RichardJackson
Engineering Consultants

Our Ref: 47455/JDP/MJD
Your Ref:

16 March 2018

Ms R Rackham
G. N. Rackham & Sons Limited
Bridge House
Denmark Hill
Palgrave
Diss
IP22 1AB

Dear Ms Rackham,

Re: Land at Sturgeons Farm, Diss –
Flood Risk and Surface Water Drainage Assessment

I refer to our instructions to assess the flood risk and preliminary surface water drainage strategy for the above site as indicated on **Figure 101**.

The site compromises of greenfield and brownfield land and is approximately 13.5ha in size. There will be two accesses, one a continuation of Farm Close and a new access onto Shelfanger Road. Our assessment for surface water drainage elements for land at Sturgeons Farm, Diss has been made on the basis of the approximately 415 proposed dwellings

The Flood Risk and Drainage Strategy has been carried out in accordance with the National Planning Policy Framework (NPPF) – Planning Practice Guidance on Flood Risk and Coastal Change, published by the Department for Communities and Local Government (DCLG). Reference is also made to the Norfolk County Council, Lead Local Flood Authority (LLFA) Guidance, dated April 2017.

The topography of the site predominantly falls from south to north east from approximately 38m to 34m AOD to the northern half of the site.

Proposed Development

The site is proposed for residential development and the total site area is approximately 13.5Ha. The site has an existing Public Right of Way (PROW) that has access from Louie's Lane, which gives the site a north-south split.

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For the purposes of establishing the likely drainage parameters for the site, the site area of 13.5Ha, with a density of impermeable area at 40% to 50%, will be used to provide a range of necessary water attenuation and/or storage. Additionally, an area of 10% of the overall site area will be assumed to be highways.

Existing Flood Sources

When assessing any development site, there are four potential sources of flooding which need to be considered both in terms of their effect on the development itself and its end users and that caused to others. The main sources of flooding that need to be considered are as follows:

- Fluvial and/or tidal flooding;
- Ground water;
- Overloading of the existing drainage network;
- Surface water flooding.

Fluvial and Tidal Sources of Flooding

From investigation of the existing watercourses and the Environment Agency (EA) floodplain maps, there are no identified influences of fluvial or tidal flooding at the site and the site is in Flood Risk Zone 1. The nearest source of flooding is approximately 550m north of the centre of the site. Therefore this has not been investigated further. An indication of the associated EA mapping is shown on **Figure 102**.

Groundwater Vulnerability

An investigation into the information provided by the British Geological Survey mapping indicates that the land has Lewes Nodular Chalk Formation sedimentary bedrock formed between 72 and 94 million years ago during the Cretaceous period.

The local ground investigations within the Site through historic borehole information found that under the 'Soil' which was present for the first approximately 500mm, there were underlying 'Boulder Clay, these soil elements comprised of 'Pebbly clay, silty, medium grey with moderate yellowish brown, firm, many pebbles of rounded to sub-angular chalk, with some angular to sub-angular flint and traces of rounded quartz and quartzite pebbles', to a depth of approximately 10.5m and then there is glacial sand and gravels to approximately 25m depth.

The EA defines groundwater Source Protection Zone around all major groundwater abstraction points. Source Protection Zones (SPZ) are defined to protect areas of groundwater that are used for potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks. From the mapping shown on **Figure 103**, the site lies within the 'Outer Zone 2' groundwater source protection zone. As a result, it is important to protect underlying groundwater, but does not preclude development.

In addition, the Groundwater Vulnerability Zone Maps see **Figure 103** show that the site is predominantly in the medium risk for groundwater vulnerability. The north east portion of the site and parts of the western boundary are shown to be a 'soluble rock risk', this will require further investigation with trial pits at a later stage of the masterplan design.

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If soluble rocks, such as chalk, are present within the site then further consideration will be required for distances of any infiltration methods and their proximity to permanent buildings.

Existing Surface Water System and Ground Conditions

Existing sewer records were obtained from Anglian Water to understand what, if any, surface water sewers were present within the vicinity of the site. Surface Water sewers were found to be present within the vicinity of the site, at Farm Close and in Shelfanger Road.

The two surface water sewers that are present in Shelfanger Road flow northwards towards the watercourse that is 550m north of the centre of the site. There also appears to be a ditch along the sites northern boundary that is connected to the watercourse via a culvert under Shelfanger Road.

The ground conditions that have been obtained via the borehole scans on the British geological survey website and are described earlier in this report. Further investigations will be required to determine whether infiltration techniques are feasible at depth but with clay to a depth of 10.5m other drainage techniques will be initially investigated.

The existing surface water flooding for the 1 in 100 and 1 in 1000 year events have been investigated and are shown on **Figure 104** and **Figure 105** respectively. There is some flooding within in the site for the 1 in 100 year event and consideration to this area of the site is to be kept clear of development and managed for potential exceedance events, this area is predominantly located along the northern boundary of the site, closest to the existing ditch. The 1 in 1000 year event shows large amounts of surface water flooding, likely due to the existing ditch systems and land drains that enter them, the proposed surface water drainage strategy will attenuate the water and therefore help to mitigate this risk.

Any new systems of drainage should consider the flow from the site and suitable SuDS to accommodate storage before discharging into the ground.

Flood Risk Impact

It has been determined using the Ordnance Survey and topographical survey level information available, that surface water runoff from the site will occur in a northerly direction. A proportion of rainfall falling across the existing site will likely infiltrate into the soils of the site given the current ground conditions. A proportion of this infiltrating surface water will also contribute to any groundwater recharge. Ground permeability has not been checked for the site as mentioned.

To determine the rainfall data for the site when undertaking the detail design, the Flood Estimation Handbook (FEH) data would be used for establishing the critical rainfall scenario where this is greater than 1 hour. The FEH data will be used and only Rainfall Studies Report rainfall (FSR) used for storms of less than 1 hour.

If the drainage calculations show a need for critical storms under 1 hour, then the FSR will be used. The FEH data normally provides higher rainfall intensity parameters however, for the assessment at this stage the FEH rainfall data will provide a strategic level of storage or attenuation required for the development sites.

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Soil Types and SuDS Suitability

The NPPF and appropriate guidance indicates that the FRA should identify the risks of flooding and manage those risks to ensure the site remains safe. One way to manage the flood risk is to incorporate Sustainable Drainage Systems (SuDS) within proposals for new sites. There is a general requirement that SuDS be installed where appropriate, in order to limit the amount of surface water runoff entering drainage systems and to return surface water into the ground to follow its natural drainage path. This advice is also replicated in the SuDS Manual C753 (2015).

The details of the ground conditions have yet to be determined through a full ground investigation but advice on the use of SuDS/soakaways is such that they will unlikely be used. Instead the surface water will have to be attenuated before being discharged into the existing ditch along the northern boundary at a reduced rate.

SuDS Assessment

The suitability of the use of SuDS on the site is based on the criteria as set out in the Ciria document C753 dated November 2015, where in Chapter 26 the appropriateness of SuDS can be established. The table below suggests the potential SuDS selection for Highways and Private Drives and also for Private Roof

Table A – SuDS Selection

Type of SuDS	Main Roads TSS=0.7 Metal=0.6 Hydrocarbons=0.7	Highways & Private Drives TSS=0.5 Metal=0.4 Hydrocarbons=0.4	Private Roofs TSS=0.2 Metals=0.2 Hydrocarbons =0.05
Filter Strip			✓
Filter Drain			✓
Swale		✓	✓
Permeable Paving	✓	✓	✓
Detention Basin		✓	✓
Pond	✓ (not hydrocarbons)	✓	✓
Wetland	✓	✓	✓
Soakaway (surrounded with infiltration materials)			✓
Infiltration Trench			✓

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Using the **Table A** above which is derived from **Table 26.3** and **26.4** of Ciria C753 then it can be concluded that the better SuDS' choices for the site are as set out below;

Private Drives – Permeable paving to Attenuation/Detention Basin

Residential Roofs – Through permeable paving to Attenuation/Detention Basin/s

Highways – To Pond/wetland, Swales or Attenuation Basin

A surface water strategy is therefore proposed to utilise the permeable paving and swales for the drives and private roof areas and swales and/or attenuation/detention basins for the highway water for events up to the 1 in 100 year storm event, plus climate change at 40%. This strategy is based on the SuDS management train as favourable soakage rates are unlikely.

Flood Risk Management

Having determined that the soils across both sites do not possess sufficient infiltration capacity for the use of infiltration devices, the methods of surface water disposal have been investigated, to determine the feasibility of discharging and attenuating the water prior to it entering the existing watercourse to the north of the site.

To determine the appropriate use of the SuDS features, the pollution indices were used to determine the type of SuDS to be used. For the purposes of the design for the site, which has yet to be detailed and is only at masterplan stage, a selection of likely solutions have been prepared for different house types, drive areas and widths of highway.

The private drives will provide permeable paving to act as a pollution treatment and then the water can be collected and drain towards the detention basins via swales or sewers. Suggested storage areas for the private dwelling permeable paving drainage are indicated on **Table B** below:

Table B – Indicative SuDS Storage Sizes

Dwelling Type	Dwelling Area (m^2)	Garage Area (m^2)	Private Drive Area (m^2)	Total Area (m^2)	1 in 100 year plus 40% CC Storage Permeable Paving Depth (m)
A	40	N/A	30	70	0.282
B	60	45	30	135	0.416
C	90	45	30	165	0.482
D	130	45	60	235	0.451

The highway water will be directed towards swales and/or attenuation/detention basins which are to be positioned in the Public Open Space along the northern boundary of the site, or could be split into smaller basins across the site. The size will be determined by the exact dimensions of the dwellings, roads and footways going to the swales/detention basin but an indication of the sizes are given in this Chapter.

The water will be discharged at 2l/s/Ha as the LLFA requirements into the existing ditch that flows west to east along the northern boundary of the site. This ditch

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culverts underneath Shelfanger Road before joining the watercourse to the north east of the site.

For an estimated Highways SuDS sizing see **Table C** below which shows swales that should be used across the site.

Table C – Highway Swale Design for Sections of Road

Overall Highway Width (m)	Length of Highway (m)	Swale Profile	1 in100 year storm plus 40% CC	
			Depth (m)	Volume (m^3)
4.8 + 1.0 = 5.8m	10m	Side Slope = 1 in 4 Base Width = 1.0m	0.388	8.9
4.8 + 1.5 + 1.5 = 7.8m	10m	Side Slope = 1 in 4 Base Width = 1.0m	0.459	11.9
6.0 + 1.8 + 1.8 = 9.6m	10m	Side Slope = 1 in 4 Base Width = 1.0m	0.501	14.9

To determine the sizing of the detention basins/ponds across the site the parameters of the site are provided as a discharge rate of 13.5l/s (assuming a 50% impermeable area of 6.75 Ha x 2 L/s/Ha) for the whole site. This could discharge in one location or multiple locations into the ditch and proportioned accordingly, positioned in various locations across the site. The overall storage requirements are likely to be in the order of 7095m^3.

Summary

It can be seen from the indicative ground conditions taken from the ground investigation via the BGS that infiltration techniques are unlikely to be suitable at shallow depths. Further intrusive investigations are required in order to determine if infiltration devices could be utilised on the site. This will confirm the underlying geology within the site boundary.

A discharge rate to the watercourse on the northern boundary will have to be agreed with the LLFA, but, with above ground storage, the strategy is in accordance with National and Local planning policy, by treating the water for quality and quantity on site, thus not creating a detrimental effect downstream of the site.

Sufficient land must be set aside for accommodating the swales, ponds and/or attenuation basins, to allow the water to drain towards the ditch. Pollution control will have to be achieved via permeable paving for the private drives and swales or ponds for the highways.

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Summary Table for Flood Risk and Surface Water Drainage

Matters	Comment	Satisfactory	Needs some Upgrade	Not Satisfactory
Flood Risk Zone	The site is in Flood Risk Zone 1. Suitable for residential development			
High Risk Surface Water Flooding	There are no existing surface water flooding issues of High Risk			
Medium Risk Surface Water Flooding	There are no existing surface water flooding issues of Medium Risk which cannot be mitigated or included within the development boundary.			
Low Risk Surface Water Flooding	There are no existing surface water flooding issues of Low Risk which cannot be accommodated within the development drainage strategy.			
Proposed Surface Water Drainage	The proposals will conform to the SuDS Manual and LLFA guidance for use of above ground storage which are dependent upon a detailed site investigation to determine if infiltration devices could be used onsite. Otherwise the water can be successfully attenuated before discharging into the ditch on the northern boundary.			

In conclusion, the site is suitable for development where the proposed dwellings can be placed outside of any flood areas and surface water drainage from the development can be adequately managed in accordance with National and Local Planning policy, so not to cause a detrimental effect downstream.

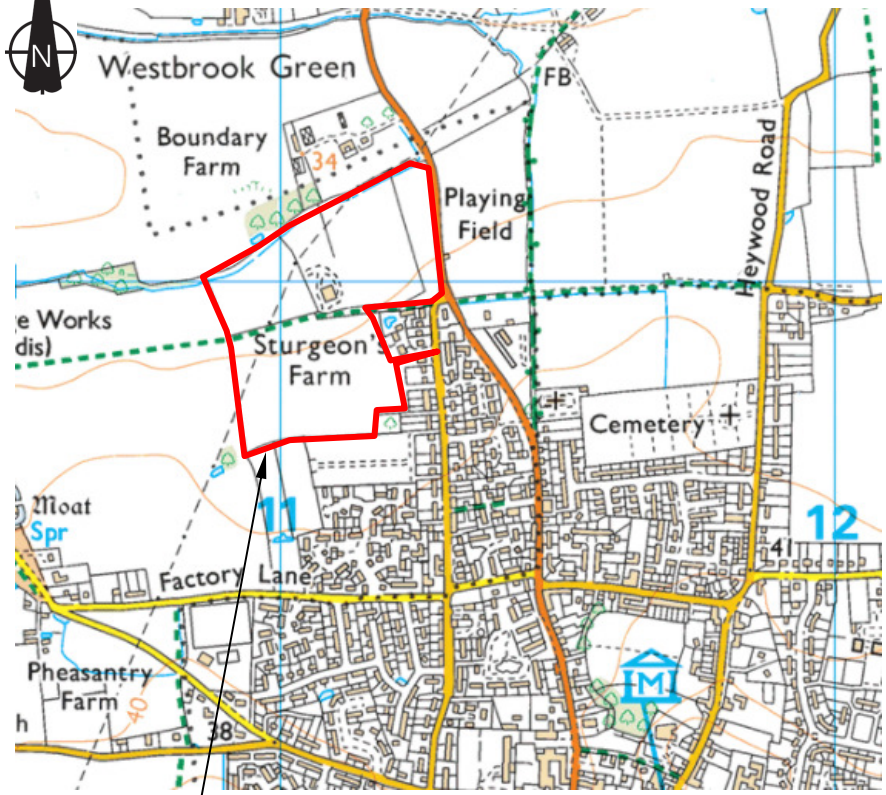
I trust the foregoing is satisfactory but if we can be of any further assistance, please do not hesitate to contact us.

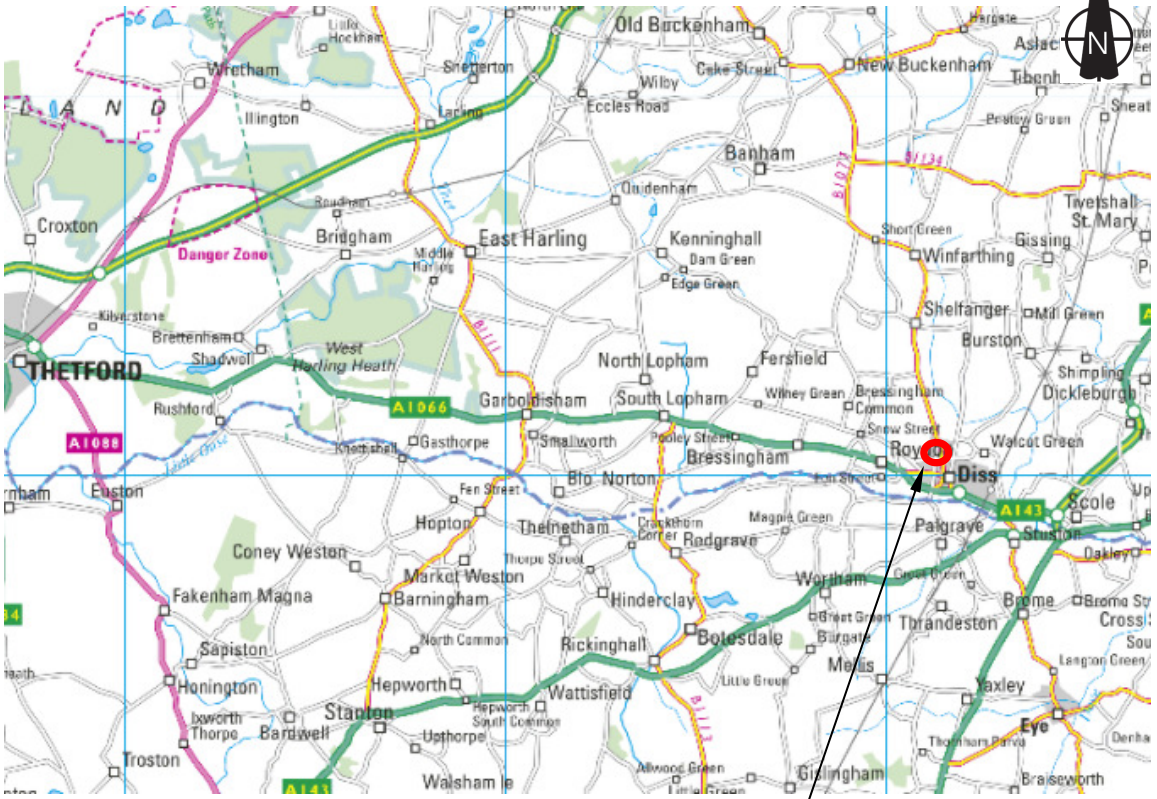
Yours sincerely

Martin Doughty BEng (Hons), CEng, FCIHT, FICE, MAPM
Director
on behalf of Richard Jackson Limited

CC Simon Henry - Bidwells

Enc Figures 101, 102, 103, 104 & 105





Site location grid reference 611055,280896
and postcode IP22 4EE

Client:	Drawing Title:		
G.N. Rackham & Sons Ltd	**Site Location Plan**		
Job Title:	Date:	Job No:	Dwg No:
Sturgeons Farm Roydon, Diss	**31.01.18**	**47455**	**Fig. 101 (NTS)**

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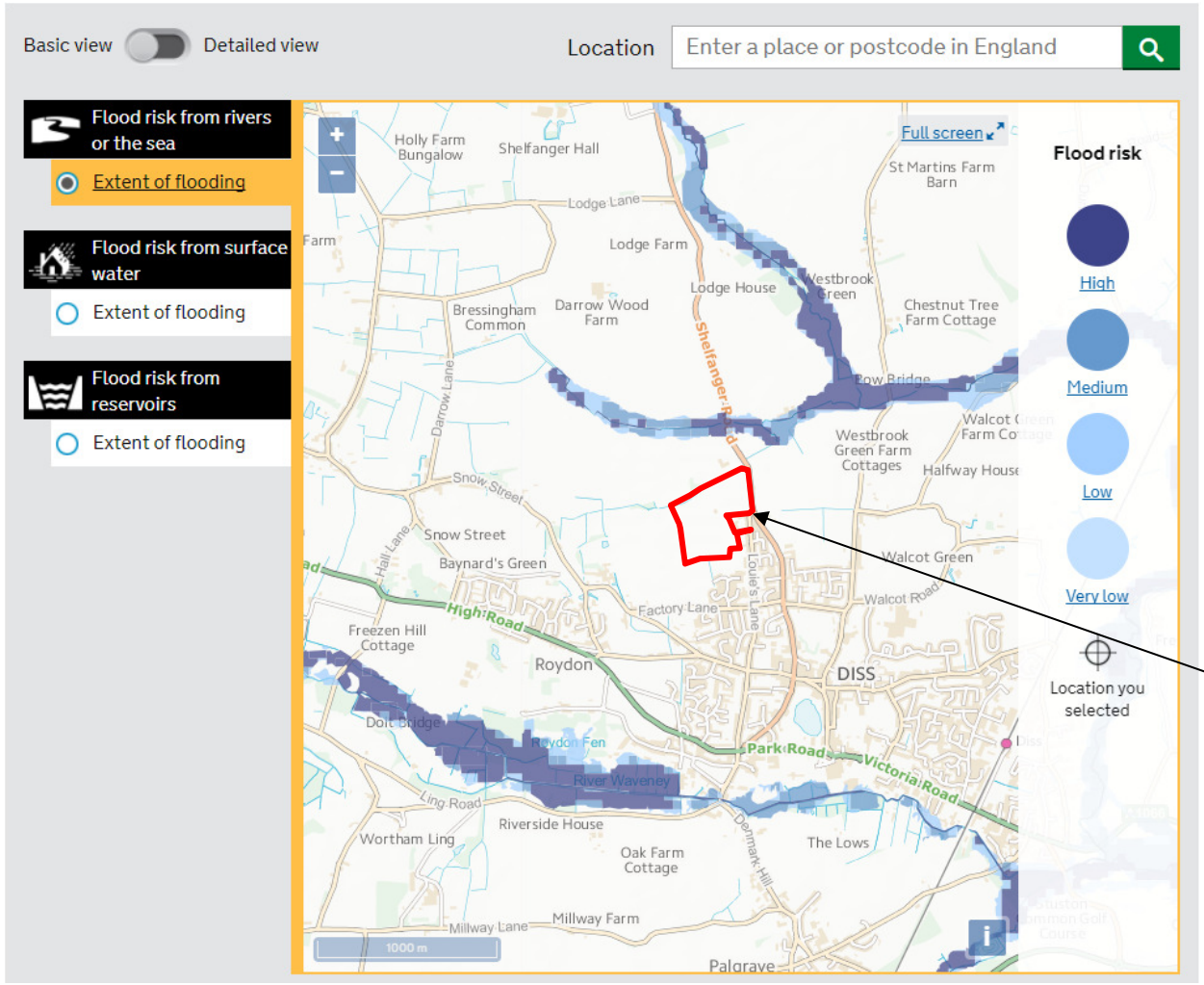

Sturgeon's Farm, Site Location Grid Reference 611055, 280896 and Postcode IP22 4EE

Client:	Drawing Title:		
G.N. Rackham & Sons Ltd	**Environment Agency Flood Plan (Rivers and Sea)**		
Job Title:	Date:	Job No:	Dwg No:
Sturgeon's Farm, Diss	**31.01.18**	**47455**	**Fig. 102**

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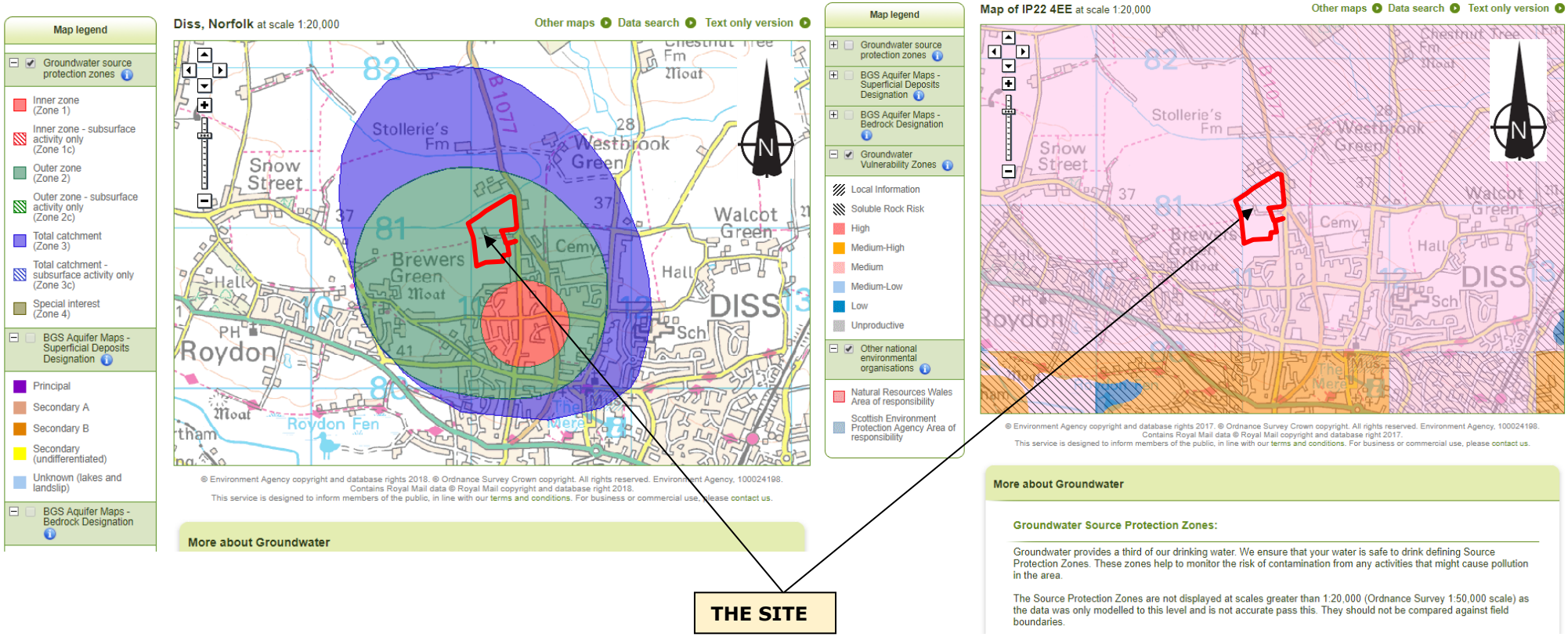

Sturgeon's Farm, Site Location Grid Reference 611055, 280896 and Postcode IP22 4EE

Client:	Drawing Title:		
G.N. Rackham & Sons Ltd	**Environment Agency Flood Plan (Groundwater)**		
Job Title:	Date:	Job No:	Dwg No:
Sturgeon's Farm, Diss	**31.01.18**	**47455**	**Figure. 103**

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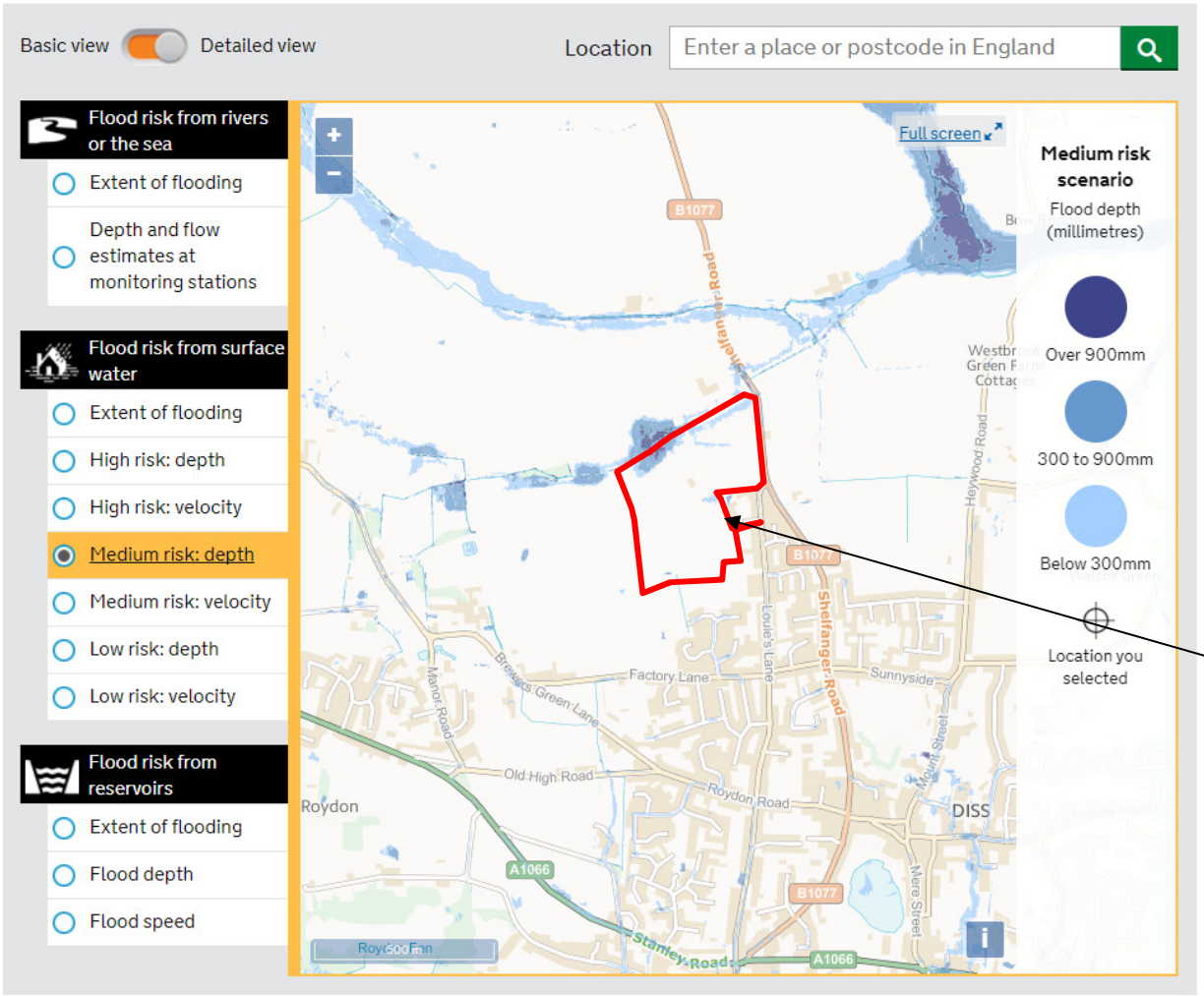

THE SITE

Sturgeon's Farm, Site Location Grid Reference 611055, 280896 and Postcode IP22 4EE

Client:	Drawing Title:		
G.N. Rackham & Sons Ltd	**Surface Water Flood Mapping (Medium Risk)**		
Job Title:	Date:	Job No:	Dwg No:
Sturgeon's Farm, Diss	**31.01.18**	**47455**	**Fig. 104**

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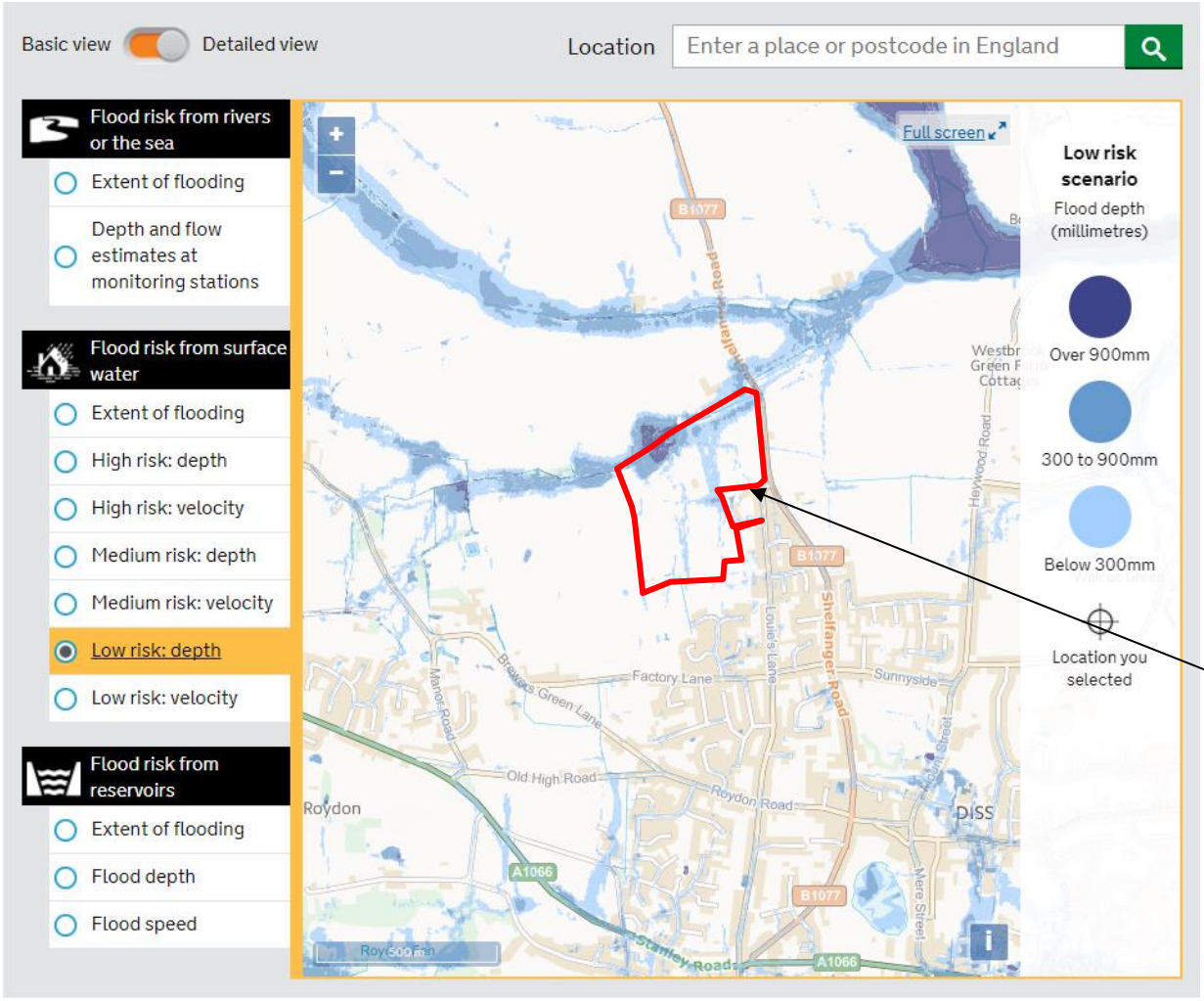

Sturgeon's Farm, Site Location Grid Reference 611055, 280896 and Postcode IP22 4EE

Client:	Drawing Title:		
G.N. Rackham & Sons Ltd	**Surface Water Flood Mapping (Low Risk)**		
Job Title:	Date:	Job No:	Dwg No:
Sturgeon's Farm, Diss	**31.01.18**	**47455**	**Fig. 105**

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