The Sizewell C Project

5.4 Southern Park and Ride Flood Risk Assessment

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Planning Act 2008
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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 Wickham Market to the south-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 southern park and ride and is submitted as part of the application for development consent for the 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, however an isolated pocket of land at 'High' risk of flooding was identified. This isolated 'high' risk area has been avoided in terms of vulnerable uses.

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 guidance for flood risk and coastal change. As per the Flood Risk Vulnerability and Flood Zone Compatibility table, 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 drainage strategy.

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

1 Introduction

1.1 Background

1.1.1 This Flood Risk Assessment (FRA) describes the flood risk, from all sources, to the proposed southern park and ride at Wickham Market (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 the 'Sizewell C Project'[1].

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

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

1.1.4 The site of the operational southern park and ride facility at Wickham Market is located entirely to the west of the A12 (referred to herein as the 'operational site'). Within the wider site of the proposed development, highway changes are proposed, including a reduction in the number of lanes on the northbound A12 carriageway and a reduction in the speed limit of roads used to access and egress the operational site. On these existing roads, no changes will be made to the existing impermeable area. This FRA focuses on flood risk to the operational site, meaning the southern park and ride facility located west of the A12.

1.1.5 The site of the proposed development is approximately 26.4 hectares (ha) in size, with the operational site located west of the A12 totalling approximately 18 ha. The operational site is proposed to provide space for approximately 1,250 cars, 10 minibuses/vans, 80 motorcycles and secure cycle parking for up to 20 bicycles. In addition, a bus terminus area, bus parking, bus shelters, amenity and welfare buildings and offices and a postal consolidation building would be included.

1.1.6 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

[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.

completion of construction of the Sizewell C Project, the proposed development would be removed, and the operational site reinstated to agricultural use.

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 Practice 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 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 National Planning Policy Framework (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 (**Table 2.1**), Vulnerability Classifications (**Table 2.2**) and Compatibility Matrix (**Table 2.3**) 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 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 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 centers; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and 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.

Vulnerability classification	Description
	• 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 caravans and camping, subject to a specific warning and evacuation plan.
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 (see table d2)		Essential infrastructure	Water compatible	Highly Vulnerable	More vulnerable	Less vulnerable
Flood Zone (see Table D.1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3	Exception Test required	✓	×	Exception Test required	✓
	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 a Strategic Flood Risk Assessment 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 a various 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 favorable 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." (Paragraph 80).

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' (**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 (1961–90 baseline)

	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%

Source: Table 2, Environment Agency Climate Change Allowances.

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 (WDC).

2.4.2 The 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 has 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.

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 site:

- 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 approximately 26.4ha of agricultural land and highway land located north-east of Wickham Market. The operational site which would contain the parking and buildings, postal consolidation building and Traffic Incident Management Area (TIMA), is approximately 18ha in size, and located to the east of the B1078/B1116, to the north of the A12. The site lies approximately 2 kilometres (km) to the north-east of the village of Wickham Market and 16km to the south-west of the main development site.

3.1.2 The operational site's boundary largely follows the existing field boundaries, except at the south-eastern perimeter where it aligns with the northern edge of the A12 embankment and northbound slip road. A wooded copse known as Whin Belt lies immediately to the west of the site.

3.2 The proposed site masterplan and design

3.2.1 The site masterplan provided at **Figure 2.1**, **Volume 4**, **Chapter 2** of the **Environmental Statement** (**ES**), shows an indicative arrangement for the

site to fulfil its objectives as a park and ride. The current layout includes: provision for parking areas, a bus terminus and an 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. The site would also include a postal consolidation building for the processing of deliveries to the Sizewell C main development site. 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 10 minibuses/vans spaces, 80 motorcycle spaces and up to 20 secure bicycle parking spaces would be provided near to the bus stops. 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 Surrounding the majority of the site would be two landscape bunds and planting.

3.2.4 Permeable surfaces would be used where possible in the main car parking area to manage the increase in surface water runoff 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. Further details are described within the **Outline Drainage Strategy** at **Appendix 2A**, **Volume 2** of the **ES.**

3.2.5 A total of up to ten SuDS features would be constructed to serve the main park and ride area, provided at **Figure 2.1**, **Volume 4**, **Chapter 2** of the **ES**; up to three infiltration basins, and up to seven swales. In addition, an underground attenuation area would be constructed beneath the bund with a pump to remove water.

3.2.6 Two of the basins would be located to the south of the traffic incident management area at the north of the site, and another basin would be located at the operational site entrance. An existing dry pond on the site would be retained although this pond would not be included as part of the SuDS infrastructure. The swales would surround the main car parking area and site access road.

3.2.7 It is proposed that foul sewage from the administration and welfare buildings would be treated on site. The effluent would either pass through to a septic tank or package treatment works before being discharged to the sustainable drainage system, where it would be further treated by vegetative filters before discharging to ground. Foul sewage from the security booth at the entrance

to the operational site would pass through to a septic tank. Further details are provided in the **Outline Drainage Strategy** at **Appendix 2A**, **Volume 2** of the **ES**.

3.2.8 The site boundary includes a section of the A12 junction to the B1078 and the B1078/ B1116 roundabout, these roads provide vehicular access and egress from the site. The proposed modifications to highways in relation to the site would not extend beyond the existing footprint of the roads.

3.3 Topography

3.3.1 **Figure 1** provides remotely sensed Light Detection and Ranging (LiDAR) data (Ref. 1.10) to show the topography of the proposed development. The figure shows that the highest ground levels, 29 metres Above Ordnance Datum (m AOD), are found along a ridge that dissects the park and ride facility, running in a north-west to south-east orientation.

3.3.2 Elevations within the proposed development reduce moving south towards Wickham Market, lowest ground levels are found at the southernmost point on the A12 of approximately 10m AOD.

3.3.3 Within the operational site, lowest ground levels of slightly below 22m AOD are located where the proposed access road would enter the facility, from the existing B1078 slip road that joins the A12 northbound.

3.4 Geology and hydrogeology

3.4.1 British Geological Survey (BGS) online geology viewer mapping (Ref. 1.11) 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 the site to be two types of the Lowestoft Formation; formed of sand and gravel in the south-western and north-eastern sections, with an approximate 500m strip of diamicton running through the centre of the site.

3.4.3 Figure 11 of Appendix A in the Strategic Flood Risk Assessment (SFRA) (Ref. 1.12) identifies that the site's hydrogeology is "*probably compatible for infiltration SuDS*".

3.4.4 The Aquifer Designation map (Ref. 1.13) 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.

3.4.6 The Groundwater Vulnerability map (Ref. 1.14) indicates the site to be located in an area defined as a Minor Aquifer with Intermediate 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 Environment Agency Catchment Data Explorer shows that the site is positioned across two Main River catchments; the River Deben to the south-west and the River Ore to the north-east. The site does not drain directly into either of these water bodies (Ref. 1.15).

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 work on main rivers to manage flood risk. **Figure 2** of this document identifies all 'Main Rivers' that are near to the site boundary.

3.5.3 The River Deben runs west to east approximately 800m west of the site boundary. The River Ore runs north-west to south-east, approximately 500m north-east of the site boundary. Both are Main Rivers under the jurisdiction of the Environment Agency.

3.5.4 Ordinary Watercourses are the remaining watercourses that are not classified as Main River. Lead Local Flood Authorities (LLFAs), local authorities (LAs) and Internal Drainage Boards (IDBs) 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 of, or within the site.

3.5.5 An Ordinary Watercourse runs approximately 750m to the west of the site boundary, flowing south and joining the River Deben.

3.5.6 Review of Ordnance Survey (OS) mapping has identified one pond within the site boundary, to the south-east of Whin Belt and two further ponds in the woods adjacent the north-west boundary of the site (**Figure 3**).

3.5.7 Three licensed surface water abstractions are located on the River Deben, with the closest located approximately 600m to the south-west. There are also three groundwater abstractions; to the north (1.4km), north-east (400m) and east (800m) of the site (Ref. 1.16).

3.5.8 The site lies within zone three of the Source Protection Zones, identified as a total catchment zone. A total catchment zone is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source (Ref. 1.17). This is a potential constraint for infiltration SuDS and has been considered as part of the **Outline Drainage Strategy** at **Appendix 2A**, **Volume 2** of the **ES**.

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 to have occurred within the site.

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 the site is located in Flood Zone 1 - low risk of flooding (**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*."

4.2.2 The risk of flooding from tidal or coastal sources is 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 (**Figure 2**). Flood Zone 1 – low risk of flooding is defined by the Environment Agency as *"land having less than 1 in 1,000 annual probability of river or sea flooding*."

4.3.2 The risk of flooding from fluvial sources is 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, which highlights the risk of surface water flooding to the proposed development.

4.4.2 The majority of the site is at 'very low' risk of surface water flooding.

4.4.3 There are 5 isolated locations of 'low' risk:

- across the proposed access road;
- to the east of the existing on site pond;
- along the southern boundary with the A12;
- along the site boundary beyond the eastern extent of the parking area; and
- at the north-east boundary outside of the landscape bunds (**Figure 3**).

4.4.4 There is an area of combined 'medium' and 'high' risk in the park and ride site, which covers the lower section of one of the swales in the proposed layout and a small section of the parking area (**Figure 4**). It is located in the north-west corner of the main parking block.

4.4.5 Towards the southern extent of the wider proposed development, there is a large area of 'medium' to 'high' surface water flood risk, situated on the A12 at the B1078 junction. There is also an area of 'medium' to 'high' surface water flood risk adjacent to the northbound A12 slip road. Whilst both areas are part of the site boundary, there will be no changes to the existing impermeable area on the existing road and therefore the risk will not be increased by the proposed development.

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 as significantly permeable. Permeable soils have the potential to present groundwater flooding problems in areas with high water table.

4.5.2 The BGS susceptibility to Groundwater Flooding map from the SFRA identifies there is limited potential for groundwater flooding to occur.

4.5.3 The Suffolk County Council PFRA (Ref. 1.19) indicates that *"there is no consistent local information available which provides evidence of possible future groundwater flood risk in Suffolk".*

4.5.4 The SFRA has no records of any groundwater incident in the area.

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

4.6 Sewer flood risk

4.6.1 The proposed location of the operational site is an undeveloped agricultural greenfield site with no known existing risk of internal flooding from sewer sources. Sewer plans have been sought and it has been confirmed that there are no public sewers on site.

4.6.2 The Suffolk Coastal and Waveney District Councils Level 1 SFRA does not identify any flooding to have occurred on site from foul or surface water sewers. The SFRA also does not identify any flooding from highway drainage to have occurred on site or the surrounding highway network.

4.6.3 The risk of sewer flooding to the site is considered to be low.

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, which are 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 proposed development 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)	Majority of the site: Very Low	Less than 1 in 1,000 annual probability of surface water flooding in any year (<0.1%).

Source of flooding	Flood risk	Description
	Isolated pockets: Low	Between 1 in 1,000 and 1 in 100 annual probability of surface water flooding (0.1% - 1%). Across the proposed access road; Along the southern boundary with the A12; Along the site boundary beyond the eastern extent of the parking area; At the north-east boundary outside of the proposed raised topsoil.
	Medium/ High	*Medium*: Land with between 1 in 100 and 1 in 30 annual probability of surface water flooding (1% - 3.3%). *High*: Greater than 1 in 30 annual probability of surface water flooding in any year (>3.3%). North-west corner of the main parking block
Groundwater	Low	*Low:* Soil is permeable, but the site is located on higher ground levels than surrounding areas.
Sewers	Low	*Low*: Greenfield site and surrounding arable land.
Reservoirs & other artificial sources	Low	*Not at risk*: Located outside the maximum reservoir flood risk extent.

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 provided in **Volume 4, 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 appropriate for this flood zone in accordance with the Flood Risk Vulnerability and Flood Zone Compatibility table (**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 in **Section 4**, 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 Environment Agency guidance, both the climate change allowances have been considered within the preparation of the **Outline Drainage Strategy** provided in **Appendix 2A** of **Volume 2** of the **ES.**

5.2.3 Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) 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.

5.2.4 The site is in Flood Zone 1, with the nearest Flood Zone 2 and 3 located approximately 450m away. Minimum topographic levels within the site are approximately 21.64m AOD. The topographic level of the modelled flood extent (Flood Zone 2 & 3) nearest to the site is approximately 11.84m AOD.

5.2.5 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.

5.3 On-site flood risk

5.3.1 The site is entirely located in Flood Zone 1 and at low risk of fluvial flooding.

5.3.2 The current high-level proposed site layout used to inform this FRA demonstrates that all ancillary buildings and the majority of parking areas have been located outside the area at 'High' risk of flooding from surface water (**Figure 4**).

5.3.3 **Figure 4** identifies the swale immediately north of the car park falls within an area of high surface water flood risk. This area of surface water flood risk extends south onto the north-west corner of the car park but is only classified as medium and low risk in these areas.

5.3.4 The swale in the area of surface water flood risk would 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.

5.4 Off-site flood risk

5.4.1 The proposed development includes sections of the A12, B1116 and B1078 which are developed highways with existing drainage systems, where the impermeable area will not increase. The operational site where the park and ride facility will be located is currently 'greenfield', with no impermeable

surfaces and small localised areas of surface water flood risk. Therefore, the proposed development would significantly increase the impermeable area in this location. Without attenuation, this increase in impermeable area will increase the surface water run-off and the associated flood risk.

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 agricultural use. The removal of the development would include the removal of any related drainage and SuDS measures that were implemented as part of the proposed development. This 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 & comments on 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 indicate that a limited amount of infiltration is likely to be possible as a form of surface water disposal. The site lies within zone three of the source protection zones. Further infiltration testing is being undertaken to determine suitability.	Potential
To a surface water body	There are two main rivers within 1km of the site. An ordinary watercourse is located approximately 750m to the west of the site, flowing south and joining the River Deben. An existing pond is located on the site along the western site boundary. Three ponds are located outside of the site boundaries to the west of the main site.	Some potential
To a surface water sewer, highway drain, or another drainage system	Sewer plans have been sought and it has been confirmed that there are no public sewers on site (Ref. 1.21). The potential to drain to the highway drains is not known and would require consultation with the highway authority.	No potential
To a combined sewer	The current land is primarily greenfield. Sewer plans have been sought and no sewers exist on the site Ref. 1.21).	No potential

5.5.2 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 (Ref. 1.22), to inform the detailed design of the site.

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 runoff. Controlled discharge would be at the greenfield runoff 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 runoff.

5.6.3 During site construction, shallow perimeter bunds would be constructed for the 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 allowances will be considered in the detailed drainage design through the application of the appropriate rainfall intensity allowances.

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 operational site would be accessed from the A12 slip road. A security booth would be located at the access gate immediately off the A12 to control the flow of traffic.

5.7.2 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.

5.7.3 Subscription to regional flood warnings from the Met Office would be considered by the site management, where necessary, 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 A flood risk emergency plan would be in place for the construction and operation of the bypass. The flood risk emergency plan would be developed in accordance with NPPF and Environment Agency guidance and would include procedures to ensure people on-site are safe in the event of a flood.

6.1.5 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.

6.1.6 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 will require regular maintenance to prevent blockage.

6.1.7 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 and implemented for the lifetime of the proposed development.

7 Summary and conclusions

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

7.1.2 **Table 4.1** shows flood risk from tidal, fluvial, groundwater, sewers and reservoirs are 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, however an isolated pocket of land at 'High' risk of flooding was identified. This isolated 'high' risk area has been avoided in terms of vulnerable uses.

7.1.4 As a result of locating the proposed development in Flood Zone 1, it is considered that there will 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 Flood Risk Vulnerability and Flood Zone Compatibility table, the proposed 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 will be mitigated by 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** provided in **Appendix 2A** of **Volume 2** of the **ES**.

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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