

# PROPOSED EXTENSION AT BARTON MILLS SERVICE STATION, FIVEWAYS ROUNDABOUT, BARTON MILLS, SUFFOLK

# **FLOOD RISK ASSESSMENT**

## **JANUARY 2024**

**REPORT REF: 3367/RE/01-24/01** 

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#### CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Wyeth Projects Services acting as agents for and on behalf of Motor Fuel Limited (MFG) to carry out a flood risk assessment for a proposed extension at the Barton Mills Service Station, Fiveways Roundabout, Barton Mills, Suffolk.

#### QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; depth analysis; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by providing specifications to third parties such as surveyors; initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a "designers risk assessment".

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#### 1. INTRODUCTION

#### **1.1 Project Scope**

- 1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Wyeth Projects Services acting as agents for and on behalf of Motor Fuel Limited (MFG) to carry out a flood risk assessment for a proposed extension at the Barton Mills Service Station, Fiveways Roundabout, Barton Mills, Suffolk.
- 1.1.2 It is understood that this Flood Risk Assessment will be submitted to the Planning Authority as part of a planning application. Specifically, this assessment intends to:
  - a) Consider the impacts of the 1 in 30 year, 1 in 100 year and 1 in 1000 year flood events (inclusive of climate change), in accordance with NPPF;
  - b) Review any literature and guidance specific to this area such as the SFRA;
  - c) Determine the extents of the aforementioned NPPF Flood Zones across the site, together with depths of floodwater and hazard;
  - d) Assess the risks to people and property and propose mitigation measures accordingly;
  - e) Review existing evacuation and warning procedures for the area;
  - f) Carry out an appraisal of flood risk from any other sources such as groundwater as required by NPPF;
  - g) Report findings and recommendations.
- 1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) dated 2023. Other documents which have been consulted include:
  - DEFRA/EA document entitled *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2)*, 2005;
  - Communities and Local Government 2007. *Improving the Flood Performance of New Buildings*. HMSO.
  - DEFRA/EA document entitled *The flood risks to people methodology* (*FD2321/TR1*), 2006;
  - EA Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose, 2008;
  - National Planning Practice Guidance Flood Risk and Coastal Change.
  - UK Government's climate change allowances guidance.
  - Environment Agency guidance entitled *Flood risk assessments: Climate change allowances East Anglia; Essex, Norfolk, Suffolk, Cambridgeshire and Bedfordshire.*
  - Suffolk Local Flood Risk Management Plan dated 2012.

- Suffolk County Council Preliminary Flood Risk Assessment dated 2011.
- Forest Heath District Council and St Edmundsbury Borough Council Strategic Flood Risk Assessment and Water Cycle Study (SFRA and WCS) dated 2009.

#### 2. DATA COLLECTION

- 2.1 To assist with this report, the data collected included:
  - Ordnance Survey 1:10,000 street view map (Evans Rivers and Coastal Ltd OS licence number 100049458).
  - Filtered LIDAR survey data at 1m resolution.
  - British Geological Survey Online Geology Viewer.
  - Product 4/6 raw GIS data from the Eastern Rivers Modelling Study (Lower Rivers MP1 Cut Off Channel) dated 2015.
  - 1:250,000 *Soil Map of Eastern England* (Sheet 4) published by Cranfield University and Soil Survey of England and Wales 1983.
  - 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
  - 1:125,000 *Hydrogeological Map of Southern East Anglia* published in 1981 by the Institute of Geological Sciences (now the British Geological Survey).
  - Environment Agency defence information via <u>https://environment.data.gov.uk/asset-management/index.html</u>

#### 3. SITE CHARACTERISTICS

#### 3.1 Existing Site Characteristics and Location

3.1.1 The site is located at the Barton Mills Service Station, Fiveways Roundabout, Barton Mills, Suffolk. The approximate Ordnance Survey (OS) grid reference for the site is 572827 274055 and the location of the site is shown on Figure 1.

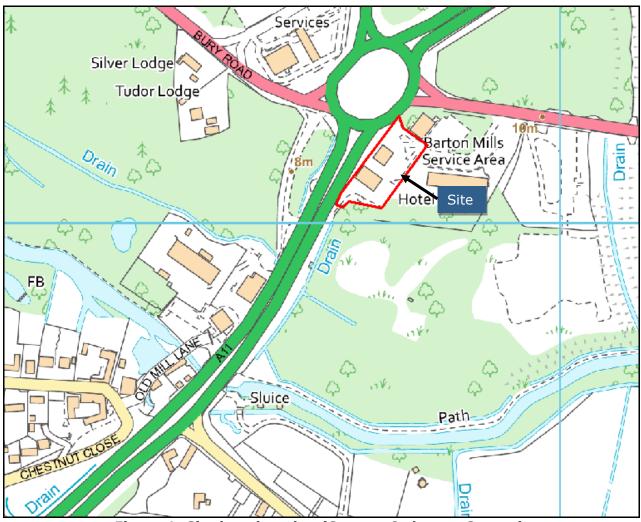


Figure 1: Site location plan (Source: Ordnance Survey)

- 3.1.2 The site currently comprises a service station shop/sales building, forecourt and hardstanding area. The site is accessed from the Fiveways Roundabout/A11 adjacent to the north western frontage of the site.
- 3.1.3 An existing site layout is shown on Drawing Number WPS-MFG-668-P-02.
- 3.1.4 Filtered LIDAR survey data at 1m resolution has been obtained to determine the topography across the site and surrounding area and is shown on Figure 2.
- 3.1.5 Inspection of the data together with on-site measurements indicates that ground levels across the site fall in a south westerly direction. The area intended for the proposed extension is set at approximately 9.10m AOD.



Figure 2: LIDAR survey data where higher ground is denoted as red, orange and yellow colours and lower areas denoted by blue and green colours

#### 3.2 Site Proposals

- 3.2.1 It is the Client's intention to extend the shop/sales building along part of its south western frontage. The proposed floor level will be set at 9.10m AOD.
- 3.2.2 The site proposals can be seen on Drawing Number WPS-MFG-668-P-04 and WPS-MFG-668-P-01.
- 3.2.3 Annex 3 of the NPPF confirms that this proposal is classified as a 'less-vulnerable' use.

#### 4. BASELINE INFORMATION

#### 4.1 Environment Agency Flood Zone Map

4.1.1 The Environment Agency's Flood Zone Map (Figure 3) and Drawing Number 0101-BM01397-BMD-02/02 of the SFRA shows that the site is located within the NPPF defined Flood Zone 1 and Flood Zone 3a.

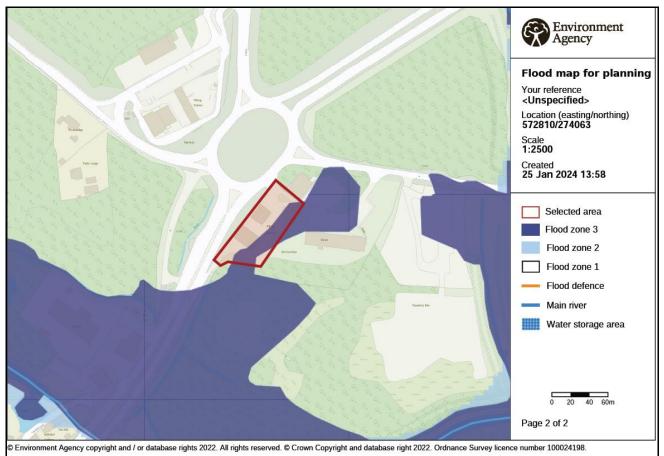


Figure 3: Environment Agency Flood Zone Map (Source: Environment Agency)

#### 4.2 Flood Defences and Environment Agency Flood Levels

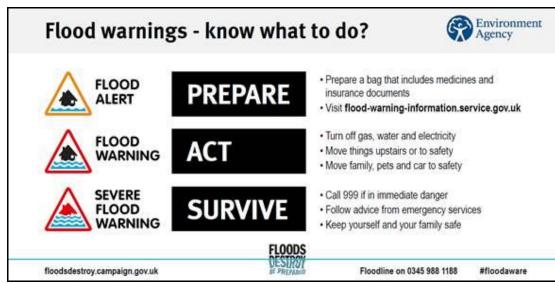
- 4.2.1 The Environment Agency flood defence information via <u>https://environment.data.gov.uk/asset-management/index.html</u> indicates that the River Lark to the south of the site, and the Eriswell Lode/Cut Off Channel to the east of the site, are not defended by flood defences, however, high ground is identified to occupy the area between the site and the rivers.
- 4.2.2 Two-dimensional Product 4/6 raw GIS flood level data from the Eastern Rivers Modelling Study (Lower Rivers MP1 Cut Off Channel) dated 2015 has been provided by the Agency and are summarised in Table 1.

Table 1: 2D fluvial flood level data at the site								
1 in 30	year	1 in	100	year	Climate	change	1 in 1000	year
(mAOD)		(mAOI	D)		20% 1	in 100	(mAOD)	-
					year	event		
					(mAOD)			
N/A		N/A			8.63		8.77	

- . ... . . . .
- N/A = event modelled but doesn't reach the site
- 4.2.3 The UK Government's climate change allowances guidance states that the "Central" climate change allowance should be used in FRA's. For the Cam and Ely Ouse Management Catchment the climate change allowance is 9% up to year 2080s.
- 4.2.4 Therefore, when considering this scenario, the Agency's fluvial modelling includes a 1 in 100 plus 20% climate change allowance, which is higher than the required 9% and will also consider the Higher Central allowance up to year 2080s.

#### 4.3 **Flood Warning and Emergency Planning**

- 4.3.1 The site is located within Environment Agency Flood Warning area 052FWFLAFSMI -River Lark at Fornham St. Martin, Mildenhall and Isleham.
- 4.3.2 Sites at risk of fluvial flooding could have a minimum of 2 hours warning before any of the levels of flood warning is issued.
- 4.3.3 Flood Alerts, Flood Warnings and Severe Flood Warnings are issued to residents and businesses within flood risk areas by the Agency's Floodline Warnings Direct (FWD) service. This system is managed by the Environment Agency and dials out a message to the recipient when a particular category of flood warning is being advised. The message is conveyed by a constant ringing of the telephone or can alternatively be communicated to mobile phones and computers. The system functions at all times, issuing flood warnings and alerts in conjunction with announcements on radio and other media. Owners and occupiers of dwellings or businesses thought to be at risk can sign up to the scheme. The owners are encouraged to confirm details with the Agency and to sign up for these warnings.



4.3.4 The various flood warning codes can be seen on Figure 4.

Figure 4: Flood warning codes (Source: Environment Agency)

4.3.5 It is understood that in the event of flooding, evacuation is managed by a multi-agency team in conjunction with the Police. The multi-agency team provides suitable premises for shelter, first aid, refreshments and possible transportation with consideration given to the elderly and vulnerable groups. It is essential that occupants produce robust Emergency Flood Plans to avoid putting themselves or emergency services at risk and that they do not rely solely on emergency services during the event.

#### 5. FLUVIAL FLOOD RISK

- 5.1 By comparing the flood levels in Table 1 with the survey data it can be seen that the area intended for the proposed extension is set at 9.10m AOD and therefore above all modelled flood levels thus providing safe refuge and no internal flooding.
- 5.2 GIS flood mapping outlines have been provided by the Agency and can be seen on Figure 5. It should be noted that the critical climate change 1 in 100 year flood extent doesn't reach the building.

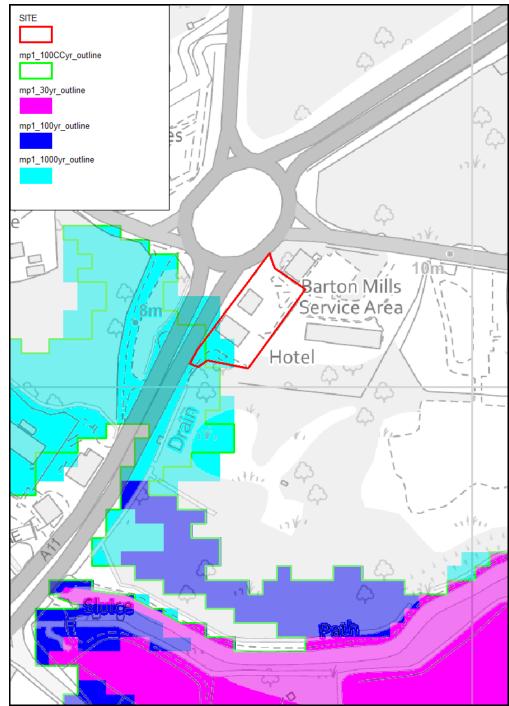


Figure 5: Flood mapping during present day events and climate change 1 in 100 year event (Source: Lower Rivers MP1 Cut Off Channel model dated 2015)

#### 6. FLOOD RISK MITIGATION AND EVACUATION

#### 6.1 Reducing Exposure to the Hazard

- 6.1.1 In order to assess and reduce the exposure to the hazard and the vulnerability to the hazard after the site has been developed, the guidance outlined in the DCLG/DEFRA/EA document entitled *Flood Risk Assessment Guidance for New Development Phase 2; Flood Risks to People, Phase 2; Improving the Flood Performance of New Buildings* has been consulted.
- 6.1.2 In accordance with the Agency's recommendations and Paragraph 002 of the NPPF Planning Practice Guidance, the "design" event is the 100yrCC flood level of 8.63m AOD. The "extreme" 1 in 1000 year flood level is 8.77m AOD.
- 6.1.3 Paragraph 004 of the NPPF Planning Practice Guidance states that the first preference is to avoid flood risk by raising floor levels above the design flood level.
- 6.1.4 The existing building and proposed floor level will be set above all modelled flood levels thus complying with policy.

#### 6.2 Reducing Vulnerability to the Hazard

- 6.2.1 The Agency aims to provide up to 2 hours warning for fluvial events. It is understood that the police and other emergency services will assist in the evacuation to rest centres operated by the Council. The Fire Service will assist in any rescuing of people from the flooded area once this has occurred.
- 6.2.2 It is recommended that the site owners liaise with the Agency in order to register with the Agency's Flood Warnings Direct service and ensure that they are aware of the flood risk so that employees have the option to escape/evacuate upon receipt of a *Flood Warning* or upon the instruction of the emergency services.
- 6.2.3 Signs and information plaques should be located regularly across the site to inform people of the flood risk. A member of staff should regularly review the flood warnings in place prior to commencing work on-site. Furthermore, staff should not proceed with the site operations if it is considered that there is a flood risk.
- 6.2.4 It is recommended that a *Business Flood Plan* is developed. Formal training would also be required and the plan would include information on what to do when receiving a flood warning, together with evacuation procedures and routes. Flood wardens (possibly site managers) would be responsible for co-ordinating the closing of the site. Staff checklists would also be useful to prioritise procedures. It may be prudent to act during the early warning stages in order to provide sufficient time to evacuate people and to implement the flood action plan.
- 6.2.5 Any Flood Plan should be practiced regularly in order to minimise the risk to people at the site (i.e. similar to a fire drill). A *Flood Kit* is a useful precautionary measure especially if evacuation from the site is prolonged and many hours after the flood event. The *Flood Kit* includes items such as:
  - 1. Important documents
  - 2. Torch and batteries
  - 3. Mobile phone (fully charged)
  - 4. First-aid kit
  - 5. Wind-up radio

- 6. Important telephone numbers
- 7. Bottled water
- Non-perishable food provisions
   Rubber Gloves and wellington boots
- 10. Medication
- 11. Blankets, warm clothes
- 12. Camera to record any damage

Table 2: Flood Event Action Plan
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Environment Agency Flood	What to do!	Evacuate?
Warning Code		
Flood Alert (Flooding Possible. Be aware/prepared! Watch Out). FLOOD ALERT Flood Warning (Flooding of homes, businesses and main roads is expected. Act now!).	<ul> <li>Monitor flood risk through media and Floodline Warnings Direct.</li> <li>Locate employees and inform them of risk. If away from the site make assessment on risk if considering returning to site (i.e. how long it will take to return etc).</li> <li>Maintain communication through Floodline Warnings Direct and the media.</li> <li>Begin to implement Flood Plan.</li> <li>Consider advice given from emergency services/Environment Agency.</li> <li>Check insurance, Check flood kit.</li> <li>Check alternative accommodation arrangements.</li> <li>Close business.</li> </ul>	Not necessary. Occupants can evacuate themselves if they feel unsafe providing that they make a judgement in relation to any external flood hazard. Occupants can evacuate themselves if they feel unsafe providing that they make a judgement in relation to any external flood hazard. No formal evacuation or rest centre set-up will be undertaken at this warning level, however, if flooding is experienced across the area emergency services will rescue people.
Severe Flood Warning (Severe flooding is expected. Imminent danger to life and property. Act now!).	<ul> <li>Leave site immediately if not already done so.</li> <li>Take flood kit with you.</li> <li>Follow advice given by Emergency Services and Council.</li> </ul>	Leave site according to advice given by Emergency Services and Council.

Warnings no longer in force (No	•	Return to site upon instruction	Not applicable, however
further flooding is expected in the area.		from emergency services and	site may be uninhabitable.
Be careful).		assess any damage.	
	•	Contact insurance company	Return to site upon
		depending on damage caused.	instruction from
	•	Beware of flood debris.	emergency services as
	•	Do not touch sources of electricity.	floodwater may not have
	•	Arrange for utilities to reconnect	receded.
		services.	

#### 6.3 Vulnerable Groups

- 6.3.1 The employees and customers at the site may include vulnerable groups such as elderly people, those with sensory or physical disabilities, minority ethnic groups, or the infirm. Priority will need to be given to these people during the flood event.
- 6.3.2 Vulnerable groups should be identified by the site management and priority should be given to these groups.

#### 6.4 Safe Access/Egress

- 6.4.1 The hazard rating along the evacuation route has been provided by the Agency in the GIS model files. The flood hazard is calculated based on different combinations of floodwater depth and velocity, and subsequently by using the hazard equation as cited in the DEFRA/EA R&D Document *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2).*
- 6.4.2 The numerical hazard rating extracted from the model is then categorised into four degrees of flood hazard (Table 3) in accordance with Table 3.2 of *FD2321/TR1* and Table 4.2 of *FD2321/TR2*.

## Table 3: Hazard to people categories (taken from Table 3.2 of FD2321/TR1 and Table4.2 of FD2321/TR2)

Hazard Rating	Degree of Flood Hazard	Description
< 0.75	Very low hazard	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 - 1.25	Danger for Some	Dangerous for some (i.e. children) "Danger: Flood zone with deep or fast flowing water"
1.25 - 2.0	Danger for Most	Dangerous for most people (i.e. general public) "Danger: Flood zone with deep fast flowing water"
> 2.0	Danger for All	Dangerous for all "Extreme danger: flood zone with deep fast flowing water"

6.4.3 When considering the climate change (20%) 1 in 100 year event, the Agency's data shows that the hazard to people leaving the site by foot would be *Very low*. People leaving the site by car would have to travel in a south westerly direction along the A11

and the hazard from the site would be a combination of *Dangerous for Some* and *Dangerous for Most* for 77m, then *Very low*.

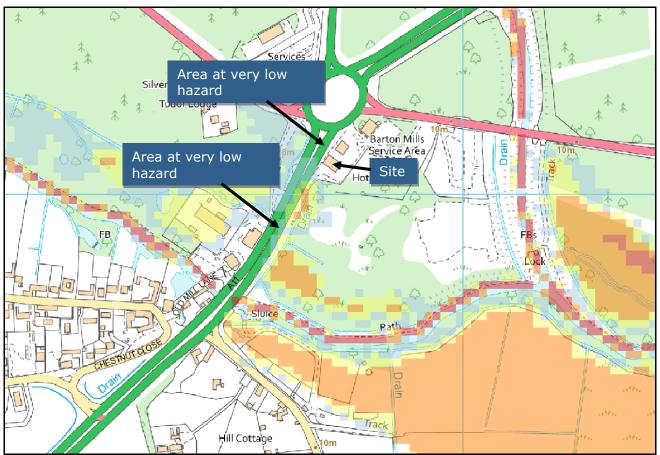


Figure 6: Hazard map during climate change (20%) 1 in 100 year event (see Table 3 above for hazard classification)

#### 6.5 Insurance

- 6.5.1 The Association of British Insurers (ABI) published a guidance document in 2012 entitled *Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England*.
- 6.5.2 The ABI guidance sets out the requirements of the insurance industry when considering flood risk and insurability of the property. The guidance suggests that properties should be protected for flood events up to the climate change 1 in 100 year event in order to access insurance at a competitive price.
- 6.5.3 The guidance also states that insurers would of course prefer to cover properties which are not at risk of flooding, however, for those properties which are at risk of flooding insurers would prefer that the properties are raised above the flood level, over resistance measures which prevent floodwater from entering the building, or resilience measures which allows floodwater to enter the building.
- 6.5.4 The ground floor level will be set above the climate change 1 in 100 year flood level. Therefore, the ABI's requirement of protection during the climate change 1 in 100 year event will be met and there will be a good chance of the property being insured at a competitive rate.

#### 7. OTHER SOURCES OF FLOODING

#### 7.1 Groundwater Flooding

7.1.1 In order to assess the potential for groundwater flooding during higher return period rainfall events, the Jacobs/DEFRA report entitled *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study*, published in May 2004, was consulted, together with the guidance offered within the document entitled *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*, commissioned by DEFRA and carried out by Jacobs in 2006.

#### Soil and Geology at the Site

7.1.2 The British Geological Survey's *Online Geology of Britain Viewer* indicates that the soils beneath the site comprise sand and gravel.

#### **Groundwater Flooding Potential at the Site**

- 7.1.3 There have been no recorded groundwater flood events across the area between 2000 and 2003, as indicated by the Jacobs study. Drawing Number 0101-BM01397-BMD-02/02 of the SFRA shows that there have been no historical records of groundwater flooding at the site.
- 7.1.4 It is considered that the evidence suggests a low risk of groundwater flooding to the site.

#### 7.2 Surface Water Flooding and Sewer Flooding

- 7.2.1 Surface water and sewer flooding across urban areas is often a result of high intensity storm events which exceed the capacity of the sewers thus causing them to surcharge and flood. Poorly maintained sewer networks and blockages can also exacerbate the potential for sewer flooding.
- 7.2.2 Drawing Number 0101-BM01397-BMD-02/02 of the SFRA shows that there have been no historical records of sewer or surface water flooding at the site.
- 7.2.3 The Agency's Surface Water Flooding Map (Figure 7) indicates that there is a very low surface water flood risk (i.e. less than 1 in 1000 year chance) across the site and along the adjacent A11.
- 7.2.4 It is generally accepted that the low risk flood event (i.e. between 1 in 1000 years and 1 in 100 years) on the Agency's map is used as a substitute for the climate change 1 in 100 year event to provide a worst-case scenario.

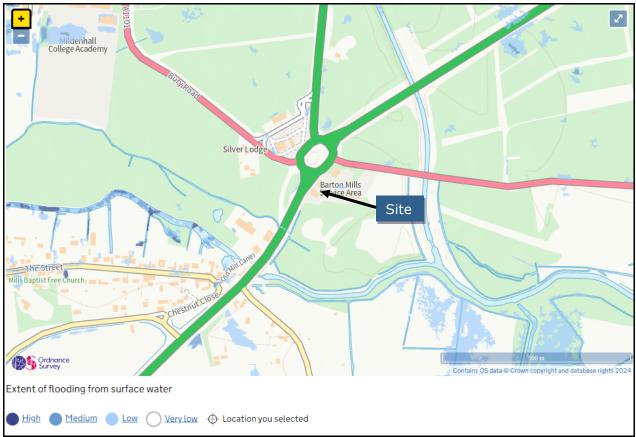


Figure 7: Environment Agency Surface Water Flooding Map (Source: Environment Agency, 2024)

#### 7.3 Reservoirs, Canals And Other Artificial Sources

- 7.3.1 The failure of man-made infrastructure such as flood defences and other structures can result in unexpected flooding. Flooding from artificial sources such as reservoirs, canals and lakes can also occur suddenly and without warning, leading to high depths and velocities of flood water which pose a safety risk to people and property.
- 7.3.2 The Environment Agency's "Risk of flooding from reservoirs" map shows that the site is at risk from reservoir flooding.
- 7.3.3 However, as the information associated with the maps suggest, it is considered that reservoir flooding is extremely unlikely to happen and such features are regularly inspected by qualified engineers under the Reservoir Act 1975.

#### 8. CONCLUSIONS

- The site is located within the NPPF Flood Zone 3a and 1.
- The area intended for the proposed extension is set above all modelled events thus providing safe refuge and no internal flooding.
- A warning and evacuation strategy has been developed within this assessment. It is proposed that the occupants register with the Agency's *Flood Warnings Direct* and prepare a *Business Flood Plan*.
- Safe access/egress is available at all times.
- It is considered that there is a low risk of groundwater flooding at the site from underlying deposits. There is a very low surface water flooding risk.

#### 9. **BIBLIOGRAPHY**

- i. Association of British Insurers 2012. *Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England.*
- ii. CIRIA 2005. *Standards for the repair of buildings following flooding, Report 623.* CIRIA.
- iii. CIRIA 2000. Groundwater Control design and practice, Report 515. CIRIA.
- iv. Cobby, D., et al. 2009. *Groundwater flood risk management: advances towards meeting the requirements of the EU Floods Directive.* Journal of Flood Risk Management.
- v. Communities and Local Government 2012. *National Planning Policy Framework.*
- vi. Communities and Local Government 2012a. Technical Guidance to the *National Planning Policy Framework.*
- vii. Communities and Local Government 2007. *Improving the Flood Performance of New Buildings*. HMSO.
- viii. DEFRA/EA 2007. *Public Response to Flood Warning, Flood and Coastal Defence R&D Programme, R&D Technical Report SC020116.* Environment Agency.
- ix. DEFRA/EA 2006. Flood Risks to People, Phase 2, R&D Technical Report FD2321/TR1, Flood and Coastal Defence R&D Programme. Water Research Council.
- x. DEFRA/EA 2006a. Flood Risks to People, Phase 2, R&D Technical Report FD2321/TR2, Flood and Coastal Defence R&D Programme. Water Research Council.
- xi. DEFRA/EA 2005. Framework and guidance for assessing and managing flood risk for new development, Phase 2, Flood and Coastal Defence R&D Programme, R&D Technical Report FD2320/TR2. Water Research Council.
- xii. DEFRA/EA 2005a. Flood Warning for Vulnerable Groups: A review of the literature, Flood and Coastal Defence R&D Programme. Environment Agency.
- xiii. DEFRA/Jacobs 2006. Groundwater flooding records collation, monitoring and risk assessment (ref HA5).
- xiv. DEFRA/Jacobs 2004. Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS), Final Report, Volumes 1 and 2.
- xv. Dickie et al. 2010. *Planning for SUDS Making it happen. Report C687*. London: CIRIA
- xvi. Environment Agency 2008. Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1.
- xvii. Geological Society of London 2006. *Groundwater and Climate Change.* Geoscientist magazine, Volume 16, No 3.

- xviii. Institute of Geological Sciences 1977. *Hydrogeological Map of England and Wales,* 1:625,000. NERC.
- xix. NERC 2009. *Flood Estimation Handbook* [CD-ROM], Version 3. Institute of Hydrology.
- xx. NERC 1975. *Flood Studies Report (FSR)*. Institute of Hydrology.
- xxi. Newman, A.P. 2004. *Protecting groundwater with oil-retaining pervious pavements: historical perspectives, limitations and recent developments*. Quarterly Journal of Engineering Geology and Hydrogeology.
- xxii. ODPM 2003. Preparing for Floods. London: ODPM.
- xxiii. Pratt, C., Wilson, S., and Cooper, P. 2002. Source control using constructed pervious surfaces; hydraulic, structural and water quality performance issues, Report C582. London: CIRIA.
- xxiv. Soil Survey of England and Wales 1983. *Soil Map of Eastern England (Sheet 4)*, 1:250,000. Cranfield University.
- xxv. UK Groundwater Forum. *Groundwater Resources and Climate Change*. http://www.groundwateruk.org/Groundwater\_resources\_climate\_change.aspx [accessed 27/01/2015]
- xxvi. Woods-Ballard., et al. 2007. The SUDS Manual, Report C697. London: CIRIA.

DRAWINGS

