LIN Consulting



Lincs Gateway, Spalding, Lincs.
Alcan Properties Ltd
Ref: AP/LG/FRA

Flood Risk Assessment

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1.0 INTRODUCTION

Alcan Properties Ltd are proposing to develop a parcel of land off Barrier Bank Road, Spalding with new development consisting of a commercial business park including commercial/ light industrial units and associated hardstanding/car parking. Under current legislation a Flood Risk Assessment should be undertaken to assist in viability and planning requirements.

It is within the general development strategy of the country for development, located in areas where there is a risk of flooding, to be assessed to avoid unnecessary increase in the requirement of flood defence. Under the National Planning Policy Framework (NPPF) and the accompanying Technical Guidance (TG), consultation is required with the Environment Agency, Land Drainage Authority and Water Authority and a Flood Risk Assessment Report should be prepared considering the development proposals and make recommendations for any flood mitigation measures.

Following the implementation of the Flood & Water Management Act 2010, Sustainable Urban Drainage Systems (SuDS) are the requisite consideration for the treatment and disposal of surface water runoff for all new development works. As part of the planning consultation the LPA in their role as LLFA, are required to provide approval for the proposed scheme to their satisfaction in line with the requirements of the National Planning Policy Framework (NPPF).

LIN Consulting Ltd have been appointed to carry out an assessment of the site, implement appropriate consultations and prepare a Flood Risk Assessment Report, in accordance with NPPF, to satisfy the requirements of the Planning Authority. Review of previous FRA reports produced by ARP Associates and Millward Associates has been undertaken as part of this study. This FRA is an update of proposals submitted and receiving planning permission under Application No.

A walkover survey was undertaken in July 2021.

This assessment has been prepared for the sole use and reliance of the Client and shall not be relied upon or transferred to any other parties without the written authorisation of LIN Consulting. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

2.0 THE SITE

2.1 LOCATION

The proposed development is located to the eastern side of Barrier Bank (B1173) on greenfield land, totalling 18.66 Hectares (186,641m2) in area.

The site is centred at approximate grid reference 524372,320040 and is indicated on the aerial view shown below:



2.2 DESCRIPTION

2.3 The land roughly triangular in shape, being bounded directly to the west by Barrier Road (B1173) and further afield, the River Wellend (0.5km), and to the east and north by the A16 and open fields respectively. The site is currently agricultural land and has no existing buildings or developments within the planning application boundary. Site levels within the development area are relatively flat at circa 2.78m AOD to the east and 1.90m AOD along the northern boundary.

There is an existing watercourse forming the northern boundary, running west to east originating from an existing culvert roughly half way down Fen End Lane, with top of bank

levels ranging from 2.30m AOD to the west and 2.10m AOD to the east, the origin and direction of the culvert are not indicated upon the topographical survey.

There is also an existing watercourse through the centre of the development area, originating from the south end of Fen End Lane, via culvert, and running west to east before being connected, via pipe, to the watercourse adjacent to the A16. At this point the watercourse crosses under the A16 and heads in a westerly direction. Top of bank levels range from 2.57m AOD to the west to 1.99m AOD to the east. Proposals allow for the diversion of this watercourse along the northern boundary.

The site is bisected by a public footpath to the west that links into the southern end of Fen End Lane and the existing housing.

To the south sits the Barrier Back Road (B1173) with open fields to the east.

There is an existing vehicular access to the development via Barrier Bank to the southern boundary of the site as per the architects drawing **22119-UMC-ZZZZ-SI-M2-A-0010-P02** contained within **Appendix B**.

3.0 CONSULTATION

3.1 ENVIRONMENT AGENCY

3.2 A consultation was requested from the Environment Agency and a copy of their response (ref: CCN/2021/228250) dated 15th April 2021, is presented in **Appendix A** for reference purposes.

3.3 The Environment Agency map provided confirms that the site lies within **Flood Zone 3** and is, therefore, assessed as having a 1 in 100 or greater annual probability of river flooding in any year (greater than 1%), and a 1 in 200 chance or greater annual probability of flooding from the sea (less than 0.5%). The map does not take into account flood defences as water can overtop or breach the defences in extreme conditions **(Map 1)**.

3.4 A review of **Map 1** indicates that the area located immediately west of the development land is indicated as flood storage, the area being bounded by Barrier Bank Road (B1173).

3.5 An Historic Flood Extents Map (**Map 2**) has been provided which shows the extent of previous recorded flooding in the area, notably 1947. No incidents were recorded on site, with flood water remaining in the flood storage area and not overtopping the existing road. It is possible that other flooding may have occurred but there are no records held by the Environment Agency. Recommendation was made to speak with the Local Authority or Internal Drainage Boards.

3.6 The Environment Agency has also been able to provide fluvial flood levels. However, it was confirmed that these are ''in channel'' levels and, therefore, may not represent the flood level on the flood plain, particularly where the channel is embanked or has raised defences.

3.7 These levels indicated show that the nearest node points to the site (all being located 0.5km away), reference Welland 17224, Wellend 16224 and Welland 16724 (**Map 3**) have modelled flood levels of 4.50m, 4.49m and 4.49m AOD respectively for the 1 in 100 year storm. The Welland Catchment model, originally prepared in April 2007 and indicated within the Royal Haskoning SFRA, also shows the 1 in 100 year (inclusive of climate change) levels at 4.67m. The Bank heights are unavailable at this time, as they are currently under review.

3.8 The site is protected by Flood Defences and a list of Flood Defence Assets in the vicinity of the site has been provided (**Map 4**).

3.9 The Environment Agency have also provided a Modelled Flood Extents Map, with defences, (**Map 5**), which indicate that flooding from all modelled storm events up to the 1 in 1000 fluvial event inclusive of climate change remains within the flood storage area.

3.10 The Environment Agency have indicated that the natural channel, in conjunction with the upstream flood storage area, provides protection against a flood event for a 0.5% chance of occurring in any one year. The channel and storage area are also inspected regularly to ensure that any potential defects are identified to reduce the risk of any failure.

3.11 The Environment Agency also make recommendations for considering Sustainable Drainage Systems.

3.12 ANGLIAN WATER

3.13 A consultation was requested from Anglian Water, who are the Water Authority for this area and a copy of their response, reference **PPE-0170849** dated 28th February 2023, is presented in **Appendix A** for reference purposes.

3.14 Records indicate that there are no public surface water sewers located within the development area. Under current guidance these would be the last option on the SuDs train for connection.

3.15 The nearest public foul sewer is located within Fen End Lane and is indicated as the connection point for foul flows generated by the development. The ownership of land between the site and the connection point indicated within Anglian Water's response will require confirmation prior to any works being carried out. A requisition may not be discounted at present.

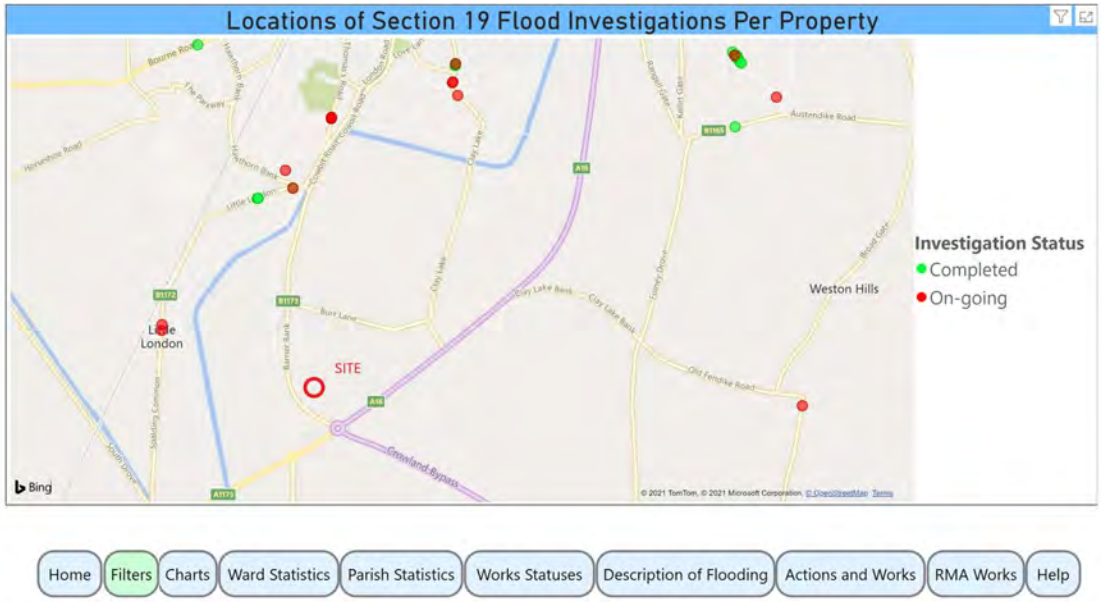
3.16 Any trade effluent that is generated by the development will need formal written consent by Anglian Water prior to discharge/connection.

3.17 LAND DRAINAGE AUTHORITY

3.18 A consultation was with the Water Management Alliance (WMA member being South Holland Internal Drainage Board), who are the Land Drainage Authority for this area, and a copy of their response dated 4th August 2021, is presented in **Appendix A** for reference purposes. Further consultation has been undertaken 19th April 2023.

3.19 The Board's investigations in the Fen End Lane area have been refreshed recently following receipt of a report that End Lane experienced severe external flooding in December 2020. The likely cause was a problem with Fen End Lane at grid reference 524329, 320264 and the condition of the open watercourse downstream – the Board states 'I understand from speaking with my colleagues that there was an unconsented infilling of a private watercourse'.

3.20 The WMA have also indicated that Lincolnshire County Council in its role as Lead Local Flood Authority holds records of any internal flooding that has occurred in the area https://www.lincolnshire.gov.uk/flood-risk-management/flood-investigations; (where records are published). Further investigation was undertaken utilising the link, with no other flooding instances indicated below;



3.21 The South Holland District Council Strategic Flood Risk Assessment Report (SFRA), prepared by Haskoning UK Ltd dated January 2010, was also referred to. This shows the development site to be fully within Flood Zone 3 (without defences). Further updates were provided in 2016/17 by way of an updated modelling and mapping note.

3.22 Request for information regarding offsite watercourse connection was requested, with further survey works of the existing watercourse to the north of the development area.

3.23 The SFRA has also been able to provide modelled flood levels adjacent to the site, which are understood to take account of the flood plain (**Appendix C**). This shows that at chainage 2.0km the 1 in 100 fluvial flood level is 2.40m A.O.D. and the 1 in 100 year inclusive of climate change level is 3.11m A.O.D for the period 2015/2115. Comparing this against the defence crest level provided of 6.05m A.O.D. gives freeboard heights of 3.65m A.O.D. and 2.94m A.O.D. respectively near to the site.

3.24 The Internal Drainage Board would normally request a 9m easement strip adjacent to any IDB watercourse and is applicable to their watercourses in their control only.

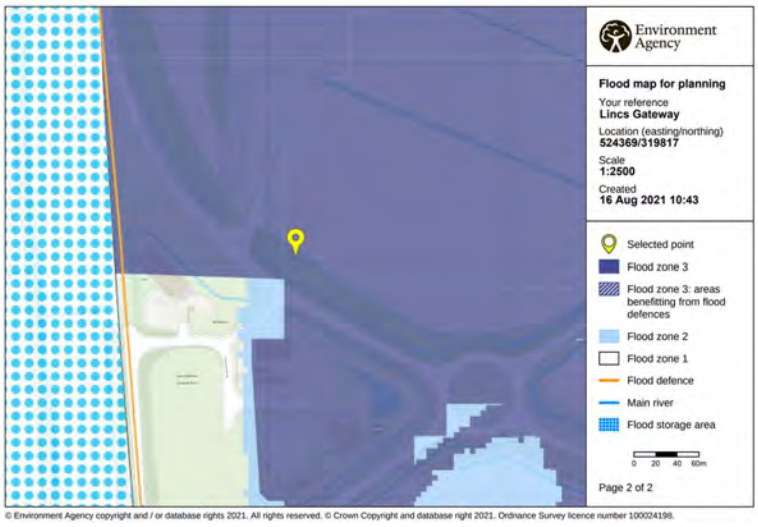
4.0 FLOOD RISK

4.1 As set out in the National Planning Policy Framework, 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.
For these purposes:
• "areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency;
• "flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

4.2 SEQUENTIAL TEST

4.3 As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The flood zones are the starting point for this sequential approach. Zones 2 and 3 are shown on the flood map1 with Flood Zone 1 being all the land falling outside Zones 2 and 3. These flood zones refer to the probability of sea and river flooding only, ignoring the presence of existing defences.

4.4 A review of the EA national flood risk maps available on their web site has been undertaken in the first instance to define, in terms of planning, what flood zone the site is contained within and the results can be seen below;



4.5 The proposed development area is shown within **Flood Zone 3** as having a 1 in 100 or greater annual probability of flooding from rivers (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

4.6 Further consultation with the South Holland Strategic Flood Risk Assessment (dated 2010 and updated in 2016/17) provides district wide assessment of the flood risk including flood defence breach scenarios which have been assessed. The study area in the South East Lincolnshire SFRA shows the whole site to be in **Flood Zone 3**.

4.7 In accordance with NPPF Table 1, the site falls within flood Zone 3A – 'High Probability';

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;

4.8 The development proposal is for the construction of a commercial development consisting of a business park, including light industrial and commercial units. A masterplan layout is presented in **Appendix B** for reference purposes. Applying **Table 3** of the NPPF, the flood risk vulnerability classification shows that the proposed end use will fall into the 'less vulnerable' classification;

Table 3: Flood risk vulnerability and flood zone '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	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

4.9 **The Sequential Test for a development within Flood Zone 3a, a "Less Vulnerable" flood risk vulnerability classification indicates that the site as being appropriate for development.**

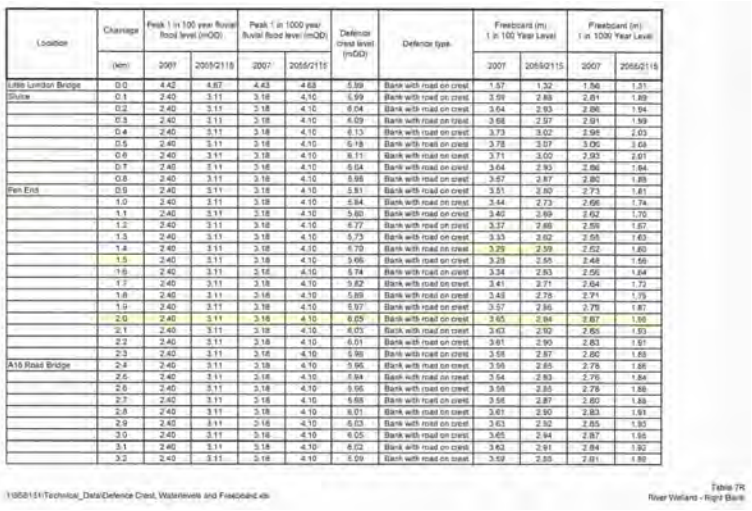
4.10 EXCEPTION TEST

4.11 The ideal situation would be to relocate the proposed development into areas of land with a lower probability of flooding. Alternative sites within Flood Zone 1 are to the east and southeast, where greenfield and agricultural sites are predominant. However, the inadequate infrastructure supporting any development of this nature renders these areas unsuitable.

4.12 Although the site is located within Flood Zone 3a, it is known that flood defences are in place to protect the surrounding areas. This is reflected in the Historic Flood Extent Map (**Map 2**), presented in **Appendix A**, showing that flooding is retained within the flood storage area located to the west of the site and constrained by Barrier Bank Road (B1173). Therefore, it is reasonable to accept that the site is well protected and is unlikely to flood in the future for standard storms.

4.13 There are flood defences in place to prevent flooding from 'normal' storms up to and 1 in 100 year storm event as highlighted by the Environment Agency. These flood defences are set at 6.05m.

4.14 Based on the level information provided in the SFRA/EA, the maximum 1 in 100 year + C/C level is 4.67m A.O.D. with flood defences set at between 5.66 6.05m depending upon location. The freeboard to the flood defences adjacent to the site averages 0.99-1.38m for the 1 in 100 year storm event inclusive of climate change. Details are provided within **Appendix C**



Location	Chainage	Peak 1 in 100 year fluvial flood level (mOD)		Peak 1 in 1000 year fluvial flood level (mOD)		Defence crest level (mOD)	Defence type	Freeboard (m) 1 in 100 Year Level		Freeboard (m) 1 in 1000 Year Level	
	(km)	2007	2065/2115	2007	2065/2115			2007	2065/2115	2007	2065/2115
Little London Bridge	0.0	4.42	4.67	4.43	4.68	5.99	Bank with road on crest	1.57	1.32	1.56	1.31
Sluice	0.1	2.40	3.11	3.18	4.10	5.99	Bank with road on crest	3.59	2.89	2.81	1.89
	0.2	2.40	3.11	3.18	4.10	6.04	Bank with road on crest	3.64	2.93	2.86	1.94
	0.3	2.40	3.11	3.18	4.10	6.09	Bank with road on crest	3.68	2.97	2.91	1.99
	0.4	2.40	3.11	3.18	4.10	6.13	Bank with road on crest	3.73	3.02	2.95	2.03
	0.5	2.40	3.11	3.18	4.10	6.18	Bank with road on crest	3.78	3.07	3.00	2.08
	0.6	2.40	3.11	3.18	4.10	6.11	Bank with road on crest	3.71	3.00	2.93	2.01
	0.7	2.40	3.11	3.18	4.10	6.04	Bank with road on crest	3.64	2.93	2.86	1.94
	0.8	2.40	3.11	3.18	4.10	5.98	Bank with road on crest	3.57	2.87	2.80	1.88
Fen End	0.9	2.40	3.11	3.18	4.10	5.91	Bank with road on crest	3.51	2.80	2.73	1.81
	1.0	2.40	3.11	3.18	4.10	5.84	Bank with road on crest	3.44	2.73	2.66	1.74
	1.1	2.40	3.11	3.18	4.10	5.80	Bank with road on crest	3.40	2.69	2.62	1.70
	1.2	2.40	3.11	3.18	4.10	5.77	Bank with road on crest	3.37	2.66	2.59	1.67
	1.3	2.40	3.11	3.18	4.10	5.73	Bank with road on crest	3.33	2.62	2.55	1.63
	1.4	2.40	3.11	3.18	4.10	5.70	Bank with road on crest	3.29	2.59	2.52	1.60
	1.5	2.40	3.11	3.18	4.10	5.65	Bank with road on crest	3.25	2.55	2.48	1.56
	1.6	2.40	3.11	3.18	4.10	5.74	Bank with road on crest	3.34	2.63	2.56	1.64
	1.7	2.40	3.11	3.18	4.10	5.82	Bank with road on crest	3.41	2.71	2.64	1.72
	1.8	2.40	3.11	3.18	4.10	5.89	Bank with road on crest	3.48	2.78	2.71	1.79
	1.9	2.40	3.11	3.18	4.10	5.97	Bank with road on crest	3.57	2.86	2.79	1.87
	2.0	2.40	3.11	3.18	4.10	6.05	Bank with road on crest	3.65	2.94	2.87	1.95
	2.1	2.40	3.11	3.18	4.10	6.03	Bank with road on crest	3.63	2.92	2.85	1.93
	2.2	2.40	3.11	3.18	4.10	6.01	Bank with road on crest	3.61	2.90	2.83	1.91
	2.3	2.40	3.11	3.18	4.10	5.98	Bank with road on crest	3.58	2.87	2.80	1.88
A16 Road Bridge	2.4	2.40	3.11	3.18	4.10	5.96	Bank with road on crest	3.56	2.85	2.78	1.86
	2.5	2.40	3.11	3.18	4.10	5.94	Bank with road on crest	3.54	2.83	2.76	1.84
	2.6	2.40	3.11	3.18	4.10	5.95	Bank with road on crest	3.55	2.85	2.78	1.85
	2.7	2.40	3.11	3.18	4.10	5.95	Bank with road on crest	3.55	2.85	2.78	1.85
	2.8	2.40	3.11	3.18	4.10	5.97	Bank with road on crest	3.57	2.86	2.79	1.87
	2.9	2.40	3.11	3.18	4.10	5.98	Bank with road on crest	3.58	2.87	2.80	1.88
	3.0	2.40	3.11	3.18	4.10	6.00	Bank with road on crest	3.60	2.89	2.82	1.90
	3.1	2.40	3.11	3.18	4.10	6.02	Bank with road on crest	3.62	2.91	2.84	1.92
	3.2	2.40	3.11	3.18	4.10	6.09	Bank with road on crest	3.69	2.98	2.91	1.99

\105815\Technical_Data\Defence Crest, Waterlevels and Freeboard.xls

Table 7R
River Welland - Right Bank

4.15 In view of the above, the site is considered to satisfy the Exception Test and the development provides wider sustainable benefits to the community that outweigh any indications of potential flood risk. There will be a requirement, however, to introduce some mitigation measures to ensure that the development will be safe, without increasing flood risk elsewhere, and these are discussed in the flood mitigation section below.

5.0 SOURCES OF FLOODING

5.1 RIVERS

5.2 The River Welland is located approximately 460m to the west of the site, and the Environment Agency consultation identifies that the River has fluvial defences protecting the site which consists of earth embankments.

5.3 The defences are in good condition (as quoted by the Environment Agency) and provide protection against a flood event with a 1% chance of occurring in any year (1 in 100). The defences are inspected regularly to ensure that any potential defects are identified early. There is also an area of flood storage to the west of the site adjacent to the River Welland, known as Cowbit Washlands, which will significantly reduce the possibility of flooding of the Spalding town centre and adjacent areas.

5.4 The Welland catchment model, dated April 2007, shows that the water depth in the channel can be seen to be around 4.67m O.D.N. for a 1 in 100 year storm, inclusive of climate change. However, it should be realised that these are channel levels and, if there was a breach of defences or overtopping of the channel embankments, then water would be spread over a much wider area and be at a reduced level across the adjacent land. This is reflected in the SFRA flood levels where modelled flood levels are considerably less than the EA levels for the same storm event, at 2.4m A.O.D (dated 2007).

5.5 The Coronation Channel, which provides flood relief around the Spalding town centre, located approximately 1.4km north, is also protected by raised embankment defences to a level of 5.8m O.D.N. closest to the site, but to a level of 5.14m O.D.N. adjacent to the disused Railway bridge.

5.6 FLOODING FROM LOCAL WATERCOURSES

5.7 The consultation undertaken with South Holland Internal Drainage Board has identified the location of a riparian owned watercourse following the northern boundary. Swales/watercourse are also located adjacent to Barrier Bank (B1173). As these features are adjacent to the highway network an assumption has been made that these are all maintained by the Highway Authority. The nearest Board maintained watercourse is Exeter Drain to the east of the site beyond the A16. Flooding from these sources are considered to be local and negligible in terms of risk to safety.

5.8 FLOODING FROM THE SEA

5.9 The site is located a considerable distance from the Wash (sea) and therefore not considered a significant risk.

5.10 FLOODING FROM GROUNDWATER

The site is generally flat with levels on boundaries concordant with the adjoining land. Open ditches and highway swales also surround the development site. Therefore, it is highly unlikely that there would be run-off of water into the site from outside the site boundaries. Flooding from surface water run-off over adjacent land is unlikely, and flooding from this source is considered to be low risk.

5.11 FLOODING FROM GROUNDWATER

Whilst there has been no intrusive ground investigation undertaken on the area, the geological map shows that the natural strata will be generally cohesive in nature and the materials will be impermeable. The presence of the rivers and watercourses in the immediate and distant vicinity of the site confirms this assumption that the ground conditions are generally impermeable and, on this basis, the probability of groundwater entering the site is low risk.

Phase II Intrusive Site Investigations have been undertaken on the area by Geodyne, indicating the presence of high water table in part – email include in **Appendix D**.

5.12 FLOODING FROM SEWERS

5.13 A new positive drainage system will be introduced on site for the development incorporating sustainable drainage techniques (SuDS). This system will be designed to attenuate to 1 in 100 year + climate change storm event as per NPPF guidelines.

5.14 There is a possibility that any blockage of the sewers will result in flooding from the lowest cover level of manholes or gullies, and this will need to be considered as part of any proposed development. Flows, volumes generated, by this instance will be directed away from buildings wherever possible and will not present a risk to human health.

5.15 FLUVIAL (UPDATE)

5.16 A review of the South East Lincolnshire Strategic Flood Risk Assessment (SFRA) Hazard Mapping 2115 1% has been undertaken and overlaid against the site layout, indicating that the site is located within an area shown as *Danger for Most*.


Drain
Drain
B1173
B1173
Drain
Drain
6m
BARRIER BA

6.00 CLIMATE CHANGE

6.01 In accordance with the NPPF Guidance, the published figures show that, for an expected life of greater than 2085 for any new development, the anticipated increase in rainfall will be around 30%. Based upon the design life of commercial buildings/offices. It will be necessary to design any new positive drainage system with a 30% increase in capacity to accommodate this requirement.

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	*+5%*	*+10%*	*+20%*	*+30%*
Peak river flow	*+10%*	*+20%*		
Offshore wind speed	*+5%*		*+10%*	
Extreme wave height	*+5%*		*+10%*	

7.00 FAILURE OF FLOOD DEFENCES

7.01 Review of the EA data provided within **Appendix A** indicates that the current defence for the development area is a man-made, raised defence consisting of a combination of Floodbank and raised channel embankment. The condition of these flood defences are considered to be Condition 2 – Minor defects that will not reduce the overall performance of the asset.

7.02 Consideration needs to be given to the possibility of a breach in the flood defences to the River Welland/Coronation Canal or the overtopping in the event of a catastrophic storm.

7.03 Tables 4.3 (Overtopping) and 4.4 (Breach of defences) of the EA/DEFRA document **FD2321/TR2 – Flood Risks to People Phase 2**, March 2006 shows the flood hazard with distance from a flood defence for breaches with different water levels above floodplain level, assuming a flat and clear flood plain.

Table 4.3 Danger to people from overtopping relative to distance from defence

Distance from defence (m)	Head above crest level (m)			
	0.5	1	2	3
100				
250				
500				
1000				
1500				
2000				
2500				
3000				
3500				
4000				
4500				
5000				

Key:
Danger for some
Danger for most
Danger for all

Table 4.4 Danger to people from breaching relative to distance from defence

Distance from breach (m)	Head above floodplain (m)						
	0.5	1	2	3	4	5	6
100							
250							
500							
1000							
1500							
2000							
2500							
3000							
3500							
4000							
4500							
5000							

Key:
Danger for some
Danger for most
Danger for all

7.04 OVERTOPPING

7.05 Considering **Table 4.3** for overtopping (above).

7.06 A review of the development area indicates that the site is positioned approximately 0.1km from the potential flood source (River Wellend), a head of 1.0m above the crest level of the embankment would need to occur to cause a danger for **all people** as indicated on Table 4.3.

In this case, taking the lowest defence crest level of 5.66m A.O.D adjacent to the site, and based on a 1.0m head above this level (i.e. 6.66m A.O.D) being **dangerous to all occupants**, then this level would be approximately 2.0m above the 1 in 100 year flood level (4.67m A.O.D). This is considered to be a very rare occurrence and, therefore, the risk is considered to be **very low**.

7.07 BREACH

7.08 Considering Table 4.4 for Breach (above)

Based upon the relative distance of 0.1km from the closest breach potential (River Wellend), a head of 2.0m above the floodplain would be required before there is a **danger to all people**. Based upon the lowest defence level of 5.66m A.O.D, the head could potentially reach a height of 2.06m based upon an average ground level of 2.60m AOD – however this would be considered a sizeable breach. These findings are further reflected on 'Update on Strategic FRA' Revision 2, by Royal Haskoning, dated Feb 2017, **Appendix C**.

7.09 The River Welland flood defences are located adjacent to the west of the development. Table 4.4 shows that, for a breach, there is a danger. However, as stated in the SFRA, raised embankments, with the road on their crest, would help resist erosion or degradation of the top part of the embankment. Also, the raised ground bounding a river is so broad and substantial that it should not be considered as an embankment, but rather as natural ground and breaching is not a plausible scenario in these locations. Furthermore, the defences are inspected regularly to ensure that any potential defects are identified early. **Therefore, based on the information above, the chance of a breach is considered to be low risk.**

7.10 As part of the development a noise bund is to be positioned to the western boundary which would form a natural barrier to any overland flows from that direction – the location of which can be seen within **Appendix B**.

8.00 CONCLUSIONS

Whilst the site falls within Flood Zone 3a and has a "**less Vulnerable**" under flood risk classification, there are sufficient reasons, as identified in the Exception Test in paragraph 4.8-4.13, and the assessment of failure of flood defences in paragraphs 7.00-7.08, for maintaining the proposed development at its present location.

It will, however, be necessary to take account of potential sources of flooding through the layout and form of the development and implement the use of Sustainable Drainage techniques where possible. Further discussion of this aspect can be seen in paragraphs 9.0-9.11.

Examination of the South East Lincolnshire Strategic Flood Risk Assessment (SFRA) Hazard Mapping 2115 1% indicates that the site is located within an area shown as Danger for Most.

The following are also to be considered in the design of the proposed buildings;

The finished floor levels to buildings shall be raised above existing ground levels by 700mm. All buildings will be 'multi' storey and provide safe refuge above ground floor level.

It is recommended that the ground level for the new buildings is designed to be resilient to flooding in accordance with the May 2007 Communities and Local Government Report ''Improving the Flood Performance of New Buildings''. This will help to reduce the cost of repairs and speed up restoration times following a flood.

External levels around the proposed buildings are to be designed to fall away from the building wherever possible, with open spaces designed with falls to non-critical areas, such as landscape, where the water can pond.

There will be no lower ground basements within the construction.

A **flood evacuation plan** should be in place for each development with the end user of the buildings signed up to the Environment Agency Flood Warning system of a telephone call when flooding is possible. This will ensure that the buildings are evacuated prior to the occurrence of a flood.

This plan is to provide a detailed emergency evacuation procedure, similar to a fire alarm system, and is to form part of any Employee Handbook and induction procedure on joining the resident companies. **The procedure is to be agreed with the Planning Authority prior to occupation** and placed in accessible positions within the buildings to ensure that all occupants are fully aware of the evacuation procedure.

9.00 SuDS AND ONSITE SURFACE WATER DISPOSAL

9.01 In order to comply with the requirements of NPPF, it is necessary to consider aspects of Sustainable Drainage Techniques for the new development.

An intrusive investigation of the ground conditions has been undertaken, but the Geological Survey Map of Great Britain, shows that the natural strata will be generally cohesive in nature and the materials will be impermeable. The presence of the rivers and watercourses in the immediate and distant vicinity of the site confirms this assumption that the ground conditions are impermeable.

Percolation tests have also been carried out to assess the suitability of soakaways, see **Appendix D** for extracts from the report.

It has been concluded that soakaways are unlikely to be suitable. Therefore, the soils will be unsuitable for soakaways or other similar infiltration systems on the site.

9.02 EXISTING SURFACE WATER RUN-OFF

The site is Greenfield in its entirety and therefore, in accordance with current guidelines and regulations, surface water calculations have been undertaken using the IH124 method of calculating Greenfield run-off rates and is presented in **Appendix E**.

This shows that a **QBAR rate of 26.08l/s** for a development area of 18.66Ha has been calculated and will be used to limit the discharge for all storm events up to 1 in 100 year plus climate change. For calculation purposes, a discharge rate of 1.4 l/s/ha of impermeable has been utilised.

9.03 PROPOSED SURFACE WATER RUN-OFF

9.04 In accordance with current Ciria C697 guidance and the appropriate use of Suds, consideration for the proposed drainage should firstly be given to infiltration techniques (to ground). However, as infiltration techniques are considered unsuitable (see paragraph 9.1), it will be necessary to utilise a positive drainage system to watercourse, limited to the discharge rate stated in paragraph 9.02, above.

9.05 An assessment has been made of the proposed impermeable areas, from the Masterplan Layout in Appendix F to assess the implications of surface water drainage from the development.

9.06 The proposed impermeable areas have been used in calculations have been carried out using the Flow Computer Program (Causeway Technologies Ltd). The proposed surface water system should be designed to accommodate a 1 in 30 year storm event without flooding and

the 1 in 100 year storm plus climate change event should be retained within the site in an area which will not affect the new buildings from flooding.

9.07 Based upon **22119-UMC-ZZZZ-SI-M2-A-0010-P02** (**Appendix B**) the total site area is approximately 18.66Ha, of which approximately 10.94Ha is impermeable, representing an impermeable rate of 58%. For simulation purposes, the discharge rates are as follows;
POND 1 A=1.735Ha, Q=2.4l/s
POND 2 A=3.322Ha, Q=4.7l/s
POND 3 A=2.645Ha, Q=3.7l/s
POND 4 A=3.236Ha, Q=4.5l/s

9.08 The site drains by pump via 4 discharge points around the site, all three outflows being controlled by pumps restricted to the above values (9.07). Discussions with the IDB have indicated that a surcharged outfall will be experienced during certain situations, with a level of 1.23mAOD being expected in the local drainage infrastructure (board controlled).

9.09 The discharge for the surface water drainage will be to the diverted watercourse located to the north of the site. The introduction of any headwalls or works to the watercourse will need to consent of the Land Drainage Authority, as will agreement to the proposed discharge rate and ditch diversion.

9.10 In order to ensure compliance accordance with the Environment Agency Pollution Prevention Guidelines PPG3, the surface water run-off will be treated prior to discharge to watercourse. Run-off from hardstanding areas shall be treated through the use of filter drains, swales and permeable paving designed in accordance with current standards. The areas subject to HGV traffic will be treated via Petrol Interceptors where necessary.

9.11 It will be necessary to provide detailed calculations and proposals to the Planning Authority showing the proposed method of drainage on the site, prior to construction.

9.12 A surface water strategy for drainage of the new development and based upon the above principles has been included within **Appendix F,** drawing **AP LG 100 Rev B**.

10.00 FOUL DRAINAGE

10.01 There are no adopted foul drainage systems suitable for the disposal of foul drainage from the site. Anglian Water have indicated a suitable discharge point within their Pre-Development assessment (PPE-0127928, dated 11/08/2021) attached in **Appendix A**.

10.02 If the route to discharge for the foul is not achievable due to ownership issues etc, an on-site treatment works should be used (subject to the required EA permitting requirements being achieved) and discharge made to the local watercourse. Given the site topography, the use of a proprietary treatment works will require a package pump to achieve discharge.

10.03 Installation of any pumped/treatment systems installed on site are to have flush lockable covers to prevent any ingress of water in the event of flooding of the site from a breach of the flood protection, overtopping of the defences or from overland water due to a blocked surface water pipe. Discharge of treated effluent to ground or watercourse will require the formal approval and a Permit from the Environment Agency and the South Holland Internal Drainage Board.

11.00 WATER QUALITY

11.01 Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SUDS in development drainage provides a significant benefit in removal of pollutant from development run-off at source.

11.02 The SuDS Manual C753 describes a '**Simple Index Approach**' for assessing the pollution risk of surface run-off to the receiving environment using indices for likely pollution levels for different land uses and SUDS performance capabilities.

11.03 CIRIA document C753 Table 26.2, as shown in Table 3a below, indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

Table 3a: CIRIA 753 Table 26.2 Pollution Hazard Indices

Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/motorways.	Medium	0.7	0.6	0.7
Sites with heavy pollution (haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites) sites where chemicals and fuels (other than domestic fuel oils) are to be delivered, handled, stored, used or manufactured, industrial sites, trunk roads and motorways.	High	0.8	0.8	0.9

11.04 For a commercial type development of the nature stated above and in accordance with Table 3a, surface water run-off requires a low level of treatment for roof area and a medium level of run-off for access roads and service yards;

Run-off generated by the roofs will generate 0.3 for total suspended solids; 0.2 for heavy metals; and 0.05 for hydrocarbons.

Run-off from yard and access road areas, the treatment requirements of; 0.7 for total suspended solids; 0.6 for heavy metals; and 0.7 for hydrocarbons should be provided.

11.05 To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. Table 26.3 of The SuDS Manual CIRIA document C753 shown as Table 3b for discharges to surface waters indicate the treatment mitigation indices provided by each SuDS feature;

Table 3b: CIRIA 753 Table 26.3 SuDS Mitigation Indices for discharges to surface waters.

Type of SUDS component	Total suspended solids (TSS)	Metals	Hydro-carbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio-retention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

11.06 Based upon the above table and the Engineering Layout, the surface water run-off generated from roofs will be routed through ponds, thus providing a mitigation indices of;
Total Suspended Solids 0.7; Metals 0.7; and Hydrocarbon treatment of 0.5 – therefore satisfying the requirements of Table 3a above .

With regards to the yards and access road, the use of permeable paving; ponds; swales; and road gullies will provide a mitigation of;
Total Suspended Solids >0.7; Metals >0.7; and Hydrocarbon Treatment >0.7.

11.07 Given the proposed layout and development land requirements, the use of a combination of storage/treatment facilities will used to provided at least a single source of treatment, and in most cases at least 2 treatment trains. Where heavy transport manoeuvring is anticipated (service yards) and flows are discharged to pond directly, the use of Petrol Interceptors will be appropriate.

12.00 SUDS MAINTENANCE REGIME

12.01 As with all developments, the implementation and maintenance of SuDS is fundamental to the operation and removal of pollutants. This purpose of a maintenance plan is to identify the frequency and scope of inspections and maintenance to all components of the drainage system (and not limited to); including pipes, manholes, flow controls, swales, ponds, headwalls and permeable paving, at Sandpit Road, Thorney, Phase 2.

The plan includes a methodology for maintaining all of the items listed below and details the scope of inspections; as well as frequency; and identification of suitable personnel to undertake such tasks.

12.02 Post construction, the stormwater system will need a regular regime of inspection in order to assess its on-going performance and identify the required maintenance to ensure continuation of its intended function. Inspections have been divided into 2 categories as follows;

- Routine inspections for maintenance – carried out by any reasonable person with no professional engineering knowledge and typically consists of management company personnel and homeowners; and
- Engineering Inspections – carried out by professional/qualified civil engineering personnel including adopting authority

The table below identifies each of the inspections, the frequency and the company/party responsible for undertaking the inspection. All inspections are to be undertaken in strict accordance with CDM Regulations 2015, with suitable risk assessment and method statements carried out by the inspector.

12.03 Routine inspections for the maintenance and operational performance of all associated drainage works shall be carried out over the lifetime of the development, with regular quarterly inspections carried out throughout the construction period of the drainage features and the site in general, and shall include a period up to and including adoption where applicable. Thereafter, annual inspections shall continue with (post) heavy rainfall inspections being carried out as soon as practicable following an intense period of rainfall – please note that an allowance must be made, in terms of time, for the drainage feature to discharge all run-off volumes, which in most cases will be a minimum 24 hours after the storm has passed.

12.04 Routine inspection/maintenance of the balancing facility (attenuation pond) and swale should be undertaken quarterly to ensure vegetation growth does not hinder the operation.

12.05 Records detailing each of the routine maintenance inspections should be completed during inspection indicating the required maintenance and time frame for completion. Upon completion of the required maintenance, records shall be updated indicating the nature of works, contractor and replacement items necessary and detailing any further works if necessary, including a timeline for carrying out the work.

12.06 Routine inspection for maintenance is required to establish the need for basic maintenance and may be undertaken by non-professionals, being carried out by any responsible person. Alternatively, professional engineering staff may be employed to complete the routine inspections for maintenance as well as concurrently carrying out any necessary engineering inspections. At all times, the inspector shall be familiar with the site wide drainage and carry out the necessary risk assessment associated with the inspection including awareness of public safety when carrying out the inspection;

Item	Maintenance Inspections	Frequency	Responsibility
Pipes/Manholes & Trapped Gullies	Regular condition inspection to be undertaken to confirm structural and operational performance, including inspection for debris/obstructions impeding flows	Annual inspection or after heavy rainfall events	Landlord
Flow Control Device	Inspection of flow control device and sump for debris. Inspection to include structural defects and/or damage as well as operational performance of by-pass	Annual inspection or after heavy rainfall events	Landlord/Pump specialist
Headwalls	Structural inspection of headwalls and grill including concrete scour and metal fatigue. Inspection for debris/obstructions impeding flows	Annual inspection or after heavy rainfall	Landlord
Permeable Paving	Inspection of upstream/downstream catchpit manholes for build-up of silt as well as condition survey of blocks and surface impediment	Annual inspection or after heavy rainfall	Landlord