



STRUCTURAL ENGINEERS

[CONSULTING CIVIL & STRUCTURAL ENGINEERS]

Land to the North of Sutton Bridge,

Flood Risk Assessment

R - 1886/S - 002

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DESIGN BRIEF

The client requires a flood risk and drainage strategy to accompany the planning application for land North of Chestnut Terrace, Sutton Bridge for a new residential development. The following report provides research into the likelihood of flooding in the area, along with preliminary design proposals to ensure storm water is managed adequately.

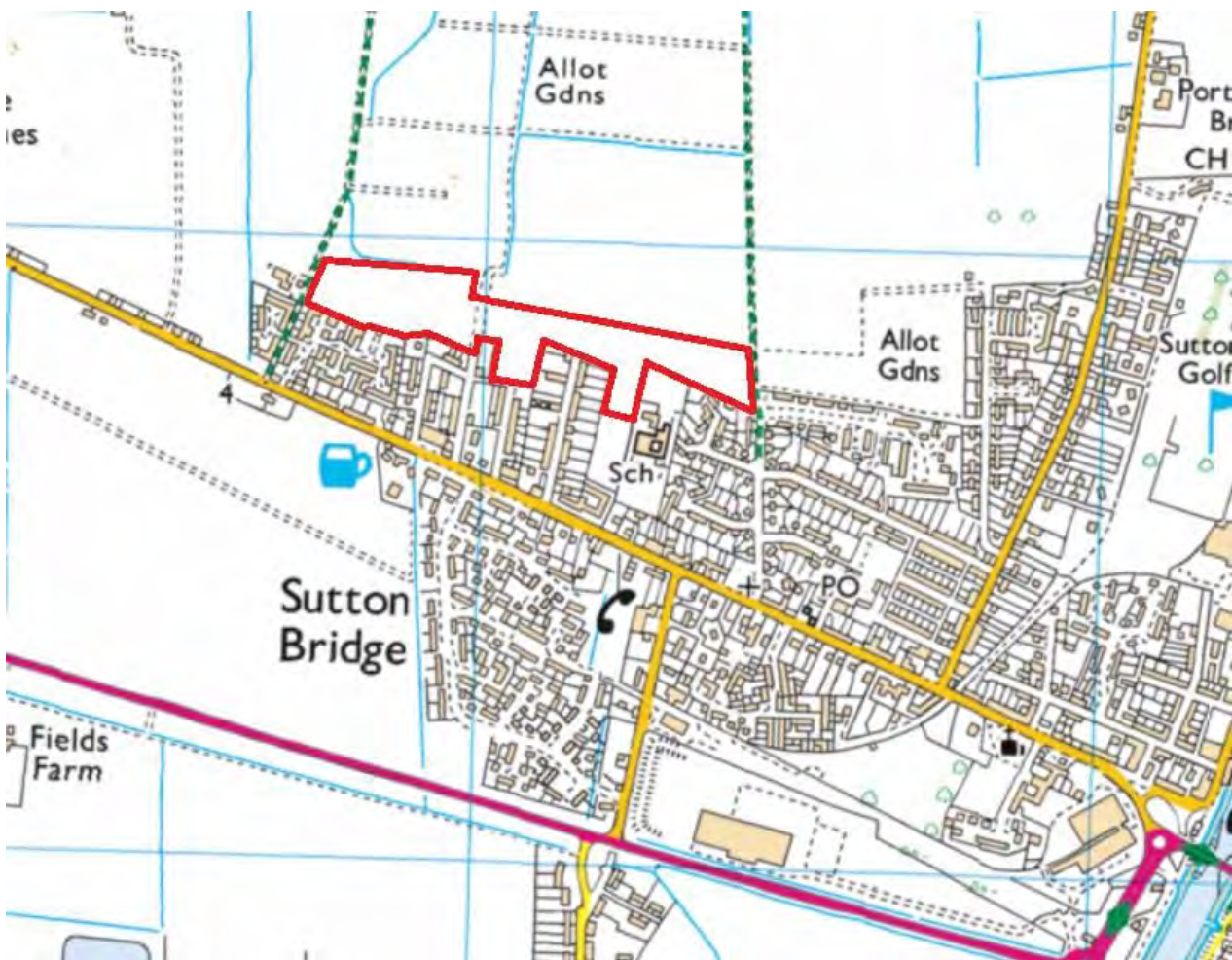
INTRODUCTION

This report is a flood risk assessment which has been prepared by SEA Structural Engineers on behalf of Lincoln Jack Ltd. for a proposed new residential development at land situated to the north of Sutton Bridge. The National Grid reference for the site is E547140, N321833. The benefit of this report is limited to our instructing Client.

The objective of this report is to advise interested parties in the development to the potential risk of flooding and management of surface water from a drainage perspective.

This report has been prepared to support an application for full planning permission.

The proposed site is located on Greenfield land towards the north of Sutton Bridge. There are existing residential developments to the south and east, with the west and northern being open greenfield land. Appendix 1 presents the site location plan.



Site location plan. Approximate site boundary outlined in red.

DESCRIPTION AND HISTORY OF THE SITE

With reference to historic maps the site has been undeveloped and can be classified as Greenfield.

Generally the site topography varies from 3.30 to 3.6 and can be considered relatively flat. Appendix 2 presents the topographical survey for the site.

Key features outside the site boundary;

- North – Agricultural land.
- East - Agricultural land and existing residential development
- South - Existing residential development and Sutton Bridge main settlement
- West - Agricultural land

PROPOSED DEVELOPMENT

The proposed development will comprise the construction of 129 new residential dwellings along with all associated infrastructure. Appendix 3 presents the development layout.

GEOLOGY OF SITE

A ground investigation has been completed by AGS Ground Solutions Ltd, ref A1816-2 and shows that the site is underlain by Tidal Flat Deposits over the Ampthill Clay formation.

As part of the ground investigation works infiltration testing was carried out in 2 locations and concludes that due to the potential for higher ground water and poor infiltration rates exhibited, that the site is unlikely to be able to drain to soakaways. Other sources will be explored as part of this report.

FLOOD RISK VULNERABILITY

In accordance with the Planning Practise Guidance to the National Planning Policy Framework (NPPF), the development can be classified as more vulnerable. An extract of table 2 of the afore mentioned guidance is presented below

More vulnerable

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

FLOODING FROM RIVERS AND SEA

The Environment Agency determines the flood risk zone from rivers and sea and their data collected is shown below;



Extract from Flood Map for Planning from the Gov.uk website dated 06.08.2020

As can be seen from the above the site is located within flood zone 3, defined as high risk (1% or greater from rivers and 0.5% or greater from the sea in any given year).

The site is shown within the defended area of the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) map and is located in the South Holland Internal Drainage Board district. Based table 3 of the EA flood risk guidance, presented below and a development classification of more vulnerable, a sequential and exception test will be required.

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.

Extract from Table 3 – Flood vulnerability and flood zone 'classification

Sequential Test

The aim of the Sequential Test, as set out in the NPPF, is to ensure that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones as defined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

As can be seen from the flood risk map presented above the whole of the west side of Sutton Bridge is in Flood Zone 3. Therefore it would be difficult to find a similar site for development within the town boundary that is in a lower flood zone. The South Holland District Council Core Strategy states that there are limited sites outside the town of Spalding available for residential development. Therefore there is a requirement for further land to be brought forward and used for residential development.

We therefore conclude that the sequential test has been passed

Exception Test

As the sequential test has demonstrated that it is not possible for the development to be located in areas with a lower probability of flooding, the Exception Test must be applied, in accordance with EA guidance for this to be passed the following must be provided;

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risks, informed by the Strategic Flood Risk Assessment; and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking into account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall..

The first section will be demonstrated by the supporting Planning Statement and compliance with South Holland District Council's planning policies. This flood risk assessment will demonstrate that the development will be safe for its lifetime and it will not increase flood risk elsewhere.

EA flood Data

To better understand the flood risk from river and seas we have obtained flood level data from the Environment Agency, this data is presented in appendix 4. This shows that there are raised flood defences along the river Nene approximately 1.4km west of the site. They have indicated that that the site is at risk of 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 and assumes that no flood defences exist. Below we have provided a table summarising the data

	Maximum Hazard	Maximum Depth	Maximum Velocity
1 in 200 (0.5%) year in 2006	0.75 and 1.25 (Danger for some)	0.25 – 0.5m	0 – 0.3 m/sec
1 in 1000 (0.1%) year in 2006	0.75 -1.25 (danger for most)	0.5 – 1.0m	0 – 0.3 m/sec
1 in 200 (0.5%) year in 2115	Greater than 2.0 (danger for all)	1.0 – 1.6m	0 – 0.3 m/sec
1 in 1000 year in 2115	Greater than 2.0 (danger for all)	1.0 – 1.6m	0 – 0.3 m/sec

Summary of flood risk from EA data

We have also reviewed the South Holland Strategic Flood Risk Assessment which was updated in 2016. The flood risk maps presented in the SFRA are identical to the maps by the EA and summarised above.

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring due to overtopping or failures of the defences is considered to be very low. The site is located approximately 1.4 km from the tidal section of the River Nene, which is maintained by the Environment Agency. The maps supplied by the Environment Agency predict flood depths of up to 1.6m if a breach were to occur in a 1 in 200 year event in 2115. It is also likely that the EA will undertake further bank raising within the next 100 years to ensure that there is a continuing 1 in 200 year defence to Long Sutton and Sutton Bridge.

We have consulted the EA with regards to a proposed mitigation strategy should a breach occur and they have advised the in accordance with the South East Lincs standard advise matrix for a predicted flood depth of 1.0-1.6m that '*Proposals must have a minimum of 2 storeys, with FFL set a minimum of 1m above existing ground level, flood resilient construction to a height 300mm above the predicted flood depth, and demountable defences to 600mm above FFL*'. This development will follow this advice and occupiers of the property will be recommended to register with the Environment Agency's Floodline Warnings Direct Service. We therefore conclude that the risk of flooding from river and sea to be low.

The predictions of flood depths used by the Environment agency presented above were produced in 2006. The EA have issued new guidance on the recommend allowances for climate change on predicted sea level rises, fluvial flow and rainfall intensities from February 2016 and updated in July 2020 which will need to be considered in this assessment. The main source of flood risk to this development is tidal; therefore the allowances of sea levels rises will need to be compared. Prior to February 2016 the recommend allowance for sea levels rises for this area from 1990 to 2115 was +1.14m. Updated guidance presented below based on river basin districts now indicates an allowance of +1.20m and +1.60m from 2000 to 2125. This represents an increase of 60-460mm, which is unlikely to have a significant impact on the flood risk maps for the area.

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20
Anglian	Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60

Extract from table 3 of EA guidance, Flood risk Assessment: Climate change allowances

FLOODING FROM SURFACE WATER

With reference to the EA map 'Flood risk from surface water', extract provided below the site can be seen to have a very low risk of surface water flooding (less than 1in1000).



Extract from flood risk from surface water flooding, gov.uk website, date 06.08.2020

The development is within an area in which local drains/watercourses/ditches are maintained by South Holland IDB who control surface water into the River Nene and the wash.

This area of Sutton Bridge is within the Westmere catchment and outfalls through the Westmere Sluice into the tidal River Nene during low tides. There are IDB drains to the north west and north east of the development and the levels around these drains are lower than the development site

The channels maintained by South Holland IDB in urban areas are classified as high priority watercourses and as such receive a higher maintenance priority. Should there be a failure of the outfall sluices then the IDB would be informed of the problem by their telemetry system and would take immediate action to deal with this

IDB systems are designed to provide a freeboard of between 600mm and 1000mm to all land in a 1 in 10 year return period rainfall event. This normally provides a standard of service of between 1 in 50 years and 1 in 100 years against flooding. With this and the proposed mitigation strategy of raising FFLS 1m above existing ground levels we therefore conclude that the risk of surface water flooding to the low.

FOODING FROM RESERVOIRS, CANALS AND OTHER ARTIFICIAL SOURCES

Below is an extract from the EA map 'Risk of Flood Flooding from Reserviors.' The site is not in an area at risk of flooding from reserviors, canals and other artifical sources.



Extract from EA map 'flood risk from reservoirs', dated 06.08.2020

FLOODING FROM GROUND WATER

We are not aware of any flooding on this site caused by groundwater and therefore consider the risk of ground water flooding to be low

FLOODING FROM SEWERS

There is a surface water sewer maintained by Anglian water to the east of development and there is a risk of overtopping of water levels within this sewer, however the risk of such an event is considered low.

HISTORIC FLOODING

With reference to the information provided by the EA presented in appendix 4 and the extract below the site has not been subject to historic flooding.

Historic Flood Map centred on TF47177 21844 - created December 2018 [Ref: CCN-2018-110730]



Extract from historic flood map from the EA

MANAGEMENT OF STORM WATER

The site is currently Greenfield with no existing drainage. Therefore Greenfield runoff calculations shall be used to calculate the allowable runoff rate from the site.

It is a requirement of the Building Regulations 2013 (part H) to discharge surface water collected by the new development to one of the following, listed in order of priority;

1. An adequate soakaway or some other adequate infiltration system.
2. A watercourse.
3. A sewer.

As discussed previously A ground investigation from AGS Ground Soluation Ltd has indicated that soakaways will not be suitable this development, therefore the use of soakways had not been consider further.

The development will be split into two catchments due to storm drainage invert level constraints. One outfall for the western catchment to an existing IDB drain to the north and one outfall for Eastern catchment to an existing Anglian Water sewer located to the east of the development.

We have undertaken a pre-development enquiry with Anglian Water, their report is present in appendix 5. They have indicated that there is surface water sewers located towards the developments eastern boundary which has capacity to receive the development flows with a restricted of 5l/s required. This Sewer is 900mm and outfalls to the north towards an existing IDB drain.

PROPOSED STORM WATER STRATEGY

The proposals are to split the development into two catchments, east and west and drain the west to an existing IDB drain and the east to the existing Anglian Water storm sewer. The design of the attenuation will be for all impermeable areas on the site to accommodate storms up to the 1 in 100 year event and allow for the increase in storm intensities up to 40% (design life of the development assumed to be greater than 60 years). The site impermeable areas are presented in appendix 6 and equates to a total area of 32,387m², we have increased the impermeable of the roof and drives by 10% to take into account urban creep.

**Table 2 peak rainfall intensity allowance in small and urban catchments
(use 1961 to 1990 baseline)**

Applies across all of England	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)
Upper end	10%	20%	40%
Central	5%	10%	20%

The allowable Greenfield runoff rate has been calculated using the HR Wallingford Greenfield runoff rate estimation tool and has been based on the sites total impermeable area of 32,387m². Appendix 7 presents the results of the Greenfield runoff calculations which indicate the Q-bar value to be 4.77l/s.

The greenfield runoff calculated above is likely to require a flow control device with a small aperture which in the long term will become a maintenance issue. We are proposing to restrict each of the catchments runoff to 5l/s based on the pre-development enquiry with Anglian Water and discussions with the IDB regarding flow rates.

It is proposed to outfall the developments surface water via a new piped network and outfall the western catchment to the IDB drain to the north and the eastern catchment to the Anglian Water sewer to the east.

Due to the invert level of the IDB drain and to ensure adequate depth for the storm water pipework we are proposing to utilise a storm water pumping station for the western catchment which will be offered for adoption to Anglian Water.

Attenuation will be in the form of an online detention basin for the western catchment and an underground storage tank for the eastern catchment which will provide attenuation for the sites flows for all storm events up to a 1 in 100 year event plus a 40% allowance for climate change. We have modelled the storm water network using Causeway Flow and have calculated that the attenuation volume to be 1125m³ for the western catchment and 1247m³ for the eastern catchment. The calculations are presented in appendix 9. An indicative drainage layout is presented in appendix 10.

SUDS

In accordance with South Holland District Council policies for any development larger than 10 dwelling there is a requirement to apply sustainable drainages principles to the development. In accordance with the CIRIA SUDS Manual surface water should be controlled at source and suitably treat any surface water runoff to ensure that water quality is improved. As explain in previous paragraphs the use of soakaways is not possible on this site.

In order to provide an assessment of the water treatment required we have referred to the SUDS Manual chapter 26 "*Water Quality Management: design methods*" table 26.2 of this chapter, extract below, provides the pollution hazard indices based on development use.

TABLE 26.2 Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
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
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Extract from table 26.2, SUDS Manual

Given the site use the hazard levels can be classified as very low and low and we need to mitigate for the following combined pollution indices;

- TSS – 0.7
- Metals – 0.6
- Hydrocarbons – 0.45

It is proposed to utilise permeable block paving for all private drives, filter drains for all access roads and for the western catchment an online detention basin, table 26.3, extract below, clearly shows the use of permeable paving, filter drains and a detention basin will adequately mitigate against the above pollution indices.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	Mitigation indices ¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	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.		

Extract from table 26.3, SuDS Manual

OVERLAND FLOWS

The proposed development will be designed for a 1 in 100 year event + 40%. There is a risk, although very low, that we could experience a storm event exceeding this return period. During such an event the sites drainage system will become overwhelmed and overland flows are likely. Any overland flows will be directed away from dwellings and towards the site access roads and POS.

MANAGEMENT OF FOUL WATER

Foul water will be outfall into existing sewers located within Chestnut Terrace as confirmed in the AW pre development enquiry. Due to level constraints at the site an outfall via gravity will not be possible, therefore it is proposed to utilise two adoptable pumping stations for each catchment.

MAINTAINANCE

It is proposed to offer the main surface water sewers for adoption to Anglian Water. Drains and SUDS located within private areas will remain the responsibility of the householder and the online detention basin will be maintained by an external management company set up on behalf of the householder by the developer. A full maintenance schedule is presented on the drainage layout

CONCLUSION

Based on the above, and providing the above strategies are adopted, the developed site will not contribute further to flood risk and therefore satisfying the requirements of the National Planning Policies Framework.

REFERENCES

Department for Communities and Local Government (July 2018) - National Planning Policy Framework.

Department for Communities and Local Government (July 2018) - Technical Guidance to the National Planning Policy Framework.

The Building Regulations (2010) - Drainage and Waste Disposal - Approved Document H.

BS EN 752:2008 Drain and sewer systems outside buildings - Hydraulic design and environmental considerations.

BS 8533:2011 Assessing and managing flood risk in development – Code of Practice.

CIRIA Report C635 Designing for exceedance in urban drainage – good practice.

Design and Analysis of Urban Storm Drainage – The Wallingford procedure – Volume 1.

<https://flood-map-for-planning.service.gov.uk>

<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>