Greater Norwich Local Plan Regulation 19 (GNLP0520)

HINGHAM – LAND SOUTH OF NORWICH ROAD REPRESENTATIONS ON BEHALF OF ABEL HOMES

Background

Policy GNLP0520 of the draft GNLP requires that development on land to the south of Norwich Road, Hingham will, as part of any planning application, be expected to address a number of specific matters, including:

> *"6. Mitigation and further investigation with regards to the site's susceptibility to surface water flooding".*

Whilst ultimately a matter to be addressed at the planning application stage, in order to demonstrate the deliverability of the site and that the requirements of Policy GNLP0520 can be addressed, the necessary technical work has been undertaken on behalf of Abel Homes.

The findings of the technical work is detailed below.

Flood Risk and Surface Water Drainage

A Flood Risk and Drainage Strategy has been prepared by Richard Jackson in support of the Regulation 18 (C) consultation (see Appendix 1). An update to the Drainage Assessment, which was informed by infiltration testing on the site, was undertaken in May 2020 (See Appendix 2) and has been followed by discussions with the Lead Local Flood Authority (LLFA).

The Assessment confirms that the site falls within Flood Zone 1, and, therefore, the site is not at risk of flooding from rivers. The north west and western boundaries of the site are subject to low/medium risk of surface water flooding (over land flow route). The vast majority of the aforementioned flow route originates to the north and north east of site from Norwich Road which has no formalised drainage network.

Additional highway drainage to Norwich Road as a result of the proposed entranceway will improve the current drainage position along Norwich Road thus reducing the risks posed to the development from the over land flow path.

The indicative layout has been designed to mitigate against any risk from the overland flow route, with plots and infrastructure located away from these areas. Landscaped open space areas ensure that post development, the existing overland flow routes remain unaffected thus reducing both on-site, and off-site, flood risk.

The drainage assessment is informed by a topographical survey, Environment Agency mapping data and a site investigation report which includes infiltration testing results. Surface water discharge for the site is to be restricted to existing greenfield run-off rates to an existing Anglian Water surface water sewer. The preliminary design concludes that infiltration is likely to be acceptable on part of the site. It goes on to advise that an infiltration strategy that incorporates above ground storage would be in accordance with national and local planning policy, by treating the water for quality and quantity on site, thereby not having a detrimental effect downstream of the site.

The remainder of the site, which is not suitable for infiltration, would incorporate permeable paving, which would drain into a main sewer system through an infiltration basin, with limited discharge. Based on limited discharge from the site, a preliminary assessment of the capacity of the sewer adjacent the pond has been undertaken and identified as being satisfactory. Accordingly, a surface water drainage strategy, including details of maintenance and management, has been prepared and submitted to the LLFA to inform pre-application discussions.

The LLFA have responded to the submitted information with no objection, subject to detailed designs being submitted at planning application stage. A copy of the pre-application response provided by the LLFA is attached as Appendix 3.

Based on the work undertaken by Richard Jackson, it is evident that the site is not susceptible to surface water flooding and that the proposed development is capable of delivering a surface water drainage strategy that is capable of accommodating surface water on site.

Through the adoption of the proposed surface water drainage strategy, the flow of surface water from the site will be restricted to the “green field” run-off rates, ensuring that no additional pressure is put onto the off-site drainage network. Accordingly, there will be no heightened flood risk either on-site or off-site as a result of the proposed development.

Accordingly, it is evident that the proposed development can satisfy criterion 6 of draft Policy GNLP0520 and that the proposed development complies with the National Planning Policy Framework.

APPENDIX 1

FLOOD RISK ASSESSMENT & SURFACE WATER DRAINAGE STRAGEY PREPARED BY RICHARD JACKSON

RichardJackson
Engineering Consultants

Our Ref: 48851/LLG/MJD
Your Ref:

06 March 2020

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 101**. The referenced "Phase 1" development relates to the neighbouring Abel Homes development to the west of this site.

The site compromises of greenfield land and is approximately 6.8 Ha in size. The main access will be off Norwich Road, with a potential pedestrian link to the west into Phase 1 and other pedestrian footway connections. 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 100 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 March 2019.

The topography of the site falls to the low point in the south western corner, which is at approximately 49.50m 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 6.8 Ha. The site has an existing Public Right of Way (PROW) to the west that creates a small south western parcel of approximately 1.6 Ha, and this contains the surface and foul water disposal from the Phase 1 development that forms the western boundary of the site. The drainage is referred to on the **drawing 49455-PP-SK16A**.

Cont'd.../

4 The Old Church
St Matthews Road Norwich
Norfolk NR1 1SP

Telephone: 01603 230240
www.rj.uk.com

For the purposes of establishing the likely drainage parameters for the site, the site area of 6.8 Ha, 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 15% 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, see the Environment Agency 'Flood Map for Planning'. Therefore this has not been investigated further. An indication of the associated Government Flood Maps are shown on **Figure 2A**.

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.

Groundwater Source Protection Zone around all major groundwater abstraction points are identified on magic.defra.gov.uk mapping. 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. The proposed site is within Groundwater Source Protection Zone 3 (total catchment). This zone is identified as the total area needed to support the abstraction or discharge from the protected groundwater source. For the EA groundwater source protection zones of the site, see **Figure 3A.**

In addition, the Groundwater Vulnerability Zone Maps see **Figure 3A** 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.

Cont'd.../

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.

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 to 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. Further, the strategy indicates that private dwelling drainage at the Phase 1 development, is managed by infiltration through the use of permeable paving.

Using the Plandescil report previously mentioned, the infiltration rates based on the Phase 1 report, suggests permeability of soils ranging from 7.7 x 10^{-6} m/s to 9.47 x 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 and is likely that this strategy could be used for the 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 4A** and **Figure 5A** 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 for 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, as indicated in LLFA guidance.

Cont'd.../

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 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 or permeable paving

Highways – To Swales or Infiltration Basin or Detention Basin

Cont'd.../

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 7.77×10^{-6} m/s or 0.02797 m/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 = 6.8m^3
B	56	23	29	106	2.0 x 3.5 x 1.2 Vol = 8.6m^3
C	65	45	19	129	2.5 x 3.5 x 1.2 Vol = 10.3m^3
D	116	45	124	285	5.5 x 3.0 x 1.6 Vol = 25.2m^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 south 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 7.77×10^{-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:

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 Base Width = 1.0m	0.254	3.7
4.8 + 1.5 + 1.5 = 7.8m	10m	Side Slope = 1 in 4 Base Width = 1.0m	0.304	5.2
6.0 + 1.8 + 1.8 = 9.6m	10m	Side Slope = 1 in 4 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 (if required)

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 Area = 276m2	0.612	106
7.8m	250m	Side Slope = 1 in 4 Area = 320m2	0.654	151
9.6m	250m	Side Slope = 1 in 4 Area = 430m2	0.544	179

Table E – Highway Infiltration Basins/Detention Basins

Overall Highway Area 15% of the 6.8 Ha	Potential Outflow (2L/s/Ha)	Area of Basin (m2)	1 in100 year storm plus 40% CC	
			Depth (m)	Volume (m^3)
1.02 Ha	2.0 l/s	874 m^2 to 1890m^2	Approx. 0.70m	851m^3

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-SK16A**.

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.

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, which could be accommodated on land immediately to the south, which is within the same ownership.

An indicative area of drainage needed for the highways is shown on drawing **48851-PP-SK16A** 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			

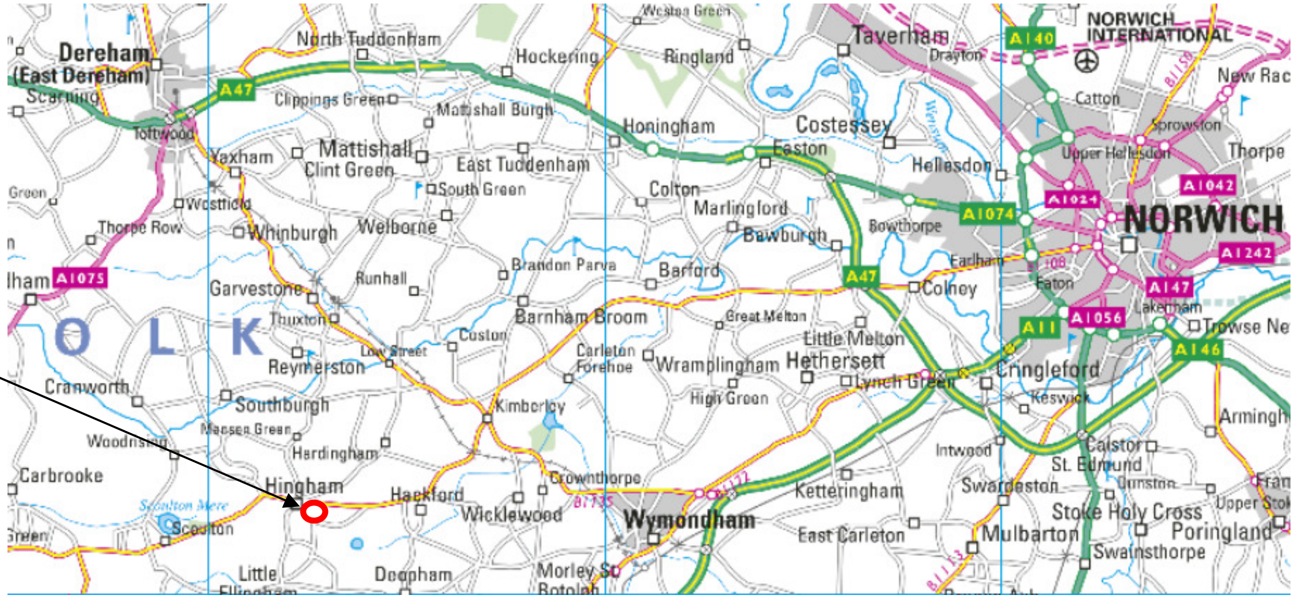
I trust the foregoing is satisfactory but if we can be of any further assistance, please do not hesitate to contact us.

Yours sincerely

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

Enc Figures 101, 2A, 3A, 4A & 5A
48851/PP/SK16A – Preliminary Surface Water Drainage Strategy

INDICATIVE SITE LOCATION



INDICATIVE SITE LOCATION

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	**06.03.20**	**48851**	**Fig. 101 (NTS)**

RichardJackson
Engineering Consultants
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
48851	**603050/302081**	**28 Feb 2020 12:07**

Your selected location is in flood zone 1, an area with a low probability of flooding.

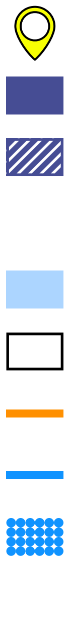
This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Flood map for planning

Your reference
48851

Location (easting/northing)
603050/302081

Scale
1:10000

Created
28 Feb 2020 12:07

Selected point

Flood zone 3

Flood zone 3: areas benefitting from flood defences

Flood zone 2

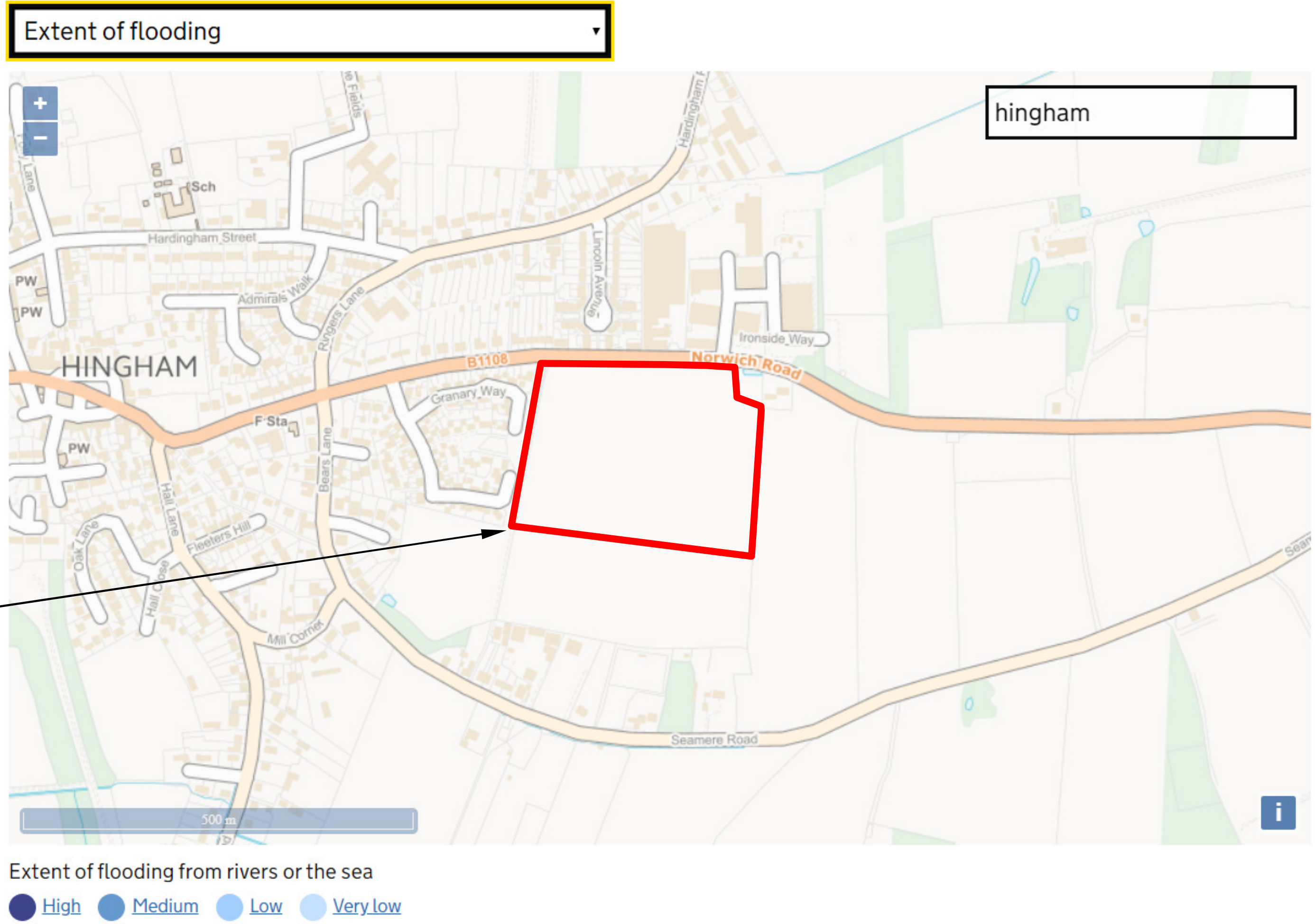
Flood zone 1

Flood defence

Main river

Flood storage area

0 100 200 300m



INDICATIVE SITE LOCATION

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

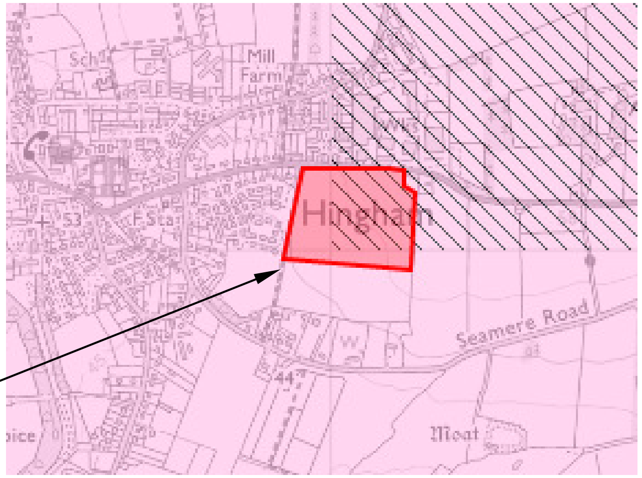
Client:	Drawing Title:		
Abel Homes Ltd	**Flood Plan (Rivers and Sea)**		
Job Title:	Date:	Job No:	Dwg No:
Land South of Norwich Road, Hingham	**06.03.20**	**48851**	**Fig. 2A (NTS)**

RichardJackson Engineering Consultants
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

FLOOD PLAN (GROUNDWATER)

Groundwater Vulnerability Map (England)

- Local Information
- Soluble Rock Risk
- High
- Medium - High
- Medium
- Medium - Low
- Low
- Unproductive

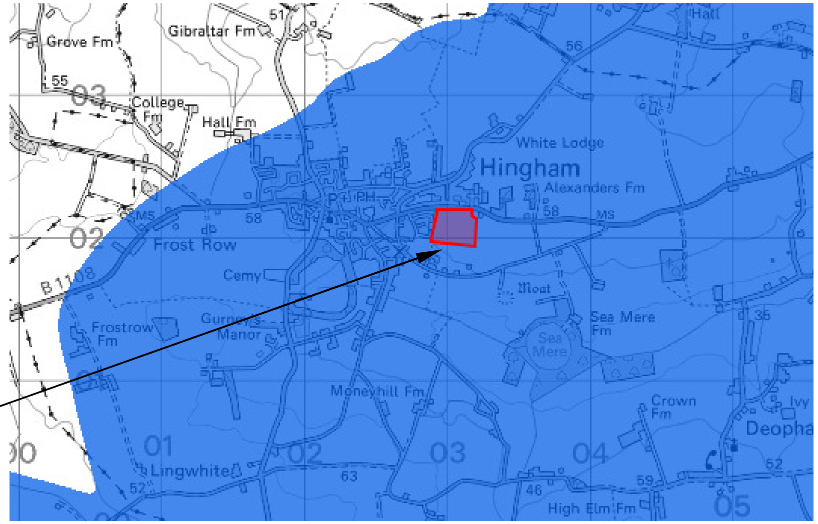


INDICATIVE SITE LOCATION

SOURCE PROTECTION ZONES (GROUNDWATER)

Source Protection Zones merged (England)

- Zone I - Inner Protection Zone
- Zone I - Subsurface Activity
- Zone II - Outer Protection Zone
- Zone II - Subsurface Activity
- Zone III - Total Catchment
- Zone III - Subsurface Activity
- Zone of Special Interest



INDICATIVE SITE LOCATION

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

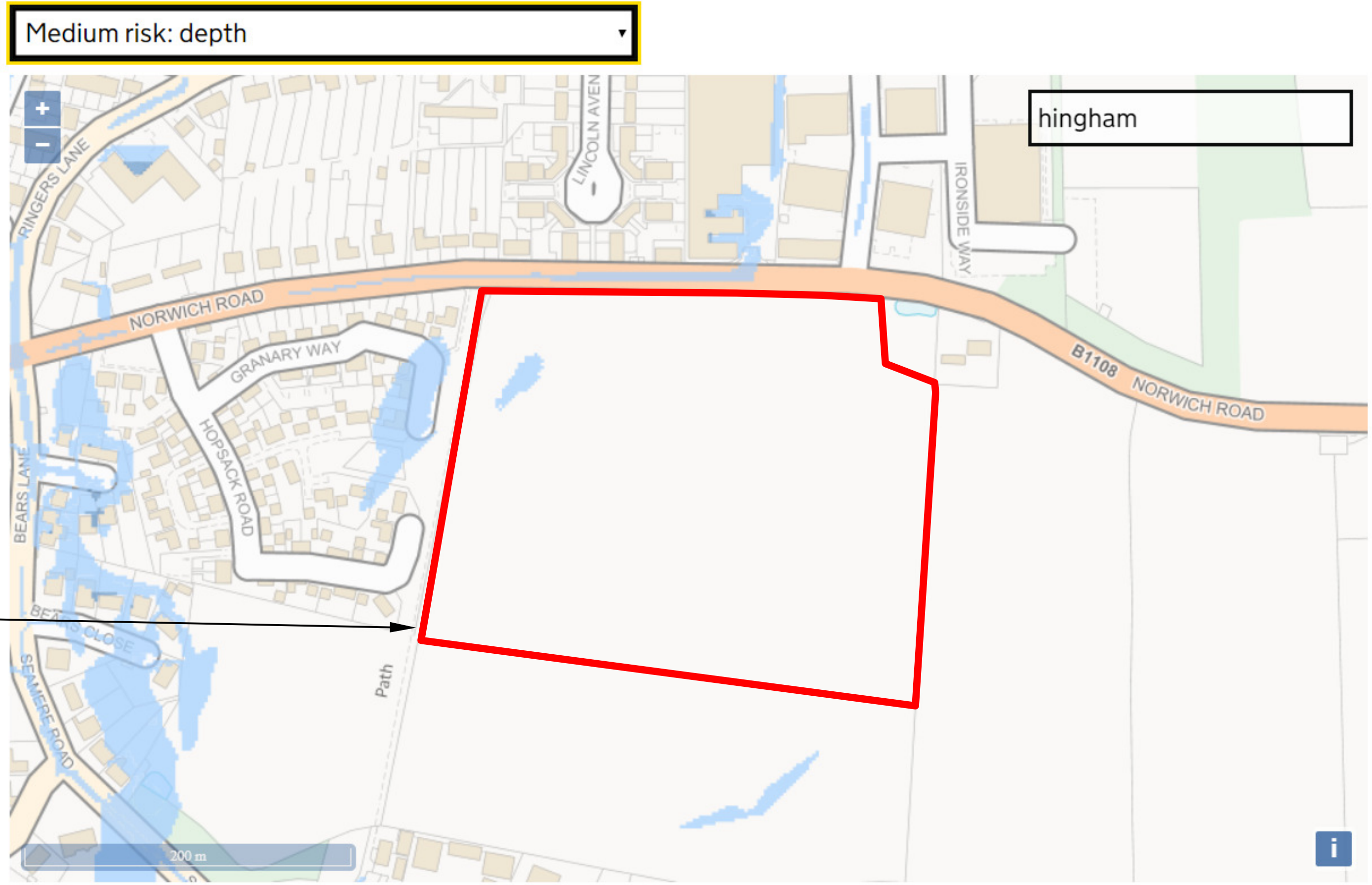
Client:	Drawing Title:		
Abel Homes Ltd	**Flood Plan (Groundwater) & Source Protection Zones (Groundwater)**		
Job Title:	Date:	Job No:	Dwg No:
Land South of Norwich Road, Hingham	**06.03.20**	**48851**	**Fig. 3A (NTS)**

RichardJackson Engineering Consultants

4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

N

INDICATIVE SITE LOCATION



Surface water flood risk: water depth in a medium risk scenario

Flood depth (millimetres)

- Over 900mm
- 300 to 900mm
- Below 300mm

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

Client:	Drawing Title:		
Abel Homes Ltd	**Surface Water Flood Mapping (Medium Risk)**		
Job Title: **Land South of Norwich Road, Hingham**	Date: **06.03.20**	Job No: **48851**	Dwg No: **Fig. 4A (NTS)**

RichardJackson Engineering Consultants
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

Low risk: depth

INDICATIVE SITE LOCATION

Surface water flood risk: water depth in a low risk scenario

Flood depth (millimetres)

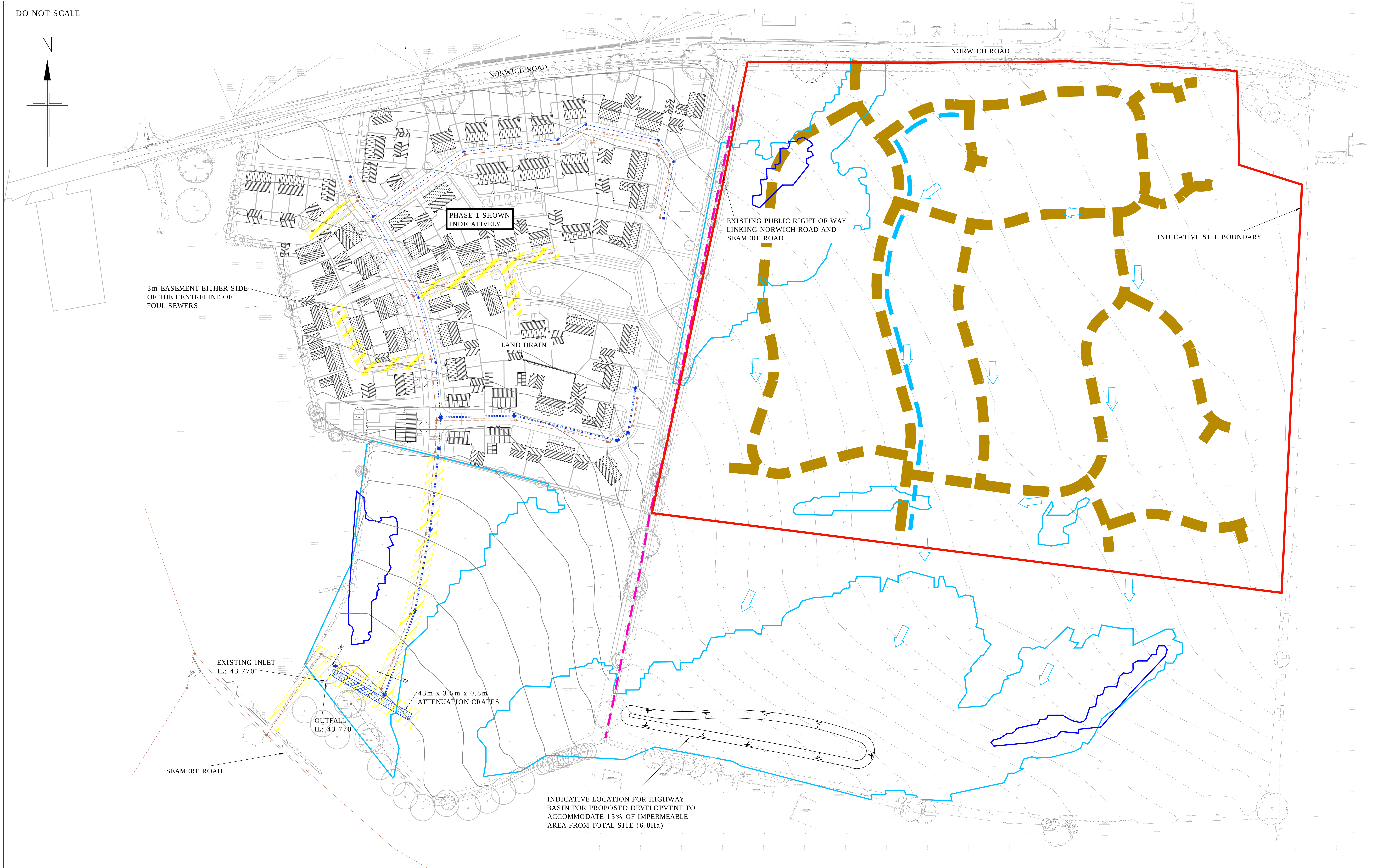
Over 900mm | 300 to 900mm | Below 300mm

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	**06.03.20**	**48851**	**Fig. 5A (NTS)**

RichardJackson Engineering Consultants
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

DO NOT SCALE

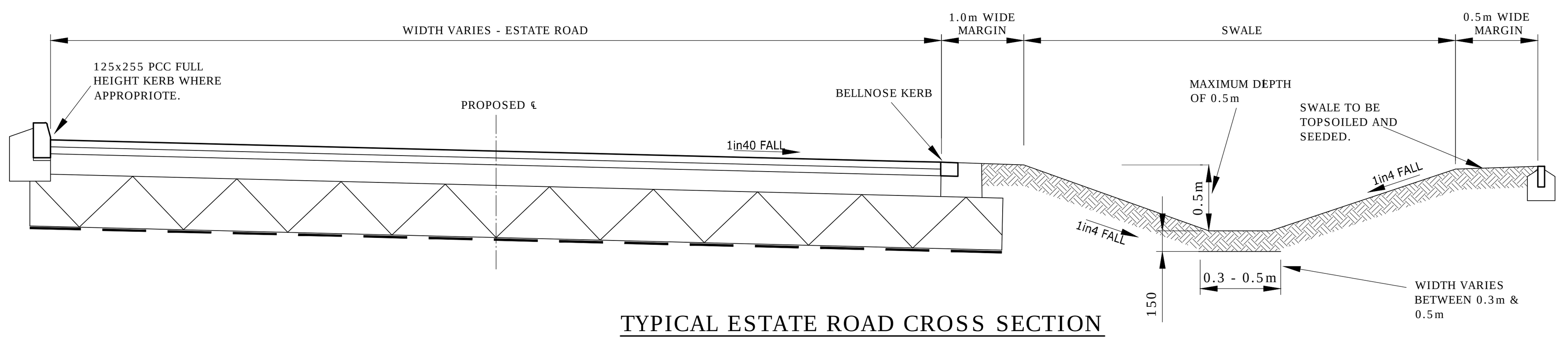


KEY:

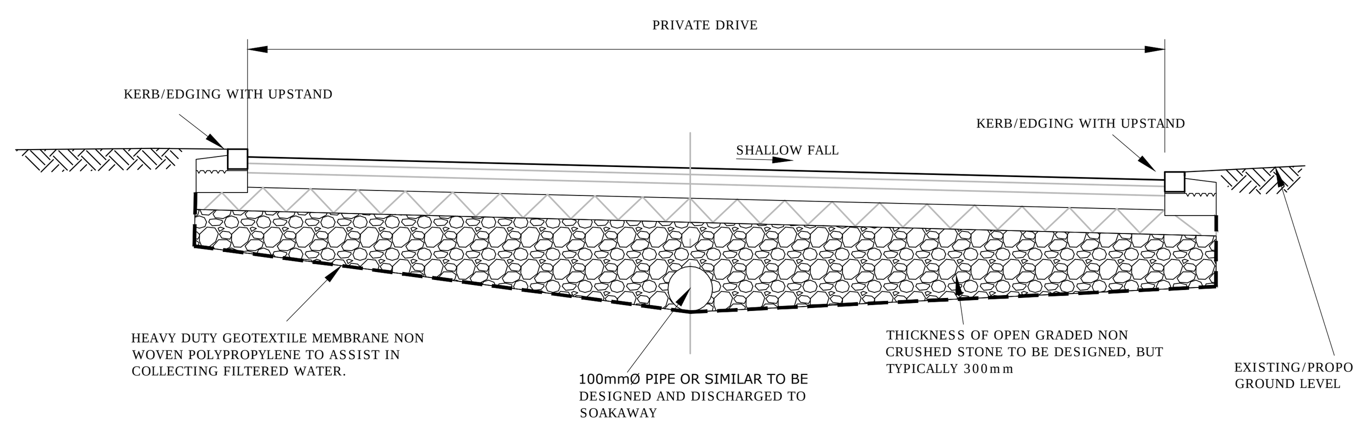
- FOUL WATER
- SURFACE WATER
- SITE BOUNDARY
- EASEMENTS
- ATTENUATION CELL
- PUBLIC RIGHT OF WAY
- LOW RISK FLOOD OUTLINE
- MEDIUM RISK FLOOD OUTLINE
- INDICATIVE SPINE ROAD
- EXCEEDENCE/TOPOGRAPHY FLOW DIRECTION

NOTES:

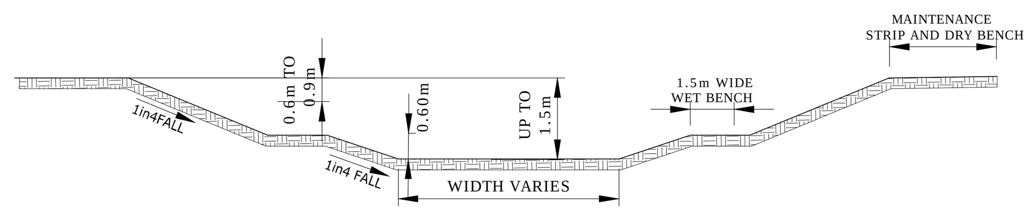
1. ALL LEVELS ARE IN METRES ABOVE ORDNANCE SURVEY DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. TOPOGRAPHICAL SURVEY DRAWING NUMBER 18731ea-01 - 06 DATED NOVEMBER 2016 SUPPLIED TO RICHARD JACKSON LTD BY SURVEY SOLUTIONS AND RJ LTD ACCEPT NO RESPONSIBILITY FOR ERROR OR OMISSION.
4. 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



TYPICAL INFILTRATION BASIN CROSS SECTION
(VARIES ACROSS THE SITE)
SCALE N.T.S

REV	DATE	DESCRIPTION	DRAWN	CHKD
A	06.03.20	UPDATED SITE LAYOUT PLAN	LLG	MJD

REVISIONS

Project: LAND SOUTH OF NORWICH ROAD, HINGHAM	Title: PRELIMINARY SURFACE WATER DRAINAGE STRATEGY	Client: ABEL HOMES LTD	Drawn: L. GRAY Job Manager: M. DOUGHTY Approved: M. DOUGHTY	Date: 28/02/20 Checked: 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.	RichardJackson Engineering Consultants

Drawing No. 48851-PP-SK16 | Revision A

Drawing Status: ☒ INFORMATION ☐ APPROVAL ☐ COSTING ☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

A1

APPENDIX 2
UPDATED DRAINAGE STRATEGY PREPARED BY RICHARD JACKSON

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
48851	**603050/302081**	**28 Feb 2020 12:07**

Your selected location is in flood zone 1, an area with a low probability of flooding.

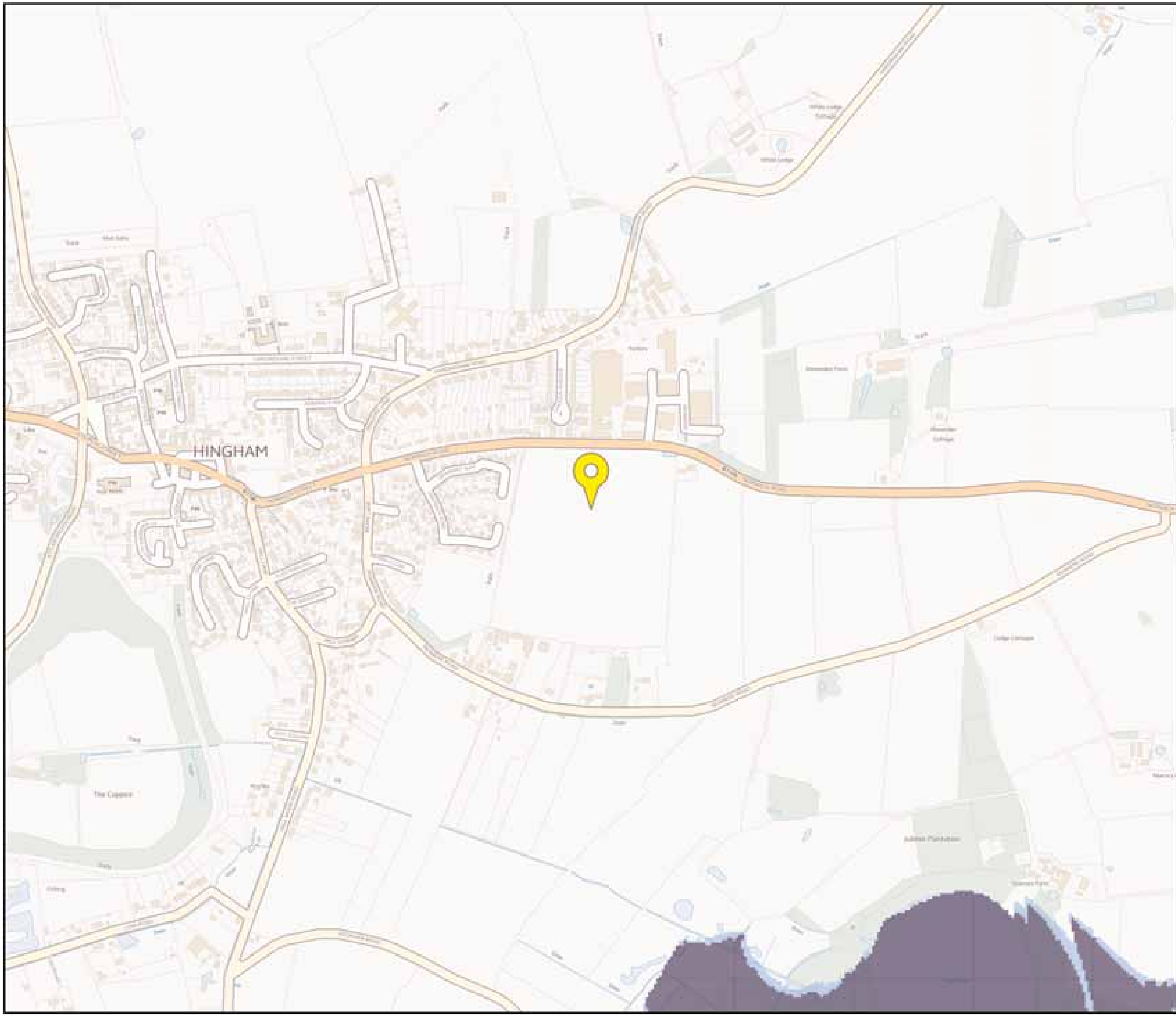
This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
48851

Location (easting/northing)
603050/302081

Scale
1:10000

Created
28 Feb 2020 12:07

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 100 200 300m

Page 2 of 2

VERSION	"FEH CD-R Version		3	exported a	17:04:56	GMT	Mon	19-Feb-18
CATCHMEI	GB	603300	301300	TG 03300 01300				
CENTROID	GB	602396	301584	TG 02396 01584				
AREA	3.4575							
ALTBAR	52							
ASPBAR	112							
ASPVAR	0.35							
BFIHOST	0.43							
DPLBAR	1.39							
DPSBAR	17.5							
FARL	1							
FPEXT	0.1142							
FPDBAR	0.615							
FPLOC	0.686							
LDP	2.96							
PROPWET	0.31							
RMED-1H	11.2							
RMED-1D	30							
RMED-2D	37.6							
SAAR	636							
SAAR4170	704							
SPRHOST	36.49							
URBCONC1	0.747							
URBEXT19	0.0694							
URBLOC19	1.097							
URBCONC2	0.877							
URBEXT20	0.0709							
URBLOC20	1.112							
C	-0.02397							
D1	0.31488							
D2	0.33457							
D3	0.24709							
E	0.31585							
F	2.4709							
C(1 km)	-0.024							
D1(1 km)	0.313							
D2(1 km)	0.339							
D3(1 km)	0.244							
E(1 km)	0.316							
F(1 km)	2.474							

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1224 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	52.387	0.387	0.1	3.8	O K
30 min Summer	52.432	0.432	0.1	4.3	O K
60 min Summer	52.482	0.482	0.1	5.0	O K
120 min Summer	52.533	0.533	0.1	5.6	O K
180 min Summer	52.562	0.562	0.1	6.0	O K
240 min Summer	52.581	0.581	0.1	6.2	O K
360 min Summer	52.604	0.604	0.1	6.5	O K
480 min Summer	52.615	0.615	0.1	6.6	O K
600 min Summer	52.619	0.619	0.1	6.7	O K
720 min Summer	52.620	0.620	0.1	6.7	O K
960 min Summer	52.617	0.617	0.1	6.7	O K
1440 min Summer	52.603	0.603	0.1	6.5	O K
2160 min Summer	52.579	0.579	0.1	6.2	O K
2880 min Summer	52.553	0.553	0.1	5.9	O K
4320 min Summer	52.476	0.476	0.1	4.9	O K
5760 min Summer	52.411	0.411	0.1	4.1	O K
7200 min Summer	52.354	0.354	0.1	3.4	O K
8640 min Summer	52.307	0.307	0.1	2.8	O K
10080 min Summer	52.266	0.266	0.1	2.2	O K
15 min Winter	52.425	0.425	0.1	4.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	214.767	0.0	19
30 min Summer	123.574	0.0	34
60 min Summer	71.102	0.0	64
120 min Summer	40.911	0.0	124
180 min Summer	29.609	0.0	182
240 min Summer	23.540	0.0	242
360 min Summer	17.037	0.0	362
480 min Summer	13.544	0.0	482
600 min Summer	11.337	0.0	602
720 min Summer	9.803	0.0	720
960 min Summer	7.852	0.0	934
1440 min Summer	5.743	0.0	1154
2160 min Summer	4.200	0.0	1536
2880 min Summer	3.364	0.0	1956
4320 min Summer	2.368	0.0	2728
5760 min Summer	1.845	0.0	3520
7200 min Summer	1.521	0.0	4256
8640 min Summer	1.299	0.0	5008
10080 min Summer	1.136	0.0	5656
15 min Winter	214.767	0.0	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	52.476	0.476	0.1	4.9	O K
60 min Winter	52.532	0.532	0.1	5.6	O K
120 min Winter	52.591	0.591	0.1	6.3	O K
180 min Winter	52.625	0.625	0.1	6.8	O K
240 min Winter	52.648	0.648	0.1	7.1	O K
360 min Winter	52.676	0.676	0.1	7.4	O K
480 min Winter	52.692	0.692	0.1	7.6	O K
600 min Winter	52.700	0.700	0.1	7.7	O K
720 min Winter	52.703	0.703	0.1	7.8	O K
960 min Winter	52.706	0.706	0.1	7.8	O K
1440 min Winter	52.691	0.691	0.1	7.6	O K
2160 min Winter	52.657	0.657	0.1	7.2	O K
2880 min Winter	52.620	0.620	0.1	6.7	O K
4320 min Winter	52.510	0.510	0.1	5.3	O K
5760 min Winter	52.414	0.414	0.1	4.1	O K
7200 min Winter	52.332	0.332	0.1	3.1	O K
8640 min Winter	52.265	0.265	0.1	2.2	O K
10080 min Winter	52.212	0.212	0.1	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	123.574	0.0	33
60 min Winter	71.102	0.0	64
120 min Winter	40.911	0.0	122
180 min Winter	29.609	0.0	180
240 min Winter	23.540	0.0	240
360 min Winter	17.037	0.0	356
480 min Winter	13.544	0.0	472
600 min Winter	11.337	0.0	588
720 min Winter	9.803	0.0	700
960 min Winter	7.852	0.0	924
1440 min Winter	5.743	0.0	1340
2160 min Winter	4.200	0.0	1664
2880 min Winter	3.364	0.0	2128
4320 min Winter	2.368	0.0	2984
5760 min Winter	1.845	0.0	3800
7200 min Winter	1.521	0.0	4536
8640 min Winter	1.299	0.0	5192
10080 min Winter	1.136	0.0	5840

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.244	Cv (Winter)	0.840
Return Period (years)	100	E (1km)	0.316	Shortest Storm (mins)	15
Site Location		F (1km)	2.474	Longest Storm (mins)	10080
C (1km)	-0.024	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.313	Winter Storms	Yes		
D2 (1km)	0.339	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.010

Time From:	(mins) To:	Area (ha)
0	4	0.010

Model Details

Storage is Online Cover Level (m) 53.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01368	Width (m)	3.0
Membrane Percolation (mm/hr)	1000	Length (m)	14.0
Max Percolation (l/s)	11.7	Slope (1:X)	80.0
Safety Factor	3.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.000	Cap Volume Depth (m)	0.000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 638 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	52.134	0.134	0.1	4.6	O K
30 min Summer	52.358	0.358	0.1	5.3	O K
60 min Summer	52.449	0.449	0.1	5.9	O K
120 min Summer	52.508	0.508	0.1	6.6	O K
180 min Summer	52.537	0.537	0.1	6.9	O K
240 min Summer	52.552	0.552	0.1	7.1	O K
360 min Summer	52.560	0.560	0.1	7.1	O K
480 min Summer	52.560	0.560	0.1	7.1	O K
600 min Summer	52.559	0.559	0.1	7.1	O K
720 min Summer	52.556	0.556	0.1	7.1	O K
960 min Summer	52.551	0.551	0.1	7.0	O K
1440 min Summer	52.530	0.530	0.1	6.8	O K
2160 min Summer	52.489	0.489	0.1	6.4	O K
2880 min Summer	52.452	0.452	0.1	6.0	O K
4320 min Summer	52.376	0.376	0.1	5.4	O K
5760 min Summer	52.138	0.138	0.1	4.7	O K
7200 min Summer	52.114	0.114	0.1	3.9	O K
8640 min Summer	52.095	0.095	0.1	3.2	O K
10080 min Summer	52.079	0.079	0.1	2.7	O K
15 min Winter	52.324	0.324	0.1	5.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	214.767	0.0	23
30 min Summer	123.574	0.0	37
60 min Summer	71.102	0.0	66
120 min Summer	40.911	0.0	124
180 min Summer	29.609	0.0	184
240 min Summer	23.540	0.0	242
360 min Summer	17.037	0.0	346
480 min Summer	13.544	0.0	398
600 min Summer	11.337	0.0	458
720 min Summer	9.803	0.0	522
960 min Summer	7.852	0.0	658
1440 min Summer	5.743	0.0	928
2160 min Summer	4.200	0.0	1324
2880 min Summer	3.364	0.0	1704
4320 min Summer	2.368	0.0	2512
5760 min Summer	1.845	0.0	3456
7200 min Summer	1.521	0.0	4176
8640 min Summer	1.299	0.0	4848
10080 min Summer	1.136	0.0	5552
15 min Winter	214.767	0.0	23

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	52.445	0.445	0.1	5.9	O K
60 min Winter	52.517	0.517	0.1	6.7	O K
120 min Winter	52.589	0.589	0.1	7.5	O K
180 min Winter	52.625	0.625	0.1	7.8	O K
240 min Winter	52.645	0.645	0.1	8.1	O K
360 min Winter	52.661	0.661	0.1	8.2	O K
480 min Winter	52.661	0.661	0.1	8.2	O K
600 min Winter	52.653	0.653	0.1	8.1	O K
720 min Winter	52.648	0.648	0.1	8.1	O K
960 min Winter	52.637	0.637	0.1	8.0	O K
1440 min Winter	52.598	0.598	0.1	7.6	O K
2160 min Winter	52.530	0.530	0.1	6.8	O K
2880 min Winter	52.470	0.470	0.1	6.2	O K
4320 min Winter	52.380	0.380	0.1	5.4	O K
5760 min Winter	52.132	0.132	0.1	4.5	O K
7200 min Winter	52.099	0.099	0.1	3.4	O K
8640 min Winter	52.073	0.073	0.1	2.5	O K
10080 min Winter	52.055	0.055	0.1	1.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	123.574	0.0	36
60 min Winter	71.102	0.0	66
120 min Winter	40.911	0.0	122
180 min Winter	29.609	0.0	180
240 min Winter	23.540	0.0	238
360 min Winter	17.037	0.0	348
480 min Winter	13.544	0.0	454
600 min Winter	11.337	0.0	492
720 min Winter	9.803	0.0	562
960 min Winter	7.852	0.0	716
1440 min Winter	5.743	0.0	1012
2160 min Winter	4.200	0.0	1428
2880 min Winter	3.364	0.0	1816
4320 min Winter	2.368	0.0	2640
5760 min Winter	1.845	0.0	3640
7200 min Winter	1.521	0.0	4392
8640 min Winter	1.299	0.0	5016
10080 min Winter	1.136	0.0	5544

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.244	Cv (Winter)	0.840
Return Period (years)	100	E (1km)	0.316	Shortest Storm (mins)	15
Site Location		F (1km)	2.474	Longest Storm (mins)	10080
C (1km)	-0.024	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.313	Winter Storms	Yes		
D2 (1km)	0.339	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.012

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.006	4	8	0.006

Model Details

Storage is Online Cover Level (m) 53.000

Complex Structure

Cellular Storage

Invert Level (m) 52.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.01368 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.01368

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	36.0	36.0	0.151	0.0	40.5
0.150	36.0	40.5			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.01368	Width (m)	3.0
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	10.0	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.300	Cap Volume Depth (m)	0.000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 584 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	52.437	0.437	0.2	6.5	O K
30 min Summer	52.495	0.495	0.2	7.4	O K
60 min Summer	52.557	0.557	0.2	8.4	O K
120 min Summer	52.617	0.617	0.2	9.4	O K
180 min Summer	52.647	0.647	0.2	9.9	O K
240 min Summer	52.664	0.664	0.2	10.1	O K
360 min Summer	52.677	0.677	0.2	10.3	O K
480 min Summer	52.677	0.677	0.2	10.3	O K
600 min Summer	52.675	0.675	0.2	10.3	O K
720 min Summer	52.672	0.672	0.2	10.3	O K
960 min Summer	52.669	0.669	0.2	10.2	O K
1440 min Summer	52.650	0.650	0.2	9.9	O K
2160 min Summer	52.610	0.610	0.2	9.2	O K
2880 min Summer	52.567	0.567	0.2	8.5	O K
4320 min Summer	52.467	0.467	0.2	6.9	O K
5760 min Summer	52.409	0.409	0.2	6.0	O K
7200 min Summer	52.380	0.380	0.2	5.6	O K
8640 min Summer	52.354	0.354	0.1	5.4	O K
10080 min Summer	52.333	0.333	0.1	5.2	O K
15 min Winter	52.488	0.488	0.2	7.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	214.767	0.0	22
30 min Summer	123.574	0.0	37
60 min Summer	71.102	0.0	66
120 min Summer	40.911	0.0	126
180 min Summer	29.609	0.0	184
240 min Summer	23.540	0.0	242
360 min Summer	17.037	0.0	360
480 min Summer	13.544	0.0	428
600 min Summer	11.337	0.0	486
720 min Summer	9.803	0.0	546
960 min Summer	7.852	0.0	678
1440 min Summer	5.743	0.0	952
2160 min Summer	4.200	0.0	1360
2880 min Summer	3.364	0.0	1736
4320 min Summer	2.368	0.0	2468
5760 min Summer	1.845	0.0	3168
7200 min Summer	1.521	0.0	3896
8640 min Summer	1.299	0.0	4672
10080 min Summer	1.136	0.0	5640
15 min Winter	214.767	0.0	22

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	52.553	0.553	0.2	8.3	O K
60 min Winter	52.623	0.623	0.2	9.5	O K
120 min Winter	52.693	0.693	0.2	10.6	O K
180 min Winter	52.730	0.730	0.2	11.2	O K
240 min Winter	52.752	0.752	0.2	11.5	O K
360 min Winter	52.772	0.772	0.2	11.9	O K
480 min Winter	52.775	0.775	0.2	11.9	O K
600 min Winter	52.770	0.770	0.2	11.8	O K
720 min Winter	52.762	0.762	0.2	11.7	O K
960 min Winter	52.754	0.754	0.2	11.6	O K
1440 min Winter	52.720	0.720	0.2	11.0	O K
2160 min Winter	52.653	0.653	0.2	9.9	O K
2880 min Winter	52.584	0.584	0.2	8.8	O K
4320 min Winter	52.447	0.447	0.2	6.6	O K
5760 min Winter	52.393	0.393	0.2	5.8	O K
7200 min Winter	52.362	0.362	0.1	5.4	O K
8640 min Winter	52.340	0.340	0.1	5.3	O K
10080 min Winter	52.138	0.138	0.1	4.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	123.574	0.0	37
60 min Winter	71.102	0.0	66
120 min Winter	40.911	0.0	124
180 min Winter	29.609	0.0	180
240 min Winter	23.540	0.0	238
360 min Winter	17.037	0.0	352
480 min Winter	13.544	0.0	460
600 min Winter	11.337	0.0	562
720 min Winter	9.803	0.0	586
960 min Winter	7.852	0.0	734
1440 min Winter	5.743	0.0	1040
2160 min Winter	4.200	0.0	1472
2880 min Winter	3.364	0.0	1876
4320 min Winter	2.368	0.0	2552
5760 min Winter	1.845	0.0	3224
7200 min Winter	1.521	0.0	3968
8640 min Winter	1.299	0.0	4928
10080 min Winter	1.136	0.0	6152

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.244	Cv (Winter)	0.840
Return Period (years)	100	E (1km)	0.316	Shortest Storm (mins)	15
Site Location		F (1km)	2.474	Longest Storm (mins)	10080
C (1km)	-0.024	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.313	Winter Storms	Yes		
D2 (1km)	0.339	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.017

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.008	4	8	0.009

Model Details

Storage is Online Cover Level (m) 53.000

Complex Structure

Cellular Storage

Invert Level (m) 52.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.01368 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.01368

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	36.0	36.0	0.151	0.0	40.5
0.150	36.0	40.5			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.01368	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	9.0
Max Percolation (l/s)	15.0	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.300	Cap Volume Depth (m)	0.000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 744 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	52.379	0.379	0.2	9.2	O K
30 min Summer	52.444	0.444	0.3	10.5	O K
60 min Summer	52.509	0.509	0.3	11.9	O K
120 min Summer	52.572	0.572	0.3	13.2	O K
180 min Summer	52.604	0.604	0.3	13.9	O K
240 min Summer	52.621	0.621	0.3	14.3	O K
360 min Summer	52.634	0.634	0.3	14.6	O K
480 min Summer	52.633	0.633	0.3	14.6	O K
600 min Summer	52.632	0.632	0.3	14.5	O K
720 min Summer	52.629	0.629	0.3	14.5	O K
960 min Summer	52.626	0.626	0.3	14.4	O K
1440 min Summer	52.606	0.606	0.3	14.0	O K
2160 min Summer	52.564	0.564	0.3	13.1	O K
2880 min Summer	52.520	0.520	0.3	12.1	O K
4320 min Summer	52.425	0.425	0.3	10.1	O K
5760 min Summer	52.381	0.381	0.2	9.2	O K
7200 min Summer	52.345	0.345	0.2	8.8	O K
8640 min Summer	52.139	0.139	0.1	8.0	O K
10080 min Summer	52.118	0.118	0.1	6.7	O K
15 min Winter	52.436	0.436	0.3	10.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	214.767	0.0	23
30 min Summer	123.574	0.0	37
60 min Summer	71.102	0.0	66
120 min Summer	40.911	0.0	124
180 min Summer	29.609	0.0	184
240 min Summer	23.540	0.0	242
360 min Summer	17.037	0.0	360
480 min Summer	13.544	0.0	420
600 min Summer	11.337	0.0	480
720 min Summer	9.803	0.0	542
960 min Summer	7.852	0.0	674
1440 min Summer	5.743	0.0	944
2160 min Summer	4.200	0.0	1348
2880 min Summer	3.364	0.0	1736
4320 min Summer	2.368	0.0	2464
5760 min Summer	1.845	0.0	3224
7200 min Summer	1.521	0.0	4040
8640 min Summer	1.299	0.0	5016
10080 min Summer	1.136	0.0	5752
15 min Winter	214.767	0.0	22

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	52.505	0.505	0.3	11.8	O K
60 min Winter	52.579	0.579	0.3	13.4	O K
120 min Winter	52.653	0.653	0.3	15.0	O K
180 min Winter	52.692	0.692	0.3	15.8	O K
240 min Winter	52.714	0.714	0.3	16.3	O K
360 min Winter	52.735	0.735	0.3	16.7	O K
480 min Winter	52.738	0.738	0.3	16.8	O K
600 min Winter	52.732	0.732	0.3	16.7	O K
720 min Winter	52.724	0.724	0.3	16.5	O K
960 min Winter	52.716	0.716	0.3	16.3	O K
1440 min Winter	52.681	0.681	0.3	15.6	O K
2160 min Winter	52.612	0.612	0.3	14.1	O K
2880 min Winter	52.543	0.543	0.3	12.6	O K
4320 min Winter	52.417	0.417	0.3	9.9	O K
5760 min Winter	52.371	0.371	0.2	9.1	O K
7200 min Winter	52.331	0.331	0.1	8.7	O K
8640 min Winter	52.122	0.122	0.1	6.9	O K
10080 min Winter	52.093	0.093	0.1	5.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	123.574	0.0	37
60 min Winter	71.102	0.0	66
120 min Winter	40.911	0.0	122
180 min Winter	29.609	0.0	180
240 min Winter	23.540	0.0	238
360 min Winter	17.037	0.0	350
480 min Winter	13.544	0.0	460
600 min Winter	11.337	0.0	560
720 min Winter	9.803	0.0	580
960 min Winter	7.852	0.0	732
1440 min Winter	5.743	0.0	1032
2160 min Winter	4.200	0.0	1456
2880 min Winter	3.364	0.0	1852
4320 min Winter	2.368	0.0	2516
5760 min Winter	1.845	0.0	3336
7200 min Winter	1.521	0.0	4392
8640 min Winter	1.299	0.0	5280
10080 min Winter	1.136	0.0	5952

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.244	Cv (Winter)	0.840
Return Period (years)	100	E (1km)	0.316	Shortest Storm (mins)	15
Site Location		F (1km)	2.474	Longest Storm (mins)	10080
C (1km)	-0.024	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.313	Winter Storms	Yes		
D2 (1km)	0.339	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 0.024

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.012	4	8	0.012

Model Details

Storage is Online Cover Level (m) 53.000

Complex Structure

Cellular Storage

Invert Level (m)	52.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01368	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.01368		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	60.0	0.151	0.0	64.8
0.150	60.0	64.8			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.01368	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	9.0
Max Percolation (l/s)	20.0	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.300	Cap Volume Depth (m)	0.000

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Martin Doughty
Site name:	Norwich Road
Site location:	Hingham

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.57849° N
Longitude:	0.99444° E
Reference:	78035866
Date:	May 14 2020 19:47

Runoff estimation approach FEH Statistical

Site characteristics

Total site area (ha): 2.245

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	8
BFI / BFIHOST:	0.43
Q_{MED} (l/s):	4.06
Q_{BAR} / Q_{MED} factor:	1.12

Hydrological characteristics

	Default	Edited
SAAR (mm):	632	632
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	4.57	6.79
1 in 1 year (l/s):	3.97	5.9
1 in 30 years (l/s):	11.19	16.63
1 in 100 year (l/s):	16.25	24.16
1 in 200 years (l/s):	19.22	28.57

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1335 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	49.389	0.389	4.1	6.5	10.3	890.7	O K
30 min Summer	49.441	0.441	4.3	6.5	10.3	1021.0	O K
60 min Summer	49.497	0.497	4.4	6.5	10.3	1164.7	O K
120 min Summer	49.555	0.555	4.6	6.5	10.4	1316.9	O K
180 min Summer	49.588	0.588	4.7	6.5	10.6	1405.4	O K
240 min Summer	49.609	0.609	5.8	6.5	11.9	1463.5	O K
360 min Summer	49.632	0.632	5.9	6.5	12.1	1533.9	O K
480 min Summer	49.644	0.644	5.9	6.5	12.2	1571.8	O K
600 min Summer	49.650	0.650	6.0	6.5	12.2	1590.9	O K
720 min Summer	49.652	0.652	6.0	6.5	12.2	1597.7	O K
960 min Summer	49.654	0.654	6.0	6.5	12.2	1602.0	O K
1440 min Summer	49.648	0.648	6.0	6.5	12.2	1585.1	O K
2160 min Summer	49.635	0.635	5.9	6.5	12.1	1544.0	O K
2880 min Summer	49.619	0.619	5.9	6.5	12.0	1494.3	O K
4320 min Summer	49.557	0.557	4.6	6.5	10.4	1321.5	O K
5760 min Summer	49.493	0.493	4.4	6.5	10.3	1154.1	O K
7200 min Summer	49.432	0.432	4.2	6.5	10.3	999.9	O K
8640 min Summer	49.380	0.380	4.1	6.5	10.3	867.8	O K
10080 min Summer	49.333	0.333	4.0	6.5	10.3	753.7	O K
15 min Winter	49.432	0.432	4.2	6.5	10.3	999.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	214.767	0.0	790.7	31
30 min Summer	123.574	0.0	848.9	45
60 min Summer	71.102	0.0	1182.4	74
120 min Summer	40.911	0.0	1350.7	134
180 min Summer	29.609	0.0	1455.0	192
240 min Summer	23.540	0.0	1529.6	250
360 min Summer	17.037	0.0	1628.2	368
480 min Summer	13.544	0.0	1682.6	486
600 min Summer	11.337	0.0	1711.9	604
720 min Summer	9.803	0.0	1722.0	722
960 min Summer	7.852	0.0	1715.3	942
1440 min Summer	5.743	0.0	1671.7	1162
2160 min Summer	4.200	0.0	2538.8	1548
2880 min Summer	3.364	0.0	2700.7	1964
4320 min Summer	2.368	0.0	2769.7	2820
5760 min Summer	1.845	0.0	2981.9	3640
7200 min Summer	1.521	0.0	3072.2	4400
8640 min Summer	1.299	0.0	3147.9	5120
10080 min Summer	1.136	0.0	3211.3	5856
15 min Winter	214.767	0.0	841.3	30

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	49.490	0.490	4.4	6.5	10.3	1145.7	O K
60 min Winter	49.552	0.552	4.6	6.5	10.4	1307.8	O K
120 min Winter	49.614	0.614	5.9	6.5	11.9	1479.7	O K
180 min Winter	49.646	0.646	6.0	6.5	12.2	1579.7	O K
240 min Winter	49.668	0.668	6.0	6.5	12.3	1647.7	O K
360 min Winter	49.696	0.696	6.1	6.5	12.6	1734.1	O K
480 min Winter	49.711	0.711	6.2	6.5	12.7	1783.5	O K
600 min Winter	49.720	0.720	6.2	6.5	12.7	1811.8	O K
720 min Winter	49.724	0.724	6.2	6.6	12.8	1826.3	O K
960 min Winter	49.730	0.730	6.2	6.6	12.8	1845.3	O K
1440 min Winter	49.723	0.723	6.2	6.6	12.8	1821.8	O K
2160 min Winter	49.705	0.705	6.1	6.5	12.6	1764.9	O K
2880 min Winter	49.682	0.682	6.1	6.5	12.5	1691.4	O K
4320 min Winter	49.606	0.606	5.8	6.5	11.9	1453.3	O K
5760 min Winter	49.524	0.524	4.5	6.5	10.3	1233.9	O K
7200 min Winter	49.435	0.435	4.2	6.5	10.3	1006.9	O K
8640 min Winter	49.359	0.359	4.0	6.5	10.3	816.8	O K
10080 min Winter	49.292	0.292	3.8	6.5	10.3	656.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	123.574	0.0	871.9	45
60 min Winter	71.102	0.0	1317.6	74
120 min Winter	40.911	0.0	1498.0	130
180 min Winter	29.609	0.0	1605.3	188
240 min Winter	23.540	0.0	1674.8	246
360 min Winter	17.037	0.0	1751.7	362
480 min Winter	13.544	0.0	1783.0	478
600 min Winter	11.337	0.0	1789.4	592
720 min Winter	9.803	0.0	1788.8	706
960 min Winter	7.852	0.0	1783.1	926
1440 min Winter	5.743	0.0	1750.9	1330
2160 min Winter	4.200	0.0	2838.3	1656
2880 min Winter	3.364	0.0	3011.7	2116
4320 min Winter	2.368	0.0	2993.1	2996
5760 min Winter	1.845	0.0	3339.8	3928
7200 min Winter	1.521	0.0	3440.9	4752
8640 min Winter	1.299	0.0	3525.8	5456
10080 min Winter	1.136	0.0	3597.6	6160

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.244	Cv (Winter)	0.840
Return Period (years)	100	E (1km)	0.316	Shortest Storm (mins)	15
Site Location		F (1km)	2.474	Longest Storm (mins)	10080
C (1km)	-0.024	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.313	Winter Storms	Yes		
D2 (1km)	0.339	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 2.245

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.561	4	8	0.561	8	12	0.561	12	16	0.562

Model Details

Storage is Online Cover Level (m) 50.500

Infiltration Basin Structure

Invert Level (m) 49.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.02590 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02590

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2106.0	0.601	3070.0	1.201	0.0	2.100	0.0
0.100	2201.0	0.700	3174.0	1.300	0.0	2.200	0.0
0.200	2296.0	0.800	3279.0	1.301	0.0	2.300	0.0
0.300	2392.0	0.900	3385.0	1.500	0.0	2.400	0.0
0.400	2490.0	1.000	3493.0	1.501	0.0	2.500	0.0
0.500	2588.0	1.001	0.0	1.900	0.0		
0.600	2688.0	1.200	0.0	2.000	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0124-6700-0700-6700
Design Head (m)	0.700
Design Flow (l/s)	6.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	124
Invert Level (m)	49.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	6.5
Flush-Flo™	0.224	6.5
Kick-Flo®	0.498	5.5
Mean Flow over Head Range	-	5.5

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	4.4	1.200	8.3	3.000	12.8	7.000	19.2
0.200	6.5	1.400	8.9	3.500	13.8	7.500	19.8
0.300	6.4	1.600	9.5	4.000	14.7	8.000	20.5
0.400	6.2	1.800	10.1	4.500	15.6	8.500	21.1
0.500	5.5	2.000	10.6	5.000	16.4	9.000	21.7
0.600	6.0	2.200	11.1	5.500	17.1	9.500	22.3
0.800	6.9	2.400	11.5	6.000	17.9		
1.000	7.6	2.600	12.0	6.500	18.6		

THE SITE

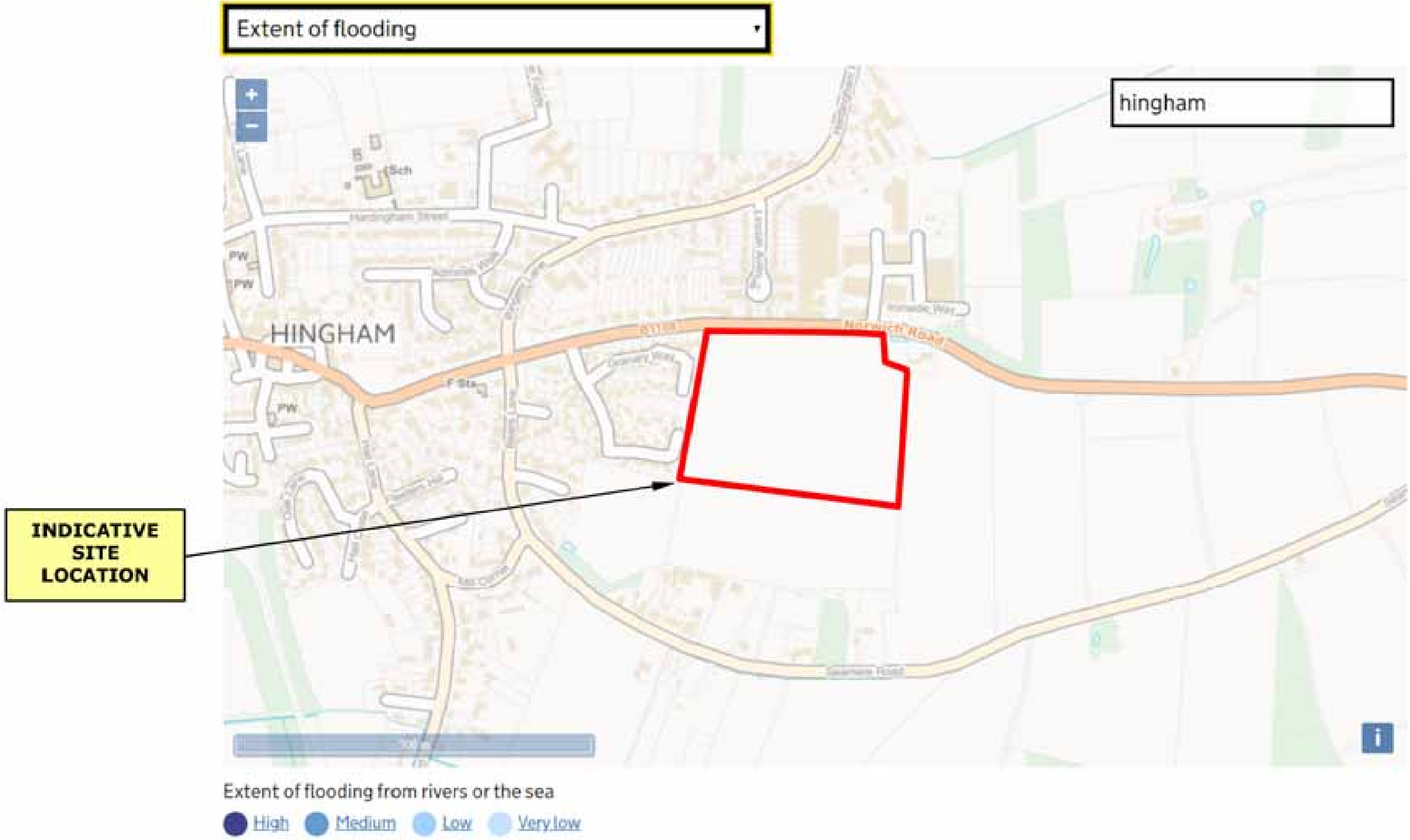
THE SITE

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	**26.2.20**	**48851**	**Fig. 101 (NTS)**

RichardJackson
Engineering Consultants

4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com



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

Client:	Drawing Title:		
Abel Homes Ltd	**Flood Plan (Rivers and Sea)**		
Job Title:	Date:	Job No:	Dwg No:
Land South of Norwich Road, Hingham	**06.03.20**	**48851**	**Fig. 2A (NTS)**

RichardJackson Engineering Consultants
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

FLOOD PLAN (GROUNDWATER)

Groundwater Vulnerability Map (England)

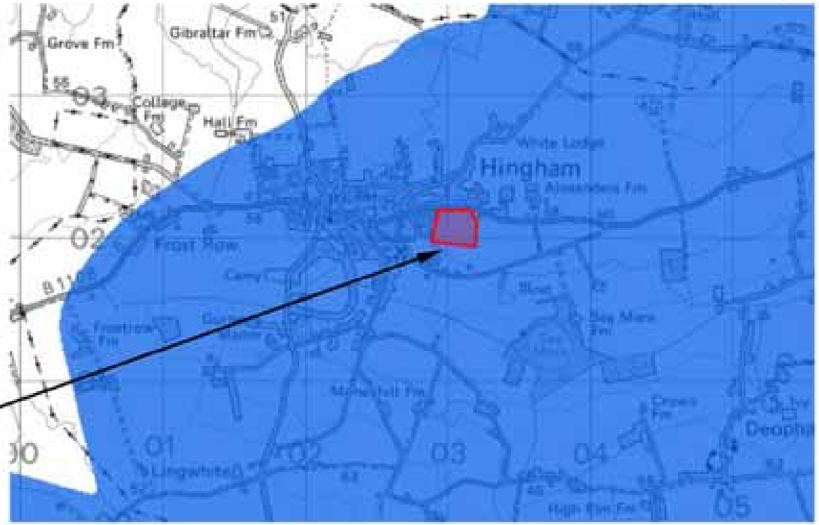
- Local Information
- Soluble Rock Risk
- High
- Medium - High
- Medium
- Medium - Low
- Low
- Unproductive

INDICATIVE SITE LOCATION

SOURCE PROTECTION ZONES (GROUNDWATER)

Source Protection Zones merged (England)

- Zone I - Inner Protection Zone
- Zone I - Subsurface Activity
- Zone II - Outer Protection Zone
- Zone II - Subsurface Activity
- Zone III - Total Catchment
- Zone III - Subsurface Activity
- Zone of Special Interest



INDICATIVE SITE LOCATION

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

Client:	Drawing Title:		
Abel Homes Ltd	**Flood Plan (Groundwater) & Source Protection Zones (Groundwater)**		
Job Title:	Date:	Job No:	Dwg No:
Land South of Norwich Road, Hingham	**06.03.20**	**48851**	**Fig. 3A (NTS)**

RichardJackson Engineering Consultants

4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

INDICATIVE SITE LOCATION

Surface water flood risk: water depth in a medium risk scenario

Flood depth (millimetres)

Over 900mm   300 to 900mm   Below 300mm

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

Client:	Drawing Title:		
Abel Homes Ltd	**Surface Water Flood Mapping (Medium Risk)**		
Job Title: **Land South of Norwich Road, Hingham**	Date: **06.03.20**	Job No: **48851**	Dwg No: **Fig. 4A (NTS)**

RichardJackson Engineering Consultants
4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

Low risk: depth

Surface water flood risk: water depth in a low risk scenario

Flood depth (millimetres)

Over 900mm 300 to 900mm Below 300mm

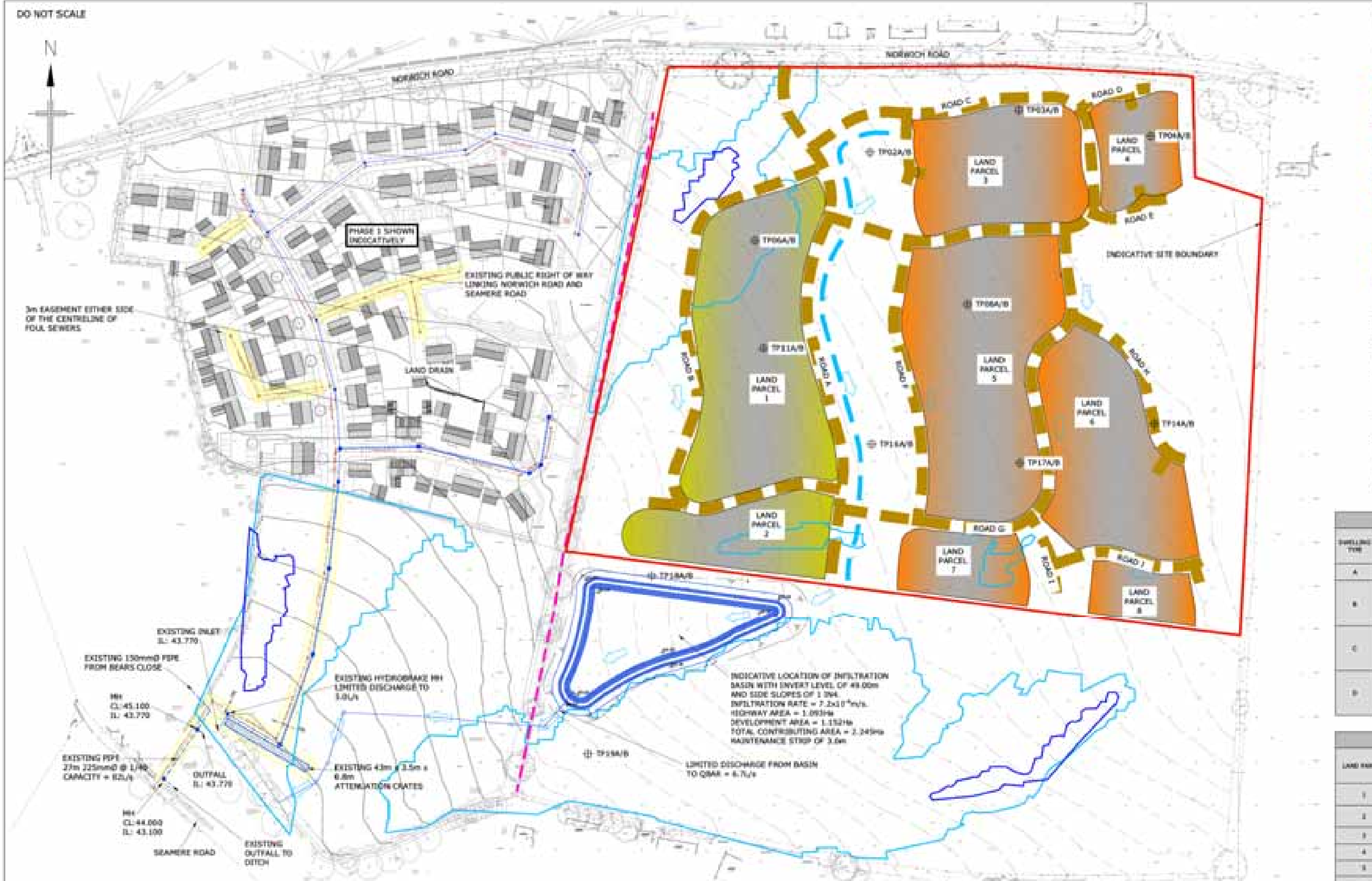
Site location grid reference 603043, 302031 and postcode NR9 4LS

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	**06.03.20**	**48851**	**Fig. 5A (NTS)**

RichardJackson Engineering Consultants

4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com

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
- EXCEEDENCE/TOPOGRAPHY FLOW DIRECTION
- LAND WITHOUT SUITABLE INFILTRATION FOR SuDS
- LAND WITH SUITABLE INFILTRATION FOR SuDS

NOTES:

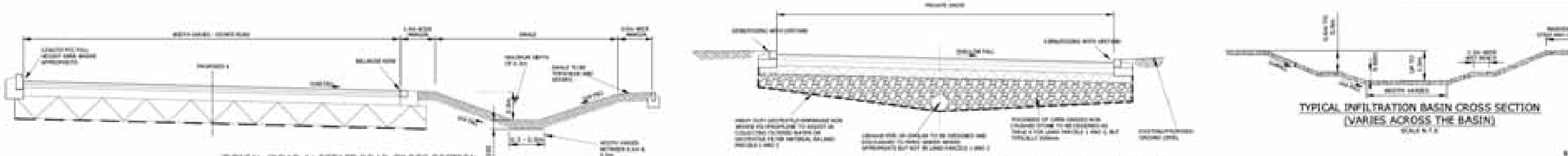
1. ALL LEVELS ARE IN METRES ABOVE ORDNANCE SURVEY DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. TOPOGRAPHICAL SURVEY DRAWING NUMBER 18731aa-01 - 06 DATED NOVEMBER 2018 SUPPLIED TO RICHARD JACKSON LTD BY SURVEY SOLUTIONS AND RJ LTD ACCEPT NO RESPONSIBILITY FOR ERROR OR OMISSION.
4. 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.
7. SOILS DATA TAKEN FROM NORFOLK COUNTY COUNCIL'S, NORFOLK PARTNERSHIP LABORATORY SITE INVESTIGATION REPORT DATED SEPT 2018.

TABLE A - PERMEABLE PAVING REQUIREMENTS LAND PARCEL 1 AND 2

DWELLING TYPE	DWELLING AREA (m^2)	URBAN CREEP (m^2)	GARAGE AREA (m^2)	DRIVE AREA (m^2)	TOTAL AREA (m^2)	DEPTH OF MATERIAL UNDER PAVING (m) & CELLULAR CRATES AS APPROPRIATE
A	46	4.6	N/A	42	95	0.706
B	56	5.6	21	36	119	0.861m using 0.373m material plus 0.15m x 3m x 12m [Permavoid or similar crate storage]
C	65	6.5	42	54	167	0.775m using 0.625m material plus 0.15m x 3m x 12m [Permavoid or similar crate storage]
D	116	11.6	42	72	242	0.738m using 0.588m material plus 0.15m x 6m x 10m [Permavoid or similar crate storage]

TABLE B - LAND PARCEL DETAILS

LAND PARCEL	LAND PARCEL AREA (m^2)	TRIAL PIT REFERENCE	DEPTH OF TRIAL HOLE / PERMEABILITY TEST	INFILTRATION RATE (m/s)
1	7194	TP6A/B TP11A/B	0.8m 0.8m	$8.5x10^{-6}$ m/s $3.8x10^{-6}$ m/s
2	3690	-	N/A	N/A
3	4015	TP3A/B	0.8m	$7.2x10^{-7}$ m/s
4	1747	TP4A/B	0.8m	$1.3x10^{-6}$ m/s
5	7329	TP8A/B	0.8m	$2.3x10^{-6}$ m/s
6	5646	TP14A/B	1.0m	$3.3x10^{-6}$ m/s
7	1793	-	N/A	N/A
8	1107	-	N/A	N/A
INFILTRATION BASIN	-	TP16A/B	0.8m	$7.2x10^{-6}$ m/s



TYPICAL (ROAD A) ESTATE ROAD CROSS SECTION
SCALE NTS

TYPICAL CROSS SECTION OF THE PRIVATE DRIVE AND PERMEABLE PAVING

TYPICAL INFILTRATION BASIN CROSS SECTION
(VARIES ACROSS THE BASIN)
SCALE N.T.S

REV	DATE	DESCRIPTION	DRAWN	CHKD
B	13.05.20	SITE LAYOUT PLAN & DRAINAGE	MJD	MDD
A	06.01.20	UPDATED SITE LAYOUT PLAN	LLG	MDD

REVISIONS

Project	Title	Client
LAND SOUTH OF NORWICH ROAD, HINGHAM	PRELIMINARY SURFACE WATER DRAINAGE STRATEGY	ABEL HOMES LTD

Drawn: L. GRAY — Date: 20/02/20
Job Manager: M. DOUGHTY — Checked: M. DOUGHTY
Approval: 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.

Richard Jackson Engineering Consultants

Drawing No. 48851-PP-SK16 — Revision B

Drawing Status: ☒ INFORMATION ☐ APPROVAL ☐ COSTING ☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

A1

RichardJackson
Engineering Consultants

Our Ref: 48851/MJD
Your Ref:

18 May 2020

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 101**. The referenced "Phase 1" development relates to the neighbouring Abel Homes development to the west of this site.

The site compromises of greenfield land and is approximately 6.8 Ha in size. The main access will be off Norwich Road, with a potential pedestrian link to the west into Phase 1 and other pedestrian footway connections. 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 100 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 (NCC), Lead Local Flood Authority (LLFA) Guidance, dated March 2019.

The topography of the site falls to the low point in the south western corner, which is at approximately 49.50m 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 6.8 Ha. The site has an existing Public Right of Way (PROW) to the west that creates a small south western parcel of approximately 1.6 Ha, and this contains the surface and foul water disposal from the Phase 1 development that forms the western boundary of the site. The drainage is referred to on the **drawing 49455-PP-SK16B**.

Cont'd.../

4 The Old Church
St Matthews Road Norwich
Norfolk NR1 1SP

Telephone: 01603 230240
www.rj.uk.com

For the purposes of establishing the likely drainage parameters for the site, with a density of impermeable area at 40% to 50%, this data will be used to provide a range of necessary water attenuation and/or storage. Where necessary on individual dwellings the drainage design will include Urban Creep of 10% which will be added to the preliminary design. Additionally, an area of the highways will be calculated and appropriate drainage design provided for these areas.

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 GOV.UK and 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, see the Environment Agency 'Flood Map for Planning'. Therefore this has not been investigated further. An indication of the associated Government Flood Maps are shown on **Figure 2A**.

Groundwater Vulnerability

Groundwater Source Protection Zone around all major groundwater abstraction points are identified on magic.defra.gov.uk mapping. 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. The proposed site is within Groundwater Source Protection Zone 3 (total catchment). This zone is identified as the total area needed to support the abstraction or discharge from the protected groundwater source. For the EA groundwater source protection zones of the site, see **Figure 3A.**

In addition, the Groundwater Vulnerability Zone Maps see **Figure 3A** 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'. The ground investigation showed some chalk at depth but no particular 'soluble rock risk', thus this is not investigated further at this stage.

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. In preference, permeable paving would normally be recommended rather than deeper soakaway use in these areas.

Infiltration testing to BRE digest 365 has been completed and is investigated further in this letter report.

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. Further, the strategy indicates that private dwelling drainage at the Phase 1 development, is managed by infiltration through the use of permeable paving.

A ground investigation has been completed for this proposed site, undertaken in September 2018 by NCC, Norfolk Partnership Laboratory (NPL). A copy of the report can be made available if necessary, but the key data is supplied in this report in respect of the drainage issues.

There were trial holes dug across the site and a summary of the infiltration test results are indicated on drawing **48851-PP-SK16B**. These were undertaken to a maximum depth of 1.9m and found that shallow infiltration was better than at depth across much of the site. The shallow testing across the site showed the lower values for infiltration rates at approximately 0.8 to 0.9m depth was $1.1x10^{-6}$ m/s. Better rates were experienced up to $7.2x10^{-6}$ m/s. Upon closer inspection the site was found to have reasonable soakage rates on the western side of the site only and the data is shown on drawing **48851-PP-SK16B**. The drawing indicates the areas that could be used for SuDS successfully and those which have poorer values. For the purposes of the SuDS design in the western part of the site a value of $3.8x10^{-6}$ m/s will be used as this is the lower value from trial pit TP11A and appears to be representative of the western side of the site, see the drawing **48851-PP-SK16B** for details.

At the detail design stage, more accurate and individual plots/area testing could be applied and design formulated accordingly attributed to those results on a localised basis.

Additionally, the NPL report indicated that the groundwater is thought to be at approximately 40m AOD, taken from the British Geological Survey showing the Hydrogeology mapping. Using the data from the trial holes located on the site, it is believed that the groundwater will be approximately 10m to 17m below ground level at the lowest point in the site.

The existing surface water flooding for the 1 in 100 and 1 in 1000 year events have been investigated and are shown on **Figure 4A** and **Figure 5A** 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 for 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/watercourse.

Cont'd.../

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, as indicated in LLFA guidance.

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. The use of SuDS will 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 been determined through a full ground investigation and advice on the use of SuDS/soakaways is such that they could be used. The permeability of the western part of the site has been determined as being 3.8×10^{-6} m/s, as a worse case but higher rates to 7.2×10^{-6} m/s have been found at shallow depths, suitable for permeable paving.

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/Roofs.

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		✓

Cont'd.../

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 and Residential Roofs - Permeable paving where pollution indices are TSS=0.7, Metals=0.6 and Hydrocarbons=0.7, all greater than the required, where possible on the site.

Highways – To Swales or Infiltration Basin or Detention Basin or a combination of these via a piped drainage network where the use of the SuDS as a minimum indicates pollution indices values of TSS=0.5, Metals=0.5 and Hydrocarbons=0.7, all greater than the required.

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%.

Flood Risk Management

Having determined that the soils across the site does possess sufficient infiltration capacity for the use of infiltration devices in the western side, 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.

The private drives will provide permeable paving to act as a pollution treatment and SuDS feature for the discharge of water from the drives and residential roof areas across the whole site, but only the western side of the site will infiltrate. The permeability rate of 3.8×10^{-6} m/s or 0.01368m/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, which could be used across the western side of the site, see drawing **48851-PP-SK16B** for details:

Table B – Indicative SuDS Storage Sizes for dwellings

Dwelling Type*	Dwelling Area (m^2)	10% urban creep (m^2)	Garage Area (m^2)	Drive Area (m^2)	Total Area (m^2)	Permeable Paving depth for 1 in 100 year plus 40% CC Storage under private drive (m)
A	48	4.8	N/A	42	95	0.706m
B	56	5.6	21	36	119	0.661m using 0.551m material plus 0.15m x 3m x 12m (Permavoid or similar crate storage)
C	65	6.5	42	54	167	0.775m using 0.625m material plus 0.15m x 3m x 12m (Permavoid or similar crate storage)
D	116	11.6	42	72	242	0.738m using 0.588m material plus 0.15m x 6m x 10m (Permavoid or similar crate storage)

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

Cont'd.../

The highway water will be captured by a piped system or swales directed towards an infiltration basin which is to be positioned south of the site. The size will be determined by the dimensions of the roads and footways going to the swales/infiltration basin and an indication of the sizes are given in this Chapter. For purposes of being robust, a permeability rate of 7.2×10^{-6} m/s or 0.0259m/hr will be used for the infiltration basin design, as indicated by the soils investigation and taken in the location of the infiltration basin at trial pit TP18A, see drawing **48851-PP-SK16B** for details.

For an estimated contribution of the impermeable land parcels flowing to the infiltration basin see **Table C below;**

Table C – Indicative Contributing Areas to Infiltration Basin from Development Areas

Land Parcel	Land Area (m^2)	Suitable for infiltration / SuDS (Y/N)	SuDS Type	Areas to Infiltration Basin (based on 50% impermea-bility) m2	Total Imp Area (m^2) to Infiltration Basin(50% plus 10% Urban Creep) m2
1	7294	Y	Permeable paving infiltration for dwellings	N/A	0
2	2660	Y	Permeable paving infiltration for dwellings	N/A	0
3	4015	N	Permeable paving to pipes and infiltration basin	2007	2208
4	1747	N	As Area 3	873	960
5	7329	N	As Area 3	3364	4030
6	5046	N	As Area 3	2523	2775
7	1700	N	As Area 3	850	935
8	1107	N	As Area 3	553	608
Total					**11520m2**

For an estimated contribution of the impermeable areas from the highways flowing to the infiltration basin see **Table D** below;

Table D – Indicative Contributing Areas to Infiltration Basin from Highways

Highway Area	Highway Length (m)	Suitable for infiltration / SuDS (Y/N)	SuDS Type	Width of Road (m)	Total Imp Area (m^2) to Infiltration Basin (m2)
A	239	Y	Highway to Swale and then to Infiltration basin	10.8	2581
B	265	Possibly	Highway to Swale and then to Infiltration basin	6.6	1749
C	305	N	Highway to piped system and then Infiltration Basin	6.6	2013
D	34	N	As Area C	6.6	224
E	95	N	As Area C	6.6	627
F	134	N	As Area C	6.6	884
G	234	N	As Area C	6.6	1544
H	90	N	As Area C	6.6	594
I	39	N	As Area C	6.6	257
J	69	N	As Area C	6.6	455
Total					**10928m2**

Infiltration / Detention Basin Design

It can be seen from **Tables C & D** that the total contributing areas to the infiltration basin are 1.152Ha and 1.093Ha from the development land and Highways respectively.

To determine the flow rate from the basin, a greenfield runoff rate calculation has been conducted using the UKSUDS.com tool for greenfield runoff calculation. Using the FEH Statistical runoff approach and a site area of 2.245Ha, the same as the contributing area and a BFIHOSt from the FEH data, a greenfield runoff rate of QBar = 6.79L/s. This will be used as the discharge rate from the infiltration basin. The sizing of the infiltration basin has been completed and the summary data is outlined below see **Table E** below;

Table E – Highway/Development Infiltration / Detention Basin

Overall contributing Area	QBar Outflow at GFR Rate (L/s)	Area of Basin (m2)	1 in100 year storm plus 40% CC (Urban Creep has been included in the contributing areas)	
			Depth (m)	Volume (m^3)
2.245 Ha	6.79 L/s	3385 m^2	Approx. 0.730m	1845m^3

The details of the basin and outfall to the existing pond to the southwest of the site are shown on drawing **48851-PP-SK16B**.

Existing Capacity check on the Receiving Sewer Network near Pond

The discharge rate to the pond from the new development will be 6.7L/s. The discharge rate from the Phase One development is limited to 5L/s. We have been informed that there is a receiving sewer adjacent to the pond which is 225mm diameter and laid at a 1 in 40 fall, which provides a capacity of 82L/s.

The sewer has an additional contributing pipe from the west which appears to accommodate up to 11 dwellings and Bears Close. The likely contributing area from this area is approximately 0.317Ha, taken from OS data. Using the formula from the SuDS Manual 2015, Eq24.5, the runoff rate from this area can be calculated. Where the flow rate will be Q=2.78xCxixA.

C=runoff coefficient (1.0)

i = rainfall intensity (50mm/hr)

A = area in Ha

Therefore the flow is likely to be, Q=2.78 x 1.0 x 50 x 0.317 = 44.0L/s.

It can be concluded therefore that if the pipe has a capacity of 82L/s and the contributing discharges are 44L/s (Bear Close), 5.0L/s (Phase One) and 6.7L/s (Proposed development) then the pipe has spare capacity of 32.3L/s and is adequate for the discharge from the proposed development through the pond.

Management and Maintenance Plan

SuDS management requires a clear understanding of who is responsible for maintenance, particularly on a self-contained small development. There are distinct areas of SuDS maintenance:

- Maintenance of the first category of feature (for example water butts and permeable driveways) is the responsibility of the land or property owner(s).
- Maintenance of the second category (for example shared permeable pavements/soakaways and highway gullies/swales) in this case will be the land owner, property owner(s) or the highway authority for associated highway drainage.
- The third category (for example detention basins, and flow control structures) links to the main attenuation/infiltration features for the site will be the adopting authority which could be Anglian Water or a Property Management Company.

Anglian Water will be the adopting body for the main foul water sewers in the development where the sewer receives more than one dwelling. Appropriate easements will be applied based on Sewers for Adoption and on the pipe diameter.

The attenuation feature will have a clear 3.0m width around the basin to allow for it to be maintained accordingly, where appropriate.

The maintenance regime will be such that the work to maintain the attenuation basin and adoptable system, regular checks and maintenance will be undertaken as indicated below, with further details of maintenance contained within the SuDS Manual (2015). A detailed management plan for the SuDS features can be a document secured through a planning condition.

Cont'd.../

SuDS Maintenance Plan

Maintenance	***Action***	***Frequency***
Regular Maintenance	Check inlets, outlets, control structures and overflows.	Monthly or annually as required
	Litter removal from site that might block inlets and outlets.	Monthly
	Grass cutting / plant control on / around detention basin as well weed removal from permeable paving.	Monthly or as required
	Gratings, inspection chambers and silt traps – Check for damage and blockages.	Bi-annually
	Regular maintenance and jetting of carrier pipes.	Annually
	Regular maintenance schedule to be updated.	Bi-annually
Occasional Tasks	Jetting and suction where silt has settled.	Bi-annually or as required by manufacturers
	Check of inlets and outlets on Pipe Storage system adopted by the adopting Authority	Annually
	Vacuum sweeping and brushing of pervious pavements – replace jointing material.	Bi-Annually
Remedial Work	Reinstate	As necessary when the function of the permeable paving fails between 10-25 years.

Summary

It can be seen from the indicative ground conditions taken from the ground investigation produced for the site that infiltration is likely to be suitable in part of the site, mainly on the western side. Further intrusive investigations are required in order to determine infiltration rates for the proposed dwellings in more detail at the appropriate stage.

An infiltration strategy, with above ground storage, where possible, 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 permeable paving for the houses have been provided indicatively where infiltration rates allow. A proposal to use permeable paving on the rest of the site, which could drain into a main sewer system and through an infiltration basin with limited discharge, with highways using swales on the main spine road where possible.

Cont'd.../

If, following further infiltration testing, at the detailed design stage, permeability of the soils was not found to be suitable for the western parcels of land, a similar strategy for that of the eastern parcels will be adopted, with under-drained permeable paving and a piped network discharging to the existing pond via the new lagoon

With limited discharge from the site, a preliminary assessment of the capacity of the sewer near the pond has also been undertaken and found to be satisfactory.

An indicative surface water drainage strategy is shown on drawing **48851-PP-SK16B** showing the infiltration basin, 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. Development has been removed from these areas.			
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 where appropriate and an infiltration basin based upon the detailed site investigation already undertaken.			

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 and Drawings

Figures 101, 2A, 3A, 4A & 5A

48851/PP/SK16B – Preliminary Surface Water Drainage Strategy

Additional Supporting Data

Flood Map for Planning

FEH Data

Microdrainage - Dwelling Permeable Paving Calcs – Type A to D

Greenfield Runoff UKSUDS.com calculation

Microdrainage - Infiltration basin design

APPENDIX 3

LOCAL LEAD FLOOD AUTHORITY PRE-APPLICATION RESPONSE 20TH MAY 2020

Norfolk County Council

Community and Environmental Services
County Hall
Martineau Lane
Norwich
NR1 2SG
NCC contact number: 0344 800 8020
Textphone: 0344 800 8011

via e-mail
Abel Homes Limited
Neaton Business Park
Norwich Road
Watton
Norfolk
IP25 6JB

Your Ref:
Date: 20 May 2020

My Ref: FW2020_0343
Tel No.: 0344 800 8020
Email: llfa@norfolk.gov.uk

Dear Mr Piper,

Town and County Planning (Development Management Procedure) (England) Order 2015

Pre-app advice: Land South Of Norwich Road, Hingham Norfolk

Thank you for your pre-app enquiry on the above site, received on 18 May 2020.

As part of any submission, we would expect the applicant to provide evidence to demonstrate that the proposals for surface water management are sufficient to prevent an increase in the risk of flooding as a result of increased speed of runoff through the development; and, appropriately integrate within the development layout the ingress, through flow and egress of surface water flow path exceedance routes identified as affecting the development site.

A written response to your previous Pre-app enquiry was sent on 16 April and subsequently discussed at a pre-app meeting carried out remotely on 17 April 2020, (meeting minutes were forwarded to yourselves on 23 April 2020).

We stated would wish to see appropriate information on the following and gave recommendations on the FRA submitted (see Appendix A).

- Appropriate assessment and mitigation of surface water flooding that may affect the development,
- Sustainable Drainage Systems (SuDS) proposals in accordance with appropriate guidance including "Non-statutory technical standards for sustainable drainage systems" March 2015 by Department for Environment, Food and Rural Affairs (DEFRA).
- At least one feasible proposal for the disposal of surface water drainage should be demonstrated and, in many cases, supported by the inclusion of appropriate information.
- It is important that the SuDS principles and hierarchies have been followed in terms of surface water disposal location, prioritised in the following order: disposal of water to

Continued…/

shallow infiltration, to a watercourse, to a surface water sewer, combined sewer / deep infiltration (generally greater than 2m below ground level),
- the SuDS components used within the management train (source, site and regional control) in relation to water quality and quantity, identifying multifunctional benefits including amenity and biodiversity.
- The drainage strategy should also contain a maintenance and management plan detailing the activities required and details of who will adopt and maintain all the surface water drainage features for the lifetime of the development.
- The drainage strategy will include a phasing schedule considering how the SuDS relates to the whole site. In particular, highlighting where different future phases rely on each another for connection to the final discharge location and how this will be implemented, during construction and operation of the development.

The following documents have now been submitted to support this enquiry:

- Sketch Masterplan Ref: SK01 Rev A04 dated 9 March 2018
- FRA letter (Richard Jackson Ref: 48851/MJD   dated 18 May 2020).
- A flood map for planning (dated 28 February 2020)
- Drainage calculations dated 13 ay 2020 including Greenfield run-off calculations

The revised Masterplan now show that properties are now not within the flood flow path in the top left of the site. However, the same cannot be said for the south of the site, where it appears properties are still within the flow path (land parcels 2 & 7). The LLFA would prefer that properties within the flood zones are avoided. If this is not possible, then attention should be paid to finished floor levels. In this case, levels may have to be 600mm above predicted flood levels. It is understood that at this stage there is still scope to design the layout around the flow paths. It is welcomed that the infiltration basin has now been moved out of the flood risk area.

Consideration has now been given to the water quality for this site. Also, greenfield run off rates have been included. The submitted documentation now accounts for 10% urban creep.

Infiltration is still proposed as the method of discharge of surface water. The infiltration rates used are now for this site as opposed to the adjacent site. Plan 48851-PP-SK16B show locations of infiltration results. This indicates that infiltration is more viable in the west of the site. At detailed design, infiltration testing should be undertaken in accordance with BRE 365 or equivalent (as in our guidance Section 15 and 16) in areas of the site which has shown that infiltration is initially favourable (better than 1x10-6 m/s). Testing should be completed three times at each proposed infiltration location at **representative depths and locations.** It should also be proven that there is 1.2m between a proposed infiltration structure invert and seasonally high groundwater levels. The evidence supporting this should be submitted. It is noted that at the pre-app meeting, the difference in infiltration rates between the west of this site and the adjacent site at the field line varied considerably. As discussed, the neighbouring phase only had shallow infiltration where a partial infiltration scheme was eventually utilised. It was proposed that there were some areas where it was felt the site need further addressing to evidence/clarify these findings or a strategy re-design may need to be considered.

Continued…/

It is now stated that if, following further infiltration testing, at the detailed design stage, permeability of the soils was not found to be suitable for the western parcels of land, a similar strategy for that of the eastern parcels will be adopted, with under-drained permeable paving and a piped network discharging to the existing pond via the new lagoon. The FRA assesses the existing outfall to the pond and concludes that there is sufficient capacity for the discharge from the proposed development through the pond.

Maintenance and Management of the site has now been considered.

Please note if there are any works proposed as part of this application that are likely to affect flows in an ordinary watercourse, then the applicant is likely to need the approval of the County Council. In line with good practice, the Council seeks to avoid culverting, and its consent for such works will not normally be granted except as a means of access. It should be noted that this approval is separate from planning.

Yours sincerely,

Lucy

Lucy Perry

Flood Risk Engineer

Flood and Water Management Team
Lead Local Flood Authority

Continued…/

Appendix A

An FRA (Richard Jackson Ref: 48851/LLG/MJD dated 29 February 2020) has been provided in support of this pre-app application. We have reviewed the information as submitted and wish to make the following comments.

Recommendations

- The drainage strategy has been developed by referring to the Plandescil report (Ref: 17758 dated October 2014) previously submitted for Phase 1, and has considered permeability of soils ranging from 7.7 x 10-6 m/s to 9.47 x 10-6 m/s. However further investigation was undertaken for Abel homes in June 2015 by A F Howland (Ref: APS/15.114/Add 2). This additional infiltration testing undertaken subsequently resulted in unfavourable soakage rates at depth. For Phase 1 it was therefore proposed to utilise shallow infiltration and discharge from the surface water sewer network on the site to the pond that is adjacent to Woodside on Seamere Road. **Full, up to date ground investigation should be carried out for this phase of the works.**
- Calculations should be provided for the determination of the depths of storage beneath any permeable surfaces as shown in the submitted drainage strategy. The applicant should therefore either: a) provide calculations demonstrating that the storage for the permeable paving will be sufficient should the rate of infiltration be lower than previously assessed; b) increase the depth of sub-base to allow for additional storage within the permeable paving system to prevent surcharging; or c) include positive outfalls from the permeable paving and include such areas in the calculations for the wider drainage network to show there is sufficient storage to prevent flooding of the surface water network.
- Urban creep should be considered to account for increases in impermeable surfaces through the lifetime of the development. If the development is for 100 dwellings, a 10% change allowance of impermeable area should be included (see table 5 of our guidance document).
- When identifying the critical rainfall event, the LLFA guidance has been updated, and that the advice to use FSR rainfall information if the critical storm duration is less than 1 hour has been removed. Only up to date FEH data will be accepted in the future.
- Modelling of the conveyance system should be provided for the 1% AEP plus climate change rainfall event, including plans showing where flood water originating from any flooded components of the drainage system (where appropriate) would be directed. Exceedance flow routes through the site should be considered. We understand that flows from off-site are not the responsibility of a landowner to attenuate. However, it is in the developer's responsibility to manage the risk within the site. The influence of offsite flows and the affect they may have on the ability of the proposed drainage system to provide the required standard of protection should be considered.
- Finished ground floor levels of properties should be a minimum of 300mm above expected flood levels of all sources of flooding (including the ordinary watercourses, SuDS features and within any proposed drainage scheme) or 150mm above ground level, whichever is the more precautionary.
- A maintenance plan for the proposed drainage system should be considered, taking into account the maintenance activities that are likely to be required, their frequency

and responsibilities. Please note that there are long term practicality issues for maintaining soakaways with shared maintenance responsibilities, which potentially could be within the back gardens of properties and not within public open space to allow easy access. They may also wish to consider if permitted development rights are removed to prevent accidental damage to the structures or building over them.

Reason

To prevent flooding in accordance with National Planning Policy Framework paragraph 163,165 and 170 by ensuring the satisfactory management of local sources of flooding surface water flow paths, storage and disposal of surface water from the site in a range of rainfall events and ensuring the SuDS proposed operates as designed for the lifetime of the development.