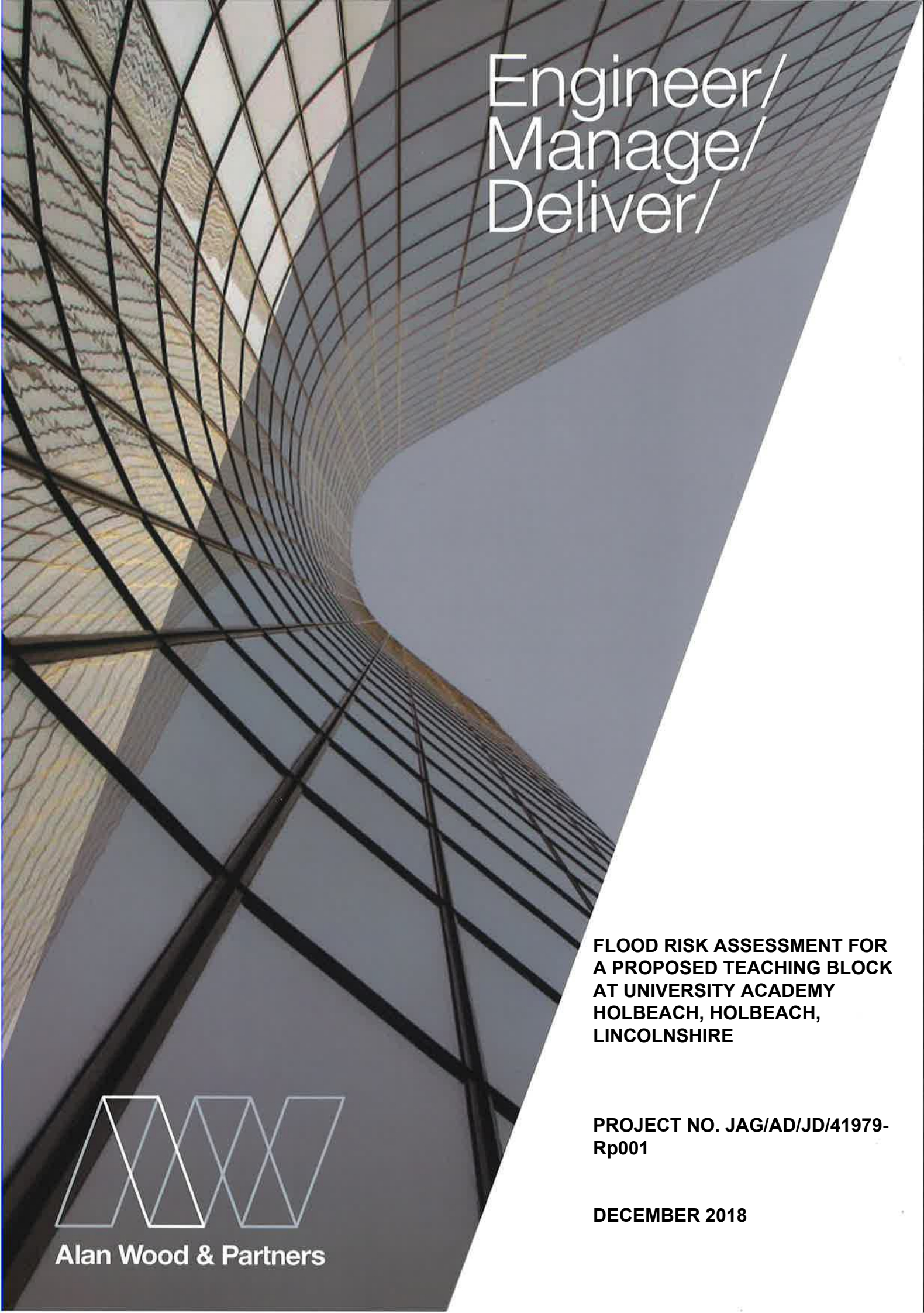


FLOOD RISK ASSESSMENT FOR A PROPOSED TEACHING BLOCK AT UNIVERSITY ACADEMY HOLBEACH, HOLBEACH, LINCOLNSHIRE

PROJECT NO. JAG/AD/JD/41979-Rp001

DECEMBER 2018

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Prepared by: A Dunn



Signed: ……
Date: 7th December 2018

Approved by: J Gibson, MEng (Hons), CEng, CWEM MCIWEM
Civil Engineering Director



Signed: ……
Date: 7th December 2018

Issue	Revision	Revised by	Approved by	Revised Date

For the avoidance of doubt, the parties confirm that these conditions of engagement shall not and the parties do not intend that these conditions of engagement shall confer on any party any rights to enforce any term of this Agreement pursuant of the Contracts (Rights of third Parties) Act 1999.
The Appointment of Alan Wood & Partners shall be governed by and construed in all respects in accordance with the laws of England & Wales and each party submits to the exclusive jurisdiction of the Courts of England & Wales.

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APPENDICES

Appendix A : Indicative Layout Drawings

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1.0 INTRODUCTION

1.1 Background

1.1.1 Alan Wood & Partners were commissioned by Lindum BMS on behalf of University Academy Holbeach to prepare a Flood Risk Assessment for a proposed Teaching Block development on land at University Academy Holbeach, Holbeach, Lincolnshire.

1.1.2 A Flood Risk (FRA) for the proposed development is required to assess the development's risk from flooding.

1.2 Layout of Report

1.2.1 Section 1 provides an introduction to the FRA, explains the layout of this FRA and provides an introduction to flood risk and the latest guidance on development and flood risk in England.

1.2.2 Section 2 provides an introduction to the site. The site description is based upon a desktop study and information provided by the developer. In order to obtain further information on flood risk, consultation was undertaken with the Environment Agency.

1.2.3 Section 3 of this report details the information gathered through the consultation.

1.2.4 Section 4 of this report details the development proposals, and considers the development proposals in relation to the current planning policy on development and flood risk in England (and what type of development is considered appropriate in different flood risk zones). National Planning Policy Framework (NPPF): and its associated Technical Guidance (Communities and Local Government, March 2012) is the current planning policy on flood risk in England, and an introduction to NPPF is provided below.

1.2.5 Section 5 considers the drainage arrangements for the proposed development. The drainage assessment is based on NPPF, and outlines an indicative foul and surface water drainage strategy.

1.2.6 Section 6 of this report considers the flood risk to site, and the potential for the development proposals to impact on flood risk. The assessment of flood risk is based on the latest planning policy and uses all the information gathered as part of FRA. Based on all the work undertaken as part of the FRA.

1.2.7 Section 7 of this report provides details of any recommendations for further work to mitigate against possible flooding.

1.2.8 Section 8 of this report provides a summary of the report.

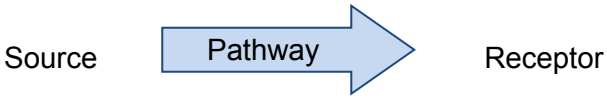
1.3 Flood Risk

1.3.1 Flood risk takes account of both the probability and the consequences of flooding.

1.3.2 Flood risk = probability of flooding x consequences of flooding

1.3.3 Probability is usually interpreted in terms of the return period, e.g. 1 in 100 and 1 in 200 year event, etc. In terms of probability, there is a 1 in 100 (1%) chance of one or more 1 in 100 year floods occurring in a given year. The consequences of flooding depends on how vulnerable a receptor is to flooding.

The components of flood risk can be considered using a source-pathway-receptor model.



1.3.4 Sources constitute flood hazards, which are anything with the potential to cause harm through flooding (e.g. rainfall extreme sea levels, river flows and canals). Pathways represent the mechanism by which the flood hazard would cause harm to a receptor (e.g. overtopping and failure of embankments and flood defences, inadequate drainage and inundation of floodplains). Receptors comprise the people, property, infrastructure and ecosystems that could potentially be affected should a flood occur.

1.4 National Planning Policy Framework

1.4.1 General

1.4.1.1 NPPF and its associated Technical Guidance replaces Planning Policy Statement 25 and provides guidance on how to evaluate sites with respect to flood risk.

1.4.1.2 A summary of the requirements of NPPF is provided below.

1.4.2 Sources of Flooding

1.4.2.1 NPPF requires an assessment to flood risk to consider all forms of flooding and lists six forms of flooding that should be considered as part of a flood risk assessment. These forms of flooding are listed in Table 1, along with an explanation of each form of flooding.

Table1: Forms of Flooding

Flooding From Rivers (Fluvial Flooding)
Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.
Flooding From the Sea (Tidal Flooding)
Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.
Flooding from Land (Pluvial Flooding)
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be taken into account in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area.

Flooding from Groundwater
Groundwater flooding occurs when groundwater levels rise above ground levels (i.e. groundwater issues). Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Chalk is the most extensive source of groundwater flooding.
Flooding from Sewers
In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall, and become blocked. Sewer flooding continues until the water drains away.
Flooding from Other Artificial Sources (i.e. reservoirs, canals, lakes and ponds)
Non-natural or artificial sources of flooding can include reservoirs, canals and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and /or as a result of dam or bank failure.

1.4.3 Flood Zones

1.4.3.1 For river and sea flooding, NPPF uses four Flood Zones to characterise flood risk. These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and are detailed in Table 2.

Table 2: Flood Zones

Flood Zone	Definition
1	Low probability (less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium probability (between 1 in 100 and 1 in 1,000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%-0.1%) in any year).
3a	High probability (1 in 100 or greater annual probability of river flooding (>1%) in any year or 1 in 200 or greater annual probability of sea flooding (>0.5%) in any given year).
3b	This zone comprises land where water has to flow or be stored in times flood. Land which would flood with an annual probability of 1 in 20 (5%), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

1.4.4 Vulnerability

1.4.4.1 NPPF classifies the vulnerability of developments to flooding into five categories. These categories are detailed in Table 3.

Table 3: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	Examples of Development Types
Essential Infrastructure	- Essential utility infrastructure including electricity generating power stations and grid and primary substations - Wind turbines
Highly Vulnerable	- Police stations, ambulance stations, fire stations, command centres and telecommunications installations required to be operational during flooding. - Emergency dispersal points. - Basement dwellings. - Caravans, mobile homes and park homes intended for permanent residential use.
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. - Sites used for holiday or short-let caravans and camping.
Less Vulnerable	- Building used for shops, financial, professional and other services, restaurants and cafes, hot foot takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable" and assembly and leisure. - Land and buildings used for agriculture and forestry.
Water Compatible	- Docks, marinas and wharves. - Water based recreation (excluding sleeping accommodation). - Lifeguard and coastguard stations. - Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.

1.4.4.2 Based on the vulnerability of a development, NPPF states within what Flood Zones(s) the development is appropriate. The flood risk vulnerability and Flood Zone 'compatibility' of developments is summarised in Table 4.

Table 4: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test	✓	✓
	3a	Exception Test	✓	x	Exception Test	✓
	3b	Exception Test	✓	x	x	x

1.4.5 The Sequential Test, Exception Test and Sequential Approach

1.4.5.1 The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Planning Authority by means of a Strategic Flood Assessment (SFRA).

1.4.5.2 The SFRA and NPPF may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and, to be passed, must demonstrate that:

- There are sustainability benefits that outweigh the flood risk and;
- The new development is safe and does not increase flood risk elsewhere.

1.4.5.3 The Sequential Approach is also a risk based approach to development. In a development site located in several Flood Zones or with other flood risk, the sequential approach directs the most vulnerable types of development towards areas of least risk within the site.

1.4.6 Climate Change

1.4.6.1 This is a planning requirement to account for climate change in the proposed design. The recommended allowances should be based on the most relevant guidance from the Environment Agency and the Lead Local Flood Authority.

1.4.7 Sustainable Drainage

1.4.7.1 The key planning objectives in NPPF are to appraise, manage and where possible, reduce flood risk. Sustainable Drainage Systems (SuDS) provide an effective way of achieving some of these objectives, and NPPF and Part H of the Building Regulations (DTLR 2002) direct developers towards the use of SuDS wherever possible.

2.0 EXISTING SITE DESCRIPTION

2.1 Location

2.1.1 The proposed development lies within the University Academy Holbeach, which is located to the west of Penny Hill Road and to the south of the A17 in Holbeach, Lincolnshire.

2.1.2 An aerial photograph is included in Figure 1 below, which identifies the location of the site.



Figure 1: Aerial Photograph

2.1.3 The Ordnance Survey grid reference for the centre of the site development is approximately 535930, 325435.

2.2 Surrounding Features

2.2.1 The proposed development lies within the grounds of the University Academy Holbeach Campus.

2.2.2 There are existing university campus buildings to the north, east, south and west of the development site.

2.2.3 To the north of the campus is Park Road and an area of grassed landscaping, beyond which is the A17 highway.

2.2.4 To the east of the campus is Penny Hill Road, “Old River” (drain) and a residential development beyond.

2.2.5 To the south of the campus buildings is a sports ground and a football ground.

2.2.6 To the west of the campus is a residential development.

2.2.7 To the north west of the campus is Holbeach Primary School.

2.3 Topography

2.3.1 A topographic survey of the site which was undertaken for a previous development shows that the existing ground levels over the area of the proposed development vary from approximately 3.07m to 3.13m OD(N).

2.4 Ground Conditions

2.4.1 No intrusive ground investigation works have currently been undertaken in respect of the proposed development.

2.4.2 However, a desktop study of the British Geological Survey map reveals the local geology to comprises superficial deposits of Alluvium-Clay, Silt and Sand overlaying bedrock comprising West Walton Formation – Mudstone and Siltstone.

2.4.3 A local borehole record indicates that silts and silty sands extend to a minimum of 6m below ground level, with ground water encountered at a depth of 3m.

2.4.4 Ground conditions in the area of the development are therefore not suitable for soakaways to be used as a means of surface water disposal from the development.

2.4.5 A study of the groundwater maps reveals that the site does not overlay an aquifer or lie within a Groundwater Vulnerability Zone.

3.0 CONSULTATION

3.1 Consultation has taken place with the Environment Agency in order to obtain relevant information in respect of flood mapping and Product 6 flood data, relevant details of which are included within this report.

3.2 Consultation has taken place with the design team in order to obtain information with regard to the development proposals.

4.0 PROPOSED DEVELOPMENT

4.1 The proposed development involves the construction of the new Teaching Block to include the following:-

- Construction of new four-storey building to provide classrooms, office, plant room, store rooms, toilet facilities, staircases and corridors etc.
- Associated services etc.

4.2 Indicative layout drawings of the proposed development are included in Appendix A.

4.3 In terms of flood risk, the development is classed as 'More Vulnerable' in terms of flood risk vulnerability (Table 3).

4.4 In terms of flood zone compatibility, the development is considered to be suitable in Flood Zone 3 (Table 4) subject to an Exception Test being provided. However, as the whose of Holbeach and the surrounding area lies within Flood Zone 3, the provision of an Exception Test should not be applicable.

5.0 DRAINAGE ASSESSMENT

5.1 Surface Water Drainage

5.1.1 From the aerial photograph included in Figure 2, it can be seen that the area of the development site currently comprises an area of external paving together with small areas of grassed landscaping.



Figure 2: Aerial Photograph

5.1.2 Requirement H3 of the Building Regulations establishes a preferred hierarchy for disposal of surface water disposal. Consideration should firstly be given to soakaway, infiltration, watercourse and sewer in that priority order.

5.1.3 The underlying strata in the vicinity of the development is considered to be unsuitable for the disposal of surface water run-off from the development into soakaways or infiltration trenches.

5.1.4 The second preferred option would be to discharge the surface water run-off from the development to a watercourse.

5.1.5 Whilst there is an open watercourse located to the east of the site, at a distance of approximately 180m the watercourse cannot be accessed without crossing third party land outside the control of the developer.

5.1.6 It is therefore proposed that the surface water run-off from the new development is discharged into the existing site drainage network.

5.1.7 The new impermeable area of the development has been calculated at approximately 1056m².

5.1.8 The existing run-off rate in the area of the new development has been calculated at approximately 11.7 litres per second, based upon the BSEN752 calculations for the existing paved area of 845m^2 which is currently positively drained, plus the greenfield discharge from the grassed area of 160m^2.

5.1.9 However, to meet the flood risk planning requirements it is unacceptable to discharge flows freely from the proposed development site at an unrestricted rate. Therefore flows from the proposed development are normally limited to the brownfield runoff rate, based on the impermeable contributing area and with a 30% reduction from the current situation to provide a degree of improvement to the drainage network.

5.1.10 The brownfield discharge rate from the development would therefore reduce to 8.2 litres per second (11.7 litres per second x 0.7) ignoring the greenfield discharge which is insignificant and consequently this figure has been used as basis for the new drainage design.

5.1.11 The required design criteria for new developments is a 1 in 100 year storm event plus an allowance for climate change.

5.1.12 It is assumed that the outfall can be achieved by means of a gravity connection to the existing sewer. However, if it is found that this is not possible due to relative levels then a pumped outfall will be required.

5.1.13 Lincolnshire County Council SuDS guidance advises that an allowance of 40% is made to account for climate change resulting from global warming.

5.1.14 Based upon the above design criteria, surface water storage calculations have been undertaken in order to assess the likely storage volume of surface water which will be required, details of which are included below:-

30 year storm	-	Volume required 11m^3
100 year storm + 40% climate change	-	Volume required 27m^3 (16m^3 of additional storage above the 30 year storm requirement)

5.1.15 The storage volumes will be dictated by the agreed discharge rate and the impermeable area created by the development.

5.1.16 Copies of the surface water storage calculations are included in Appendix B.

5.1.17 To comply with current design requirements the drainage system will need to contain the 30 year storm volume below ground within the drainage network in the form of oversized pipes or an appropriate storage tank, which has been calculated at approximately 11m^3.

5.1.18 The additional storage volume required to accommodate the 100 year storm + 40% climate change can be stored above ground on site providing it does not pose a risk of flooding to the development and does not leave the confines of the site, or alternatively can be stored below ground in a suitable storage tank. This storage volume has been calculated at approximately 16m^3 (27m^3 – 11m^3).

5.2 Foul Water Drainage

5.2.1 Based upon the British Code of Practice 'Flows and Loads – 4' and a maximum number of 200 occupants, the peak flow generated by the new development would be approximately 0.2 litres per second.

5.2.2 Allowing for factoring the peak flow rate, the discharge from the development would be less than 1 litre per second.

5.2.3 It is proposed that the foul water discharge from the development will be connected to the existing site drainage network.

5.2.4 It is envisaged that the connection to the existing sewer can be achieved by means of a gravity connection.

5.2.5 It is considered that such low rate of discharge would not have any impact on the sewer network.

6.0 FLOOD RISK ASSESSMENT

6.1 Flood Zone

6.1.1 A copy of the Environment Agency Flood Map for Planning is included in Figure 3 below which identifies the development site to be located within an area designated as Flood Zone 3, (high probability of flooding), comprising land assessed as having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 year or greater annual probability of flooding from the sea.

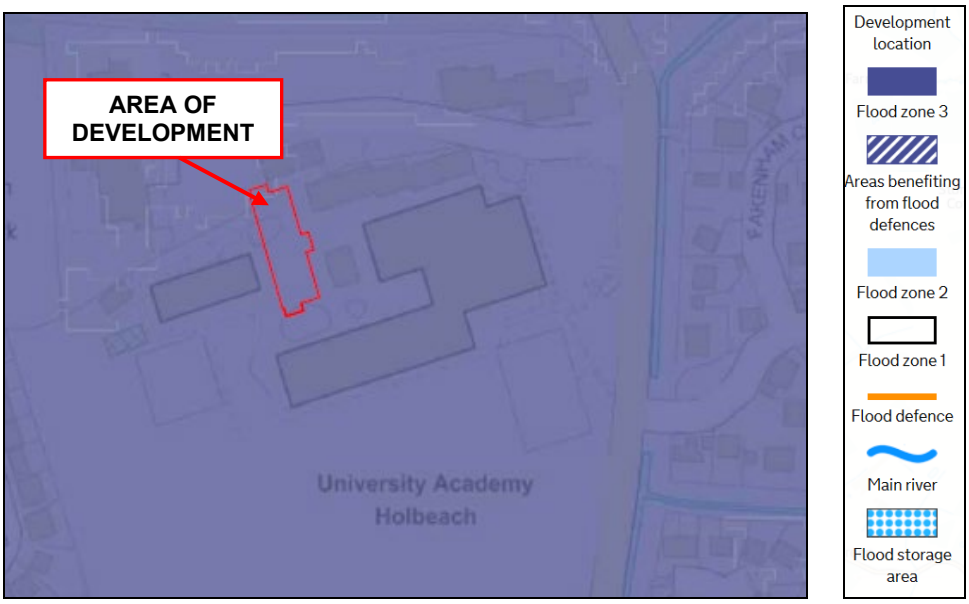


Figure 3: Environment Agency Flood Map for Planning dated December 2018

6.2 Tidal Flooding

6.2.1 The site is located at a distance of approximately 11km from the coastline of The Wash which is the main potential source of flooding to the development and approximately 0.5km to the north of The Haven, which is tidally influenced.

6.2.2 The predicted 1 in 200 year tidal water level for The Wash is stated as 5.95m OD(N).

6.2.3 For a development with a design life of 50 years the predicted sea level rise is 415mm, resulting in a predicted flood level of 6.37m OD(N).

6.2.4 A copy of the map produced by the Environment Agency showing the extent of flooding from rivers or the sea is included in Figure 4 below.



Figure 4: Environment Agency Map dated December 2018 showing the Extent of Flooding from Rivers or the Sea

6.2.5 The map shows that the site is considered to be at 'low risk' of flooding.

6.2.6 The region is protected by concrete sea defence walls. However, there remains a residual risk of flooding should the defences become breached or overtopped.

6.2.7 Flood data has been obtained from the Environment Agency in respect of potential flood risk to the development.

6.2.8 The data indicates for a situation where there is a breach of the defences, for an annual probability of 1:200 incorporating the predicted sea level rise resulting from global warming, the site lies in an areas which is considered to lie in an area with a hazard rating classed as 'Danger to Some' and in an area likely to flood to a depth of 0.25 to 0.5 metres.

6.2.9 Flood mitigation measures will consequently need to be incorporated within the design of the project. Details of such measures are included in Section 7 of this report.

6.3 Fluvial Flooding

6.3.1 The River Welland is located approximately 10km to the west of the development site.

6.3.2 The River Nene is located approximately 13km to the east of the development site.

6.3.3 These watercourses are tidally influenced and consequently the rivers could overtop their banks at periods of high tides.

6.3.4 However, with the watercourses being located at such a distance from the development, the likelihood of any such flooding affecting the site is extremely remote.

6.3.5 The risk to the development from fluvial flooding is considered to be low and acceptable.

6.4 Flooding from Open Drainage Ditches

6.4.1 There are a large number of open drainage ditches in the region which drain the local low-lying land towards the locals rivers and the North Sea.

6.4.2 The outfalls from the ditches into the local river network are tidally influenced and consequently there is a risk of the ditches overtopping their banks during periods of high tides.

6.4.3 The maps produced by the Environment Agency considering flood risk from surface water flooding included in Section 6.5 below do not indicate any risk of flooding to the development.

6.4.4 The risk to the development from this potential flood source is considered to be low and acceptable.

6.5 Surface Water Flooding

6.5.1 A copy of the Environment Agency map showing the extent of flooding from surface water is included in Figure 5 below.

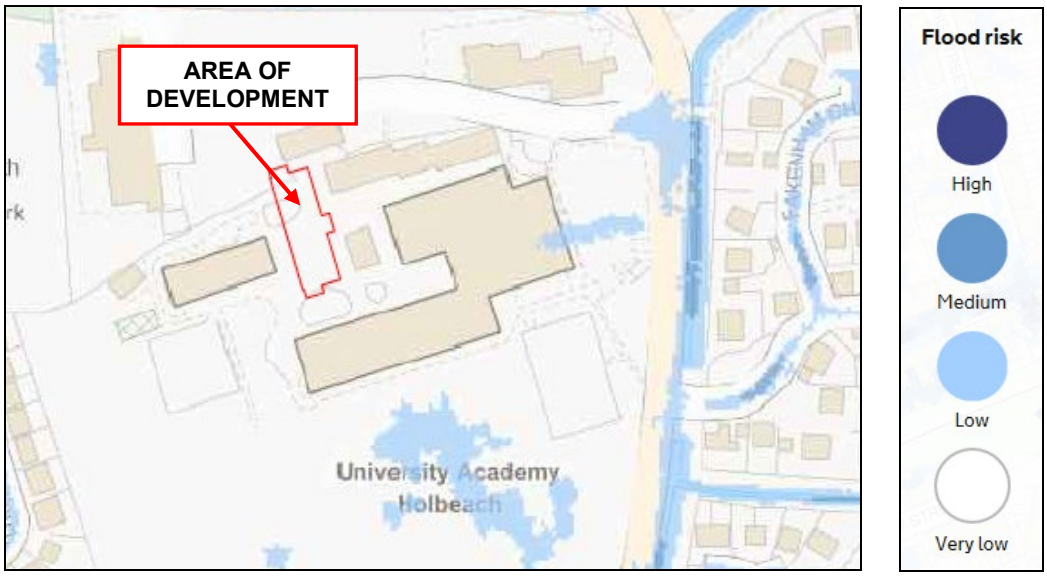


Figure 5: Environment Agency Map dated December 2018 Showing the Extent of Flooding from Surface Water

6.5.2 The map shows that the site lies in an area which is not considered to be at risk of surface water flooding.

6.5.3 The risk to the development from Surface Water flooding is considered to be low and acceptable.

6.6 Flood Risk from Existing Water Mains

6.6.1 There are likely to be water mains present in the vicinity of the development site serving the adjacent buildings.

6.6.2 There are no known issues with regard to these water mains.

6.6.3 The risk the of the development from this potential flood source is therefore considered to be low and acceptable.

6.7 Flood Risk from Existing Drainage Sewers

6.7.1 There are likely to be existing domestic drainage services serving the adjacent buildings.

6.7.2 There are no known issues with regard to the capacity or condition of the existing drainage services.

6.7.3 The risk of flooding to the new development from this potential source is considered to be low and acceptable.

6.8 Flooding from Reservoirs, Canals and Other Artificial Sources

6.8.1 Investigations indicate that there are no structures in proximity to the development which are likely to pose any risk of flooding.

6.8.2 A copy of the map produced by the Environment Agency showing the extent of flooding from reservoirs is included in Figure 6 below.

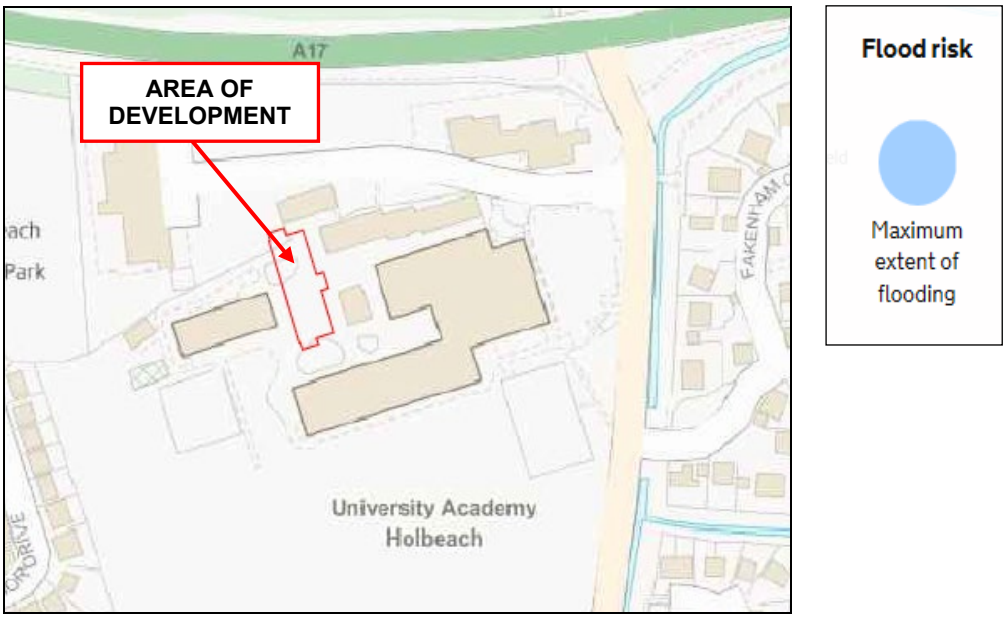


Figure 6: Environment Agency Map dated December 2018 Showing the Extent of Flooding from Reservoirs

6.8.3 The map shows that the development site lies in an area which is not considered to be at risk from reservoir flooding.

6.8.4 The risk to the development from any such potential flood source is considered to be low and acceptable.

6.9 Groundwater Flooding

6.9.1 Groundwater flooding can occur when the sub-surface water levels are high and emerges above ground level.

6.9.2 There are no proposals to create any basements within the development.

6.9.3 The construction works will not involve deep excavation works and consequently the risk to the development from this potential flood source is considered to be low and acceptable.

7.0 FLOOD MITIGATION MEASURES

7.1 Managerial

7.1.1 The building is shown to be at potential risk of flooding from a breach or overtopping of the coastal defences to the North Sea.

7.1.2 If it is not already registered, the campus should be connected to the Environment Agency's 'Flood Direct' flood warning system. This would then ensure that there is sufficient time available for safe evacuation measures to be put in place should this prove necessary.

7.1.3 An evacuation plan is to be provided and warning notices displayed in prominent locations within the building to advise occupants of the procedures to follow should a major flood situation occur.

7.1.4 The University Academy Holbeach already has an Emergency Procedures Policy in place and the new building will subscribe to this to ensure safe procedures are followed should a flood event occur.

7.2 Passive Flood Protection

7.2.1 For new development lying in Flood Zone 3 it is normally a requirement to raise the ground floor construction level above the predicted flood level and provide an additional 300mm of flood resilience above floor level.

7.2.2 The new building is required to provide level pedestrian access from the adjacent paved areas to all entrances and consequently it is not possible to raise the ground floor level of the building in excess of 300mm to mitigate against flooding.

7.2.3 Due to the constraints imposed by the limited scale of the building there is insufficient space to accommodate internal ramps to provide compliant access up to a further raised floor level.

7.2.4 This would result in a finished ground floor construction level of 3.40m OD(N).

7.2.5 For this development it will therefore be necessary to increase the height of flood resilience in order to minimise the extent of any flood damage occurring should the building be affected by flood waters during a major flood event.

7.2.6 In order to achieve the required degree of flood protection, it will be necessary for flood resilient methods of construction to be provided within the building up to a minimum height of 600mm above the finished floor level.

7.3 Safe Refuge

7.3.1 It is a requirement for safe refuge to be provided within new developments above the predicted flood level to ensure that there will be no requirement for evacuation measures.

7.3.2 This requirement has been met as the development incorporates accommodation at first floor level which is above the required refuge level. Access from the ground floor accommodation is provided by means of communal staircases and a passenger lift.

7.4 Flood Resilience

7.4.1 Other than doorways there should be no other voids in the external walls within 600mm of finished floor level which could otherwise enable flood waters to enter the building.

7.4.2 All new partition walls constructed at ground floor level should be of suitable robust construction or metal stud partitions fixed with plasterboard, with the lower boarding laid horizontally for ease of replacement.

7.4.3 All new electrical apparatus or other flood sensitive equipment within the building should be elevated to a minimum of 600mm above finished floor level to prevent damage occurring should flood waters enter the building. All cables should be routed at high level with vertical drops to the fittings.

7.4.4 All service entry points must incorporate adequate flood resistant seals or should preferably be located above the flood protection level.

7.4.5 All drainage service pipes will need to be fitted with proprietary anti-flood valves to prevent the ingress of flood waters through the drainage network.

7.4.6 Floor finishes provided at ground floor level should be suitable for ease of cleaning after flooding without incurring damage.

8.0 SUMMARY

8.1 This report has been prepared to assess the flood risk implications for a new teaching block at University Academy Holbeach, Holbeach, Lincolnshire.

8.2 The site falls in Flood Zone 3a (high flood risk) on the Environment Agency maps and in an area shown to be subject to flooding to a depth between 0.25m to 0.5m and the proposals are considered to include 'More Vulnerable' development.

8.3 The primary risk to the site is from tidal flooding from the North Sea resulting from the coastal defences being breached or overtopped during an extreme flood event.

8.4 The primary focus for flood risk assessment is to protect life, and then consideration should be given to buildings, contents, operation and re-use. As the scheme is progressed the design should consider exceedance and routing of flows away from the buildings.

8.5 Mitigation works are proposed which we consider will reduce the risk to the development from flooding down to an acceptable level.

8.6 This report has considered other potential sources of flooding to the site, including groundwater, surface water, existing sewers, water mains and other artificial sources.

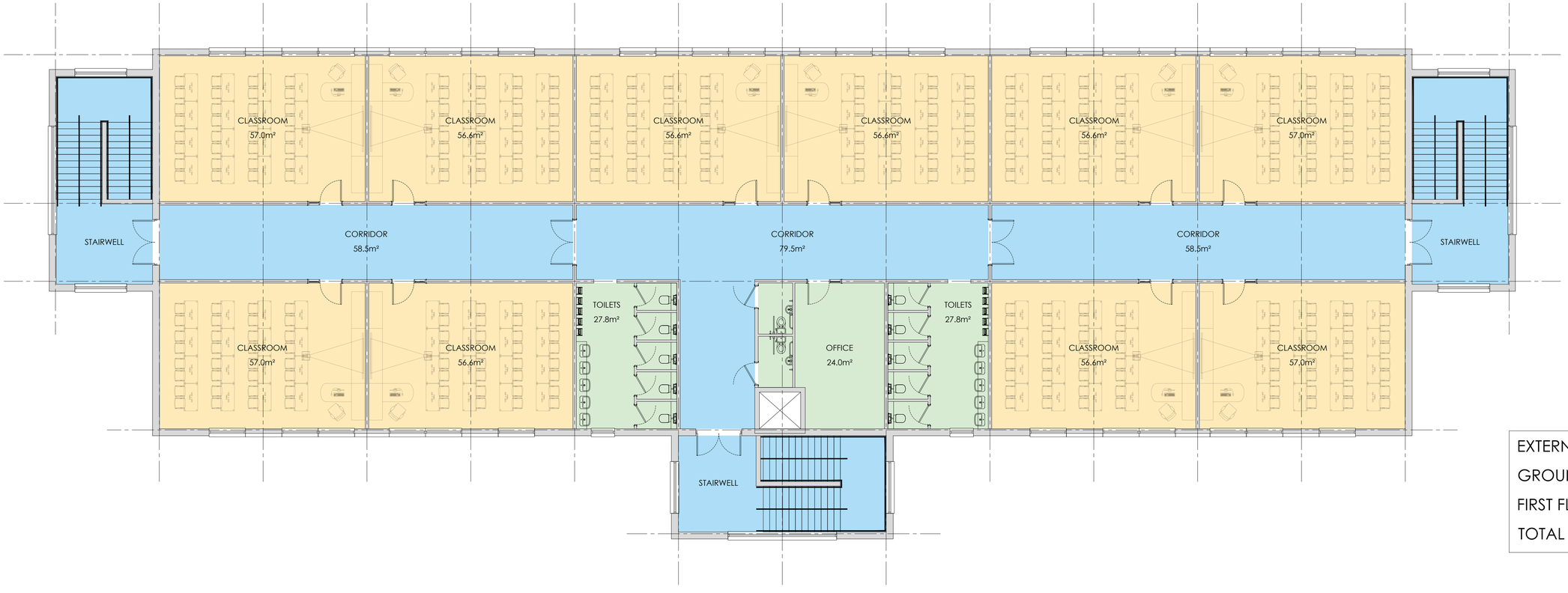
8.7 Overall, this report demonstrates that the flood risk to the development is reasonable and acceptable.

Alan Wood & Partners

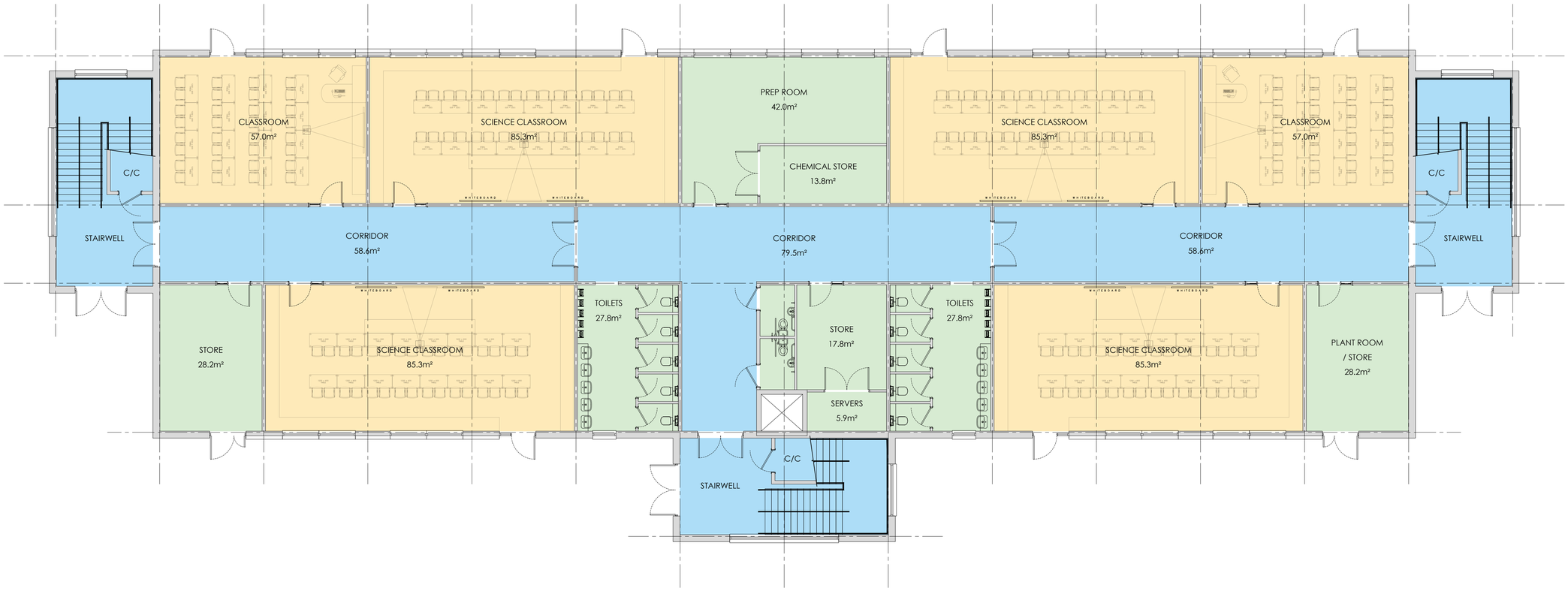
APPENDIX A

Indicative Layout Drawings

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EXTERNAL FOOTPRINT	1056.2m²
GROUND FLOOR AREA	1005.0m²
FIRST FLOOR AREA	1005.0m²
TOTAL FLOOR AREA	2010m²



Revision	Date	Details	Revised By
B	28.11.18	Rooms Revised	SR
A	22.11.18	Gridlines Shown	SR

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Client: University Academy Holbeach

Project: New Classroom Block

Drawing: New Classroom Block Plans

Date	Oct 2018	Scale	1:100
Drawn	SR	Checked	IH	Size	A1

Status: PLANNING

Drawing No.: 31468 425 04

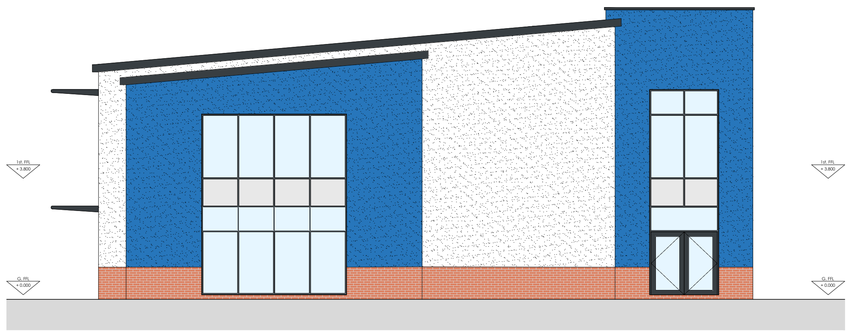
Revision: B

New Classroom Block Plans

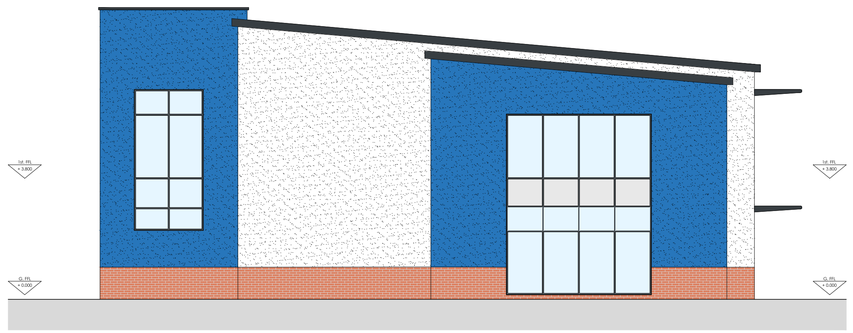
University Academy Holbeach, New Classroom Block

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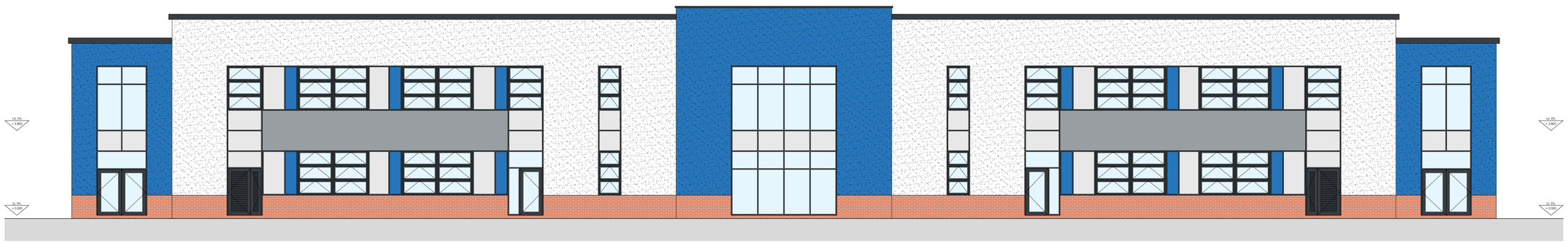
side elevation
1:100



side elevation
1:100



rear elevation
1:100



front elevation
1:100

Revision	Date	Details	Revised By
A	25.10.18	Brise Soleil Added	SR

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Client
University Academy Holbeach

Project
New Classroom Block

Drawing
New Classroom Block Elevations

Date	Oct 2018	Scale	1:100
Drawn	SR	Checked	IH
Size	A1		

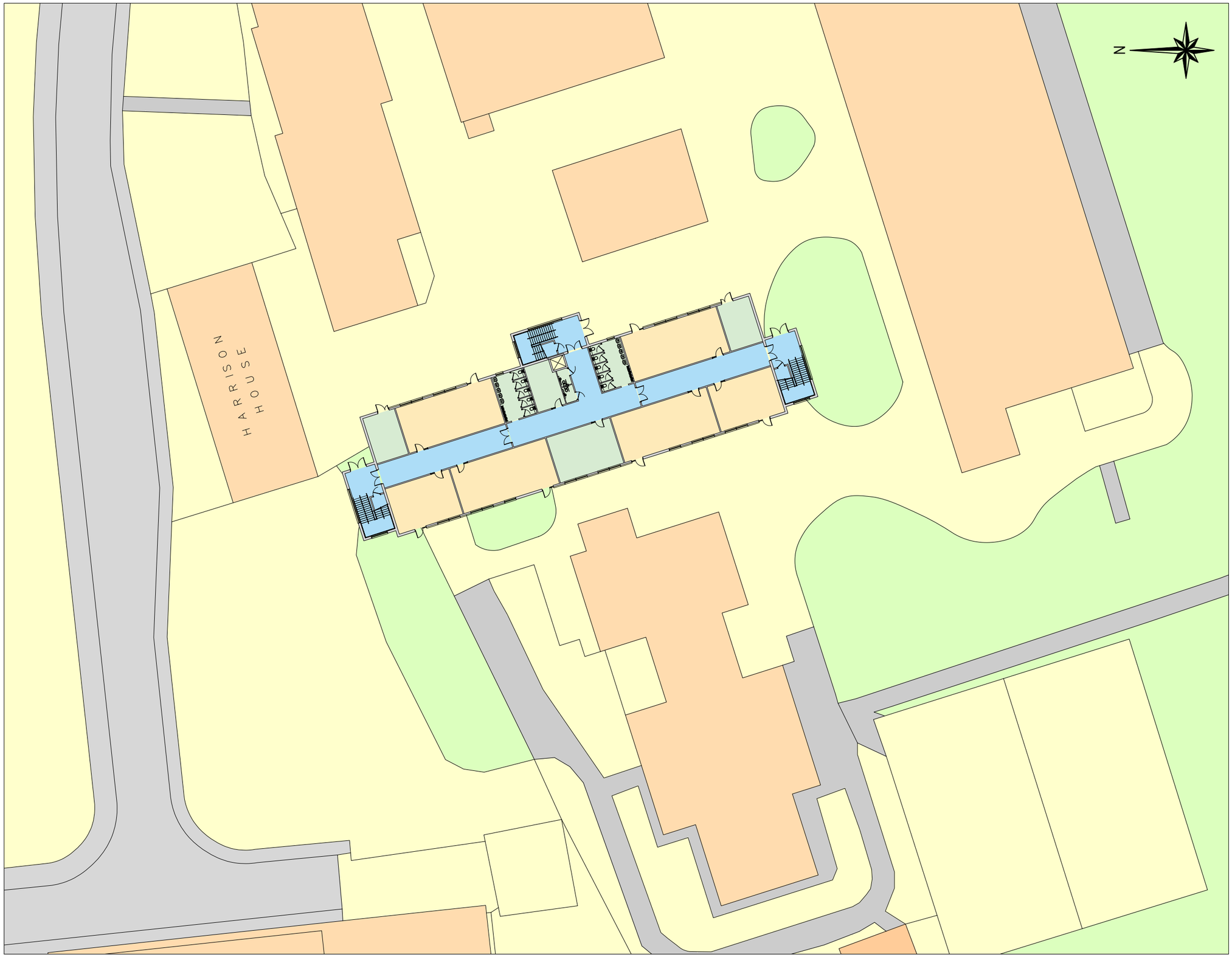
Status
FEASIBILITY

Drawing No.	Revision
31468 425 05	A

New Classroom Block Elevations

University Academy Holbeach, New Classroom Block

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Revision	Date	Details	Revised By

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Project
New Classroom Block

Drawing
Proposed Site Plan Option 2

Date	Oct 18	Scale	1:500
Drawn	SR	Checked IH	Size A3

Status
FEASIBILITY

Drawing No.	Revision
31468 425 07	–

Proposed Site Plan Option 2

University Academy Holbeach, New Classroom Block

APPENDIX B

Surface Water Storage Calculations

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	100.805	0.805	8.2	8.8	O K
30 min Summer	100.844	0.844	8.2	9.3	O K
60 min Summer	100.756	0.756	8.2	8.3	O K
120 min Summer	100.469	0.469	8.2	5.2	O K
180 min Summer	100.277	0.277	8.2	3.0	O K
240 min Summer	100.180	0.180	7.8	2.0	O K
360 min Summer	100.125	0.125	6.4	1.4	O K
480 min Summer	100.105	0.105	5.2	1.2	O K
600 min Summer	100.094	0.094	4.4	1.0	O K
720 min Summer	100.086	0.086	3.8	0.9	O K
960 min Summer	100.075	0.075	3.1	0.8	O K
1440 min Summer	100.063	0.063	2.2	0.7	O K
2160 min Summer	100.052	0.052	1.6	0.6	O K
2880 min Summer	100.046	0.046	1.3	0.5	O K
4320 min Summer	100.039	0.039	0.9	0.4	O K
5760 min Summer	100.035	0.035	0.8	0.4	O K
7200 min Summer	100.032	0.032	0.6	0.3	O K
8640 min Summer	100.029	0.029	0.5	0.3	O K
10080 min Summer	100.028	0.028	0.5	0.3	O K
15 min Winter	100.926	0.926	8.2	10.2	O K
30 min Winter	100.955	0.955	8.2	10.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	71.211	0.0	14.0	14
30 min Summer	46.390	0.0	18.3	23
60 min Summer	28.921	0.0	22.8	40
120 min Summer	17.521	0.0	27.6	72
180 min Summer	12.939	0.0	30.6	100
240 min Summer	10.393	0.0	32.7	126
360 min Summer	7.592	0.0	35.9	184
480 min Summer	6.076	0.0	38.3	244
600 min Summer	5.109	0.0	40.2	306
720 min Summer	4.433	0.0	41.9	366
960 min Summer	3.541	0.0	44.6	490
1440 min Summer	2.577	0.0	48.7	720
2160 min Summer	1.874	0.0	53.1	1100
2880 min Summer	1.494	0.0	56.5	1428
4320 min Summer	1.084	0.0	61.5	2136
5760 min Summer	0.863	0.0	65.2	2856
7200 min Summer	0.723	0.0	68.3	3592
8640 min Summer	0.625	0.0	70.9	4320
10080 min Summer	0.553	0.0	73.2	5072
15 min Winter	71.211	0.0	15.7	15
30 min Winter	46.390	0.0	20.5	24

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	100.798	0.798	8.2	8.8	O K
120 min Winter	100.355	0.355	8.2	3.9	O K
180 min Winter	100.161	0.161	7.7	1.8	O K
240 min Winter	100.125	0.125	6.4	1.4	O K
360 min Winter	100.099	0.099	4.7	1.1	O K
480 min Winter	100.085	0.085	3.8	0.9	O K
600 min Winter	100.077	0.077	3.2	0.8	O K
720 min Winter	100.071	0.071	2.8	0.8	O K
960 min Winter	100.062	0.062	2.2	0.7	O K
1440 min Winter	100.052	0.052	1.6	0.6	O K
2160 min Winter	100.044	0.044	1.2	0.5	O K
2880 min Winter	100.039	0.039	0.9	0.4	O K
4320 min Winter	100.033	0.033	0.7	0.4	O K
5760 min Winter	100.029	0.029	0.5	0.3	O K
7200 min Winter	100.027	0.027	0.5	0.3	O K
8640 min Winter	100.025	0.025	0.4	0.3	O K
10080 min Winter	100.023	0.023	0.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	28.921	0.0	25.5	44
120 min Winter	17.521	0.0	30.9	74
180 min Winter	12.939	0.0	34.2	98
240 min Winter	10.393	0.0	36.7	126
360 min Winter	7.592	0.0	40.2	184
480 min Winter	6.076	0.0	42.9	246
600 min Winter	5.109	0.0	45.1	304
720 min Winter	4.433	0.0	46.9	366
960 min Winter	3.541	0.0	50.0	490
1440 min Winter	2.577	0.0	54.6	728
2160 min Winter	1.874	0.0	59.5	1076
2880 min Winter	1.494	0.0	63.2	1456
4320 min Winter	1.084	0.0	68.8	2204
5760 min Winter	0.863	0.0	73.1	2936
7200 min Winter	0.723	0.0	76.5	3552
8640 min Winter	0.625	0.0	79.4	4296
10080 min Winter	0.553	0.0	81.9	5104

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.800	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.105

Time (mins) From:	To:	Area (ha)
0	4	0.105

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Model Details

Storage is Online Cover Level (m) 102.000

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	11.0	1.000	11.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0133-8200-1000-8200
Design Head (m)	1.000
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	100.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.2
Flush-Flo™	0.301	8.2
Kick-Flo®	0.662	6.8
Mean Flow over Head Range	-	7.0

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)
0.100	4.8	1.200	8.9	3.000	13.8	7.000	20.6
0.200	7.9	1.400	9.6	3.500	14.8	7.500	21.3
0.300	8.2	1.600	10.2	4.000	15.8	8.000	22.0
0.400	8.1	1.800	10.8	4.500	16.7	8.500	22.7
0.500	7.8	2.000	11.4	5.000	17.6	9.000	23.3
0.600	7.4	2.200	11.9	5.500	18.4	9.500	23.9
0.800	7.4	2.400	12.4	6.000	19.2		
1.000	8.2	2.600	12.9	6.500	19.9		

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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
15 min Summer	100.740	0.740	8.2	20.0	O K
30 min Summer	100.848	0.848	8.2	22.9	O K
60 min Summer	100.861	0.861	8.2	23.2	O K
120 min Summer	100.767	0.767	8.2	20.7	O K
180 min Summer	100.631	0.631	8.2	17.0	O K
240 min Summer	100.494	0.494	8.2	13.3	O K
360 min Summer	100.300	0.300	8.2	8.1	O K
480 min Summer	100.197	0.197	7.9	5.3	O K
600 min Summer	100.149	0.149	7.5	4.0	O K
720 min Summer	100.131	0.131	6.7	3.5	O K
960 min Summer	100.109	0.109	5.4	2.9	O K
1440 min Summer	100.088	0.088	4.0	2.4	O K
2160 min Summer	100.072	0.072	2.9	1.9	O K
2880 min Summer	100.063	0.063	2.3	1.7	O K
4320 min Summer	100.053	0.053	1.6	1.4	O K
5760 min Summer	100.047	0.047	1.3	1.3	O K
7200 min Summer	100.042	0.042	1.1	1.1	O K
8640 min Summer	100.039	0.039	0.9	1.1	O K
10080 min Summer	100.036	0.036	0.8	1.0	O K
15 min Winter	100.843	0.843	8.2	22.8	O K
30 min Winter	100.975	0.975	8.2	26.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.089	0.0	25.4	16
30 min Summer	84.848	0.0	33.4	28
60 min Summer	53.188	0.0	41.9	44
120 min Summer	32.259	0.0	50.8	80
180 min Summer	23.779	0.0	56.2	112
240 min Summer	19.047	0.0	60.0	142
360 min Summer	13.827	0.0	65.3	198
480 min Summer	11.024	0.0	69.4	254
600 min Summer	9.241	0.0	72.8	308
720 min Summer	7.997	0.0	75.6	368
960 min Summer	6.361	0.0	80.1	490
1440 min Summer	4.600	0.0	86.9	732
2160 min Summer	3.321	0.0	94.1	1100
2880 min Summer	2.633	0.0	99.5	1460
4320 min Summer	1.896	0.0	107.5	2164
5760 min Summer	1.500	0.0	113.4	2888
7200 min Summer	1.251	0.0	118.2	3560
8640 min Summer	1.077	0.0	122.2	4400
10080 min Summer	0.949	0.0	125.6	5136
15 min Winter	129.089	0.0	28.5	16
30 min Winter	84.848	0.0	37.4	29

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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
60 min Winter	100.980	0.980	8.2	26.5	O K
120 min Winter	100.829	0.829	8.2	22.4	O K
180 min Winter	100.613	0.613	8.2	16.5	O K
240 min Winter	100.409	0.409	8.2	11.0	O K
360 min Winter	100.186	0.186	7.9	5.0	O K
480 min Winter	100.132	0.132	6.7	3.6	O K
600 min Winter	100.114	0.114	5.7	3.1	O K
720 min Winter	100.102	0.102	4.9	2.8	O K
960 min Winter	100.088	0.088	3.9	2.4	O K
1440 min Winter	100.072	0.072	2.9	1.9	O K
2160 min Winter	100.060	0.060	2.1	1.6	O K
2880 min Winter	100.053	0.053	1.6	1.4	O K
4320 min Winter	100.044	0.044	1.2	1.2	O K
5760 min Winter	100.039	0.039	0.9	1.1	O K
7200 min Winter	100.036	0.036	0.8	1.0	O K
8640 min Winter	100.033	0.033	0.7	0.9	O K
10080 min Winter	100.031	0.031	0.6	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	53.188	0.0	46.9	48
120 min Winter	32.259	0.0	56.9	86
180 min Winter	23.779	0.0	62.9	120
240 min Winter	19.047	0.0	67.2	148
360 min Winter	13.827	0.0	73.2	198
480 min Winter	11.024	0.0	77.8	250
600 min Winter	9.241	0.0	81.5	308
720 min Winter	7.997	0.0	84.6	368
960 min Winter	6.361	0.0	89.8	490
1440 min Winter	4.600	0.0	97.4	726
2160 min Winter	3.321	0.0	105.4	1096
2880 min Winter	2.633	0.0	111.5	1440
4320 min Winter	1.896	0.0	120.4	2168
5760 min Winter	1.500	0.0	127.0	2936
7200 min Winter	1.251	0.0	132.3	3584
8640 min Winter	1.077	0.0	136.8	4312
10080 min Winter	0.949	0.0	140.7	4976

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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)	18.800	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.105

Time (mins) From:	To:	Area (ha)
0	4	0.105

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Model Details

Storage is Online Cover Level (m) 102.000

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	27.0	1.000	27.0	1.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0133-8200-1000-8200
Design Head (m)	1.000
Design Flow (l/s)	8.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	100.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.2
Flush-Flo™	0.301	8.2
Kick-Flo®	0.662	6.8
Mean Flow over Head Range	-	7.0

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)
0.100	4.8	1.200	8.9	3.000	13.8	7.000	20.6
0.200	7.9	1.400	9.6	3.500	14.8	7.500	21.3
0.300	8.2	1.600	10.2	4.000	15.8	8.000	22.0
0.400	8.1	1.800	10.8	4.500	16.7	8.500	22.7
0.500	7.8	2.000	11.4	5.000	17.6	9.000	23.3
0.600	7.4	2.200	11.9	5.500	18.4	9.500	23.9
0.800	7.4	2.400	12.4	6.000	19.2		
1.000	8.2	2.600	12.9	6.500	19.9		

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