G3O CONSULTING

Flood Risk Assessment

Northons Lane, Holbeach, Lincolnshire

MJ Gleeson PLC

QUALITY MANAGEMENT

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REVISION SCHEDULE

Flood Risk Assessment

Northons Lane, Holbeach, Lincolnshire

Rev	Date	Details	Prepared By	Approved By
A	11/06/2020	First Issue	S. Griffiths	S. Griffiths

CONTRACT

The report describes work commissioned by MJ Gleeson PLC as outlined within fee proposal dated 6th January 2020.

PURPOSE

This document has been prepared as a Flood Risk Assessment for MJ Gleeson PLC. G30 Consulting Ltd accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

G30 Consulting Ltd has no liability regarding the use of this report except to MJ Gleeson PLC.

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1. EXECUTIVE SUMMARY

Site Name	Northons Lane, Holbeach, Lincolnshire
Location	Northons Lane, Holbeach, Lincolnshire
Client	MJ Gleeson PLC
Grid Reference	535308, 325547
Area (ha)	3.900 ha
Current Land Use	Undeveloped agricultural land
Environment Agency Flood Zone	Flood Zone 2
NPPF Development Classification	More Vulnerable
History of Flooding	No incidents of flooding
Flood Defences	No flood defences
Summary of Risks	The site is not at risk of flooding from pluvial, sewer sources, tidal/coastal flooding, groundwater sources and artificial bodies. The site is subject to fluvial flooding, finished floor levels are to be raised a minimum of 300mm above existing ground levels to protect against the flood risk.
Runoff Rate (l/s)	**5.6 l/s** for 1 in 100 year + 40% CC

2. INTRODUCTION

2.1 Scope of Assessment

G30 Consulting Ltd have been commissioned by MJ Gleeson PLC to prepare a Flood Risk Assessment Report to support the planning application for a proposed 110no. unit residential development at land off Northons Lane, Holbeach, Lincolnshire.

2.2 Study Objectives and Methodology

The Report is a holistic risk-based approach to consider flood risk from all possible sources, so to satisfy the requirements of the National Planning Policy Framework (NPPF). The objectives of this report are as follows:

- Determine likely sources of flooding,
- Assess the proposals in the context of the National Planning Policy Guidance,
- Propose an appropriate drainage strategy, and
- Determine appropriate mitigation and/or protection measures.

The methodology followed in the preparation of this report include the following:

- An investigation of the flood risk within and external to the Site,
- Consideration of the pre-development and post-development surface water runoff and identification of a means of storm water disposal, and
- Consideration of storm events up to and including the 1 in 100 year return period storm event, plus Climate Change, and calculations of the required volume of onsite storage, where this is applicable.

The report deals with environmental issues that are associated with flooding, other impacts on the environment are not considered. Existing sources of flood risk have been formally assessed, this includes both ground water and urban drainage systems.

3. DEVELOPMENT SITE AND LOCATION

3.1 Existing Site

The site is located between the A17 and Northan's Lane and is centred around Ordnance Survey Grid Reference 535308, 325547. The site is accessed by vehicle via Northon's Lane. The site occupies an area of approximately 3.900 ha. Figure 1, below shows the site location.



Figure 1 - Site Location Plan

The site is irregular in shape bordering an existing housing estate. The site is currently undeveloped agricultural land and is part of a large field. The Northern and Western boundaries are currently undefined forming part of the agricultural land. To the South and East of the site lies a housing estate which is accessed via Boston Road South and Northon's Lane. The Southern and Eastern boundaries are defined by established fences and hedges to the housing estate.

There are two sections of carriageway which have been stop ended at the site boundary, Cedar Drive and Oakwood Glade which can provide future access to the site. The roads are currently blocked by bollards / fencing to prevent unwanted access to the land.

3.2 Topography

A topographical survey of the site and the immediate surrounding area was undertaken by Haycock + Todd in December 2019 to confirm existing ground levels and physical features. The topographical survey confirmed the site to be relatively flat with levels ranging from 3.030m AOD to 3.300m AOD.

A copy of the site topographical survey, drawings S9550 – Site Survey by Haycock + Todd can be found in Appendix A.

3.3 Geology and Groundwater

British Geological Survey (BGS) 1:50,000 scale geology mapping has been reviewed to confirm the geology on site. The details of the underlying geology can be found below:

Bedrock Geology: West Walton Formation - Mudstone and Siltstone. Sedimentary Bedrock formed approximately 157 to 164 million years ago in the Jurassic Period. Local environment previously dominated by shallow seas. These sedimentary rocks are shallow-marine in origin. They are detrital, ranging from coarse- to fine-grained (locally with some carbonate content) forming interbedded sequences.

Superficial Deposits: Tidal Flat Deposits - Clay and Silt. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by shorelines (U). These sedimentary deposits are shallow-marine in origin. They are detrital, generally coarse-grained forming beaches and bars in a coastal setting.

3.4 Hydraulic Features

The nearest major watercourse to the site is the River Welland which is located approximately 8.000km West of the site. The River Bain flows in a North Easterly direction ultimately outfalling to The Wash.

There are a number of minor watercourses in close proximity to the site the closest being the New River (Drain) which is located approximately 0.100km West of the site. The New River (Drain) flows in a Northernly direction discharging to the Holbeach River. The Holbeach River ultimately outfalls to the River Welland approximately 8.50km North of the site.

The New River (Drain) is managed by the Water Management Alliance.

3.5 Current Site Drainage

Anglian Water are responsible for adopted drainage assets in Holbeach. Anglian Water have been consulted and a copy of their sewer asset record plans obtained which show the position of adopted assets in relation to the site.

Anglian Water sewer asset record plans confirm there are no adopted assets within the extents of the site.

Anglian Water sewer asset record plans confirm there are adopted foul water sewers within the housing estate to the South of the site. Manhole reference 3501 is located at the end of Cedar Drive with a 225mm dia. pipe downstream. Manhole 3501 has an invert level of 1.280m AOD. Manhole reference 2301 is located at the end of Oakwood Glade with a 150mm dia. pipe downstream. Manhole 2301 has an invert level of 2.170m AOD.

The foul water drainage system discharges to a foul water pumping station which is located at the junction between Oakwood Glade and Cedar Drive.

The asset record plans show there are no adopted surface water assets within the roads to the south of the site.

A copy of the Anglian Water developer enquiry and sewer asset record plans can be found in Appendix B.

4. DEVELOPMENT PROPOSALS

The proposed development comprises the construction of 110no. residential development with a combination of 2 / 3 bedroom semi-detached and 3 / 4 bedroom detached properties. The site is to be accessed via two site entrances, one off Oakwood Glade and the second off Cedar Drive.

A new on site adopted highway is proposed which will serve the residential properties. The access road will be constructed to adoptable standards and put forward for adoption with Lincolnshire County Council highways under a Section 38 agreement. On plot parking shall be provided to each of the residential properties.

A copy of the proposed site layout plan, drawing 3162-0-00 by Niemen Architects, can be found in Appendix C.

5. POLICY AND GUIDANCE

The following planning policies and guidance are relevant to the Proposed Development with regards to flood risk and surface water management.

5.1 Flood and Water Management Act, 2010

In combination with the Flood Risk Regulations 2009, (which enact the EU Floods Directive in England and Wales) the Act places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act and the Regulations together raise the requirements and targets Local Authorities need to meet, including:

- To play an active role in leading Flood Risk Management in the local area;
- The development of the Surface Water Management Plans (SWMPs);
- To implement the requirements of Flood and Water Management legislation;
- The preparation of preliminary Flood Risk Assessments (FRAs) and Flood Risk Management Plans (FRMPs);
- The development and implementation of drainage and flooding management strategies; and
- The responsibility for first approval, then subsequent adoption, management and maintenance of Sustainable Urban Drainage Systems (SuDS).

The Flood and Water Management Act also clarifies three key areas that influence development:

1. Sustainable Drainage (SuDS) - the Act makes provision for a national standard to be prepared on SuDS, and that developers will be required to obtain local authority approval for SuDS in accordance with the standards, likely with conditions. Supporting this, the Act requires local authorities to adopt and maintain SuDS, removing any ongoing responsibility for developers to maintain SuDS if they are designed and constructed robustly.

2. Flood Risk Management Structures - the Act enables the EA and local authorities to designate structures such as flood defences or embankments owned by third parties for protection if they affect flooding or coastal erosion. A developer or landowner will not be able to alter, remove or replace a designated structure or feature without first obtaining consent.

3. Permitted flooding of Third-Party Land - The EA and local authorities have the power to carry out work which may cause flooding to third party land where the works are deemed to be in the interest of nature conservation, the preservation of cultural heritage or people's enjoyment of the environment or of cultural heritage.

5.2 National Planning Policy Framework (NPPF), 2018

The NPPF, originally published in 2012, was part of a series of reforms to simplify and make more accessible all planning legislation that is applicable within England. This is supported by the National Planning Policy Guidance (NPPG), an online planning resource published in July 2018 supersedes all previous technical guidance.

Both the NPPF and NPPG must be taken into consideration in the development of local and neighbourhood plans and must be considered in determining all planning applications.

The NPPF and NPPG also recommends that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and to develop local policies to manage flood risk from all sources and take account of advice from the Environment Agency and other relevant flood risk management bodies such as Internal Drainage Boards (IDBs). Local Plans should apply a risk based, sequential approach to the proposed development site to avoid, where practicable, flood risk to people and property. As well as to manage any residual flood risk, and to consider the impact of Climate Change, by:

- The application of the Sequential Test;
- Applying the Exception Test, if required;
- Prevent development on land that is required for current and future flood management;
- Use the opportunity from new development to reduce the source and impact of flooding; and
- To seek opportunities to relocate development, including housing to more sustainable locations, should Climate Change increase flood risk to a current development and render it unsustainable in the long term.

5.3 The Sequential Test and Exception Test

The purpose of the Sequential Test is to steer new development towards areas with the lowest probability of flooding (Flood Zone 1). Where there are no reasonably available sites within Flood Zone 1, local planning authorities in their decision making should consider the flood risk vulnerability of land uses and consider all reasonably available sites in Flood Zone 2 (areas with a medium probability of flooding), and only applying the Exception Test as required. Only when there are no reasonably available sites in either Flood Zone 1 or 2, should sites in Flood Zone 3 (areas with a high probability of flooding) be considered. With full reference made to the land use flood risk vulnerability and applying the Exception Test when necessary.

For the Exception Test to be passed:

- the development must demonstrate that it will provide wider sustainability benefits to the community that outweigh flood risk, and that is informed by a comprehensive Strategic Flood Risk Assessment, where one has been prepared; and
- a site-specific flood risk assessment must demonstrate that the development will be safe for its entire lifetime, that the vulnerability of its users is considered, that it will not increase flood risk elsewhere and it will aim to reduce the overall flood risk.

5.4 The SuDS Manual (C753) 2015

The SuDS Manual provides best practice guidance on the planning, design, construction, operation, and maintenance of Sustainable Drainage Systems (SuDS) to facilitate their effective implementation within the planning process.

The SuDS Manual has been referred to in the decision-making process of which SuDS features will be suitable for the site. Section 10.5 details the methodology used, the SuDS features that have been selected, and the reasoning for the selection.

6. CLIMATE CHANGE

The National Planning Policy Framework states that Climate Change should be considered as part of the formal flood risk assessment process. This is should be done in accordance with the "Flood Risk Assessments: Climate Change Allowances", February 2016 guidance when assessing the flood risk to a Development.

As the site falls within Anglian basin, the peak river flow and rainfall intensities for the 2020s, 2050s and 2080s are as follows:

Table 1 – Peak River Flow Allowances for the Anglian River Basin

River Basin District	Allowance Category	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Anglian	Upper End	25%	35%	65%
	High Central	15%	20%	35%
	Central	10%	15%	25%

Table 2 - Peak Rainfall Intensity Allowances for England (2020's, 2050's and 2080's)

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%

7. SITE SPECIFIC FLOOD RISK

7.1 Fluvial Flooding

The Environment Agency Risk of Flooding from Rivers or the Sea mapping has been reviewed to give guidance for the fluvial and tidal risk to the site. Figure 2, below, shows the current Risk of Flooding from Rivers or the Sea map for the site.



Figure 2 - Environment Agency Risk of Flooding from Rivers and Sea mapping for the site.

The site is shown to be located within in Flood Zone 2 and is considered to be at a Low Risk of flooding between 0.1% (1 in 1000 years) and 1% (1 in 100 years).

As stated within Table 3 below, Flood Zone 2 is defined as land that has 'Medium Probability' of flooding with a less than 1 in 1000 year annual probability.

Table 3 - Flood Zone Classifications.

Flood Zone	Definition
Zone 1 **Low Probability**	Land having a less than 1 in 1000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map - all land outside Zones 2 and 3).
Zone 2 **Medium Probability**	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1000 annual probability of sea flooding. (Land shown in light blue on the Flood Map).
Zone 3a **High Probability**	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map).
Zone 3b **The Functional Floodplain**	This zone comprises land where water must flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional flood plain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map).

In addition to the Environment Agency Risk of Flooding mapping the South East Lincolnshire Joint Strategic Planning Committee – Strategic Flood Risk Assessment (SFRA) has been reviewed to determine the site suitability and flood risk measures to be taken.

The Residual Flood Hazard District – Year 2115 1% Fluvial / 0.5% Tidal Event Probability mapping shows the site to be located in a Less than 0.75 (Low Hazard) area. When reviewed against the South East Lincs Standing Advice Matrix 2016 the following recommendations are made for setting of finished floor levels on a site in a Less than 0.75 (Low Hazard) area.

"Finished floor levels (FFL) should be set 300mm above ground level."

Inline with the guidance with the South East Lincs Standing Advice Matrix 2016 all plot finished floor levels shall be set a minimum of 300mm above existing ground levels.

Copies of the South East Lincolnshire Joint Strategic Planning Committee – Strategic Flood Risk Assessment (SFRA) flood mapping can be found in Appendix D.

The proposed development is to consist of 110 new residential properties. Using Table 2: Flood Risk Vulnerability Classification of the National Planning Guidance, the development is classed being 'More Vulnerable'.

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.

Figure 3 - Extract from the National Planning Policy Guidance- Flood Risk Vulnerability Classification

7.2 Pluvial (Surface Water) Flooding

Pluvial, or surface water, flooding occurs when natural and manmade systems have insufficient capacity to cope with high volumes of rainfall. Pluvial flooding can occur in urban areas during extreme, high intensity, short duration summer rainfall events, which overwhelm the surface water drainage network. Or in rural areas following a medium intensity, long duration events, where the ground conditions are saturated and there is no additional storage capacity within the underlying soils. The flood water is then conveyed via overland flow routes that are in turn dictated by the local topography.

The Environment Agency Risk of Flooding from Surface Water mapping has been reviewed which shows the site is not at risk of flooding from Pluvial Sources as shown in Figure 4, below.

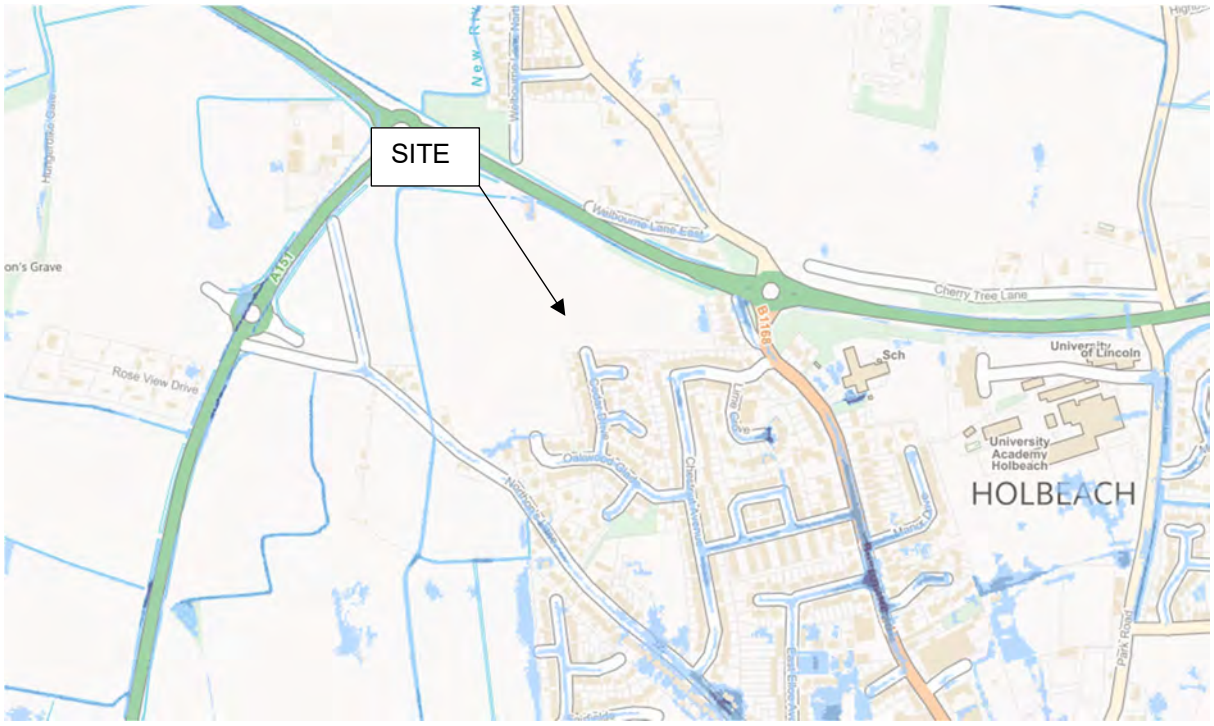


Figure 4 - Environment Agency Flood Mapping - Flood Risk from Surface Flooding – Low Risk

7.3 Tidal Flooding

The site not in a coastal location and as such is not affected by coastal or tidal flooding.

7.4 Flooding from Artificial Sources

Flooding from artificial sources refers to all flooding generated by manmade sources. This includes reservoirs, canals, artificial lakes and from mining abstraction. Reservoir flooding is extremely unlikely to happen, and there are no recorded fatalities from a breach of a reservoir retaining dam in the UK since the 1920s. The Reservoir Act 1975, mandates that the Environment Agency is responsible for all reservoirs in England to be regularly inspected, and that essential maintenance works are carried out as and when required.

The Environment Agency Risk of Flooding from Surface Water mapping has been reviewed which shows the site is not at risk of flooding from Pluvial Sources as shown in Figure 5, below.

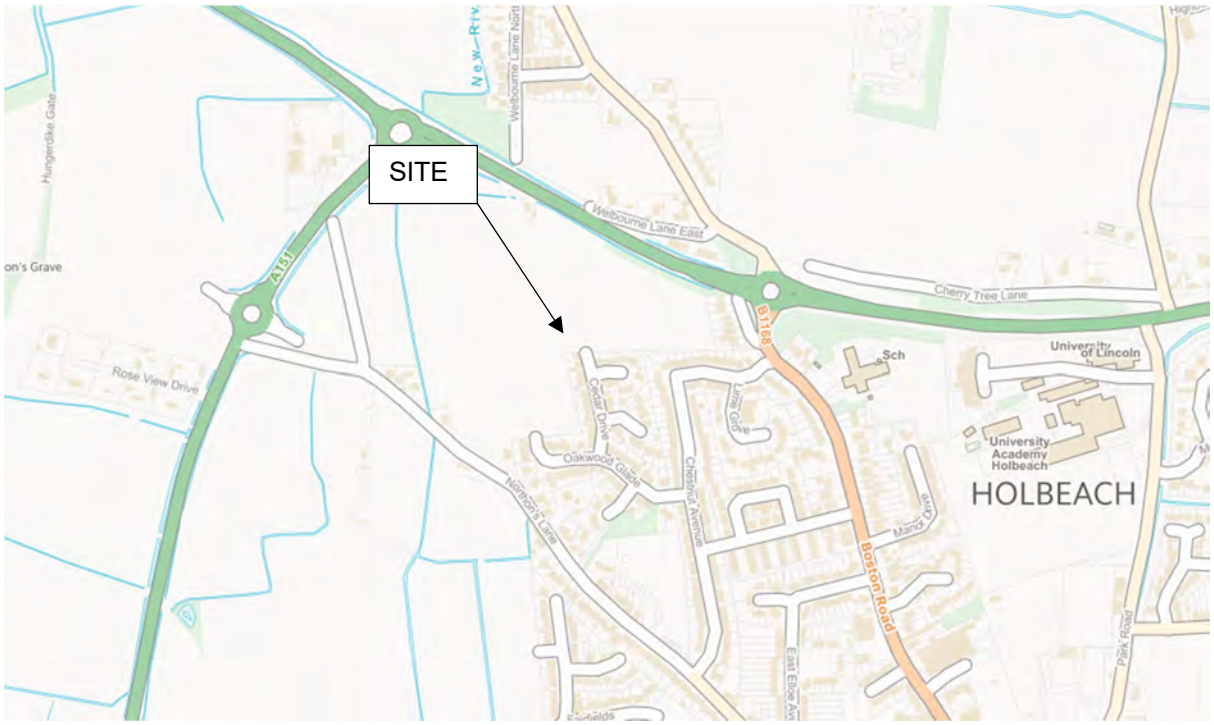


Figure 5 - Environment Agency Risk of Flooding from Artificial Sources.

7.5 Groundwater Flooding

Groundwater flooding occurs when water rises from an underlying aquifer or from water rising from abnormal springs. This usually occurs following long periods of sustained heavy rainfall, and the areas that are most susceptible are those that are low lying, and where there is a high-water table. Groundwater flooding is also known to occur in areas underlain by major aquifers, although increasingly it is associated with more localised floodplain sand and gravels.

Ground conditions on site have been noted as clay and slit at shallow depth with mudstone at bedrock geology level. Given the cohesive nature of clay where it exists groundwater moves slowly through its structure as such the site is not considered to be at risk of flooding from groundwater.

7.6 Flooding from Drainage Infrastructure

Flooding can also arise from the drainage network when it is either overwhelmed from high rainwater volume following an intense storm event, or when there is a blockage within the network. Blockages in the drainage system can lead to localised flooding where this occurs.

Anglian Water are responsible for adopted drainage assets in Holbeach. Sewer asset record plans show there are no adopted assets on site.

The nearest assets to the site are located within the adjacent housing estate comprising foul assets only.

Anglian Water have not indicated any flooding incidents from their assets which have affected the site and as such the development is not considered to be at risk of flooding from drainage infrastructure.

8. SEQUENTIAL TEST

As stated in Section 5.2, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. All sources of flooding have been reviewed which have confirmed the site is located in Flood Zone 2.

The Sequential Test has been applied to the development site in accordance with the National Planning Policy Guidance Paragraph 20, 21 and Diagram 2: Application of the Sequential Test for Local Plan Preparation. In accordance with the National Planning Policy Guidance the proposed development is considered suitable.

9. EXCEPTION TEST

The Exception Test is not required, in accordance with Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility' of the National Planning Policy Guidance. Table 4 below, shows the Flood Risk Vulnerability Classification from the NPPF.

Table 4 – NPPF - Flood Risk Vulnerability and Flood Zone 'Compatibility'.

Flood Zone	Flood Zone 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.

10. SURFACE WATER MANAGEMENT

10.1 Requirements and Regulations

The means of draining surface water generated by a site are required to mirror the behaviour of the existing site run-off, so far as is practicable, to offset the off-site flood risk that might otherwise be created, or to bypass it entirely.

The following documents have been referred to as part of the development of the drainage strategy for the development to ensure current standards and industry best practice are adhered to:

- Buildings Regulations Part H - Drainage and Waste Disposal
- Sewers for Adoption 6th Edition - A Design and Construction Guide for Developers - March 2006
- Sewers for Adoption 7th Edition - A Design and Construction Guide for Developers - August 2012
- CIRIA Report 753 - The SuDS Manual, 2015
- BRE Digest 365 - Soakaway Design

In accordance with Building Regulations Part H - Drainage and Waste Disposal, surface water runoff generated by a site should look to discharge to one of the following listed in order of priority:

- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
- A watercourse; or where that is not reasonably practicable,
- A surface water sewer; or where that is not reasonably practicable,
- A combined water sewer.

10.2 Surface Water Drainage Strategy

In accordance with the surface water hierarchy outlined in Building Regulations Part H, surface water runoff should look to discharge to a soakaway and / or infiltration drainage system. Ground conditions have been confirmed as clay deposits at shallow depth. Where clay deposits exist infiltration rates are generally low and as such infiltration drainage techniques have been discounted as a potential solution for the disposal of surface water runoff.

As infiltration drainage techniques are not suitable surface water runoff should look to discharge to watercourse. The closest managed watercourse to the site is the New River (Drain) which is located approximately 0.100km to the West of the site.

Rights have been agreed with the adjacent landowner to install a surface water drainage within their land from the site across to the New River (Drain). A new headwall will be constructed at the outfall into the New River (Drain).

A new surface water drainage system is to be constructed on site to convey surface water runoff from the residential properties and the adopted highway. The adopted highway is to be constructed with a cross-falling carriageway with highways runoff falling towards swales running along the highway. Perforated drains shall be installed beneath the swales to convey surface water runoff to the outfall.

The piped system will run down the road joining onto the carriageway which connects to Oakwood Glade before turning through 90 degrees and heading towards the New River (Drain). Prior to the drain leaving site a hydrobrake flow control chamber shall be constructed to restrict surface water runoff from the site.

A detention basin shall be provided adjacent the hydrobrake flow control to provide attenuation storage for the surface water runoff prior to discharge.

The New River (Drain) is managed by the Water Management Alliance. The Water Management Alliance have been consulted with regards to a discharge to the watercourse. The Water Management Alliance have confirmed surface water runoff is to mirror the behaviour of the existing site run-off. Surface water discharge rates shall be discussed further in Section 10.4.

Individual SuDS features for the site have been reviewed based on the site characteristics, such as the underlying soil type and geology. As well as the design considerations from the development that may limit the feasibility of certain SuDS features from being implemented. Details of the specific SuDS features selected for the site can be found in Section 10.5.

Attenuation shall be provided to attenuate surface water flooding from storms, up to and including 1 in 100 years plus 40% Climate Change with a 10080-minute duration. Onsite attenuation requirements shall be discussed further in Section 10.6.

An indicative foul and surface water drainage layout plans, drawing 08-0048-001 can be found in Appendix E.

10.3 Drainage Catchment

The site is currently undeveloped agricultural land. An area take-off has been undertaken to compare the impermeable area discharging from the pre-development and post develop site, the area take-off can be found in Table 5, below.

Table 5 - Area Take-Off

Category	Area Take-Off		Increase Due to Development
	Pre-Development Site (ha)	Post Development Site (ha)	Absolute (ha)
Impermeable Area – Roof	0.000	0.643	**0.643**
Impermeable Area – Roads / Paved	0.000	0.712	**0.712**
Impermeable Area - Total	**0.000**	**1.355**	**1.355**
Impermeable Area- %	**0%**	**35%**	**35%**
Permeable – Pervious Surfaces	0.000	0.000	**0.000**
Permeable – Others	3.900	2.545	**-1.355**
Permeable Area – Total	**3.900**	**2.545**	**0.350**
Permeable Area- %	**100%**	**65%**	**-35%**
Site Area Total	**3.900**	**3.900**	**-**

The above area take-off is based on the site topographical survey and the proposed site layout plan which can be found in Appendix A and Appendix C, respectively.

10.4 Drainage Discharge and Outfalls

Surface water runoff from the site is to discharge to the New River (Drain) at a rate to mirror the behaviour of the existing site run-off. As the site is currently undeveloped agricultural land with no positive outfall surface water runoff from the site will look to discharge at Greenfield Runoff Rate.

Using the HR Wallingford online Greenfield Runoff Rate calculator tool a Q_{bar} discharge rate of 5.6l/s has been calculated based on a site area of 3.900 ha.

Surface water runoff from the site shall be restricted to **5.6l/s** for all storm events up to and including 1 in 100 year + 40% Climate Change for a 10080-minute (7 days) duration.

Surface water runoff shall be restricted to **5.6l/s** via a hydrobrake flow control device which will be constructed at the downstream end of the surface water drainage system.

A copy of the HR Wallingford Greenfield Runoff Rate calculations can be found in Appendix F.

10.5 Use of SuDS

To ensure the quality of runoff leaving the site is treated to a suitable level, SuDS features have been assessed for their suitability within the proposed development. In accordance with CIRIA Report C753 - The SuDS Manual 2015 features have been considered and their suitability evaluated in relation to the development.

Table 6, below, details all the SuDS features that have been considered for this site and providing supporting evidence to why each SuDS features type have or have not been deemed suitable.

Table 6 - SuDS Selector Table

SuDS Selector Table		
Feature	**Suitable Y / N**	**Evidence**
Rainwater Harvesting	**Y**	Rainwater harvesting in the form of waterbutts could be used to store surface water runoff for reuse or external irrigation purposes.
Green Roofs	**N**	Green roofs are ideally suited to flat roofs, a pitched roof has been proposed and as such is not suitable for the development.
Infiltration Systems	**N**	Due to the ground conditions infiltration systems are not considered suitable.
Proprietary Treatment Systems	**Y**	Trapped gullies are to be provided within the adopted highway to assist with the removal of sediment.
Filter Strips	**N**	Due to the ground conditions filter strips are not considered suitable.
Filter Drains	**N**	Due to the ground conditions filter strips are not considered suitable.

Swales	**Y**	Swales are to be used along some sections of the adopted highway. The carriageway shall crossfall into the swale shall offer attenuation storage and treatment. The swales shall be under-drained with a perforated piped network to convey water to the outfall.
Bioretention Systems	**N**	Bioretention system could be utilise however sufficient storage and treatment is provided within the swales and detention basin, these features have therefore been discounted.
Trees / vegetation	**Y**	New planting will be incorporated into the development which will assist with the disposal of surface water runoff.
Pervious Pavements	**N**	Due to the ground conditions pervious pavements are not considered suitable.
Attenuation Storage Tanks	**N**	Attenuation storage tanks could be utilise however sufficient storage and treatment is provided within the swales and detention basin, these features have therefore been discounted.
Detention Basins	**Y**	A detention basin is to be constructed at the downstream end of the surface water drainage system to attenuate surface water runoff prior to discharge.
Ponds and Wetlands	**N**	Ponds and wetlands could be utilise however sufficient storage and treatment is provided within the swales and detention basin, these features have therefore been discounted.

10.6 Storage

Surface water attenuation shall be provided for runoff from the adopted highway and the residential property roofs for all storm events up to and including 1 in 100 year + 40% Climate Change for a 10080-minute (7 days) duration.

Attenuation storage shall be provided within the piped drainage network and the detention basin. XP Solutions MicroDrainage Surface Water drainage calculations have been undertaken to confirm the size of the upstream surface water drainage system and the detention basin required to attenuate for the required storm events.

Copies of XP Solutions MicroDrainage Surface Water drainage calculations can be found in Appendix G.

10.7 Ownership and Maintenance

The surface water drainage system shall be put forward for adoption with Anglian Water under a Section 104 agreement and designed to Sewers for Adoption 6th Edition.

The private surface water drainage system around the residential properties to the adopted system shall be the responsibility of the individual property owners to maintain.

The swales and highways gullies will be the responsibility of Lincolnshire County Council highways to maintain as part of the Section 38 agreement.

The detention basin shall be maintained under a long-term maintenance contract by MJ Gleeson PLC.

The surface water discharge to the New River (Drain) shall be approved by the Water Management Alliance under a Section 23 consent.

Future maintenance schedules for elements of the drainage system can be found in Appendix H.

11. FOUL WATER DRAINAGE PROPOSAL

11.1 Requirements and Regulations

The following documents have been referred to as part of the development of the drainage strategy for the development to ensure current standards and industry best practices are adhered to:

- Buildings Regulations Part H - Drainage and Waste Disposal
- Sewers for Adoption 6th Edition - A Design and Construction Guide for Developers - March 2006
- Sewers for Adoption 7th Edition - A Design and Construction Guide for Developers - August 2012

In accordance with Building Regulations Part H - Drainage and Waste Disposal, foul effluent generated by a site should look to discharge to one of the following listed in order of priority:

- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
- A private sewer communicating with a public sewer; or where that is not reasonably practicable,
- Either a septic tank which has an appropriate form of secondary treatment or another wastewater treatment system; or where it is not reasonably practicable,
- A cesspool.

11.2 Foul Water Drainage Strategy

Anglian Water are responsible for adopted drainage assets in Holbeach. Sewer asset record plans have been obtained which show an adopted foul water system within estate roads to the South of the site. Manhole reference 3501 is located at the end of Cedar Drive with a 225mm dia. pipe downstream. Manhole 3501 has an invert level of 1.280m AOD. Manhole reference 2301 is located at the end of Oakwood Glade with a 150mm dia. pipe downstream. Manhole 2301 has an invert level of 2.170m AOD.

A new foul water drainage system is to be constructed on site the majority of which shall discharge to manhole 3501 due to its depth and the large diameter outfall pipe. The remaining properties shall discharge to manhole 2301.

The drainage system shall discharge to the Anglian Water sewer via gravity. Foul effluent from the development shall discharge to the adopted Anglian Water foul water sewer at an unrestricted rate.

A private foul water drainage system will be constructed to convey foul water effluent from the residential properties to the adopted drainage system.

An indicative foul and surface water drainage layout plans, drawing 08-0048-001 can be found in Appendix E.

11.3 Operations and Maintenance

The foul water drainage system shall be put forward for adoption with Anglian Water under a Section 104 agreement and designed to Sewers for Adoption 6th Edition.

The new foul water connection into the adopted foul water manholes 3501 and 2301 shall be made under a Section 106 application with Anglian Water.

All private drainage on site will be the responsibility of the individual property owners to maintain.

12. CONCLUSIONS

12.1 Flood Risk

Based on the work carried out in the preparation of this report the following conclusions are made:

- The site is not at risk of flooding from pluvial, sewer sources, tidal/coastal flooding, groundwater sources and artificial bodies.
- The site is subject to fluvial flooding, finished floor levels are to be raised a minimum of 300mm above existing ground levels to protect against the flood risk in accordance with the South East Lincolnshire Joint Strategic Planning Committee – Strategic Flood Risk Assessment
- The site is located in Flood Zone 2 – 'Medium Probability'.
- The development is classified as being 'More Vulnerable'
- The development satisfies the requirements of the Sequential Test.
- The Exception Test is not required as the site is deemed appropriate.

12.2 Drainage Summary - Surface Water

The disposal of surface water runoff generated by the proposed development has been assessed in accordance with the guidance outlined by the Buildings Regulations Part H - Drainage and Waste Disposal.

A new surface water drainage system is to be constructed on site to convey surface water runoff from the residential properties and the adopted highway. The adopted highway is to be constructed with a cross-falling carriageway with highways runoff falling towards swales running along the highway. Perforated drains shall be installed beneath the swales to convey surface water runoff to the outfall.

The piped system will run down the road joining onto the carriageway which connects to Oakwood Glade before turning through 90 degrees and heading towards the New River (Drain). Prior to the drain leaving site a hydrobrake flow control chamber shall be constructed to restrict surface water runoff from the site.

A detention basin shall be provided adjacent the hydrobrake flow control to provide attenuation storage for the surface water runoff prior to discharge.

Surface water runoff from the site shall be restricted to **5.6l/s** for all storm events up to and including 1 in 100 year + 40% Climate Change for a 10080-minute (7 days) duration. Surface water runoff shall be restricted via a hydrobrake flow control device.

The surface water drainage system shall be put forward for adoption with Anglian Water under a Section 104 agreement and designed to Sewers for Adoption 6th Edition.

The private surface water drainage system around the residential properties to the adopted system shall be the responsibility of the individual property owners to maintain.

The swales and highways gullies will be the responsibility of Lincolnshire County Council highways to maintain as part of the Section 38 agreement.

The detention basin shall be maintained under a long-term maintenance contract by MJ Gleeson PLC.

The surface water discharge to the New River (Drain) shall be approved by the Water Management Alliance under a Section 23 consent.

12.3 Drainage Summary - Foul Water

The disposal of foul water effluent generated from the proposed development has been assessed in accordance with the guidance outlined by the Building Regulations Part H - Drainage and Waste Disposal.

A new foul water drainage system is to be constructed on site the majority of which shall discharge to manhole 3501 due to its depth and the large diameter outfall pipe. The remaining properties shall discharge to manhole 2301.

The drainage system shall discharge to the Anglian Water sewer via gravity. Foul effluent from the development shall discharge to the adopted Anglian Water foul water sewer at an unrestricted rate.

A private foul water drainage system will be constructed to convey foul water effluent from the residential properties to the adopted drainage system.

The foul water drainage system shall be put forward for adoption with Anglian Water under a Section 104 agreement and designed to Sewers for Adoption 6th Edition.

The new foul water connection into the adopted foul water manholes 3501 and 2301 shall be made under a Section 106 application with Anglian Water.

All private drainage on site will be the responsibility of the individual property owners to maintain.

APPENDIX

APPENDIX A

Station	Easting	Northing	Level
S1	535313.949	325510.498	3.293
S2	535334.295	325427.335	3.286
S3	535327.512	325366.114	3.310
S4	535313.677	325483.839	3.331
S5	535245.721	325367.928	3.436
S6	535212.858	325468.934	3.093
S7	535128.776	325379.102	3.279
S8	535091.316	325413.197	3.161
S10	535167.019	325554.697	3.229
S10A	535070.939	325552.530	3.244
S10B	535059.347	325742.657	3.563
S10C	535204.684	325736.117	3.134
S10D	535255.221	325691.023	3.038
S11	535279.301	325580.228	3.150
S11A	535247.198	325730.162	2.975
S12	535324.557	325572.534	3.313
S13	535419.860	325548.222	3.289
S14	535488.497	325520.911	3.876
S15	535543.551	325525.434	3.279
S16	535523.125	325609.743	4.000
S17	535609.409	325468.714	3.522
S18	535488.594	325609.682	4.137
S19	535455.141	325621.530	4.217
S20	535410.974	325641.345	3.960
S21	535370.897	325661.695	3.848
S22	535326.962	325686.315	3.533

Haycock+Todd
Land Survey Consultants Architectural Surveyors
The Hollies, 43 Church Street, Royston, Barnsley, S71 4QU. T01226 729630
Edn@wind-surveying.co.uk Wind-surveying.co.uk

SITE SURVEY

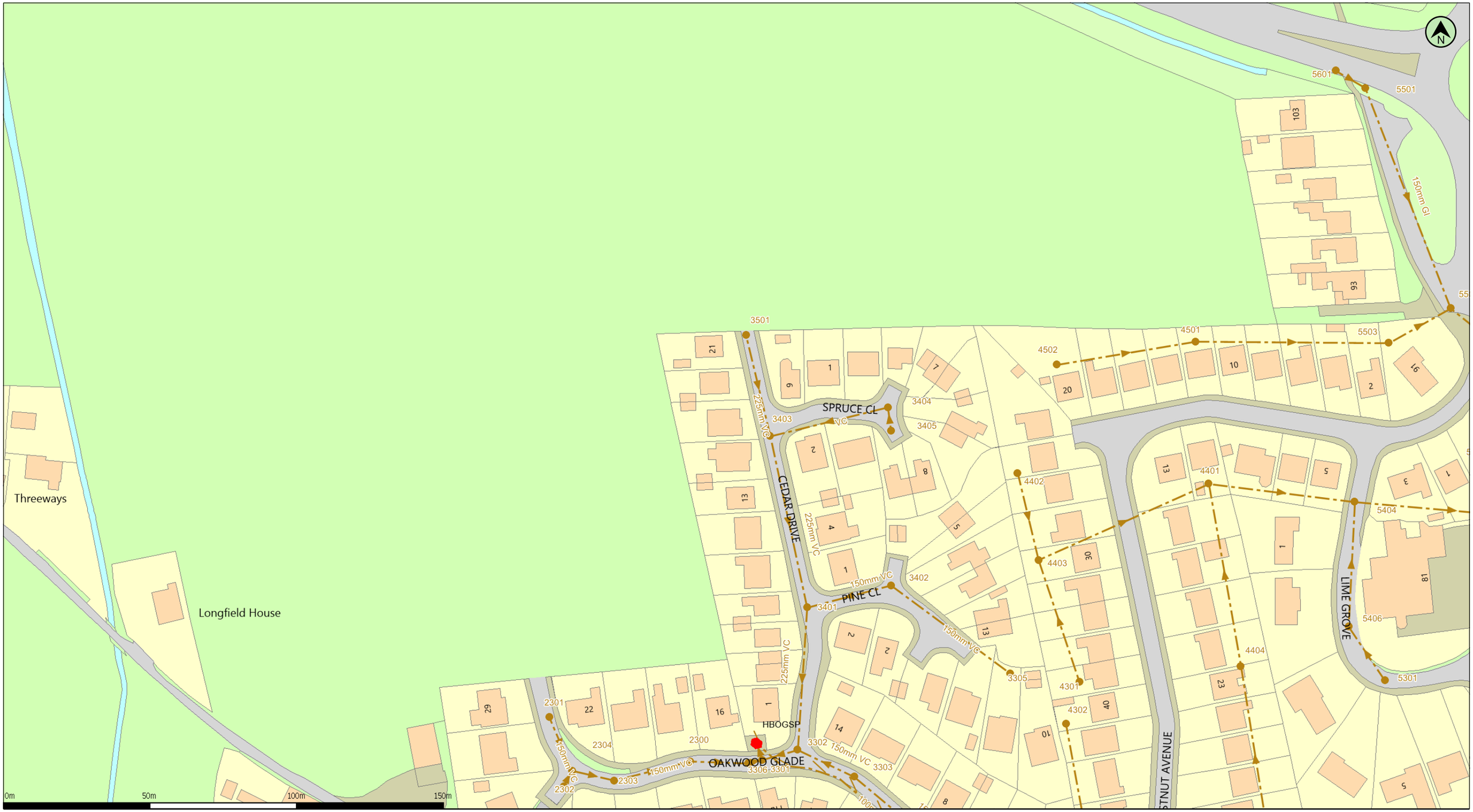
NORTHONS LANE
HOLBEACH
PE12 7JS

Sheet 1 of 1	Surveyed by DR, SH
Datum	Drawn by DR, SH
GRID- Related to Ordnance Survey using One Point Localisation on Station S1, Orientation at OS Grid North.	Date of Survey December 2019
LEVEL- Related to Ordnance Survey by connection to the OS Active Network by G.P.S	Scale 1/200
	Survey Job No. S9550

LEGEND

Manhole shown thus		Floor Level	FL 15.907
Inspection Cover	IC	Height floor to ceiling	H 2.733
Gully gratel	GG	Height floor to sill/cill width	Sc 1.220
Gully	G	Height floor to fitted ceiling	FC 2.533
Lamp post	LP	Height of Sill	SI 0.913
Telephone Pole	TP	Height sill to window head	SH 1.213
Electricity Pole	EP	Height of Door	DH 2.133
Traffic Lights	TL	Height floor to underside	UB 0.83
Road Sign	RS	Ceiling Shadow Up	SU n
British Telecom	BT	Height floor to Arch	As 2.99
Cable Television	CATV	Height floor to Arch Spring	Sp 2.67
Water Stop Valve	WV	Kerb	K
Sanitary Valve	SV	Fall Pipe	FP
Stop tap Water	ST	Water Tap	WT
Stop tap Gas	GV	Water Gutter	W
Unknown Stopcap	UST	Bore	B
		Bower Column	BC

APPENDIX B



(c) Crown copyright and database rights 2020 Ordnance Survey 100022432 | Date: 11/06/20 | Scale: 1:1250 | Map Centre: 535307,325491 | Data updated: 01/06/20 | Our Ref: 395476 - 1 | Wastewater Plan A3

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2020 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Rising Main*
- Private Sewer*
- Decommissioned Sewer*
- Outfall*
- Inlet*
- Manhole*
- Sewage Treatment Works
- Public Pumping Station
- Decommissioned Pumping Station

*(Colour denotes effluent type)

admin@g30consulting.com
Northons Lane

love every drop anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
2300	F	-	-	-
2301	F	-	-	-
2302	F	-	-	-
2303	F	-	-	-
2304	F	-	-	-
3301	F	-	-	-
3302	F	-	-	-
3303	F	-	-	-
3305	F	-	-	-
3306	F	-	-	-
3401	F	-	-	-
3402	F	-	-	-
3403	F	-	-	-
3404	F	-	-	-
3405	F	-	-	-
3501	F	-	-	-
4301	F	-	-	-
4302	F	-	-	-
4401	F	-	-	-
4402	F	-	-	-
4403	F	-	-	-
4404	F	-	-	-
4501	F	-	-	-
4502	F	-	-	-
5301	F	-	-	-
5404	F	-	-	-
5406	F	-	-	-
5501	F	2.92	1.53	1.39
5502	F	3.1	1.21	1.89
5503	F	-	-	-
5601	F	-	-	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert


Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX C

Schedule of Accommodation

To be read in conjunction with drawing no. 3162-0-001-A - DRAFT OVERLAY

Housetype	No. of Beds	Type	No. of Units	Percentage	Sq. Ft.	Total Sq. Ft.
201	2 Bedrooms	Semi-detached	17	15.45	651.00	11067.00
202	2 Bedrooms	Semi-detached	6	5.45	671.00	4026.00
301	3 Bedrooms	Semi-detached	11	10.00	759.00	8349.00
307	3 Bedrooms	Detached	12	10.91	807.00	9684.00
310S	3 Bedrooms	Semi-detached	13	11.82	788.00	10244.00
311	3 Bedrooms	Semi-detached	11	10.00	759.00	8349.00
313	3 Bedrooms	Semi-detached	4	3.64	811.00	3244.00
314	3 Bedrooms	Detached	3	2.73	811.00	2433.00
315	3 Bedrooms	Detached	17	15.45	816.00	13872
401	4 Bedrooms	Detached	11	10.00	1066.00	11726.00
403	4 Bedrooms	Detached	3	2.73	1048.00	3144.00
405	4 Bedrooms	Detached	2	1.82	1172.00	2344
Totals			110	100.00		88482.00



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SKETCH
subject to structural review
subject to accurate measured survey

revision	date	content	initials
–	–	–	–

project: PROPOSED RESIDENTIAL NORTHON'S LANE HOLBEACH

client: GLEESON DEVELOPMENT

title: SCHEMATIC SITE LAYOUT

date	scale	drawn
23.01.20	1:500@A1	DDS

drawing number: 3162-0-0A1 | checked:

niemen architects
Niemen Architects
Deck 2 The Waterscape
42 Leeds & Bradford Road
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LS5 3EG
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APPENDIX D

N

NOTES

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

2. This update only included new flood risk information from River Welland (Fluvial), River Glen (Fluvial) and Tidal hazard mapping (River Welland, River Nene and the Wash sea defences). No new information from the Internal Drainage Boards and associated systems was used for this update.

3. In addition to the potential flood extents shown on this map, there may be shallow flooding in low-lying rural areas

4. The consequences designated as being a Residual Risk arise from direct overtopping of defences, where this would occur, together with breach failure which is assumed could occur at any point along the defences.

5. Functional Floodplain encompasses areas where water is intended to flow or be stored in times of flood.

6. Land outside South Holland District is not considered.

7. This map shows the extents only of the flooding probability bands relevant to the map Title

Map Legend

Peak Depth

- 0m - 0.25m
- 0.25m - 0.5m
- 0.5m - 1m
- 1m - 2m
- 2m +
- Functional Floodplain
- South Holland District Boundary

REV	DATE	REMARKS
2	Feb 17	Modelling and Mapping Update
1	Dec 16	Modelling and Mapping Update

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LINCOLNSHIRE
PE11 2XE

UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT

Residual Peak Depth
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: Feb 2017 **REV NO:** 2

SCALE: 1 : 60,000 @ A1

MAP NO:

N

NOTES

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

2. This update only included new flood risk information from River Welland (Fluvial), River Glen (Fluvial) and Tidal hazard mapping (River Welland, River Nene and the Wash sea defences). No new information from the Internal Drainage Boards and associated systems was used for this update.

3. In addition to the potential flood extents shown on this map, there may be shallow flooding in low-lying rural areas

4. The consequences designated as being a Residual Risk arise from direct overtopping of defences, where this would occur, together with breach failure which is assumed could occur at any point along the defences.

5. The potential flooding consequences relate to flood probability bandings as follows:

Probability Band	Annual probability of Flooding	
	from a river (fluvial)	from the sea (tidal)
Low	<0.1%	<0.1%
Medium	1%-0.1%	0.5%-0.1%
High	>1%	>0.5%

6. Functional Floodplain encompasses areas where water is intended to flow or be stored in times of flood.

7. Land outside South Holland District is not considered.

8. This map shows the extents only of the flooding probability bands relevant to the map Title

Map Legend

Flooding Probability bands :

- High
- Low or medium, but reliant on protection by flood defences for this standard
- Functional Floodplain
- South Holland District Boundary

REV	DATE	REMARKS
2	Feb 17	Modelling and Mapping Update
1	Dec 16	Modelling and Mapping Update

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UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT

Residual Risk Extent
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: Feb 2017 **REV NO:** 2

SCALE: 1 : 60,000 @ A1

MAP NO:

N

NOTES

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

2. This update only included new flood risk information from River Welland (Fluvial), River Glen (Fluvial) and Tidal hazard mapping (River Welland, River Nene and the Wash sea defences). No new information from the Internal Drainage Boards and associated systems was used for this update.

3. In addition to the potential flood extents shown on this map, there may be shallow flooding in low-lying rural areas

4. The consequences designated as being a Residual Risk arise from direct overtopping of defences, where this would occur, together with breach failure which is assumed could occur at any point along the defences.

5. Functional Floodplain encompasses areas where water is intended to flow or be stored in times of flood.

6. Land outside South Holland District is not considered.

7. This map shows the extents only of the flooding probability bands relevant to the map Title

Map Legend

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)
- Functional Floodplain
- South Holland District Boundary

REV	DATE	REMARKS
2	Feb 17	Modelling and Mapping Update
1	Dec 16	Modelling and Mapping Update

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UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT

Residual Flood Hazard
District - Year 2115
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: Feb 2017 **REV NO:** 2

SCALE: 1 : 60,000 @ A1

MAP NO:

APPENDIX E

G30 Consulting Ltd

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General Notes

1. Do not scale this drawing.
2. All dimensions are in millimeters unless stated otherwise.
3. This drawing is to be read in conjunction with all other relevant drawings & specifications.
4. All proprietary items to be installed in strict compliance with manufacturers instructions and recommendations.
5. No works shall commence on site until approval has been obtained from all relevant Agencies / Authorities.
6. All dimensions referred to in this drawing must be verified.

Key

- Site boundary
- Foul water drainage - Existing
- Foul water manhole - Existing
- Foul water drainage - Proposed
- Foul water manhole - Proposed
- Surface water drainage - Proposed
- Surface water manhole - Proposed
- 50mm contour
- 250mm contour

N

New outfall headwall to be constructed to New River (Drain). Headwall to be constructed under a Section 23 application with the Water Management Alliance.

6.000m sewer easement.

Hydrobrake flow control chamber restricting surface water runoff rate to 5.6l/s for 1 in 100 year + 40% Climate Change storm events.

Invert Level: 1.795m

Offline detention basin to provide attenuation storage for all storms up to and including 1 in 100 year + 40% Climate Change.

Top of Basin Level: 3.100m
Invert Level: 1.800m

Storage to be provided between 1.800m and 2.800m allowing for 300mm of freeboard.

Area at 1.800m = 1005 m²
Area at 2.800m = 1711 m²

Foul water drainage to discharge to existing Anglian Water foul water manhole 3501. Connection to manhole to be made under a Section 106 agreement.

Foul water drainage to discharge to existing Anglian Water foul water manhole 2301. Connection to manhole to be made under a Section 106 agreement.

PL1	First Issue	11.06.2020
Revision	Description	Date

PRELIMINARY

G30 CONSULTING

59 Springfield Road, Sheffield, South Yorkshire, S7 2GG
W: www.g30consulting.com
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T: 0114 349 2720

Project
MJ Gleeson PLC
Proposed Residential Development, Northon's Lane, Holbeach

Title
Foul and Surface Water Drainage Layout Plan

Drawn by	Checked by	Paper Size
SG	SG	A0

Drawing Number	Revision	Scale	Date
08-0048-001	P2	1:500	11.06.2020

APPENDIX F

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Steven Griffiths
Site name:	Northans Lane
Site location:	Holbeach

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.81046° N
Longitude:	0.00536° E
Reference:	835967789
Date:	Jan 17 2020 14:54

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 3.900

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	573	573
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	5.62	5.62
1 in 1 year (l/s):	4.89	4.89
1 in 30 years (l/s):	13.78	13.78
1 in 100 year (l/s):	20.02	20.02
1 in 200 years (l/s):	23.67	23.67

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

APPENDIX G

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	2.094	0.294	5.6	324.6	O K
30 min Summer	2.179	0.379	5.6	425.1	O K
60 min Summer	2.262	0.462	5.6	528.1	O K
120 min Summer	2.342	0.542	5.6	629.7	O K
180 min Summer	2.384	0.584	5.6	685.1	O K
240 min Summer	2.411	0.611	5.6	720.7	O K
360 min Summer	2.442	0.642	5.6	762.4	O K
480 min Summer	2.461	0.661	5.6	788.4	O K
600 min Summer	2.473	0.673	5.6	803.5	O K
720 min Summer	2.479	0.679	5.6	811.7	O K
960 min Summer	2.481	0.681	5.6	815.0	O K
1440 min Summer	2.465	0.665	5.6	793.9	O K
2160 min Summer	2.433	0.633	5.6	750.7	O K
2880 min Summer	2.399	0.599	5.6	705.3	O K
4320 min Summer	2.335	0.535	5.6	620.4	O K
5760 min Summer	2.274	0.474	5.6	543.3	O K
7200 min Summer	2.218	0.418	5.6	473.7	O K
8640 min Summer	2.167	0.367	5.6	411.6	O K
10080 min Summer	2.122	0.322	5.6	356.9	O K
15 min Winter	2.128	0.328	5.6	364.1	O K
30 min Winter	2.221	0.421	5.6	476.9	O K
60 min Winter	2.313	0.513	5.6	593.1	O K
120 min Winter	2.402	0.602	5.6	708.8	O K
180 min Winter	2.450	0.650	5.6	773.1	O K
240 min Winter	2.481	0.681	5.6	814.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	295.9	24
30 min Summer	85.337	0.0	383.5	39
60 min Summer	53.483	0.0	525.2	68
120 min Summer	32.428	0.0	635.4	128
180 min Summer	23.896	0.0	699.5	186
240 min Summer	19.136	0.0	743.2	246
360 min Summer	13.890	0.0	798.9	366
480 min Summer	11.074	0.0	832.8	484
600 min Summer	9.283	0.0	848.1	604
720 min Summer	8.033	0.0	847.6	722
960 min Summer	6.389	0.0	828.2	962
1440 min Summer	4.620	0.0	783.4	1342
2160 min Summer	3.335	0.0	1203.6	1672
2880 min Summer	2.644	0.0	1269.2	2020
4320 min Summer	1.904	0.0	1355.1	2808
5760 min Summer	1.506	0.0	1464.6	3576
7200 min Summer	1.256	0.0	1525.0	4328
8640 min Summer	1.082	0.0	1574.2	5104
10080 min Summer	0.953	0.0	1613.0	5840
15 min Winter	129.843	0.0	330.8	24
30 min Winter	85.337	0.0	421.3	39
60 min Winter	53.483	0.0	587.9	68
120 min Winter	32.428	0.0	708.7	126
180 min Winter	23.896	0.0	776.0	184
240 min Winter	19.136	0.0	818.3	242

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	2.516	0.716	5.6	863.4	O K
480 min Winter	2.538	0.738	5.6	894.2	O K
600 min Winter	2.552	0.752	5.6	913.2	O K
720 min Winter	2.560	0.760	5.6	924.6	O K
960 min Winter	2.566	0.766	5.6	933.2	O K
1440 min Winter	2.556	0.756	5.6	918.8	O K
2160 min Winter	2.518	0.718	5.6	866.0	O K
2880 min Winter	2.480	0.680	5.6	813.8	O K
4320 min Winter	2.386	0.586	5.6	687.1	O K
5760 min Winter	2.292	0.492	5.6	566.0	O K
7200 min Winter	2.207	0.407	5.6	459.8	O K
8640 min Winter	2.132	0.332	5.6	369.0	O K
10080 min Winter	2.069	0.269	5.6	294.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	13.890	0.0	859.6	360
480 min Winter	11.074	0.0	863.6	476
600 min Winter	9.283	0.0	854.1	592
720 min Winter	8.033	0.0	843.3	708
960 min Winter	6.389	0.0	821.7	934
1440 min Winter	4.620	0.0	782.3	1374
2160 min Winter	3.335	0.0	1344.7	1776
2880 min Winter	2.644	0.0	1413.6	2220
4320 min Winter	1.904	0.0	1491.4	3076
5760 min Winter	1.506	0.0	1640.6	3872
7200 min Winter	1.256	0.0	1708.7	4680
8640 min Winter	1.082	0.0	1764.3	5360
10080 min Winter	0.953	0.0	1809.0	6048

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.355

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	5	0.904	5	10	0.451

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Model Details

Storage is Online Cover Level (m) 3.100

Tank or Pond Structure

Invert Level (m) 1.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1034.0	1.300	1711.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0111-5600-1000-5600
Design Head (m)	1.000
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	1.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.6	Kick-Flo®	0.641	4.6
Flush-Flo™	0.294	5.6	Mean Flow over Head Range	-	4.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	0.800	5.0	2.000	7.7	4.000	10.7	7.000	14.0
0.200	5.4	1.000	5.6	2.200	8.1	4.500	11.4	7.500	14.5
0.300	5.6	1.200	6.1	2.400	8.4	5.000	11.9	8.000	15.0
0.400	5.5	1.400	6.6	2.600	8.8	5.500	12.5	8.500	15.4
0.500	5.3	1.600	7.0	3.000	9.4	6.000	13.0	9.000	15.8
0.600	4.9	1.800	7.4	3.500	10.1	6.500	13.5	9.500	16.2

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APPENDIX H

Operation and maintenance requirements for Rainwater Harvesting (Waterbutts)		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters.	Annually (and following poor performance)
	Cleaning of tank inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris.	Annually (and following poor performance)
Occasional Maintenance	Cleaning and/or replacement of any filters.	Three monthly (or as required)
Remedial Actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Maintenance procedures must be carried out as per CIRIA guidance C753 - The SuDS Manual page 229.

Operation and maintenance requirements for Proprietary Treatment Systems		
Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary- indicated by system inspections or immediately following significant spill
Regular Maintenance	Replacement of any filters	Three monthly (or as required)
Remedial Actions	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Maintenance procedures must be carried out as per CIRIA guidance C753 - The SuDS Manual page 287.

Operation and maintenance requirements for Swales		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range.	Monthly (during growing season), or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start, then as required.
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours.	Monthly, or when required.
	Inspect vegetation coverage.	Monthly for 6 months, quarterly for 2 years, then half yearly.
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant type to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the swale treatment area.
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding.	As required.
	Relevel uneven surfaces and reinstate design levels.	As required.
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of soil surface.	As required.
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required.
	Remove and dispose or oils or petrol residues using safe standard practices.	As required.

Maintenance procedures must be carried out as per CIRIA guidance C753 - The SuDS Manual page 329.

Operation and maintenance requirements for Trees / Vegetation		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris.	Monthly (or as required)
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
Occasional Maintenance	Check tree health and manage tree appropriately.	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary.	Annually, or as required.
	Water.	As required (in periods of drought).
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies.	Half yearly

Maintenance procedures must be carried out as per CIRIA guidance C753 - The SuDS Manual page 382.

Operation and maintenance requirements for Detention Basin		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris.	Monthly
	Cut grass – for spillways and access routes.	Monthly (during growing season), or as required.
	Cut grass – meadow grass in and around basin.	Half yearly (spring – before nesting season, and autumn).
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect banksides, structures, pipework etc for evidence of physical damage.	Monthly.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required.
	Check any penstocks and other mechanical devices.	Annually.
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from inlets, outlets and forebay.	Annually (or as required).
	Manage wetland plants in outlet pool - where provided.	Annually (as set out in Chapter 23).
Occasional Maintenance	Reseed areas of poor vegetation growth.	As required.
	Prune and trim and trees and remove cuttings.	Every 2 years, or as required.
	Remove sediment from inlets, outlets, forebay and main basin when required.	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided).

Remedial Actions	Repair erosion or other damage by reseeding or re-turfing.	As required.
	Realignment of rip-rap.	As required.
	Repair/rehabilitation of inlets, outlets and overflows.	As required.
	Relevel uneven surfaces and reinstate design levels.	As required.

Maintenance procedures must be carried out as per CIRIA guidance C753 - The SuDS Manual page 483.