Appendix 8.1 Site Specific Flood Risk Assessment including flood compensation and surface water drainage schemes (July 2019)

CATALYST BICESTER

WENDLEBURY ROAD, BICESTER

Site Specific
Flood Risk Assessment

Issue 2

30th July 2019

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J O H N S O N

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(i) The date on which this assessment was undertaken, and
(ii) The date on which the final report is delivered

EXECUTIVE SUMMARY

Subject	Element	Findings
Site Flood Risk	*Fluvial*	The existing site has a high risk of flooding from the Langford Brook located on the eastern boundary and the watercourse on the southern boundary boarding Promised Land Farm.
	Ground Water	The Ground Investigation report indicates, while the water table is shallow, there is a low risk of ground water flooding on this site.
	Surface Water	Surface water flood maps indicate low risk of flooding. Existing ditches to remain where possible.
	Sewers and Artificial Sources	No Artificial sources of flooding present. Existing sewers indicate very low risk of flooding.
Planning Requirements	*Vulnerability Classification*	Class B1 offices, technological knowledge industry and storage buildings are proposed. They are classified as 'less vulnerable', appropriate for Flood Zone 1, 2, 3a, by the NFFP.
	Sequential Test and Exception Test	As the site is allocated within the adopted LDP, the Sequential Test is considered to have been passed. An Exception Test is not required for this site.
	Sequential Approach	A sequential approach has been applied to position buildings in the eastern side of the site, at the higher levels and away from the rivers/watercourses.
Mitigation Measures for the Proposed Development	***Floodplain Compensation***	The proposed development currently will result in a loss of floodplain volume. To mitigate this a Flood Compensation Scheme has been developed to provide betterment of floodplain storage volume. Compensation is to be provided up to the 1 in 100 year + 35% level of 64.15m AOD in agreement with the EA.
	Surface water drainage strategy	Primary drainage infrastructure is to be constructed on site with discharge rates limited to greenfield rates. SuDS utilisation with attenuation systems will protect against flood water exceedance events preventing the site from flooding. No soil infiltration is possible due to impervious clay type ground conditions.
	Design Flood Event	The 1 in 100 year + 35% climate change event for flooding located at 64.150m AOD has been adopted for design.
	Climate change	Thames region river flow allowances for Zone 3 sites are within category 'central' of 25% and 'higher central' of 35% for climate change up to the maximum projection '2080s'
	Rainfall Intensity	Total potential change anticipated for the '2080s' of 40%
	Finished Floor Levels	Finished floor levels are proposed to be set at a minimum of the 1 in 100 year + 35% climate plus 300mm freeboard so no less than 64.450m AOD.
	Safe access and egress	Safe access and egress will be provided to Wendlebury Road with the construction of a new intersection and associated roads above the 1 in 100 year + 35% level.
	Construction Phase	Contractor will need to sign up to EA's flood warning service and locate stockpiles outside the 1 in 1000 year flood extent.
	Residual Risk	A flood evacuation and management plan should be considered during the detailed design to manage the risk flooding posed to the community areas of people, animal

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APPENDICES

1.0 INTRODUCTION

1.1 This Flood Risk Assessment (FRA) is compliant with the requirement set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA has been produced on behalf of Albion Land Limited in respect of a review of the flood risk at Bicester 10 in the local plan, or now known as Catalyst Bicester.

Table 1.1 - Site Summary

Site Name	Catalyst Bicester
Location	Wendlebury Road, Bicester
NGR (approx.)	457500, 221000
Development Type	Multiple proposals are being considered by the client which are to include predominantly class B1 offices, technological industries, storage & production buildings with the possibility of David Lloyd health and wellbeing centre
NFFP Vulnerability	Less Vulnerable
EA Flood Zone	Flood Zones 1, 2 and 3
EA Office	North Thames – Banbury
LPA	Cherwell District Council
LLFA	Oxfordshire County Council

Sources of Data

1.2 The report is based on the following information:

(i) Proposed Masterplan Layout Options
(ii) Topographical Survey Data
(iii) Ordnance Survey Mapping Data
(iv) Environment Agency Product 4 Flood information
(v) Cherwell Level 1 & 2 Strategic Flood Risk Assessments
(vi) Applied Geology Ground Investigation (November 2018)
(vii) Bailey Johnson Hayes – Proposed Plans/Cross Sections
(viii) Bailey Johnson Hayes – Flood Compensation Scheme Options
(ix) Bailey Johnson Hayes – Surface Water Drainage Design

Existing Site

1.3 The current existing site is located to the South of Bicester in the Cherwell District of Oxfordshire. The site is bounded by Wendlebury Road to the west with Bicester 10 development currently taking place adjacent. Bicester Avenue shopping centre is to the north, Langford brook to the east with protected wildlife wetland on the opposite side of the brook and Promised Land Farm to the south of which consists of open fields. The total area of development 'Catalyst Bicester' is 18.4 Ha. (See Figure 1.1).

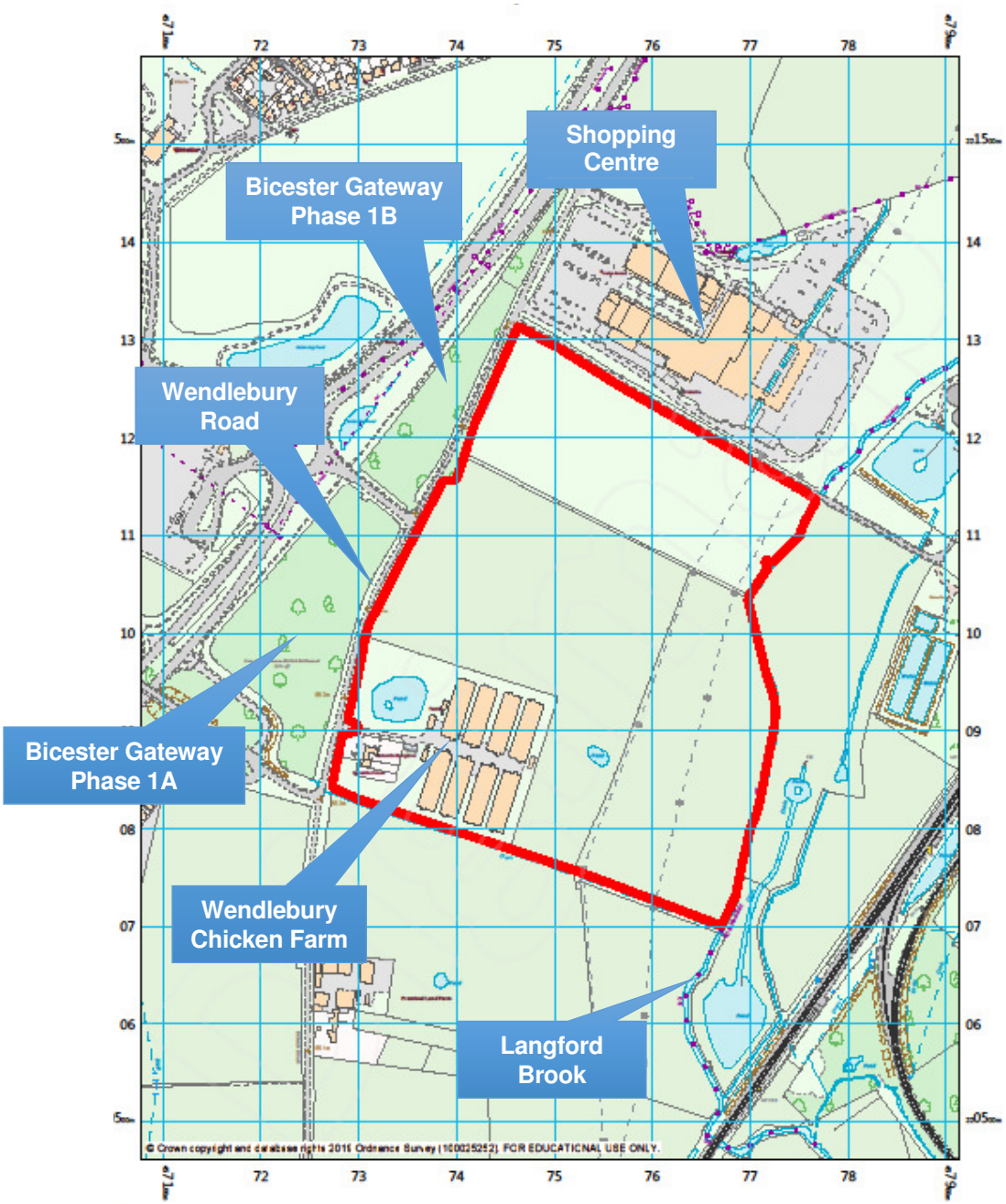


Figure 1.1 - Site Location

1.4 The existing site currently comprises of three undeveloped grassed fields understood to be used for grazing by cattle. Historically agricultural ditches within hedgerows and site boundaries have allowed surface water runoff to drain into the Langford Brook. Electricity Pylons are situated to the west of the site and run from north to south across the entire length of the development. The western region of the site has been identified as having cultural heritage value (formally an Iron Age-Romano British Settlement), although archaeological digs carried out in early 2019 found nothing of significance.

1.5 In the south-western corner of the site there is an existing chicken breeding farm which has been established for approximately 40-50 years. This compromises of eight large chicken houses which are 60m x 20m x 3m high in stature each, as well as associated concrete hardstanding. Inside the farm area there is also a large man made pond circular in shape of 50m in diameter. This does not appear to connect to the Langford Brook or any associated drains/watercourses.

1.6 To the west is a new development consisting of Phase 1 of the proposed new business park ("Bicester Gateway") comprising up to 14,972 sq m (Gross External Area) of B1 employment based buildings, plus a hotel (up to 149 bedrooms), with associated infrastructure, car parking and marketing boards. While this development is not directly associated with Catalyst Bicester, it does look to achieve joint objectives set out in Cherwell local development plans for this area.

1.7 Topographic survey data from June 2018, updated in October 2018 (MK Surveys) is available for the site and adjacent floodplain. The survey can be found in **Appendix B**. The survey indicates that land levels peak in the north-western corner are typically between 66.1 - 65.0m AOD, decreasing gradually across the site to the south-east corner to a lowest recorded level of 63.3m AOD excluding the river. These levels represent very shallow general falls of around 1 in 200 from Wendlebury road perpendicular down to the Langford Brook.

1.8 The Langford Brook is located to the east of the site, flowing in a south westerly direction away from Bicester Village. Generally the brook is 6-8 m wide throughout the whole eastern boundary. A watercourse has been identified in the SFRA to the north-east flowing through Bicester Avenue Retail Park. Upon inspection while the existing culvert remains it appears to have been cut off and no longer in use. Drains to the south of the site still carry water frequency from surface water runoff in the surrounding local area. Further investigation will be carried out to establish the viability and benefits of opening up the culvert.

1.9 Currently it is thought that there is no existing sewers, manholes or drainage features within the existing site. The only historical drainage identified would be field ditches which were created when the fields were first assigned boundaries of which it is unknown to when this dates back.

Proposed Site

1.10 Catalyst Bicester is outlined in the Cherwell Local development plan, named as Bicester 10 & Bicester Gateway, to provide employment for up to 3,500 people. This will be a significant increase in potential occupants in contrast to the existing 20 people work force on the chicken farm. Future operational hours will generally be longer than existing business hours on the farm. In order to facilitate this risk in both the short and long term, this assessment is carried out assuming that the future site will be fully occupied.

1.11 The original masterplan layout proposals were prepared by Cornish Architects in October 2018. After pre-application meetings with Cherwell in March 2019 the client has been advised to make four separate planning applications. The site layout proposals can be found in **Appendix A**. An artist impression of what the proposed site will look like is shown in Figure 1.2. Note this is still indicative only at the time of carrying out the report. For the purposes of this FRA option 8 has been selected at the primary scheme to incorporate.

1.12 The proposed new business park ("Catalyst Bicester") is to comprise of up to 300,000 sq ft. (Gross Internal Area) of B1 employment based buildings, split over multiple units to be sized based on end user demand with associated infrastructure, car parking and service yards. In addition the proposals include allocation for Class D2 health and recreational facilities in the form of David Lloyd Racquet Club. The development is expected to have a design life of at least 100 years.

Figure 1.2 – Artist impression of Catalyst Bicester development

2.0 FLOOD RISK PLANNING POLICY AND GUIDANCE

National Planning Policy Framework

2.1 In line with National Planning Policy Framework (NPPF) this FRA will adopt conditions 155 – 165 specific to Planning and Flood Risk. NPPF sets strict rules to protect people and property from flooding which all local planning authorities are expected to follow.

2.2 In plan-making, local planning authorities apply a sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk. In plan-making this involves applying the 'Sequential Test' to Local Plans and, if needed, the 'Exception Test' to Local Plans.

2.3 The NPPF states that 'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere'. The aim of the Sequential Test is to steer new developments to areas of the lowest probability of flooding. If this cannot be achieved the exception test is then required if indicated by the conditions specified in NPPF.

2.4 Where the development needs to be in locations where there is a risk of flooding as alternative sites are not available, local planning authorities and developers ensure development is appropriately flood resilient and safe for its users for the development's lifetime, not increasing flood risk overall.

2.5 Local planning authorities and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems in developments).

Flood Zones

2.6 The Flood Zone Map for Planning has been prepared by the Environment Agency. This identifies areas potentially at risk of flooding from fluvial or tidal sources. Mapping reproduced using the Environment Agency Flood Zone data under special licence is included as Figure 2.1.

2.7 The Environment Agency Flood Zone mapping shows Catalyst Bicester to be located to the west in Flood Zone 1 (Low Probability) while predominantly in Flood Zone 2 (Medium Probability) and Flood Zone 3 (High Probability) to the east.

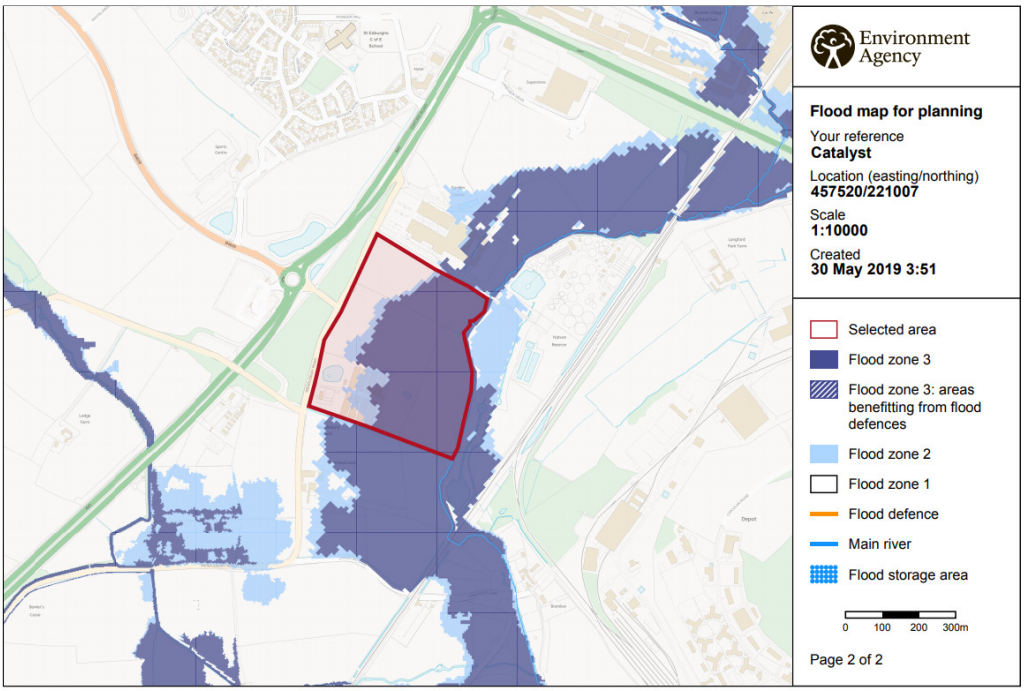


Figure 2.1 – Environment Agency Flood Map for Planning (Rivers & Sea)

2.8 The NPPF defines Flood Zones 1 and 2 as land assessed as having a less than 1 in 1000 annual probability of river flooding and as land assessed as having between a 1 in 100 and a 1 in 1000 or greater annual probability of river/tidal flooding respectively.

2.9 Flood Zone 3 is defined in the NPPF as land assessed as having a 1 in 100 or greater annual probability of river flooding and/or a 1 in 200 annual probability of flooding from tidal sources.

2.10 Table 2 of the Planning Practice Guidance classifies land use. Under these classifications the proposed development use; high tech industries is considered to be 'Less Vulnerable' appropriate for Flood Zone 1, 2, 3a.

2.11 In further assessment of Flood Zone 3 the EA split zone 3 into sub-categories of Flood Zone 3a and 3b. Flood Zone 3a is defined in the NPPF as land assessed as having a 1 in 100 or greater annual probability. Flood Zone 3b is defined by the EA as land assessed as having a 1 in 20 or greater annual probability as a starting point.

2.12 It is believed that Catalyst Bicester is located in Flood Zone 3a due to the lack of history of flooding. One of the key characteristics of a functional floodplain is its ability to regularly fill during times of flooding. As flooding at the 5% AEP is predicted to be less than 300mm on average than regular flood storage capacity would be very limited. Final identification of the functional floodplain is dependent on the local circumstance and must be defined by the EA.

Local Authority Planning Policy

Sequential and Exception Test

2.13 The Cherwell Local Development Plan (LDP) 2011-2031 Part 1 was adopted in July 2015 and re-adopted in December 2016. The site is allocated in the LDP under policy Bicester Gateway and Bicester 10 for employment use. The sequential test for this development is considered to be passed. Justification is provided in Cherwell District Local Plan.

2.14 The Sequential test and Exception test strategic sites' document was originally published in August 2012, with the 2nd Addendum Published in October 2014. This document mentions the proposed development site; 'The Exception test is not required for the Proposed Development as 'More Vulnerable' uses are not proposed on the site.'

Cherwell Local Plan Guidance (Bicester 10: Bicester Gateway)

2.15 Policy Bicester 10: Bicester Gateway sets out the following employment and infrastructure needs. Those that are relevant to this FRA include:

a. Creating open spaces, planting and strong landscape supporting SuDS.

b. Consideration of the Strategic Flood Risk Assessment for this site including all sources of flooding applicable to the site.

c. Floodplain land in the eastern parts of the site to be used for informal recreation, ecological benefit or wildlife enhancement.

d. Development should not encroach within 8m of the watercourse banks.

e. A sequential approach should be followed; where possible, buildings should be located away from areas at high risk of flooding. Where the development is at high risk of flooding, the development should be made safe without measures increasing flood risk elsewhere.

f. Full mitigation of flood risk in compliance with Policy ESD 6. Surface water mitigation in compliance with Policy ESD 7 specifically taking into account the councils SFRA's for the site.

g. Investigation into opening of culverted watercourse to the east of the site.

h. No built development is to be located in Flood Zone 3b.

This site specific flood risk assessment will look to incorporate all the above points in the mitigation proposals and in the development proposals section. Most of these points have already been considered by the architects and engineers in formulating the masterplan, so this FRA will be assessing its compliance.

Flooding and SUDS Planning Policy

Policy ESD 6: Sustainable Flood Risk Management

2.16 Properties at risk of flooding are dispersed across the District. The SFRA highlights some of areas potentially affected by fluvial flooding. The Flood and Water Management Act 2010 assigns local authorities with a responsibility of managing flood risk. In Cherwell District, Oxfordshire County Council is the Lead Local Flood Authority (LLFA) assigned to support Cherwell in all matters related to flooding.

2.17 Development will only be permitted in areas at lower risk of flooding and the benefits of the development outweigh the risks from flooding. In addition to safeguarding of floodplains, opportunities will be sought to restore natural river flows and floodplains, increasing their amenity and biodiversity value. Building over watercourses should be avoided and removal of existing culverts will be encouraged.

2.18 There will be no increase in surface water discharge rates or volumes during storm events up to including the 1 in 100 year storm event with an allowance for climate change. Developments will not flood from surface water up to and including the design flood event and will be safety contained on site.

Policy ESD 7: Sustainable Drainage Systems (SuDS)

2.19 SuDS is a national level requirement for all new developments in order to manage drainage more sustainably and reduce pollution risks from surface water. SuDS seeks to manage surface water as close to its source as possible, mimicking surface water flows prior to the proposed development. Potential SuDS usage is to be investigated as part of this site specific flood risk assessment.

2.20 The Level 2 SFRA contains additional guidance relating to the use of SuDS on the proposed strategic site allocations. In consideration of SuDS solutions, the need to protect ground water quality must be taken into account especially where infiltration is proposed. Any drainage proposal will require the approval of the LLFA and SuDS Approval Body, including agreement on future management, maintenance and replaces of SuDS features.

Strategic Flood Risk Assessments

Cherwell Level 1 Strategic Flood Risk Assessment (May 2017)

2.21 In line with the Level 1 SFRA, it has been outlined that the climate change allowances have changed. As the development is classified as 'Less Vulnerable' then Catalyst Bicester should fall into the category of Central and Higher Central estimates for climate change. The expected change for river flows over the lifetime of the development should be assessed at 25% and 35%. In addition, peak rainfall intensity should also have a climate change allowance of 20% and 40% for consideration in design.

2.22 The flood map for planning outlined in figure 2.1 does not separately distinguish Flood Zone 3a/3b. On the advice in the Level 1 SFRA communication with the environment agency should be sought to identify the extent of the functional floodplain (also referred to as Flood Zone 3b). This should take into account local circumstances and not be defined solely on rigid probability parameters. Bailey Johnson Hayes will confirm with the EA on this clarification and this FRA will be updated accordingly.

Cherwell Level 2 Strategic Flood Risk Assessment (August 2017)

2.23 A more specific Level 2 SFRA was undertaken by URS in August 2014. It recommends that development should be restricted to outside the Flood Zone 3 envelope for the Langford Brook and set a minimum of 20m away from all small ordinary watercourses/drains to create 'blue corridors' which may provide reduced flood risk, wildlife habitation and public areas.

2.24 It is identified in the Level 2 SFRA that the Langford Brook is not an EA main river, but still recommend that development does not encroach within 8m of the watercourse banks. If it is proposed that the development will be located within part of site located in Flood Zone 3, then the site should be subject to flood compensation scheme on a level for level basis.

2.25 The EA and SFRA have highlighted an opportunity as part of the development to open up the culverted water course that crosses the north-east of the site from the shopping centre next door. Bailey Johnson Hayes will confirm with the EA on this clarification although it is assumed that the existing culvert is blocked and unlikely to benefit from being re-opened. The recent developments in the shopping centre next door suggest that surface water is directed to on site attenuation surface water and is unlikely to pass onto the Catalyst Bicester site.

Environment Agency Guidance

2.26 The Environment Agency has provided Bailey Johnson Hayes with the following Product 4 information as follows. A full copy of the data received and information provided by the EA is include in **Appendix C**.

i. Flood map for planning;
ii. Flood defence information;
iii. Flood map based on Promised Land Farm;
iv. Modelled floodplain flood levels (2010 model based on 20% CC);
v. Historical Flood data information;
vi. Hazard Flood map;
vii. Bicester Flood Risk Mapping Study, Final Modelling Report (Dec 09);

2.27 In summary, the Environment Agency information received to date and current guidelines suggest the following:

- The approach taken by Bailey Johnson Hayes to define the flood events for the 1 in 20 (5% AEP), 1 in 100 (1% AEP) and 1 in 1000 (0.1% AEP) year using the EA's flood levels against topographic data is acceptable.

- Hydraulic modelling would generally be required to accurately define the flood levels for the 1 in 100 year + 25% and 1 in 100 year + 35% climate change scenarios required by the new 2016 climate change guidance.

- The Design Flood Event (DFE) for the Proposed Development is the 1 in 100 year + 35% climate change allowance from 2016, assumed through interpolation as 64.150m AOD as detailed flood modelling was not available at the time.

- A Sequential Approach should be taken to locating development on site. The EA advise that the buildings should be outside of the 1 in 100 year + 35% climate change.

- Minimum finished floor levels should be set at or above the DFE flood level plus 300mm freeboard, i.e. the 1 in 100 year + 35% change plus freeboard. Therefore, finished floor levels should be set at 64.450m AOD

- Ground raising inside the floodplain is not advised but would be acceptable provided floodplain compensation is provided up to the 1 in 100 year + 35% flood extent. The requirements for floodplain compensation will be provide through a layer for layer replacement scheme as agreed by Cherwell Council, Oxford Flood Authority and the Environment Agency.

3.0 POTENTIAL SOURCES OF FLOOD RISK

3.1 The table below identifies the potential sources of flood risk to the site, and the impacts which the development could have in the wider catchment prior to mitigation. These are discussed in greater detail in the forthcoming section. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within **Section 4.0**.

Table 3.1 – Pre-Mitigation Sources of Flood Risk

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Fluvial/Tidal	X				Located within River Flood Zone's 2 & 3
Canals				X	None Present.
Groundwater			X		No recorded history of Groundwater flooding.
Reservoirs and waterbody's				X	The site is outside the zone of risk of reservoir failure.
Sewers			X		No known water services run through the site.
Pluvial Runoff			X		Levels locally are very flat exceedance runoff unlikely
Effect of development on wider catchment		X			Increase in the amount of impermeable surfaces such as roofs and yards

Fluvial Flood Risk (River/Sea)

Main Rivers

3.2 The Langford Brook lies 0m away from the Catalyst Bicester site. Town Brook connects into the Langford Brook approximately 800m north-east.

3.3 The Langford Brook generally flows towards the south-west. Environment Agency mapping indicates that predicted flooding is generally constrained to areas directly adjacent to the river in Bicester. Locally in south Bicester, predicted flooding becomes more wide spread into Greenfield zones.

3.4 On the other side of the Langford Brook, opposite Catalyst Bicester is a wetland nature reserve on the site of sewage treatment works. Historically this site has been better protected from flooding due to construction of higher embankments to the river banks. This was to prevent flood water mobilising potential contamination from existing sewage treatment works and associated land.

3.5 The proposed development does not have any history of fluvial flooding.

Other Rivers/Watercourses

3.6 A significant watercourse is located on the southern boundary of the site. This has been labelled as the 'Promised Land Farm Ditch' on Figure 3.1. This ditch collects water from the surrounding land which then flows in a westerly direction under Wendlebury road, collecting additional runoff from the chicken farm and fields before merging into the Langford Brook.

Figure 3.1 – Location of Fluvial Rivers and Other Watercourses

3.7 Hedgerow ditches along the whole of the western boundary parallel to Wendlebury Road pick up surface water runoff and flow in a south-westerly direction. They either outlet into hedgerow ditch 'A' or the Promised Land Farm drain. Ditches 'A' & 'B' which are located in the Catalyst Bicester hedgerows generally observed as small flows, filling up quickly in exceedance events to carry water to the Langford Brook. The level 2 SFRA indicates there has been no history of flooding from these drains.

3.8 There is a small animal feed pond around 10m in diameter which fills up naturally from ditch 'B'. It was observed that only a small amount of water is held in the pond and is shallow in depth. The 50m diameter large pond within the chicken farm grounds appears to of been constructed at the same time as the associated chicken farm from historical mapping. It may act as attenuation for surface water from the existing site. It is unlikely to be connected to local drains and constantly holds water at the approximately the ground water level. The ponds are unlikely to pose risk of flooding and removal would have a negligible effect on flood risk.

3.9 Environment Agency data provides floodplain nodes, however in this instance due to the distance of the site from the modelled nodes only Floodplain Node 1 located within Catalyst Bicester should be used. Figure 3.2 shows an extract from the EA of this flooding data.

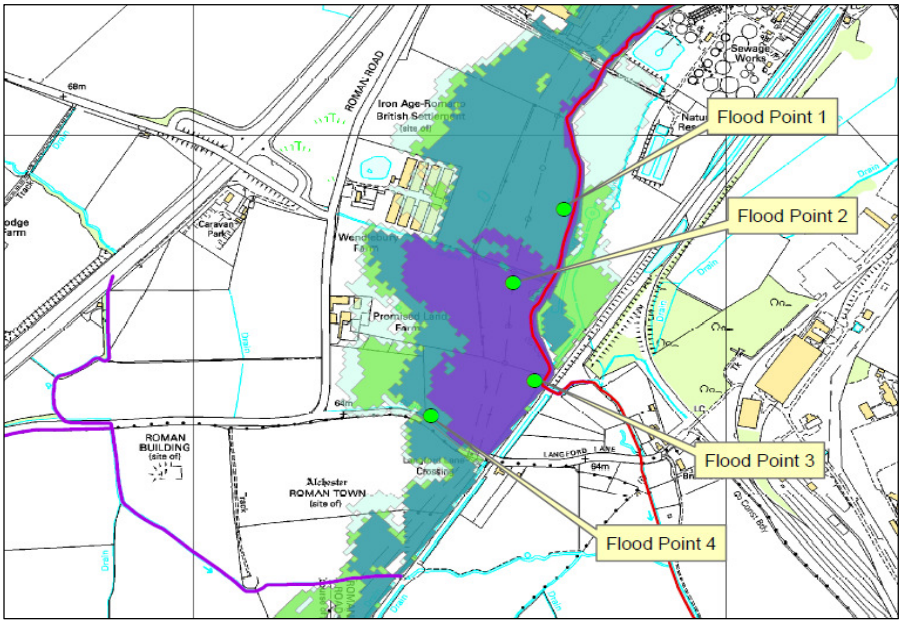


Figure 3.2 – Environment Agency Node Locations Extract

3.10 A review of the modelled flood levels (flood point 1) indicates that flood levels could range from 64.05m AOD in the 1% annual probability event to 64.11m AOD for the same event with a 20% allowance for climate change. As detailed hydraulic modelling is not available at the current time, it is assumed that the new allowance of 35% will yield a level of 64.15m AOD. The flood levels are shown on Table 3.2. Flood contours have been produced by BJH and can be found in **Appendix D**.

Table 3.2 – Environment Agency Bicester Model, Modelled Flood Levels

Modelled Flood Levels (m AOD)				
Flood Point	Annual Exceedance Probability (AEP)			
	5%	1%	1% + CC 20%	0.1%
1	63.94	64.05	64.11	64.20

3.11 During a 0.1% annual probability where flood levels are estimated up to 64.2m AOD, flood water depths would be approximately 0.7m (worst case) to the extreme South East. The proposed development is to be located well away from these dangerous levels of water where most of the development will be in Flood Zone 1. Flooding is only expected to be up to 0.3m level in the eastern part of the built proposals. As a result mitigation measures are presented in **Section 4.0.**

3.12 The EA have provided details of the areas at most danger on the proposed site. Towards the south of the site below the chicken farm is at danger for most which represents a danger to the general public. This is only a small area and no buildings or roads are proposed here. The large swale will be located in an area at danger for some. This means that there is a danger for those with small children or the elderly. It is unlikely that this demographic will ever need to enter that area. The rest of the site has none or very low hazard.

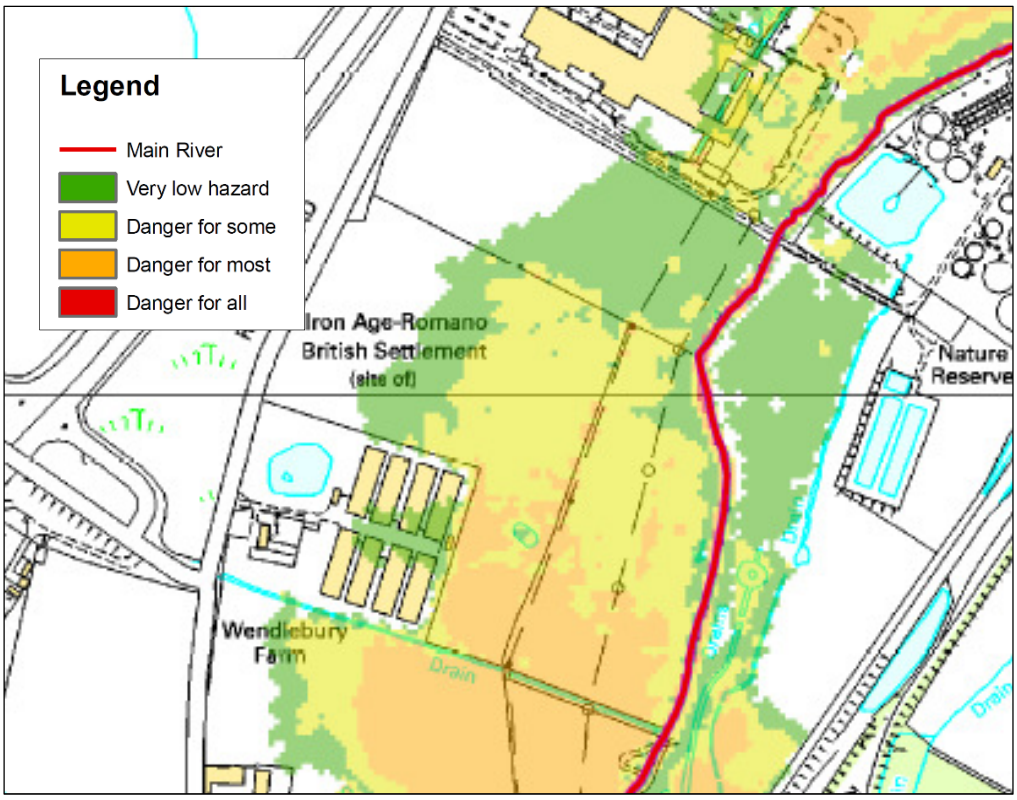


Figure 3.3 – Environment Agency Hazard Map Extract

3.13 Overall there is considered to be a high risk posed to Catalyst Bicester from the fluvial source.

Groundwater Flood Risk

3.14 Applied Geology carried out a Ground Investigation on behalf of Bailey Johnson Hayes in November 2018. 18 number of 2m deep trial pits were opened throughout the site where seepage was recorded in all trial pits. Some moderate inflows were recorded at a couple of the trial pits located in the north-west of the site at depths of 0.8 – 1.2m bgl. The Applied Geology Ground Investigation can be found in **Appendix E**.

3.15 The site does not have any history of groundwater flooding although the water table is relatively shallow at 1m bgl. Groundwater appears to be perched within shallow layers of River Terrance Deposits throughout the site. As a result the construction of foundations may encounter groundwater in some areas around the site. The site has been defined as having poor infiltration which makes it difficult for the movement of groundwater through cohesive layers.

3.16 Overall there is considered to be a low risk posed to Catalyst Bicester from groundwater flooding. During construction of foundations control measures may need to be implemented in order for construction to be carried out successfully.

Flood Risk from Reservoirs & Large Waterbodies

3.17 Reservoir failure flood risk mapping identifies the site to be located outside of the area considered to be affected by nearby reservoir breach.

3.18 Located approximately 3km to the southwest of the site is a medium waterbody near the M40 with an approximate area of 1000m^2. Due to the distance and intervening topography the risk posed is conserved to be low.

Flood Risk from Sewers

3.19 The Thames Water DG5 register identifies no recorded incidents of sewer flooding within the post code areas coving the site around 2000 - 2010. Cherwell DC are aware of the limited sewer capacity in Bicester, however there have been no sewer flooding incidents.

3.20 The development is to be served by a new foul and surface water drainage network. It is currently assumed that there are no existing drainage features run through the site. Bailey Johnson Hayes are in the process of currently obtaining asset location plans from the relevant providers in the area.

3.21 Overall there is considered to be a low risk posed to Catalyst Bicester from sewer flooding based on current information.

Pluvial Flood Risk (Surface Water)

3.22 Risk of flooding from surface water mapping has been prepared by the Environment Agency, this shows the potential flooding which could occur when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. An extract from the mapping is included as Figure 3.3.

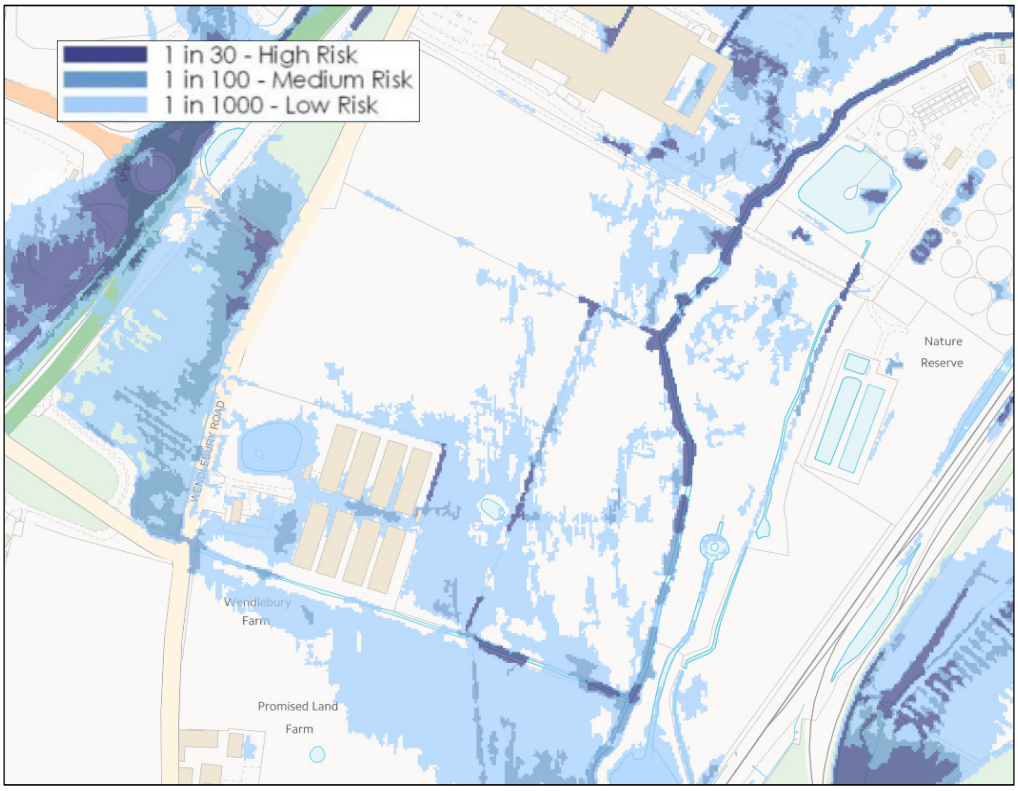


Figure 3.4 – Risk of Flooding from Surface Water Mapping

3.23 There is a low flood risk posed to Catalyst Bicester from surface water flooding. Any minor ponding would only occur during extreme (1 in 1000 year) storm events. Results seem to pond around the existing chicken farm structures and adjacent field which would likely drain away into the ditches.

3.24 There is an opportunity in the south of the site, below the chicken farm, to re-grade the levels to better improve overland flows into surrounding ditches and drains. These measures will be discussed more in later sections.

3.25 Depths of flooding are not considered to be significant and so mitigation measures within the development proposals (to be discussed within **Section 4.0**) should address any risk posed by this source.

Effect of Development on Wider Catchment

Development Drainage

3.26 In the case of Catalyst Bicester SuDS will be adopted where possible to decrease the surface runoff up to the 1 in 100 year exceedance event and attenuate at source. There will be a large amount of roofs constructed which will need to enter a surface water drainage system, preventing over spill into surrounding areas. Any additional impermeable surfaces will need to be drained appropriately to limit run off to keep risk to a minimum.

3.27 Landscaping to the eastern side of the site, which in the proposals will remain as wetland for ecological benefit, will pose no increased flood risk as long as levels stay similar. There may be an opportunity to clean out, extend and renew existing ditches so that surface water flows are less likely to pond. Generally the risk of negative effects locally are low.

4.0 FLOOD RISK MITIGATION

4.1 Section 3.0 has identified the sources of flooding which could potentially pose a risk to the site and the proposed development. Section 5.0 describes the current proposals for the Catalyst Bicester development. This section of the FRA sets out the mitigation measures which are either already incorporated or to be incorporated within the final proposed development to reduce the risk of flooding to within acceptable levels. Flood mitigation is in accordance with CIRIA C624.

Development Zoning

4.2 Careful planning of the development layout can manage to reduce the need for many other mitigation measures. Green space zone separation has been provided between the Langford Brook and the closest built feature surface water swale is located a minimum of 75m away from the brook. The swale is still within Flood Zone 3 but is generally much less sensitive to flood damage than other forms of development and within shallow flood depths which may therefore be acceptable.

4.3 There are some areas designed to encourage public access in Flood Zone 3 at a minimum of 100m away from the Langford Brook. At this distance away from the river only very low levels of flooding are predicted to occur in the most extreme of flooding events. With appropriate flood warning systems as described later on in this chapter risk can be mitigated and therefore be acceptable.

4.4 The remaining areas of the built development that are located within the floodplain are at least 120m away from the primary source of flooding. The predicted flooding in these areas is going to be less than 0.3m in the 0.1% AEP event. In these areas building in Flood Zone 3 is deemed acceptable if the land is raised so that the buildings, carparks and roads are out of the floodplain. Level for level compensation should be provided and is also described later in this report.

Land Raising

Finished Floor Levels

4.5 Typically, finished floor levels are set with a freeboard above the environment agency local modelled flood levels. Catalyst Bicester lies within Flood Zone 3, modelled floodplain levels. The EA indicates a 1% AEP plus climate change (35%) flood level nearest the site of 64.15m AOD. It is recommended to raise finished floor levels for the entire multi-unit scheme an additional 300mm above this level to provide suitable mitigation in the event of fluvial flooding, therefore the recommended finished floor levels will be 64.15m AOD + 300mm = **64.45m AOD.**

External Levels

4.6 It is recommended that the finished floor levels of the proposed buildings are also set a nominal 150mm above finished external ground levels to direct any overland flows away from proposed or existing buildings. While surrounding infrastructure such as roads, footpaths and yards are water compatible it is recommended that ground raising takes place so that the minimum external level is no lower than design flood level = **64.15m AOD.**

4.7 All raising of land within the design floodplain should be compensated using an appropriate flood compensation scheme approved by the environment agency.

Safe Access and Egress

4.8 Safe access will be available into the development for motor vehicles, pedestrians and emergency vehicles via the new roundabout access to be constructed to the west of the site located within Flood Zone 1. The surrounding estate roads will be constructed above the design flood level with appropriate flood defence landscaping freeboards to ensure critical road networks do not become inaccessible. Flooding to the wider environment may limit movement beyond the site so in this case the preference may be to remain on site rather than evacuate the site.

Flood Warning

4.8 The majority of new developments are designed so that flood warnings are not necessary part of development design. Even so, for Catalyst Bicester it would be advised for the areas in the south-eastern part of the site, designed for public access, that adequate flood warnings are provided as this area poses danger to most.

4.9 A flood evacuation and management plan will be required for any members of the public using the undeveloped land around the Proposed Development. This plan will be required during the detailed design stage to manage the residual risk of flooding on the site posed to both people and vehicles. The plan will consider:

- Signing up to the EA's flood warning service to provide early warning of flood events in the surrounding area;
- Closing of parts of the site predicted to be affected by flooding to prevent people entering the floodwater;
- Moving cars within car parking areas predicted to be affected by flooding to other areas on site or offsite;
- Methodology to establish how the flood levels are monitored and what/when actions are taken on site.

Flood Proofing

4.10 Flood proofing is a technique whereby buildings built in the flood plain are designed to withstand the effects of flooding. In this scenario flood proofing will not be appropriate for business premises and uneconomic use of materials. Land rising instead will provide much better flood proofing and increases sustainability.

Landscaped Flood Defences

4.11 Landscaping type flood defence mounds should be provided with an appropriate freeboard, usually 300mm, between the carparks, service yards and buildings in areas bordering Flood Zone 2 & 3 subject to detailed design. In the major flooding events this will ensure that the floodwater and debris do not enter the development. In the reverse, flood protection will prevent contamination of chemicals into flood water and prevent flood water entering surface water systems.

Pollution Prevention

4.12 As the development is likely to include knowledge based industries and commercial premises, these often involve using potentially polluting substances. Most commonly car parks and service yards where HGV's spend extended periods of time are likely to encounter spillages such as fuels and chemicals. Mitigation is essential to reduce the risk of chemicals entering into soft landscaping, drainage systems or watercourses.

4.13 This can be done by draining heavily trafficked areas that are cleansed through various systems such as; petrol interceptors in a piped system, sub-grade layers if using porous paving finishes, filter channels

Wetlands Wildlife Space

4.14 An outline Wildlife scheme has been proposed in **Appendix F** by Bailey Johnson Hayes. In additional to the initial plans the following items should be considered when moving to detailed design:

- Raised footpaths where appropriate to provide safe pedestrian access and egress to users of the wetland fields.
- Flood evacuation and management plan in wetland and pedestrian encouraged areas within the floodplain.
- Protective fences and signs to the floodplain that warn the public of water hazards. These are to be located in appropriate places where visibility can be maintained.

Management of Surface Water Runoff

4.15 The surface water management system is to be based on CIRIA C753 SuDS Manual as required by Cherwell County Council and Oxfordshire District Council. Infiltration is not recommended from the ground investigation. Advice will be given about the feasibility, appropriateness and management of surface water concepts based on **Appendix F** (Drainage Layout) and **Appendix H** (Surface water drainage calculations) in the following paragraphs.

4.16 The surface water management system should be designed to ensure that the level of flood risk from the drainage system is acceptable for the site. All runoff should remain within the designated conveyance and storage areas for the design event (1% AEP + 40%), including an appropriate freeboard allowance. When designing a surface water management system for a very flat site, the following challenges should be considered within the design process:

- Achieving sufficient gradients to drain runoff effectively
- Difficulty in meeting outlet levels to existing watercourses or sewers
- Impacts of downstream water levels on drainage system performance.
- Protecting the surface water system from inundation from fluvial flooding

4.16 On very flat sites, it is often not possible to construct piped drainage systems with sufficient falls to achieve minimum self-cleansing velocities. So using shallow SuDS components such as swales, pervious pavements or high capacity linear drainage channels is an advantage in these situations. Good SuDS design should aim to divide the site into small sub-catchments and provide local combined storage networks.

4.17 A normal drainage system will often end up being fairly deep. Even using shallow SuDS components, the end of the surface water drainage system may still end up below the minimum allowable outfall level. In such cases, a pumping station will be necessary. Several SuDS schemes have included pumping stations, but they should be a last resort and only allowable in situations where guaranteed maintenance of the pumps can be ensured. Pumping within the floodplain is not acceptable and should not be considered for this development.

4.18 To reduce off-site impacts of surface water run-off, attenuation swales have been proposed to control outflow at Greenfield run-off rates. This will ensure that the run off released into the Langford brook will not be increased. Non-return values should be used to ensure that flood water does not enter into attenuation systems located in the floodplain. An increased outflow could create severe flooding impacts downstream at Promised Land Farm. The wetland areas will be drained naturally very similarly to the existing arrangement with some re-grading.

SuDS on Floodplains

4.19 The role of a floodplain is primarily to mitigate flood risk from rivers, during extreme events these areas will naturally flood with river water, making them ineffective for use in storing surface water runoff. All storage volume should normally be provided within the development footprint, outside of the floodplain.

4.20 The presence of a floodplain, however, should not preclude the site from including SuDS, as they could still be effective in managing routine rainfall, and runoff may need to be discharged safely across the floodplain. SuDS in the floodplain may also be acceptable in terms of providing treatment for frequent events. The design of those parts of SuDS in a floodplain should not reduce floodplain storage or conveyance.

Flood Compensation

4.21 Compensatory flood storage works are required where the development proposals result in a loss of volume of the floodplain. The current flood compensation scheme can be found in **Appendix G.**

4.22 Compensatory flood storage must become effective at the same point in a flood event as the lost storage would have done. It should therefore provide volume directly in a 'level' for 'level' compensation. It is advised that loss and compensation of volume should be recorded in 200mm intervals below the design 1 in 100 year flood level + climate change of 64.15m.

4.23 In some circumstances, due to the shallow level of flooding, indirect replacement of volume may be considered acceptable. Flow controls must be in place in order to ensure that storage is filled at the same rate during a flood event as would have occurred under existing conditions.

Residual Risk

4.24 Residual risk is defined as the threat that still remains after all efforts to identify and eliminate risk have been made. There remains residual flood risk to the wildlife areas allocated for wetland use across the eastern boundary of Catalyst Bicester. Approximately 6 Ha of land will remain within the 1 in 20 year event. In order to mitigate this further, access will be strictly limited in these areas for authorised personal only and those carrying out maintenance works.

4.25 There is a very small residual flood risk to surface water flooding for the 1 in 1000 year to the external areas of the site. In this situation only a small amount of surface water will collect and present a very unlikely probability of danger to the occupants within the Proposed Development.

5.0 DETAILED DEVELOPMENT PROPOSALS

Design Philosophy

5.1 An approach has been taken by the developer in liaison with advice from the FRA that enables the site to be sustainable in the long term future and meet the needs of the community. It does this by offering benefits to Cherwell District Council, neighbouring land owners, future occupants of the development and the ever increasing residential population. As described in **Section 1.0** the development will be assessed in terms of Cornish Architects masterplan option 8.

5.2 The main ways in which the proposed development achieves this are:

- Proposed flood compensation scheme (FCS) to create betterment of flood storage volume capacity greater than the existing volume capacity.
- SuDS used within the proposed development in the form of swales, permeable paving in carparks and underground restricted attenuation as recommend in the LDP which also enhances local ecology
- Strategic landscaping to reduce hazards in areas with public access and reduce risk to acceptable level within the whole development.
- Total of approximately 45,000m^2 for wetland wildlife zoning which enhances and protects the floodplain in the long term.

5.3 The existing/proposed site sections, proposed external finishes/drainage and proposed wetland landscaping is found in **Appendix F**.

Appropriate Development

5.4 Land use has been allocated sensitively as clearly visible on the proposed site sections. Wildlife conservation areas to the east of the site are entirely appropriate for areas subject to the deepest flooding of up to 600 – 700mm in the design flood event. Ecology in these area will thrive similar to wetlands locally across the river.

5.5 Land which will remain as landscaping with paths, benches for public access will be tweaked very slightly so that the levels are at 63.95m. The maximum flooding encountered in this area will be 200mm. 200mm flood levels present a low danger hazard and can be easily negotiated in times of flooding. The raised development is in close proximity of flood risk areas so means of escape can be easily achieved.

5.6 The main development is classified as less vulnerable and located in the west of the site least susceptible of flooding. This makes the development the most appropriate considering the land is allocated for development. To mitigate even small risk the development has been raised well above the design flood level and compensation proposals submitted in order to prevent loss of floodplain storage. The development zoning and land raising is considered appropriate mitigation.

Surface Water Drainage Concept

5.7 The proposed surface water drainage scheme can be found in **Appendix F** and **Appendix H**. Some of the key point's surface water drainage generally are:

- The existing site is presently undeveloped and drains naturally in a south-easterly direction towards the Langford brook on the eastern boundary.
- The Proposed Development raises the building levels and finished levels above the design floodplain levels of 64.15 mAOD.
- The site utilises attenuation swales and below ground drainage networks with flow controls to drain surface water. Infiltration is not considered appropriate for this development due to dense clay type ground conditions.
- Greenfield runoff rate (GRR) calculated using the Hydrology Report 124 method confirms an existing rate of 20.43 litres/second.
- Future overflow outfalls limited to a total of 20 litres/second in the Langford Brook.
- All surface water drainage is to be designed to the latest EA climate change boundary's set in 2016 as design level of 1 in 100 year + 40% CC Storm.
- Preliminary storage estimates using the greenfield run-off rates predicts required attenuation storage of approximately 7500 m^3 in 1 in 100 year + 40% CC Storm.
- The proposed scheme is designed so that no flooding will occur on the Proposed Development up to the 1 in 100 year + 40% CC Storm event.

5.8 The current preliminary surface water drainage proposals allow for the following surface water storage volumes:

1. Swale 1 – Approximately 2000 m^3
2. Swale 2 – Approximately 4500 m^3
3. Subgrade Attenuation - Approximately 1200 m^3 (Permeable Paving)

5.9 Overall preliminary design has tried to utilise SuDS where ever possible. All car parks where feasible have been designed with pervious paving and open graded stone to retain surface water at source. Swale 1 is located within Flood Zone 1 and contributes significantly to the required attenuation storage. Flow control devices have been fitted to ensure that in exceedance events that local watercourses are not overwhelmed.

5.10 Swale 2 unconventionally is located in Flood Zone 3. This swale will need to be specially designed to ensure that groundwater cannot enter into the swale reducing surface water capacity. In addition there is a risk of flood water overtopping the swale which will need adequate freeboard. This will require a freeboard of at least 300mm around the whole perimeter of the swale and lining of the swale sides to protect from flood water seepages. From the information provided it is unlikely there is enough space anywhere else on the site for any further SuDS systems or drainage systems.

Flood Mitigation Proposals

5.11 The main estate road will provide constant access and is currently located within Flood Zone 1. Other paths and estate roads are also located well above the design flood level and can be considered to have flood risk equal to that of Flood Zone 1. The only paths that will be at flood risk are those in the landscaped zone. Further details will need to be provided at detailed design stage for flood warning systems in risk areas. Overall the current scheme mitigates any issues with access and egress risk.

5.12 A landscaping plan has not yet been submitted to assess the use of flood protection landscaping. This will need to be carried out in detailed design to establish the required freeboard to prevent the built development from flooding.

5.13 A Flood Compensation Scheme has been provided in **Appendix G.** The FCS provides background literature, design and calculations justifying that there is no overall loss of floodplain volume storage. This is to be submitted to the EA and Cherwell Flood Authority for separate approval.

5.14 Floodplain compensation is considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change of 35%. The design of the scheme allows flood water to be able to flow in and out and not pond. This FRA demonstrates that there is no loss of flood storage capacity and details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development are provided in **Appendix G**.

Wildlife Conservation Details

5.15 A concept conservation plan has been developed in **Appendix F** to outline key wildlife wetland features. Constructed Wetlands and SuDS (Sustainable Drainage Systems) are man-made systems which function by mimicking the water treatment properties of natural wetlands. Constructed Wetlands range from simple vegetated pond-based systems up to complex, multistage systems treating concentrated point-source effluent.

5.16 Constructed wetlands provide an ideal solution for treating low to moderate strength effluent such as runoff from fields and offer high ecological value. They also come with the possibility of amenity use (e.g. public access, educational visits) and an ability to retain fine sediments containing nutrients such as phosphorus. When accumulated this sediment can normally be spread on farmland after consultation with the Environment Agency.

5.17 Figure 5.1 shows a cross section of an ideal edge, illustrating the benefits of the various water depths for biodiversity (emerging, floating and submerged plants and associated animal communities).

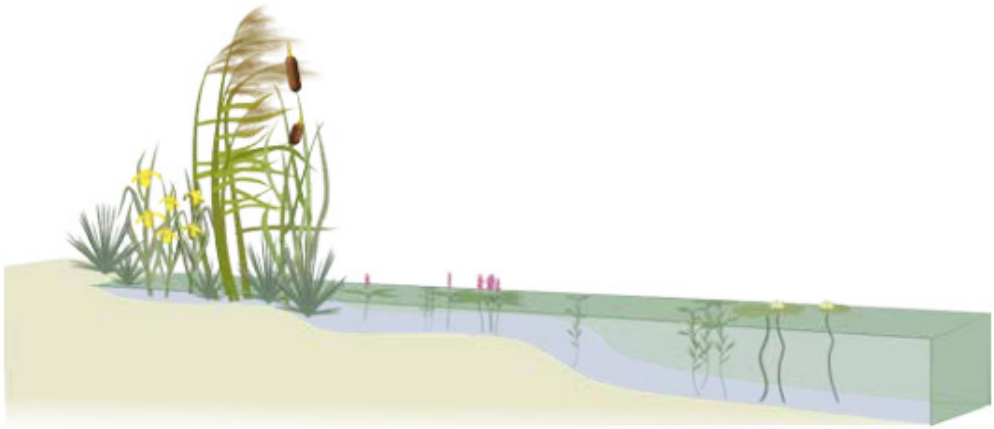


Figure 5.1 – Ideal typical cross-section of wetlands edge.

5.18 In order to prevent any contamination of groundwater or adjacent waterbodies constructed wetlands should either be constructed on an impermeable clay substrate or be lined with an artificial liner. Where constructed wetlands are required to hold water, care must be taken to ensure that they are not constructed near to or below the water table as this could lead to potential groundwater contamination risk. The water table should be no less than 0.5 m below the bottom of the wetland if using an artificial liner and no less than 1 m below the bottom if an in-situ natural liner is used.

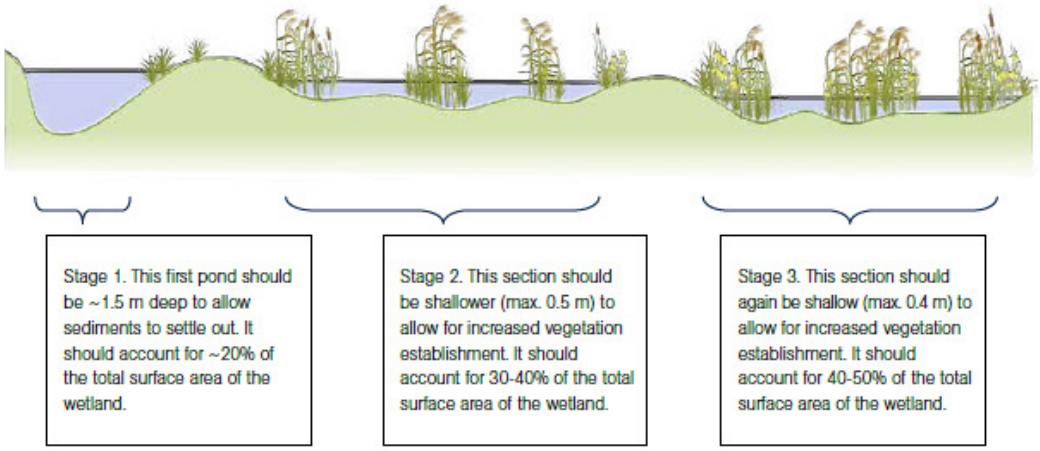


Figure 5.2 – Three-stage constructed wetland.

5.19 Several methods exist for the sizing of wetlands. One of the most widely recognised would be using the three-stage method shown in Figure 5.2. Stage 1 should be 20% of the total wetland area, maximum depth 1.5m. This would include the existing ditches already found on the site. Stage 2 & 3 are shallow vegetated cells with a maximum depth of 0.5m and 0.4 m respectively. These would need to be cut to suit the conditions. Stage 2 should comprise approximately 30-40% and stage 3 approximately 40-50% of the total wetland area.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 This Flood Risk Assessment (FRA) is compliant with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA has been produced on behalf of Albion Land Ltd in respect of a planning application for the proposed Catalyst Bicester development on Wendlebury Road, Bicester.

6.2 This report demonstrates that the proposed development is at an acceptable level of flood risk, subject to the recommended flood mitigation strategies being implemented. The identified risks and mitigation measures are summarised within Table 6.1.

Table 6.1 – Summary of Flood Risk Assessment

Flood Source	Proposed Mitigation Measure
Fluvial/Tidal	Land rising so FFL's are at a safe level, Landscaped flood defences preventing flood water encroachment, Flood warning systems and Flood Compensation scheme to maintain flood storage volume.
Groundwater	Any residual flood risk from groundwater sources will be mitigated by raising the development.
Sewers & Pluvial Runoff	Any surface water risk can be mitigated with management of surface water runoff using on site storage in Flood Zone 1 where possible.
Impact of the development	Development Zoning, Safe access and egress and Pollution Prevention and understanding of residual risks
This summary should be read in conjunction with BJH's full report. It reflects an assessment of the Site based on information received by BJH at the time of production.	

6.3 In compliance with the requirements of National Planning Policy Framework, and subject to the mitigation measures proposed, the development could proceed without being subject to significant flood risk. Moreover, the development will not increase flood risk to the wider catchment area as a result of suitable management of surface water runoff discharging from the site.

APPENDIX A

CORNISH ARCHITECTS
SITE MASTERPLAN OPTIONS
18022-SK-018/020/024/025

ILLUSTRATIVE MASTERPLAN (1:1250 @ A1)

UNIT STUDIES VIEW 01

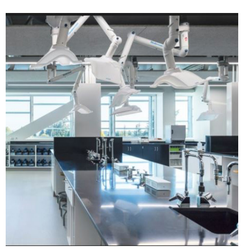
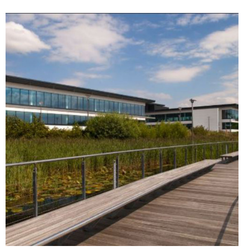
SITE VISUAL 01

UNIT STUDIES VIEW 02

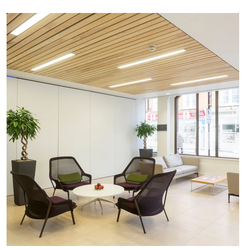
UNIT STUDIES VIEW 03

SITE VISUAL 03

PRECEDENT STUDIES

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18022 CATALYST BICESTER

MASTERPLAN SCENARIO 01

Schedule of approximate areas GIA						
UNIT	**Ground Floor**	**First**	**Total sm**	**Total sf**	**Unit parking**	**Total parking**
1	1085	362	1447	15572	43	95
2	637	212	849	9142	26	
3	630	210	840	9042	26	
4	1230	410	1640	17653	46	102
5	1460	487	1947	20954	56	
6	1666	555	2221	23910	65	131
7	1666	555	2221	23910	66	
8	2156	719	2875	30943	84	168
9	2156	719	2875	30943	84	
10	2156	719	2875	30943	84	186
11	1460	487	1947	20954	56	102
12	1230	410	1640	17653	46	
Totals			**23376**	**251619**	**682**	
Total Development area: 17.4 acres		Parking @ approximately 1:35				

NOTES

Do not scale. Work only to figured dimensions.

Subject to Statutory Approvals.

Subject to survey

Subject to design development

Where applicable this drawing is to be read in conjunction with other consultants drawings and with the specification.

N

Planning Boundary

Rev	Description	Chk	Date
B	Roundabout layout amended	RC	21.05.19
A	Landscapling added.	HS	13.03.19

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RIBA Chartered Practice

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Project Title.

CATALYST
BICESTER

Drawing Title.

TECH SCHEME OPTION 5B

Drawing Status.

PRELIMINARY

0 10 metres 80

Drawn By.	Scale.	Date.	Chk'd By.
R C	1:1000 @ A1	15/02/2019	C S

ANGLE PROPERTY by D

Drawing No. 18022 - SK - 020 | Rev. B