Flood Risk Assessment



Site:
Barns at Risegate House Farm, Hedgefield Hurn, Gosberton, Spalding PE11 4JE

Applicant:
Mr D Charlton

Prepared by:
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RIBA
Chartered Practice

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Introduction

Origin Design Studio Ltd have been appointed by Mr D Charlton to prepare a Flood Risk Assessment to accompany a planning application to South Holland District Council for a residential development.

The site is contained within a Flood Zone 3 and this is the basis upon which a Flood Risk Assessment is required. The approach to flood risk is set out in the National Planning Policy Framework (NPPF), refer to Appendix A with more local planning policy set out in the South East Lincolnshire Local Plan (SELLP), refer to Appendix B. This Flood Risk Assessment assesses the site in accordance with the policy requirements of the NPPF and the SELLP.

The Site

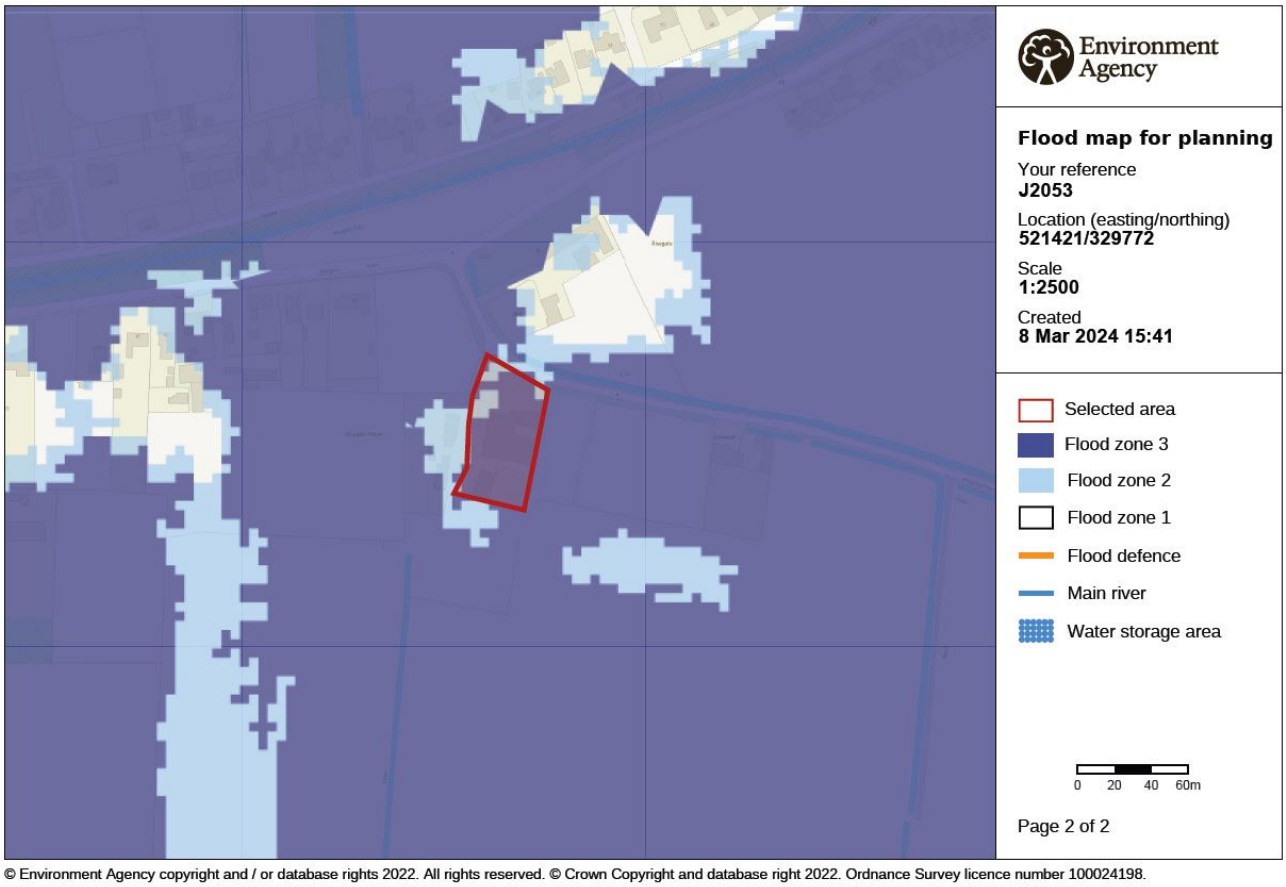
The site is located to the south of Hedgefield Hurn to the south of Hubbert's Bridge. The site has a number of agricultural buildings on it. These include a traditional range, potentially 18th Century and more modern 20th Century buildings. The site is adjoined on the western side of the farm access track by an existing bungalow. To the east and south of the site are agricultural fields. The proposed development is for the conversion of the existing agricultural dwellings to form 3No. dwellings, with two proposed to be single storey and the third to be two storey.

Findings

Risk of Flooding from River and Seas

Flood Zone

The site is contained mainly within a Flood Zone 3 with parts in a Flood Zone 2. Flood Zone 3 shows the area at risk of flooding for an undefended flood event with: a 1% or greater probability of flooding from rivers or 0.5% or greater probability of flooding from the sea.



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Figure 1 - Flood zone map (the site is marked with a red line).

Historic Flooding

The Environment Agency do not have any information about historical flooding on the site, refer to Appendix E.

Sequential & Exception Test

The proposed development is residential and will result in 3No. dwellings from the conversion of the existing agricultural buildings. Therefore, flood risk is considered on this basis.

Developments need a sequential test when the development is in flood zone 2 or 3 and a sequential test hasn't already been done for a development of the type planned on the proposed site.

The purpose of the sequential test is to direct development to land of lower flood risk. The sequential test compares the proposed development site with other available sites to find out which has the lowest flood risk.

The residential use is classified as "more vulnerable" in accordance with Table 2 – Flood Risk Vulnerability Classification.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 2 - Table 3 – Flood Risk Vulnerability and Flood Zone Compatibility (www.gov.uk)

In accordance with Table 3 where a site is located in a Flood Zone 3 with a vulnerability classification of “more vulnerable” development is considered to be compatible providing the exception test is satisfied. Therefore, the development will need to pass both a sequential test and exception test.

In this case the proposed development is for a ‘Change of Use’, accordingly it will pass both the Sequential and Exception Test.

Site Levels

A topographical survey has been undertaken to inform the design for the proposed development, refer to Appendix C. The site is generally flat. The lowest levels on the site are located centrally on the site between the single storey traditional building and the modern portal frame shed at around +2.35mAOD with the highest levels located closer to the road where the land ramps up to join Hedgefield Hurn at around +3.41mAOD. The road, Hedgefield Hurn to the north of the site, is shown to be around +3.35mAOD. The existing floor levels of the buildings vary at +3.02mAOD up to +3.14mAOD. The average ground level around the permitter of the buildings is around +3.0mAOD.

Calculating the Flood Level

Where possible all habitable floors should be above the flood level. Where the accommodation is proposed to be two storeys the 1 in 100/200-year flood level plus climate change will be used to ensure habitable floors are above the flood level. In the case where a single storey building is proposed habitable floors should be above the 1 in 1000-year flood level plus climate change. In both cases a safe point of refuge can be established and therefore provide protection to the inhabitants of the building.

In this case it is proposed to create a 1No. two-storey dwelling and 2No. one storey dwellings. To determine the flood level the fluvial and tidal sources will be looked at to determine the worst case and an appropriate floor level.

Tidal Flood Sources

The site is not at risk from tidal sources of flooding.

Fluvial Flood Sources

The site is at risk of fluvial flooding from main rivers. The main risk to the site is the River Glen approximately 3.5km to the southeast of the site at its nearest point.

The site is protected by fluvial flood defences from the River Glen. These include earth embankments. They are in a fair condition and reduce the risk of flooding (at the defence) to a 1% (1 in 100) chance of occurring in any year.

Data from the Environment Agency includes in channel data for the River Glen in the Welland Glen Model, refer to Appendix D. It does not contain Hazard mapping for modelled breaches or overtopping which may affect the site.

A simplistic breach model using the in-channel levels of the River Glen offer a basic way to establish a 1:100-year flood level including climate change for the site. The worst-case levels for the River Glen local to the site are from node 4901 & 4825.07. A topographical survey profiling the watercourse has not been undertaken of the River Glen however information available on OS maps suggest the embankment levels are around 3-4m. The simplistic model only considers an oncoming wave depth and assumes the land downstream of the breach to be taken down to 1.7m. The breach of the River Glen is discussed in this section. It also assumes the defences have been raised to meet the calculated in-channel level, thus creating a larger head for the purposes of calculating the flood depth on site.

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events such as both tidal and fluvial flooding. The climate change allowances in the NPPF Guidance were updated on the 19th February 2016 and again on 17th December 2019. The site lies within the Welland Management Catchment and allowances for climate change should be made on the following basis. For a worst-case scenario, the site shall be considered to be in a Flood Zone 3a and the use classification is ‘more vulnerable’ therefore Peak River flows use the higher central and upper end to assess a range of allowances.

The adjustments for peak flows can be seen in the table below. Under guidance of the Planning Practice Guidance for developments that are ‘more vulnerable’ in a flood zone 3 the central allowance shall be used for design. It will be tested for sensitivity using the upper allowance.

River basin district	Allowance category	Total potential change anticipated for the ‘2020s’ (2015 to 2039)	Total potential change anticipated for the ‘2050s’ (2040 to 2069)	Total potential change anticipated for the ‘2080s’ (2070 to 2115)
Witham	Upper	22%	26%	53%
	Higher	10%	10%	28%
	Central	5%	4%	17%

Figure 3 - Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline)

A flow discharge curve can be established using the increase in flow to calculate and establish in-channel levels of the River Glen for the additional climate change scenarios.

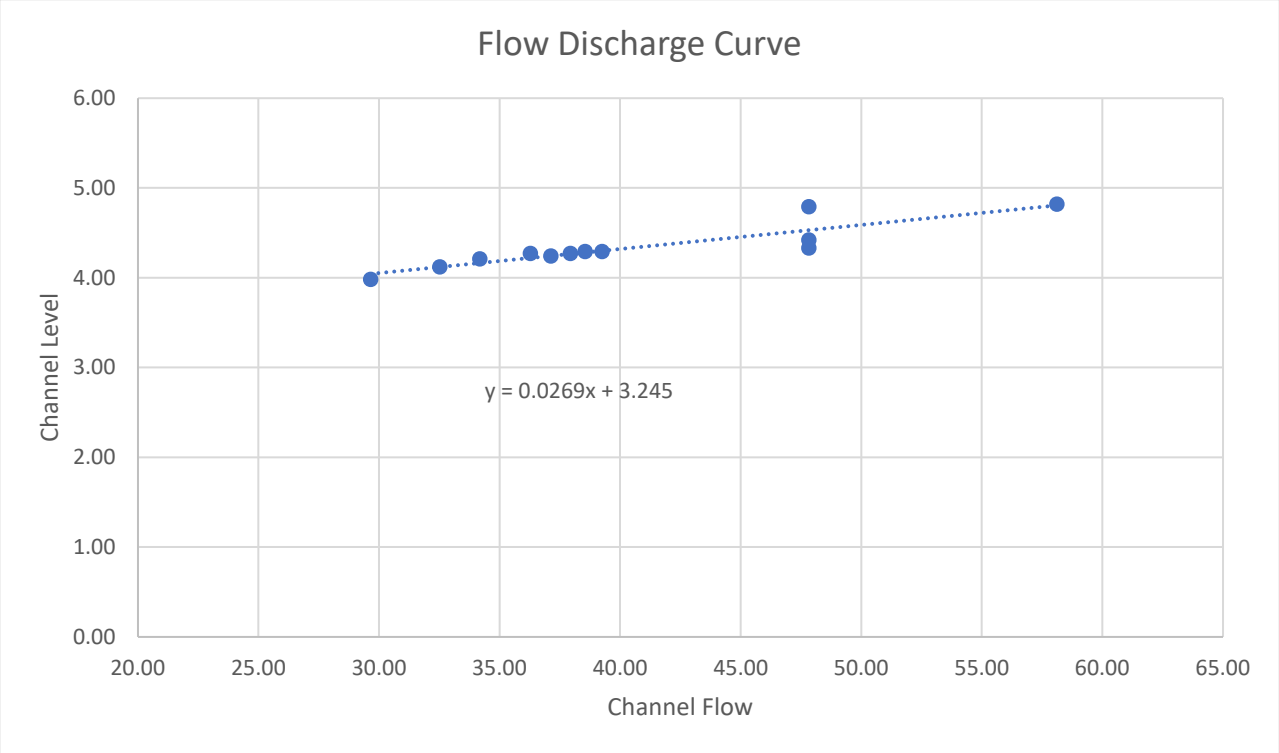


Figure 4 - Flow discharge curve for River Glen nodes 4901 & 4825.07

Event & Climate Change (%)	Flow (m^3)	Level (m)
1% +53%CC	61.98	4.85
0.1% +53%CC	75.05	5.26

Figure 5 - Calculated Levels for Climate Change for nodes 4901 & 4825.07

The climate change levels for the central allowance i.e. 17% are lower than the 20% increase allowed for in the EA model. Therefore, the central allowance will use the 20% value for both the 1% and 0.1% for design purposes. The climate change levels for the 53% scenarios using a growth curve result in a higher levels than the 1 in 100 year plus 20% for climate change. Consequently, the in-channel level for the 53% climate change breach analysis will use the levels in Figure 5 above, and test the resulting design.

A breach analysis using data for nodes 4901 & 4825.07 is contained in Appendix D. The 1:100-year and 1:1000-year level including 17% climate change for the buildings are +0.115m and +0.116m above ground level respectively. These will be the design events for the proposed dwellings.

The 1:100-year and 1:1000-year level including 53% climate change for the buildings are +0.117m and +0.135m above ground level respectively. These levels will be used to test the flood resilience of the proposed dwellings.

Given the significant distance between the fluvial source and the site and the simplistic nature of the calculation it is considered the breach scenario is a worst case and flood routing may not result in the site being flooded to the extent indicated by simple breach calculation.

Drainage Board Flood Sources

The site is located in an area of an Internal Drainage Board (IDB). In this case Welland & Deepings IDB who maintain drains near to the site. The nearest board-maintained drain is the Risegate Eau, located approximately 125m to the north of the site and the site lies in the catchment are of the Risegate Eau. Data from the IDB indicates that the level of the Risegate Eau for the 1:100-year level would be +1.79m. No further information about more extreme events i.e. 1 in 1000 year including climate change scenarios are held by the IDB.

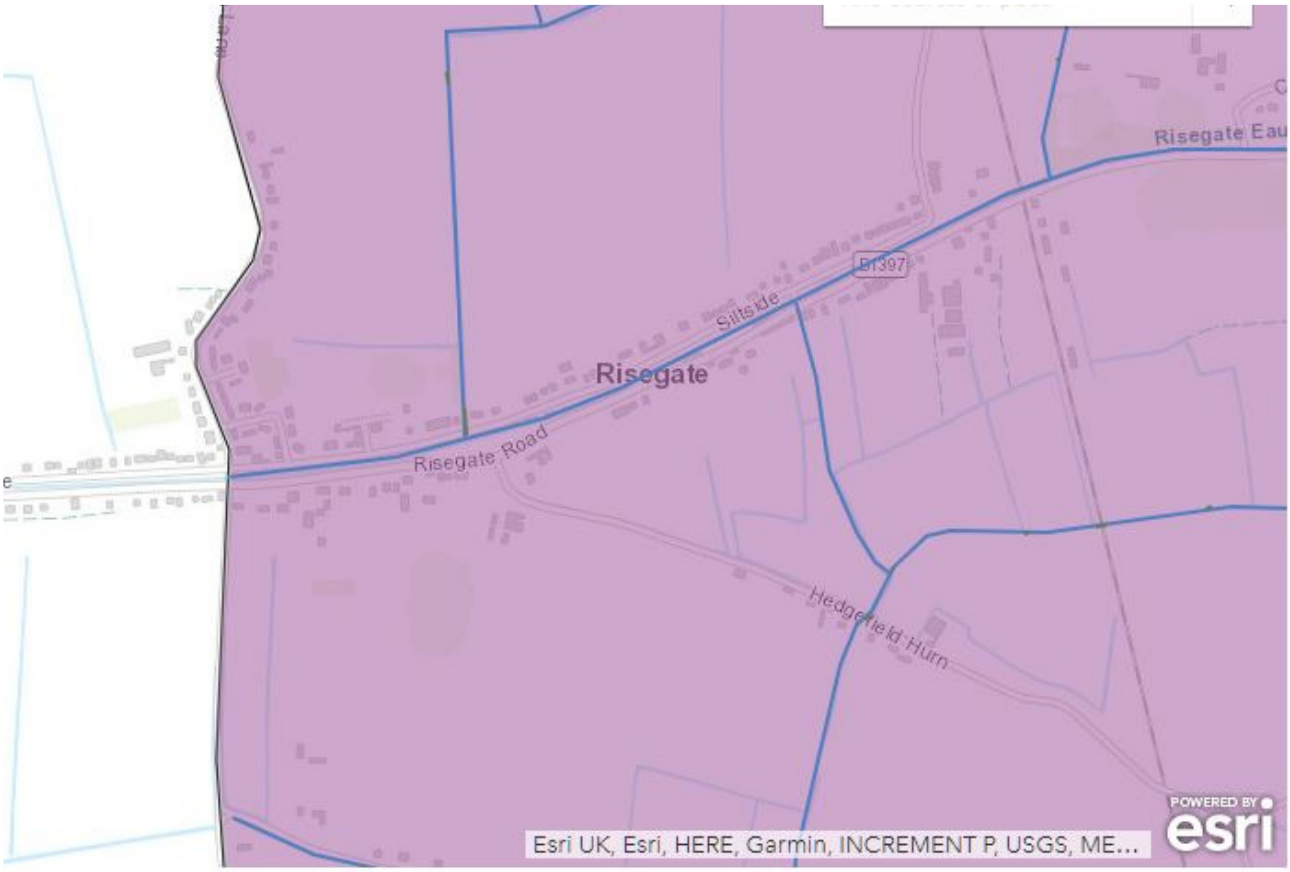


Figure 6 - Map of Welland & Deepings Drains

Risk of Flooding from Surface Water

The risk of flooding from surface water is very low in the area of the buildings with a small area of low-risk flooding immediately south of the buildings, according to the surface water flood map shown in Figure 7.

The maps for surface water define the risk as High, Medium, Low and Very Low. The chance of flooding for the area defined in any given year is shown below:

- High: greater than 1 in 30 (3.3%).
- Medium: between 1 in 100 (1%) and 1 in 30 (3.3%).
- Low: between 1 in 1000 (0.1%) and 1 in 100 (1%).
- Very Low: less than 1 in 1000 (0.1%)

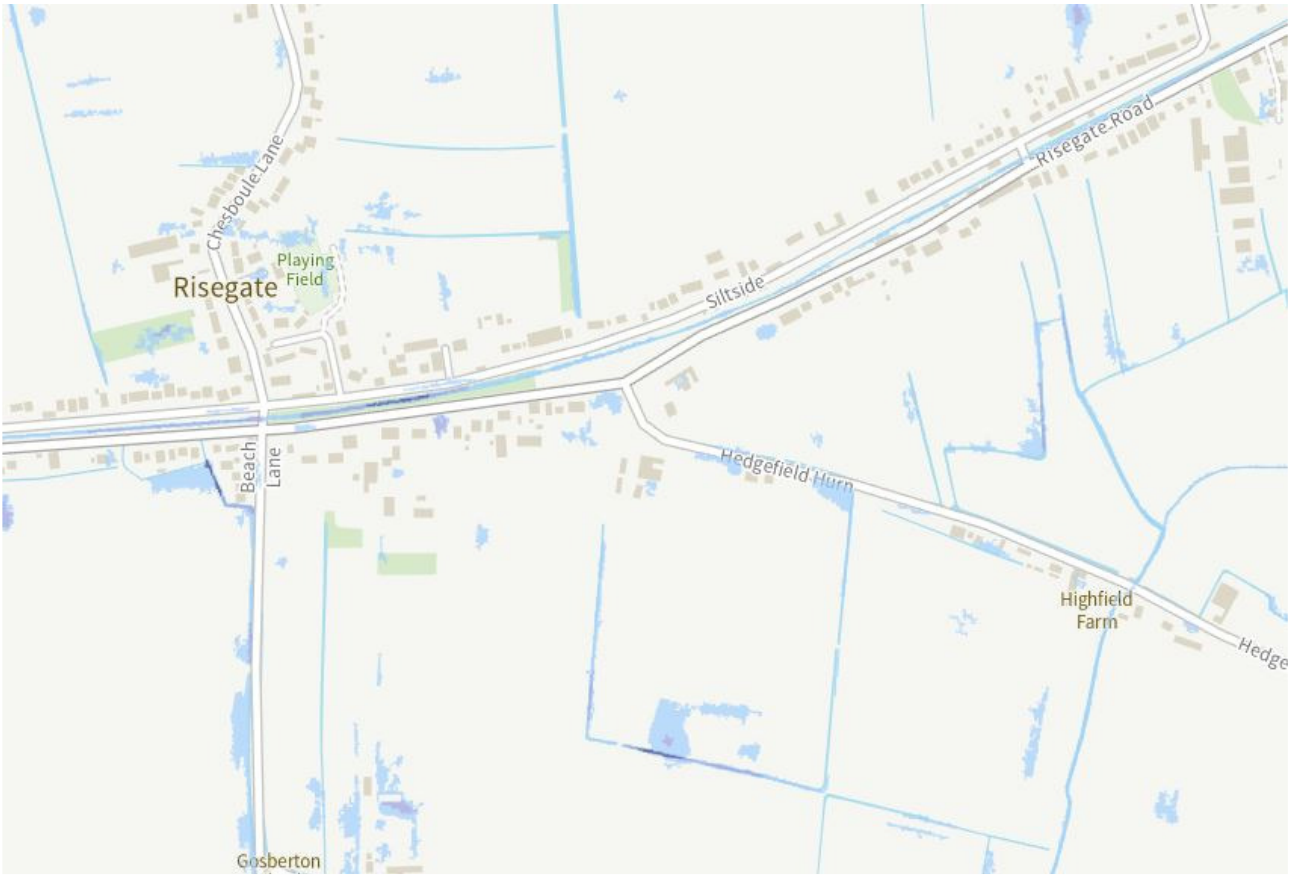


Figure 7 - Surface Water Flood Map (www.gov.uk)

Unlike the fluvial mapping, which is based on a detailed hydraulic model, this mapping is based purely on applying rainfall to a digital terrain model. As such this mapping serves to represent a worst-case scenario which may well overstate the actual probability of flooding in this area.

There is a caveat on the Defra Data website, as to the use of these maps and that they are not to be used to identify that an individual property will flood. Because of the way they have been produced and the fact that they are indicative, these maps are not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

The Environment Agency and the Lead Local Flood Authority (custodians of the surface water flood risk dataset) have subsequently confirmed that the published high-level data should not be used on a site-specific basis and that mapping is only suitable for National to County Scale use.

Risk of Flooding from Reservoirs

There is no risk of flooding from reservoirs when there is flooding from rivers. The following map shows this on the Environment Agency's Risk of Flooding from Reservoirs map:



Figure 8 - Reservoir Flood Map (www.gov.uk)

The source of reservoir flooding is not clear by observing maps. However, the nearest reservoir is located near Tumby Woodside some 15km to the north. Given the site does not flood when river levels are normal it is considered that the flooding will be worse from fluvial and tidal flooding sources identified above. The mitigation measures considered for these will provide sufficient protection against flooding from reservoirs.

Risk of Flooding from Sewers

There are no known public surface water and foul water sewers that currently exist on the site that are known to suffer from sewer surcharging. All new infrastructures to service the dwelling shall be appropriately designed to the relevant standards to ensure failures do not present a problem.

Safe Access & Egress

The proposed ground floor level will be above the predicted worse case flood level and provide a safe refuge. The road to the front of the site may remain passable allowing for safe passage along Harrison's Drove away from the site.

Setting the floor level

Standing advice requires finished floor levels (FFL) should be a minimum of whichever is higher of 300mm above the:

- Average ground level of the site
- Adjacent road level to the building
- Estimated river or sea flood level

In this case it is proposed that the minimum FFL should be set at a minimum of +0.3m above the existing ground level which provides sufficient freeboard for both the predicted 1 in 100-year flood level plus 17% climate change for the site (+0.115m) and 1 in 1000-year flood level plus 17% climate change for the site (+0.116m).

Based on an average ground level of 3.0mAOD the floor should be set at +3.3mAOD for all buildings.

Conclusion

The proposed development is for 1No. two-storey dwelling and 2No single storey dwellings. The site is contained mainly within a Flood Zone 3.

The site is not at risk from tidal flooding but is at risk from fluvial flooding. The site is protected by adequate tidal and fluvial flood defences which are maintained by the Environment Agency. A residual risk to breaching of these defences exist and this has the potential to impact the site.

The residential use falls within "more vulnerable" uses of land in Table 2 Flood Risk Vulnerability Classification and Table 3 shows that developments of this nature are appropriate in flood zone 3 subject to passing the Sequential and Exception Test.

In this case the proposed scheme is for a change of use and therefore automatically passes the Sequential and Exception Test.

The predicted fluvial flood depth for the design event (1 in 100-year plus climate change) for the site is +0.115 above existing ground level. The predicted fluvial flood depth for the design event (1 in 1000-year plus climate change) for the site is +0.116 above existing ground level. Therefore, minimum floor level of +3.3mAOD is to be used for all dwellings. Flood resilient construction to a height 300mm above the predicted flood depth shall also be installed.

At the detailed design stage of the development advice contained in “Improving the Flood Performance of New Buildings - Flood Resilient Construction” should be followed.

Further to this the property will register to Floodline to receive advance warning of potential flooding.

New foul and surface water drains will be designed to the relevant standards.

Appendices

Appendix A – National Planning Policy Framework

PLANNING AND FLOOD RISK

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

160. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

161. All plans should apply a sequential, risk-based approach to the location of development–taking into account the current and future impacts of climate change[49] Except for applications for the repowering of existing wind turbines, a proposed wind energy development involving one or more turbines should not be considered acceptable unless itis in an area identified as suitable for wind energy development in the development plan; and, following consultation, it can be demonstrated that the planning impacts identified by the affected local community have been fully addressed and the proposal has their backing so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

    a) applying the sequential test and then, if necessary, the exception test as set out below;
    b) safeguarding land from development that is required, or likely to be required, for current or future flood management;
    c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and
    d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

162. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

163. If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site

and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.

164. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

165. Both elements of the exception test should be satisfied for development to be allocated or permitted.

166. There planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[55]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
b) the development is appropriately flood resistant and resilient;
c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
d) any residual risk can be safely managed; and
e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

168. Applications for some minor development and changes of use[56] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

[55] A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.
[56] This includes householder development, small non-residential extensions (with a footprint of less than 250m2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

169. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;
b) have appropriate proposed minimum operational standards;
c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
d) where possible, provide multifunctional benefits.

Appendix B – South East Lincolnshire Local Plan

POLICY 4: APPROACH TO FLOOD RISK

Development proposed within an area at risk of flooding (Flood Zones 2 and 3 of the Environment Agency's flood map or at risk during a breach or overtopping scenario as shown on the flood hazard and depths maps in the Strategic Flood Risk Assessment) will be permitted, where:

1. It can be demonstrated that there are no other sites available at a lower risk of flooding (i.e. that the sequential test is passed). The sequential test will be based on a Borough or District wide search area of alternative sites within the defined settlement boundaries, unless local circumstances relating to the catchment area for the development justify a reduced search area, i.e. there is a specific need for the development in that location. The sequential test is not required for sites allocated in the Local Plan, minor development1or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).
2. It can be demonstrated that essential infrastructure in FZ3a & FZ3b, highly vulnerable development in FZ2 and more vulnerable development in FZ3 provide wider sustainability benefits to the community that outweigh flood risk.
3. The application is supported with a site-specific flood risk assessment, covering risk from all sources of flooding including the impacts of climate change and which:
    a) demonstrate that the vulnerability of the proposed use is compatible with the flood zone;
    b) identify the relevant predicted flood risk (breach/overtopping) level, and mitigation measures that demonstrate how the development will be made safe and that occupants will be protected from flooding from any source;
    c) propose appropriate flood resistance and resilience measures (following the guidance outlined in the Strategic Flood Risk Assessment), maximising the use of passive resistance measures (measures that do not require human intervention to be deployed), to ensure the development maintains an appropriate level of safety for its lifetime;
    d) include appropriate flood warning and evacuation procedures where necessary (referring to the County's evacuation routes plan), which have been undertaken in consultation with the authority's emergency planning staff;
    e) incorporates the use of Sustainable Drainage Systems (SuDS) (unless it is demonstrated that this is not technically feasible) and confirms how these will be maintained/managed for the lifetime of development (surface water connections to the public sewerage network will only be permitted in exceptional circumstances where it is demonstrated that there are no feasible alternatives);
    f) demonstrates that the proposal will not increase risk elsewhere and that opportunities through layout, form of development and green infrastructure have been considered as a way of providing flood betterment and reducing flood risk overall;
    g) demonstrates that adequate foul water treatment and disposal already exists or can be provided in time to serve the development;
    h) ensures suitable access is safeguarded for the maintenance of water resources, drainage and flood risk management infrastructure.

Development in all flood zones, and development over 1 hectare in size in Flood Zone 1, will need to demonstrate that surface water from the development can be managed and will not increase the risk of flooding to third parties.

Change of use of existing buildings will be supported providing they do not pose an increase in risk to people. Change of use that would result in self-contained ground floor residential accommodation in areas of hazard rating 'danger for some', 'danger for most' and 'danger for all' will not be supported. In these areas unrestricted access to a habitable room above the flood level and an emergency evacuation plan will be required.

Caravans, mobile homes and park homes intended for permanent residential use will not be permitted in areas at risk of flooding. Caravan, chalet, log cabin, camping and touring sites at risk of fluvial flooding where there is a 'danger for most' and 'danger for all' will not be permitted. Occupancy of caravan, chalet, log cabin, camping and touring sites at risk of tidal flooding will not be permitted to open between 1st November in any one year and the 14th March in the succeeding year.

No development will be permitted within a 50m buffer from the toe of the raised Witham Haven Banks (flood defences), as shown on the indicative Plan contained in Appendix 10, to allow access for construction and maintenance.

Flood risk management infrastructure shall be provided at the strategic level, where development opportunities allow, to reduce the hazard and probability of flooding.

Appendix C – Topographical Survey

Appendix D – Breach Analysis

River Glen - 1:100-year event + 17% Climate Change

Defence Crest Levels (h1)	4.79	m
Average Ground Level behind defences (h2)	2	m
1 in 100 year flood level plus climate change (h3)	4.79	m
Assumed length of breach (B)	40	m
Max head over breach (h)	2.79	m
Peak flow (Q) = $1.7xBxh^{3/2}$	316.9	m^3s^{-1}

Peak flow (Q)	316.9	m^3s^{-1}
Assuming Energy Grad (S)	0.001	-
Assume % obstructions to flow	0	-
Assuming mannings (n)	0.03	-

	Scenario					
	1	2	3	4	5	6
Distance from breach	0	1000	2000	3000	3500	4000
Perimeter of Flood Wave (Assumed Channel Width)	40	3182	6324	9466	11037.0	12608
Effective perimeter (P)	40	3182	6324	9466	11037.0	12608
Normal Depth y = $((Qn/(b \times S^{0.50}))^{0.6}$	3.354	0.243	0.161	0.126	0.115	0.106

Time to Reach Development

Distance from breach above plus 1.0m	1	1001	2001	3001	3501	4001
Perimeter of Flood Wave (Assumed Channel Width)	43.1	3185.1	6327.1	9469.1	11040.1	12611.1
Normal Depth y = $(Qn/(bxS^{0.5}))^{0.6}$	3.205	0.243	0.161	0.126	0.115	0.106
Volume in Additional 1.0m	138.3	772.8	1017.0	1194.9	1270.6	1340.1
Speed to cover additional 1.0m (m/s)	2.29	0.41	0.31	0.27	0.25	0.24
Average time to reach radius (secs)	-	2197.0	5779.4	10184.5	12633.7	15227.2
Average time to reach radius (mins)	-	36.6	96.3	169.7	210.6	253.8

River Glen - 1:100-year event + 53% Climate Change

Defence Crest Levels (h1)	4.85	m
Average Ground Level behind defences (h2)	2	m
1 in 100 year flood level plus climate change (h3)	4.85	m
Assumed length of breach (B)	40	m
Max head over breach (h)	2.85	m
Peak flow (Q) = $1.7xBxh^{3/2}$	327.2	m^3s^{-1}

Peak flow (Q)	327.2	m^3s^{-1}
Assuming Energy Grad (S)	0.001	-
Assume % obstructions to flow	0	-
Assuming mannings (n)	0.03	-

	Scenario					
	1	2	3	4	5	6
Distance from breach	0	1000	2000	3000	3500	4000
Perimeter of Flood Wave (Assumed Channel Width)	40	3182	6324	9466	11037.0	12608
Effective perimeter (P)	40	3182	6324	9466	11037.0	12608
Normal Depth y = $((Qn/(b \times S^{0.50}))^{0.6}$	3.419	0.247	0.164	0.129	0.117	0.108

Time to Reach Development

Distance from breach above plus 1.0m	1	1001	2001	3001	3501	4001
Perimeter of Flood Wave (Assumed Channel Width)	43.1	3185.1	6327.1	9469.1	11040.1	12611.1
Normal Depth y = $(Qn/(bxS^{0.5}))^{0.6}$	3.267	0.247	0.164	0.129	0.117	0.108
Volume in Additional 1.0m	141.0	787.8	1036.6	1218.0	1295.2	1366.0
Speed to cover additional 1.0m (m/s)	2.32	0.42	0.32	0.27	0.25	0.24
Average time to reach radius (secs)	-	2169.2	5706.0	10055.3	12473.5	15034.0
Average time to reach radius (mins)	-	36.2	95.1	167.6	207.9	250.6

River Glen - 1:1000-year event + 17% Climate Change

Defence Crest Levels (h1)	4.82	m
Average Ground Level behind defences (h2)	2	m
1 in 1000 year flood level plus climate change (h3)	4.82	m
Assumed length of breach (B)	40	m
Max head over breach (h)	2.82	m
Peak flow (Q) = $1.7xBxh^{3/2}$	322.0	m^3s^{-1}

Peak flow (Q)	322.0	m^3s^{-1}
Assuming Energy Grad (S)	0.001	-
Assume % obstructions to flow	0	-
Assuming mannings (n)	0.03	-

	Scenario					
	1	2	3	4	5	6
Distance from breach	0	1000	2000	3000	3500	4000
Perimeter of Flood Wave (Assumed Channel Width)	40	3182	6324	9466	11037.0	12608
Effective perimeter (P)	40	3182	6324	9466	11037.0	12608
Normal Depth y = $((Qn/(b \times S^{0.50}))^{0.6}$	3.387	0.245	0.162	0.127	0.116	0.107

Time to Reach Development

Distance from breach above plus 1.0m	1	1001	2001	3001	3501	4001
Perimeter of Flood Wave (Assumed Channel Width)	43.1	3185.1	6327.1	9469.1	11040.1	12611.1
Normal Depth y = $(Qn/(bxS^{0.5}))^{0.6}$	3.236	0.245	0.162	0.127	0.116	0.107
Volume in Additional 1.0m	139.6	780.3	1026.8	1206.5	1282.9	1353.0
Speed to cover additional 1.0m (m/s)	2.31	0.41	0.31	0.27	0.25	0.24
Average time to reach radius (secs)	-	2183.0	5742.4	10119.3	12552.9	15129.8
Average time to reach radius (mins)	-	36.4	95.7	168.7	209.2	252.2

River Glen - 1:1000-year event + 53% Climate Change

Defence Crest Levels (h1)	5.33	m
Average Ground Level behind defences (h2)	2	m
1 in 1000 year flood level plus climate change (h3)	5.33	m
Assumed length of breach (B)	40	m
Max head over breach (h)	3.33	m
Peak flow (Q) = $1.7xBxh^{3/2}$	413.2	m^3s^{-1}

Peak flow (Q)	413.2	m^3s^{-1}
Assuming Energy Grad (S)	0.001	-
Assume % obstructions to flow	0	-
Assuming mannings (n)	0.03	-

	Scenario					
	1	2	3	4	5	6
Distance from breach	0	1000	2000	3000	3500	4000
Perimeter of Flood Wave (Assumed Channel Width)	40	3182	6324	9466	11037.0	12608
Effective perimeter (P)	40	3182	6324	9466	11037.0	12608
Normal Depth y = $((Qn/(b \times S^{0.50}))^{0.6}$	3.933	0.285	0.189	0.148	0.135	0.125

Time to Reach Development

Distance from breach above plus 1.0m	1	1001	2001	3001	3501	4001
Perimeter of Flood Wave (Assumed Channel Width)	43.1	3185.1	6327.1	9469.1	11040.1	12611.1
Normal Depth y = $(Qn/(bxS^{0.5}))^{0.6}$	3.759	0.285	0.188	0.148	0.135	0.125
Volume in Additional 1.0m	162.2	906.2	1192.5	1401.2	1489.9	1571.4
Speed to cover additional 1.0m (m/s)	2.55	0.46	0.35	0.29	0.28	0.26
Average time to reach radius (secs)	-	1975.7	5197.3	9158.7	11361.3	13693.5
Average time to reach radius (mins)	-	32.9	86.6	152.6	189.4	228.2

E521360.00 E521400.00 E521420.00 E521440.00 E521460.00 E521480.00 E521500.00

N329820.00 N329800.00 N329780.00 N329760.00 N329740.00



NOTES

ABBREVIATIONS & SYMBOLS

AV	AIR VALVE	OHC	OVERHEAD CABLE
BH	BORE HOLE	PB	POST BOX
BOL	BOLLARD	PINV	PIPE INVERT LEVEL
CATV	CABLE TV MH	PM	PARKING METER
CCTV	SECURITY CAM	PO	POST
CL	COVER LEVEL	PT	PIPE TOP LEVEL
CH	CHANNEL	P/R	POST & RAIL FENCE
COL	COLUMN	P/W	POST & WIRE FENCE
DC	CABLE TV LID	RD	EDGE OF ROAD.NO KERB
DP	DOWN PIPE	RE	RODDING EYE/POINT
DR	DRAIN	RL	RIDGE LEVEL
EL	EAVES LEVEL	RP	REFLECTIVE POST
EP	ELECTRIC POLE	RS	ROAD SIGN
ER	EARTH ROD	SLVL	STONE LEVEL
FB	FLOWER BED	SOFF	SOFFIT LEVEL
FH	FIRE HYDRANT	SV	VALVE
FFL	FINISHED FLOOR LEVEL	SW	SURFACE WATER
FP	FLAG POLE	Tac	TACTILE PAVING
FW	FOUL WATER	TH	TRIAL HOLE
GV	GAS VALVE	TL	TRAFFIC LIGHTS
HW	HEADWALL	TLVL	TARMAC LEVEL
IC	INSPECTION COVER	TOW	TOP OF WALL LEVEL
IL	I NVERT LEVEL	TP	TELEGRAPH POLE
KB	KERB BOTTOM	TRK	TRACK
KO	KERB OFFLET	UTL	UNABLE TO LIFT
KT	KERB TOP	VP	VENT PIPE
LP	LAMP POST	WL	WATER LEVEL
LC	LIGHT COLUMN	WLVL	WATER LEVEL
MH	MANHOLE	WM	WATER METER
MP	MARKER POST	WO	WASH OUT POINT

FENCE, HEDGE, ELECTRIC, BANK EDGE, STORM LINE, FOUL LINE, TELECOM LINE, GAS LINE, LARSON PILES, CHANNELS, WATER MAIN

TREE, BOREHOLE, STATION, TBM, MANHOLE, GULLY, BATTER, WATER LVL, GATE

1. THE POSITION OF THIS SURVEY IS BASED ON GPS OSTN15 GRID
2. ALL LEVELS RELATE TO HGTS TAKEN USING TRIMBLE VRS NOW
3. TREES SPREADS ARE DRAWN TO SCALE AND SHOW THE GENERAL/AVERAGE CANOPY SPREAD.
4. ALL BELOW GROUND LEVEL INFORMATION INCLUDING VOIDS, DRAINAGE & SERVICES HAVE BEEN IDENTIFIED FROM THE SURFACE LEVEL ONLY, THEREFORE PIPE SIZES ETC ARE ESTIMATIONS ONLY. ALL CRITICAL DIMENSIONS SHOULD BE CHECKED PRIOR TO THE COMMENCEMENT OF ANY SITE WORKS
5. EVERY EFFORT HAS BEEN MADE TO LOCATE AND SURVEY ALL VISIBLE FEATURES. IT SHOULD BE NOTED THAT SOME ITEMS MAY HAVE BEEN OBSCURED AT THE TIME OF THE SURVEY AND THEREFORE NOT SHOWN ON THIS DRAWING.
6. PHYSICAL BOUNDARY FEATURES SHOWN ON THIS DRAWING DO NOT NECESSARILY REPRESENT THE ACTUAL LEGAL BOUNDARIES. THIS INFORMATION SHOULD BE CONFIRMED WITH THE RELEVANT DOCUMENTATION.
7. THE CONTRACTOR MUST CHECK AND VERIFY ALL SITE LEVELS, DIMENSIONS, UTILITIES AND DRAINAGE DETAILS PRIOR TO THE COMMENCEMENT OF ANY SITE WORKS. ANY DISCREPANCIES MUST BE NOTIFIED TO CASTLE HILL SURVEYS LTD.
8. ALL SURVEY STATION CONTROL POINTS MUST BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING ANY SITE WORKS.

Point	Easting	Northing	Elevation
J1	521467.656	329798.126	3.155
J2	521446.048	329804.430	3.316
J3	521419.302	329822.977	3.229

SURVEY DATE	03 / 04 / 2024	INITIALS	JT

REV	AMENDMENTS	DRN	DATE
A	EAVES ADDED FOR HOUSE	JT	5/4/24

Client:
ORIGIN DESIGN STUDIO

Project Title:
RISEGATE HOUSE
HEDGEFIELD HURN
GOSBERTON

Drawing Title:
TOPOGRAPHICAL SURVEY

Scale @ A1: 1:200	Date: 03 / 04 / 2024
Drawing No: C H S 2 4 - 7 0 - 0 1	Rev: A
C.A.D.Title: ods risegate house gosberton\topo (chs 24-70-01).mjo	
Drawn By: JT	Checked By: SRW

CASTLE HILL SURVEYS LTD
Land Surveying & Site Setting Out Services
Commerce House, Carlton Boulevard,
Lincoln, LN2 4WJ Tel : 07710649549
E-mail : castlehillsurveys@outlook.com
Website : www.castlehillsurveys.co.uk

Appendix E – Environment Agency Flood Data

Rob Cole
rob@origindesignstudio.co.uk

Our ref: CCN-2024-350989

Date: 15/03/2024

Dear Rob,

Provision of Flood Risk Information for Hedgefield Hurn, Gosberton Risegate.

Thank you for your request for our flood risk information for the above site. The information is set out below and attached. It is important you read any contextual notes on the maps provided.

If you are preparing a Flood Risk Assessment (FRA) for this site, please note this information may not be sufficient by itself to produce an adequate FRA to demonstrate the development is safe over its lifetime. Additional information may be required to carry out an appropriate assessment of all risk, such as consequence of a breach in defences.

We aim to review our information on a regular basis, so if you are using this data more than twelve months from the date of this letter, please contact us again to check it is still valid.

Please read the letter in full as the information covered has been updated in **June 2023.**

1. Flood Map for Planning

The attached map includes the current Flood Map for Planning for your area. The map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

In some locations, such as around the fens and the large coastal floodplains, showing the area at risk of flooding assuming no defences may give a slightly misleading picture in that if there were no flood defences, water would spread out across these large floodplains. This flooding could cover large areas of land but to relatively shallow depths and could leave pockets of locally slightly higher land as isolated dry islands. It is important to understand the actual risk of the flooding to these dry islands, particularly in the event of defence failure.

The Flood Map for Planning also shows the location of formal raised flood defences and flood storage reservoirs. It represents areas at risk of flooding for present day only and does not take account of climate change.

The Flood Map for Planning only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered flooding may occur from other sources such as surface water sewers, road drainage, etc.

2. Recorded Flood Outlines

With regards to the history of flooding I can advise we do not have any records of flooding in this area. It is possible recent flooding may have occurred which we are currently investigating, therefore this information may be subject to change. It is possible other flooding may have occurred which other risk management authorities, such as the Lead Local Flood Authority (ie top tier council) or Internal Drainage Board (where they exist) have responsibility.

Please note, our Recorded Flood Outlines do not reflect the latest (October 2023-present) flood incidents. Due to the scale of the events, it will take time to gather the information and verify the extent of the flooding before we are able to provide this information.

3. Schemes in the area

There are no ongoing capital projects to reduce or sustain the current flood risk to this site.

4. Fluvial Flood Risk Information

This site is considered to be at risk of flooding from main rivers.

The site may also be at risk from local ordinary watercourses for which other risk management authorities, such as the Lead Local Flood Authority (ie top tier council) or Internal Drainage Board (where they exist) have responsibility.

4.1 Fluvial Defence Information

There are no formal flood defences reducing the risk of flooding to this site.

4.2 Fluvial Modelled Levels and Flows

Available modelled fluvial flood levels and flows for the model nodes shown on the attached map are set out in the data table attached. This data is taken from the model named on the data table, which is the most up-to-date model currently available.

Please note 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.

Our models may not have the most up to date climate change allowances. In time we will update our models for the latest allowances. You should refer to 'Flood risk assessments: climate change allowances' to check if the allowances modelled are appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.

4.3 Fluvial Modelled Flood Extents

Please find attached a map showing available modelled flood extents, taking into account flood defences, for your area. This data is taken from the model named on the map, which is the most up-to-date model currently available.

In some cases the flood extents shown may not be from main river, but may be from other sources such as IDB lowland drainage networks.

4.4 Fluvial Hazard Mapping

For certain locations we have carried out modelling to map the maximum values of flood depth, velocity and hazard rating (danger to people) resulting from overtopping and / or breaching of defences at specific locations for a number of scenarios.

At present this information is available for fluvial flood risk in Northampton, Lincoln, Wainfleet and some isolated rural locations.

The number of locations we have this information for is expected to increase in time.

At present this site is not covered by any Environment Agency hazard mapping.

Detailed Hazard Mapping is available within the 2017 Update of South Holland Strategic Flood Risk Assessment. This can be downloaded via the following link:
http://www.southeastlincslocalplan.org/water/

5. Tidal Flood Risk Information

This site is not considered to be at risk from tidal flooding.

6. Development Planning

If you would like local guidance on preparing a flood risk assessment for a planning application, please contact our Sustainable Places team at LNplanning@environment-agency.gov.uk. It will help if you mention this data request and attach your site location plan.

We provide free preliminary advice; additional/detailed advice, review of draft FRAs and meetings are chargeable at a rate set to cover our costs, currently £100 (plus VAT) per hour of staff time. Further details are available on our website at
https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals.

General advice on flood risk assessment for planning applications can be found on GOV.UK at https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

Climate change will increase flood risk due to overtopping of defences. Please note, unless specified otherwise, the climate change data included has an allowance for 20% increase in flow. Updated guidance on how climate change could affect flood risk to new development - 'Flood risk assessments: climate change allowances' was published on GOV.UK in **July 2021**. The appropriate updated climate change allowance should be applied in a Flood Risk Assessment.

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

7. Data Licence and Other Supporting Information

We respond to requests for recorded information we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

This information is provided in accordance with the Open Government Licence which can be found here: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Further information on flood risk can be found on the GOV.UK website at:
https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather

8. Other Flood Risk Management Authorities

The information provided with this letter relates to flood risk from main river or the sea. The Flood Map for Surface Water can be viewed at https://www.gov.uk/check-long-term-flood-risk

Additional information may be available from other risk management authorities, such as the Lead Local Flood Authority (ie top tier council) or Internal Drainage Board (where they exist).

I hope we have correctly interpreted your request. If you have any queries or would like to discuss the content of this letter further please contact Christopher using the email address below and quoting our CCN reference number above.

Yours sincerely,

Yours sincerely,

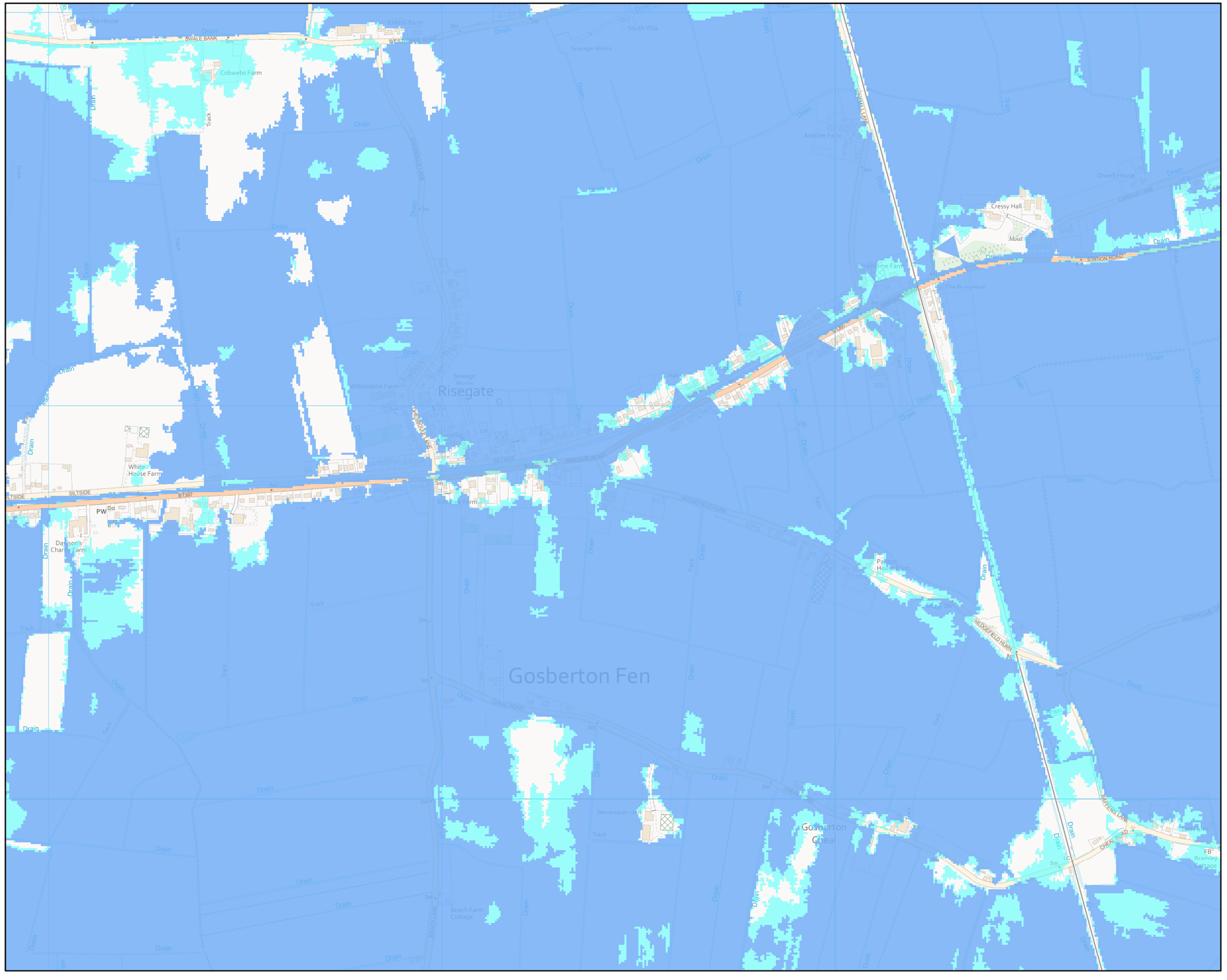


+44 7385226602

for Ben Thornely
Area Flood and Coastal Risk Manager
e-mail PSOWN@environment-agency.gov.uk

Enc.
Flood Map for Planning
Modelled Node Points Map
Modelled Fluvial Levels and Flows Data Sheet
Modelled Flood Extent Maps

Flood Map centred on TF 21421 29772 - created March 2024 [Ref: CCN-2024-350989]



Environment Agency

Scale 1:10,000

N

Legend

- Main Rivers
- Raised Defences
- Flood Storage Areas
- Areas at Risk of Flooding from Rivers or the Sea
- Extreme Flood Outline

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.

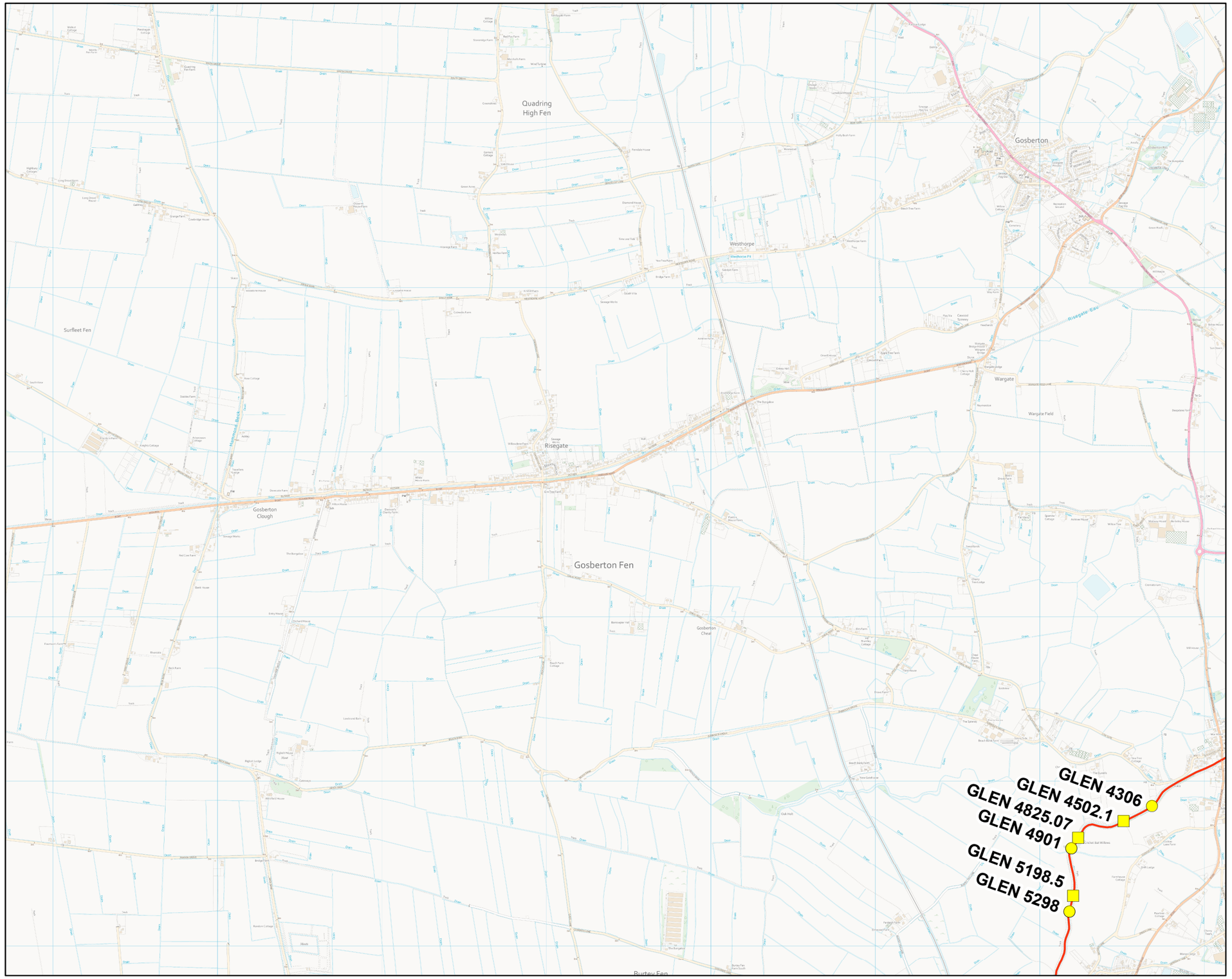
These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Sites outside the two extents, but behind raised defences, may be affected by flooding if the defences are overtopped or fail.

Created by the Partnerships and Strategic Overview Team, Kettering

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Modelled Nodes Map centred on TF 21421 29772 - created March 2024 [Ref: CCN-2024-350989]



Environment Agency

Scale 1:24,000

N

Legend

- Modelled Nodes - Levels
- Modelled Nodes - Flows
- Main Rivers

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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).

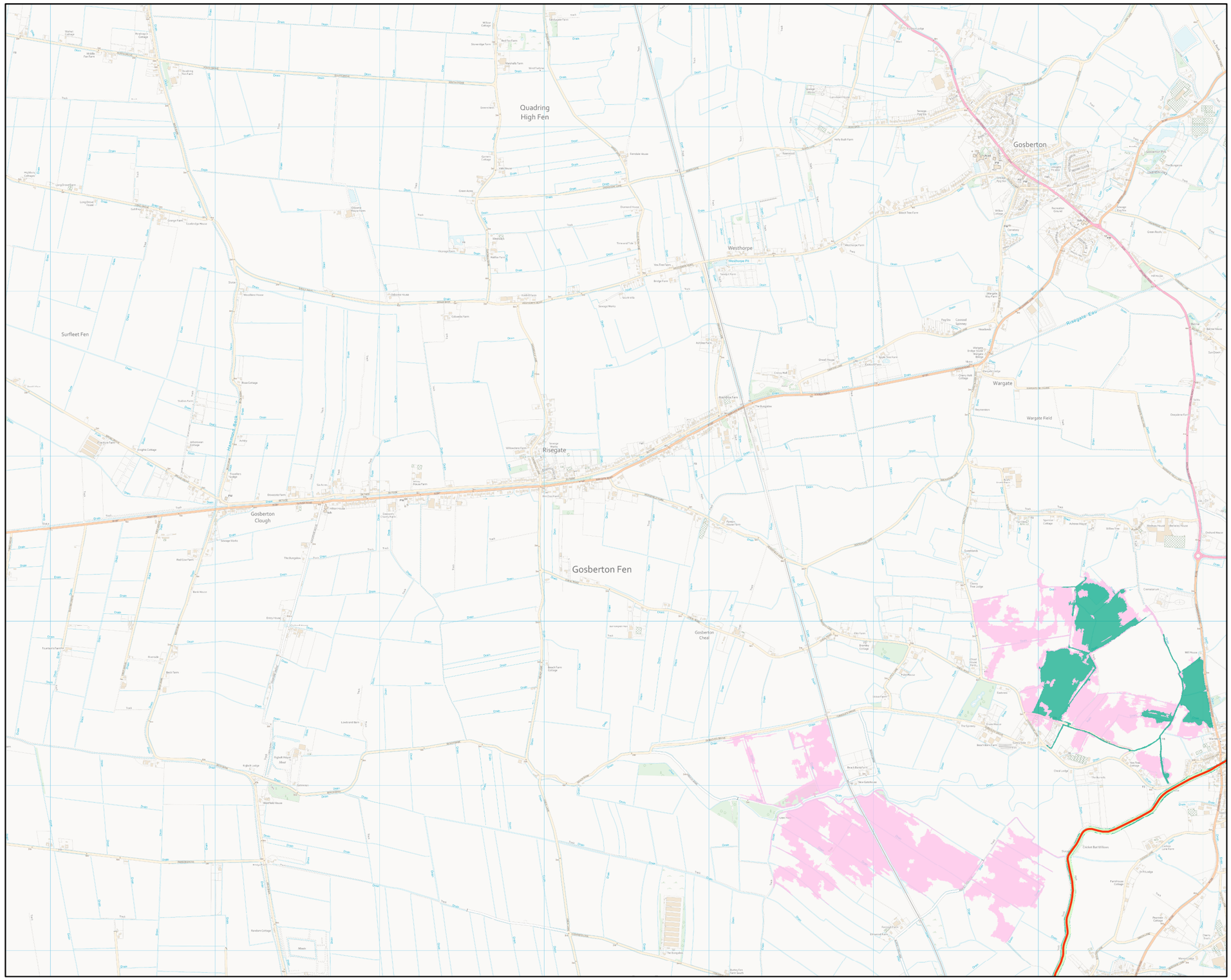
			Annual Exceedance Probability - Maximum Water Levels (mODN)											
Node Label	**Easting**	**Northing**	**50% (1 in 2)**	**20% (1 in 5)**	**10% (1 in 10)**	**5% (1 in 20)**	**3.33% (1in 30)**	**2% (1 in 50)**	**1.33% (1 in 75)**	**1% (1 in 100)**	**1% (1 in 100) inc 20% Climate Change**	**0.5% (1 in 200)**	**0.1% (1 in 1000)**	**0.1% (1 in 1000) inc 20% Climate Change**
GLEN 4306	524683	327849	3.97	4.12	4.20	4.25	4.23	4.25	4.26	4.27	4.78	4.33	4.41	4.81
GLEN 4901	524192	327594	3.97	4.12	4.21	4.27	4.24	4.27	4.29	4.29	4.79	4.33	4.42	4.82
GLEN 5298	524181	327209	3.98	4.12	4.21	4.29	4.26	4.28	4.30	4.31	4.80	4.35	4.44	4.84

Fluvial Flood Flows (m^3/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 (m^3/s).

			Annual Exceedance Probability - Maximum Flows (m^3/s)											
Node Label	**Easting**	**Northing**	**50% (1 in 2)**	**20% (1 in 5)**	**10% (1 in 10)**	**5% (1 in 20)**	**3.33% (1in 30)**	**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**
GLEN 4502.1	524509	327759	30.92	33.63	35.17	37.21	38.21	39.03	39.82	40.35	49.42	49.42	49.42	59.19
GLEN 4825.07	524234	327657	29.64	32.51	34.17	36.26	37.11	37.93	38.54	39.24	47.82	47.82	47.82	58.10
GLEN 5198.5	524204	327305	28.41	31.52	33.21	35.41	36.06	36.89	37.55	38.20	46.59	46.59	46.59	57.39

Modelled Flood Extents (with defences) Model: Welland Strategic Model (2016) centred on TF 21421 29772 - created March 2024 [Ref: CCN-2024-350989]



Environment Agency

Scale 1:24,000

N

Legend

- Main Rivers
- 3.33% (1 in 30) fluvial event
- 1% (1 in 100) fluvial event
- 1% (1 in 100) inc 20% climate change fluvial event
- 0.1% (1 in 1000) fluvial event
- 0.1% (1 in 1000) inc 20% climate change fluvial event

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