JBA consulting

Flood Risk Assessment & Surface Water Drainage Strategy at former Bengeo Garden Centre

Draft Report

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Revision History

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Contract

This report describes work commissioned by Jim Udale, on behalf of Bovis Homes Ltd, by a email dated 10th October 2012. Bovis Homes Ltd's representative for the contract was Jim Udale. Daryl Taylor and Andrew Waite of JBA Consulting carried out this work.

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Purpose

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Executive Summary

Background

Bovis Homes Ltd commissioned JBA Consulting to undertake a Flood Risk Assessment (FRA) for the proposed redevelopment of the Bengeo Garden Centre, Hertford, in accordance with National Planning Policy Framework (NPPF).

The 1.67 Ha site is currently occupied by Bengeo Garden Centre and is therefore designated as Brownfield land. The existing development consists of glasshouse structures, a gravel car park and surrounding scrubland. The site is bordered by Sacombe Road to the west and allotments to the south. The proposed housing development that will occupy the site would involve the demolition of existing structures and the building of a small residential estate consisting of 58 dwellings, car parking, access roads and a pumping station.

Planning and Flood Risk

The Environment Agency Flood Maps show that the development site falls entirely within Flood Zone 1. Fluvial flooding at the site does not pose a significant risk to the development and a detailed assessment of fluvial flood risk is not required.

The site is located on a Secondary "A" aquifer underlain by Principle aquifer. These are described as being permeable layers capable of supporting water supplies at a local scale and forming in cases base flows to river. Although the geology has the potential for groundwater emergence no incidences have been highlighted in the East Hertfordshire Level 1 Strategic Flood Risk Assessment conduct for the region. Ground investigations conducted by MLM Environmental did not encounter groundwater to a depth of at least 2m, indicating that the site is not affected by a high groundwater table. It is therefore unlikely that groundwater flooding poses a significant risk to the development site.

JBA's Comprehensive flood map was used to assess the risk of surface water flooding to the development. This map provides an indication of the depth and extent of flooding during a range of return periods. It was shown that the expected frequency of surface water flooding is low, and the depth of flooding during all events remains low, with areas of ponding in localised topographic depressions. The risk of surface water flooding to the development is considered to be low.

The National Planning Policy Framework (NPPF) classifies residential development as more vulnerable to flooding. Development of this type is acceptable within Flood Zone 1 so the site is considered to automatically pass the Sequential Test. The exception test is not required.

Mitigation

A surface water drainage strategy for the site has been prepared. This strategy is designed to manage 1 in 30 year storm events below ground or in well-defined storage features. All surface water up to the 1 in 100 year (plus climate change) storm event will be contained within the site to ensuring that the proposed development cannot affect surrounding developments. This will be achieved using a SUDS systems comprising pervious paving and soakaways, with the public open space area operating as an infiltration basin during more extreme storm events. The designed system complies with the requirements of Sewers for Adoption (7th Edition).

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Abbreviations

mAOD	Metres above Ordnance Datum
CFMP	Catchment Flood Management Plan
FRA	Flood Risk Assessment
ha	Hectares
IDB	Internal Drainage Board
JBA	Jeremy Benn Associates
JBACFM	JBA Comprehensive Flood Map
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
SAB	SUDS Approving Body
SFRA	Strategic Flood Risk Assessment
SUDS	Sustainable Drainage Systems

Definitions

WinDES	Industry standard drainage system design and modelling software

1 Introduction

1.1 Terms of Reference

JBA Consulting was commissioned in October 2012 by Bovis Homes Ltd to undertake a Flood Risk Assessment (FRA) at the former Bengeo Garden Centre, Hertford for a proposed residential development.

The FRA provides information on the nature of flood risk at the site and follows Government guidelines with regards to development and flood risk.

1.2 FRA Requirements

It is a requirement for development applications to consider the potential risk of flooding to a proposed development over its expected lifetime and any possible impacts on flood risk elsewhere, in terms of its effects on flood flows and runoff.

Where appropriate, the following aspects of flood risk should be addressed in all planning applications in flood risk areas:

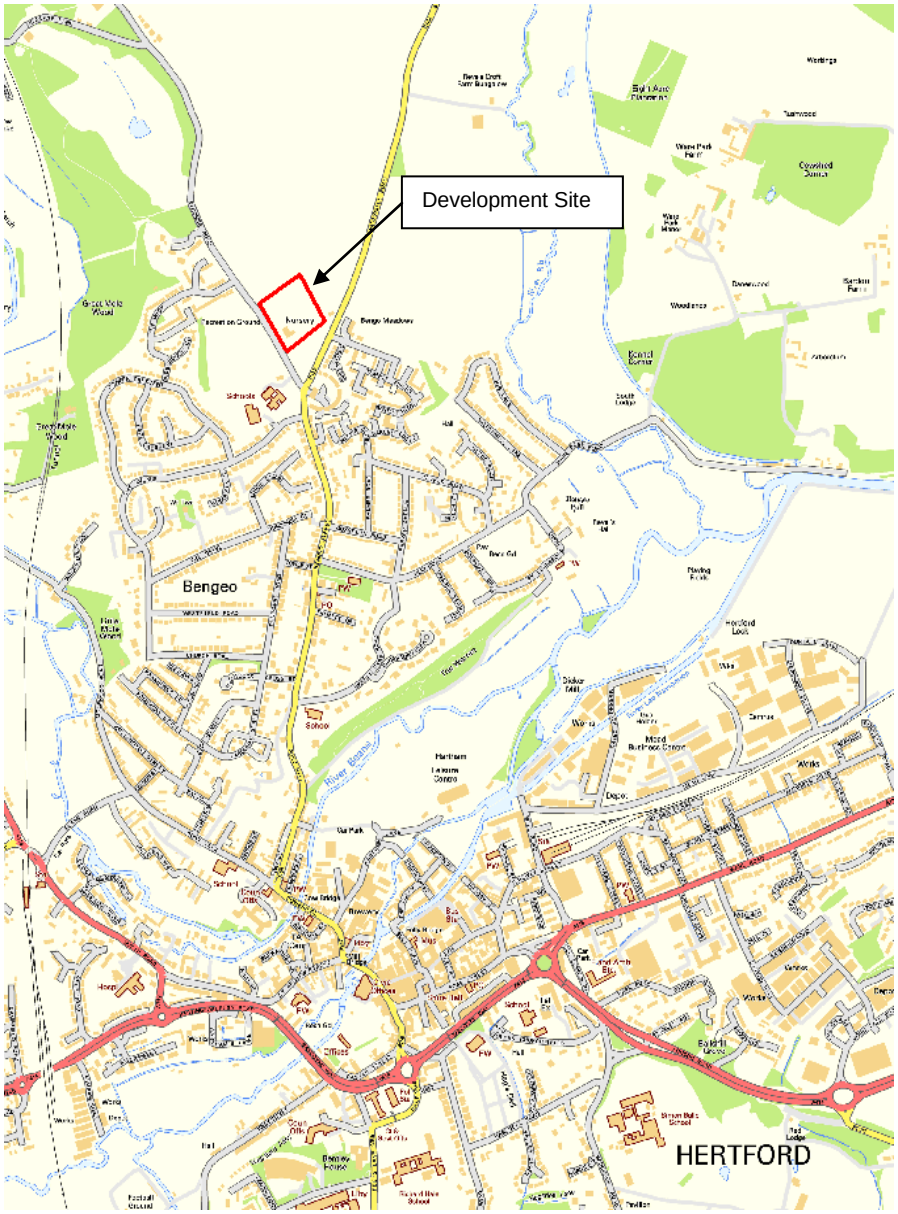
- The area liable to flooding.
- The probability of flooding occurring now and over time.
- The extent and standard of existing flood defences and their effectiveness over time.
- The likely depth of flooding.
- The rates of flow likely to be involved.
- The likelihood of impacts to other areas, properties and habitats.
- The effects of climate change.
- The nature and currently expected lifetime of the development proposed and the extent to which it is designed to deal with flood risk.

This FRA follows government guidance on development and flood risk set out in the National Planning Policy Framework (March 2012). Appendix A details how this FRA meets these requirements.

1.3 Site Details

Table 1: Summary of Site Details

Site name	Former Bengeo Garden Centre Development Site
Site area	1.67ha
Existing land-use	Brownfield. Site is currently occupied by Bengeo Nursery.
Purpose of development	Residential Development
OS NGR	TL 32320 14260
Country	England
County	Hertfordshire
Local Planning Authorities	East Hertfordshire Council
Lead Local Flood Authority	Hertfordshire County Council



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1.4 Site Description

The development site is situated at the Bengeo Garden Centre to the east of Sacombe Road, Bengeo. The site is approximately 1.67 hectares in size, and is promoted as a strategic site for residential developments.

The site is currently occupied and operational as a garden centre. The existing development consists of glasshouses; large gravel covered parking facilities and areas of scrubland to the north and east of the site boundary which surround the glasshouses. The glasshouses and associated buildings account for approximately 25% of the total site area. Site photos have been collected by JBA staff during a site walkover on 28/02/2011. These photos are displayed in Figure 1.

Figure 1: Photographs of Existing Site (Feb 2011)

Current Bengeo Nursery

Series of Glasshouses

Large gravel car park with vegetation divides.

Scrubland surrounding glasshouses along northern and eastern boundary.

1.5 Proposed Development

The proposed development will involve demolishing the existing glasshouse structures and replacing them with 58 dwellings with associated parking and access roads. A new foul sewage pumping station is to be constructed in the south-eastern corner of the site to serve the new development. Plans of the proposed development are provided in Appendix B.

1.6 Existing Drainage Network

The site is considered to be brownfield as it is currently occupied, however there is no formal drainage network discharging to public sewers. The glasshouses and hardstanding areas are believed to drain via runoff to pervious surfaces such as the gravel car park and surrounding scrubland. This site is therefore considered to drain as a greenfield site with surface water draining via infiltration into the ground and as overland flows from saturated surfaces.

A Phase II Geo-environmental Assessment Report was produced by MLM Environmental, which describes the site geology as "underlain by Kesgrave Catchment Sub-group (sand and gravel) over Lewes Nodular and Seaford Chalk Formation." Intrusive ground investigations and soakaway tests were carried out as part of this assessment, which showed that the site is permeable and will allow some drainage by infiltration.

According the Environment Agency website, the site is located on a Secondary aquifer (A) which contains permeable layers capable of supporting water supplies at a local scale, sometimes forming an important source of base flow for rivers. The superficial deposits designation describes the site as having high intergranular and/or fracture permeability which usually provides a high level of water storage

The nearest major watercourses are an unnamed ditch to the east of the site. The River Beane is located approximately 700m to the west and the River Rib 600m to the east.

2 Planning Policy and Flood Risk

2.1 Planning Context

2.1.1 Applicable Planning Policy

The National Planning Policy Framework (NPPF) was introduced by the Department for Communities and Local Government in March 2012 and supersedes the Planning Policy Statements. The NPPF considers flood risk to developments using a sequential characterisation of risk, based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

2.2 NPPF Flood Zones

Table 2 shows how the Flood Zones relate to a sequential planning response.

Table 2 NPPF Flood Zones

Zone 1: Low Probability	
Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	**Appropriate uses** All uses of land are appropriate in this zone. **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless factors above or other local considerations require particular attention. **Policy aims** Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.

Zone 2: Medium Probability	
Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.	**Appropriate uses** The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table 2 are appropriate in this zone. Highly vulnerable uses in Table 2 are only appropriate in this zone if the Exception Test is passed. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability	
Land assessed as having a 1 in 100 or greater probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	**Appropriate uses** The water-compatible and less vulnerable uses of land in Table 2 are appropriate in this zone. The highly vulnerable uses Table 2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table 2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** Developers and local authorities should seek opportunities to: • reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land in zones with a lower probability of flooding; • create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b: Functional Floodplain	
Land where water *has* to flow or be stored in times of flood. Local Planning Authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designated to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify functional floodplain.	**Appropriate uses** Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted. It should be designed and constructed to: • remain operational and safe for users in times of flood; • result in no net loss of floodplain storage; • not impede water flows; and • not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test. **FRA requirements** All proposals in this zone should be accompanied by a FRA. **Policy aims** In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land with a lower probability of flooding.

Source: Table 1, NPPF Technical Guidance

Table 3 Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and 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 (Sequential and Exception Tests required for any change of land use to these sites). • Installations requiring hazardous substances consent (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the faculties should be classified as "Essential Infrastructure").

More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels • Non-residential uses for health services, nurseries and educational establishments • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravan and camping, *subject to a specific warning and evacuation plan.*
Less Vulnerable	• Police, ambulance and fire stations which are *not* required to be operation during flooding. • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food 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. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works and which do *not* need to remain operation during times of flood. • Sewerage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • 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 • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan.*

Source: Table 2, NPPF Technical Guidance

Notes:

1. This classification is based partly on Defra/Environment Agency research on Flood Risks to People (FD2321/TR2) and also on the need of some uses to keep functioning during flooding.

2. Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

3. The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

Table 4 Flood Risk Vulnerability and Flood Zone 'Compatibility'

Vulnerability Classification (Table 2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test	✓	✓
	Zone 3a	Exception Test	✓	×	Exception Test	✓
	Zone 3b	Exception Test	✓	×	×	×

Source: Table 3, NPPF Technical Guidance

✓ Development is appropriate

× Development should not be permitted

Notes:

This table does not show:

1. the application of the sequential test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;

2. Flood risk assessment requirements;

3. The policy aims for each flood zone.

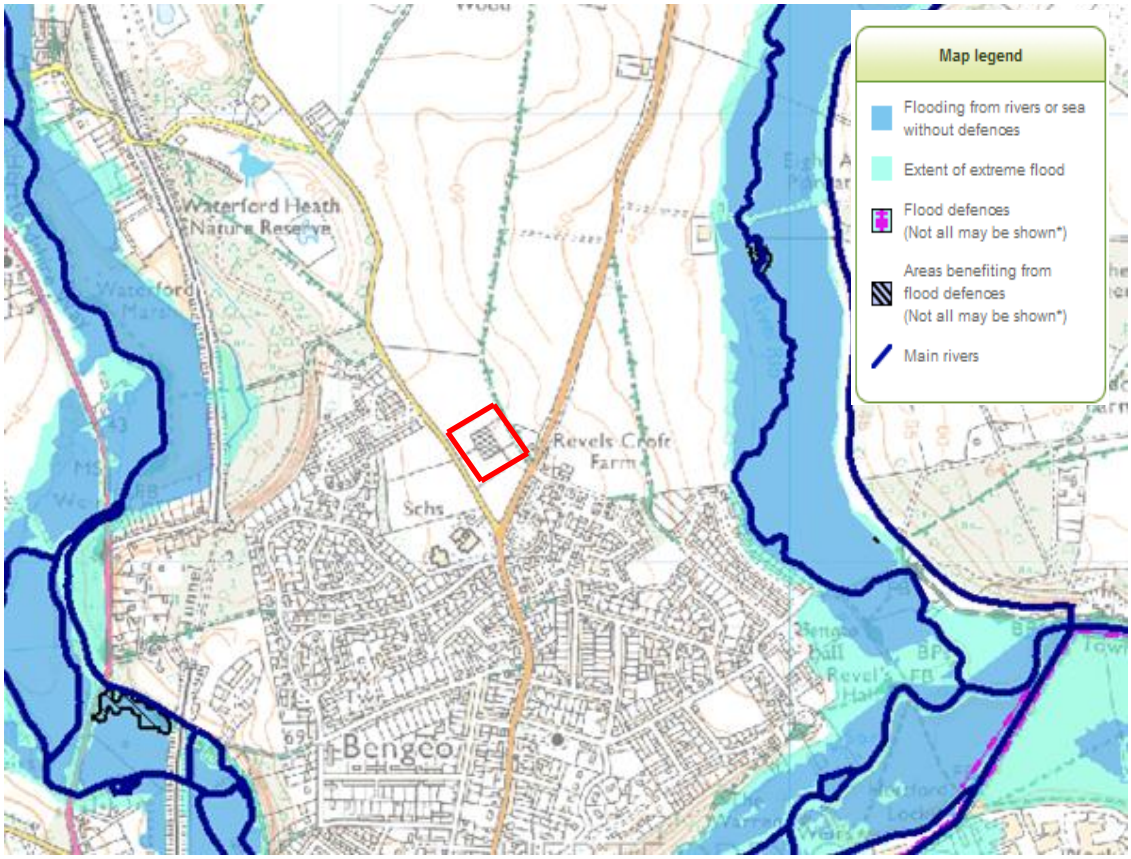
2.3 Development Site Flood Zones

The Environment Agency has developed a Flood Map which shows the risk of flooding in England and Wales for different return period events. This map provides the basis for the assessment of flood risk and development suitability to NPPF. The Environment Agency's Flood Map is, in the majority of cases, based on broad-scale river modelling and provides an indication of the potential flood risk to a site rather than a detailed assessment. When a detailed river modelling study is undertaken, the broad-scale river model outputs are updated using the detailed river model.

Figure 2 overleaf shows the Environment Agency Flood Zones[1] for the site and surrounding area. The proposed development site is shown to be located within Flood Zone 1 (low risk of fluvial and coastal flooding).

[1] http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=_e&ep=map&scale=7&x=532500&y=213500#x=532500&y=214294&lg=1,&scale=10

Figure 2: Environment Agency Flood Maps (Site and Surrounding Area)



2.4 Planning for Flood Risk

2.4.1 Sequential and Exception Tests

The NPPF requires that the Sequential and Exception tests should be applied when choosing the location of new development and the layout of the development site. The Sequential Test aims to promote development in low flood risk areas. The Exception Test is used where no suitable development areas can be found in low risk zones.

When planning a development a sequential approach should be applied to identify suitable sites which are at minimal risk from flooding, avoiding Flood Zones 2 and 3 where possible. If no suitable areas can be identified in Flood Zone 1 then sites with the lowest flood risk should be considered next. If development is necessary within a medium or high risk zone an exception test may be needed to demonstrate the need for the development in that location and plans to mitigate flood risk.

The proposed development site is located within Flood Zone 1 and the development therefore automatically passes the Sequential Test. The Exception Test is not required.

2.4.2 Site Layout planning

At the site planning stage a sequential approach should be applied to the layout design, with more vulnerable development being located in the low risk areas and water compatible land uses being located in higher risk areas. As the site is located within Flood Zone 1, all areas of the site are considered to be at equal risk of fluvial flooding. Surface water flood risk should be considered when planning the site layout, ensuring that new development is directed away from surface water conveyance routes or areas of deep ponding.

Proposals for development should ensure that emergency access to the site will be available at all times. For this reason there should be at least one access road which does not pass through an area at risk of flooding. Sacombe Road to the west of the site and Wadesmill Road to the east are shown not to be at risk of flooding on the Environment Agency Flood maps. Dry access to the site can be achieved from these routes during significant local flooding events.

2.5 Policy and Guidance Review

2.5.1 Flood Risk and Water Management Strategies, Policy and Guidance

East Hertfordshire SFRA (Strategic Flood Risk Assessment)

Bengeo, Hertford falls within the district of East Hertfordshire and is covered by the East Herts Level 1 Strategic Flood Risk Assessment (SFRA) which was completed in 2008. This document sets out the planning context, flood zone maps and summarises the flood risk in the East Herts area. The document provides recommendations of policies and approaches for future developments in regards to flood risk.

No site-specific site information is contained within the SFRA.

Thames Catchment Flood Management Plan

The Thames Catchment Flood Management Plan (CFMP) was produced in 2009. Its purpose was to help understand the scale and extent of flood risk now and in the future and develop preferred flood risk management policies at catchment scale. The CFMP is designed to inform planning and decision made by key stakeholders such as the Environment Agency, regional planning bodies, IDB's, Land owners and public businesses.

The Thames catchment was divided into a number of sub-catchments based on the major tributaries and urban conurbations. Bengeo falls within Sub-Area 4, the Upper Lee. The main flood risk in this Policy Unit is fluvial flooding, sometimes in combination with high groundwater levels.

The CFMP recommended that Policy Option 3 should be applied to this policy unit:

> *"This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future. However, we keep our approach under review, looking for improvements and responding to new challenges/new information as they emerge"*

The CFMP makes recommendations for flood risk management practises within the policy area as follows:

- *Maintain the existing capacity of the river systems in the developed areas to reduce the risk of flooding from more frequent events.*
- *Work with the LPA to retain the remaining floodplain for uses that are compatible with flood risk management and put in place policies that lead to long term adaption of urban environments in flood risk areas*
- *Continue to increase public awareness, including encouraging people to sign up to the Floodline Warnings Direct service.*

Previous Flood Risk Assessments

Alongside the other sources of flooding information discussed above, a flood risk assessment has previously been produced for the site before detailed plans were provided. The previous FRA used the JBA Consulting 'Comprehensive Flood Map' to assess the risk from all sources of flooding.

The JBA Comprehensive Flood Map (JBACFM) is an in-house set of indicative flood maps covering mainland UK. It provides information on fluvial, costal and surface water flooding. In the case of this development site, only a surface water map was provided as fluvial and coastal risk was deemed to not be significant. This JBACFM displays surface water flood risk for three return periods, 75 year, 200 year and 1000 year.

Additional Flood Risk Assessments have been identified in the immediate vicinity of development site. Scott Wilson was commissioned to produce a Level 2 FRA for a residential development of 2.12ha to the west of Sacombe Road in 2010[2]. An additional FRA was also conducted by Hyder based on proposed development of Bengeo Primary School in 2012[3]. These documents were used as reference to surrounding physical conditions and possible flood risk to the proposed development in this FRA.

2.5.2 Code for Sustainable Homes

The Code for Sustainable Homes is an environmental assessment method for rating and certifying the performance of new homes. It is a national standard for use in the design and construction of new homes with a view to encouraging continuous improvement in sustainable home building. The Code was launched in December 2006 with the publication of *Code for Sustainable Homes: A Step-change in Sustainable Home Building Practice* (Communities and Local Government, 2006). The Code became operational in April 2007 in England, and became mandatory from 1st May 2008.

The assessment works on a point-scoring basis, whereby developments gain credits based on their environmental performance in each of 9 distinct categories. Each category has an associated weighting factor, to account for its relative importance in the environmental assessment. These credits are then combined to provide an overall percentage score, and a code level is given to the development. The categories which are most relevant to Flood Risk Assessments are:

- Water
- Materials
- Surface Water Run-off
- Waste
- Ecology

With regards to Flood Risk Assessment, most of these categories relate to the efficient design, construction and operation of surface water drainage systems and flood mitigation systems. There is however a flood risk category which aims to encourage housing development in low flood risk areas, and as the site is entirely within Flood Zone 1 any constructed property would automatically gain 2 credits towards a code rating. To gain further credits the following could be considered:

- Installation of Sustainable Drainage Systems (SUDS) to attenuate and store flows from paved areas and roofs.
- Responsible management of construction waste generated by installation of Surface Water Drainage Systems or Flood Mitigation Systems.
- Improving the ecological standard of the site through maintaining ecologically important regions of the site and providing increased habitat area within the development area. This can be done through the provision of green corridors and green infrastructure in the form of SUDS.

[2] ScottWilson-2010-Onlinesource: http://online.eastherts.gov.uk/rkyvportal/showimage.asp?j=3/10/1198/FP&index=186199

[3] Hyder-2012-Onlinesource: http://online.eastherts.gov.uk/rkyvportal/showimage.asp?j=3/12/0686/CC&index=352127

3 Assessment of Flood Risk

The approach to assessing flood risk at the development site was informed by the requirements of NPPF in conjunction with the client and Environment Agency requirements. The primary objectives of this FRA are as follows:

- Determine whether the site is at significant risk from any forms of flooding.
- If the site is at risk of flooding, determine if safe access to and from the site will be maintained during an extreme flood event
- Assess the impact of the development on flood risk to other sites, with particular focus on the effects of surface water from the site

To meet the above objectives a desk-based study was used. Prior to the production of this detailed FRA, a previous FRA was produced by JBA in March 2011. This FRA was for the same site but detailed development plans were not available. Using the results of this study, along with a review of local flood risk policy documents, historic flooding data, topography and geology, an initial assessment of flood risk to the development has been carried out to identify the key risks to the development.

3.1 Flood Risk Assessment Requirements

All new developments must comply with the requirements of the NPPF. As the development is greater than 1ha in area, a detailed flood risk assessment is required that considers the risk to the development from all sources of flooding including fluvial (river), tidal, coastal, pluvial (surface runoff/surcharging sewers) and groundwater. The NPPF advocates a risk-based approach to flood risk management in terms of appraising, managing and reducing the consequences of flooding both to and from a development site.

3.2 Historical Flooding

A review of historical flooding has been undertaken using a variety of resources. Whilst historical flood records can often be anecdotal and earlier records often do not provide a complete account of the event, they can be an invaluable data source when undertaking a hydrological assessment.

East Hertfordshire Council conducted a Level 1 Strategic Flood Risk Assessment (SFRA) in November 2008. This describes historic flooding on the River Rib in 1993 and 2001. Historic flood events are also described for the River Beane in 1978, 1979, 1993, 2000 and 2003. The flood extents of these events did not affect the proposed development site.

Data held on the British Hydrological Society's Chronology of British Hydrological Events[4] database found no further records of past flooding incidents with the vicinity of the development site

Overall, there were no records found regarding recorded incidences of flooding at the site or in the vicinity of the proposed development site.

3.3 Sources of Flooding

3.3.1 Fluvial Flood Risk

The site is located within Flood Zone 1, indicating that the annual probability of the site flooding from fluvial sources is less than 1 in 1000 and no records of previous flooding to the site have been identified. The closest watercourses are the River Beane, approximately 700m to the west of the site and the River Rib approximately 600m to the east of the site. There are no other drainage channels or ordinary watercourse in the area that would influence the development site. Fluvial flooding is therefore not considered to pose a significant risk to the development and a detailed assessment of fluvial flood risk is not required.

[4]British Hydrological Society. Chronology of British Hydrological Events http://www.trp.dundee.ac.uk/cbhe/welcome.htm Accessed Oct 2012.

3.3.2 Surface Water Flood Risk

Flooding from surface water occurs when extreme rainfall exceeds the infiltration or drainage capacity of the ground surface. This can pose a risk to the site but also adjacent sites as a result of increased areas of impervious surfaces resulting from development of the site. The previous FRA produced by JBA in March 2011 used the JBA comprehensive flood map to assess surface water flood risk to the site. This mapping illustrated that the development site is at minimum risk from surface water flooding. Surface water flooding is shown to occur in small localised areas with the site that correspond with depressions in the topography. These are shown to appear with the 200 and 1000 year events. Surface water flows appear to flow away from the development site to the south-east following the localised topography. The mapped flood outlines from the JBA comprehensive flood map can be found in Appendix C.

Sewer maps provided by Thames Water show that no public surface water sewers are present within the site or along Sacombe road to the west of the site. No private sewer systems were identified in the topographic survey of the site. The risk of sewer flooding is therefore considered to be low. The sewer maps provided by Thames Water can be found in Appendix D.

The risk of surface water flooding to the development is considered to be low

With the proposed development significantly increasing the impervious area of the site there will be an increase in surface water runoff rates and volumes from the site. A surface water drainage system will be provided on-site which will effectively drain the site and mitigate surface water flood risk to the site and other developments, ensuring that the risk of surface water flooding does not increase as a result of developing the site.

3.3.3 Groundwater Flood Risk

The SFRA[5] indicates that the underlying geology is comprised of upper chalk formation bedrock and ancestral Thames river terrace drift deposits. Groundwater flooding occurs when water originating in aquifers reaches the surface, typically as a result of high water tables. Environment Agency groundwater maps [6](Figure 3) show the site to be underlain by a Secondary 'A' Aquifer with the whole region underlain by a principal aquifer. Secondary 'A' aquifers are described on the EA website as being permeable layers capable of supporting water supplies at a local scale and forming in some cases an important base flow for rivers.

Permeable geology has the potential for groundwater emergence, although the SFRA did not highlight any incidents of groundwater flooding in the Bengeo area.

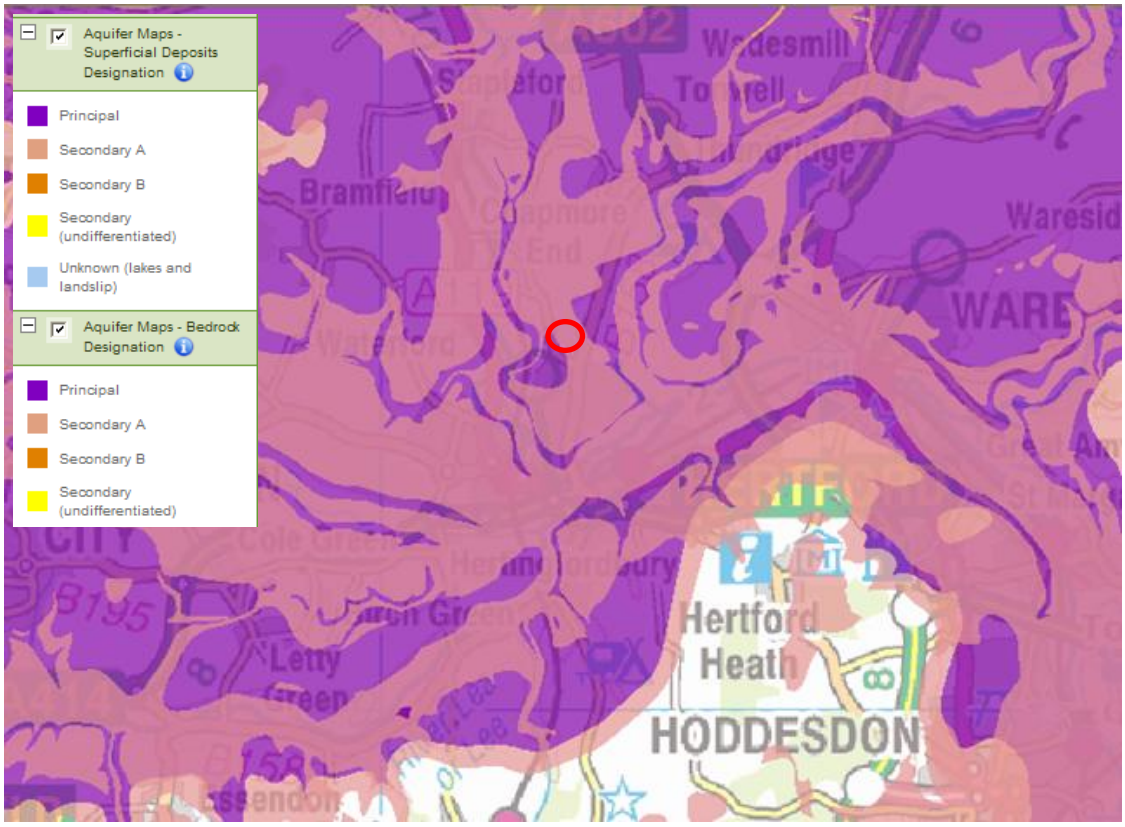
Ground investigations conducted by MLM Environmental did not encounter groundwater during intrusive tests, indicating that the groundwater table is at least 2m below ground level. Tests were carried out in both summer and winter, so groundwater levels are not considered to be seasonally high such that they may cause groundwater flooding.

Given the above, the proposed development site is not considered to be at significant risk of flooding from groundwater sources.

[5] East Herts (2008) Level 1 Strategic Flood Risk Assessment

[6] http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=532500.0&y=213500.0&topic=groundwater&ep=map&scale=6&location=Bengeo, Hertfordshire&lang=_e&layerGroups=4&distance=&textonly=off#x=531508&y=213500&lg=4,3,&scale=7

Figure 3: Site Location and EA Groundwater Maps



3.4 Flood Risk Mitigation

Given that the site is located within Flood Zone 1 and elevated significantly above nearby watercourses, mitigation against fluvial flooding is not required.

It is recommended that the finished floor levels be raised at least 150mm above surrounding ground levels to minimise the risk of surface water flooding from localised ponding or overland flows. In the south-eastern corner of the site, the highway will be designated as a floodable area during the 100 year plus climate change event in case of exceedance of the propsed sewer system. The peak water level in this area is expected to be around 64.15m AOD, so the minimum floor level for all properties on site should be set to at least 64.30m to provide 150mm freeboard above the design water level.

All properties should have a solid floor construction, either suspended timber floors over concrete or solid concrete, to prevent potential ingress of groundwater from below the property. Although the risk of groundwater flooding is considered to be low, soakaways will be located within the site which will introduce water to the ground at shallow depths. Groundwater flows will be able to travel laterally as well as vertically, so localised increases in the groundwater table may occur during extended wet periods, which could potentially generate flood risk to properties.

4 Site Drainage Strategy

4.1 Existing Drainage Arrangement

Although the site is designated as brownfield land, currently occupied by Bengeo Garden Centre, it is considered to drain as a Greenfield site. There are no known connections to the public sewer network, and no private sewer network was identified in the site topographic survey. Large areas of the site such as the car park and the development fringes have pervious surfaces, allowing rainfall it infiltrate directly into the ground or be taken up by vegetation. The existing glasshouses and areas of hardstanding are not formally drained to sewers, runoff is allowed to flow onto the surrounding pervious areas where it is drained by infiltration

4.2 Outline Drainage Strategy

A strategy for managing surface water on-site has been developed by JBA Consulting. The proposed drainage system has been modelled using WinDES software to confirm that the ground conditions are suitable to drain by infiltration and that the design criteria for runoff quantity (Section 4.3) can be achieved whilst maintaining a suitable level of protection against surface water flooding.

An outline layout plan of the proposed surface water drainage system is provided in Appendix E and WinDES system details can be found in Appendix F.

Surface water runoff from the site will be managed primarily through pervious paving, soakaways and over-sized pipes laid in open space and car parking areas. Some properties will have individual ring or trench soakaways installed in garden spaces. The proposed public open space area in the central portion of the site will be landscaped such that it operates as an infiltration basin that will be inundated during extreme storm events, preventing on-site properties and local developments from flooding as a result of exceedance of the on-site system.

Proposed home zones, turning circles and car parking areas will be surfaced with pervious paving to prevent the generation of surface water runoff and encourage infiltration drainage. The construction of the paving will be such that the crushed stone sub-base will provide a volume of storage during extreme storm events. Within the home zones and turning areas, soakaway trenches will be provided beneath the pervious paving, constructed using un-lined plastic geocellular tanks, will provide a substantial volume of storage whilst allowing drainage by infiltration to the ground. Each of these soakaways will drain the properties surrounding it, typically serving 5 - 10 properties each.

A larger soakway will be constructed beneath the proposed public open space area, draining surface water from site highways. This soakaway will also be constructed of plastic geocellular storage tanks to provide a large storage volume and infiltration area. The public open space above will be landscaped to create a 400mm deep basin which will remain dry during typical rainfall events but will be waterlogged or inundated during more extreme storm events.

In addition to the formal drainage system proposed for the site, it is recommended that individual property-level measures such as water butts be provided to reduce the volume of runoff entering the formal drainage system and to encourage water efficiency. Disconnection of downpipes from the private sewer into bioretention planters or rain gardens should also be encouraged, the pervious nature of the site soils will further reduce the volume of runoff entering the drainage system and reduce external water demand.

4.3 Design Criteria

It is a requirement of all new developments that surface water runoff should be managed on site, ensuring that surface water flood risk to the development is minimised and flood risk to other developments is not increased as a result of the proposed development.

The surface water drainage system should be designed in line with any design criteria set out in the upcoming National SUDS Standards, local guidance or following the requirements of the relevant SUDS Approving Body (Hertfordshire County Council).

The following criteria are based on current best practise and design standards in those areas which currently have a formal adoption process in-place. These are considered to provide a suitable indication of the likely design criteria which will be introduced following the formation of Hertfordshire County Council SUDS Approving Body and publication of national standards for SUDS.

Discharge Location

Building regulations have introduced a 'drainage hierarchy' with infiltration on site as the preferred option for surface water discharge, followed by discharge to a watercourse and then connection to a sewer as a last resort.

Infiltration systems are not suitable for use within areas which experience high water tables and groundwater flooding. Although the geology has the potential for groundwater flooding, The SFRA has not identified any records of groundwater flooding and there is not considered to be a significant risk of groundwater flooding to the site. Intrusive ground investigation conducted by MLM Environmental indicated that the depth of the groundwater table in summer and winter are at least 2m below ground level and concluded that the site would be suitable for forms of infiltration.

Given that the site geology is sufficiently permeable to allow infiltration drainage, and the fact the site is located a significant distance from a suitable recieving watercourse, it is proposed that all surface water runoff generated on-site will be disposed of by infiltration to the ground on-site.

Runoff Quantity

The surface water drainage system should ensure that the rate and volume of runoff from the site will not exceed the pre-development values to prevent increases in flood risk resulting from development of the site. The proposed drainage strategy will aim to ensure that no surface water runoff will leave the site up to the 1 in 100 year (plus climate change) storm event therefore removing the risk that the proposed development may have to surrounding development.

Runoff Quality

The surface water drainage system should ensure that a sufficient level of water quality treatment is provided to ensure that development of the site does not cause significant contamination of receiving watercourses.

In the CIRIA SUDS manual, residential developments are considered to present a medium source of runoff pollution, and therefore at least two treatment stages are required within the SUDS system. The proposed drainage strategy for the development site intends to use a mixture of pervious paving and soakaways to achieve the desired level of treatment.

SUDS guidance recommends that no runoff should leave the site during the water treatment event (5mm rainfall across the entire site), instead being captured and treated by the SUDS system, before draining by infiltration or through evapo-transpiration processes. The proposed development will drain all runoff via infiltration, therefore this criteria will be met automatically.

Ecology & Amenity

In addition to the stricter design criteria of water quality and quantity, a SUDS system should seek to maintain or improve the ecological quality of the site and provide visual and amenity benefits in addition to the drainage function of the system.

The proposed system will maintain the ecological quality of the site, the nature of the system results in drainage infrastructure being located underground. The use of soakaways distributed around the site will ensure that groundwater levels and soil moisture content, which can impact on local fauna, are retained at their current levels.

The proposed system will utilise the proposed open space area during extreme events, but will not be inundated and should quickly dry during 'normal' weather conditions. This will allow the public open space to remain useable in all but the most extreme of rainfall events. In accordance with the requirements of Sewers for Adoption, the sub-surface system will not flood during all events up to the 1 in 30 year event. This will ensure that all parts of the site remain usable for their primary function during all but the most extreme storm events.

Health and Safety

The surface water drainage system will be designed so that it minimises health and safety risk to the public and maintenance staff. SUDS are sometimes perceived as unsafe features, with fears of drowning and overturning cars, but with correct design these risks can be minimised. There will be no permanently wet areas, the infiltration basin only becoming operational during extreme rainfall events, so the risk of drowning will be low. The banks of the basin will have a slope of at least 1 in 5 or shallower for ease of access and egress for both vehicles and people.

Design for Exceedance

The drainage system has been designed in accordance with Sewers for Adoption (7th Edition), such that the underground system has sufficient capacity to store all flows from the 1 in 30 year storm event but the 1 in 100 year (plus climate change) event is retained on site.

The WinDES 'Floodflow' module was used to test the system under this extreme scenario and confirm that exceedance flows will not cause flooding of the proposed properties or surrounding development. The 480 minute winter storm is considered to be the critical storm for the system, as it generates the greatest volume of flooding on-site. A flood flow analysis was run for this event (results included in Appendix F) which shows that exceedance flows will be retained on the highway, public open space and proposed car parking area in the south-western corner of the site without causing flooding of properties.

4.4 Foul Sewerage

This report does not deal with foul sewerage disposal. A foul drainage strategy has been developed by Bovis Homes and will be submitted separately; however a brief summary is included below.

Due to the topgraphy of the site and the location and depth of existing public sewers, it is not possible to achieve drainage by gravity. A new foul pumping station will therefore be constructed in the south-eastern corner of the site, which will pump foul sewerage flows into the existing public sewer on Sacombe Road.

All foul sewerage infrastructure will be constructed in accordance with Sewers for Adoption (7th Edition) and additional requirements of Thames Water.

5 Conclusions

- Bovis Homes Ltd commissioned JBA Consulting to undertake a Flood Risk Assessment (FRA) for the proposed development of the former Bengeo Garden Centre, Bengeo, Hertford, in accordance with National Planning Policy Framework (NPPF).
- The site, which is currently operational and occupied by Bengeo garden centre, is considered to be Brownfield. The existing development consists of glasshouse structures, a gravel car park and surrounding scrubland. The site is bordered by Sacombe Road to the west and allotments to the south.
- The development proposal is for a 1.67ha housing development that will consist of 58 dwellings with associated highways and car parking areas. A new foul sewage pumping station will be constructed to serve the site.
- The Environment Agency Flood Maps show that the development site falls entirely within Flood Zone 1 and is therefore at low risk of fluvial flooding.
- The site is located on a Secondary "A" aquifer underlain by Principle aquifer. These are described as being permeable layers capable of supporting water supplies at a local scale and forming in cases base flows to river. Although there is potential for groundwater emergence the development site is unlikely to be at risk from groundwater flooding.
- JBA's Comprehensive flood map was used to assess surface water flood risk to the site. This map indicates that the primary flood risk to the proposed development is surface water flooding; however, the extent and frequency of flooding are low and therefore surface water flooding is not considered to pose a significant risk to the development.
- The National Planning Policy Framework (NPPF) classifies residential development as more vulnerable to flooding. Development of this type is acceptable within Flood Zone 1 so the site is considered to automatically pass the Sequential Test. The exception test is not required.
- Although the site is not considered to be at significant risk of flooding, it is recommended that the finished floor level of all properties is raised 150mm above ground level and at a level of at least 64.30m AOD to mitigate against surface water flooding. Solid floor construction for all properties is recommended to mitigate against any potential groundwater flooding.
- A drainage strategy has been developed for the site to ensure that the development is effectively drained whilst ensuring that there is low risk of flooding to the site occupants and no increase in flood risk to surrounding developments. Surface water runoff will drain via infiltration into the ground, through soakaways and pervious paving. The proposed public open space area will operate as an infiltration basin during more extreme events when the capacity of the drainage system is exceeded.

Appendices

A Flood Risk Assessment Pro Forma

1.	Development Description and Location
a.	*What type of development is proposed and where will it be located? Include whether it is new development, an extension to existing development or change of use etc.* The development site is located in Bengeo, Hertfordshire. The proposal involves construction of a residential development consisting of 58 dwellings with associated car parking and access roads.
b.	*What is its vulnerability classification?* Residential units are classified as more vulnerable to flooding.
c.	*Is the proposed development consistent with the Local Development Documents?* The site was not explicitly identified in the East Herts Local Development Plan. The local development allocation documents were not consulted for the FRA
d.	*Please provide evidence that the Sequential Test and where necessary the Exception Test has been applied in the selection of this site for this development type?* The site is located within Flood Zone 1, therefore all development types are suitable at this site. The development is considered to automatically pass the Sequential Test, and the Exception Test is not required.
2.	Definition of Flood Hazard
a.	*What sources of flooding could affect the site* The site could be affected by groundwater flooding and surface water flooding.
b.	*For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available.* Surface water flooding could occur from overland flows caused by runoff from impervious surfaces and saturated ground. Groundwater flooding could occur through elevation of the water table above surrounding ground levels, either at the site or off-site causing overland flows to enter the development.
c.	*What are the existing surface water drainage arrangements for the site?* The site is considered to be brownfield development, however there is no formal drainage system and the site drains as a greenfield site by infiltration into the ground and overland flows from saturated surfaces.
3.	Probability
a.	*Which flood zone is the site within?* The site is entirely located within Flood Zone 1.
b.	*If there is a Strategic Flood Risk Assessment covering this site; what does it show?* Bengeo, Hertford falls within the district of East Hertfordshire and is covered by the East Herts Strategic Flood Risk Assessment completed in 2008. The SFRA has no site specfic data relating to the site.
c.	*What is the probability of the site flooding, taking account of the contents of the SFRA and of any further site-specific assessment?* The annual probability of the site flooding from fluvial sources is less than 0.1% The probability of surface water flooding to significant depth is less than 5%, however this will significantly reduce following regrading and landscaping of the site during construction. SUDS systems have also been proposed for the site which will further lower the risk of flooding within the site. The probability of groundwater flooding is currently unknown, although the risk is considered to be negligible.
d.	*What is the existing rate of run-off generated by the site?* These were not calculated for the site as it is assumed that the site drains entirely by infiltration.

4.	Climate Change
a.	*How is flood risk at the site likely to be affected by climate change?* Climate change is expected to increase the intensity of extreme storm events, so the risk of surface water flooding to the site will increase. The risk of groundwater flooding is not expected to see significant increases as a result of climate change.
5.	Detailed Development Proposals
a.	*Please provide details of the development layout, referring to the relevant drawings.* Appendix B shows the proposed site layout.
b.	*Where appropriate, demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding.* Car parking and open space will be located within the areas shown to be at highest risk of surface water flooding (i.e. south-western corner of the site at lowest ground levels). New buildings will be located within areas shown to be at low risk of surface water flooding.
6.	Flood Risk Management Measures
a.	*How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?* A surface water drainage strategy has been prepared, which will effectively manage surface water generated on-site. Finished floor levels will be raised above surrounding ground levels to prevent ingress of overland flows. Solid floor construction will prevent potential ingress of groundwater.
7.	Off Site Impacts
a.	*How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?* SUDS systems are planned to be implemented across the site in an effort to reduce the impact the proposed development has on flood risk at the site and elsewhere. Infiltration techniques will prevent runoff from the site up to the 100 year event (with climate change). During events less extreme than the 30 year event, flows will be kept below ground or in well-defined storage areas. During the 100 year design event the sub-surface system is allowed to flood but these exceedance flows will be retained onsite in the highway, POS and car parking areas.
b.	*How will you prevent run-off from the completed development causing an impact elsewhere?* As above
8.	Residual Risks
a.	*What flood-related risks will remain after you have implemented the measures to protect the site from flooding?* The development will remain at risk of flooding during storm events more extreme than the design events used to design the surface water drainage system.
b.	*How, and by whom, will these risks be managed over the lifetime of the development?* Flood risk will be managed by the site-owner and, if the surface water drainage system is adopted, by Hertfordshire County Council in their role as SUDS approval body.

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B Proposed Development Site Plan

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C JBA Comprehensive Flood Map (March 2011)

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D Thames Water Sewer Map

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E Surface Water Drainage Strategy

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F WinDES Drainage Network Details

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Edinburgh
Haywards Heath
Limerick
Newcastle upon Tyne
Newport
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