

FLOOD RISK ASSESSMENT

**PROPOSED RESIDENTIAL CARE HOME
GOODFELLOWS SCHOOL
SPALDING COMMON
SPALDING
LINCOLNSHIRE
PE11 3AS**



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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.

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APPLICATION SITE

The site is located at the old Goodfellows School, Spalding Common, Spalding Lincolnshire PE11 3AS within the administrative area of South Holland District Council. The National Grid Reference for the middle of the site is TF23442 20038 with a site area 0.62Ha or thereabouts. **Plan 1**

The current planning application is for the erection of a three storey 60-bed residential care home., on a brown field site, situated at land to the west of Spalding Common Road. The site, which is irregular in shape is accessed from Spalding Common. **Plans 2, 3, & 4.**

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 1 Ha.

The National Planning Policy Framework 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 care home

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 level varies from 2.21mODN in the southern area to over 3.00mODN in the northern area of the site. Floor levels for the existing building are 2.50mODN and the mid-level on Spalding Common Road is 3.35mODN. **Plan 5**

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
- Welland and Deepings 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.

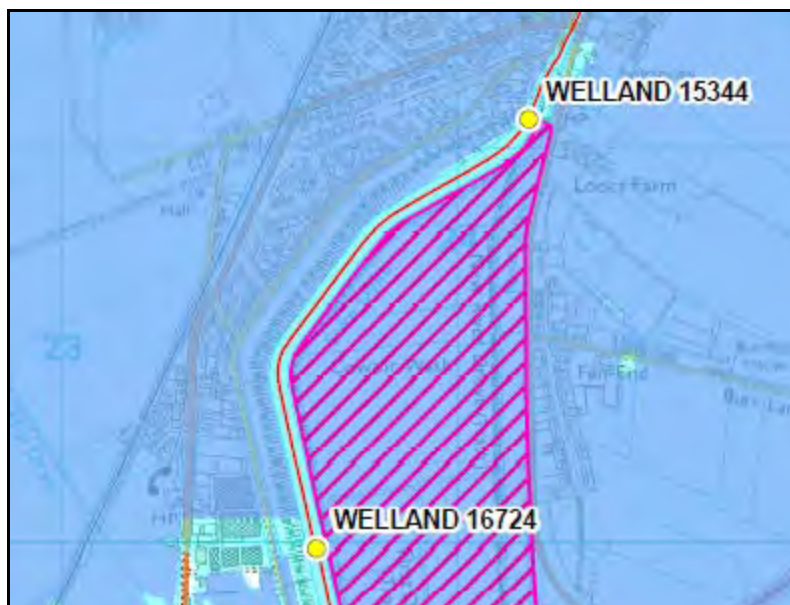
The flood zone maps show that the site of the proposed development is considered at risk from flooding. These maps indicate that the area would be flooded without flood defences, which are in place, (with an annual probability of more than 0.5% i.e. return frequency of less than 1 in 200 years for tidal 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 partly at a medium risk of flooding. Medium means that each year, this area has a chance of flooding of less than 1 in 30 (3.3%) but Greater or equal to 1 in 100 (1.0%) 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 110m from the eastern boundary of the site. The left bank of the River Welland 1km upstream of Little London Road bridge is 6.05mODN. the right bank is somewhat lower which would allow high flows to overtop into the adjacent Cowbit Washes, an area of designated flood storage area to protect Spalding.

The Environment Agency has provided fluvial flood levels for the 1 in 100-year with climate change for the River Welland, these are shown below. The fluvial defences consist of earth embankments to the Crowland and Cowbit flood storage reservoir which are in good condition and provide a defence for a flood event of 1 in 100-year event.



Extract from Environment Agency Node Map

Datasheet [Ref: CCN-2016-15021]

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
WELLAND 15344	524181	321070	4.00	4.24	4.33	4.39	4.43	4.45	4.45	4.67	4.47	4.47	4.68
WELLAND 16724	523645	319986	4.01	4.28	4.37	4.43	4.47	4.48	4.49	4.67	4.50	4.50	4.67
WELLAND 18224	523963	318521	4.02	4.32	4.41	4.47	4.51	4.52	4.53	4.67	4.54	4.54	4.67

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
WELLAND 15344	524181	321070	61.90	78.16	83.31	87.24	90.06	90.58	90.87	90.59	91.09	91.37	91.31
WELLAND 16724	523645	319986	60.92	77.45	82.77	87.35	90.12	90.59	90.87	90.47	91.07	91.29	91.27
WELLAND 18224	523963	318521	59.90	76.73	82.24	87.49	90.17	90.61	90.87	90.46	91.07	91.50	91.25

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 the fluvial earth embankments.

The fluvial river level at Node point Welland 16724 for the 1 in 1000-year with 20% climate change is 4.67mODN. Based upon the crest heights of the earth embankment flood defence at a minimum of 6.05mODN the proposed site is protected with a freeboard of over 1.3m.

Extrapolating the new climate change allowances issued 19th February 2016, using 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 shown in Appendix A for the 1 in 1000-year event Node Welland 16724.

From the results it is clear this is a location where the spreadsheet and extrapolation will not work correctly, because of the upstream attenuation and the washes, etc. into which high river flows would be diverted by the Environment Agency to keep the maximum river level through Spalding Town to below 5.0mODN to prevent flooding of parts of Spalding.

Examination the numbers it is clear the River Welland has plateaued at around 4.50mODN for the present day at 4.67mODN for all the climate change scenarios.

As both the 1 in 100-year flood level with 20% climate change and the 1 in 1000-year flood level with 20% climate change is the same 4.67mODN could be used for the other allowances up to 65%

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

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

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

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 110m east of the site.

1 in 100-year level with climate change (Upper End) in the River Welland is 4.67mODN

Lowest ground level rear of defences 2.60mODN. (Cradge Bank road level)

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: -

$$Q = 1.7 \times B \times H^{3/2} = 1.7 \times 40 \times (4.67 - 2.60)^{3/2}$$

$$Q = 202.52 \text{ m}^3/\text{sec}$$

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

$$V = 202.52 / 40 \times 2.07 = 2.45 \text{ m/sec}$$

From spread sheet below the HR at 100m from the breach, at the site is 2.08 (Danger for All), Velocity

1.31m/sec and depth 0.60mm (2.6 + 0.60) = 3.20mODN therefore the as the site is subject to flooding from a breach to the River Welland.

Hazrd Rating (Upper)													
Fluvial River - Earth Bank													
Ground Level at breach			2.6	mODN	Flood Level	4.67	mODN	Head at Breach			2.07	m	Hazard Ratings Danger for some Danger for most Danger for all
Breach Width			40	m									
Increments from breach			110	m									
Debris Factor Shallow			0.5		Deep	1	(note: shallow <0.26m)						
DISTANCE FROM BREACH													
	0	11	22	33	44	55	66	77	88	99	110	121	132
1.87	6.31	4.52	3.65	3.14	2.80	2.55	2.37	2.23	2.11	2.02	1.94	1.88	1.82
1.92	6.51	4.65	3.75	3.22	2.87	2.61	2.42	2.27	2.16	2.06	1.98	1.91	1.85
1.97	6.71	4.79	3.85	3.30	2.93	2.67	2.47	2.32	2.20	2.10	2.01	1.94	1.88
2.02	6.92	4.92	3.96	3.38	3.00	2.73	2.53	2.37	2.24	2.13	2.05	1.97	1.91
2.07	7.13	5.06	4.06	3.46	3.07	2.79	2.58	2.41	2.28	2.17	2.08	2.00	1.94
2.12	7.34	5.20	4.16	3.55	3.14	2.85	2.63	2.46	2.32	2.21	2.12	2.04	1.97
2.17	7.55	5.34	4.27	3.63	3.21	2.91	2.68	2.51	2.37	2.25	2.15	2.07	2.00
2.22	7.77	5.48	4.37	3.72	3.28	2.97	2.74	2.56	2.41	2.29	2.19	2.11	2.03
2.27	7.98	5.62	4.48	3.80	3.35	3.03	2.79	2.60	2.45	2.33	2.23	2.14	2.06
2.32	8.20	5.77	4.59	3.89	3.42	3.09	2.85	2.65	2.50	2.37	2.26	2.17	2.10

Velocity (Upper)													
DISTANCE FROM BREACH													
	0	11	22	33	44	55	66	77	88	99	110	121	132
1.87	2.34	2.01	1.82	1.68	1.58	1.50	1.43	1.38	1.33	1.29	1.25	1.21	1.18
1.92	2.37	2.04	1.84	1.71	1.60	1.52	1.45	1.39	1.35	1.30	1.26	1.23	1.20
1.97	2.40	2.07	1.87	1.73	1.62	1.54	1.47	1.41	1.36	1.32	1.28	1.25	1.22
2.02	2.43	2.09	1.89	1.75	1.64	1.56	1.49	1.43	1.38	1.34	1.30	1.26	1.23
2.07	2.46	2.12	1.91	1.77	1.66	1.58	1.51	1.45	1.40	1.35	1.31	1.28	1.25
2.12	2.49	2.14	1.94	1.79	1.68	1.60	1.53	1.47	1.41	1.37	1.33	1.29	1.26
2.17	2.52	2.17	1.96	1.81	1.70	1.62	1.54	1.48	1.43	1.38	1.34	1.31	1.28
2.22	2.55	2.19	1.98	1.83	1.72	1.63	1.56	1.50	1.45	1.40	1.36	1.32	1.29
2.27	2.58	2.22	2.00	1.85	1.74	1.65	1.58	1.52	1.46	1.42	1.38	1.34	1.31
2.32	2.60	2.24	2.03	1.87	1.76	1.67	1.60	1.53	1.48	1.43	1.39	1.35	1.32

Depth (Upper)		DISTANCE FROM BREACH												
		0	11	22	33	44	55	66	77	88	99	110	121	132
DEPTH AT BREACH	1.87	1.87	1.40	1.14	0.98	0.86	0.78	0.71	0.66	0.61	0.57	0.54	0.51	0.49
	1.92	1.92	1.44	1.18	1.01	0.89	0.80	0.73	0.67	0.63	0.59	0.55	0.52	0.50
	1.97	1.97	1.48	1.21	1.03	0.91	0.82	0.75	0.69	0.64	0.60	0.57	0.54	0.51
	2.02	2.02	1.51	1.24	1.06	0.93	0.84	0.77	0.71	0.66	0.62	0.58	0.55	0.52
	2.07	2.07	1.55	1.27	1.09	0.96	0.86	0.79	0.73	0.68	0.63	0.60	0.57	0.54
	2.12	2.12	1.59	1.30	1.11	0.98	0.88	0.80	0.74	0.69	0.65	0.61	0.58	0.55
	2.17	2.17	1.63	1.33	1.14	1.00	0.90	0.82	0.76	0.71	0.66	0.63	0.59	0.56
	2.22	2.22	1.66	1.36	1.16	1.03	0.92	0.84	0.78	0.72	0.68	0.64	0.61	0.58
	2.27	2.27	1.70	1.39	1.19	1.05	0.94	0.86	0.80	0.74	0.69	0.65	0.62	0.59
	2.32	2.32	1.74	1.42	1.22	1.07	0.96	0.88	0.81	0.76	0.71	0.67	0.63	0.60

As a sensitivity test taking the 2115 Upper End 65% flood level of 4.67mODN, from the Discharge Relationship Curve interpolation, the hazard rating is 2.08 (Danger for All), flood depth would be 60m and velocity 1.31m/sec– as the site is within 110m from the washes, this would be worst case scenario.

The minimum mitigation measures required for developments that do have any ground floor sleeping shall be determined by the flood depths arising from the 2115 breach scenario for the 1 in 1000 (0.1%) event. The finished floor Level FFL of any new properties shall be informed by the flood depths.

The FFL shall be set at a level of 3.20mODN and flood resilient construction incorporated to a minimum height of 300mm above the predicted flood levels and 600mm high flood barriers fitted to all external doors.

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 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 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 Residual Peak Depth Spalding - Year 21150.1% Event Probability Map shows that approximately 95% of the site is within a flood depth of 0 – 0.5m. This would set a GFL of 3.00mODN

However, the latest climate change allowances show that following a breach to the River Welland the flood level at the site would be 3.20mODN and therefore the floor level has been set at the revised flood level for climate change.

Welland and 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. Map 6

The Boards Drains which are close to the site are: -

Hills Drain

This watercourse flows westwards from the railway line and outfalls into the South Drove Drain for a distance of approximately 1.3km. The design flood level at the outfall is 0.00mODN and at the railway 1.06mODN.

Fantail Drain

This watercourse flows in a north-westerly direction from the railway line to its outfall into Hills Drain The design flood levels are 0.60mODN at Hills Drain and 0.69mODN at the railway line.

With the proposed ground floor level being 3.20mODN the site will not be affected by flooding from these sources.

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 600mm 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. 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 600mm 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.
- 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. There are no known facilities close to the proposed development.

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 an area is reliant on protection by flood defences providing a standard of protection of 1 in 100 years return period.

The ground floor level has been set at 3.20mODN which is above the site's lowest ground level.

With the properties having lounges and coffee rooms at first floor and above these provide a safe haven for the ground floor residents to retreat to and await the flood level to recede or to be rescued.

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	✓	x	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	x	x	x

Sequential Test & Exception Test

The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The NPPF states that development should not be permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. It is important to note that the Sequential Test does not specifically mean that sites such as this cannot be developed, rather that sites at less risk should be developed first.

A Sequential and Exception Test has been prepared by the “Planning Hub”, and for the purpose of this Flood assessment it is concluded that both the Sequential and Exception Tests are satisfied.

With the properties being three storeys there is a safe haven for residents to await the flood level to recede or to be rescued. Also the ground floor levels have been raised above the predicted flood level.

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

HISTORIC FLOOD EXTENT

The Historic flood map produced by the Environment Agency shows the extent of the March 1947 flood. The site is shown not to have been affected. **Map 6**

MANAGEMENT OF SURFACE WATER RUN-OFF

In accordance with the House of Commons Written Statement (HCWS161 – 18th December 2014) there is an expectation for SuDS to be incorporated in all residential developments of 10 houses or more (major developments) unless demonstrated to be inappropriate.

Furthermore, in accordance with recognised guidance, Part H of the Building Regulations 2010 and National Planning Policy Framework 2012, there is a hierarchy of where surface water should discharge.

This hierarchy should be followed where practicable, and is as follows:

- 1) Infiltration
- 2) Watercourse
- 3) Public sewer

The drainage strategy prepared by Construction Design Solutions, is the preliminary overview and will be subject to the detailed design being undertaken when planning permission and final layout has been determined. It is proposed to utilise source control techniques to reduce the storm water discharge from the proposed development in order to minimise the impact of the development on the surrounding area and to comply with EA guidelines, which require at least one workable solution for managing surface water. **Plan**

Consultation with National Rail confirms that no SUDS percolation system can be located within 20m of the NR boundary line.

The re-location of the SUDS system to the car park area was considered, however, ground Investigation percolation test results yielded a good result to the North of the site in BH2 but a very poor result in BH3 to the South of the site. As such, half drain times within this area would not be compliant with BRE365 and flood risk would be increased.

Connection to the local sewer network is not feasible as the sewers are foul only with no capacity for storm flow.

The development surface water strategy is to deal with all runoff using a 'deep bore' soakaway system. All proposals will be subject to further testing, investigation and advice from a Specialist Geotechnical Engineer. Falling head Soakaway tests will need to be carried out in the vicinity of the new proposed soakaway structures and advice be taken on the capacity/flow characteristics of a deep bore soakaway solution.

If it is deemed that deep bore soakaway(s) will be able to accommodate storm runoff from the development, it is envisaged that 2 deep bore soakaways plus the possibility of an attenuation tank within the car park area to accommodate runoff from a high intensity storm until this water percolates down the bore holes.

Following the testing procedure, the hole liners will be left in place to form the permanent pipes for the deep bore soakaways.

Infiltration

A ground investigation has been completed by AG Ground Investigations and percolation values calculated for two locations within the site. To the north BH2 the better percolation values were found with $k = 5.33 \times 10^{-5}$ m/s. At BH3 $k = 3.02 \times 10^{-7}$. It is expected that Infiltration can be used as the method of disposal of surface water from all areas of the development, as detailed below, subject to the relevant approvals. For robustness and, to ensure no overland exceedance flows, all infiltration structures will be designed to the 100 year plus 30% climate change standard:

Watercourse

There are no proposals to discharge surface water to any watercourses.

Sewers

There are no proposals to discharge surface water to any public sewer.

Foul Water Drainage

It is anticipated, that a gravity foul water solution will be achievable and the network of foul drains will be provided and connected into the Anglian Water manhole No 3402, similar to the existing arrangements.

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

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 ground floor to be constructed with a solid concrete floor with no voids beneath and no low level wall vents. However, if a beam type floor is to be used, provision should be incorporated for draining the under floor void.
- The lowest ground floor level for the care home is to be raised to a lowest level being 3.20mODN.
- Avoid the use of absorbent cavity insulation to the ground floor level.
- Treated and sealed timber skirting and architraves.
- Arrange for all service circuits to be routed at first floor level where practical socket outlets, boilers etc. to be a minimum of 0.5m above the raised ground floor level.
- It is recommended that “Storm Guard doors or similar are fitted to the entrance doors to the properties as when these are locked they provide a flood barrier for a depth of 600mm.
- As this site is in an area that is capable of receiving flood warnings from the Environment Agency Floodline Warning Direct system. It is recommended that the property Owner contact the Environment Agency’s Floodline on 0845 988 1188 to register the property to receive advance warning of flooding by telephone, mobile, fax, SMS text, email or pager. The Environment Agency aim to issue a ‘severe flood warning’ approximately 2 hours before existing defences are overtopped.

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/ tidal flood defences which are well maintained by the Environment Agency for both the present day and also for climate change.
- o The ground floor of the care home has been set at the 1 in 1000-year climate change flood level set at 3.20mODN with 600mm high flood barriers fitted to all external doorways.
- o The proposed care home 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.
- o The Sequential and Exception Tests are considered to be passed for the proposed development.

- o A drainage strategy for the development has been proposed which is outlined in this report.
- 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.

NOTE: -

The Drainage Statement prepared by Constuction Design Solutions dated October 2016

Ref:- 2014.5563 should be read in conjunction with this Flood Risk Assessment

APPENDIX

Map 1	Environment Agency Flood Zone Map
Map 2	NaFRA Map
Map 3	Extract from Welland & Deepings IDB Catchment Map
Map 4	Historic Flood Map
Plan 1	Location Plan
Plan 2	Proposed Layout Plan
Plan 3	Proposed Ground Floor Layout Plan
Plan 4	Proposed First Floor Layout Plan
Plan 5	Proposed Elevations
Plan 6	Topographical Survey
Plan 7	Proposed Drainage Plan
Plan 8	AW Foul Sewer Plan
Appendix A	Discharge Relationship Curve for Climate Change Allowances