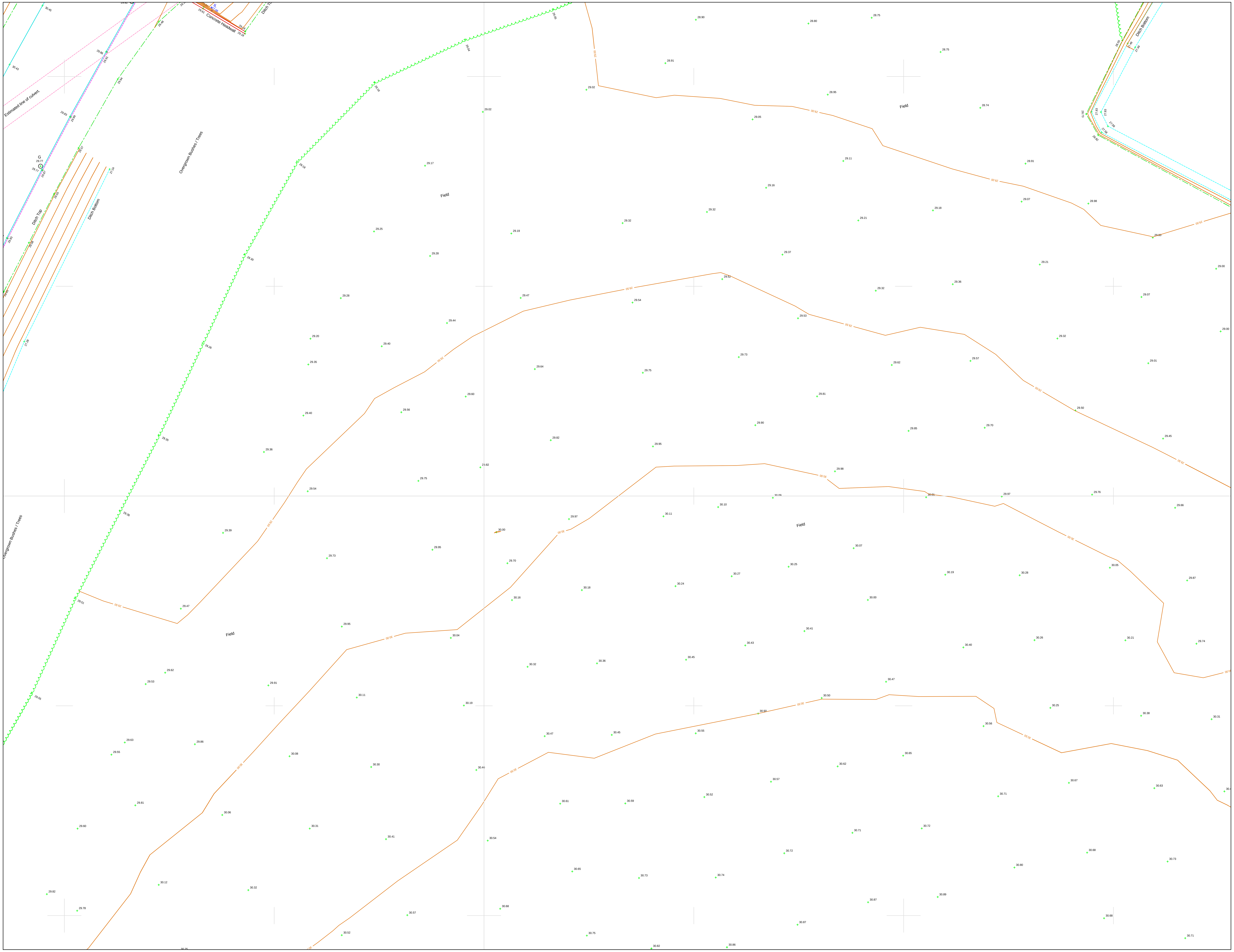
Sheet 4

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S05



DRAWING NUMBER:

2219-244-S06

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers
Storm Sewers
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey.
Deciduous
Coniferous

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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STATION TABLE

Code	Easting	Northing	Height
STNBBS1	616377.901	282515.227	30.813
STNBBS2	616400.063	282645.599	30.262
STNBBS3	616435.446	282735.731	30.381
STNBBS4	616470.805	282796.282	30.443
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STNBBS12	616601.275	282284.598	32.800

DATE:	REV:	REVISIONS
07.07.16	-	Survey Issued

BBS
BB SURVEYS LTD
38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

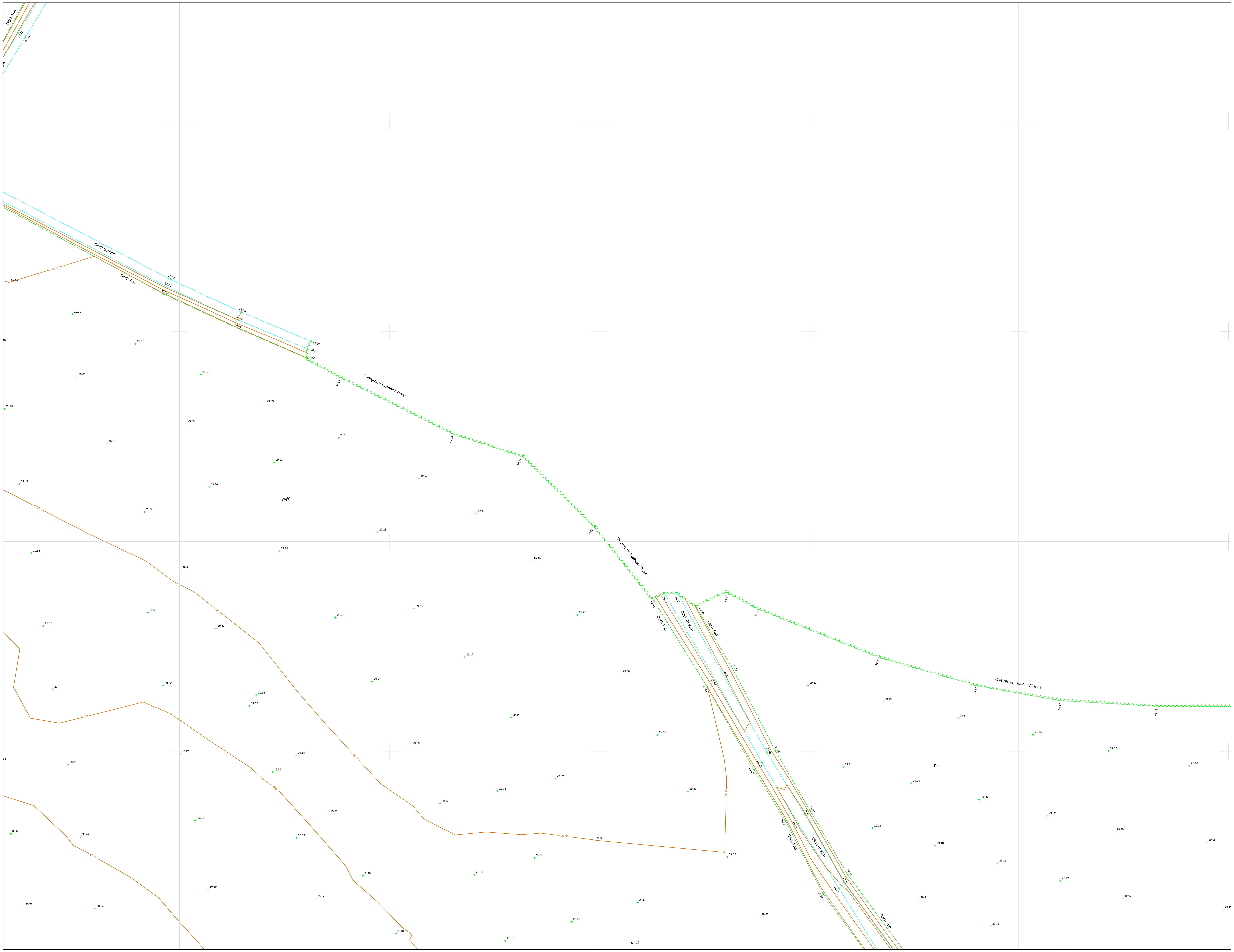
CLIENT:
La Ronde Wright
Tom Wright

PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 5

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S06



DRAWING NUMBER:

2219-244-S07

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
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Control Station
Column
X.XX Floor to Ceiling Height
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Features

Fences — FCB 1.6h
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Services

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Trees

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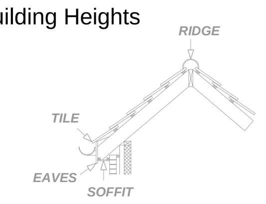
Deciduous
Coniferous

Building Heights



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BBS
BB SURVEYS LTD

38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

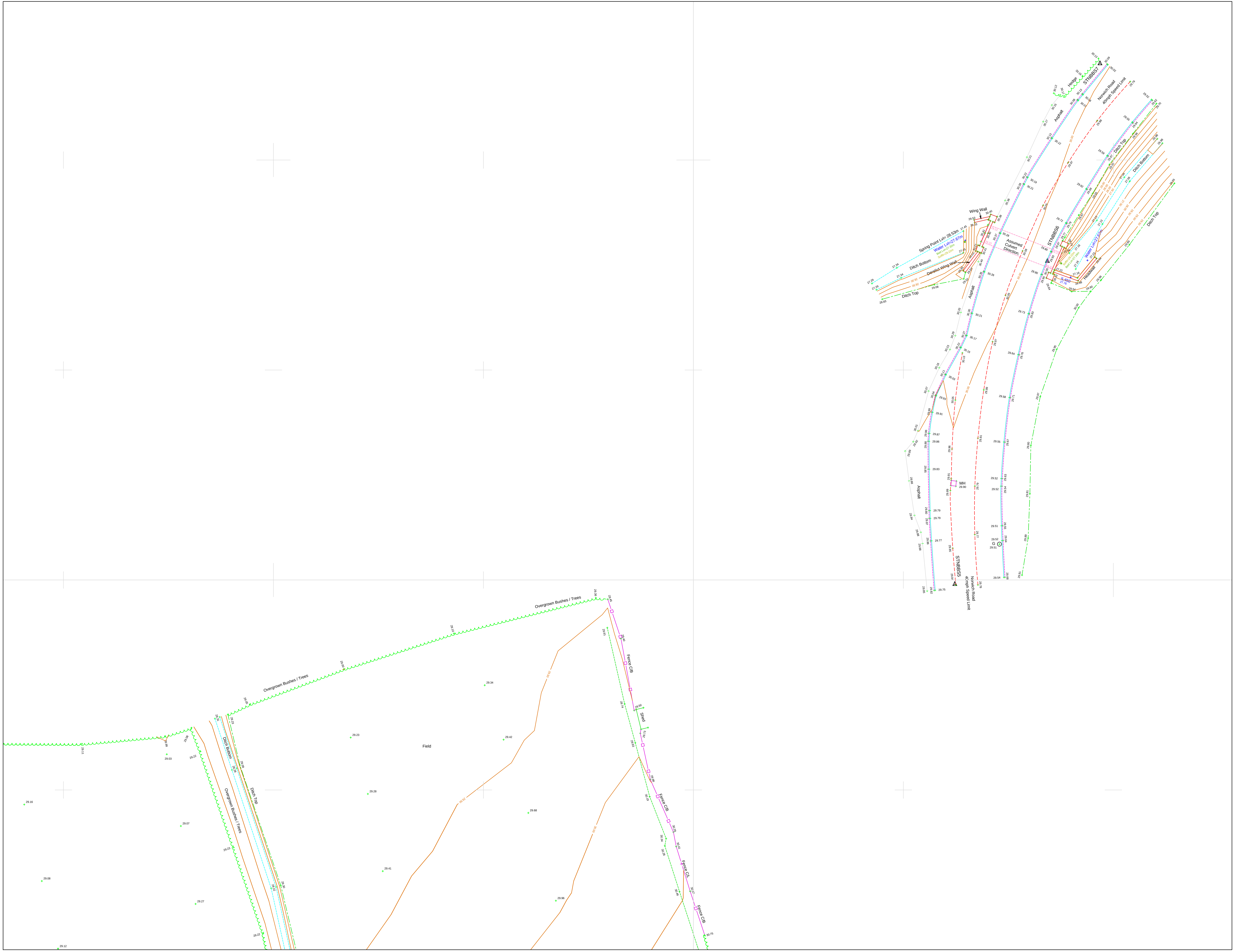
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 6

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S07



DRAWING NUMBER:

2219-244-S08

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
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Control Station
Column
X.XX Floor to Ceiling Height
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Features

Fences — FCB 1.6h
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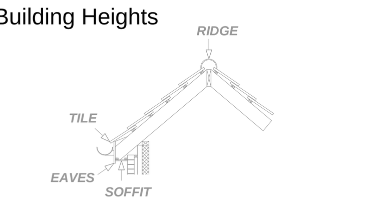
Trees

Trees are drawn to scale on the survey,

Deciduous
Coniferous

Building Heights



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DATE:	REV:	REVISIONS
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BBS
BB SURVEYS LTD

38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

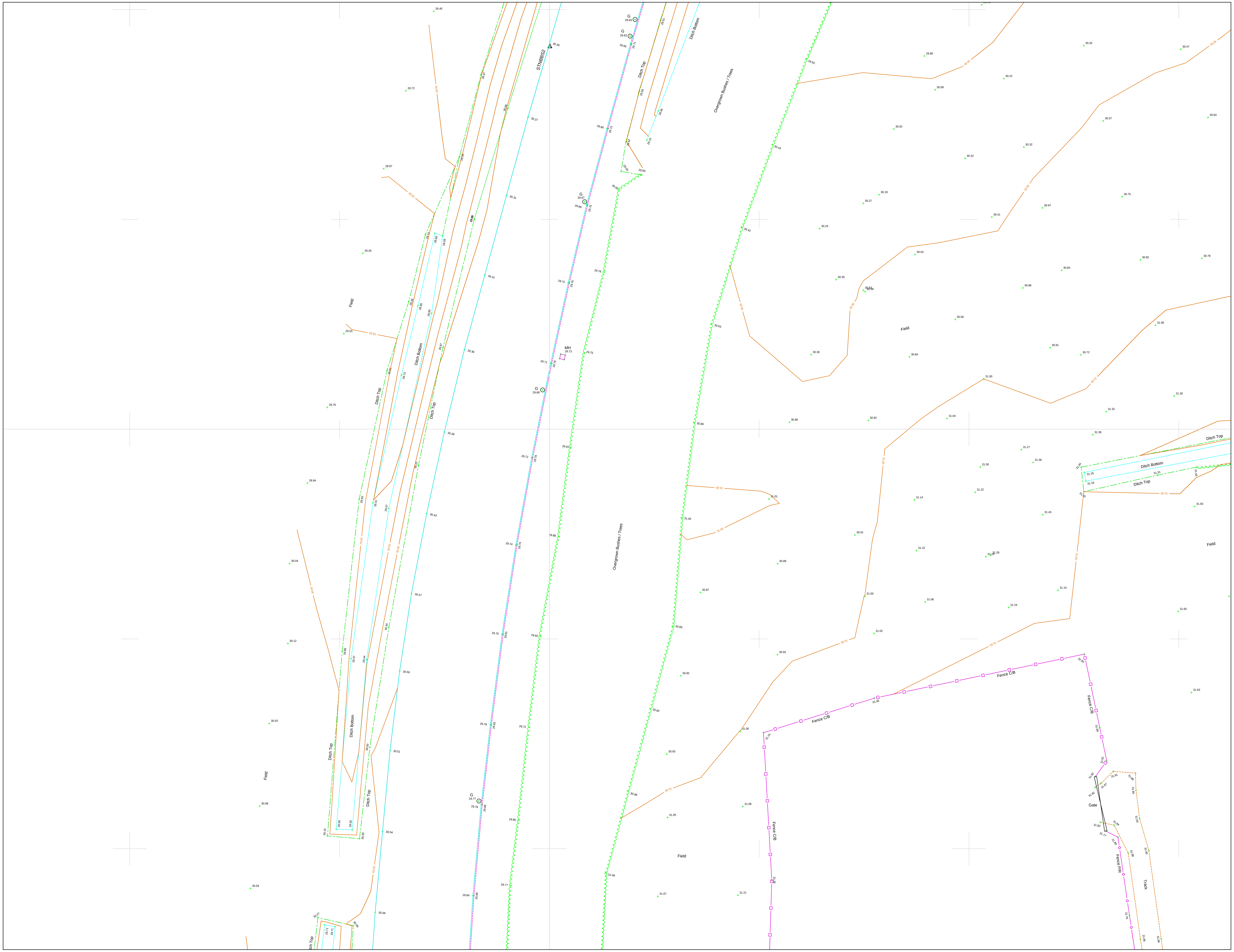
CLIENT:
La Ronde Wright
Tom Wright

PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 7

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S08



DRAWING NUMBER:

2219-244-S09

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
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Control Station
Column
X.XX Floor to Ceiling Height
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Features

Fences — FCB 1.6h
Walls — Wall 1.2h
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Storm Sewers
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Deciduous
Coniferous

Building Heights

RIDGE
TILE
EAVES
SOFFIT

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Sheet 8

SCALE:	DRAWN:	SHEET SIZE:	DATE:
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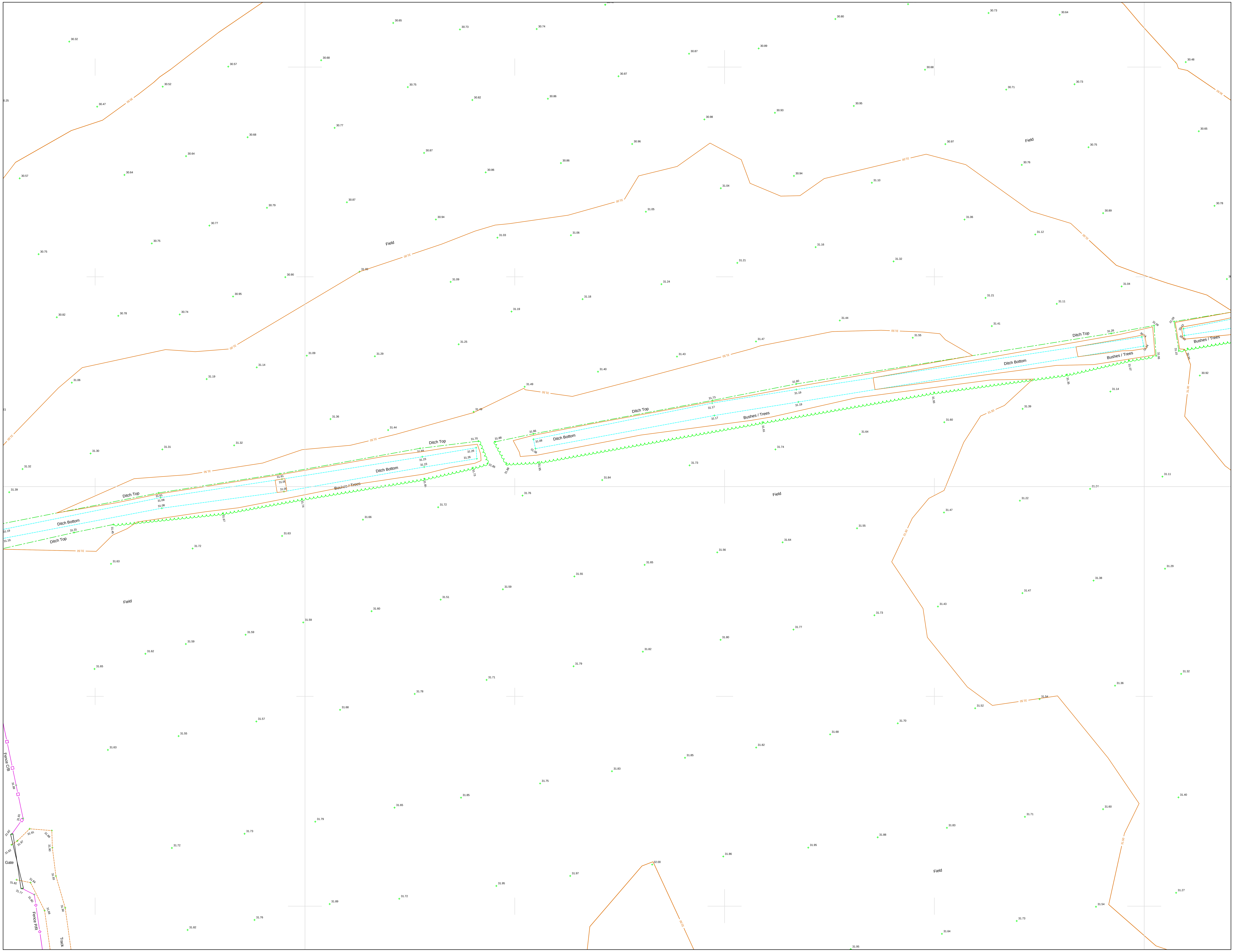
DRAWING NUMBER:
2219-244-S09



DRAWING NUMBER:

2219-244-S10

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
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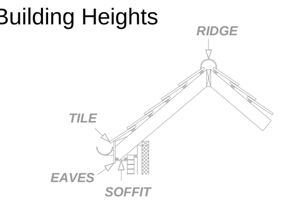

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STATION TABLE

Code	Easting	Northing	Height
STNBBS1	616377.901	282515.227	30.813
STNBBS2	616400.063	282645.599	30.262
STNBBS3	616435.446	282735.731	30.381
STNBBS4	616470.805	282796.282	30.443
STNBBS5	616831.126	282699.498	29.836
STNBBS6	616842.146	282737.958	29.925
STNBBS7	616848.405	282761.489	30.124
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STNBBS10	616684.813	282329.846	32.351
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STNBBS12	616601.275	282284.598	32.800

DATE:	REV:	REVISIONS
07.07.16	-	Survey Issued

BBS
BB SURVEYS LTD
38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

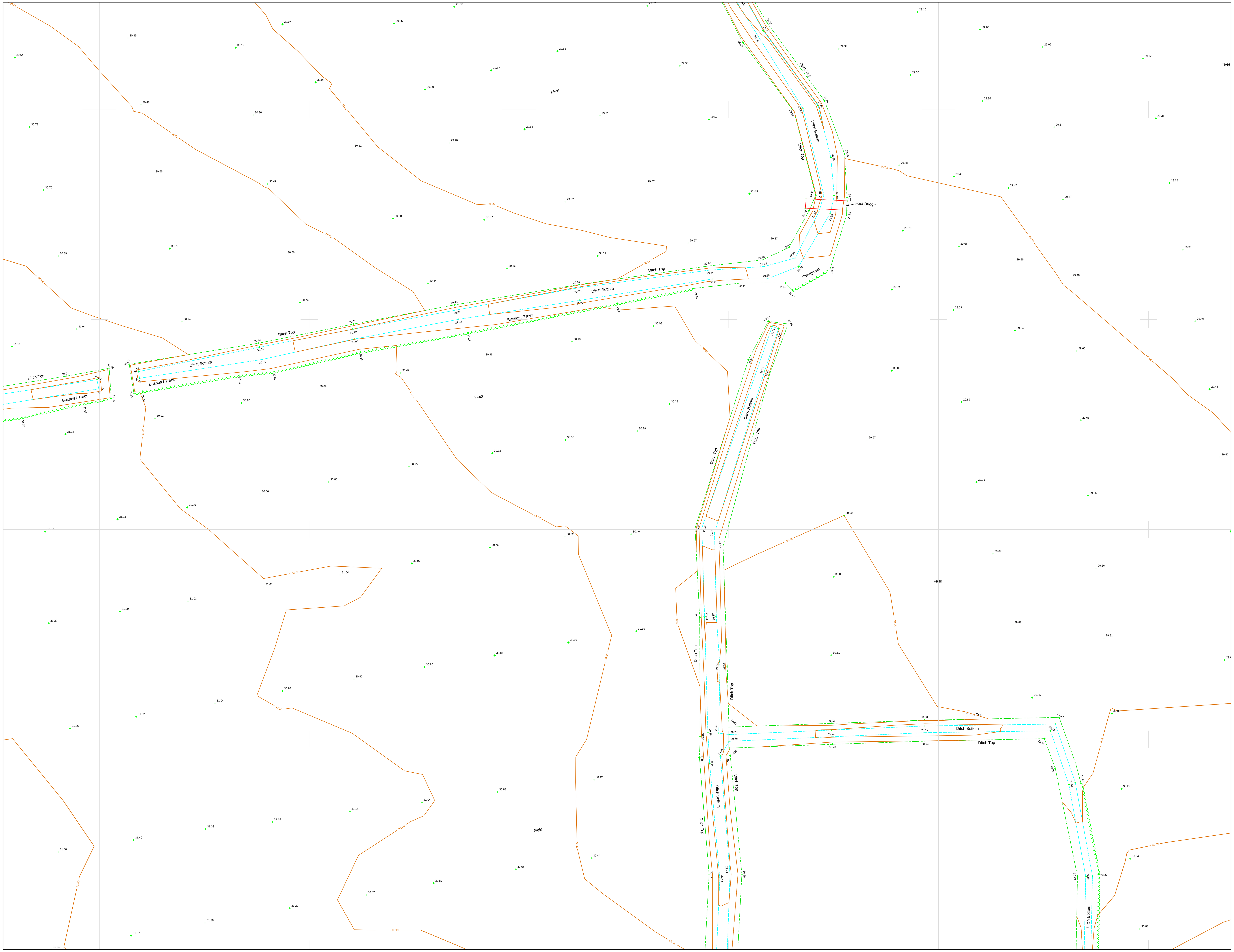
CLIENT:
La Ronde Wright
Tom Wright

PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 9

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S10



DRAWING NUMBER:

2219-244-S11

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

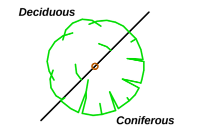
Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

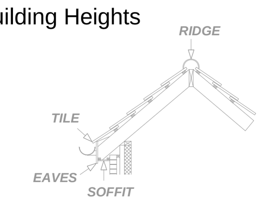
Foul Sewers — 0.225Ø FW MH
Storm Sewers — 0.375Ø SW MH
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey,



Building Heights



SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS.
ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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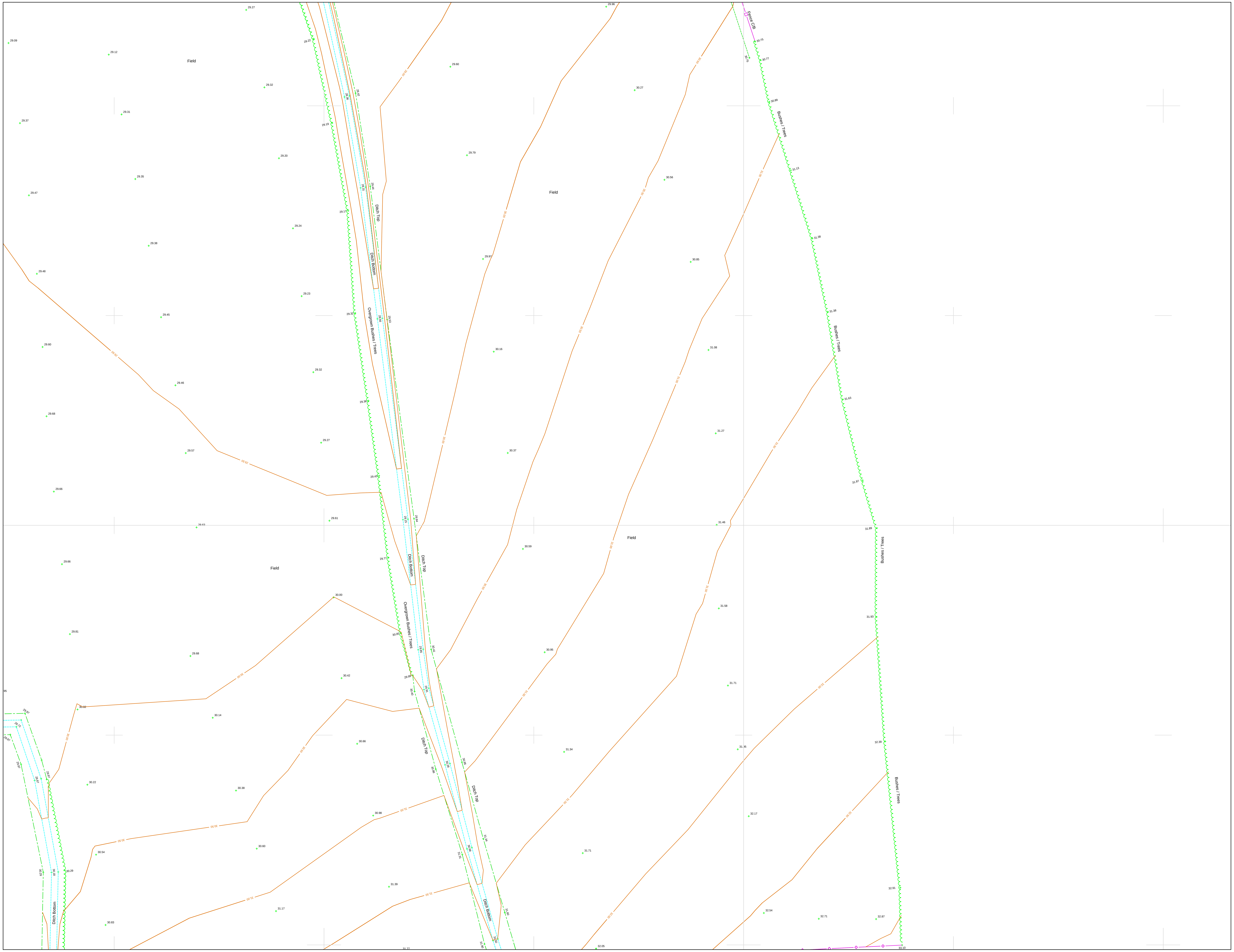
CLIENT:
La Ronde Wright
Tom Wright

PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 10

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S11



DRAWING NUMBER:

2219-244-S12

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
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Control Station
Column
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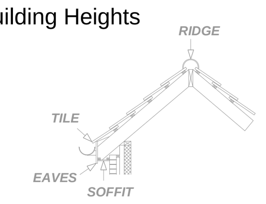
Trees are drawn to scale on the survey,
Deciduous
Coniferous

Building Heights



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CLIENT:
La Ronde Wright
Tom Wright

PROJECT:
Land off Norwich Road
Dickleburgh

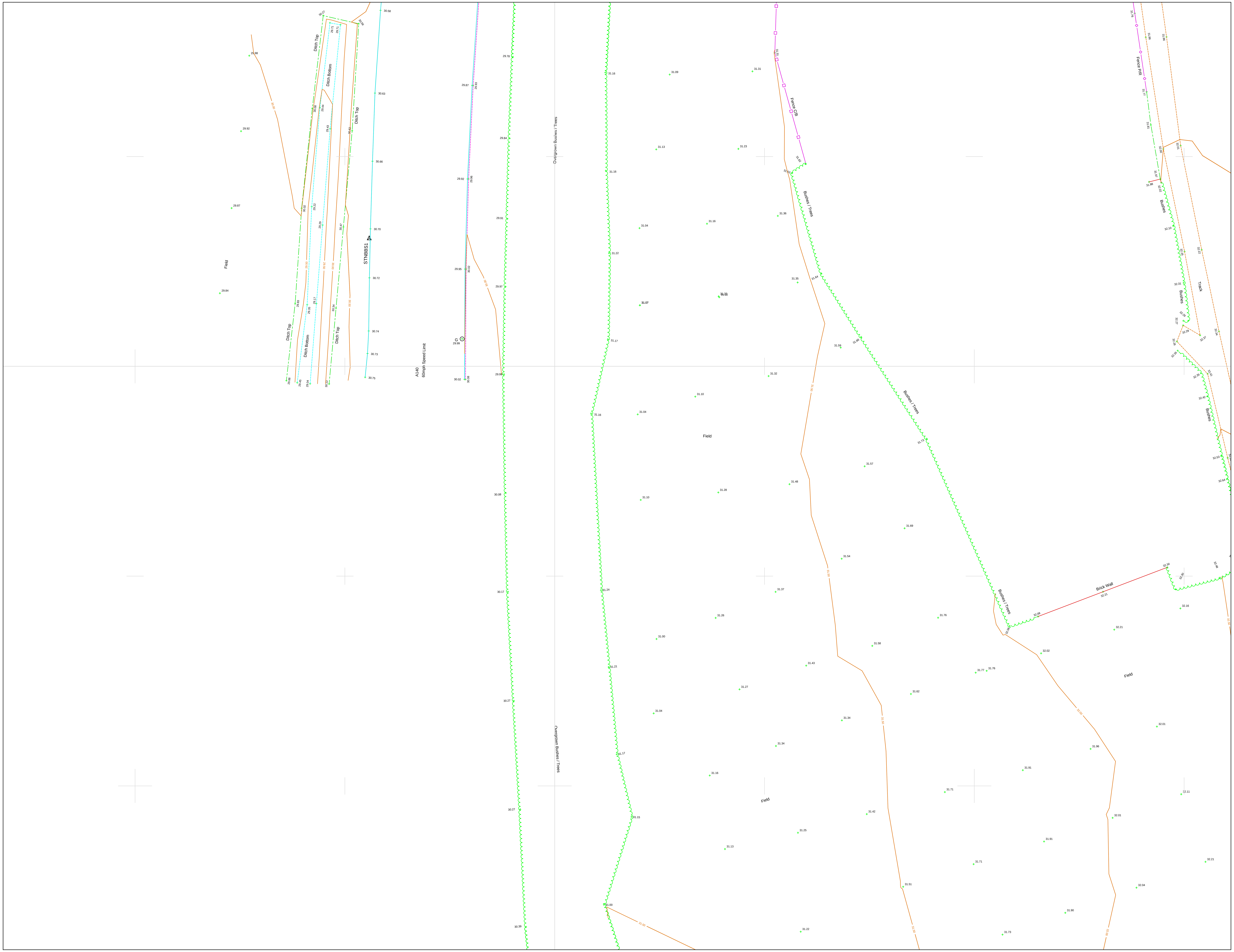
TITLE:
Existing Ground Level Survey
Sheet 11

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S12

DRAWING NUMBER:

2219-244-S13



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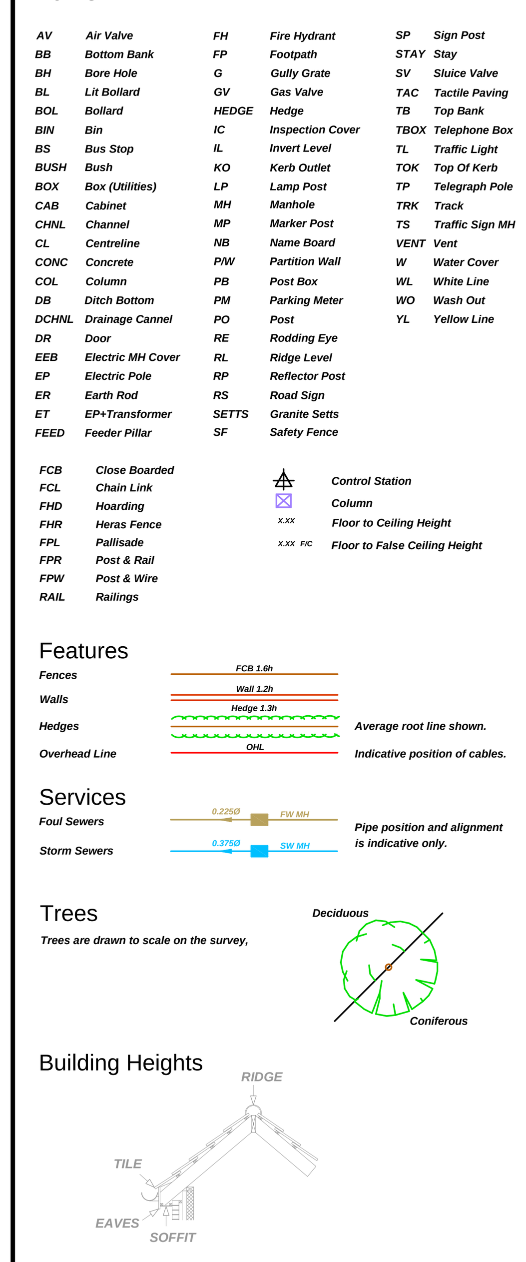

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CLIENT:

La Ronde Wright
Tom Wright

PROJECT:

Land off Norwich Road Dickleburgh

TITLE:

Existing Ground Level Survey
Sheet 12

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S13

DRAWING NUMBER:

2219-244-S14

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
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RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers — 0.225Ø FW MH
Storm Sewers — SW MH

Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey.

Deciduous
Coniferous

Building Heights

RIDGE
TILE
EAVES
SOFFIT

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Tom Wright

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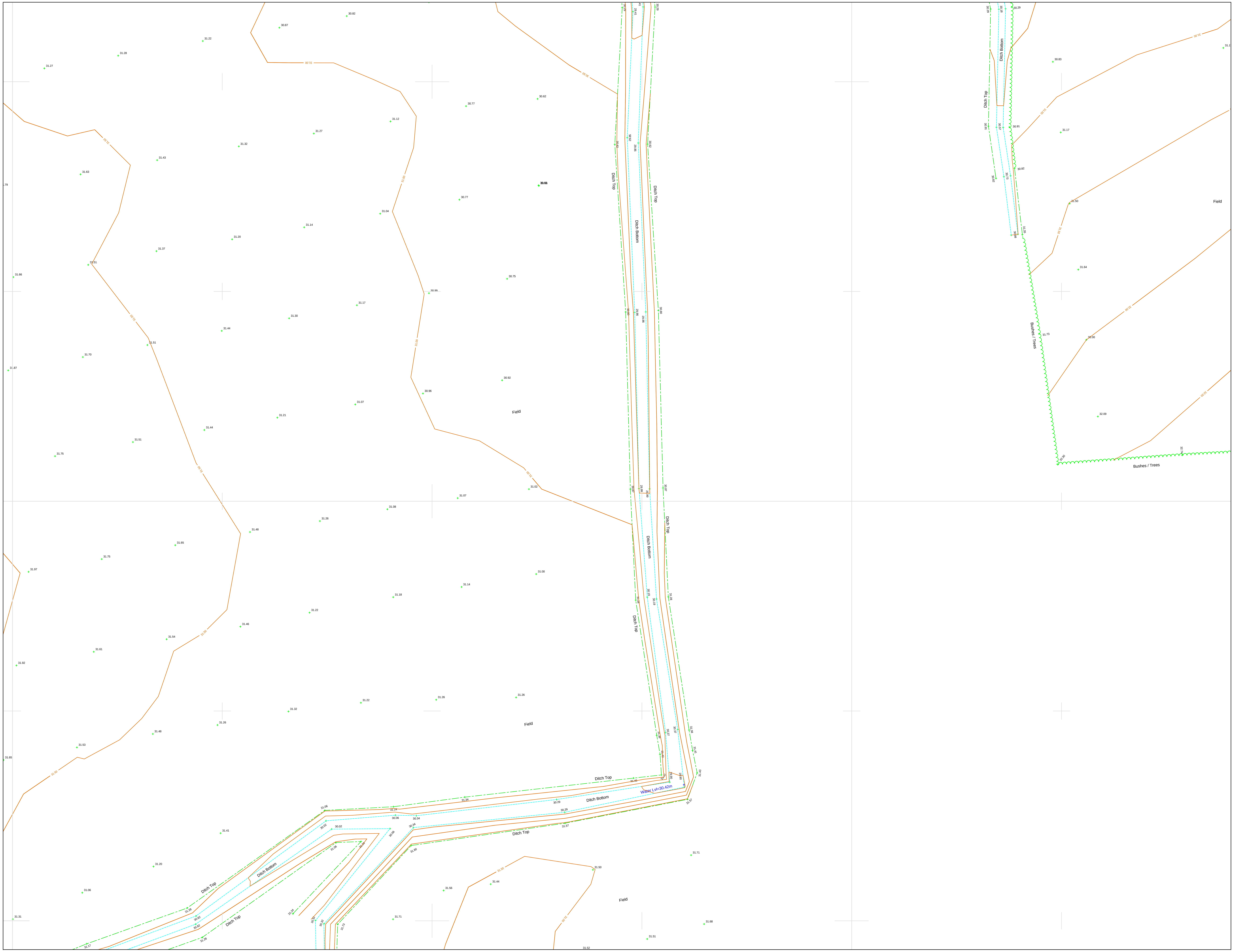
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 13

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S14



DRAWING NUMBER:

2219-244-S15

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
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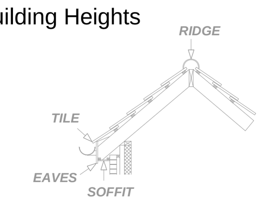
Building Heights



SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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STATION TABLE

Code	Easting	Northing	Height
STNBBS1	616377.901	282515.227	30.813
STNBBS2	616400.063	282645.599	30.262
STNBBS3	616435.446	282735.731	30.381
STNBBS4	616470.805	282796.282	30.443
STNBBS5	616831.126	282699.498	29.836
STNBBS6	616842.146	282737.958	29.925
STNBBS7	616848.405	282761.489	30.124
STNBBS8	616665.627	282297.420	32.491
STNBBS9	616723.636	282306.322	32.250
STNBBS10	616684.813	282329.846	32.351
STNBBS11	616554.886	282269.681	32.004
STNBBS12	616601.275	282284.598	32.800

DATE:	REV:	REVISIONS
07.07.16	-	Survey Issued

BBS
BB SURVEYS LTD
38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

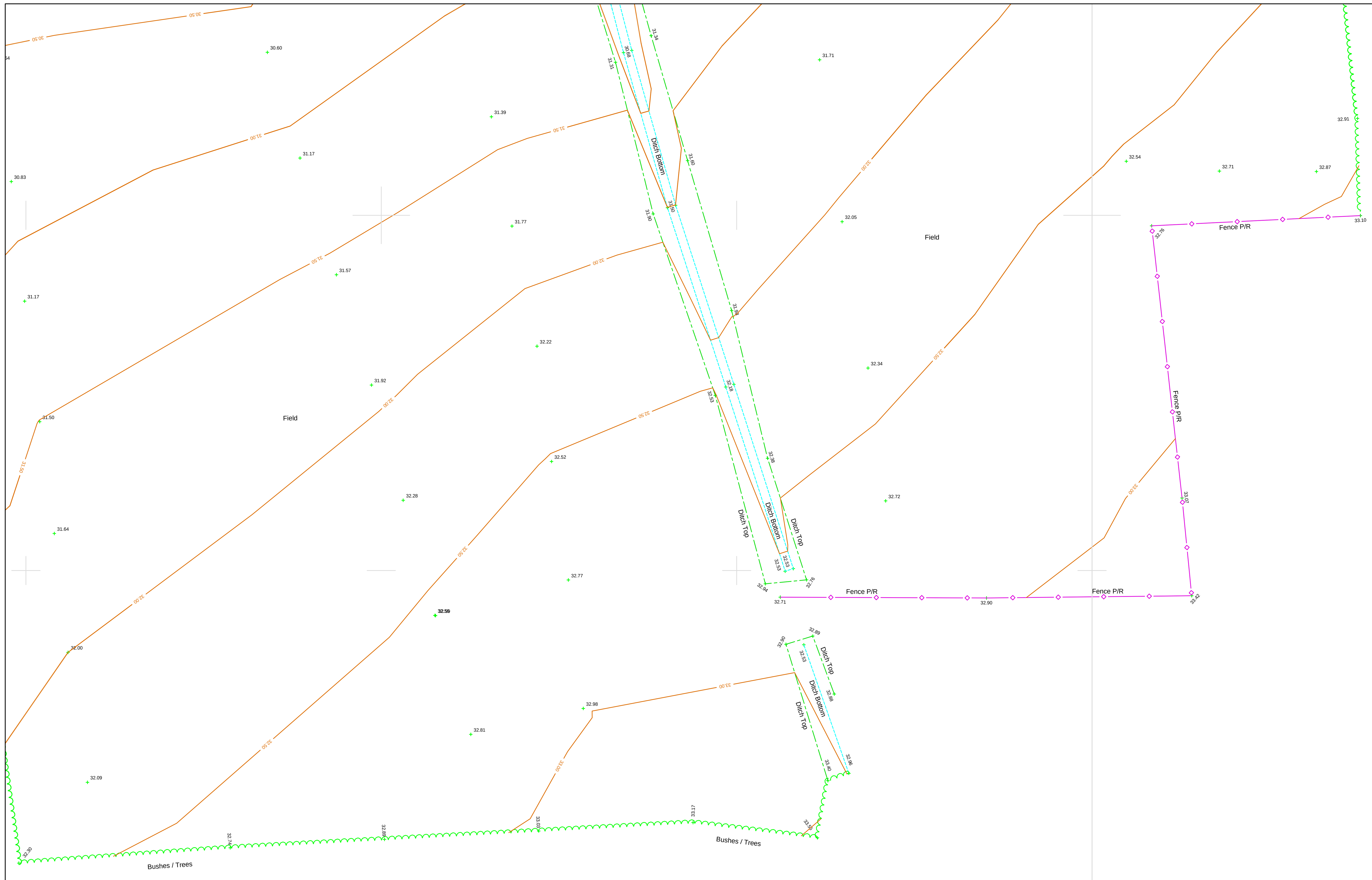
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 14

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S15



DRAWING NUMBER:

2219-244-S16

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers
Storm Sewers
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey.
Deciduous
Coniferous

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

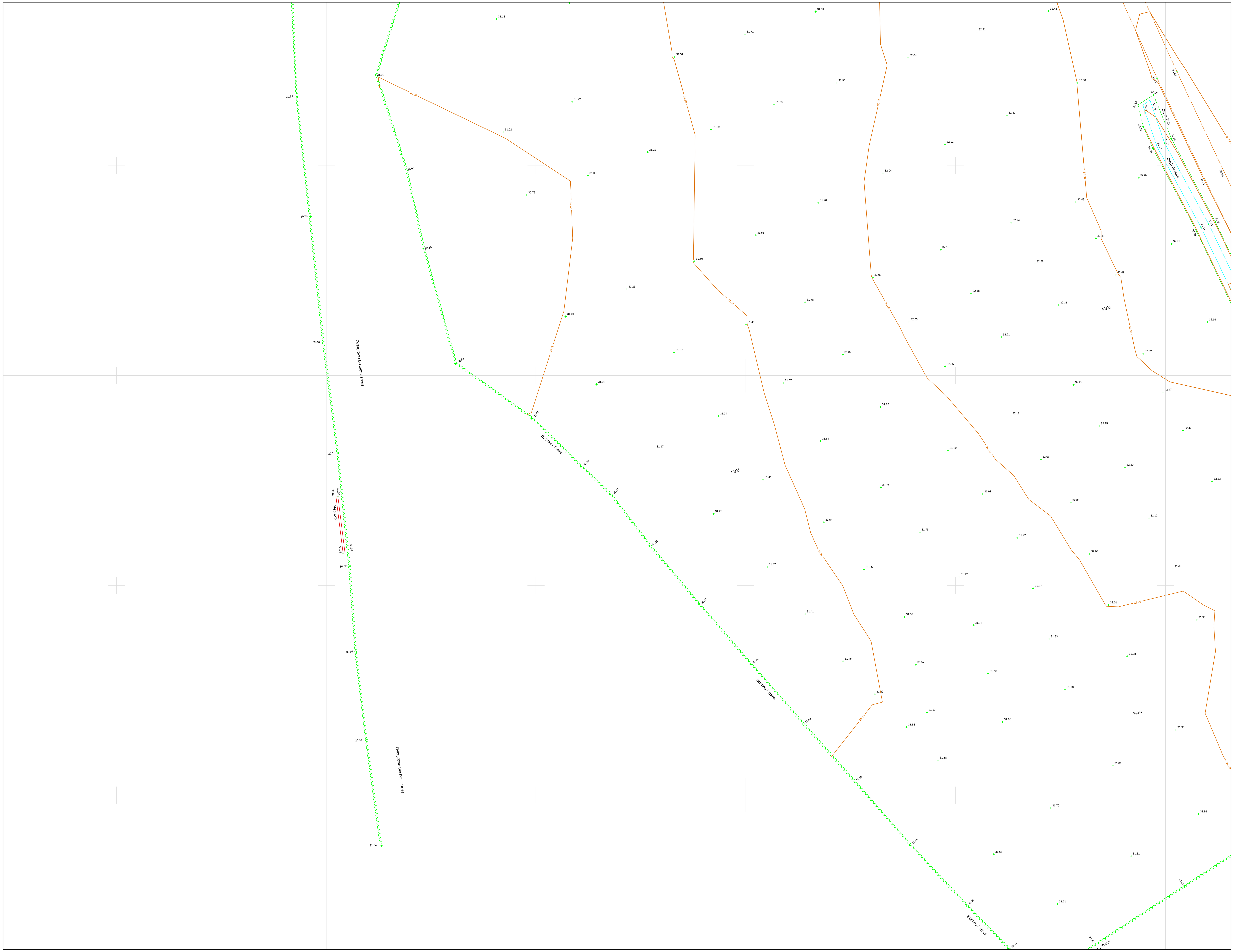
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 15

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S16



DRAWING NUMBER:

2219-244-S17

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
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CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
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DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded		Control Station
FCL	Chain Link		Column
FHD	Hoarding	X.XX	Floor to Ceiling Height
FHR	Heras Fence	X.XX F/C	Floor to False Ceiling Height
FPL	Pallisade		
FPR	Post & Rail		
FPW	Post & Wire		
RAIL	Railings		

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — *Average root line shown.*
Overhead Line — OHL — *Indicative position of cables.*

Services

Foul Sewers — 0.225Ø FW MH
Storm Sewers — 0.375Ø SW MH
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey,

Deciduous *Coniferous*

Building Heights

RIDGE TILE EAVES SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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BBS BB SURVEYS LTD

38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

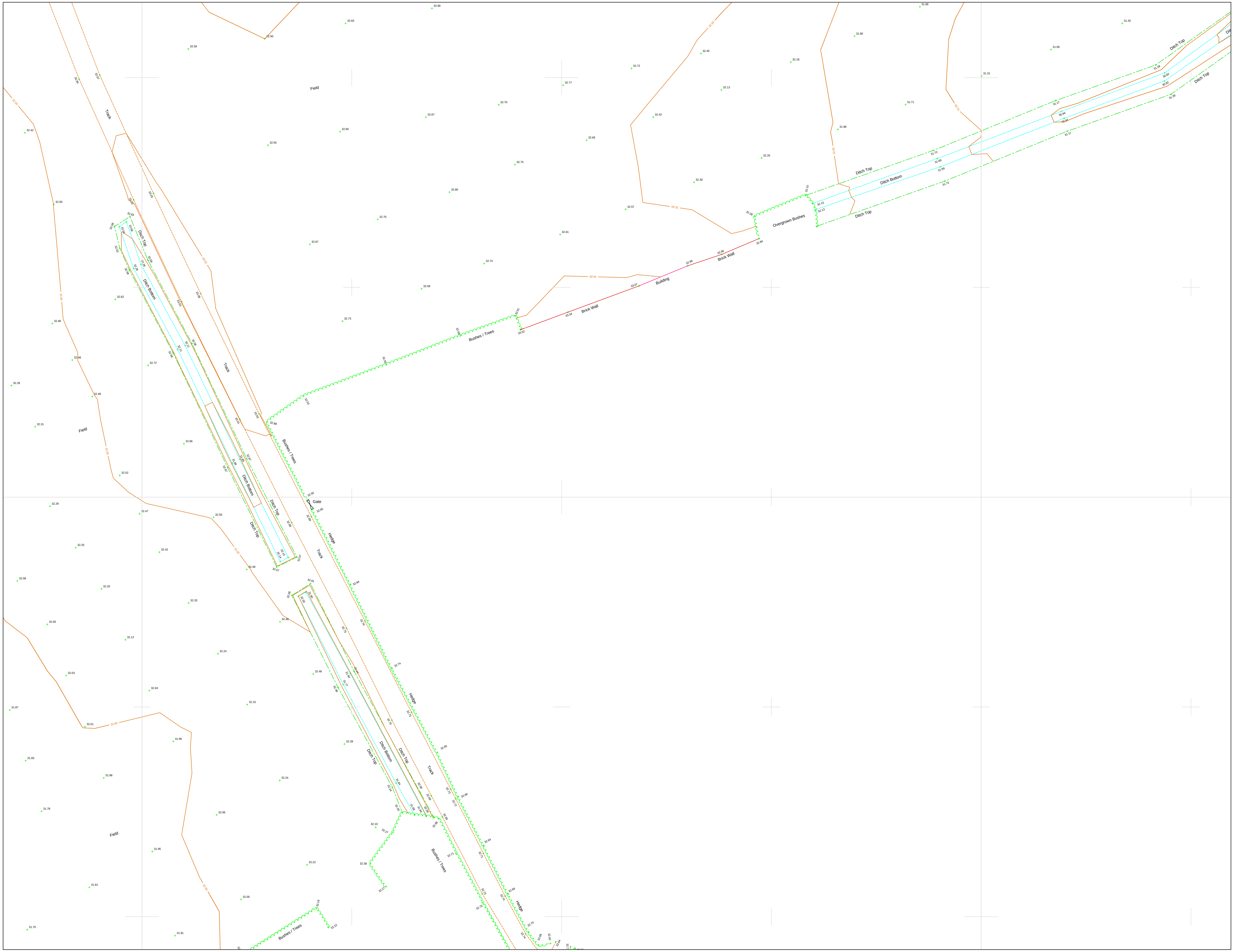
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 16

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S17



DRAWING NUMBER:

2219-244-S18

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
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COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

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Deciduous
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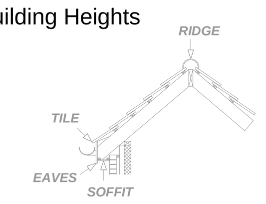
Building Heights



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La Ronde Wright
Tom Wright

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Land off Norwich Road
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TITLE:
Existing Ground Level Survey
Sheet 17

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S18

DRAWING NUMBER:

2219-244-S19

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
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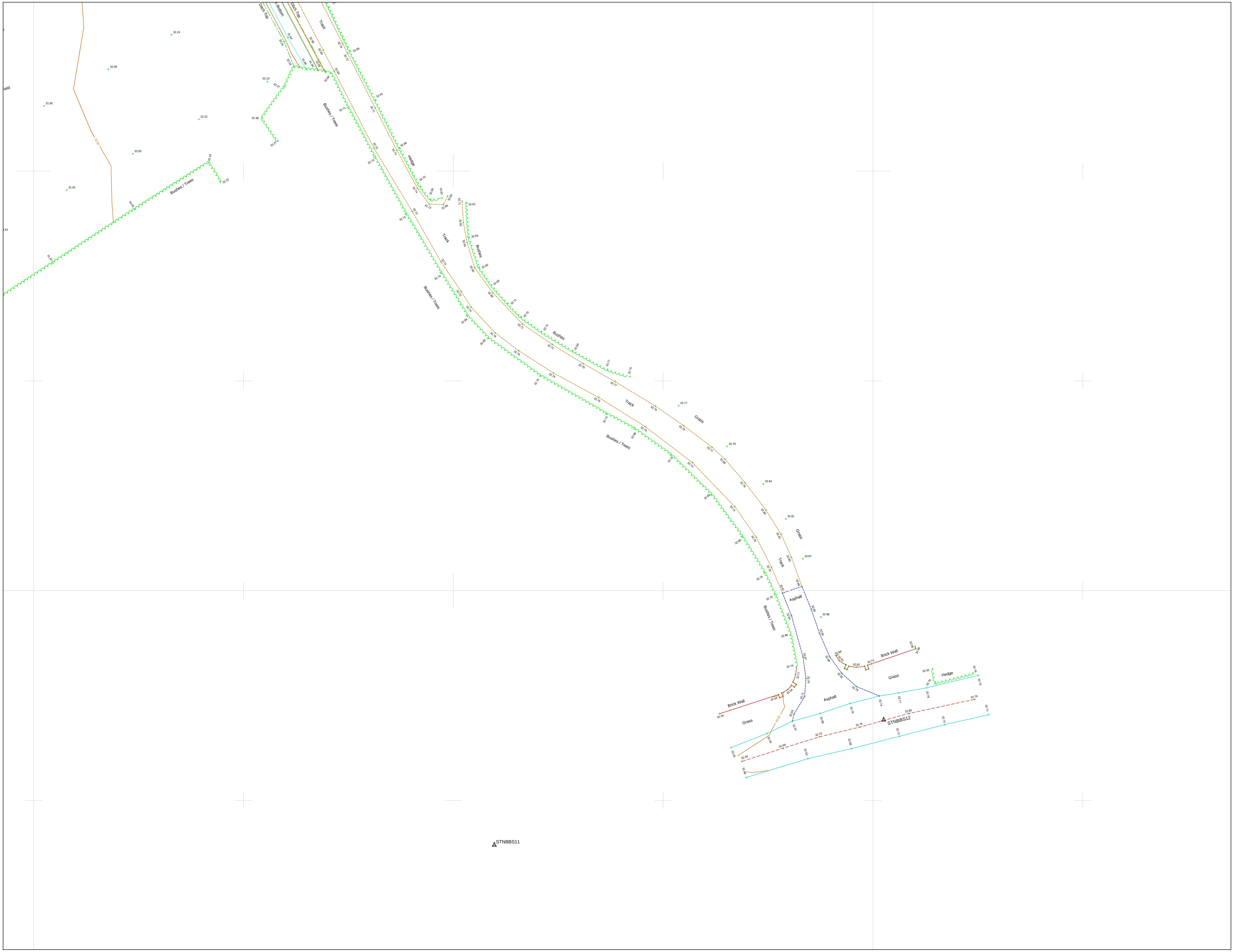
Sheet 18

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S19



DRAWING NUMBER:

2219-244-S20

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
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BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Cannel	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 Rod	RS	Road Sign		
ET	EP+Transformer	SETTS	Granite Setts		
FEED	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
X.XX Floor to Ceiling Height
X.XX F/C Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

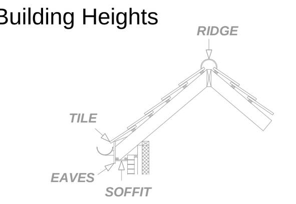
Foul Sewers — 0.225Ø FW MH
Storm Sewers — 0.375Ø SW MH
Pipe position and alignment is indicative only.

Trees

Trees are drawn to scale on the survey,

Deciduous
Coniferous

Building Heights



SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS. ALL SURVEY DATA TO ORDNANCE SURVEY NATIONAL GRID (OST02)

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STATION TABLE

Code	Easting	Northing	Height
STNBBS1	616377.901	282515.227	30.813
STNBBS2	616400.063	282645.599	30.262
STNBBS3	616435.446	282735.731	30.381
STNBBS4	616470.805	282796.282	30.443
STNBBS5	616831.126	282699.498	29.836
STNBBS6	616842.146	282737.958	29.925
STNBBS7	616848.405	282761.489	30.124
STNBBS8	616665.627	282297.420	32.491
STNBBS9	616723.636	282306.322	32.250
STNBBS10	616684.813	282329.846	32.351
STNBBS11	616554.886	282269.681	32.004
STNBBS12	616601.275	282284.598	32.800

DATE:	REV:	REVISIONS
07.07.16	-	Survey Issued

BBS BB SURVEYS LTD
38 Almond Drive
Cringleford
Norwich
Norfolk
NR4 7SJ
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

CLIENT:
La Ronde Wright
Tom Wright

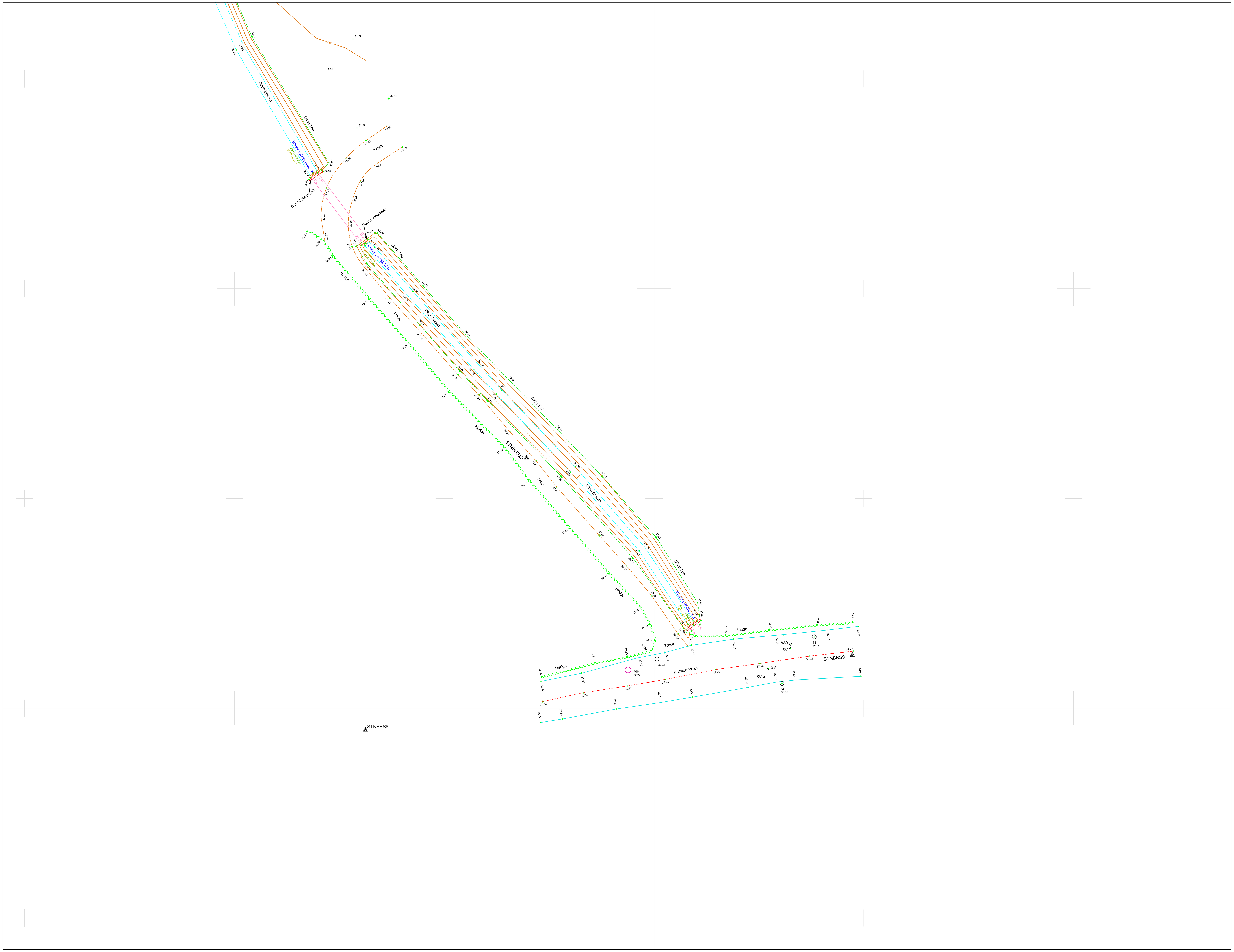
PROJECT:
Land off Norwich Road
Dickleburgh

TITLE:
Existing Ground Level Survey
Sheet 19

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:

2219-244-S20



DRAWING NUMBER:

2219-244-S21

NOTES:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	HEDGE	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
BUSH	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BOX	Box (Utilities)	LP	Lamp Post	TP	Telegraph Pole
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FEED	Feeder Pillar	SF	Safety Fence		

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Fences — FCB 1.6h
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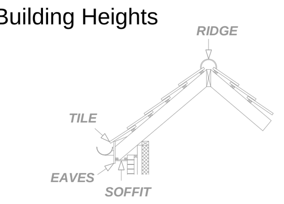

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BBS
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38 Almond Drive
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t: 01603 507917
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CLIENT:
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TITLE:
Existing Ground Level Survey
Sheet 20

SCALE:	DRAWN:	SHEET SIZE:	DATE:
1:200	B.B.	A1	07.07.16

DRAWING NUMBER:
2219-244-S21

EVANS

Rivers and Coastal

Appendix E – Surface Water Calculations

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.000	21.382	0.052	410.0	0.070	1.00	0.600	o	450	Pipe/Conduit
*	1.001	27.237	0.066	410.0	0.070	0.00	0.600	o	450	Pipe/Conduit
*	1.002	42.761	0.104	410.0	0.070	0.00	0.600	o	450	Pipe/Conduit
*	1.003	19.221	0.047	410.0	0.070	0.00	0.600	o	450	Pipe/Conduit
*	1.004	54.215	0.132	410.0	0.070	0.00	0.600	o	450	Pipe/Conduit
*	1.005	31.513	0.077	410.0	0.068	0.00	0.600	o	450	Pipe/Conduit
*	1.006	15.896	0.039	410.0	0.000	0.00	0.600	o	450	Pipe/Conduit
*	1.007	17.932	0.044	410.0	0.000	0.00	0.600	o	450	Pipe/Conduit
*	1.008	7.167	0.072	100.0	0.000	0.00	0.600	o	150	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	1	30.000	28.000	1.550	29.800	27.948	1.402		1500
*	1.001	2	29.800	27.948	1.402	29.600	27.882	1.268		1500
*	1.002	3	29.600	27.882	1.268	30.200	27.778	1.972		1500
*	1.003	4	30.200	27.778	1.972	30.200	27.731	2.019		1500
*	1.004	5	30.200	27.731	2.019	29.300	27.599	1.251		1500
*	1.005	6	29.300	27.599	1.251	29.200	27.522	1.228		1500
*	1.006	7	29.200	27.522	1.228	29.300	27.483	1.367		1500
*	1.007	8	29.300	27.483	1.367	29.100	27.439	1.211		1500
*	1.008	9	29.100	27.439	1.511	29.300	27.367	1.783	Hydro-Brake®	1500

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	10	29.300	27.367	0.000	1500	0

Simulation Criteria for Storm

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

Number of Input Hydrographs	0	Number of Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	1

Simulation Criteria for Storm

Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.008, Volume (m^3): 5.5

Unit Reference	MD-SHE-0047-1200-1400-1200
Design Head (m)	1.400
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	27.439
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	1.2
Flush-Flo™	0.211	0.9
Kick-Flo®	0.423	0.7
Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.1	3.000	1.7	7.000	2.5
0.200	0.9	1.400	1.2	3.500	1.8	7.500	2.6
0.300	0.8	1.600	1.3	4.000	1.9	8.000	2.7
0.400	0.7	1.800	1.3	4.500	2.0	8.500	2.7
0.500	0.8	2.000	1.4	5.000	2.1	9.000	2.8
0.600	0.8	2.200	1.5	5.500	2.2	9.500	2.9
0.800	0.9	2.400	1.5	6.000	2.3		
1.000	1.0	2.600	1.6	6.500	2.4		

Storage Structures for Storm

Tank or Pond Manhole: 8, DS/PN: 1.007

Invert Level (m) 27.483

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	96.0	1.400	333.0	2.800	0.0	4.200	0.0
0.200	123.0	1.600	376.0	3.000	0.0	4.400	0.0
0.400	152.0	1.800	421.0	3.200	0.0	4.600	0.0
0.600	184.0	2.000	0.0	3.400	0.0	4.800	0.0
0.800	218.0	2.200	0.0	3.600	0.0	5.000	0.0
1.000	254.0	2.400	0.0	3.800	0.0		
1.200	292.0	2.600	0.0	4.000	0.0		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.450
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 400.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%	100/15 Winter				28.107
1.001	2	15 Winter	1	+0%	100/15 Winter				28.072
1.002	3	15 Winter	1	+0%	100/15 Winter				28.019
1.003	4	15 Winter	1	+0%	30/720 Winter				27.943
1.004	5	15 Winter	1	+0%	30/360 Winter				27.891
1.005	6	480 Winter	1	+0%	30/60 Winter				27.849
1.006	7	480 Winter	1	+0%	30/30 Winter				27.849
1.007	8	480 Winter	1	+0%	30/30 Winter				27.849
1.008	9	480 Winter	1	+0%	1/15 Winter				27.851

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.343	0.000	0.09		11.9	OK	
1.001	2	-0.326	0.000	0.14		18.7	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	3	-0.313	0.000	0.18		25.4	OK	
1.003	4	-0.285	0.000	0.26		32.3	OK	
1.004	5	-0.290	0.000	0.27		38.5	OK	
1.005	6	-0.200	0.000	0.05		6.5	OK	
1.006	7	-0.123	0.000	0.06		6.1	OK	
1.007	8	-0.084	0.000	0.01		1.2	OK	
1.008	9	0.262	0.000	0.06		0.8	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.450
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 400.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	720 Winter	30	+0%	100/15 Winter				28.229
1.001	2	720 Winter	30	+0%	100/15 Winter				28.229
1.002	3	720 Winter	30	+0%	100/15 Winter				28.229
1.003	4	720 Winter	30	+0%	30/720 Winter				28.229
1.004	5	720 Winter	30	+0%	30/360 Winter				28.230
1.005	6	720 Winter	30	+0%	30/60 Winter				28.230
1.006	7	720 Winter	30	+0%	30/30 Winter				28.230
1.007	8	720 Winter	30	+0%	30/30 Winter				28.229
1.008	9	600 Winter	30	+0%	1/15 Winter				28.327

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.221	0.000	0.01		1.8	OK	
1.001	2	-0.169	0.000	0.03		3.6	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	3	-0.103	0.000	0.04		5.3	OK	
1.003	4	0.001	0.000	0.05		6.5	SURCHARGED	
1.004	5	0.049	0.000	0.05		7.9	SURCHARGED	
1.005	6	0.181	0.000	0.07		9.1	SURCHARGED	
1.006	7	0.258	0.000	0.08		8.9	SURCHARGED	
1.007	8	0.296	0.000	0.05		6.2	SURCHARGED	
1.008	9	0.738	0.000	0.06		0.9	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	400.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	960 Winter	100	+40%	100/15 Winter				28.748
1.001	2	960 Winter	100	+40%	100/15 Winter				28.748
1.002	3	960 Winter	100	+40%	100/15 Winter				28.748
1.003	4	960 Winter	100	+40%	30/720 Winter				28.748
1.004	5	960 Winter	100	+40%	30/360 Winter				28.747
1.005	6	960 Winter	100	+40%	30/60 Winter				28.747
1.006	7	960 Winter	100	+40%	30/30 Winter				28.747
1.007	8	960 Winter	100	+40%	30/30 Winter				28.746
1.008	9	960 Winter	100	+40%	1/15 Winter				28.851

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.298	0.000	0.02		2.6	SURCHARGED	
1.001	2	0.350	0.000	0.04		5.1	SURCHARGED	

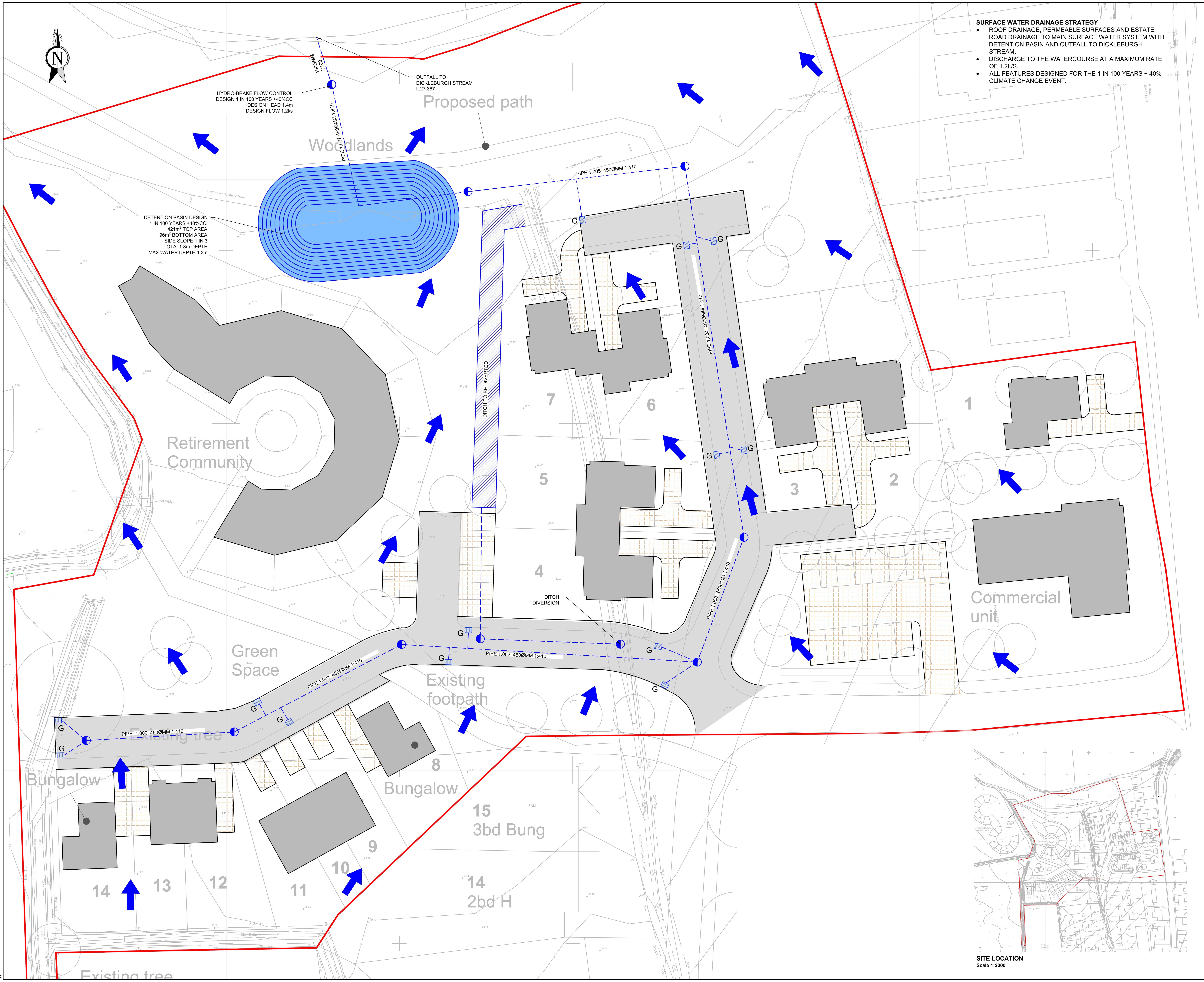
100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	3	0.416	0.000	0.05		7.4	SURCHARGED	
1.003	4	0.520	0.000	0.08		9.8	SURCHARGED	
1.004	5	0.566	0.000	0.08		11.9	SURCHARGED	
1.005	6	0.698	0.000	0.10		14.2	SURCHARGED	
1.006	7	0.775	0.000	0.13		14.1	SURCHARGED	
1.007	8	0.813	0.000	0.06		7.1	SURCHARGED	
1.008	9	1.262	0.000	0.07		1.1	FLOOD RISK	

Appendix F – Drainage Strategy Drawing

SURFACE WATER DRAINAGE STRATEGY

- ROOF DRAINAGE, PERMEABLE SURFACES AND ESTATE ROAD DRAINAGE TO MAIN SURFACE WATER SYSTEM WITH DETENTION BASIN AND OUTFALL TO DICKLEBURGH STREAM.
- DISCHARGE TO THE WATERCOURSE AT A MAXIMUM RATE OF 1.2L/S.
- ALL FEATURES DESIGNED FOR THE 1 IN 100 YEARS + 40% CLIMATE CHANGE EVENT.



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

NOTES: THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RISK REGISTER PRODUCED FOR INCLUSION IN THE HEALTH AND SAFETY PLAN. THE HAZARDS NOTED ARE IN ADDITION TO THE NORMAL HAZARDS AND RISKS FACED BY A COMPETENT CONTRACTOR WHEN DEALING WITH THE TYPE OF WORKS DETAILED ON THIS DRAWING.

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MAINTENANCE/CLEANING RISKS:

DEMOLITION RISKS:

NOTE:

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LEGEND

- SITE BOUNDARY
- PERMEABLE PAVING TYPE B
- ESTATE ROAD
- SURFACE WATER SEWER
- EXCEEDANCE FLOOD FLOW ROUTING

PRELIMINARY DRAWING:
THIS DRAWING IS FOR PRELIMINARY PURPOSES ONLY AND MUST NOT BE READ AS A CONSTRUCTION ISSUE. IT INDICATES DESIGN INTENT ONLY AND IS SUBJECT TO AMENDMENT DURING FINAL DESIGN DEVELOPMENT.

REV	DESCRIPTION	DATE	BY	AUTH
P1	PRELIMINARY ISSUE.	28/03/18	DT	

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CLIENT
CHAPEL FARM PARTNERSHIP

PROJECT
NORWICH ROAD
DICKLEBURGH

TITLE
SURFACE WATER DRAINAGE STRATEGY

DRAWN	AUTHORISED	DATE	SCALE AT A1
DT	RAC	Mar'18	1:250

PROJECT NO.	DRAWING NO.	REV
151492	CL-01	P1

STAGE:
PRELIMINARY

Appendix G – Preliminary Management & Maintenance Plan

Rossi Long Consulting

SuDS Management and Maintenance Plan

Residential Development

Norwich Road

Dickleburgh

RLC Ref: 151492

March 2018

Prepared for

Chapel Farm Partnership

1.0 General Description

1.1 The site is a development of residential dwellings, retirement units and a community facility with access off Norwich Road, Dickleburgh. The responsibility for the maintenance of SuDS features rests with the following.

1.2 The responsibility for the maintenance of private systems rests with householders for features within the curtilage of their own property. Shared features will be maintained by a Management Company on behalf of the residents.

1.3 The principal surface drainage system with attenuation storage, flow control and discharge to the Dickleburgh Stream will be offered for adoption by Anglian Water. Anglian Water will be responsible for the operation and maintenance of this system. Should Anglian Water not be prepared to adopt the system, the responsibility for future maintenance will rest with the Management Company.

1.4 For the purposes of this manual, maintenance refers to:

1) Inspections required to identify performance issues and plan appropriate maintenance needs.

2) Operation and maintenance of the drainage system.

1.5 The SuDS features comprise:

1) Pervious Paving

2) Inlets, Outlets and Inspection Chambers

3) Detention Basin

2.0 Operation and Maintenance Requirements

2.1 Pervious Paving – Table 20.15 CIRIA C753

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

2.2 Detention Basin

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Detention basins will require ongoing regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of bioretention systems is dependent on maintenance, and robust management plans will be required to ensure maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance.

Maintenance responsibility for a basin should always be placed with an appropriate organisation. Adequate access should be provided to all detention basin areas for inspection and maintenance, including for appropriate equipment and vehicles. Litter and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management task. All litter should be removed from site.

The major maintenance requirement for detention basins is usually mowing. Regular mowing in and around detention basins is only required along maintenance access routes, amenity areas (eg footpaths), across any embankment and across the main storage area. The remaining areas can be managed as "meadow", unless additional management is required for landscape/amenity/recreational or aesthetic reasons.

Mowing should ideally retain grass lengths of 75–150 mm across the main "treatment" surface to assist in filtering pollutants and retaining sediments and to reduce the risk of flattening during runoff events. Longer lengths of vegetation may be appropriate, depending on the functionality of the component, and its associated design criteria and are not considered to pose a significant risk to functionality.

Shorter lengths may be required when recreational facilities form part of the basin, but in this case the basin will be dealing with exceedance flows only and not treatment.

Grass clippings should be disposed of off-site or outside the detention basin area to remove nutrients and pollutants. Where a detention basin has a small permanent pool at the outlet, its submerged and emergent aquatic vegetation should be managed as for ponds or wetlands. Plant management, to achieve the desired habitat effect, should be clearly specified in a maintenance schedule. All vegetation management activities should take account of the need to maximise biosecurity and prevent the spread of invasive species.

Occasionally sediment will need to be removed (eg once deposits exceed 25 mm in depth). Sediments excavated from a detention basin that receives runoff from residential or standard road and roof areas are generally not toxic or hazardous and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For runoff from busy streets with high vehicle traffic, sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so. Further detail on waste management is provided in Chapter 32. Any damage due to sediment removal or erosion and scour resulting from major events should be repaired and immediately reseeded or planted.

3.0 Operation and Maintenance Activities

3.1 Operation and Maintenance Activity Categories

Maintenance activities can be broadly defined as:

1) regular maintenance (including inspections);
2) occasional maintenance; and
3) remedial maintenance.

There may also be initial one-off requirements sometimes referred to as "establishment maintenance", particularly for planting (e.g. weeding and watering). Regular maintenance consists of basic tasks carried out to a frequent and predictable schedule, including inspections / monitoring, silt or oil removal if required more frequently than once per year, vegetation management, sweeping of surfaces and litter and debris removal.

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks (e.g. sediment removal or filter replacement). The table overleaf summarises the likely maintenance activities required for each SuDS component.

Remedial maintenance describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design, construction and regular maintenance activities. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and so timings are difficult to predict. Remedial maintenance can comprise activities such as:

- inlet and outlet repairs;
- erosion repairs;
- infiltration surface rehabilitation;
- replacement of blocked filter materials / fabrics;
- construction stage sediment removal (although this activity should have been undertaken before the start of the maintenance contract);
- system rehabilitation immediately following a pollution event.

3.2 Operation and Maintenance Activity Schedule

Operation and maintenance activity	SuDS component			
	Inspection chambers	Conveyance pipes	Pervious pavement	Detention basin
Regular maintenance (Monthly or as Required)				
Inspection	■	■	■	■
Inspect after leaf fall in the Autumn	■	□		■
Litter and debris removal	■	■	■	■
Grass cutting	■	■	□	□
Weed and invasive plant control	□	□	□	□
Shrub management (including pruning)	□		□	□
Brush regularly and remove sweepings			■	
Occasional maintenance (Annually)				
Sediment management	■	■	■	■
Vegetation replacement				□
Vacuum sweeping and brushing			■	
Check topsoil levels are 20mm above chambers to avoid mower damage	■			
Remove covers and inspect ensuring water is free flowing and that any inlet / outlet is unobstructed	■	□		
Remedial maintenance (As Required)				
Jet wash and suction cleaning			□	
Structure rehabilitation / repair	□	□	□	□
Infiltration surface reconditioning			□	

Key
■ will be required
□ may be required