RichardJackson
Engineering Consultants

Our Ref: 48851/JDP/MJD
Your Ref:

02 March 2018

Mr D Piper
Abel Homes Ltd
Neaton Business Park
Norwich Road
Watton
Norfolk
IP25 6JB

Dear Mr Piper,

## Re: Land South of Norwich Road, Hingham– Flood Risk Assessment

I refer to our instructions to assess the preliminary surface water drainage strategy for the above site as indicated on **Figure 1**. The referenced "Phase 1" development relates to the neighbouring existing/being constructed Abel Homes development to the west of this site.

The site compromises of greenfield land and is approximately 13ha in size. The main access will be off Norwich Road, with a potential pedestrian link and vehicular access to the west into Phase 1. Our assessment for a surface water strategy on the land south of Norwich Road, Hingham, has been made on the basis of approximate number of 250 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 falls to the low point in the south western corner, which is at approximately 44.9m AOD. The high point is in the north eastern corner which is at the 57.4m AOD.

### Proposed Development

The site is proposed for residential development and the total site area is approximately 13Ha. The site has an existing Public Right of Way (PROW) that creates a small south western parcel of approximately 1.6Ha, and this contains the surface and foul water disposal from the phase 1 development that forms the western boundary of the site.

For the purposes of establishing the likely drainage parameters for the site, the site area of 13Ha, with a density of impermeable area at 40% to 50%, will be

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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. Therefore this has not been investigated further. An indication of the associated EA mapping is shown on **Figure 2**.

**Groundwater Vulnerability**

The ground investigation from the Phase 1 development produced by Plandescil Consulting Engineers was used for an indicative assessment for the proposed development. There were trial holes undertaken in October 2014 to a maximum depth of 3m, and groundwater was not observed in any of the trial holes.

Additionally, Plandescil Consulting Engineers produced the FRA for the Phase 1 development which included mapping from the British Geological Survey showing the Hydrogeology mapping. The mapping indicates that the groundwater will be between 40 and 50 metres above ordnance survey datum. Using the data from the trial holes located in Phase 1, it is believed that the groundwater will be approximately 5m below ground level at the lowest point in the site.

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 in the vicinity of the site. For the EA groundwater source protection zones of the site, see **Figure 3.**

In addition, the Groundwater Vulnerability Zone Maps see **Figure 3** show that the site is predominantly in the medium risk for groundwater vulnerability. The north east corner of the site is shown to be a 'soluble rock risk', this will require further investigation with trial pits to identify the geology of the site.

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. This does not preclude the use of soakaways, however, further precautions may need to be made during design and construction.

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The surface water storage for Phase 1 is in the south western corner of that Phase. Due to the topography of the site, surface water storage will be located in the south west of this additional Phase. Infiltration testing to BRE digest 365 will need to be undertaken to obtain accurate information.

**Existing Surface Water System and Ground Conditions**

Abel Homes Ltd have provided us with the surface water drainage strategy for the Phase 1 development to the west and it shows that Highway surface water sewers, lead to cellular storage crates before discharging into an existing ditch in the south west corner of the development site.

Using the Plandescil report previously mentioned, the infiltration rates based on the Phase 1 report, suggests permeability of soils ranging from $7.7 \times 10^{-6}$ m/s to $9.47 \times 10^{-6}$ m/s. A ground investigation of Phase 1 in 2014 provided data indicating no water strike at 3.0m below ground level, thus, soakaways or other infiltration devices could be utilised on the site, it is likely that this strategy could be used for the additional proposed site also.

The existing surface water flooding for the 1 in 100 and 1 in 1000 year events have been investigated and are shown on **Figure 4** and **Figure 5** respectively. There is some minor 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. The 1 in 1000 year event shows some amounts of surface water flooding, likely due to the topography of the site, the proposed surface water drainage strategy will incorporate attenuation of water and therefore should mitigate this risk within the new development.

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 south westerly 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, 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 could be used. The permeability of the site has been determined as being between 7.7 x $10^{-6}$ m/s to 9.47 x $10^{-6}$ m/s based on the soil type for the neighbouring site.

**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 | Highways & Private Drives<br><br>TSS=0.5 Metal=0.4 Hydrocarbons=0.4 | Private Roofs<br><br>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 or permeable paving

Highways – To Swales or Infiltration Basin or Detention Basin

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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 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 $7.77 \times 10^{-6}$m/s or 0.02797m/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 ($m^2$) | 1 in 100 year plus 40% CC Storage (LxWxH)m |
|---|---|---|---|---|---|
| A | 48 | N/A | 42 | 90 | 2.5 x 3.5 x 0.8 Vol = 6.8$m^3$ |
| B | 56 | 23 | 29 | 106 | 2.0 x 3.5 x 1.2 Vol = 8.6$m^3$ |
| C | 65 | 45 | 19 | 129 | 2.5 x 3.5 x 1.2 Vol = 10.3$m^3$ |
| D | 116 | 45 | 124 | 285 | 5.5 x 3.0 x 1.6 Vol = 25.2$m^3$ |

The dwelling, garage and drive areas have been based on the Phase 1 layout, and the dwelling types that are used.

The highway water will be directed towards the swales and/or infiltration basins which are to be positioned in the Public Open Space in the south west corner of the site. 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 $7.77 \times 10^{-6}$ m/s or 0.02797m/hr will be used.

For an estimated Highways SuDS sizing see **Table C** below which shows swales and **Table D** shows catchments of larger areas in infiltration basins:

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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 + 1.0 = 5.8m | 10m | Side Slope = 1 in 4<br>Base Width = 1.0m | 0.254 | 3.7 |
| 4.8 + 1.5 + 1.5 = 7.8m | 10m | Side Slope = 1 in 4<br>Base Width = 1.0m | 0.304 | 5.2 |
| 6.0 + 1.8 + 1.8 = 9.6m | 10m | Side Slope = 1 in 4<br>Base Width = 1.0m | 0.349 | 6.6 |

For an estimated Highways SuDS sizing see **Table D** below:

**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 ($m^3$) |
| 5.8m | 250m | Side Slope = 1 in 4<br>Area = 276m2 | 0.612 | 106 |
| 7.8m | 250m | Side Slope = 1 in 4<br>Area = 320m2 | 0.654 | 151 |
| 9.6m | 250m | Side Slope = 1 in 4<br>Area = 430m2 | 0.544 | 179 |

**Table E – Highway Infiltration Basins/Detention Basins**

| Overall Highway Area | Potential Outflow | Area of Basin | 1 in100 year storm plus 40% CC | |
|---|---|---|---|---|
| | | | Depth (m) | Volume ($m^3$) |
| 0.216 Ha | 0.8 l/s | 186$m^2$ | Approx. 0.8m | 148 |
| 1.344 Ha | 2.2 l/s | 1370$m^2$ | Approx. 0.8m | 996 |

For the scenarios of drainage and areas required for the SuDs as outlined in Tables C & E, an indicative strategy is shown on Drawing **48851-PP-SK04**.

The alternative options shown on Table D are not indicated on the drawing but could be implemented across the site if required as an alternative.

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**Summary**

It can be seen from the indicative ground conditions taken from the ground investigation produced for the site to the west of the proposed that infiltration is likely to be suitable. Further intrusive investigations are required in order to determine infiltration rates for the proposed, and confirm the underlying geology within the site boundary. If chalk is present within the site then, an easement distance from soakaways to buildings will have to be agreed with the LLFA.

An infiltration strategy, with above ground storage, would be 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.

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 must be set aside for accommodating the swales / infiltration facilities.

An indicative area of drainage needed for the highways is shown on drawing **48851-PP-SK04** showing the infiltration basins and locations, subject to further masterplanning processes.

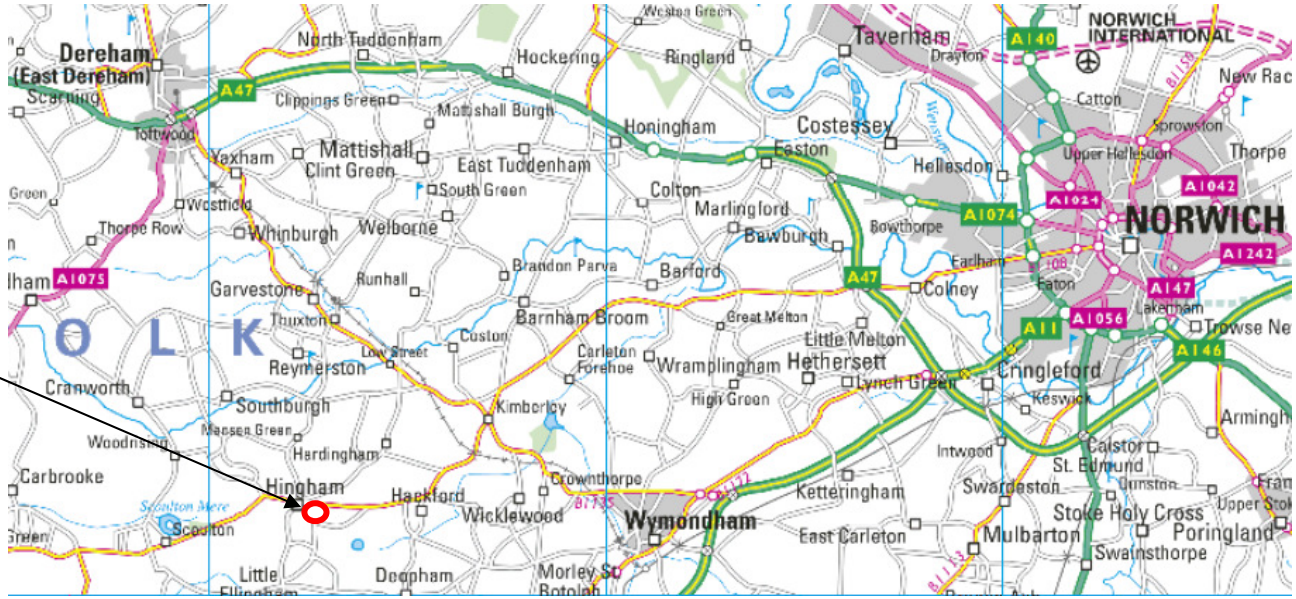
| Matters | Comment | Satisfactory | Needs some Upgrade | Not Satisfactory |
|---|---|---|---|---|
| Flood Risk Zone | The site is in Flood Risk Zone 1. Suitable for residential development | | | |
| High Risk Surface Water Flooding | There are no existing surface water flooding issues of High Risk | | | |
| 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 | | | |

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

Enc Figures 1, 2, 3, 4 & 5
48851/PP/SK04 – Preliminary Surface Water Drainage Strategy


Site location grid reference 603043, 302031
and postcode NR9 4LS



| Client: | Drawing Title: | | |
|---|---|---|---|
| **Abel Homes Ltd** | **Site Location Plan** | | |
| Job Title: | Date: | Job No: | Dwg No: |
| **Land south of Norwich Road, Hingham** | **07.02.18** | **48851** | **Fig. 1 (NTS)** |

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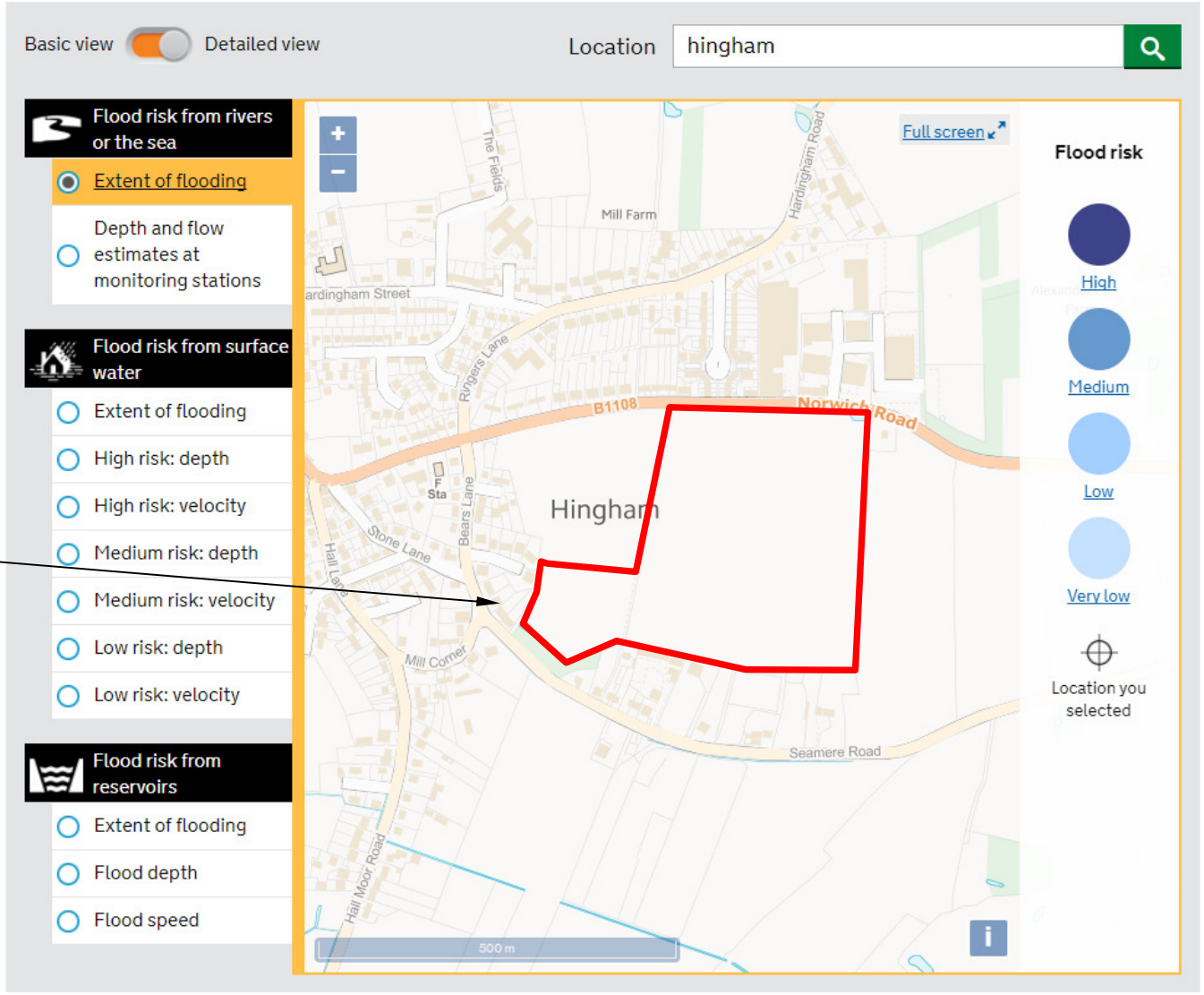


THE SITE

Site location grid reference 603043, 302031 and postcode NR9 4LS



| Client: | Drawing Title: | | |
|---|---|---|---|
| **Abel Homes Ltd** | **Environment Agency Flood Plan (Rivers and Sea)** | | |
| Job Title: | Date: | Job No: | Dwg No: |
| **Land South of Norwich Road, Hingham** | **13.02.18** | **48851** | **Fig. 2 (NTS)** |

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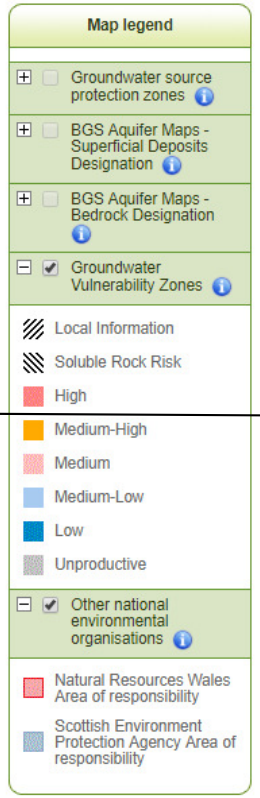
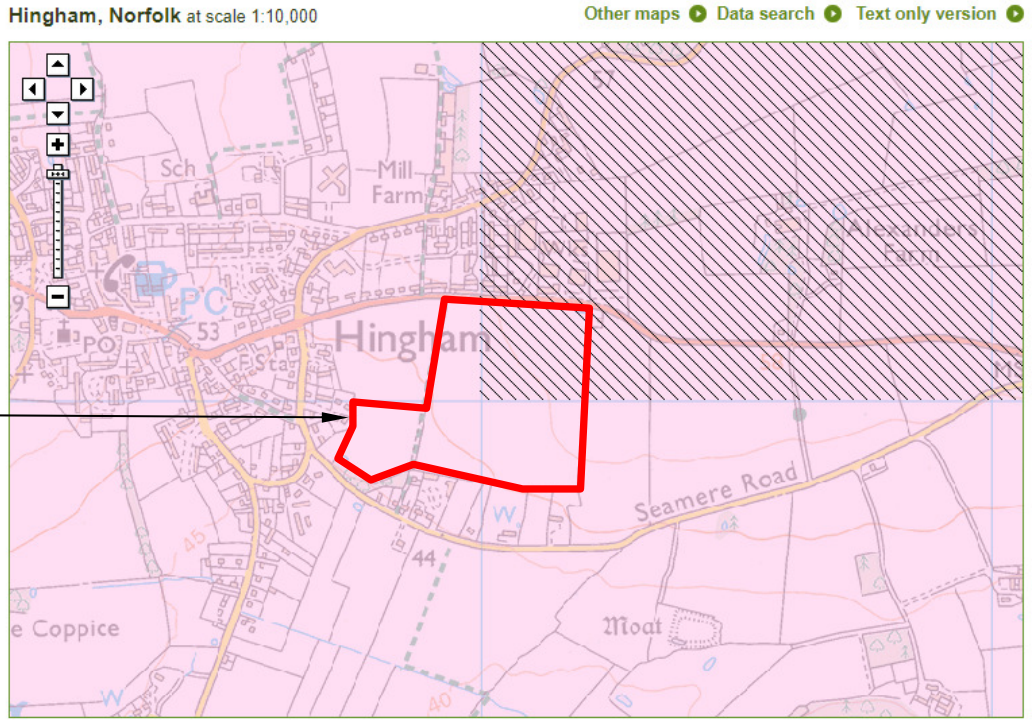
**THE SITE**






**More about Groundwater**

**Groundwater Source Protection Zones:**

Groundwater provides a third of our drinking water. We ensure that your water is safe to drink defining Source Protection Zones. These zones help to monitor the risk of contamination from any activities that might cause pollution in the area.

The Source Protection Zones are not displayed at scales greater than 1:20,000 (Ordnance Survey 1:50,000 scale) as the data was only modelled to this level and is not accurate pass this. They should not be compared against field boundaries.

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| Client: | Drawing Title: | | |
|---|---|---|---|
| **Abel Homes Ltd** | **Environment Agency Flood Plan (Groundwater)** | | |
| Job Title: | Date: | Job No: | Dwg No: |
| **Land South of Norwich Road, Hingham** | **13.02.18** | **48851** | **Fig. 3 (NTS)** |

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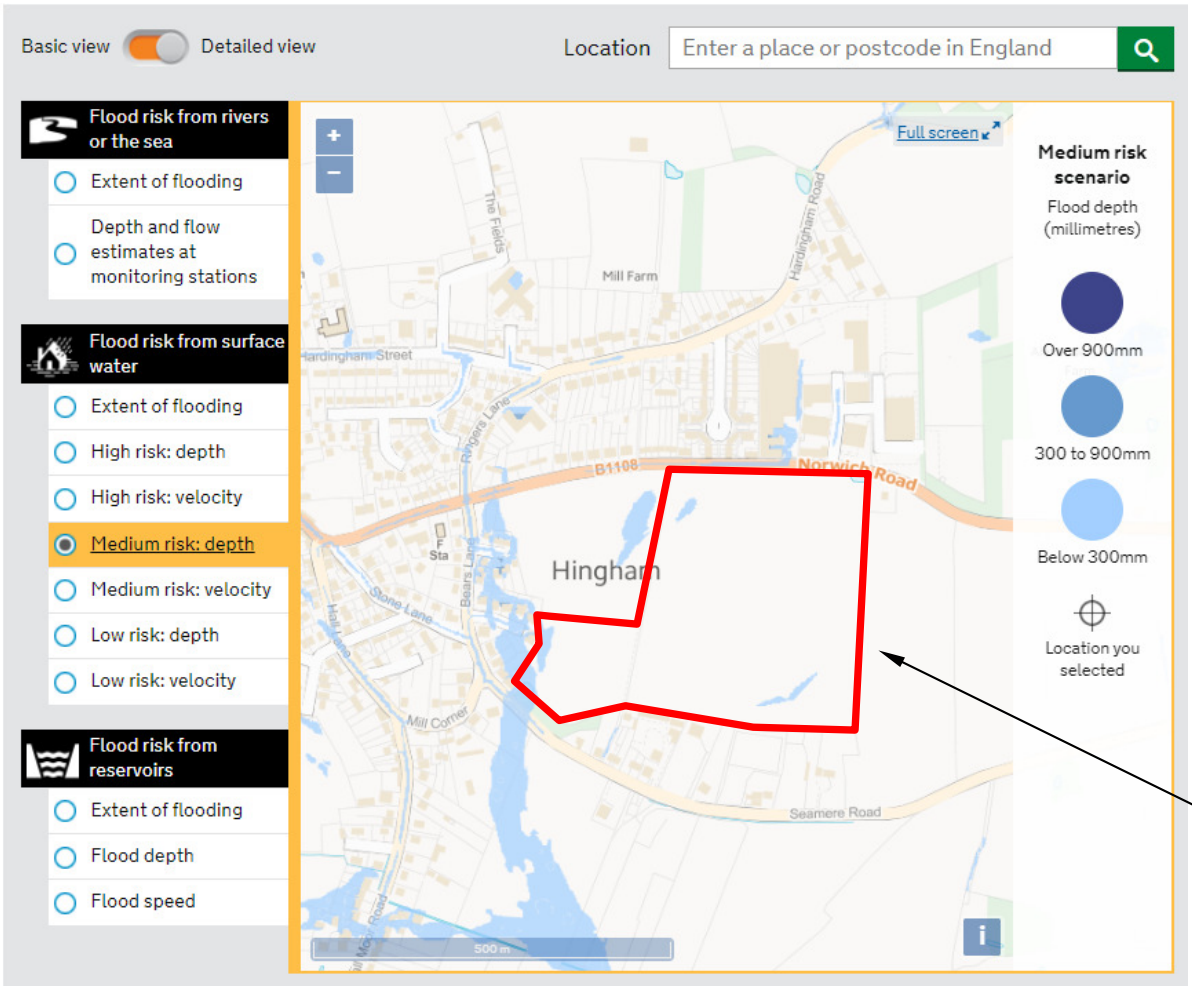




Site location grid reference 603043, 302031 and postcode NR9 4LS

| Client: | Drawing Title: | | |
|---|---|---|---|
| **Abel Homes Ltd** | **Surface Water Flood Mapping (Medium Risk)** | | |
| Job Title: | Date: | Job No: | Dwg No: |
| **Land South of Norwich Road, Hingham** | **13.02.18** | **48851** | **Fig. 4 (NTS)** |

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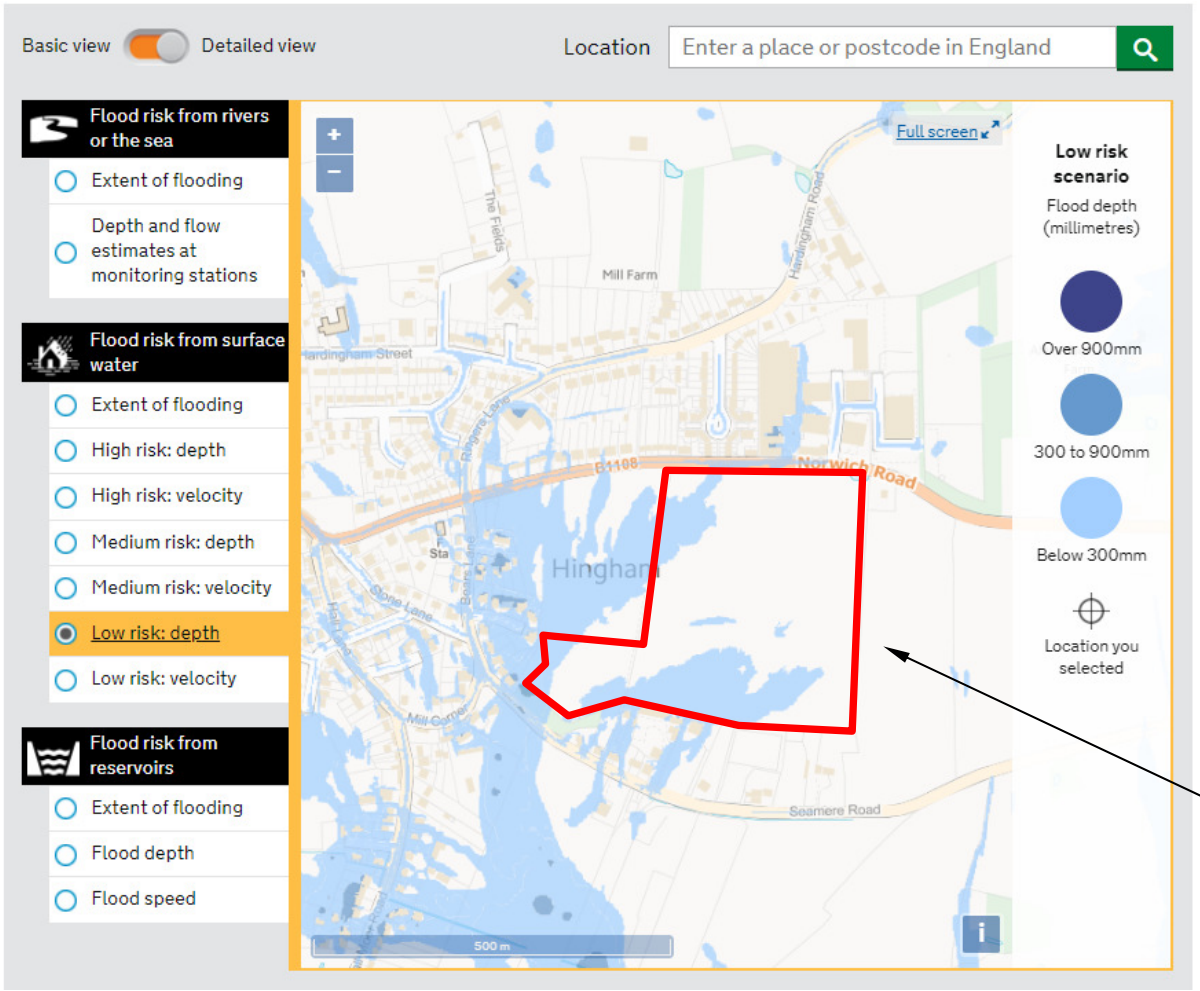




Site location grid reference 603043, 302031 and postcode NR9 4LS

| Client: | Drawing Title: | | |
|---|---|---|---|
| **Abel Homes Ltd** | **Surface Water Flood Mapping (Low Risk)** | | |
| Job Title: | Date: | Job No: | Dwg No: |
| **Land South of Norwich Road, Hingham** | **13.02.18** | **48851** | **Fig. 5 (NTS)** |

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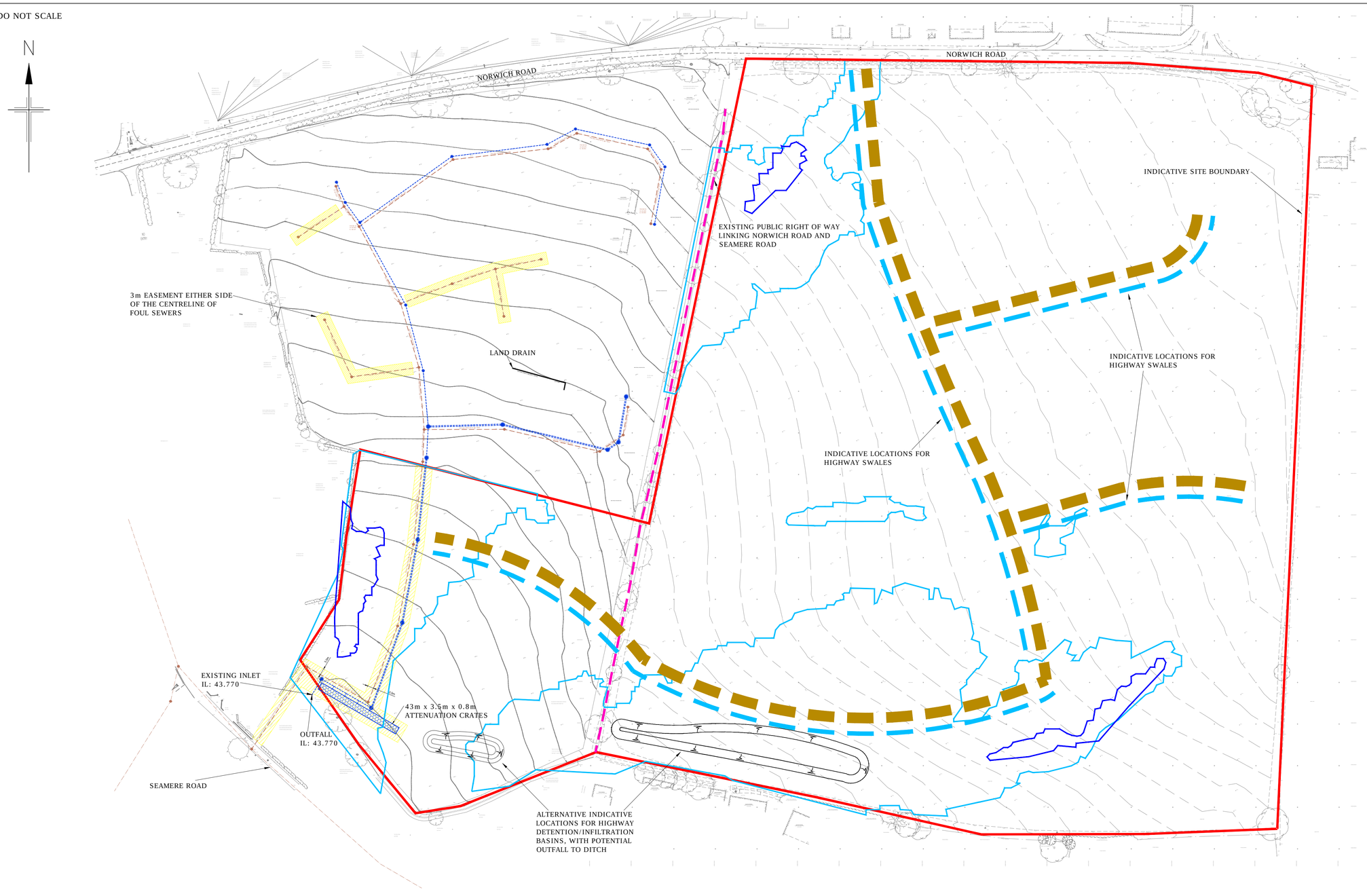
DO NOT SCALE

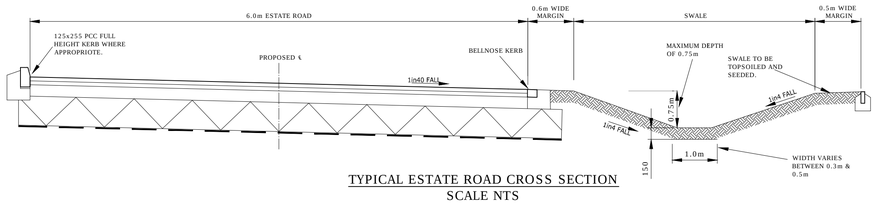



KEY:

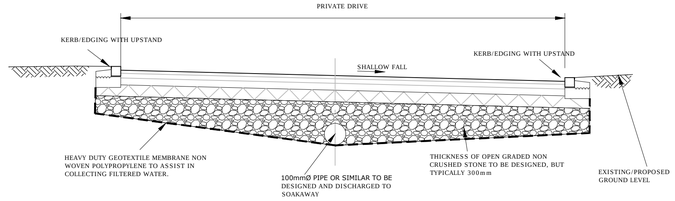
- FOUL WATER
- SURFACE WATER
- SITE BOUNDARY
- EASEMENTS
- ATTENUATION CELL
- PUBLIC RIGHT OF WAY
- LOW RISK FLOOD OUTLINE
- MEDIUM RISK FLOOD OUTLINE
- INDICATIVE SPINE ROAD
- INDICATIVE SWALE POSITION
- INDICATIVE HIGHWAY BASIN POSITIONS

NOTES:

1. ALL LEVELS ARE IN METRES ABOVE ORDNANCE SURVEY DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. TOPOGRAPHICAL SURVEY DRAWING NUMBER 18731ea-01 - 06 DATED NOVEMBER 2016 SUPPLIED TO RICHARD JACKSON LTD BY SURVEY SOLUTIONS AND RJ LTD ACCEPT NO RESPONSIBILITY FOR ERROR OR OMISSION.
4. NOT ALL MANHOLE COVERS HAVE BEEN IDENTIFIED AND THEREFORE SEWER RUNS REMAIN INDICATIVE.
5. NOT ALL UTILITIES ARE SHOWN FOR CLARITY.
6. LOW AND MEDIUM FLOOD OUTLINES TAKEN FROM GOVERNMENT FLOOD RISK WEBSITE.




TYPICAL ESTATE ROAD CROSS SECTION
SCALE NTS




TYPICAL CROSS SECTION OF THE PRIVATE DRIVE AND PERMEABLE PAVING
SCALE NTS

| REV | DATE | DESCRIPTION | DRAWN | CHKD |
|---|---|---|---|---|

REVISIONS

| | | | |
|---|---|---|---|
| Project: LAND SOUTH OF NORWICH ROAD, HINGHAM | Title: PRELIMINARY SURFACE WATER DRAINAGE STRATEGY | Client: ABEL HOMES LTD | Drawn: J. PITCHER; Date: 20/02/18; Job Manager: M. DOUGHTY; Checked: J. PITCHER; Approved: M. DOUGHTY; Scale: 1:1000@A1 |

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

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The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF — Tel: 01172 020070
Email Address: mail@rj.uk.com — Website: http://www.rj.uk.com

Drawing No.: 48851-PP-SK04
Revision:

Drawing Status

- [X] INFORMATION
- [ ] APPROVAL
- [ ] COSTING
- [ ] TENDER
- [ ] CONSTRUCTION
- [ ] AS CONSTRUCTED

A1