

FLOOD RISK ASSESSMENT

**PROPOSED RESIDENTIAL DEVELOPMENT
SPALDING ROAD,
PINCHBECK,
SPALDING.
LINCOLNSHIRE**



RM ASSOCIATES

10 Main Street
Thorpe on the Hill
Lincoln
LN6 9BG

Tel 01522 681728

Mobile 07967 304737

e-mail ray.rmassociates@gmail.com

Version 1 May 2016

FLOOD RISK ASSESSMENT FOR PROPOSED RESIDENTIAL DEVELOPMENT, SPALDING ROAD, PINCHBECK, SPALDING, LINCOLNSHIRE.

INTRODUCTION

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process. This seeks to reduce the future damage to property and the risk to life from incidents of flooding. Their expectations relating to flooding are contained in the National Planning Policy Framework (NPPF) March 2012, which identify how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications by avoiding inappropriate development in areas at risk from flooding.

Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change.

The Environment Agency's flood maps show areas that are at risk, from fluvial and tidal flooding. These maps show the limits of the flood plain of the area which could be affected by flood events, over topping or breaching of flood defences. They are based on the approximate extent of floods with a 1% annual probability of exceedance (1 in 100-year flood) for rivers and 0.5% annual probability of exceedance (1 in 200-year flood) for coastal areas under present expectations or the highest known flood. However, they do not take into account of the presence of defences or the likelihood that flood return intervals will be reduced by climate change.

This Flood Risk Assessment has been prepared in support of the planning application and considers the risk of flooding from fluvial and tidal sources. It also considers the risks of localised flooding due to inadequate Foul and Surface Water Sewers, Failure of Reservoirs, Water Main pipe bursts, Sewer Blockages, Pump Failures or High Ground Water Table etc.

RM Associates accepts no responsibility or liability for any use of this document other than by the client Egar Brothers, for the purposes for which it was originally commissioned and prepared. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and RM Associates owe them no duty of care or skill. All comments contained in this report, including any conclusions are based upon information available at the time of writing the report. RM Associates accepts no liability if additional information exists or becomes available after the time of writing this report.

This document is the copyright of RM Associates. The reproduction or transmission of all or part of this document, whether by photocopying or storing in any medium by electronic means or otherwise, without the prior written consent of RM Associates is prohibited.

This report contains Environment Agency information © Environment Agency and database.

APPLICATION SITE

The site is located off Spalding Road, Pinchbeck, Spalding, Lincolnshire within the administrative area of South Holland District Council. The National Grid Reference for the middle of the site is TF24570 24741, with a site area 0.63acres or thereabouts. **Plan 1**

The current outline planning application is for the erection of 4No detached two storey dwellings with private access driveway.

The Site would be classed as Non Major Development applying the National Planning Policy Guidance (NPPG) as the site is to be developed for less than 10 dwellings.

The National Planning Policy Framework Technical Guidance NPPF defines three levels of flood risk depending upon the annual probability of fluvial flooding occurring.

Zone 1 – Low Probability (<0.1%)

Zone 2 – Medium Probability (0.1 – 1.0%)

Zone 3 – High Probability (>1.0%)

The proposed development site is shown to be within Flood Zone 3a 'High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences, and as defined in Table 1 of NPPF. Map1

Table 1: Flood Zones Definition (Ignoring the presence of defences)

Zone 3a - high probability
Definition This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Appropriate uses The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.
Flood risk assessment requirements All development proposals in this zone should be accompanied by a flood risk assessment.
Policy aims In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems; • relocate existing development to land in zones with a lower probability of flooding; and • create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF the proposed residential development

is classified as “More Vulnerable”, with Table 1 of NPPF stating that such uses are appropriate in this zone subject to the Exception Test.

Table 2: Flood Risk Vulnerability Classification

More vulnerable • Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste⁶. • Sites used for holiday or short-let caravans and camping, <i>subject to a specific warning and evacuation plan.</i>⁷

From the topographical survey the site is roughly rectangular in shape and reasonably level averaging 2.95m ODN with levels on the western boundary being 3.00mODN and on the eastern boundary 2.95mODN and the road level on Spalding Road at the site entrance is 3.64mODN

It is proposed that the lowest ground floor level of the dwellings be raised 500mm above the existing ground level to a minimum level of 3.50mODN.

This proposed level is the same as that by the planning approval for 169 properties surrounding the site granted planning approval on 25 May 2016 ref no H14-0156-14

DRAINAGE AUTHORITIES

Environment Agency

The Environment Agency is responsible for reducing the risk of flooding from designated main rivers and from the sea.

The following potential sources of flooding affecting the development site have been identified as:

- From the River Welland
- South Holland Internal Drainage Board system

The Flood Zone Maps identify river catchments over 3 sq. km. These maps are a theoretical estimate of areas that could be inundated should no defence exist. In practice current standards of protection would result in flood envelopes substantially less than shown by these maps. The maps make no allowance for local, site specific features.

The flood zone maps show that the site of the proposed development is considered at risk from flooding. These maps indicate that the area would be flooded without flood defences, which are in place, (with an

annual probability of more than 0.5% i.e. return frequency of less than 1 in 200 years for tidal flooding or more than 1.33% return frequency of less than 1 in 100 years for fluvial flooding). (**Map 1**)

The National Flood Risk Assessment Map shows that the site is at very low risk of flooding. Very Low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%). This takes into account the effect of any flood defences that may be in this area. Flood defences reduce, but do not completely stop the chance of flooding as they can be overtopped or fail. **Map 2**

RIVER WELLAND

The River Welland lies some 1.5Km to the east of the site and is tidal down stream of Marsh Lane Sluice and the present day 1 in 200-year tide flood level is 5.98mODN. The tidal flood defences of the tidal River Welland consist of earth embankments which are in good condition and the crest heights are circa 7.00mODN.

The Environment Agency has provided fluvial flood levels upstream of Marsh Road Sluice for the 1 in 100-year with climate change are shown below. The fluvial defences consist of earth embankments which are in good condition and provide a defence for a flood event of 1 in 100-year event.

These levels are taken from the Welland Catchment FMI Model (2007) and are the most up to-date currently available. These levels are “in-channel” levels and therefore may not represent the flood level on the floodplain, particularly where the channel is embanked or has raised defences.

The greatest risk of flooding of the site would therefore be from a breach to either the fluvial or tide earth embankments.

Fluvial Flood Levels (mODN)

The fluvial flood levels for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

Node Label	Easting	Northing	Annual Exceedance Probability - Maximum Water Levels (mODN)										
			50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
SPALDING CHANNEL 259	525779	323995	4.04	4.23	4.29	4.34	4.40	4.42	4.43	4.68	4.44	4.45	4.69
WELLAND 10090	526078	324809	4.12	4.11	4.15	4.20	4.24	4.25	4.25	5.28	4.28	4.27	5.25
WELLAND 9881	526240	324975	4.11	4.10	4.14	4.19	4.22	4.23	4.23	5.25	4.24	4.25	5.25

South Holland District Council

In order to inform the process of risk assessment and site selection the District Council commissioned Haskoning UK Ltd Consultants to prepare a Strategic Flood Risk Assessment in December 2002. They have carried out an update of this report and this report was published in January 2010

This Flood Risk Assessment has taken the results of the updated South Holland Strategic Flood Risk Assessment (SHSFRA) into account in its findings.

It was found that the actual risk from primary sources of flooding (taken as being rivers and the sea) was assessed as being the product of:

- Medium probability (assigned because the standards of the primary defences are variable) and
- Low consequence (assigned because of the District's generally rural nature and because any urban flooding is likely to be shallow with minimal impact).

The findings reflect the considerable protection afforded to the area by coastal and tidal & fluvial flood defences and by the extensive well organised system of lowland IDB fluvial drainage.

The computer modelling used in the SFRA to produce the Hazard, depth and velocity maps simulated the spread of flood waters over the land and allowed for the presence of locally raised features such as road embankments etc. The maps produced by the Environment Agency took a more precautionary approach.

The potential flooding consequences shown on this map relate to flooding from the sea, main rivers and Internal Drainage Board systems taking into account the presence of current flood risk management measures such as flood defences.

The consequences designated as being an Actual Risk arise from direct overtopping of defences, where this would occur, together with assumed breach failure of some defences. Breach failure has been assumed to occur in places where the freeboard between peak sea or river water level and the defence crest level is less than the minimum desirable for structural security of the defence.

From the Residual Flood Hazard, Depth and Velocity Spalding - Year 2115 1% Fluvial / 0.5% Tidal Event Probability maps, from the update of strategic flood risk assessment for South Holland District Council the site is affected from a breach to the flood defences. **Map 2 & Map 3 Map 4**

Welland & Deepings Internal Drainage Board

The proposed development site is located within Catchment area of Welland & Deepings Internal Drainage Board. The Board is responsible to operate and maintain the arterial fluvial system.

The Board's nearest watercourse is the Pennygate Pup Drain located some 250m to the north east of the site. The 1:100-year level in the Pennygate Pup Drain is approximately 1.80m ODN currently and 2.40m ODN in 2100. (This assumes climate change and development) This drain connects to the Blue Gowt Drain which flows to the Pinchbeck Marsh Pumping Stations which pump water into the Blue Gowt Outfall Drain. This watercourse gravitates into the River Glen just upstream of Surfleet Reservoir. Flooding from this source has been discounted due to the proposed floor levels being set at 3.50mODN.



Extract from Welland and Deepings IDB Drainage Map

FLOODING FROM OTHER SOURCES

Flooding is a natural process and can happen at any time from sources other than watercourses and the sea.

- Flooding from land can occur from intense rainfall, often over short duration of time that is unable to soak into the ground or enter the drainage system. However, with the natural topographic nature of the ground being flat, with no high ground around the site this will not cause any rapid inundation of the site and is likely only lead to local ponding of shallow depth and low velocity following the natural land contours. The properties are also raised 500mm above the average ground level. The updated SFRA concluded that flooding from this source is limited to minor isolated cases and is not of strategic significance as regards to flood risk.
- The area is not known to suffer from any groundwater problems and therefore is taken as having no strategic significance as regards to flood risk.
- Flooding from sewers can occur from over loading from heavy rainfall caused by blockages or having inadequate capacity. The resulting back pressure could cause foul sewage to flow from manholes which would flow over areas of the carriageway at a lower level and be contained within the confines of the kerb lines following the natural land contour to the south-west. The Updated SFRA concluded that flooding from sewers is limited to minor isolated cases and is not of strategic significance as regards to flood risk.
- Non-natural or artificial sources of flooding such as reservoirs, lakes or canals where water is stored above natural ground level could cause flooding if the structure fails or is over topped.

SEQUENTIAL APPROACH

When applying the sequential approach for flood risk in accordance NPPF the site would fall into Zone 3a (High Probability) as the site is shown to be within the tidal flood plain as shown on the Environment Agency's Flood Map without defences in place.

However, the results of the updated SHSFRA shows that the site is located within a low/medium probability flood zone but the area is reliant on protection by flood defences providing a standard of protection of 1 in 100 years return period.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF, the proposed residential development is classified as "More Vulnerable", with Table 1 of NPPF stating that such uses are appropriate in this zone (as summarised in Table 3 NPPF).

TABLE 3: Flood risk vulnerability and flood zones 'compatibility'

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

The Sequential and Exception Tests are subject to a separate report and for the purpose of this flood risk assessment they are deemed to have been satisfied.

With the properties being two storeys there is a safe haven for residents to await the flood level to recede or to be rescued.

INFRASTRUCTURE

Foul Water

Foul sewers designed and laid in accordance with Sewers for adoption 7th edition, adopted by Anglian Water Services Ltd, under Section 104 of the Water Industry Act 1991, (as amended by the Water Act 2003) will be provided to serve the development and connected into the Anglian Water sewer serving the area.

Anglian Water have confirmed in their Predevelopment Report Ref **00011507** that they have assessed the impact of gravity flows from the planned development to the public foul sewerage network and confirm that this is acceptable as the foul sewerage system, at present, has available capacity for the site.

As there is a positive drainage system capable of receiving flows from the development there is no likely impact on neighbouring property.

CLIMATE CHANGE

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events as both tidal and fluvial flooding. The Climate change allowances in the NPPF Guidance was updated on the 19th February 2016.

The site is located within the Anglian River Basin, for sites within Flood Zone 3a and for “More vulnerable” land uses the Higher Central and Upper End river flow allowances figures in Table 1 should be used.

Table 1 Peak river flow allowances by river basin district (1961 to 1990 baseline)				
River basin District	Allowance category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Anglian	Upper End	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

The effect of global warming on peak rainfall allowances is given in Table 2.

Table 2 Peak rainfall intensity allowance in small and urban catchments (1961 to 1990 baseline)			
Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

The annual sea rise due to climate change is given in NPPF and the recommended contingency allowances are stated in Table 3

Table 3 Peak sea level allowance for each epoch in (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)					
Area of England) (Use River Basin maps	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative Rise 1990 to 2115 (m)
East, Midlands, London, South East	4 (140mm)	8.5 (212.5mm)	12 (360mm)	15 (525mm)	1.24m

From Information requested from the Environment Agency the Main risk of flooding of the site is from the River Welland which is located some 1.5 Km east of the site and is tidal down stream of Marsh Lane Sluice, the 1 in 200-year tide flood level for year 2115 is 7.16mODN. (The Still Water Tidal Levels mODN - Tidal Model Analysis 2006 I in 200-year flood level is 5.98mODN + 1.18m climate change to 2115 taken from Table 3, = 7.16mODN). The tidal flood defences of the tidal River Welland consist of earth embankments which are

in good condition and the minimum crest heights are 7.57mODN. This provides a protected freeboard of 400mm.

The fluvial river levels upstream of Marsh Road Sluice for the 1 in 100-year with 20% climate change is 4.69mODN. Based upon the crest heights of the earth embankment flood defence at an average of 5.80mODN the proposed site is protected with a freeboard of circa 900mm. With the new climate change allowances, this is assessed as 4.90mODN.

The right bank of the River Welland downstream of Marsh lane is formed by an earth bank which is provided with a soak dyke on the landward toe. The right bank to the River Welland upstream of Little London forms the embankment to the Cowbit Washes which allows water to overtop bank which consequently controls the river levels downstream during a high flow event. Further upstream there is a similar controlling flood storage washes at Crowland. The standard of protection provided by these defences is for the 1 in 100-year flood event.

The fluvial defences protecting this site consist of earth embankments. They are in good condition and provide protection against a flood event with a 1% chance of occurring in any year (1 in 100). The Environment Agency inspect these defences regularly to ensure that any potential defects are identified early.

The fluvial flood levels and flows for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

The Flood Levels and Flood Flows are taken from the Welland Model (2007) and are the most up-to-date currently available.

Fluvial Flood Levels (mODN)

The fluvial flood levels for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

Node Label	Easting	Northing	Annual Exceedance Probability - Maximum Water Levels (mODN)										
			50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
SPALDING CHANNEL 259	525779	323995	4.04	4.23	4.29	4.34	4.40	4.42	4.43	4.68	4.44	4.45	4.89
WELLAND 10090	526078	324609	4.12	4.11	4.15	4.20	4.24	4.25	4.25	5.26	4.26	4.27	5.25
WELLAND 9891	526240	324975	4.11	4.10	4.14	4.19	4.22	4.23	4.23	5.25	4.24	4.25	5.25

Fluvial Flood Flows (m³/s)

The fluvial flood flows for the model nodes shown on the attached map are set out in the table below. They are measured in metres cubed per second (m³/s).

Node Label	Easting	Northing	Annual Exceedance Probability - Maximum Flows (m³/s)										
			50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
SPALDING CHANNEL 259	525779	323995	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
WELLAND 10090	526078	324609	68.28	82.95	87.14	90.62	91.72	91.97	92.14	92.38	92.41	92.41	93.05
WELLAND 9891	526240	324975	68.87	83.39	87.52	90.95	92.05	92.30	92.47	92.87	92.74	92.73	93.52

The greatest risk of flooding of the site would therefore be from a breach to either the fluvial or tidal earth embankments.

Interpolating the river flow and level data issued by the Environment Agency it is assessed that for the climate change figures stated in Table 1 are as follows for the 1 in 100-year event Node 9691.

Allowance	Factor	Interpolated Level
Central	25	4.57
Higher Central	40	4.70
Upper End	65	4.90

Breach Analysis for a Breach to the Fluvial Flood Defences for The River Welland

Taking the precautionary approach, the Hazard Rating following a breach which in Flood Risk Assessment (FD 2320) Guidance for New Development Phase 2 R& D Technical Report these are classified as low <0.75, moderate 0.75 - 1.25, significant 1.25 - 2.50 and extreme >2.50 based upon an empirical measure of velocity and depth.

Flood Hazard value	Degree of flood hazard	Description	Indicative depth range
< 0.75	Low	Caution 'Flood zone with shallow flowing water or deep standing water'	Up to 0.25 m
0.75 – 1.25	Moderate	Danger for some (i.e. children) 'Danger: flood zone with deep or fast flowing water'	Up to 0.5 m
1.25 – 2.0	Severe	Danger for most 'Danger: flood zone with deep fast flowing water'	0.5 m to 3 m
> 2.0	Extreme	Danger for all 'Extreme danger: flood zone with deep fast flowing water'	0.5 m to over 3 m

$$HR = d \times (v + 0.5) + DF$$

Where V = Flood flow velocity (m/sec)

D = Flood depth (m)

DF = A debris factor included to represent the greater damage, or risk of injury to people, that can occur if debris is swept along with the water. = 0.5 for depths <0.25 or 1.0 for depths

Flood depth (m)	All areas (rural and urban)
≤ 0.25	0.5
> 0.25	1

For the degree of Flood Hazard to be classified as low HR has to be <0.75

The Fluvial River Welland lies some 1.5km east of the site.

1 in 100-year level with climate change (Upper End) in the River Welland is 4.90mODN

Lowest ground level rear of defences 2.80mODN.

Length of Breach 40m (Earth Bank)

It is assumed that the defences will be similar to Broad Crested Weir.

Volume and velocity at the location of the breach is: -

$$Q = 1.7 \times B \times H^{3/2} = 1.7 \times 40 \times (4.90 - 2.80)^{3/2}$$

$$Q = 206.94 \text{ m}^3/\text{sec}$$

$$\text{Velocity at the breach } V = Q/A$$

$$V = 206.94 / 40 \times 2.10 = 2.46 \text{ m/sec}$$

From spread sheet below the HR at 1.5km from the breach, at the site is 0.60 (Low Hazard), Velocity 0.49m/sec and depth 90mm (2.8 + 0.09) = 2.89mODN therefore the as the site is not subject to flooding from a breach to the River Welland (fluvial) as this is below the average ground level of 2.95mODN.

Hazard Rating				Site Name Spalding Road Pinchbeck		Date Jun-16								
Defence Type Fluvial River - Earth Bank														
Ground Level at breach		2.8	mODN	Flood Level	4.48	mODN	Head at Breach		1.68	m	Hazard Ratings			
Breach Width		40	m									Danger for some		
Increments from breach		150	m									Danger for most		
Debris Factor Shallow		0.5	Deep	1	(note: shallow <0.26m)							Danger for all		
DISTANCE FROM BREACH														
		0	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800
DEPTH AT BREACH	1.38	4.48	1.49	0.78	0.70	0.66	0.63	0.61	0.60	0.59	0.58	0.58	0.57	0.56
	1.43	4.44	1.52	0.80	0.71	0.67	0.64	0.62	0.61	0.59	0.59	0.58	0.57	0.57
	1.48	4.43	1.54	0.81	0.72	0.67	0.65	0.62	0.61	0.60	0.59	0.58	0.58	0.57
	1.53	5.00	1.57	0.82	0.73	0.68	0.65	0.63	0.61	0.60	0.59	0.59	0.58	0.57
	1.58	5.13	1.59	0.84	0.74	0.69	0.66	0.64	0.62	0.61	0.60	0.59	0.58	0.58
	1.63	5.17	1.62	0.85	0.75	0.70	0.66	0.64	0.62	0.61	0.60	0.59	0.59	0.58
	1.68	5.54	1.64	1.37	0.76	0.71	0.67	0.65	0.63	0.62	0.60	0.60	0.59	0.58
	1.73	5.76	1.67	1.38	0.77	0.71	0.68	0.65	0.63	0.62	0.61	0.60	0.59	0.59
	1.78	5.85	1.69	1.39	0.78	0.72	0.68	0.66	0.64	0.62	0.61	0.60	0.60	0.59
1.83	6.13	1.72	1.41	0.79	0.73	0.69	0.66	0.64	0.63	0.62	0.61	0.60	0.59	

Depth														
		0	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800
DEPTH AT BREACH	1.38	1.38	0.33	0.22	0.17	0.14	0.12	0.11	0.10	0.09	0.08	0.08	0.07	0.07
	1.43	1.43	0.34	0.23	0.17	0.15	0.13	0.11	0.10	0.09	0.09	0.08	0.08	0.07
	1.48	1.48	0.36	0.23	0.18	0.15	0.13	0.12	0.10	0.10	0.09	0.08	0.08	0.07
	1.53	1.53	0.37	0.24	0.19	0.16	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08
	1.58	1.58	0.38	0.25	0.19	0.16	0.14	0.12	0.11	0.10	0.09	0.09	0.08	0.08
	1.63	1.63	0.39	0.26	0.20	0.17	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.08
	1.68	1.68	0.40	0.27	0.21	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.09	0.08
	1.73	1.73	0.42	0.27	0.21	0.18	0.15	0.14	0.12	0.11	0.10	0.10	0.09	0.09
	1.78	1.78	0.43	0.28	0.22	0.18	0.16	0.14	0.13	0.12	0.11	0.10	0.09	0.09
1.83	1.83	0.44	0.29	0.22	0.19	0.16	0.14	0.13	0.12	0.11	0.10	0.10	0.09	

Velocity														
		0	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800
DEPTH AT BREACH	1.38	2.01	0.98	0.79	0.70	0.64	0.59	0.56	0.53	0.51	0.49	0.47	0.46	0.44
	1.43	2.04	1.00	0.81	0.71	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.47	0.45
	1.48	2.08	1.02	0.82	0.72	0.66	0.61	0.58	0.55	0.53	0.51	0.49	0.47	0.46
	1.53	2.12	1.03	0.84	0.74	0.67	0.62	0.59	0.56	0.54	0.51	0.50	0.48	0.47
	1.58	2.15	1.05	0.85	0.75	0.68	0.63	0.60	0.57	0.54	0.52	0.51	0.49	0.48
	1.63	2.18	1.07	0.86	0.76	0.69	0.64	0.61	0.58	0.55	0.53	0.51	0.50	0.48
	1.68	2.22	1.08	0.88	0.77	0.70	0.65	0.62	0.59	0.56	0.54	0.52	0.51	0.49
	1.73	2.25	1.10	0.89	0.78	0.71	0.66	0.63	0.59	0.57	0.55	0.53	0.51	0.50
	1.78	2.28	1.11	0.90	0.79	0.72	0.67	0.63	0.60	0.58	0.56	0.54	0.52	0.51
1.83	2.31	1.13	0.91	0.80	0.73	0.68	0.64	0.61	0.59	0.56	0.54	0.53	0.51	

In practice if river levels within the River Welland passing through Spalding will be controlled by the flows being diverted into the two upstream washes at Cowbit and Crowland, to prevent over topping of the channel through Spalding town.

Breach Analysis for a Breach to the Tidal Flood Defences for The River Welland

The Environment Agency has not undertaken Hazard mapping for the River Welland upstream of Welland Bridge, therefore the Peak Residual Depth and Velocity Maps included in the South Holland SFRA Update 2010 have been assessed

The peak depth maps show that part of the site is within the band depth 0 - 0.5m and the peak velocity map shows part of the site is within band velocity 0 – 0.1m/sec. The hazard map shows the site to lie within a low to moderate area. **Maps 4, 5 & 6.**

The minimum mitigation measures required for developments that do not have any ground floor sleeping shall be determined by the flood depths arising from the 2115 0.5% breach scenario. The finished floor Level FFL of any new dwellings shall be informed by the flood depths. For flood depths between 0.25 – 0.5m deep the FFL shall be set at a minimum of 500mm above the ground level and flood resilient construction incorporated to a minimum height of 300mm above the predicted flood levels.

With the main risk to flooding of the site being tidal flooding following a breach to the tidal defences, any flooding from fluvial flooding sources has been mitigated against.

With the average site ground level being 2.95mODN, the minimum floor level will be set at 3.50mODN. which is considered to be above the tidal breach level to the River Welland for 2115.

FLOOD PROTECTION

Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design and construction techniques. There are two forms of flood protection works: -

- **Flood-resistance or proofing works:** - these try to reduce the amount of water actually entering a building.
- **Flood-resilient works:** - these reduce the amount of damage caused by water entering the building.

The proposed property will have the following resilient measures incorporated in the construction in accordance with “Improving the flood performance of new buildings” CLG (2007).

- The lowest ground floor level for the properties is to be raised 500m above existing average ground level with a lowest level being 3.50mODN.
- Arrange for all service circuits at ground floor level to be routed at first floor level and where practical socket outlets, boilers etc. to be a minimum of 0.5m above the raised ground floor level.
- The owners of the property will register their property with the Environment Agency to receive automated early warnings of potential flood events.

CONCLUSION

- o The proposed development site is shown to be within Flood Zone 3a 'High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences.
- o The site does have the protection of fluvial flood defences which are well maintained by the Environment Agency.
- o The lowest ground floor level for the properties is to be raised 500m above the existing average ground level with the lowest level being 3.50mODN, which is considered to be above the 2115 climate change breach level at the site.

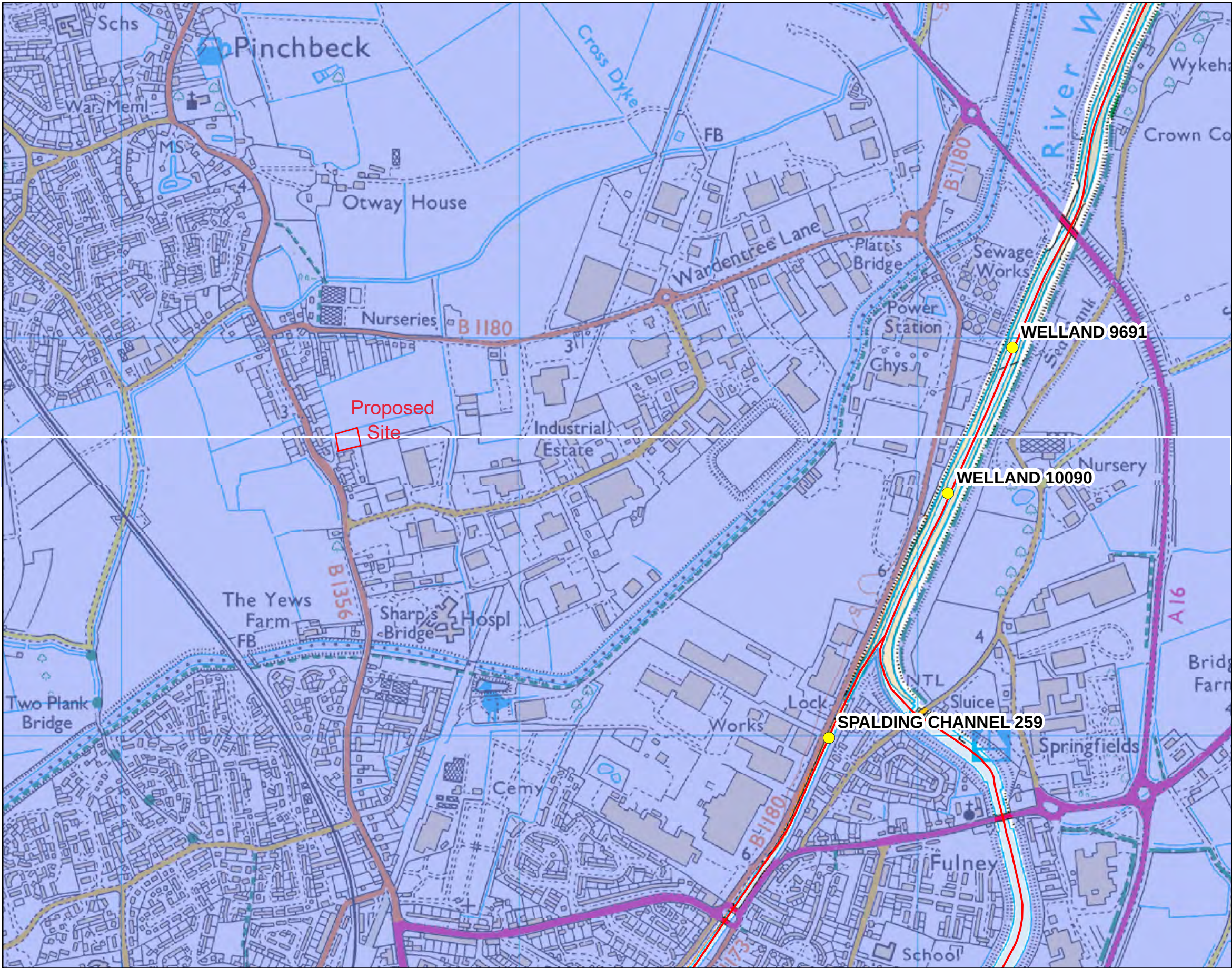
- o The Flood Risk Vulnerability Classification in Table 2 of NPPF Technical Guide the proposed residential development is classified as “More Vulnerable”, with Table 1 of NPPF Technical Guide stating that such uses are appropriate in this zone. However, the results of the updated SHSFRA shows that the site is located within a low/medium probability flood zone but the area is reliant on protection by flood defences providing a standard of protection of 1 in 100 years return period.
- o The drainage strategy for the development is the utilisation of on- site Suds infiltration methods.
- o Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design and construction techniques. They will be constructed using materials which are flood resilient construction as outlined in the report
- o Flooding from other sources is unlikely to affect the site.

APPENDIX

Map 1	Extract from Environment Agency Flood Zone and Node point Map
Map 2	NaFRA Flood Map
Map 3	Tidal Model Analysis 2006 Map
Map 4	South Holland SFRA Residual Flood Hazard Spalding year 2115 1% Fluvial/0.5% Tidal Event Probability
Map 5	South Holland SFRA Residual Peak Depth Spalding year 2115 1% Fluvial/0.5% Tidal Event Probability
Map 6	South Holland SFRA Residual Peak Velocity Spalding year 2115 1% Fluvial/0.5% Tidal Event Probability
Plan 1	Location Plan
Plan 2	Site Layout
Plan 3	Site Levels to OS Datum
Plan 4	Typical Soakaway and Permeable Surfacing Details

Basic FRA Map

Map centred on TF24568 24731 - created May 2016 [Ref: CCN-2016-11599]



Scale 1:10,000

- Pinchbeck Node Points
- Main River
- Area Containing Site
- Area at Risk of Flooding from Rivers or The Sea

Dark blue shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year.
- or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

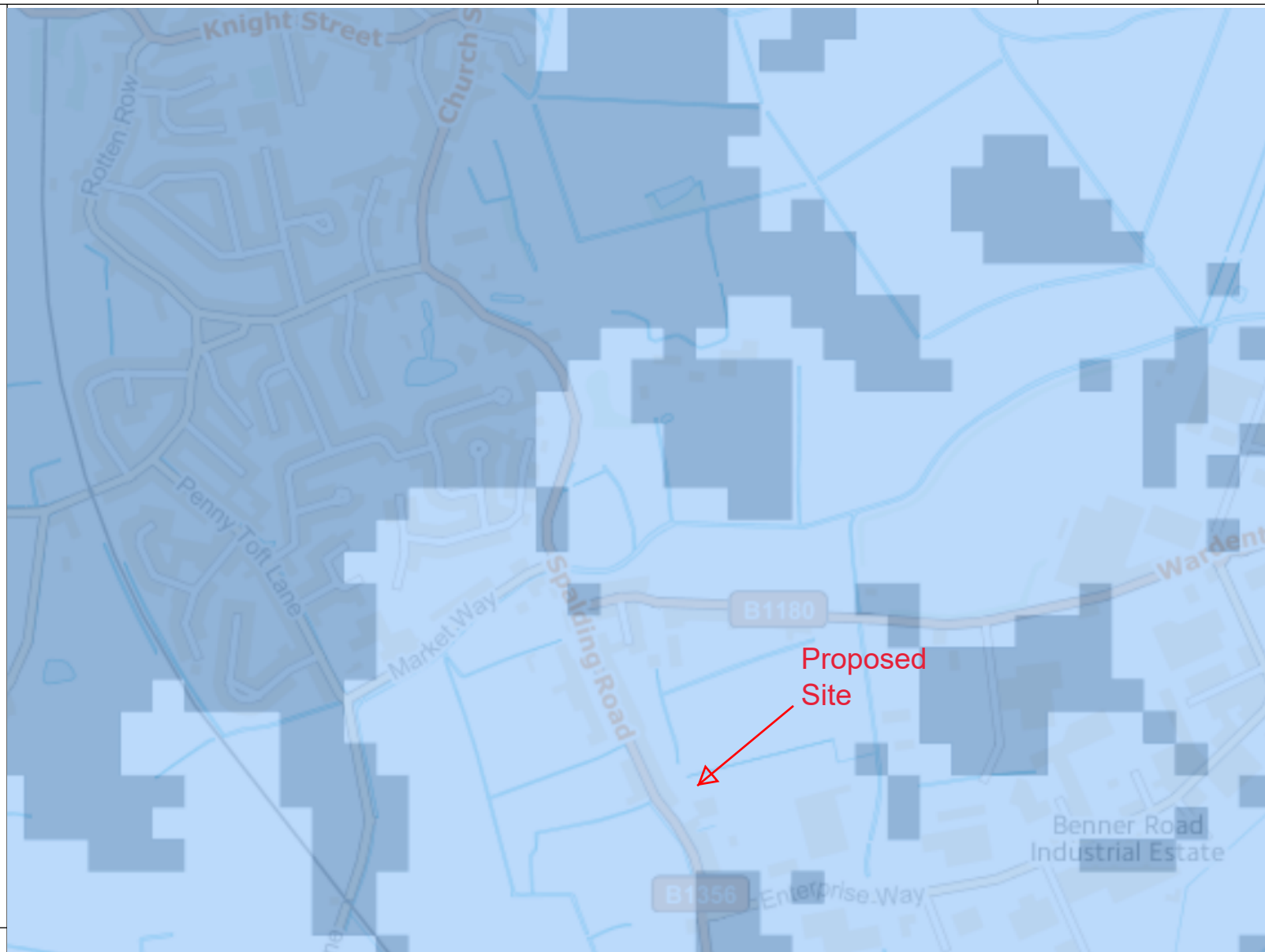
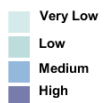
Light blue shows the extent of the Extreme Flood Outline, which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Sites outside the two extents, but behind raised defences, may be affected by flooding if the defences are overtopped or fail.

Created by the Partnerships & Strategic Overview Team, Kettering

Nafra FM centred on Spalding Road Pinchbeck

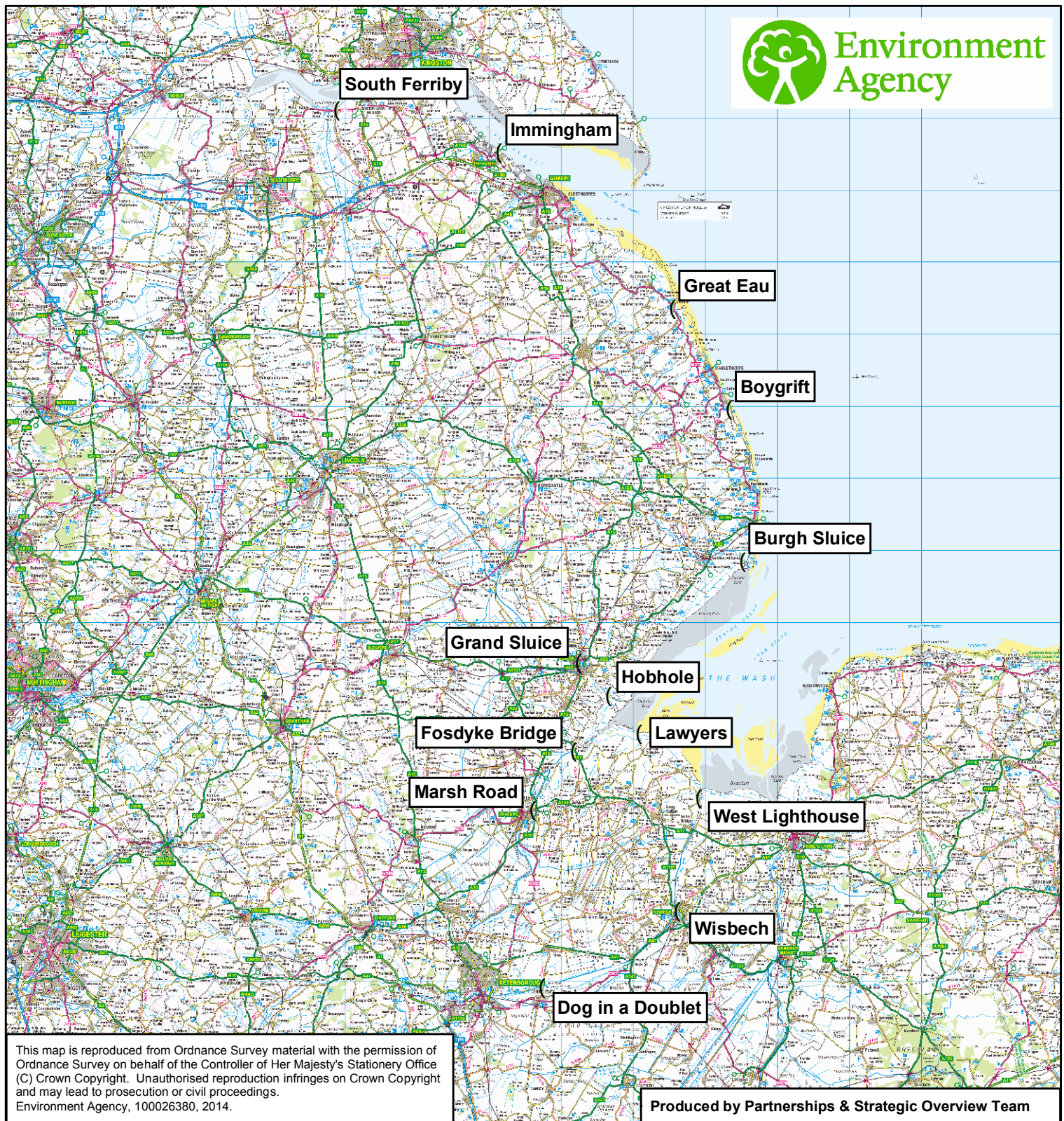
National Flood Risk Assessment (NaFRA)



© Environment Agency copyright and / or database rights 2014. All rights reserved. © Crown Copyright and database right 2014. Ordnance Survey licence number 100024198.



Environment
Agency



Still Water Tidal Levels mODN - Tidal Model Analysis 2006

Location	Easting	Northing	100% (1 in 1)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1% (1 in 100)	0.5% (1 in 200)	0.1% (1 in 1000)
South Ferriby	498772	421418	4.90	5.29	5.45	~	~	5.55	5.63
Immingham	521381	415464	4.08	4.49	4.65	4.76	4.88	5.05	5.34
Great Eau	545500	393800	3.80	4.19	4.34	4.46	4.57	4.69	4.96
Boygriff	553300	379800	3.84	4.24	4.41	4.53	4.65	4.77	5.05
Burgh Sluice	555190	358620	4.26	4.45	4.63	4.76	4.90	5.03	5.34
Hobhole	536610	339940	4.82	5.30	5.49	5.64	5.78	5.93	6.27
Lawyers	540750	334550	4.84	5.32	5.51	5.66	5.80	5.95	6.29
West Lighthouse	549150	325750	4.88	5.37	5.57	5.71	5.86	6.01	6.35
Grand Sluice	532400	344500	4.88	5.33	5.51	5.65	5.78	5.93	~
Fosdyke Bridge	531700	332200	4.91	5.38	5.56	5.71	5.85	5.99	~
Marsh Road	526000	324000	5.04	5.44	5.60	5.73	5.85	5.98	~
Wisbech	546100	310000	4.83	5.25	5.41	5.53	5.66	5.78	~
Dog in a Doublet	527300	299300	3.67	4.00	4.13	4.22	4.32	4.42	~

Extract From South Holland District Council SFRA

UPDATE OF STRATEGIC
FLOOD RISK ASSESSMENT
Residual Flood Hazard
Spalding - Present Day
1% Fluvial / 0.5% Tidal Event Probability

Legend

Map Legend

Peak Hazard

Low



Moderate



Significant



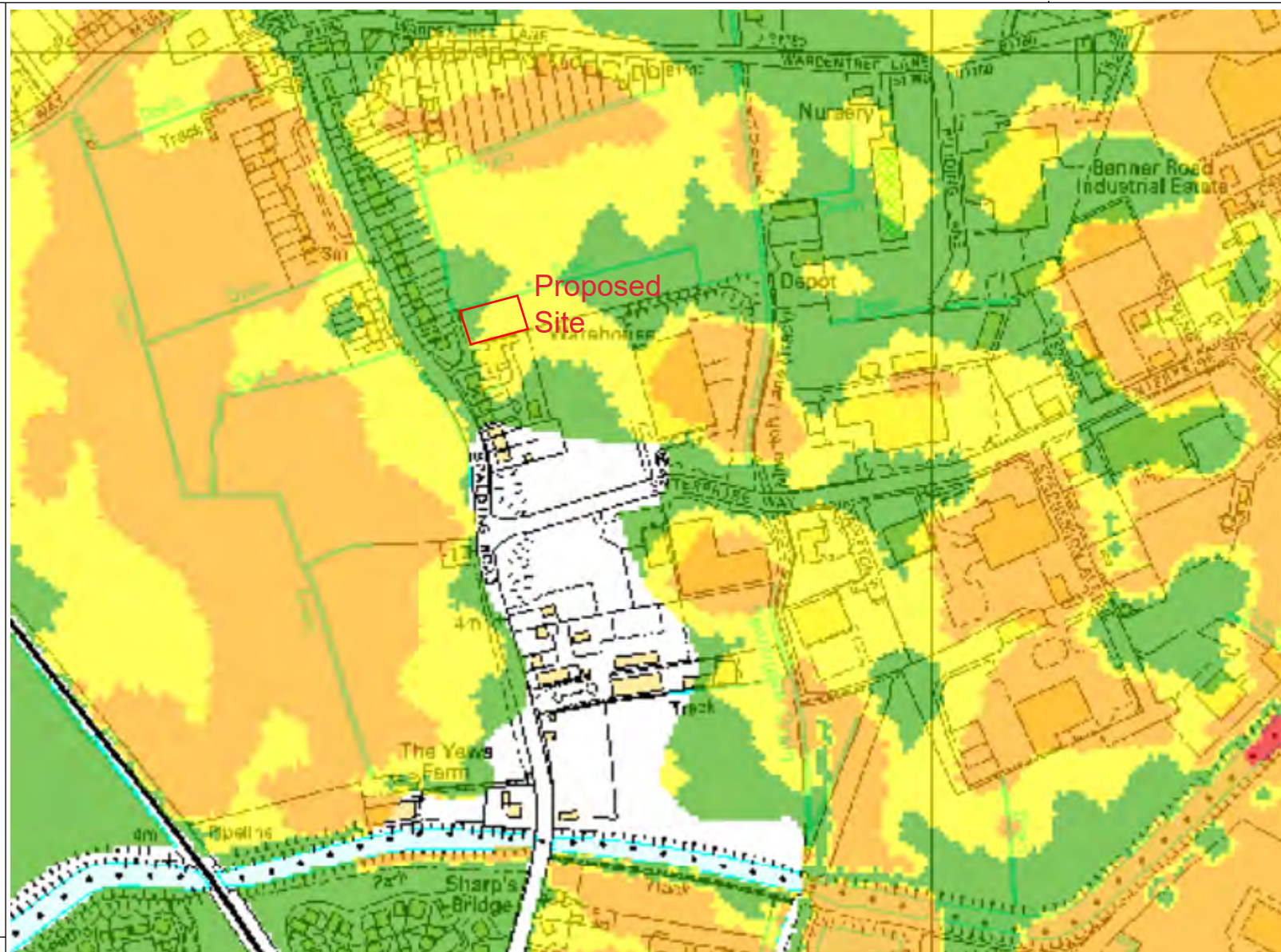
Extreme



Functional Floodplain



South Holland District
Boundary



Ordnance Survey © Crown Copyright 2016 All Rights Reserved Licence Number 100047316

Extract From South Holland District Council SFRA

UPDATE OF STRATEGIC
FLOOD RISK ASSESSMENT
Residual Peak Depth
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

Legend

Peak Depth

0m - 0.5m



0.5m - 1m



1m - 1.5m



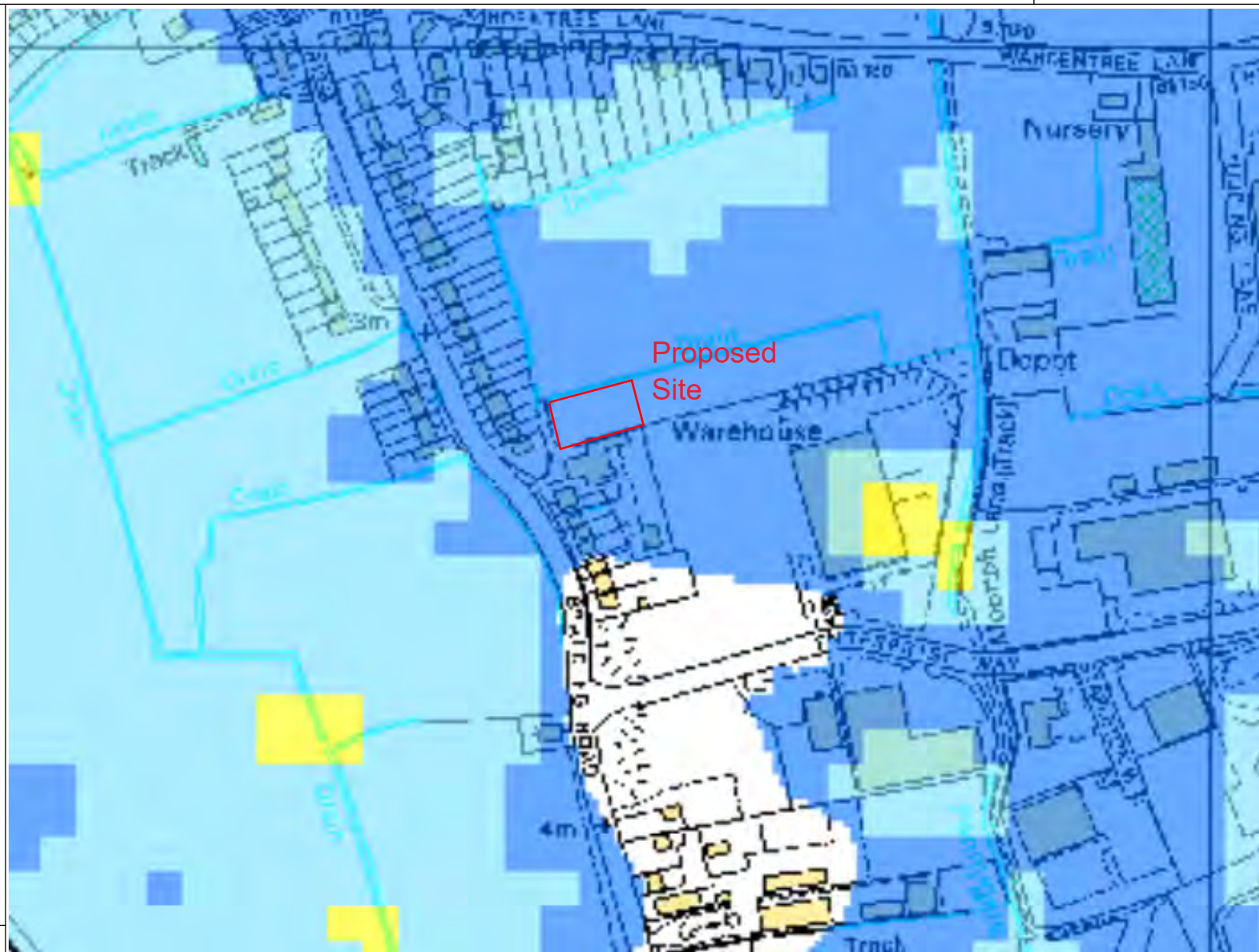
>1.5m



Functional Floodplain



South Holland District
Boundary



Ordnance Survey © Crown Copyright 2016 All Rights Reserved Licence Number 100047316

Extract From South Holland District Council SFRA

UPDATE OF STRATEGIC
FLOOD RISK ASSESSMENT
Residual Peak Velocity
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

Legend

Peak Velocity (metres per second)

0 - 0.1



0.1 - 0.25



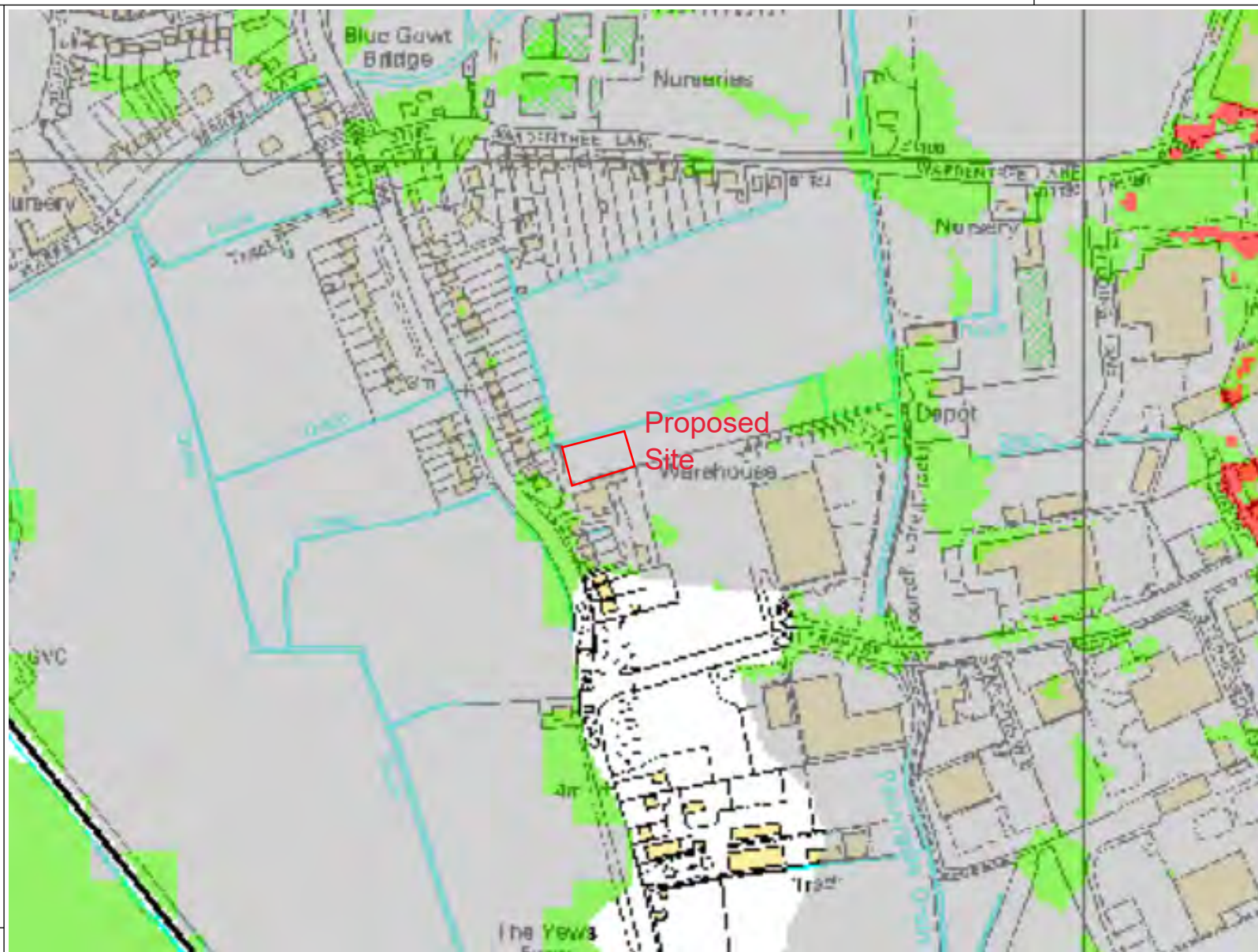
> 0.25



Functional Floodplain



South Holland District
Boundary



Ordnance Survey © Crown Copyright 2016 All Rights Reserved Licence Number 100047316

Land off Spalding Rd, Pinchbeck, Lincs PE11 3UE



Ordnance Survey © Crown Copyright 2015. All rights reserved. Licence number 100022432. Printed Scale - 1:1500

Ordnance Survey © Crown Copyright 2016 All Rights Reserved Licence Number 100047316





CDM NOTE:

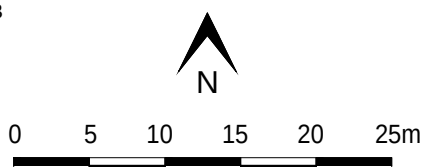
The design has been undertaken as far as possible to avoid risks to health and safety or to reduce and control the effects of any unavoidable risks.

Any relevant information identifying risks which are not able to be eliminated will be included within the project Health and Safety file.

Reproduced from Ordnance Survey Map with the permission
of the controller of HM Stationery Office.
Crown Copyright reserved

Robert Doughty Consultancy Licence No. AR 100010613

THIS DRAWING IS FOR THE
PURPOSE OF OBTAINING
PLANNING PERMISSION ONLY

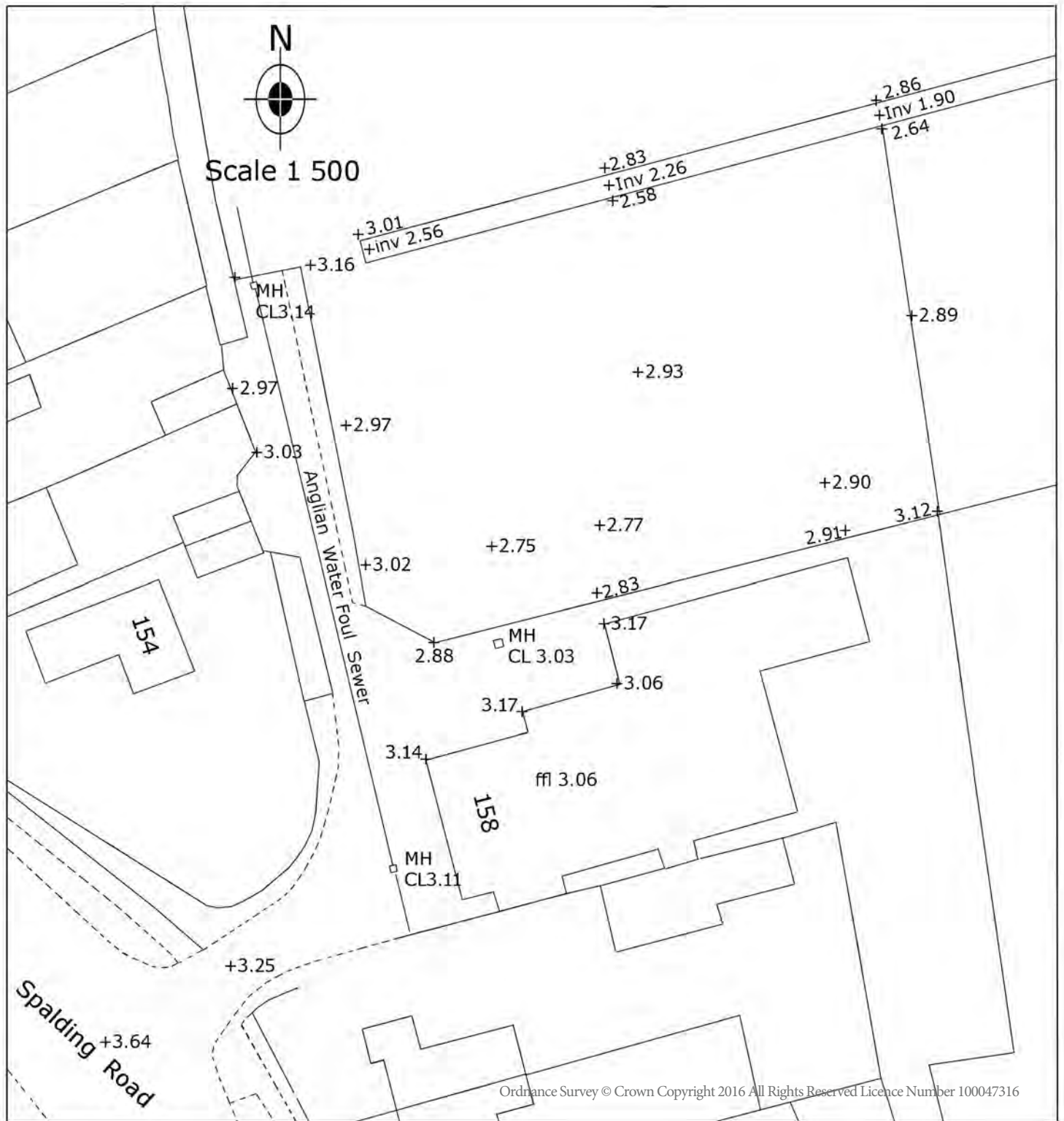


Rev.	By	Notes	Date
rdc Robert Doughty Consultancy 32 High Street, Helpingham Sleaford, Lincolnshire NG34 0RA Tel: 01529 421646 Fax: 01529 421358 Email: admin@rdc-landplan.co.uk Web: www.rdc-landplan.co.uk			
Client: Messers M&K Egar			
Project: Spalding road, Pinchbeck			
Drawing title: Indicative site layout			
Drawing No. 1198-2-SL01	Rev.	Drawn WW	
Scale 1:500 @ A4	Date 03/06/16	Checked LMS	

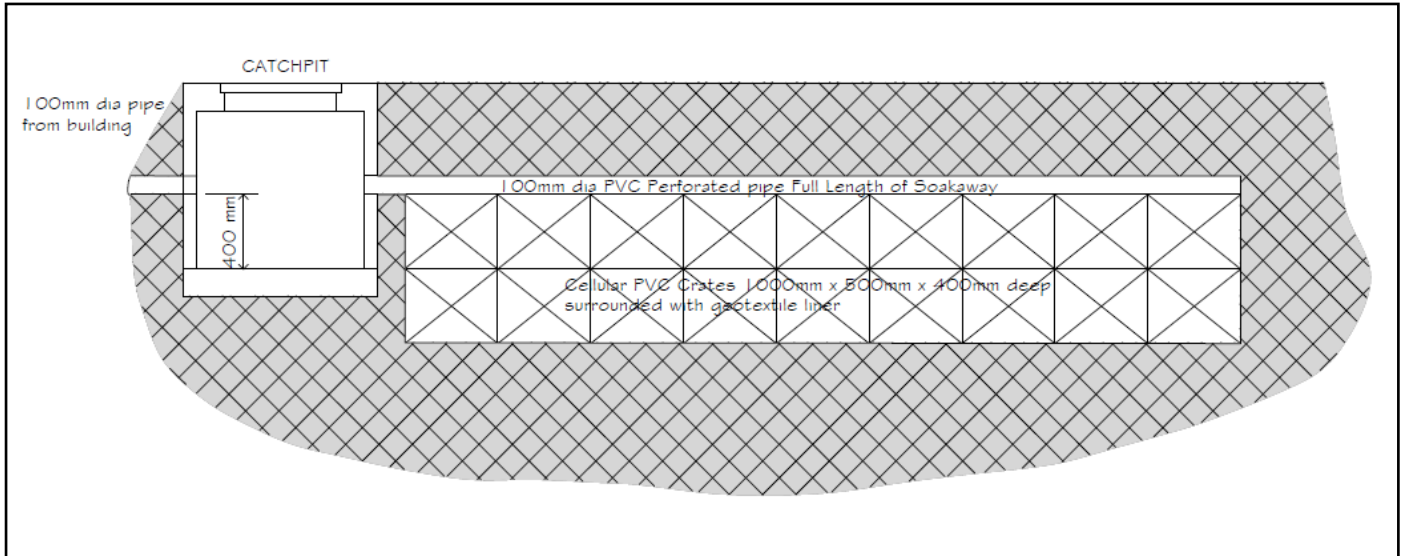
All measurements should be checked against on site conditions and any discrepancies should be brought to the attention of the Robert Doughty Consultancy.



Scale 1 500



TYPICAL SOAKAWAY DETAIL



TYPICAL PERMEABLE PAVING DETAIL

