The Sizewell C Project

5.3 Northern Park and Ride Flood Risk Assessment

Revision: 1.0

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Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Executive Summary

The proposed development is one of the Sizewell C Project's associated development sites; a temporary park and ride facility at Darsham to the north-west of the main development site. This proposed development is one of two park and ride facilities that would intercept traffic movements from locations west of the A12.

This **Flood Risk Assessment** (**FRA**) presents an assessment of existing flood risk from all sources of flooding to the proposed northern park and ride and is submitted as part of the application for development consent for Sizewell C Project. The FRA also describes future flood risk to the site taking account of climate change and considers possible changes in flood risk to off-site receptors as a result of the proposed development. It also presents mechanisms for managing residual risk.

The proposed development is in Flood Zone 1. The site is at low flood risk from fluvial, coastal, groundwater, sewers and reservoirs.

Flood risk from surface water is variable across the site. The majority of the site is at 'very low' risk of flooding from surface water, however, land along the south-west and northern edges of the site are at 'high' risk of flooding from this source. These isolated 'high' risk areas have been avoided in terms of vulnerable uses or integrated into the drainage system. The surface water flood risk is managed as part of the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **Environmental Statement (ES).**

The proposed development is in Flood Zone 1 and is classed as 'low probability of flooding from river or sea' under the National Planning Policy Framework (NPPF) (Ref 1.1) guidance for flood risk and coastal change. The proposed development is considered appropriate in terms of flood risk vulnerability that passes the Sequential Test.

The proposed development would use sustainable drainage to manage the potential increase of surface water run-off through the attenuation and controlled discharge of flows to ground and local watercourses. This is addressed as part of the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES**.

The proposed development is considered to be appropriate in terms of flood risk, the proposed mitigation measures and in accordance with NPPF guidance.

1 Introduction

1.1 Background

1.1.1 The proposed development is one of the Sizewell C Project's associated development sites; a temporary park and ride facility to the north-west of the main development site. There would be a second temporary park and ride facility at Wickham Market, to the south-west of the main development site. Both park and ride facilities would intercept traffic movements from locations west of the A12.

1.1.2 This **Flood Risk Assessment** (**FRA**) (Doc Ref. 5.3) describes the flood risk, from all sources, to the proposed northern park and ride site at Darsham (referred to herein as the 'proposed development') and the predicted impact of the proposed development on flood risk in general. This FRA is submitted as part of the application for development consent for 'Sizewell C Project'[1].

1.1.3 This **FRA** also describes how the risk of flooding would be managed and provides recommendations to minimise any residual flood risk impacts associated with the proposed development.

1.1.4 Once operational, the proposed development would transport the Sizewell C Project workforce to and from the main development site for the duration of the construction phase. Once the need for the facility has ceased, with the completion of construction of the Sizewell C Project, the proposed development would be removed, and the site reinstated to its original agricultural use and the A12 reinstated back to its original alignment.

1.1.5 The proposed development is located to the west of the A12 (referred to herein as the 'site'). The site is approximately 27.9 hectares (ha) in size and would provide space for approximately 1,250 cars, 10 minibuses/vans, 80 motorcycles and secure cycle parking for up to 20 bicycles. In addition, a secure bus terminus, bus parking, bus shelters, amenity and welfare buildings and offices would be provided on the site.

1.1.6 To access the site, a new three arm roundabout on the A12 is proposed, approximately 125 metres (m) to the north of the existing Willow Marsh Lane junction. The proposed development also includes the realignment of the A12

[1] SZC Co.'s proposal to build and operate a new nuclear power station, comprising two UK European Pressurised Reactors™ (EPRs™), at Sizewell in Suffolk, north of the existing Sizewell B power station.

and Willow Marsh Lane. An access road would run from the new roundabout through the centre of the site to the car parking areas and proposed buildings.

2 Legislation, policy, and guidance

2.1 Introduction

2.1.1 This section identifies and describes the legislation, policy and guidance of relevance to the FRA for the proposed development.

2.1.2 Legislation and policy have been considered at a national and local level. The following are relevant as they have influenced the scope and/or methodology adopted for the FRA:

- Overarching National Planning Policy Statement (EN-1) (Ref. 1.1).
- ONR/EA Joint Advice Note: Principles for Flood and Coastal Erosion Risk Management (Ref. 1.2).
- National Planning Policy Framework (Ref. 1.3).
- National Planning Policy Guidance (Ref. 1.4).
- Flood Risk Assessments: Climate Change Allowances (Environment Agency) (Ref 1.5).
- Flood and Water Management Act 2010 (Ref 1.6).
- Suffolk Coastal Local Plan (Ref 1.7).
- Suffolk Flood Risk Management Strategy (Ref 1.8).

2.2 Legislation

a) Flood and Water Management Act 2010

2.2.1 The Flood and Water Management Act was enacted in 2010. It aims to improve both flood risk management and the way we manage our water resources by creating clearer roles and responsibilities. This includes a lead role for upper tier and unitary local authorities in managing local flood risk (from surface water, ground water and ordinary watercourses) and a strategic overview role of all flood risk for the Environment Agency. The Flood and Water Management Act provides opportunities for a more comprehensive, risk-based approach on land use planning and flood risk management by local authorities and other key partners.

2.3 National policies and guidance

a) Overarching National Policy Statement for Energy EN-1

2.3.1 The Overarching National Policy Statement for Energy (EN-1) was prepared in 2011 and provides specific guidance on the development of energy infrastructure in relation to flood risk for the lifetime of the facilities. The national flood risk policies reflected in this document have since been superseded, however the guiding principles are still applicable and are also embedded in the current national policies (NPPF). EN-1 confirms that an FRA is required to assess flood risk from all sources for the lifetime of the Sizewell C Project by competent people. The FRA would, among other aspects, need to identify flood risk reduction and management measures. Residual risks would also require assessment to consider their acceptability.

2.3.2 In relation to surface water management, EN-1 promotes the appropriate use of sustainable drainage (SuDS) to facilitate the sustainable development of energy developments. The SuDS should aim to prevent an increase in surface water flood risk associated with the increase in discharge from the site.

b) Joint Office for Nuclear Regulation and Environment Agency Principles for Flood and Coastal Erosion Risk Management Advice Note

2.3.3 The Office for Nuclear Regulation and Environment Agency joint advice note sets out "*the approach to flood risk in the nuclear new-build programme in England*.". The note states that flood hazard analysis should be reported to the Environment Agency via planning submissions in the form of Flood Risk Assessments and to the Office for Nuclear Regulation in nuclear safety cases.

2.3.4 The principle of the flood risk analysis set out in the note is that all flood risk analysis work would be suitable for both the FRA and nuclear safety case(s).

2.3.5 Appendix D of the joint advice note, confirms that for associated development site if the associated infrastructure is not critical to the day to day running of the site, such as a road built to assist with local transport capacity improvements, "*then the most relevant climate change criteria must be applied in accordance with national planning policy*".

c) National Planning Policy Framework and Guidance

2.3.6 The NPPF sets out the Government's planning policies for England. The NPPF seeks to ensure that flood risk is considered at all stages of the planning and development process, to avoid inappropriate development in

areas at risk of flooding, and to direct development away from areas at highest risk of flooding. Where there are no reasonably available sites in Flood Zone 1, the local planning authority can consider reasonably available sites in Flood Zone 2. Only when there are no reasonably available sites for development in Flood Zones 1 and 2 should the suitability of sites in Flood Zone 3 be considered.

2.3.7 In addition, the NPPF states that "*the development should be made safe for its lifetime without increasing flood risk elsewhere*". For a development to be considered acceptable with regards to flood risk, the Sequential Test requirements must be satisfied, along with demonstrating the development:

- within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- is appropriately flood resistant and resilient;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

2.3.8 Further details of the requirements for sequential testing and sustainable drainage are provided in the following two sections.

i. Sequential testing

2.3.9 The National Planning Practice guidance on flood risk and coastal change supports the NPPF with additional guidance on flood risk vulnerability classifications and managing residual risks. The National Planning Practice Guidance provides further description of flood zones, vulnerability classifications and compatibility matrix, as described in **Tables 2.1, 2.2** and **2.3** respectively, in order to assess the suitability of a specific site for a certain type of development.

Table 2.1: Summary of flood zone definitions

Flood Zone	Probability of Flooding	Return Periods
1	Low	Land having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
2	Medium	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1–0.1%); or

Flood Zone	Probability of Flooding	Return Periods
		Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5–0.1%).
3a	High	Land having a 1 in 100 or greater annual probability of river flooding (≥1%); or Land having a 1 in 200 or greater annual probability of sea flooding (≥0.5%).
3b	High – functional floodplain.	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their strategic flood risk assessments (SFRAs) areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on flood maps.)

Table 2.2: Summary of flood risk vulnerability classifications

Vulnerability Classification	Description
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 and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes & park homes intended for permanent residential use. • 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 facilities 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 & educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Vulnerability Classification	Description
Less vulnerable.	• Police, ambulance, and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; 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 which do not need to remain operational during times of flood. • Sewage 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 working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence 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.

Table 2.3: Flood risk vulnerability and flood zone compatibility

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3	Exception Test required	✓	×	Exception Test required	✓

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
	Zone 3b 'Functional Floodplain'	Exception Test required	✓	×	×	×
Key: ✓ Development is appropriate × Development should not be permitted						

2.3.10 Following application of the Sequential Test, if it is not possible (consistent with wider sustainability objectives) for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied, if appropriate. For the Exception Test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared; and
- a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

2.3.11 Where the Exception Test is required, both elements of the Exception Test will have to be passed for development to be allocated or permitted. Within each flood zone, surface water and other sources of flooding also need to be taken into account in applying the sequential approach to the location of development.

ii. Sustainable drainage and surface water

2.3.12 The National Planning Practice guidance on flood risk and coastal change supports the NPPF with additional guidance on flood risk, which states that *"developers should seek opportunities to reduce the overall level of flood risk in the area and beyond. This can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of sustainable drainage systems, through safeguarding land for flood risk management, or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally".*

2.3.13 In order to manage surface water on the site, it is necessary to consider the appropriateness of sustainable drainage system (SuDS) measures, using the SuDS hierarchy set out in the National Planning Practice Guidance.

2.3.14 The aim should be to discharge surface run-off as high up the drainage options hierarchy as reasonably practicable. These are listed with the most favourable option first and least preferable last:

> *"1. into the ground (infiltration);*
>
> *2. to a surface water body;*
>
> *3. to a surface water sewer, highway drain, or another drainage system;*
>
> *4. to a combined sewer."*

2.3.15 The National Planning Practice Guidance acknowledges that some types of sustainable drainage systems may not be practicable in all locations. Locations may be constrained in areas of flood risk.

2.3.16 The Environment Agency classifies surface water flood risk (Ref 1.9) into four categories; 'very low', 'low', 'medium' and 'high' outlined in **Table 2.4**.

Table 2.4: Summary of flood risk from surface water definition

Probability of Surface Water Flooding	Return Periods
Very low.	Land with less than 1 in 1,000 annual probability of surface water flooding (<0.1%).
Low	Land with between 1 in 1,000 and 1 in 100 annual probability of surface water flooding (0.1% – 1%).
Medium	Land with between 1 in 100 and 1 in 30 annual probability of surface water flooding (1%–3.3%).
High	Land with greater than 1 in 30 annual probability of surface water flooding (>3.3%).

d) Flood Risk Assessments: Climate Change Allowances

2.3.17 The Environment Agency's online advice note Flood Risk Assessments: Climate Change Allowances was published in February 2016 and amended in April 2016, February 2017 and February 2019. The guidance has since been updated in December 2019 to take account of updated guidance on:

> *"1) Updated the sea level rise allowances using UKCP18 projections.*
>
> *2) Added guidance on how to a) calculate flood storage compensation, b) use peak rainfall allowances to help design drainage systems, c) account for the impact of*

climate change on storm surge, d) assess and design access and escape routes for less vulnerable development.

3) Changed the guidance on how to apply peak river flow allowances so the approach is the same for both flood zones 2 and 3." (Ref.1.5).

2.3.18 This advice note provides guidance for determining appropriate climate change allowances for fluvial, tidal and peak rainfall intensities. The climate change allowances consider the geographical location, life span of the proposed development, flood risk, vulnerability classification associated with the type of development and critical drainage areas. The guidance on peak rainfall intensity allowances is outlined in **Table 2.5**.

Table 2.5: Peak rainfall intensity allowance in small and urban catchments (1961–1990 baseline) (Source: Table 2, Environment Agency Climate Change Allowances (Ref 1.3))

	Total Potential Change Anticipated for 2010–2039	Total Potential Change Anticipated for 2040–2059	Total Potential Change Anticipated for 2060–2115
Upper End.	10%	20%	40%
Central	5%	10%	20%

2.4 Local plans

a) Suffolk Coastal Local Plan

i. Final Draft Proposed Local Plan

2.4.1 On 1 April 2019, East Suffolk Council (ESC) was created, merging the former districts of Suffolk Coastal District Council (SCDC) and Waveney District Council.

2.4.2 ESC is in the process of replacing the former SCDC Local Plan. The final draft of the new local plan was published, and a six-week period set for the receipt of representations in relation to legal compliance and soundness between 14 January 2019 and 25 February 2019. The SCDC have stated that the adoption of the plan is scheduled for Spring 2020.

ii. Existing Local Plan

2.4.3 The existing SCDC Local Plan sets out how the area should be developed. It incorporates core strategy and development management policies and

saved policies. This document forms part of the formal development plan and is used in the determination of planning applications.

2.4.4 The existing SCDC Local Plan was updated in July 2018 and includes a number of saved policies. Previously saved policies have been superseded or abandoned whilst others have remained. None of the remaining saved policies are considered relevant for the proposed development in respect of flood risk.

2.4.5 Two strategic policies and one development management policy have been identified as relevant for the proposed development, as outlined within **Table 2.6**. No reference to the allocation of the site has been found in the SCDC Local Plan.

Table 2.6: Relevant Suffolk Coastal Local Plan policies

Policy Number	Policy Name	Summary
SP10	A14 & A12.	The Council supports the provision of improvements to the A12.
SP12	Climate Change.	The District Council will contribute towards the mitigation of the effects of new development on Climate Change by minimising the risk of flooding and ensuring appropriate management of land within floodplains.
DM28	Flood Risk.	Proposals for new development, or the intensification of existing development, will not be permitted in areas at high risk from flooding, i.e. Flood Zones 2 and 3, unless the applicant has satisfied the safety requirements in NPPF (and any successor).

b) Suffolk Flood Risk Management Strategy

2.4.6 ESC is responsible for coordinating a partnership approach to flood and coastal risk management with all risk management authorities in Suffolk. They do this through the Suffolk Flood Risk Management Partnership who produced the local flood risk management strategy in March 2016.

2.4.7 The objective of the strategy is "*to take a pragmatic approach to reduce the current flood risk and ensure that we do nothing to make this worse in the future.*" This objective is in accordance with the principles laid out in the NPPF.

2.4.8 Seven objectives of the local flood risk management strategy have been identified, two of which are of relevance to the proposed development:

- to prevent an increase in flood risk as a result of development by preventing additional water entering existing drainage systems wherever possible; and
- take a sustainable and holistic approach to flood and coastal management, seeking to deliver wider economic, environmental and social benefits, climate change mitigation and improvements under the Water Framework Directive.

3 Development description and scope of this assessment

3.1 The existing site

3.1.1 The site comprises of 27.9ha of primarily agricultural land located approximately 1.5 kilometres (km) west of the village of Darsham. The site lies to the west of the A12, to the east of the East Suffolk line and to the north of Darsham railway station. The site is approximately 6km to the north-west of the main development site.

3.1.2 The site's western boundary is defined by the East Suffolk line and Little Nursey Wood, a parcel of woodland. The northern boundary is defined by agricultural fields and Willow Marsh Lane, except at the north-eastern corner where the site's boundary extends past Willow Marsh Lane and connects to the A12.

3.1.3 The eastern boundary is defined by the A12 at the northern and southern end of the site. In the middle section of the eastern boundary, the alignment follows the rear boundaries of properties along the A12 (Moat Hall, Darsham Cottage and White House Farm Bed and Breakfast). Part of the site encompasses the A12 carriageway and pavement, including an abnormal indivisible loads lay-by on the western side of the road.

3.2 The proposed site masterplan and design

3.2.1 The site masterplan depicted in **Figure 2.1** of **Volume 3**, **Chapter 2** of the **Environmental Statement (ES)** shows an indicative arrangement for the site to fulfil its objectives as a park and ride. However, this arrangement, whilst providing a likely scenario, is subject to change at the detailed design stage. The current layout includes: provision for a new access roundabout and access approach road, parking areas, a bus terminus and internal road network, accessed off the A12. The current masterplan also includes provision for an amenity building (including welfare and security facilities), a security booth at the site entrance and bus and cycle shelters. A turning area would also be provided at the site entrance barrier to allow vehicles to be turned away if necessary.

3.2.2 Parking spaces would be provided for 1,250 cars (of which 40 would be provided for disabled users close to the amenity/welfare building and bus stop). There would be a further ten minibus/van spaces, 80 motorcycle spaces and up to 20 secure bicycle parking spaces. Additionally, 12 pick-up and drop-off spaces would be provided close to the entrance and a waiting area would be provided for park and ride buses.

3.2.3 Two landscape bunds would be provided along part of the eastern boundary and part of the northern boundary. Planting would also be provided within and around the parking areas.

3.2.4 Permeable surfaces would be used where possible in the main car parking area to manage the increase in surface water run-off on the site. Water falling onto impermeable surfaces from the access roads would pass through a bypass separator before being channelled into the SuDS infrastructure, where it would be passed through swales. The run-off from roofed areas will be combined with run-off from paved areas either within the piped network (after run-off from the paved areas has passed through the bypass separator) or within the SuDS system. Further details are provided in **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES**.

3.2.5 A total of five SuDS features would be constructed to serve the main park and ride area, as shown in **Figure 2.1** of **Volume 3**, **Chapter 2** of the **ES**; four swales to the west of the parking areas, one swale to the west of the internal access road and two infiltration basins adjacent to the overnight bus parking area. There would also be a further four swales adjacent to the proposed temporary roundabout and access road north of Willow Marsh Lane, which would potentially be drained to an additional infiltration basin to the north of the proposed roundabout, west of the A12, if necessary.

3.2.6 It is proposed that foul sewage from the administration and welfare buildings would be discharged either into a proposed low flow package treatment plant where the treated effluent would discharge to ground, or if the flow is insufficient for the low flow package treatment works the foul effluent would be tankered away for treatment and disposal off-site. Infiltration testing has been organised in accordance with Building Research Establishment Digest 365 (Ref. 1.10) to inform the detailed design of the site.

3.3 Topography

3.3.1 **Figure 1** provides remotely sensed Light Detection and Ranging (LiDAR) data (Ref 1.11) to show the topography of the site. The figure identifies a ridgeline that runs from north to south through the centre of the site which

has the highest ground levels of approximately 32m Above Ordnance Datum (m AOD).

3.3.2 Moving west from this ridgeline, the elevation becomes progressively lower through a moderate slope, reaching the lowest point at the south-west of the site, where ground levels are slightly below 19m AOD.

3.4 Geology

3.4.1 British Geological Survey (BGS) online geology viewer mapping (Ref 1.12) show the Crag Group (marine deposits) as the dominant solid geology type found within the site. This type of geology presents variable permeability.

3.4.2 The BGS map records superficial geology for much of the site as the Lowestoft Formation; unsorted material from a local environment previously dominated by ice age conditions. Along the western boundary the superficial geology is head; fragmented material moved downslope via aeolian transport, formed up to three million years ago in an environment previously dominated by subaerial slopes.

3.4.3 The Suffolk Coastal and Waveney District Councils SFRA states that: *"towards the east of the District the main soil types are deep well-drained sandy soils, deep well-drained sandy often ferruginous soils and deep stone less non-calcareous and calcareous clayey soils. These soil types allow free drainage"* (Ref 1.13).

3.4.4 The Aquifer Designation Map (Ref 1.14) indicates the bedrock geology of the area is classified as a principal aquifer. Principal aquifers are defined by The Environment Agency as: *"geology that exhibit high permeability and/or provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale".*

3.4.5 The Aquifer Designation Map classifies the superficial geology as a secondary undifferentiated aquifer. Secondary undifferentiated aquifers are defined in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

3.4.6 The Groundwater Vulnerability Map (Ref 1.15) indicates the site to located in an area defined as a minor aquifer with low vulnerability. Groundwater vulnerability classification is a product of soil type and the underlying geology; however, the depth to groundwater is not considered. The Groundwater Vulnerability Map is intended to indicate: *"the vulnerability of groundwater to a*

pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties".

3.5 Hydrology

3.5.1 The site is entirely located in the Minsmere Old River catchment (Ref 1.16).

3.5.2 Environment Agency main rivers are typically larger rivers and streams which the Environment Agency maintain and improve. The Environment Agency also has the power to improve and construct work on main rivers to manage flood risk. **Figure 2** identifies all main rivers that are near to the site boundary.

3.5.3 There are two Environment Agency main rivers within 1km of the site boundary. The River Yox runs east to west approximately 1km south of the site, eventually becoming a tributary of the Minsmere River. The Darsham Watercourse runs north to south, approximately 100m from the eastern edge of the site.

3.5.4 Ordinary watercourses are the remaining watercourses that are not classified as main rivers. Lead local flood authorities, local authorities and internal drainage boards have powers to carry out flood risk management work on ordinary watercourses within their geographical areas. **Figure 3** shows identified watercourses and ponds in the vicinity to or within the site boundary.

3.5.5 An ordinary watercourse borders the site to the west and flows southwards under the railway line and the A12. The ordinary watercourse increases in size before eventually joining the Minsmere River approximately 1.2km to the south-east of the site boundary.

3.5.6 Review of Ordnance Survey mapping has identified one pond within the site boundary, this is located immediately west of Moat Hall, as shown on **Figure** The current site layout suggests this pond would be separated from the main park and ride area through the positioning of the landscape bunds shown on **Figure 4**. A further three ponds are located within the gardens of the properties adjacent to the A12, immediately to the east of the site.

3.5.7 The site is not located within a source protection zone, with the closest about 3.5km to the north-west (Ref 1.17).

4 Flood risk appraisal

4.1 Historical flooding

4.1.1 The ESC SFRA historic flood record maps provide location points for recorded historic flood events from fluvial, tidal, sewer, groundwater, highway drainage and surface water sources. These maps do not identify any historic flooding as having occurred within the site. However, the maps do identify two cases of highways drainage flooding that has occurred immediately south of the site, near Darsham railway station.

4.1.2 An absence of record does not necessarily confirm that no flooding has occurred.

4.2 Tidal/coastal flood risk

4.2.1 The flood map for planning (Ref 1.18) shows that the site is located in Flood Zone 1 – low risk of flooding – as shown on **Figure 2**. Flood Zone 1 is defined by the Environment Agency as *"land having less than 1 in 1,000 annual probability of river or sea flooding"* (Ref 1.4).

4.2.2 The risk of flooding from tidal or coastal sources is, therefore, considered to be low.

4.3 Fluvial flood risk

4.3.1 The flood map for planning shows the site is located in Flood Zone 1 – low risk of flooding – as shown on **Figure 2**. Flood Zone 1 is defined by the Environment Agency as *"land having a less than 1 in 1,000 annual probability of river or sea flooding"* (Ref 1.4).

4.3.2 The risk of flooding from fluvial sources is therefore considered to be low.

4.4 Surface water (pluvial) flood risk

4.4.1 **Figure 3** provides the Environment Agency 'long term flood risk map' dataset (Ref 1.9), which highlights the risk of surface water flooding to the site.

4.4.2 This shows that the majority of the site is at 'very low' risk of surface water flooding.

4.4.3 A potential surface water flow route is indicated along the western site boundary. This flow route runs from north to south and connects to the ordinary watercourse located immediately west of Darsham railway station,

before discharging to the Minsmere River to the south. No part of the development crosses this flow route.

4.4.4 An area of high surface water flood risk is shown in **Figure 3** at the northern end of the site. It is suggested that the lower topography adjacent to the A12 to the west leads to pooling of surface water during peak flow events.

4.4.5 Smaller isolated areas of low to high surface water flood risk are also located within the site. Analysis of topographic data shows these are a mixture of topographically low points, ridges and furrows associated with existing agricultural land management practices.

4.5 Groundwater flood risk

4.5.1 The BGS Geology of Britain viewer and the SFRA, identify the main soil types in the area are significantly permeable. Permeable soils have the potential to present groundwater flooding problems in areas with a high-water table.

4.5.2 The BGS susceptibility to groundwater flooding map from the SFRA identifies there is potential for groundwater flooding of property situated below ground level.

4.5.3 Records of a number of historic borehole scans in the vicinity of the site (less than 2km) are available for consultation in the BGS Geology of Britain viewer. These boreholes show water levels between 4m and 6.5m AOD. The lowest point at the site has a ground level of approximately 19m AOD, substantially above these values.

4.5.4 Suffolk County Council's Preliminary Flood Risk Assessment indicates that: *"there is no consistent local information available which provides evidence of possible future groundwater flood risk in Suffolk"* (Ref 1.19).

4.5.5 The SFRA has no records of any groundwater incidents in the area.

4.5.6 It is concluded that the risk of groundwater flooding to the site is low.

4.6 Sewer flood risk

4.6.1 The existing site is an undeveloped agricultural greenfield with no known risk of internal flooding from sewer sources. No sewer records have been received for this site.

4.6.2 Considering the existing topography, potential sources of external sewer flooding to the site are from three residential properties located to the east of the site boundary; Moat Hall, Darsham Cottage and White House Farm.

4.6.3 The risk of sewer flooding to the site from these properties is considered to be low to moderate, due to the proximity of these residential properties.

4.7 Flood risk from reservoirs and other artificial sources

4.7.1 Flooding from reservoirs is defined as an uncontrolled release of water from registered reservoirs, i.e. greater than 25,000m^3.

4.7.2 The flood risk from reservoirs map (Ref. 1.20) shows the site is not at risk of reservoir flooding.

4.8 Summary of potential flood mechanisms

4.8.1 A summary of flood risk to the site is provided in **Table 4.1**.

Table 4.1: Summary of flood risk to the site

Source of Flooding	Flood Risk	Description
Tidal/coastal	Low	Flood Zone 1 – Low: less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
Fluvial	Low	Flood Zone 1 – Low: less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
Surface water (pluvial)	Very low: majority of the site.	Less than 1 in 1,000 annual probability of surface water flooding in any year (<0.1%).
	Low/medium: overland flow routes identified to the east of the site (running south) and the north of the site (running north into the area of high risk). - No part of the development is located within or crosses these flow paths.	Low: land with between 1 in 1,000 and 1 in 100 annual probability of surface water flooding (0.1%–1%). Medium: land with between 1 in 100 and 1 in 30 annual probability of surface water flooding (1% – 3.3%).
	High: 20m–25m wide strip of land on western edge of site and area at the north. No part of the development is located within or crosses these flow paths. An infiltration pond located in the area to the north is proposed to account for the surface water flood risk.	Greater than 1 in 30 annual probability of surface water flooding in any year (>3.3%).

Source of Flooding	Flood Risk	Description
Groundwater	Low	Low: soil is generally permeable (pending further ground investigation), but the site is located on higher ground levels than surrounding areas.
Sewers	Low to moderate.	Internal – Low: greenfield site and surrounding arable land. *External – Low to moderate*: three properties are located on higher ground levels near the site.
Reservoirs & other artificial sources.	Low	Not at risk of flooding from reservoirs or other artificial sources.

5 Flood risk management

5.1 The Sequential Test – application of flood risk vulnerability and flood zone compatibility

5.1.1 The proposed development would only be required for the duration of construction of the Sizewell C main development site and as such, would be in operation for 9–12 years, as described in **Volume 3, Chapter 2** of the **ES**.

5.1.2 In terms of flood risk and vulnerability the proposed development is classified as 'less vulnerable' in accordance with the definitions given in **Table 2.2**. The site is located wholly in Flood Zone 1 (defined in **Table 2.1**).

5.1.3 Given this, the proposed development is considered to be appropriate for this flood zone in accordance with **Table 2.3** and, therefore, passes the Sequential Test.

5.2 Application of climate change

5.2.1 Given the potential sources of flooding outlined above, the actual flood risk posed to the site is derived from surface water and groundwater sources. Therefore, the climate change allowance to be applied relates to an increase in the intensity of rainfall events likely to affect surface water and potentially groundwater flooding.

5.2.2 The NPPF requires that the proposed development remains safe through the development's lifetime. The site is not within a critical drainage area. In accordance with the guidance, both the central and upper end allowances (given in **Table 2.5**) have been considered within the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES**.

5.3 On-site flood risk

5.3.1 As set out above, the site is entirely located in Flood Zone 1 and at low risk of fluvial flooding.

5.3.2 The indicative site masterplan used to inform this FRA demonstrates that all parking areas and ancillary buildings have been located outside the area at risk of flooding from surface water, as shown on **Figure 2.1** of **Volume 3, Chapter 2** of the **ES**.

5.3.3 SuDS features in areas of surface water flood risk would need to be sized appropriately, as part of the drainage design, to ensure sufficient capacity for surface water drainage attenuation and the existing surface water flood volumes to be managed.

5.3.4 At the south-east boundary of the site on the A12, a pedestrian link to the existing footpath would be required to cross a small ditch. The crossing will be sized appropriately to the approval of Suffolk County Council, the lead local flood authority and any required land drainage consent approval sought. This would occur as part of the detailed design.

5.4 Off-site flood risk

5.4.1 The majority of the existing site is currently greenfield, with small localised areas of surface water flood risk, impermeable surfaces limited to those areas where the site extends to include parts of the existing Willow Marsh Lane and A12. Therefore, the proposed development would significantly increase the impermeable area on the site. Without attenuation, this would increase the surface water run-off and the associated flood risk both on and off-site.

5.4.2 The current layout of the proposed development provides appropriate on-site drainage, incorporating SuDS measures, ensuring that surface water run-off does not increase flood risk elsewhere. Further details are provided in the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES**.

5.4.3 Once the operation of the proposed development has ceased, the site would be returned to its original agricultural use. This would include the removal of any related drainage and SuDS measures, which would have no adverse impact on flood risk to the site.

5.5 Applicability of sustainable drainage systems

5.5.1 In accordance with National Planning Practice guidance for flood risk and coastal change, the sustainable drainage hierarchy has been applied to the

proposed development and comments on the suitability of options are provided in **Table 5.1**.

Table 5.1: Application of sustainable drainage hierarchy

Option	Comment	Viability
Into the ground infiltration.	An initial review of geological conditions on-site indicates that a limited amount of infiltration is likely to be possible as a form of surface water disposal. However further infiltration testing is being undertaken to determine suitability of ground conditions. It is possible that other drainage discharge options could be required.	Some potential
To a surface water body.	There are two main rivers within 1km of the site boundary, the River Yox runs 1km south of the site, and the Darsham watercourse runs 100m from the eastern boundary of the site. An ordinary watercourse borders the site to the west and flows south towards lower ground levels, under the railway line and the A12. An existing pond is located on the eastern site boundary.	Potential
To a surface water sewer, highway drain, or another drainage system.	Anglian water sewer records (Ref.1.21) confirm there is no public surface water in close vicinity to the site.	No potential
To a combined sewer.	Anglian water sewer records (Ref. 1.21) confirm there are no public combined sewers in close vicinity to the site.	No potential

5.5.2 As the site is located on a bedrock formed of sand and a superficial deposit consisting of sand and gravel, the ground conditions have infiltration drainage potential. To ascertain ground infiltration rates, infiltration testing has been arranged in accordance with Building Research Establishment Digest 365, to inform the detailed design of the site. However, there is the possibility the infiltration rates may not be suitable to discharge all the surface water to ground and that some surface water may need to be discharged to the local watercourse network. Any such discharge would need to be limited to the applicable greenfield run-off through the application of SuDS. This would be confirmed at the detailed design stage.

5.6 Water management and drainage

5.6.1 The **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES** provides information about the proposed surface water management and drainage for the proposed development, including the design approach, use of SuDS and consideration of climate change. These considerations are summarised below.

5.6.2 The proposed development would include sustainable drainage for the lifetime of the site to manage any additional surface water run-off from it. A combination of infiltration and controlled discharge methods are proposed for

the discharge of surface water run-off. Controlled discharge would be at the greenfield run-off rate to the local ordinary watercourses. Due to the size of the parking area, bypass separators would provide a second level of treatment to the surface water run-off.

5.6.3 During construction, shallow perimeter bunds would be constructed for majority of the site. This would retain surface water run-off within the site and enable infiltration. A perimeter ditch would be constructed immediately outside of the proposed bunds to capture any off-site run-off.

5.6.4 Climate change would be taken into account in the detailed drainage design through the application of the appropriate rainfall intensity allowances as discussed in **section 1.5.3b**.

5.6.5 Monitoring and maintenance of the drainage system would be carried out to preserve its integrity and maintain its design capacity for the lifetime of the proposed development.

5.7 Access

5.7.1 The site would be accessed directly off the A12. A security booth would be located at the access gate immediately off the A12 to control the flow of traffic.

5.7.2 Pedestrian access would be via the existing public footway connection between Darsham railway station and the proposed site entrance.

5.7.3 The Environment Agency long term flood risk map identifies that access to or from the site could be affected during a high rainfall event, with road links in the area potentially inundated by surface water flooding. This is considered as part of the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES**

5.7.4 Subscription to regional flood warnings from the Met Office would be considered by the site management, to inform safe access and egress for workers during high intensity rainfall.

6 Residual risk

6.1.1 In any development there is always a potential for there to be a residual flood risk to people and property due to:

- the failure of systems and defences;
- more extreme events than those defined in the NPPF; or

- uncertainties associated with modelled water levels.

6.1.2 Residual risk may remain after flood risk management or mitigation measures have been installed. Hence an FRA should consider the residual flood risk and the need for any further measures to ensure the residual risk is managed appropriately.

6.1.3 Climate change is a potential residual risk for the site. The flood zones shown on the Environment Agency's flood map for planning do not take account of the possible impacts of climate change and consequent changes in the future probability of fluvial flooding. This also applies to the flood extents of the flood map for surface water.

6.1.4 The site is in Flood Zone 1, with the nearest Flood Zone 2 and 3 located approximately 750m away. Minimum topographic levels within the site are approximately 19.64m AOD. The topographic level of the flood extent (Flood Zone 2 and 3) nearest to the site is approximately 9.77m AOD.

6.1.5 Due to the geographical and elevation distances between the modelled flood extents and the site, the risk of fluvial or tidal flooding to the site is currently considered to be low and remains low taking account of future climate change.

6.1.6 A flood risk emergency plan would be in place for the proposed development. The flood emergency plan would be prepared in accordance with the standards set out in the Environment Agency and ONR Joint Advice Note would include procedures to ensure people on-site are safe in the event of a flood.

6.1.7 Monitoring of the weather would be in place to monitor storm conditions. This would probably involve the registration of appropriate staff to the Environment Agency flood warnings and Met Office weather warnings to manage the potential impacts of flooding. This could lead to, if necessary, the halting of construction.

6.1.8 Sustainable drainage and existing land drainage structures require regular maintenance to ensure continuing operation to design performance standards. Poor maintenance could result in increased risk of flooding from surface water. The sustainable drainage features would require regular maintenance to prevent blockage.

6.1.9 There is potential residual risk for the site, should an off-site culvert under the East Suffolk line to the west be blocked. Review of the topographic data shown on **Figure 2** identifies that the upstream start of this culvert is situated at approximately 17m AOD. The current site layout as shown on **Figure 1** shows that the closest feature to this culvert is the southernmost swale SuDS

feature. The car park is situated approximately 55m to the east of the culvert, over which distance the elevation increases to 22m AOD. It is therefore considered that the proposed development has been designed so that this residual risk is sufficiently mitigated.

6.1.10 Typical maintenance of dry swales includes mowing and occasional sediment removal, unless additional sediment trap measures are put in place. Maintenance plans or schedules would be developed during the detailed design phase.

7 Summary and conclusions

7.1.1 This report has considered all sources of flood risk and identified the flood risk mitigation measures included within the proposed development.

7.1.2 **Table 4.1** shows that the flood risk from tidal, fluvial, groundwater, sewers and reservoirs is low.

7.1.3 Flood risk from surface water is variable across the site. The majority of the site is at 'very low' risk of flooding from surface water, however, land along the south-west and northern edges of the site are at 'high' risk of flooding from this source. These isolated 'high' risk areas have been avoided in terms of vulnerable uses or integrated into the drainage system. The surface water flood risk is managed as part of the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES.**

7.1.4 As a result of locating the development in Flood Zone 1, it is considered that there would be no loss in functional floodplain storage or displacement of sea or river flood water as a result of the proposed development.

7.1.5 The proposed development is classed as being 'low vulnerability' under the NPPF. As per the **Table 2.3**, the development is considered appropriate in terms of flood risk vulnerability and, therefore, passes the Sequential Test.

7.1.6 The increase in impermeable area associated with the proposed development would require sustainable drainage to manage surface water run-off through the attenuation and controlled discharge of flows to ground and local watercourses. This, including the impact of climate change, is addressed as part of the **Outline Drainage Strategy** at **Appendix 2A, Volume 2** of the **ES** to ensure there is no increased risk of flooding from the proposed development.

7.1.7 The proposed development is considered to be appropriate in terms of flood risk based on the information presented, the proposed mitigation measures and in accordance with NPPF guidance.

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