RichardJackson
Engineering Consultants

Our Ref: 48749/RL/SEC
Your Ref:

13 March 2018

Mrs E Peplow
c/o Mr Jake Lambert
Bidwells
16 Upper Kings Street
Norwich
Norfolk
NR3 1HA

Dear Mr Lambert

RE: Land off Taverham Road, Drayton - Surface Water Drainage Strategy

We refer to our instructions to assess the preliminary flood risk and surface water drainage strategy for the above site as indicated on **Figure 1.** The Site is to be considered as a stand-alone development, thus, the surface water strategy will need to be self-contained.

The site is located off Taverham Road in Drayton with a grid reference of 617500, 313350 and an approximate postcode of NR8 6RY. The site is located on the land between Taverham Road and Costessey Lane. To the south of the site is Costessey Lane and beyond that agricultural fields and the River Wensum. To the east of the site, there is a small field and dwellings fronting Station Road. To the north beyond Taverham Road there are residential housing estates for Drayton. The Site is mainly vacant land, used for some agriculture.

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 sites' topography is such that the highest point is along the northern boundary and it falls in a southerly direction. The high point is at about 21m Above Ordnance Datum (AOD) and the southern boundary is at about 8.5m AOD.

Proposed Development

The site compromises of greenfield land and is approximately 3.2ha in size. The size of the land leads to suggest that the development land could be promoted for approximately 70 dwellings.

The site is proposed for residential development and for the purposes of establishing the likely drainage parameters for the site, the site area of 3.2Ha,

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with a density of impermeable area at 50% taking into account urban creep, will be used to provide a range of necessary water attenuation and/or storage.

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 as well as 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. Therefore this has not been investigated further. An indication of the associated EA mapping is shown on **Figure 2**. It is also noted that the site does not lie in the area of a critical drainage catchment.

Groundwater Vulnerability

An investigation into the information provided by the British Geological Survey mapping indicates that the land has Superficial deposits: Happisburgh Glacigenic Formation and Lowestoft Formation - Sand and gravel. Sedimentary superficial deposit formed between 480 and 423 thousand years ago during the Quaternary period.

The local ground investigations for the land to the east of the Site through historic borehole information found that under the 'Soil / Made Ground' of approximately 600mm there were underlying 'Glacial Sand and Gravel', these soil elements comprised of Gravel: fine with coarse, subangular to subrounded flint, with traces of subrounded quartz and Sand: medium with coarse subangular to rounded; brown.

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. There are no groundwater source protection zones covering the site, see **Figure 3**.

In addition, the Groundwater Vulnerability Zone Maps see **Figure 3** show that the site is covered by a 'High' classification. This classification means that the area is able to easily transmit pollution to groundwater. They are characterised by high leaching soils and the absence of low permeability superficial deposits.

As a result the Groundwater will need protection via suitable SuDS and surface water management from a potential development to be maintained to protect the underlying groundwater. This is explored later in this letter report.

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Existing Surface Water System and Ground Conditions

No records from Anglian Water have been analysed or been made available but it is understood that it is unlikely any surface water sewers exist across the site.

Using the parameters above to establish the existing soil parameters, a desk top investigation into the potential ground conditions has been undertaken. The likely parameters of infiltration for the Site, based on the existing soil type, taken from local recorded boreholes of the soils locally. The recordings suggest permeability of soils ranging from 1.0×10^{-4} m/s to 1.0×10^{-5} m/s. No groundwater recordings were made.
Based on the data above, which will need clarifying through a site investigation, soakaways or other infiltration devices could be utilised on the site.

The existing surface water flooding has been investigated and this is shown on **Figure 4**. For the events which are for high risk (1 in 30 year return period), medium risk (1 in 100 year return period) there is no surface water flooding on the site and low risk (1 in 1000 year return period), there is some very minor surface water flooding. It is therefore concluded that there is no risk from existing surface water flooding across the site, as any water flowing across the site in its future developed format will be accommodated by the proposed drainage scheme for the residential properties.

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 information available, that surface water runoff from the site will occur in a southerly direction.

A proportion of rainfall falling across the existing site will also 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 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, so for the assessment at this stage the FEH rainfall data will provide a strategic level of storage or attenuation required for the development sites.

For the purposes of this report, the rainfall intensity will be increased by 40% to allow for a rise in climate change.

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

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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 could be used. The permeability of the site has been determined as potentially being between 1 x 10^{-4} m/s and 1.0 x 10^{-5} m/s based on the soil type.

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 A**, below, suggests the potential SuDS selection for Highways and Private Drives and also for Private Roof

Table A – SuDS Selection

Type of SuDS	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	✓	✓
Wetland	✓	✓
Soakaway (surrounded with infiltration materials)		✓
Infiltration Trench		✓

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 soakaway

Residential Roofs – To soakaway/permeable paving

Highways – To Swales or Infiltration Basin

A surface water strategy is therefore proposed to utilise the permeable paving and soakaways for the drives and private roof areas and swales and/or infiltration basins for the highway water for events up to the 1 in 100 year storm event, plus

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climate change at 40%. This strategy is based on the SuDS management train and also the favourable soakage rates as previously indicated.

Flood Risk Management

Having determined that the soils across both sites do 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 treating the water prior to it entering the ground.

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 soakaway proposed for the private dwelling. The permeability rate of 1 x 10^{-5}m/s or 0.036m/hr as indicated as the lower permeability rate will be used for a robust assessment. Suggested sizes for the private dwelling 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)	Soakaway storage requirements, 1 in 100 year plus 40% CC	Approx. Soakaway Size
A	40	N/A	30	70	Vol = 5.5m^3	2.0 x 2.5 x 1.2
B	60	45	30	135	Vol = 9.7m^3	4.0 x 2.5 x 1.2
C	90	45	30	165	Vol = 11.3m^3	4.0 x 2.5 x 1.2
D	130	45	60	235	Vol = 17.4m^3	5.0 x 2.5 x 1.6

The highway water will be directed towards the swales and/or infiltration basins which are to be positioned adjacent to the highway or in the Public Open Space and in low points. The size will be determined by the exact dimensions of the roads and footways going to the swales/infiltration basin but an indication of the sizes are given in this Chapter. For purposes of being robust, a permeability rate of 1 x 10^{-5} m/s or 0.036m/hr will be used.

For an estimated Highways SuDS sizing see **Table C** below which shows swales for a 10m length of road and **Table D** shows catchments of larger areas in infiltration basins, for a predicted total area of adopted roads for the development:

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Table C – Highway Swale/Infiltration Design for smaller areas

Overall Highway Width (m)	Length of Highway (m)	Swale Profile	1 in100 year storm plus 40% CC	
			Depth (m)	Volume (m^3)
4.8 + 1.5 + 1.5 = 7.8m	10m	Side Slope = 1 in 4 Base Width = 1.0m	0.287	4.7

For an estimated Highways SuDS sizing see **Table D** below for a length of road 420m which is likely to provide the storage for all the adoptable roads within the site:

Table D – Highway Infiltration Basin Design for Larger areas

Overall Highway Width (m)	Length of Highway (m)	Basin Profile	1 in100 year storm plus 40% CC	
			Depth (m)	Volume (m^3)
7.8m	420m	Side Slope = 1 in 4 Area = 300m2	0.764	225

Summary

To collate the issues and highlight the matters that are relevant to Flood Risk and Surface Water Drainage for the proposed development at Taverham Road, Drayton, the following table shows the summary of benefits that this scheme includes:

Summary Table

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.			
Low Risk Surface Water Flooding	There are no existing surface water flooding issues of Low Risk which can not be accommodated within the development drainage strategy			
Proposed Surface Water Drainage	The proposals are likely to conform to the SuDS Manual and LLFA guidance for use of infiltration devices which are dependant upon a detailed site investigation to determine the permeability rate for the site			

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It can be seen from the information above that the site is satisfactory for residential development in terms of flood risk and that a drainage strategy can be used which is compliant with the SuDS Manual and local policy from the LLFA.

The sizes of the soakaways for the houses might be a little large to fit into back gardens, so if this is the case, then alternative arrangements for the water in line with the areas and volumes indicated for the highways could be introduced for the water from the private dwellings. Sufficient land should be set aside for accommodating the swales / infiltration facilities. It is proposed that the masterplan for the site reviews the SuDS Manual for how it can be accommodated into landscape design and make it a feature whilst still making infrastructure benefit.

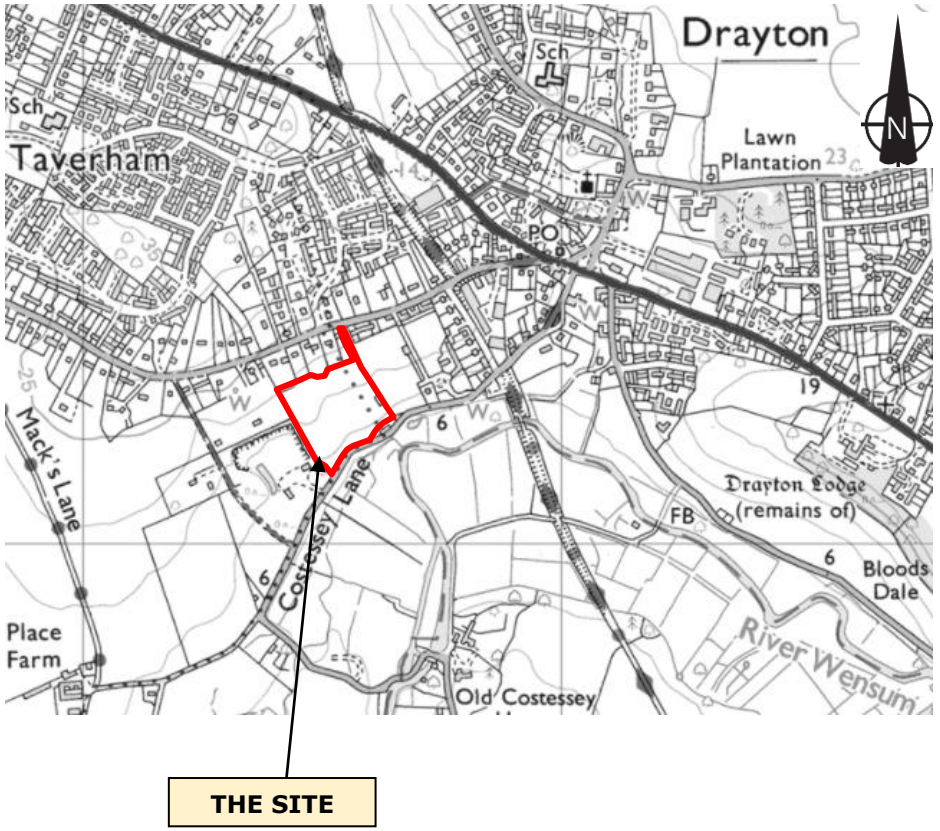
I trust the foregoing is satisfactory but if we can be of any further assistance, please do not hesitate to contact us.

Yours sincerely

Raymond Long BSc (Hons) IEng MCIHT MICE
Senior Engineer

on behalf of Richard Jackson Limited

encs Figures 1, 2, 3 & 4



Taverham Road, Site Location Grid Reference 617500, 313350 and Postcode NR8 6RY

Client:	Drawing Title:		
Mrs E Peplow	**Site Location Plan**		
Job Title:	Date:	Job No:	Dwg No:
Land off Taverham Road, Drayton	**21.02.18**	**48749**	**Fig. 1**

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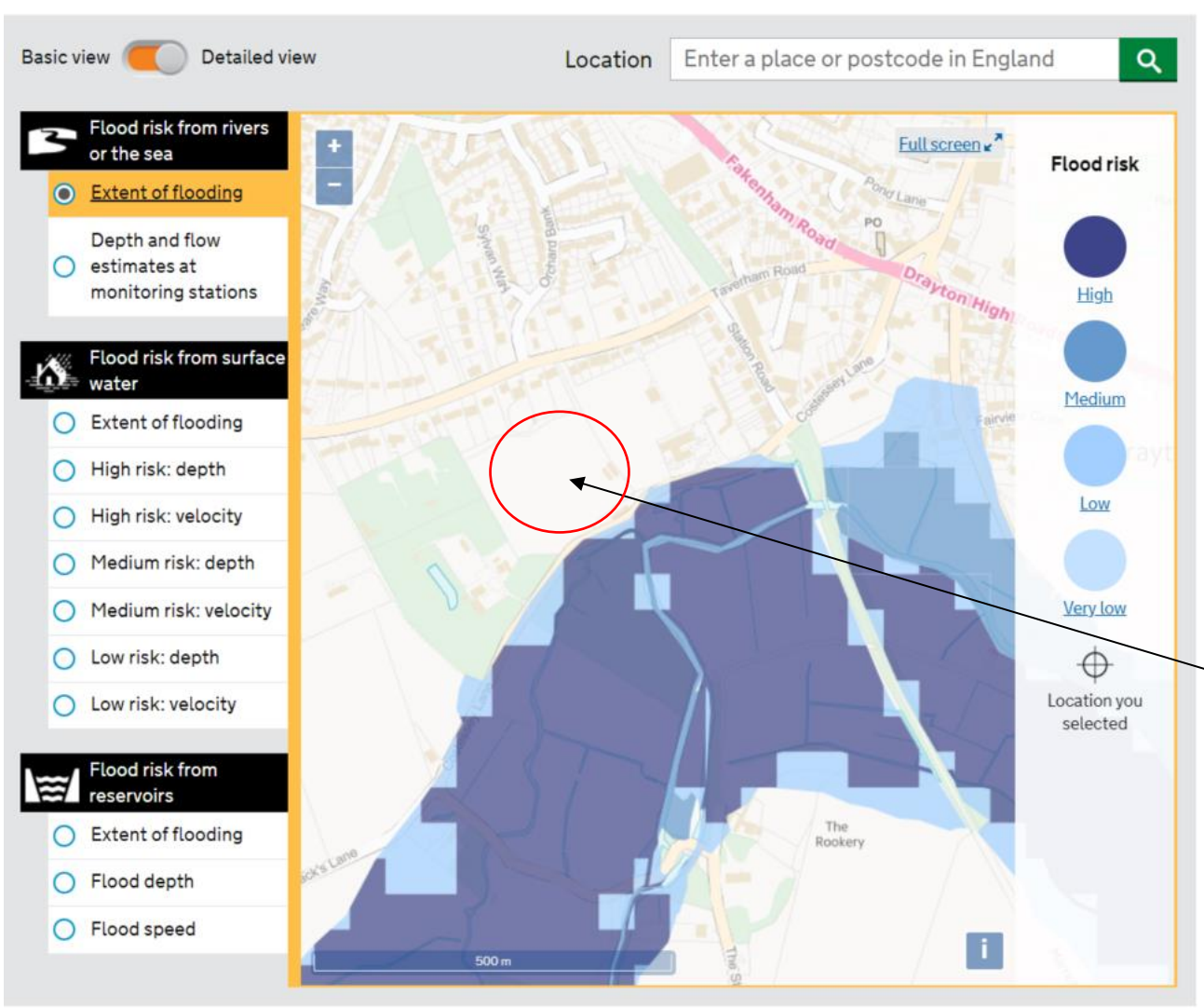

The Site

Client:	Drawing Title:		
Mrs E Peplow	**Flood Mapping**		
Job Title:	Date:	Job No:	Dwg No:
Land at Taverham Road, Drayton	**20.2.18**	**48749**	**Fig. 2**

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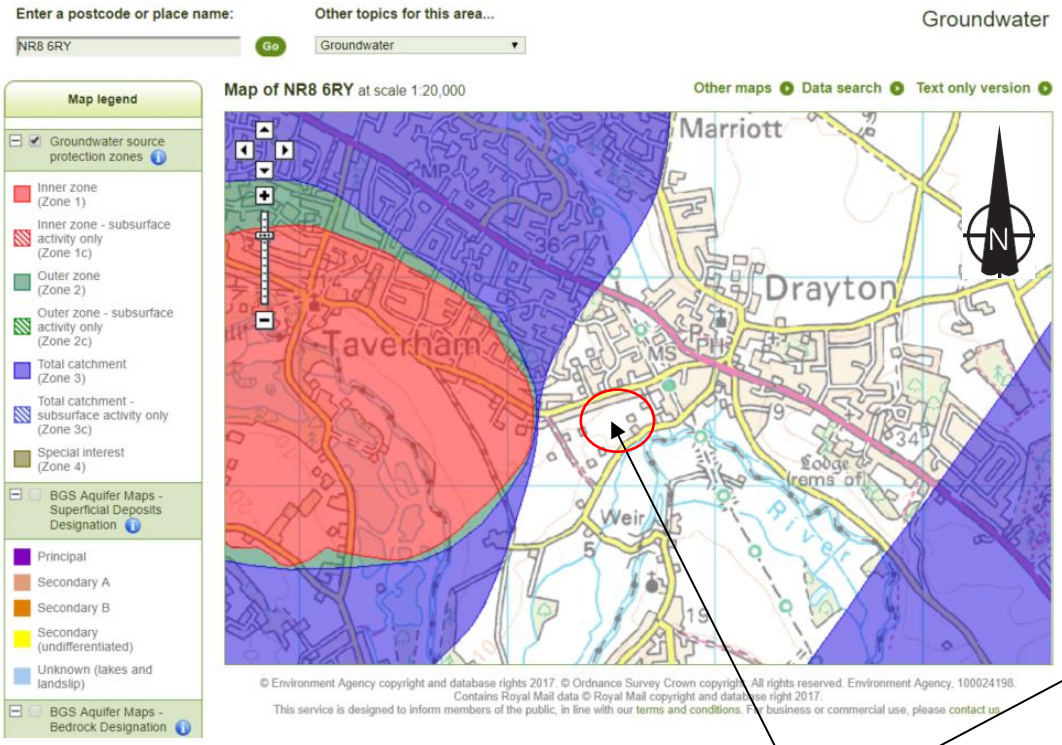

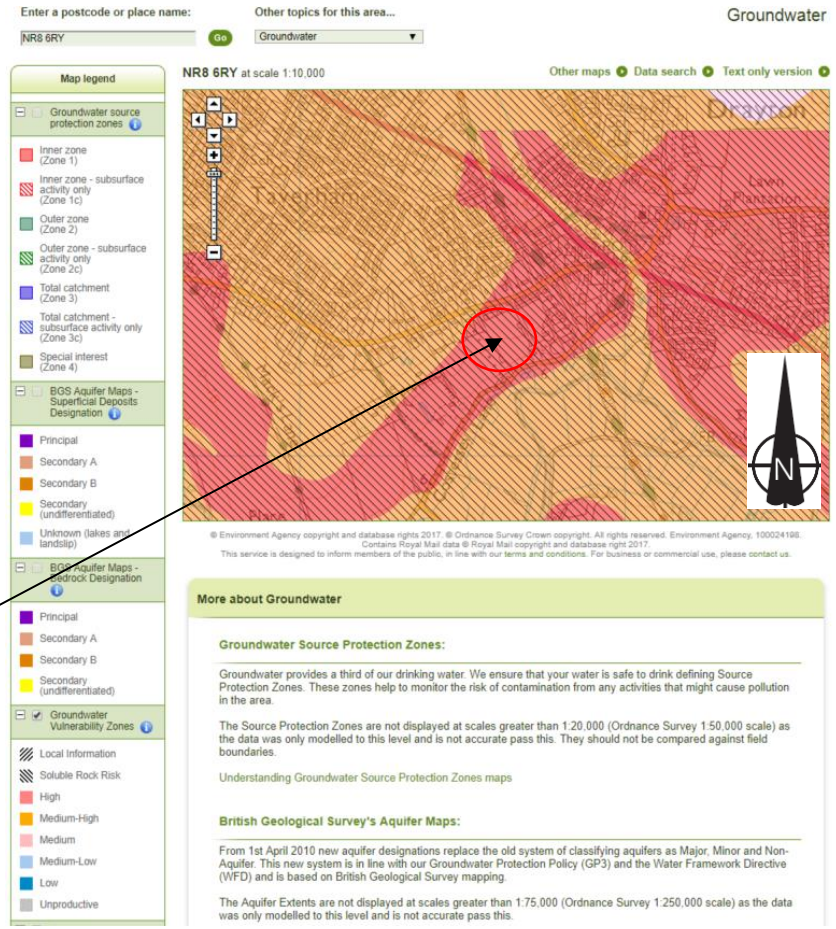

The Site

`REPRODUCED FROM ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE, © CROWN COPYRIGHT RICHARD JACKSON LTD – ACC No. 100002572

Client:	Drawing Title:		
Mrs E Peplow	**Groundwater Mapping**		
Job Title:	Date:	Job No:	Dwg No:
Land at Taverham Road, Drayton	**20.2.18**	**48749**	**Fig. 3**

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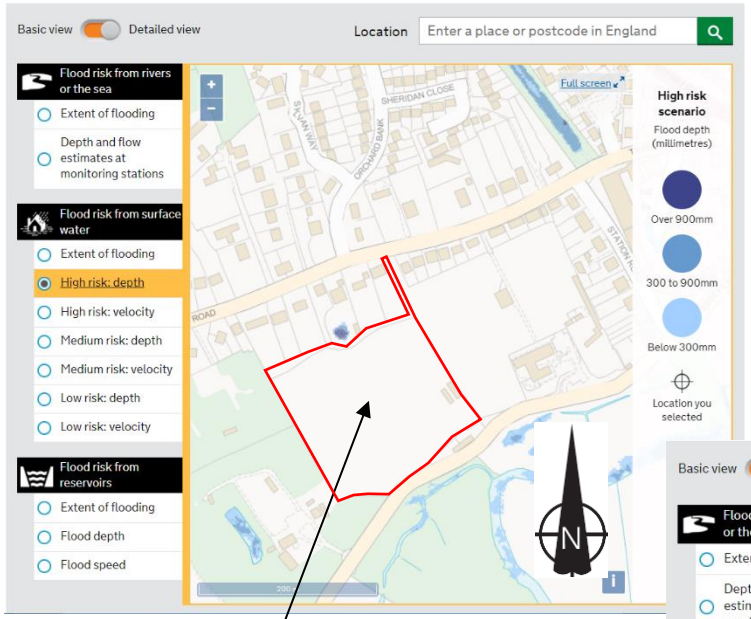

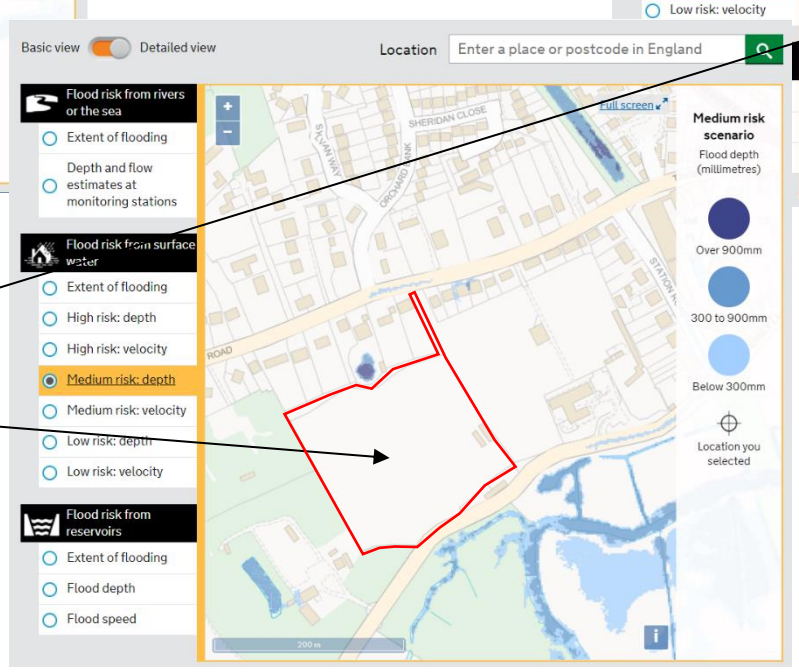

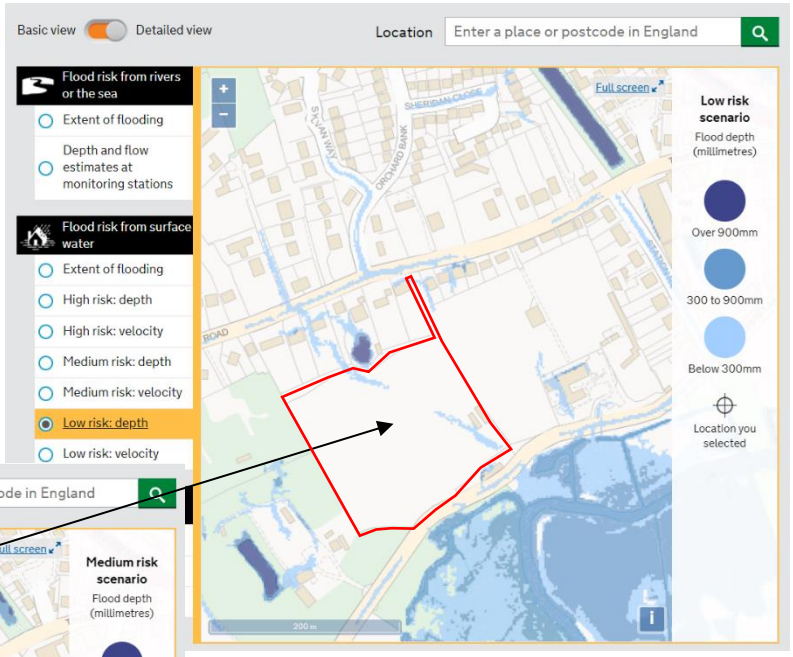

The Site

Client:	Drawing Title:		
Mrs E Peplow	**Surface Water Flood Mapping**		
Job Title:	Date:	Job No:	Dwg No:
Land at Taverham Road, Drayton	**20.2.18**	**48749**	**Fig. 4**

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