The Sizewell C Project

5.2 Main Development Site Flood Risk Assessment

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a) Introduction

This Flood Risk Assessment (FRA) provides an assessment of existing flood risk from all sources of flooding to the proposed main development site of the Sizewell C power station. 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 FRA assesses the risk from all sources of flooding up to the 1 in 1,000-year return period event. More extreme events, such as the 1 in 10,000-year and 1 in 100,000-year events are considered in the safety case assessment as set out by the Office for Nuclear Regulation (ONR) and are not considered in detail in this FRA. However, on occasion, information from the 1 in 10,000-year event is used to inform consideration of residual risk within the FRA.

b) Main platform and SSSI crossing

The proposed main development platform area would involve extensive alterations to the ground levels to facilitate the platform construction. The proposed platform location is located behind existing sand dunes with a shingle beach and an earth embankment, known as the Bent Hills. The Bent Hills would be excavated in stages during the first phase of construction of the platform. The Hard Coastal Defence Feature (HCDF) would be constructed between the reinstated sand dunes with a shingle beach, known as the Soft Coastal Defence Feature (SCDF), and the proposed platform. The proposed main platform and SSSI crossing are to be at a level of 7.3m AOD.

The HCDF would be designed to protect the main platform from still water levels up to 1 in 10,000-year return period for the entire operation phase and the spent fuel store decommissioning phases. The sea defence crest level would initially be constructed to a level of 10.2m AOD with adaptive design to potentially raise the defence in the future up to 14.2m AOD, if sea level changes require.

The SSSI crossing is set back from the coastline and would not directly benefit from the HCDF. As coastal change occurs the coastline would progress inland to the SSSI crossing leading to an increased risk of wave overtopping and would experience higher rates of wave overtopping. The proposed SSSI crossing design has the potential to construct adaptive flood defences with a crest level of 10.5m AOD on the crossing.

Breach modelling was undertaken to assess the risk to the site if the coastal defences were to fail. Three breach locations were considered at the tank traps (to the north of the main platform), at the Sizewell Gap (to the south of the main platform) and a breach of the HCDF for the main platform (adjacent to the platform). The breach modelling shows the main platform area is not at flood risk from a breach of the existing sand dunes with a shingle beach to the north of the platform at the tank traps. However, the off-site impacts equate to an increase of the maximum water depths by up to 0.19m, although the increase is to over 3m depth of water at the 1 in 200-year event in 2030 and about 5.7m depth at the 1 in 200-year event in 2190. This increase only occurs at the peak, does not lead to new flooding of residential property and does not affect the overall duration of flooding.

Once constructed, the main platform and SSSI crossing would be above the current and future 1 in 1,000-year fluvial flood extents including allowances for climate change. However, the platform and the SSSI crossing do encroach into the existing fluvial floodplain of the Leiston Drain and would slightly reduce the flood storage volume.

The fluvial modelling results predict a change in the maximum water levels of up to 15mm for the range of considered scenarios from 1 in 5-year annual probability event up to 100-year event with 65% climate change allowance. The Environment Agency has confirmed that flood storage compensation or flood mitigation is not usually required when the change in flood depth is less than 30mm, where the impacts are insignificant. The 15mm additional flood depth is considered to have an insignificant impact on the floodplain and any off-site receptors because it does not lead to new flooding of residential properties, and does not change the duration of flooding, which could have been significant for the habitats in the RSPB reserves or Minsmere Levels. Therefore, no flood storage compensation or flood mitigation measures are proposed.

The majority of the site is currently classified by the Environment Agency as being at ‘very low’ surface water flood risk with a few localised areas at an increased surface water flood risk due to the topographical landscape and the Leiston Drain. The installation of two drainage systems to serve the site during the construction and operation phases will allow for the management of surface water pooling in low topographical spots. Both the temporary and the permanent surface drainage systems would be designed to appropriate parameters to meet the requirements of the different phases, as set out in the **Outline Drainage Strategy** at **Volume 2, Chapter 2, Appendix 2A** of the **Environmental Statement** (Doc Ref. 6.3).

The development of the site and the increase in the extent of impermeable surfaces would increase the surface water run-off. The surface water from the main platform would be collected in a drainage system discharging to the sea. The construction of the platform at this location is assessed to be at low future surface water flood risk. A bespoke drainage system that serves the requirements of the site would be provided. The surface water from the SSSI crossing would drain to an infiltration basin to the north of the causeway. Given these measures, the surface water flood risk on-site would remain low during all phases.

The main platform and SSSI crossing areas were identified as being predominantly in an area with 'no' potential for groundwater flooding with a smaller area with 'limited' potential for groundwater flooding. The groundwater modelling results indicate that during the construction phase the dewatering activities would reduce the groundwater levels in the vicinity of the platform area and in adjacent off-site areas, reducing groundwater flood risk further.

To facilitate excavation, the main platform site will be dewatered within a below ground cut-off wall. While the groundwater levels would fluctuate due to the dewatering activities in the construction phase, the overall groundwater flood risk would remain as being of 'limited' potential. Following cessation of the construction phase dewatering, the limited drawdown beyond the cut-off wall would no longer occur. Groundwater levels outside the cut-off wall would re-equilibrate and are expected to recover fully by the operation phase.

The main platform and SSSI crossing areas are currently classified by the Environment Agency as being are outside the maximum flood extents for the Sizewell Walks reservoir. Only the access road to the south of Sizewell A is partially within the maximum flood extent. Alternative access through the SSSI crossing exists as an alternative if this very low probability of reservoir breach occurs, making this a low risk overall to Sizewell C. This flood risk is considered to remain the same in the future should the reservoir remain in situ.

The main platform and the SSSI crossing areas are located on a predominantly undeveloped area of land with no foul sewers. The south-western corner of the proposed main platform includes a group of Sizewell B buildings served by foul and surface water sewers, with a pumping station. These facilities are being relocated as part of the Sizewell B relocated facilities component of this application. The construction of the main platform with the power station facilities would introduce the risk of sewer flooding on-site as no sewers were previously present.

During the construction phase only, these sewers would be conveyed across the SSSI crossing. However, through appropriate design, installation and management of the foul water system, the risk of sewer flooding would remain low. The sewer and surface water flood risk would be low at the main platform and SSSI crossing.

During the decommissioning phase, the main platform would remain above the maximum coastal, fluvial and groundwater water levels. For the 1 in 1,000-year reasonably foreseeable scenario for 2190, there would be some wave overtopping, although with the construction of the adaptive flood defence, the overtopping rate would reduce to about 0.02 l/s/m and result in a safe working environment.

In the more conservative safety case scenario for the 1 in 10,000-year event, the rate of overtopping would also reduce with the construction of the adaptive flood defence to retain a manageable working environment for staff on-site.

The flood risk associated with breach to the platform is low; however, the breach would increase the water depths to the off-site area around the development platform.

Overall the main platform and SSSI crossing areas are assessed to be at a low level of flood risk at present. During the early construction phase, there is a risk of coastal flooding to both the main platform and SSSI crossing areas for a short period while the new HCDF is still under construction. The flood emergency plan to be developed would be used to manage this risk.

The main platform and access via the SSSI crossing are designed for a safety case of a 1 in 10,000-year storm event.

Once the site is operational, the main platform would be at low risk of flooding for the reasonably foreseeable climate change scenario for 1 in 1,000-year probability of occurrence and for the more extreme safety case event for 1 in 10,000-year probability of occurrence.

The SSSI crossing design is safe for use up to a 1 in 1,000-year coastal event at the end of the operation phase, after which there would be a high risk of coastal overtopping that would make crossing dangerous during storm conditions. Prior to this, the adaptive flood defences on the SSSI crossing would be constructed to reduce this risk through the remaining lifetime of the proposed site.

A flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice would be developed to ensure people on-site are safe in the event of a flood.

The main platform in the decommissioning phase would be at low flood risk. While the flood risk associated with breach to the platform is low, the off-site water depths during a breach would increase along with the associated flood risk.

c) Temporary construction area

The temporary construction area would contain the contractor compounds, borrow pits, stockpiles, access roads, accommodation campus, rail route extension, and other infrastructure to facilitate the construction of the new power station on the main development platform. After the construction is complete, the temporary construction area and the majority of the infrastructure would be removed, and the site reinstated in accordance with the **Outline Landscape and Ecology Management Plan (oLEMP)** (Doc Ref. 8.2). The access road and car parking would remain on the northern side of the SSSI crossing.

The majority of the temporary construction area is situated beyond the coastal and fluvial flood extents for the current and future 1 in 1,000-year including allowances for climate change. The temporary construction area includes three small areas of greater flood risk along the eastern, south eastern and northern boundaries.

On the eastern boundary, the infiltration basin in water management zone 1 and the retained woodland on Goose Hill are within current and future coastal and fluvial flood extents.

On the south eastern boundary with the Sizewell Belts, the fluvial and coastal flood risk extend into that part of the temporary construction area associated with the common user facilities area and car parking areas. However, the facilities are set back from the boundary to enable boundary treatment to occur which would prevent interaction with the flood extents.

On the northern boundary, the site coastal and tidal breach flood risk extends along the boundary, while the fluvial flood risk extends into the site.

The majority of the temporary construction area is currently at ‘very low’ surface water flood risk with only one area at an increased surface water flood risk due to a topographical linear depression in the existing landscape. This feature in the landscape has been used to locate one of the proposed temporary water management zones.

The development of the site would temporarily increase the surface water run-off. The surface water would be collected in a sustainable drainage system that would retain the majority of the run-off on-site before discharging to the ground.

Where the infiltration rates are more limited, the surface water run-off would discharge to both the ground and the local watercourses at a controlled discharge rate.

Further details of the proposed surface water drainage are available in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **Environmental Statement (ES)**). Therefore, the surface water flood risk on-site would remain low whilst the temporary construction area is in use.

The temporary construction area is identified as being situated in an area with ‘limited’ potential for groundwater flooding. The groundwater modelling results show minor differences in groundwater levels relative to baseline conditions across the temporary construction area. The most pronounced increase in predicted variation is in the borrow pits and accommodation campus area of the site. While the variation in groundwater levels would be slightly greater due to the development, the resulting overall groundwater flood risk during the construction period would remain ‘limited’.

At present, the temporary construction area is outside of the Sizewell Walks reservoir maximum flood extent and this would remain the same in the future should the Sizewell Walks reservoir remain in situ. However, the construction of a temporary water resource storage area creates a new potential reservoir flood risk where none had previously existed. The temporary nature of the reservoir means this risk would be limited to the construction phase. While it is in the Environment Agency’s Flood Zone 3 map, detailed fluvial, tidal breach and coastal overtopping modelling has shown that it is not at risk during a 1 in 100-year fluvial event or 1 in 200-year tidal/coastal overtopping event up to the end of the construction phase.

There remains a residual risk of a breach of the raised defences of the temporary water resource storage area. Based on the local topography and the volume of water held by the temporary water resource storage area it is considered that one property downstream in the Minsmere Levels within the RSPB reserve could be at a residual risk of flooding from this breach. This risk will be explored further as part of detailed design and appropriate management measures put in place as part of the site’s wider safety procedures.

The temporary construction area is located on an area of predominantly agricultural land, with no existing foul sewers within the current site area. The construction of the accommodation campus and various welfare facilities within the temporary construction area would increase the risk of foul water sewer flooding due to the introduction of foul water sewers on-site. However, through appropriate design, installation and management of the proposed foul water system, the risk of sewer flooding would remain low.

Overall the temporary construction area is assessed to be generally at a low level of flood risk at present, during the construction phase and on completion of the site works when the area is reinstated in accordance with the **oLEMP** (Doc Ref. 8.2).

d) Land east of Eastlands Industrial Estate

The Land East of Eastlands Industrial Estate (LEEIE) site would be used temporarily for contractor compounds, workers’ accommodation and stockpiles for the construction phase only (assumed up to 2034 for the purposes of this assessment).

Once Sizewell C has been built, the LEEIE construction facilities and the associated infrastructure would be removed, and the site returned to the pre-development state.

The LEEIE is situated beyond the coastal and fluvial flood extents for the current and future 1 in 1,000-year probability events including allowances for climate change.

The site is currently at ‘very low’ surface water flood risk. The development of the site would temporarily increase the surface water run-off. To address this, the impermeable surfaces would be minimised to reduce the surface water run-off. On-site surface water run-off would be collected on-site and attenuated before being discharged.

During the Sizewell C Project construction phase, to prevent the possibility of surface water flows leaving the site in an uncontrolled manner particularly along the north western boundary, surface water would be collected and discharged in a controlled manner through the drainage system. The surface water flood risk on-site would remain low. Further details of the proposed surface water drainage are available in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES)** (Doc Ref. 6.3).

The LEEIE area is identified as being in an area with ‘limited’ potential for groundwater flood risk. The groundwater modelling results show no predicted differences in groundwater levels relative to baseline on the LEEIE during construction and into the operation phase.

At present, the LEEIE is outside of the Sizewell Walks reservoir maximum flood extents from the current Environment Agency’s flood map. This is considered to remain the same in the future should the reservoir remain in situ.

The LEEIE is located on an agricultural field to the north-east of Leiston with no foul sewers within the current site area. The establishment of the construction area on the LEEIE would increase the risk of foul water sewer flooding given the introduction of foul water sewers on-site. However, through appropriate design, installation and management of the foul water system, the risk of sewer flooding would remain low.

Overall the LEEIE area is assessed to be at a low level of flood risk at present and during the Sizewell C construction phase. Once Sizewell C has been built, the construction site would be removed, and the area would be returned to its former use.

e) Off-site sports facilities

The off-site sports facilities are considered to be at low risk of flooding from groundwater, reservoirs, fluvial, coastal and breach.

The development of the off-site sports facilities would marginally increase the localised risk of flooding from surface water and sewers. The proposed embedded design approach for surface water and sewers provides suitable mitigation to maintain a low flood risk while the site is in use. Therefore, the mitigated surface water and sewer flood risk is considered to be low.

The off-site sports facilities are a permanent development in Leiston and would remain in use by the local community throughout the operation and decommissioning phases of the Sizewell C power station. The level of mitigated flood risk would remain unchanged due to the inclusion of climate change allowances in the design.

f) Fen meadow sites and marsh harrier habitat improvement area

The fen meadows are permanent sites, water compatible and considered to be appropriately located in accordance with the sequential test.

The fen meadows are on low lying ground adjacent to the main rivers of the River Blyth and the River Fromus. The fen meadows are at a medium to high risk of flooding that will remain throughout the lifetime of the Sizewell C project. Due to the low topography, the surface water flood risk on both sites varies from low to high and would remain in the future. Groundwater flooding has the potential to reach the surface on both fen meadow sites that would also remain unaltered. The fen meadows are proposed for a water compatible use.

The fen meadow near Halesworth is within the maximum flood extent of Heveningham Hall Reservoir and would continue to be so in the future for as long as the reservoir was present. The fen meadow near Benhall and the marsh harrier habitat improvement area at Westleton is not at risk of reservoir flooding.

The fen meadow sites and the marsh harrier habitat improvement area are considered to be at low risk of flooding from sewers, coastal and breach. The marsh harrier habitat improvement area is not at fluvial, reservoir flood risk.

The phased construction of the main platform, SSSI crossing and other operational infrastructure is supported by large temporary site areas that are to be returned to the former land use once the construction is complete. The marsh harrier habitat improvement area is a temporary site that would be returned to its former agricultural use at the end of the construction period.

The fen meadow sites would remain as permanent developments and are a water compatible land use. There are no planned alterations to the sites created in the construction phase or in the operation and decommissioning phases. Therefore, the only anticipated change to flood risk is associated to the predicted climate change projections associated. The flood risk would remain similar to the construction phase depending of the sensitivity of the source of flood risk to climate change.

g) Sizewell B relocated facilities

The Sizewell B relocated facilities are to be moved from the proposed Sizewell C main platform area onto the existing Sizewell B site, the Coronation Wood development area and the Pillbox Field to the south of the Sizewell A and B platforms. The facilities relocated onto the Sizewell B site and the Coronation Wood development area are at low risk of coastal inundation, tidal breach, fluvial, surface water, groundwater, reservoir and sewer flooding.

The design life of the relocated facilities is up to 2055. Therefore, the future water extents, depths and velocities in 2055 are expected to be closer to those modelled in 2030 rather than 2190. Therefore, the proposed vehicular access road crossing to Pillbox Field is within the 1 in 200-year and 1 in 1,000-year extents for coastal inundation, tidal breach and fluvial flooding in 2030.

The relocated facilities would not alter any off-site flood risks. These on-site and off-site flood risks would continue from the construction phase into the operation phase of the Sizewell C project.

h) Summary

The overall mitigated flood risks for each of the development areas are summarised for each phase of the development in **Table 0.1**. The justification of the summary level of flood risk is provided in the conclusions in **section 12** of this **report**.

Table 0.1: Summary of overall mitigated flood risks to the areas of main development site for all phases

Site Summary		Flood Risk						
Site	Phase	Coastal	Breach	Fluvial	Surface Water	Ground Water	Reservoir	Sewer
Main Platform	Construction	M	M	L	L	L	L	L
	Operation	L	L	L	L	L	L	L

Site Summary		Flood Risk						
Site	**Phase**	**Coastal**	**Breach**	**Fluvial**	**Surface Water**	**Ground Water**	**Reservoir**	**Sewer**
	Decommissioning	L	M	L	L	L	L	L
SSSI Crossing	Construction	L	M	L	L	L	L	L
	Operation	L	L	L	L	L	L	L
	Decommissioning	M	M	L	L	L	L	L
Temporary construction area	Construction	L	L	L	L	L	L	L
	Operation	L	L	L	L	L	L	L
	Decommissioning	L	L	L	L	L	L	L
LEEIE	Construction	L	L	L	L	L	L	L
	Operation	L	L	L	L	L	L	L
	Decommissioning	L	L	L	L	L	L	L
Off-site sports facility	Construction	L	L	L	L	L	L	L
	Operation	L	L	L	L	L	L	L
	Decommissioning	L	L	L	L	L	L	L
Fen meadows	Construction	L	L	M	M	L	M	L
	Operation	L	L	M	M	L	M	L
	Decommissioning	L	L	M	M	L	M	L

Site Summary		Flood Risk						
Site	Phase	Coastal	Breach	Fluvial	Surface Water	Ground Water	Reservoir	Sewer
Marsh harrier improvement area	Construction	L	L	L	L	L	L	L
	Operation	L	L	L	L	L	L	L
	Decommissioning	L	L	L	L	L	L	L

1. Introduction

1.1 Background

1.1.1 This Flood Risk Assessment (FRA) presents an assessment of existing flood risk from all sources to the proposed main development site of the Sizewell C power station. The FRA describes future flood risk to the site including 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 risks.

1.1.2 The location of Sizewell C and the area covered by the main development site is shown in **Figure 1** and the study extent in **Figure 4** of this FRA. Further figures and detailed descriptions of the site and proposed development at the main development site are presented in **Volume 2, Chapters 1** to **3** of the **Environmental Statement** (**ES**).

1.1.3 This FRA is supported by detailed data and hydrological analyses, and hydraulic modelling. The technical reports presenting their outcomes are provided as Appendices to this FRA. These are;

- **Appendix 1**: The Coastal Modelling Update Report;
- **Appendix 2**: Fluvial Modelling Update Report;
- **Appendix 3**: Hydrology Review and Design Event Methodology Report;
- **Appendix 4**: Tidal Breach and Coastal Inundation Modelling Update Report; and
- **Appendix 5**: UK Climate Change Projections 2018 - Review and Proposed Response.

1.1.4 A stand-alone FRA has been developed for the relocation of certain Sizewell B facilities from the footprint of the proposed Sizewell C main platform to other locations to facilitate the development of Sizewell C. This relocated facilities FRA is provided as **Appendix 6** and **Appendix 7** to this FRA. Key outcomes from the relocated facilities FRA are included within the main platform sections of this FRA.

1.2 The proposed site masterplan and design

a) Main development site

1.2.1 The main development site has been divided into development areas to facilitate presentation within this FRA:

- Main platform: comprising works on the main platform including the existing southern access road to Sizewell A and B, beach landing facility on the seaward side of the main platform, Sizewell B relocated facilities at Coronation Wood development area and the outage car park at Pillbox Field with its associated new access road on to Sizewell Gap;
- SSSI crossing;
- the temporary construction area: comprising works on the temporary construction area and off-site developments (including the off-site sports facilities at Leiston and habitat creation areas); and
- the land east of Eastlands Industrial Estate (LEEIE).

1.2.2 The temporary construction area is known by two names; the temporary construction area during the construction phase and the former temporary construction area following the construction phase.

1.2.3 For the purposes of the FRA, components of the development that will remain on-site throughout the operation phase have been considered to be ‘permanent’ and those that would support the construction phase only have been considered as ‘temporary’.

1.2.4 Temporary development, including the locations of buildings, structures, plant, equipment, uses, haul roads, construction hoardings, water resource storage area and means of enclosure identified in this FRA are indicative for the purposes of assessment and will be delivered in general accordance with **Volume 2, Chapter 3** of the **Environmental Statement** (Doc Ref. 6.3) and the Main Development Site Construction Parameter Plan (SZC-SZ0100-XX-100-DRW-100046), unless otherwise agreed by the local planning authority.

1.2.5 **Figure 1** shows the location of the development sub-areas which we have aggregated into four, for the purposes of this FRA. **Table 1.1** provides a summary of the components of the development and whether they are considered permanent or temporary.

Table 1.1: Summary of development components

Development Locations	Component Description	Temporary	Permanent
Main Platform	Main power station platform, realignment of Sizewell Drain and northern mound redevelopment.		X
	Flood defence and coast protection measures.		X
	Beach landing facility and private access road.		X
	Fuel and waste storage facilities, including interim spent fuel and waste storage.		X
	Internal power station access roads.		X
	Operational service building, including offices, training centre, controlled access to the nuclear island, workshops, laboratories, medical and other welfare facilities.		X
	Auxiliary administration centre and storage facilities, and buildings including meteorological station, conventional waste storage, transit areas.		X
	Water supply and drainage infrastructure.		X
	A new National Grid 400kV substation.		X
	Six monopoles and four pylons to connect the conventional islands to the National Grid substation.		X
	Two nuclear islands with associated infrastructure.		X
	Two conventional islands and other associated infrastructure.		X
	Two onshore cooling water pumphouses and associated infrastructure.		X
	Marine works and associated infrastructure including cooling water structures with the fish recovery and return systems, and combined drainage outfall in the North Sea.		X
Sizewell B relocated facilities (considered as part of main platform assessment)	Training centre, visitor centre, laydown area, replacement car park, outage store and western access road.		X
	Outage car park on Pillbox Field and associated access		x
	Temporary relocation of the Visitor Centre within the existing Technical Training Centre;	X	
	Facilities in outline development zone (offices, canteen and welfare facilities);		X
SSSI crossing	A vehicular and pedestrian causeway crossing over Sizewell Marshes SSSI connecting the power station to the		X

Development Locations	Component Description	Temporary	Permanent
	new access road to the north.		
Temporary Construction Area (TCA)	Temporary workers' accommodation campus.	X	
	Rail terminal with associated security and off-loading facilities.	X	
	Common user facilities, including concrete batching plant and prefabrication facilities.	X	
	Construction contractors' compounds, including working areas, laydown areas, workshops and storage.	X	
	Temporary water resource storage area and distribution network	X	
	Site access and entrance hub with related parking, security, induction and temporary offices.	X	
	Car parking, bus interchange and heavy goods vehicle (HGV) holding area.	X	
	Temporary site access roads, earthworks haul roads and other temporary internal roads.	X	
	Site-wide infrastructure including drainage, lighting and environmental boundary treatment.	X	
	Spoil management including borrow pits and topsoil, subsoil and excavated material storage.	X	
	Old Abbey Farm electrical substation.		X
	Upper Abbey Farm emergency equipment store and back-up generator.		X
	Car parking (including Kenton Hills improvements) and associated security buildings.		X
	Access road to the north of main platform, linking the causeway crossing with a new junction onto Abbey Road (B1122).		X
Leiston off-site sports facilities (considered as part of TCA assessment)	Leiston off-site sports facility at Alde Valley Academy shared facility with a 3G pitch and MUGA courts.		X
Fen meadows (considered as part of TCA	The two areas are to the south of Benhall and to the east of Halesworth, which would be used to compensate for the loss of fen meadow from Sizewell Marshes SSSI.		X

Development Locations	Component Description	Temporary	Permanent
assessment)			
Marsh harrier habitat improvement area (considered as part of TCA assessment)	Land west of Westleton which could be used to mitigate potential disturbance effects on marsh harriers from the temporary loss of foraging habitat during construction.	X	
Land East of Eastlands Industrial Estate	Caravan park for temporary accommodation and associated welfare facilities.	X	
	Stockpile areas	X	
	Freight management facilities including car park, HGV park and park and ride facilities	X	
	Temporary rail infrastructure including single railway line with sidings.	X	

b) Off-site areas of habitat creation

1.2.6 Areas of habitat creation have been identified to compensate for the ecological effects of the proposed development on marsh harriers and on fen meadow habitat (**Figure 4**). The areas where this compensation can be provided have been identified and these areas are geographically separate to the main development site area. However, as these areas are compensation for actual or theoretical habitat loss in the SSSI due to the construction of the proposed development, they are considered part of the main development site.

i. Marsh Harriers

1.2.7 The marsh harrier habitat improvement area is to the west of Westleton. This off-site area is proposed, in addition to an on-site area, to provide further habitat for marsh harriers due to any potential temporary disturbance effects which might discourage marsh harriers from foraging over parts of the Minsmere South Levels and Sizewell Marshes SSSI during construction.

1.2.8 The habitat improvement area is designed to provide habitat for marsh harrier prey through altering the land use and management practices. The cessation of arable cultivation and the implementation of a set-aside approach to develop a rough grassland and the establishment of 'game strips' that would attract flocks of small birds and increase the numbers of small mammals. Due to the nature of this work, further flood risk analysis is not considered necessary for the marsh harrier habitat improvement area.

ii. Fen Meadows

1.2.9 Fen meadow habitats are generally located in damp lowland areas with typically groundwater-dependent ecology.

1.2.10 To compensate for the loss of 0.7ha of existing fen meadow habitat from Sizewell Marshes SSSI, associated with the western edge of the new power station platform, two permanent compensation areas would be provided. These are located on land to the south of Benhall and land to the east of Halesworth.

1.2.11 The two fen meadow compensation areas will provide approximately 16 ha of new lowland fen meadow habitat, including modified landforms to raise water levels, where necessary, new minor watercourses and associated planting.

c) Sizewell B relocated facilities

1.2.12 A hybrid planning application for the relocation, demolition and replacement of a number of existing Sizewell B facilities (known as the Sizewell B relocated facilities works) was submitted to East Suffolk Council (ESC) in April 2019 (application ref. DC/19/1637/FUL) and planning permission for these works was granted on 13 November 2019. The Flood Risk Assessment and Flood Risk Assessment Addendum submitted with this application is provided in **Appendices 5 and 6** of this document.

1.2.13 As the Sizewell B relocated facilities works are critical elements to facilitate the construction of Sizewell C, the proposals for these facilities are also included in the application for development consent and have been considered to form part of the Sizewell C Project in this FRA.

1.2.14 The Sizewell B relocated facilities consists of the construction of replacement facilities within the Sizewell B power station site, at Coronation Wood and to the south of the Sizewell A power station at the Pillbox Field. The existing facilities on the proposed Sizewell C power station main platform area would then be demolished and removed. The works associated with the Sizewell B relocated facilities are:

- Coronation Wood development area includes the western access road, training centre, laydown area and replacement car park;
- Outage store to replace the existing general store within the Sizewell B power station complex;
- Temporary relocation of the visitor centre within the existing technical training centre;
- Outage car park and associated access at Pillbox Field;
- Facilities in outline development zone (offices, canteen and welfare facilities) within the Sizewell B power station complex; and
- New visitor centre at Coronation Wood development area.

1.2.15 The Sizewell B relocated facilities works included within the DCO are the same as consented by ESC under the Town and Country Planning Act 1990. However, since the preparation of the Sizewell B relocated facilities ES, two changes to the design proposals have been made and are included within the DCO, as these formed planning conditions to the permission granted by ESC:

- A footpath between the proposed outage car park at Pillbox Field and Coronation Wood development area has been removed from the design to prevent loss of land within the Sizewell Marshes SSSI, which would have been required for the construction of the footpath.
- An alternative junction arrangement for outage car park access and Sizewell Gap road has been developed to minimise effects on road safety.

d) Development lifetime

1.2.16 The proposed development would go through a number of phases throughout its lifetime. The proposed timings of each phase are assumed to be as follows for the purposes of this assessment:

- **2022**: start of construction;
- **2034**: end of construction and start of operation;

- **2090**: end of operation;
- **2140**: interim spent fuel store decommissioned; and
- **2190**: theoretical maximum site lifetime.

1.2.17 In this study, the 2030 epoch was modelled as the indicative time within the construction phase when key infrastructure would be substantially in place. The projected timeframe for the construction phase is 9-12 years starting from 2022 (end of construction at 2034).

1.2.18 Temporary components including the temporary construction area and the accommodation campus are assumed to be removed from the site by 2034, whilst some permanent components would be removed from the site between 2090 and 2140.

1.2.19 Unless there is a licensed extension to its operational life, the site would begin the decommissioning process around 2090. By 2140 the Interim Spent Fuel Storage would have been decommissioned and the wider decommissioning process would be completed by 2190 which is the theoretical maximum site lifetime.

1.3 Scope and structure of this Flood Risk Assessment

a) Scope of FRA

1.3.1 This FRA presents an assessment of existing flood risk from all sources to the proposed main development site of the Sizewell C power station. The FRA describes future flood risks to the site including the consequences of climate change and also considers possible changes in flood risk to off-site receptors as a result of the proposed development. It also presents mechanisms for managing residual risks.

1.3.2 To manage potential change through the design development processes, SZC Co. is proposing a parameter-based approach (known as the Rochdale envelope) for the consenting of construction and operation phases of the Sizewell C Project. As such, the application for an order granting development consent will largely be based on bounded parameters rather than a defined design, although, the main large structures are broadly fixed in their siting and design. The parameters are sufficiently flexible to accommodate a reasonable level of change that would be expected between the concept design and detailed design phases.

Parameters (such as limits on height and location of buildings) are secured in Schedule 2 of the draft Development Consent Order (**Doc. Ref 3.1**).

1.3.3 Due to the increase in traffic to facilitate the construction of the development, an integrated transport strategy has been developed. The FRA is based on the defined envelopes shown in **Figure 3**.

1.3.4 The FRA assesses both the flood risk posed on-site to the development and off-site impacts due to the development. On-site and off-site flood risk have been assessed up to the end of decommissioning in 2190, the theoretical maximum site lifetime.

1.3.5 Due to the uncertain timing and nature of the decommissioning phase (2140 to 2190) a separate planning application would be submitted at the appropriate time and the effects on flood risk would be reassessed at that time. However, to provide some confidence on flood risk impacts, this FRA considers in broad terms a conservative assessment to 2190.

1.3.6 The FRA assesses the risk from all sources of flooding up to 1 in 1,000-year return period event. More extreme events, such as the 1 in 10,000-year and 1 in 100,000-year events are considered in the safety case assessment as set out by the Office for Nuclear Regulation (ONR).

b) Structure of FRA

1.3.7 A summary of the content of each section is outlined within **Table 1.2**.

Table 1.2: Summary of section content within this FRA

Section	Brief description of content
1	INTRODUCTION Project background, introduction to the existing site and introduction to the proposed development.
2	LEGISLATION, POLICY AND GUIDANCE Brief descriptions of national and local policies relevant to flood risk for the site location and proposed development.
3	EXISTING SITE CHARACTERISTICS Outline information on the existing baseline characteristics of the main development site, including topography, geology and

Section	Brief description of content
	hydrology.
4	CLIMATE CHANGE Overview of the climate change allowances utilised within the flood risk assessment.
5	BASELINE (EXISTING) FLOOD RISK Details of the existing flood risk (known as baseline flood risk) posed to the main development site.
6	APPLICATION OF THE SEQUENTIAL TEST AND EXCEPTION TEST Analysis of the development in relation to flood risk vulnerability and the Sequential Test.
7	MAIN PLATFORM FLOOD RISK ON-SITE Analysis of the flood risk posed to the main platform area of the site taking account of climate change, the proposed flood risk management on-site and the impacts of the development on flood risk off-site.
8	SSSI CROSSING FLOOD RISK ON-SITE Analysis of the flood risk posed to the SSSI crossing area of the site taking account of climate change, the proposed flood risk management on-site and the impacts of the development on flood risk off-site.
9	CONSTRUCTION AREA FLOOD RISK ON-SITE Analysis of the flood risk posed to the construction area of the site taking account of climate change, the proposed flood risk management on-site and the impacts of the development on flood risk off-site.
10	LEEIE FLOOD RISK ON-SITE

Section	Brief description of content
	Analysis of the flood risk posed to the 'Land East of the Eastlands Industrial Estate' area of the site taking account of climate change, the proposed flood risk management on-site and the impacts of the development on flood risk off-site.
11	OFF SITE IMPACTS AND MITIGATION For all sources of flooding and all areas impacted by the proposed development.
12	SUMMARY AND CONCLUSIONS From the flood risk assessment.
13	REFERENCES

2. Legislation, policy and guidance

2.1 Introduction

2.1.1 This section identifies and describes legislation, policy and guidance of relevance to the flood risk assessment associated with this development.

2.1.2 Legislation and policy have been considered at a national, regional and local level. The relevant legislation and policy that would influence the scope and/or methodology of the Flood Risk Assessment includes:

- Overarching National Planning Policy Statement (EN-1) (Ref 1.1);
- National Policy Statement for Nuclear Power Generation (EN-6) (Ref 1.2);
- ONR/EA Joint Advice Note: Principles for Flood and Coastal Erosion Risk Management (Ref 1.3);
- National Planning Policy Framework (Ref 1.4);
- National Planning Policy Guidance (Ref 1.5);

- Flood and Water Management Act 2010 (Ref 1.6);
- Flood Risk Assessments: Climate Change Allowances (Environment Agency) (Ref 1.7);
- UK Climate Projections 2018 (Ref 1.8);
- Suffolk Coastal Local Plan 2013 (Ref 1.9);
- Final Draft - Suffolk Coastal Local Plan (Ref 1.10);
- Suffolk Flood Risk Management Strategy (Ref 1.11); and
- Leiston Surface Water Management Plan (SWMP) (Ref 1.12).

2.2 Legislation

a) Flood and Water Management Act 2010

2.2.1 The Flood and Water Management Act (FWMA) (Ref 1.6) came into force in 2010. It aims to improve both flood risk management and the management of water resources by creating clearer roles and responsibilities. This includes a lead role for upper-tier Local Authorities (Lead Local Flood 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 FWMA provides opportunities for a comprehensive, risk-based approach to 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 NPS EN-1 section 5.7 requires applicants to submit a flood risk assessment (FRA) if their proposal lies within Flood Zones 2 or 3 or is more than one hectare in size and located in Flood Zone 1. The aim of planning policy with regard to flood risk is stated to be:

> *"…to ensure that flood risk from all sources of flooding is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of*

> *flooding, and to direct development away from areas at highest risk."*

2.3.2 Section 5.7 sets out the minimum requirements for FRAs. Decision makers are required to be satisfied that, where relevant:

- the application is supported by an appropriate FRA;
- the Sequential Test has been applied as part of site selection;
- a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk;
- the proposal is in line with any relevant national and local flood risk management strategy;
- priority has been given to the use of SuDS;
- in flood risk areas the project is appropriately flood resilient and resistant;
- including safe access and escape routes where required; and
- residual risk can be safely managed over the lifetime of the development.

2.3.3 NPS EN-1 states that the decision maker should not consent development in Flood Zone 2 unless it is satisfied that the sequential test requirements have been met. It should not consent development in Flood Zone 3 unless it is satisfied that the Sequential and Exception Test requirements have been met.

2.3.4 The Sequential Test gives preference to sites at lower risk of flooding. The Exception Test applies to projects that cannot be located in areas other than Flood Zone 3 or alternative sites at lower risk of flooding that are inappropriate for other reasons (for example being located in an AONB or SSSI). NPS EN-1 confirms the requirements for passing the Exception Test:

> *“All three elements of the test will have to be passed for development to be consented. For the Exception Test to be passed:*
>
> - *it must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk;*

- *the project should be on developable, previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously developed land subject to any exceptions set out in the technology-specific NPSs; and*
- *a FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere subject to the exception below and, where possible, will reduce flood risk overall".*

2.3.5 NPS EN-1 requires that the sequential approach should be applied at the site selection stage and at the site level (in terms of layout and design) with more vulnerable uses located on parts of the site at lower probability of flooding.

i. NPS EN-6

2.3.6 Section 3.6 of NPS EN-6 acknowledges that nuclear power stations need access to cooling water and so need to be located in coastal or estuarine areas. This makes them more likely to be at risk of flooding without appropriate mitigation measures. The Government has decided to identify the sites listed in section 4.1 of NPS EN-6 as potentially suitable for new nuclear power stations

> *"…in spite of some being located in higher flood risk zones, noting that the independent Nuclear Regulators have advised that they have the potential to be protected from flood risk throughout their lifetime, and because of the lack of alternative sites and the need for new nuclear development. As a result, the second limb of the Exception Test does not apply to new nuclear development."*

2.3.7 NPS EN-6 confirms that the Sequential Test has been applied by the Government as part of the SSA process. Nuclear power stations promoted on any of the listed sites are therefore excluded from the need to apply the Test (and the second limb of the Exception Test). The Sequential Approach still applies at site level and so an FRA is still required.

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

2.3.8 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.” (*Ref 1.3*).* 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.

2.3.9 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).

c) National Planning Policy Framework

2.3.10 The National Planning Policy Framework (NPPF) (Ref 1.4) 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 (LPA), 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.

2.3.11 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.

2.3.12 The NPPF does not contain specific policies for nationally significant infrastructure projects, such as Sizewell C. However, the EN-1 refers to it and its associated guidance as source information for further definitions such as on flood zones.

2.3.13 While the National Policy Statement for Nuclear Power (EN-6) has provided an allocated site at Sizewell, the proposed development may extend beyond the previously nominated site boundary. Any area outside of the previous nominated site boundary requires the application of the sequential testing. Further details of the requirements for sequential testing and sustainable drainage are given in the following sections.

i. Sequential Test

2.3.14 The National Planning Practice Guidance (NPPG) (Ref 1.5) on Flood Risk and Coastal Change supports the NPPF with additional guidance on flood risk vulnerability classifications and managing residual risks. The NPPG 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.

2.3.15 Where there are no reasonably available sites in Flood Zone 1 the Local Planning Authority (LPA), 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.

Table 2.1: Summary of flood zone definitions

Flood zone	Probability of flooding	Definition
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 (equal to or greater than 1%); or Land having a 1 in 200 or greater annual probability of sea flooding (equal to or greater than 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

Flood zone	Probability of flooding	Definition
		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 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

Vulnerability Classification	Description
	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 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	Vulnerable		
				Highly	More	Less
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						

ii. Sustainable drainage and surface water

2.3.16 The NPPG on Flood Risk and Coastal Change (Ref 1.5) 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."*

2.3.17 In order to manage surface water on the site, it would be necessary to consider the appropriateness of a various sustainable drainage (SuDS) measures using the SuDS hierarchy as given in the NPPG for flood risk and development.

2.3.18 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;

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

2.3.19 The NPPG acknowledges that some types of sustainable drainage systems may not be practicable in all locations. Locations may be constrained in areas of flood risk. Fluvial and coastal flood zones are defined in **sections 5.2 and 5.3**.

2.3.20 The Environment Agency classifies surface water flood risk (Ref 1.12) 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%).

2.3.21 The SuDS management train would be considered to understand potential opportunities to limit or attenuate surface water drainage from the site.

2.3.22 The CIRIA SuDS Manual (Ref 1.13) identified the requirement for SuDS to be designed to maximise the opportunities and benefits for:

- Water quantity – Controlling the quality of run-off to support the management of flood risk, and to maintain and protect the natural water cycle;
- Water quality – Managing the quality of the run-off to prevent pollution;
- Amenity – Creating and sustaining better places for people; and
- Biodiversity – Creating and sustaining better places for nature.

d) Flood Risk Assessments: Climate Change Allowances

2.3.23 As the government's expert on flood risk, the Environment Agency has published online advice note 'Flood Risk Assessments: Climate Change

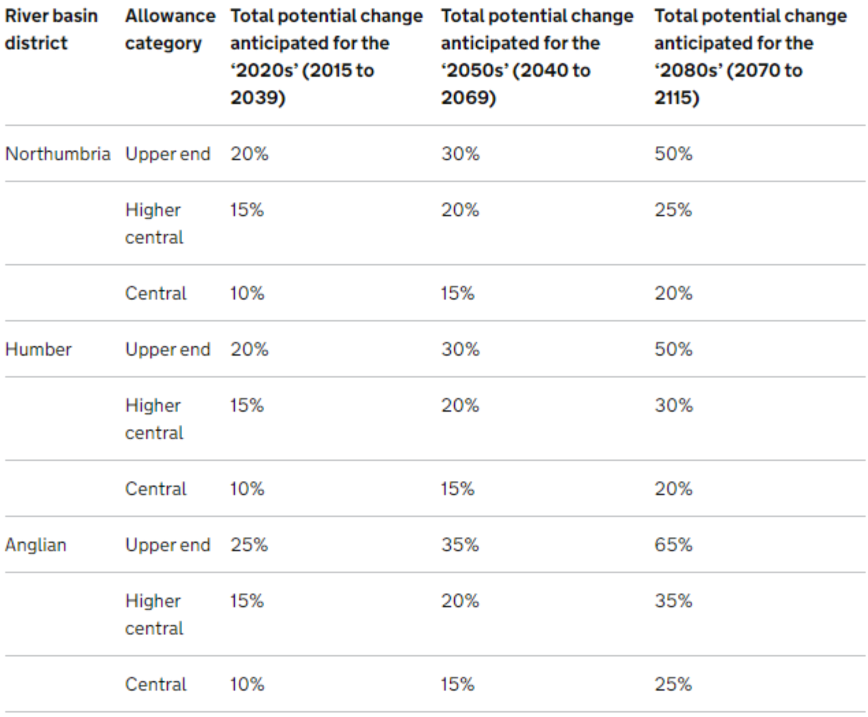
Allowances', first published in February 2016 and then amended in 2017 and 2019 (Ref 1.7) that sets out when and how to use climate change allowances in FRAs and SFRAs.

2.3.24 The updates in December 2019 were to include the revised sea level change allowances based on the UKCP18 findings.

2.3.25 This guidance provides climate change allowances which consider the geographical location, life span of the proposed development, flood zones and vulnerability classification associated with the type of development and critical drainage areas.

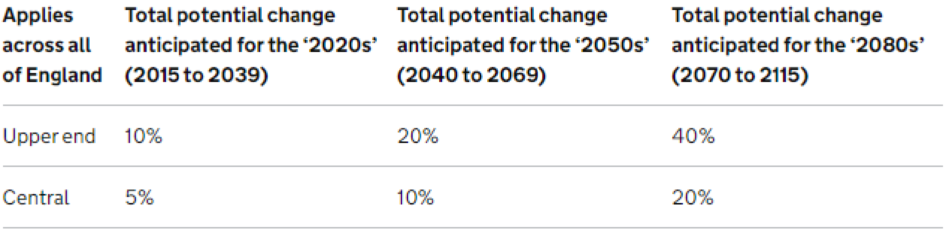
2.3.26 Guidance is provided for determining appropriate climate change allowances for peak fluvial flows, peak rainfall intensities, sea level rise, offshore wind speed and extreme wave height, height as presented in **Plate 2.1** to **Plate 2.4** respectively.

Plate 2.1: Extract from Table 1 of Environment Agency guidance on climate change allowances – peak river flow allowance



River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

Plate 2.2: Extract from Table 2 of Environment Agency guidance on climate change allowances – peak rainfall intensity allowance

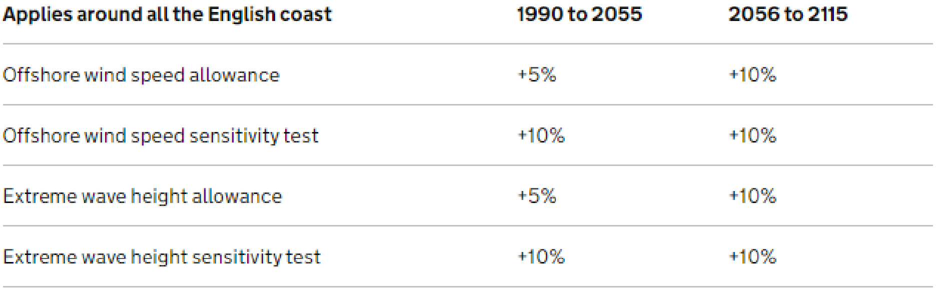


Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Plate 2.3: Extract from Table 3 of Environment Agency guidance on climate change allowances – sea level rise allowance

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115	Cumulative rise 1990 to 2115 / metres (m)
East, east midlands, London, south east	4 (140 mm)	8.5 (255 mm)	12 (360 mm)	15 (450 mm)	1.21 m
South West	3.5 (122.5 mm)	8 (240 mm)	11.5 (345 mm)	14.5 (435 mm)	1.14 m
North west, north east	2.5 (87.5 mm)	7 (210 mm)	10 (300 mm)	13 (390 mm)	0.99 m

Plate 2.4: Extract from Table 4 of Environment Agency guidance on climate change allowances – offshore wind speed and extreme wave height allowance



Applies around all the English coast	1990 to 2055	2056 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitivity test	+10%	+10%

2.3.27 In 2018, the Met Office published an update to UK Climate Projections 2018 (UKCP18) (Ref 1.8) that supersedes the previous UK Climate Projections 2009 study (UKCP09).

2.3.28 The Environment Agency has provided advice on the use of UKCP18 for Sizewell C study. Further details on the application of UKCP18 for this FRA are provided in **section 4** of this **report**.

2.3.29 The Office for Nuclear Regulation (ONR) and Environment Agency in March 2019 issued a position statement on the 'Use of UK Climate Projections 2018 (UKCP18) by the nuclear industry' (Ref 1.14), which sets out expectations regarding UKCP18 and its application when undertaking climate change assessments in support of safety cases.

2.3.30 Both the Environment Agency Climate Change Allowance guidance and the ONR and Environment Agency UKCP18 position statement set a requirement for the high++ (H++) allowances to be considered in testing different adaptation options over time periods appropriate for the nuclear energy industry.

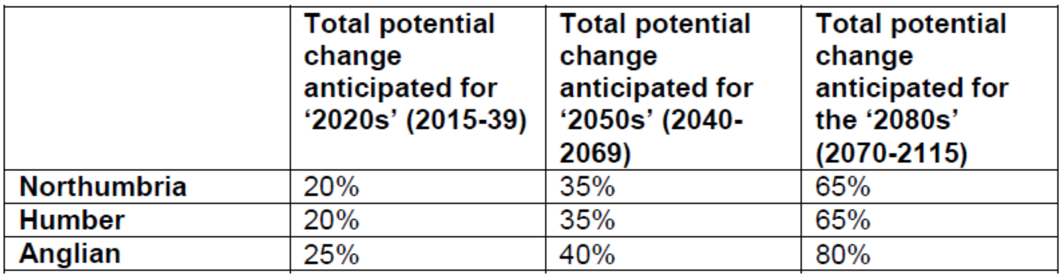
2.3.31 The H++ allowances are available in the Environment Agency guidance 'Adapting to climate change - advice for flood and coastal erosion risk management authorities' (Ref 1.15). The guidance states:

> *'For circumstances where the consequences of rare events could be extreme, RMAs may wish to test their designs and plans against the H++ scenario. Extreme consequences could include flooding of nuclear installations[…]. This would help illustrate the risks such changes could present, but given that H++ estimates represent the Upper limit of climate projections that are considered plausible, it would not normally be expected for schemes or plans to be designed to/ incorporate built-resilience for the H++ estimate.'*

2.3.32 ONR and Environment Agency 'Principles for Flood and Coastal Erosion Risk Management' (Ref 1.3) states that the current H++ scenarios based on UKCP09 for sea level rise and storm surge are an example of the credible maximum scenario in accordance with NPS EN1 (Ref 1.1).

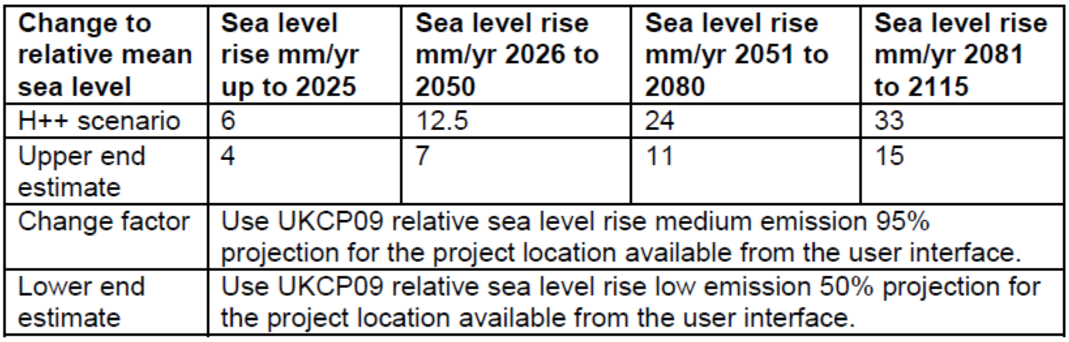
2.3.33 The H++ allowances for peak river flow and mean sea level rise are presented in **Plate 2.5** and **Plate 2.6** respectively. No H++ allowances are available for peak rainfall intensity or extreme wave climate. Storm surge allowances are provided for the H++ scenario, but for the purpose of this study they were adopted from a separate extreme water levels and surge allowances assessment carried out for the Sizewell C project, as discussed in **section 4.2 1.1.1c)** of this **report**.

Plate 2.5: Extract from Table 3 of Environment Agency's guidance on adapting to climate change – H++ river flood flow scenarios



	Total potential change anticipated for '2020s' (2015-39)	Total potential change anticipated for '2050s' (2040-2069)	Total potential change anticipated for the '2080s' (2070-2115)
Northumbria	20%	35%	65%
Humber	20%	35%	65%
Anglian	25%	40%	80%

Plate 2.6: Extract from Table 5 of Environment Agency's guidance on adapting to climate change – mean sea level allowance (includes land movement)



Change to relative mean sea level	Sea level rise mm/yr up to 2025	Sea level rise mm/yr 2026 to 2050	Sea level rise mm/yr 2051 to 2080	Sea level rise mm/yr 2081 to 2115
H++ scenario	6	12.5	24	33
Upper end estimate	4	7	11	15
Change factor	Use UKCP09 relative sea level rise medium emission 95% projection for the project location available from the user interface.			
Lower end estimate	Use UKCP09 relative sea level rise low emission 50% projection for the project location available from the user interface.			

2.3.34 Further assessment of available climate change allowances and their application for this Sizewell C FRA are provided in section 4 of this **report**.

2.3.35 Since the development of the hydraulic models, the Environment Agency has revised their Flood Risk Assessment Climate Change Allowance guidance in December 2019.

2.3.36 The allowances for peak river flow and peak rainfall intensity in 'Flood risk assessments: climate change allowances' (Ref 1.53) have not been updated yet to reflect the changes based UKCP18 results. This is because high resolution rainfall projections were only published recently (September 2019) and research is still underway to assess the impact of the rainfall projections in UKCP18 on peak river flow. It is anticipated that Environment Agency would publish updates to these allowances in late 2020.

2.3.37 In addition, following completion of updates to hydraulic modelling in October 2019 to inform this Sizewell C FRA, in December 2019 the Environment Agency has published updated guidance on climate change allowances for flood risk assessments (Ref 1.7). This has updated sea level rise allowances to reflect the latest climate change projections

(UKCP18). The sea level rise allowances in the updated guidance are based on the UKCP18 RCP8.5 95th percentile and 70th percentile and provide an average figure for each scenario.

2.4 Local Policies

2.4.1 On 1st April 2019, Suffolk Coastal District Council (SCDC) and Waveney District Council (WDC) were merged and became East Suffolk Council (ESC). Prior to this date Suffolk Coastal and Waveney District Council's worked in partnership to produce various policy documents. These documents are referred to here by their published names and references authors as they were at the time of their publication. Further information is provided in **Volume 2, Chapter, 1** of the **ES** (Doc Ref. 6.3).

a) Suffolk Coastal Local Plan

2.4.2 The ESC is in the process of replacing the former SCDC Local Plan (Ref 1.9). The final draft of the new local plan was published for a six-week period to receive representations in relation to legal compliance and soundness between 14 January 2019 and 25 February 2019. SCDC has stated that the adoption of the plan is scheduled for Spring 2020. This local plan covers only the geographical area formerly within the Suffolk Coastal District Council boundary.

2.4.3 The existing SCDC Local Plan sets out how the area should be developed. It incorporates core strategy, 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 includes a number of saved policies, last updated in July 2018. Some previously saved policies have been superseded or abandoned whilst others have remained saved policies. None of the remaining saved policies are considered relevant for this development. The SCDC Plan acknowledges that Sizewell is one of the locations formally identified as a potential for new nuclear provision.

2.4.5 Four strategic policies and one development management policy have been identified as relevant for this development, as outlined within **Table 2.5**.

Table 2.5: Relevant Suffolk Coastal Local Plan policies

Policy Number	Policy Name	Summary
SP10	A14 and A12	The Council supports the provision of improvements to the A12.

Policy Number	Policy Name	Summary
SP11	Accessibility	The transfer of freight from road to rail will also be encouraged.
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.
SP13	Nuclear Energy	The possible construction of the new nuclear facility at Sizewell requires that local issues arising from the development and its construction are adequately addressed and to maximise the benefits to the local community.
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 Suffolk County Council is responsible for coordinating a partnership approach to flood and coastal risk management with all risk management authorities in Suffolk. The Suffolk Flood Risk Management Partnership produced the Local Flood Risk Management Strategy (LFRMS) (Ref 1.11) in March 2016.

2.4.7 The LFRMS states its objective as “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 The LFRMS identifies seven objectives, three of which are most relevant to the site. The relevant objectives are;

- Objective 3: To prevent an increase in flood risk as a result of development by preventing additional water entering existing drainage systems wherever possible;

- Objective 4: 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;

- Objective 5: Encourage maintenance of privately-owned flood defences and ordinary watercourses and minimise unnecessary constrictions in watercourses.

c) Leiston Surface Water Management Plan

2.4.9 The Leiston SWMP was published in 2017. It used a one-dimensional hydraulic model to obtain a more accurate assessment of flood risk for the town and surrounding area. The aim of the Plan was to identify areas at risk of surface water flooding and assist with the development of capital schemes in future studies (Ref 1.12).

3. Existing Site Characteristics

3.1 The existing site

3.1.1 The site is situated on the Suffolk coast approximately halfway between Felixstowe and Lowestoft. The onshore area of the site comprises an area that extends inland from the coast to the eastern edge of Leiston and north towards Eastbridge, as shown in **Figure 3**. In addition, there are additional isolated areas that are included as part of the main site, areas of habitat creation and the off-site sports facilities in Leiston. A summary of the site study area is shown in **Figure 4.**

3.1.2 Within the main development site redline boundary, topography generally slopes from west to east and is predominantly rural undeveloped agricultural land, except for the existing Sizewell power station complex and the existing road network.

3.1.3 Further description on the site is provided in sections 3.2 to 3.5 of this **report**.

3.2 Topography

3.2.1 The remotely sensed Light Detection and Ranging (LiDAR) data shows topographic levels, which vary from approximately 19.7m AOD in the west and generally slope eastwards to approximately 0m AOD in the Sizewell Belts (**Figure 6**).

3.2.2 The highest areas are adjacent to Abbey Road (marked in **Figure 5**), while the lowest areas are in the lowland drainage network north of the existing Sizewell B power station.

3.2.3 The lowest topography in the areas are generally associated with watercourses and marshlands including the Sizewell Belts and the Minsmere Levels. The areas of existing urban development, such as Leiston town are generally positioned on areas of relatively higher elevation.

3.2.4 Whilst topographic levels in the area generally slope eastwards towards the coast, raised sand dunes with a shingle beach extends north and south along the coastline. The sand dunes with a shingle beach extend northwards to the Minsmere Sluice (south of Minsmere Nature Reserve) and has a topographic crest level of between 4.2m AOD and 6.0m AOD. Land directly west of the sand dunes with a shingle beach within the Minsmere Levels has a topographic level of between approximately 0m AOD and 1.0m AOD.

3.2.5 The existing topography in the proposed platform area generally slopes from south to north. The exception to this is along the existing sea defences where elevations vary from approximately 7.5m AOD up to approximately 12m AOD on the area known as the northern mound.

3.2.6 The location of the temporary construction area is on an outcrop of higher topography with the highest ground levels to the west of the area. However, at the southern and northern temporary construction area boundaries, the local slope direction varies. The local variation is generally southwards towards the Leiston Drain and Sizewell Belts in the south of the area and northwards towards the River Minsmere and Minsmere Royal Society for the Protection of Birds (RSPB) Reserve along the northern area.

3.2.7 The Sizewell Gap road is located at the bottom of a valley feature. There are two existing access roads that run north towards the existing Sizewell power station; the existing access road to the power station and the Sandy Lane track leading to Rosery Cottages. The existing power station access road is raised on an embankment with a lowest approximate level of 3.2m AOD in the middle of the access road rising to a level of approximately 5m AOD at the Sizewell A platform.

3.2.8 The Sandy Lane track to Rosery Cottages, to the west of the Pillbox Field, has a level at the junction with the Sizewell Gap road of approximately 4m AOD then rising to approximately 9.5m AOD on a topographical outcrop and then falling to a low at the end of the Sandy Lane next to Rosery Cottages with an approximate level of 1.8m AOD. The existing land level within the marshland adjacent to the drain and the end of the track has a level of 0.4m AOD.

3.2.9 The LEEIE is reasonably level with a gentle slope, down towards the northern and eastern site boundaries. The lowest topographic levels are in the north-western corner, north-eastern corner and along the south-eastern site edge. The railway embankment forms a topographically high feature along the south-western LEEIE boundary.

3.2.10 The proposed fen meadows at Halesworth and Benhall are sited on low-lying, relatively flat ground along existing watercourses. The fen meadow at Halesworth has a high point in the northern corner of 8.5m AOD and a low point of 5.6m AOD in the south-western corner of the site.

3.2.11 The fen meadow at Benhall has a slope that runs west to east. Two high points are found at 6.2m AOD at the north-west and south-west extents. A low point is found in the south-east corner at 3.1m AOD (**Figure 7**).

3.2.12 The marsh harrier habitat improvement area is sited on high ground with a high point in the north-western corner of 22.5m AOD and a low point at 10.5m AOD on the south-eastern corner to the east of the watercourse (**Figure 7**).

3.3 Environmental classifications

3.3.1 The surface water environment surrounding the proposed Sizewell C main development site supports sensitive water-dependent habitats that are of national and international importance. The area to the south and west of the main platform area is within the Sizewell Marshes Site of Special Scientific Interest (SSSI). While the area to the north is within the Minsmere to Walberswick Heaths and Marshes SSSI, Special Protection Area (SPA), Special Area of Conservation (SAC) and Ramsar site.

3.3.2 The proposed fen meadow and the marsh harrier habitat improvement areas are not within or adjacent to national and international habitat designations.

3.3.3 The existing southern access road to the existing Sizewell power station and the Pillbox Field are also not subject to national and international habitat designations. While the proposed western access road along the western boundary of Sizewell A and B is positioned outside but immediately adjacent to the eastern edge of the Sizewell Marshes SSSI.

3.4 Geology and Hydrogeology

3.4.1 The British Geological Survey (BGS) Geology of Britain maps show the main development site is on an area of bedrock geology of the Crag Group, formed predominantly of sand (Ref 1.16).

3.4.2 The main development site is located across six superficial geologies:

- The Lowestoft Formation formed of glacial till (diamicton);
- The Lowestoft Formation formed of sand and gravel;
- The Lowestoft Formation formed of clay and silt;
- Peat;
- Tidal Flat Deposits formed of clay and silt; and
- Marine Beach Deposits formed of sand and gravel.

3.4.3 The BGS maps also identify five areas of artificial ground within the site:

- Three are identified as being worked ground (undivided - void). These voids are; to the north of Lovers Lane, within an area identified as a disused pit by OS mapping, and to the east of Upper Abbey;
- One is identified as landscaped ground at the existing power station platform; and
- One is identified as made ground is north of the existing power station platform. Made ground is present where existing roads are located.

3.4.4 The marsh harrier habitat improvement area and fen meadow compensation sites are located away from the main development site.

3.4.5 The BGS maps show the marsh harrier site at Westleton and the fen meadow sites at Halesworth and Benhall are all on an area of bedrock geology of the Crag Group, formed predominantly of sand (Ref 1.16).

3.4.6 The BGS maps identify that both fen meadow areas are located on a superficial geology of Alluvium formed of clay, silt, sand and gravel.

3.4.7 While the marsh harrier habitat improvement area is located across four superficial geologies of:

- The Lowestoft Formation formed of diamicton:
- The Crag Group – Sand;
- The Lowestoft Formation formed of sand and gravel; and
- Areas of no deposits.

3.4.8 The Aquifer Designation map (Ref 1.17) indicates the bedrock geology of the site 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”.*

3.4.9 The Aquifer Designation map classifies the differing superficial deposits of the site with different aquifer classifications.

3.4.10 The Marine Beach Deposits and The Lowestoft Formation formed of sand and gravel are classified as ‘Secondary A’ aquifers. These are permeable strata capable of supporting water supplies at local rather than strategic scale and in some cases forming an important source of base flow to rivers.

3.4.11 The Lowestoft Formation formed of clay and silt is classified as a ‘Secondary B’ aquifer. These are predominantly lower permeability strata which may in part have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.

3.4.12 The Lowestoft Formation formed of glacial till (diamicton) is classified as a ‘Secondary (undifferentiated)’ aquifer. This is geology that is not unproductive but where the Secondary A or Secondary B aquifer definition is not suitable.

3.4.13 Tidal Flat Deposits and Peat are classified as being ‘unproductive’. These are geological strata with low permeability that have negligible significance for water supply or river base flow (Ref 1.17).

3.4.14 The National Soil Resources Institute Soilscapes web resource (Ref 1.18) identifies a total of five soil types across the site including the fen meadows, marsh harrier improvement areas and the off-site sports facilities, which are:

- Sand dune soils;
- Loamy and clayey soils of coastal flats with naturally high groundwater;
- Freely draining slightly acid sandy soils;
- Freely draining slightly acid but base-rich soils; and
- Fen peat soils.

3.4.15 A summary table presenting the geological properties by soil type and locating the site area is available in **Table 3.1**.

Table 3.1: Summary table of soil types, aquifer designations and drainage potential on-site

Soil Type	BGS Superficial Deposit Geology	Aquifer Superficial Deposit Designation	Natural Drainage Type	Approximate location(s) within site; site area name
Sand dune soils	Marine Beach Deposits	Secondary A	freely draining	Coastal extent; Platform along the coastal edge
Loamy and clayey soils of coastal flats with naturally high groundwater	Tidal Flat Deposits	Unproductive	naturally wet	Existing land to the north of Sizewell B; Platform and TCA eastern boundary
Fen peat soils	Peat	Unproductive	naturally wet	Associated with Sizewell Belts marshland and existing sewage treatment works area; Platform and SSSI crossing

Soil Type	BGS Superficial Deposit Geology	Aquifer Superficial Deposit Designation	Natural Drainage Type	Approximate location(s) within site; site area name
Freely draining slightly acid sandy soils	Lowestoft Formation – Sand and Gravel	Secondary A	freely draining	Majority of site; TCA, platform, LEEIE western boundary, western access road, the Pillbox Field and the fen meadows.
Freely draining slightly acid but base-rich soils	Lowestoft Formation - Diamicton	Secondary undifferentiated	freely draining	North of Leiston Old Abbey; TCA western edge, marsh harrier improvement area and LEEIE

3.5 Hydrology

a) Coastal (still water level and wave action)

3.5.1 The site is located on the east coast of England adjacent to the North Sea. The North Sea within this area is also referred to as Minsmere Haven.

3.5.2 Due to its location, the site could be exposed to coastal and tidal influences, including combination of extreme surge water levels and wave action. Further information is provided in **section 7.1** of this **report**.

3.5.3 The area of the main development site benefits from existing coastal flood defences. The Environment Agency has provided asset information of the coastal defences in **Table 3.2** and a flood defence plan (**Figure 8**).

3.5.4 The privately maintained embankment (5831) has been identified by the Environment Agency to have a crest level of 6.8m AOD. However, details of this embankment identified from LiDAR data supplied by the Environment Agency show that majority of this embankment has a crest level of approximately 10m AOD along most of its length with two low spots at 6.8m AOD and higher elevations (up to 12m AOD) at the northern mound.

Table 3.2: Coastal defence asset information

Asset Reference	Maintainer	Asset Type	Asset Description	Crest Level (m AOD)
168964	Environment Agency	Dunes	Artificially raised dune system	4.13
178292	Private	Dunes	Raised dune	4.195

Asset Reference	Maintainer	Asset Type	Asset Description	Crest Level (m AOD)
			system	
5831	Private	Embankment	Sizewell Power Station Embankment (Secondary defence line)	6.8
8759	Environment Agency	Dunes	Dune system with clay core	5.197

3.5.5 An earth embankment with a crest height level of approximately 9m AOD to 10m AOD exists along most of main development site's length. Higher elevations are found on the northern mound.

3.5.6 A sand dunes bund is positioned on the seaward side of the embankment coastal defence with a crest level of approximately 5m AOD. The bund acts as a berm with function to partially dissipate wave energy prior to reaching the main coastal defence.

3.5.7 Sand dunes with a shingle beach also extends from the main development site northwards to the Minsmere Sluice (south of Minsmere Nature Reserve) and beyond, with a crest height varying mainly between 4m AOD and 6m AOD.

3.5.8 The Environment Agency are responsible for the maintenance of the two coastal defences to the north and south of the existing and proposed main development site frontage. The sea defences to the east of the existing Sizewell power station complex and the proposed development are privately maintained by EDF Energy.

3.5.9 The existing shoreline management plan for this area (Ref 1.19) states that the planned policy for the frontage adjacent to the existing power station (Min 13.1) is hold the line up to 2105. The planned policy for the frontage to the north of the main development site (Min 12.4) is for managed realignment up to 2105, where overtopping of defences would be accepted, and flooding of the Minsmere Valley allowed. The planned policy for the frontage to the south of the main development site (Min 13.2) is for no active intervention.

b) Breach of sea defences

3.5.10 There are limited sections of man-made defences along the frontage, with defences tending to be set back behind the active shingle beach. The Minsmere Sluice does cut through the shore as a hard structure. Behind the natural shoreline there is the embankment to the northern end of the Minsmere valley and a more substantial bank and a maintained dune system set back in front of Sizewell Power Station (**Table 3.2**).

3.5.11 The existing shoreline management plan for this area (Ref 1.19) states that policy over the main section of Minsmere is to ‘Hold the Line’ initially, but with an underlying intent that management of the existing sand dunes with a shingle beach sea defences would cease if actions resulted in significant disruption to the natural ridge. This would lead the defences to be susceptible to erosion and potential breach.

3.5.12 In the past, there have been occasions when the sand dunes with a shingle beach over the Minsmere valley has breached. Although after many events this required intervention to maintain the defence. This indicates there might be a risk of breach in the future considering natural function of the shoreline and current climate change projections for sea level rise.

c) Fluvial

3.5.13 ‘Main rivers’ are larger watercourses that have been identified as being important by the Department for Environment, Food and Rural Affairs (Defra). While main rivers are usually larger streams and rivers, smaller watercourses of local significance may also be assigned this status. Main rivers are marked on an official document called the main river map which can be found at Environment Agency local offices or online (Ref 1.20).

3.5.14 Main rivers can include any structure that controls or regulates the flow of water into or out of the channel. There are two main rivers in the study area: Leiston Drain and Minsmere River. The Environment Agency regulates the main rivers.

3.5.15 Ordinary watercourses are every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows, but which does not form part of a main river. The Lead local flood authorities (LLFA), local authority (LA) or Internal Drainage Board (IDB) has powers on ordinary watercourses similar to the Environment Agency’s powers on main rivers and can carry out work on ordinary watercourses. All of the surface drainage channels in the study area, with the exception of the two main rivers, are ordinary watercourses.

3.5.16 The East Suffolk Drainage Board (Ref 1.21) covers the geographical area of the main development site. The main platform, SSSI crossing and a small area of the construction area are in the IDB district (**Figure 9**).

3.5.17 The site is in the hydrological catchment of the Leiston Drain, which is a Main River. The Leiston Drain system is located to the west of the proposed main platform area. Leiston Drain rises near Abbey Road in Leiston, from where it flows in an easterly direction until it reaches Lover's Lane (note that this reach is also referred to as Aldhurst Valley Stream, to denote the section upstream of its confluence with discharge from Leiston Sewage Treatment Works (STW)). The drain continues to flow eastwards through Sizewell Belts and Marshes. From here, it flows in a northerly direction in an artificial channel along the coast until it discharges into the sea at Minsmere Sluice.

3.5.18 The Minsmere River system is located to the north of the Sizewell C site. The Minsmere River rises as the River Yox, to the north west of Saxmundham. From here, it flows in an easterly direction towards Yoxford, downstream of which it is renamed the Minsmere River. It continues to flow in a south easterly direction through Middleton and Eastbridge, where it enters the extensive Minsmere wetland system. Flow becomes divided between the Minsmere New Cut, an engineered channel which drains into the sea at Minsmere Sluice, and the Minsmere Old River, the remnant of the natural channel which joins the New Cut just upstream of the Minsmere Sluice.

3.5.19 The Leiston Drain and Minsmere River, to the north of the proposed development, comprise low energy systems with extensive marshlands and field drains, which drain into the North Sea through the Minsmere Sluice.

3.5.20 The catchment of the Rivers Minsmere, Leiston Drain and Scotts Hall Drain, with a combined catchment area of approximately 80km^2 drains through the Minsmere Sluice into the North Sea (Ref 1.15). The Minsmere Sluice is the primary outfall into the sea for the Minsmere River, Leiston Drain and Scott's Hall Drain. The flow is controlled by tidal flaps and penstocks that limit discharge from the watercourses during high tide, and also limit the saltwater ingress. The majority of the Minsmere Sluice structures are operated and maintained by the Environment Agency, with the exception of the Scott's Hall Drain tidal flaps that are operated by RSPB.

3.5.21 Upstream of the Leiston Drain main river extent at Lover's Lane, the watercourse is an IDB ordinary watercourse known as the Leiston Beck.

3.5.22 The site intersects the Leiston Drain at two locations; Lover’s Lane to the west and south of Sandlings Walk (**Figure 6**).

3.5.23 The Sizewell Drain is an IDB ordinary watercourse that flows northwards past the western side of the existing Sizewell power station complex and north-east through the Sizewell Belts before joining Leiston Drain to the north.

3.5.24 Further unnamed ordinary watercourses and field drains on-site were identified using Ordnance Survey (OS) 2017 mapping. These watercourses are largely associated with the Sizewell Belts and the Minsmere Levels. There is potential for additional local drainage watercourses intersect the site which have not been identified by the OS mapping.

3.5.25 The fen meadow at Halesworth is to the north of the River Blyth and within the associated floodplain. The River Blyth is a main river and a series of local ordinary watercourses are on site and they connect to the River Blyth to discharge.

3.5.26 The fen meadow at Benhall Green is to the west of the River Fromus and within the associated floodplain. The River Fromus is a main river and a series of local ordinary watercourses are on site and connect to the River Fromus to discharge.

3.5.27 The marsh harrier habitat improvement area is near an ordinary watercourse that is adjacent to Wash Lane. This ordinary watercourse discharges into the Minsmere River.

4. Climate Change

4.1 Background

4.1.1 The risk of flooding from all potential sources will be increased as a result of climate change. Considering all potential sources of flooding at proposed Sizewell C development with main focus on coastal, breach, fluvial, surface water and groundwater flooding, the main aspects of climate change likely to impact the site are:

- Sea level rise, directly affecting coastal flood risk and also influencing fluvial flood risk due to backwater at Minsmere Sluice;
- Increase in storminess and associated wave action (and possibly surge);

- Increase in the intensity of rainfall events likely to affect surface water flooding;
- Increase in duration of rainfall events likely to affect groundwater flooding; and
- Increase in fluvial flows.

4.1.2 To assess the full range of risks that might need to be managed, there is a need to understand the reasonably foreseeable and credible maximum climate change impacts. The reasonably foreseeable is defined as a reasonable level of certainty that the future impacts of climate change would lie somewhere between the Central and Upper allowances, whereas an example of the credible maximum climate change is the H++ scenario provided by the UKCP09 projections (Ref 1.22).

4.1.3 The climate change allowances for the Sizewell C FRA have been principally derived from a combination of;

- Environment Agency's Flood Risk Assessment: Climate Change Allowances (Ref 1.7);
- UK Climate Projections 2018 (Ref 1.8); and
- BECC Scoping Paper: How to Define Credible Maximum Sea Level Change Scenarios for the UK Coast (Ref 1.23).

4.1.4 Based on current Environment Agency and ONR guidance (Ref 1.6 and Ref 1.14) discussed in **section 2** of this **report**, the Sizewell C FRA needs to consider climate change for the reasonably foreseeable scenario, whereas the credible maximum scenario would be considered in the FRA for testing mitigation at the end of the site lifetime and also for the Safety Case assessment for the Nuclear Site Licence.

4.1.5 For the reasonably foreseeable scenario, climate change allowances defined in the Environment Agency's Flood Risk Assessment: Climate Change Allowances (Ref 1.7) and the latest available UK Climate Projections were adopted.

4.1.6 In 2018, UK Climate Projections (UKCP18) were published (Ref 1.8), which provided an updated set of climate projections up to 2100 and exploratory projections up to 2300 in the UK and globally. In addition, tools to access climate data were redesigned to help decision-makers assess their risk exposure to climate.

4.1.7 The publishing of the UK Climate Projections 2018 led to a review of the climate change allowances applied to the assessment of flood risk for all sources of flooding for the Sizewell C Project. A summary of the previous sources of information and approach along with the findings of the review are available in UK Climate Change Projections 2018 – Review and Proposed Response Report (**Appendix 5**).

4.1.8 UKCP09 provided low probability, high-end allowances for sea-level rise for the period up to 2100, known as the H++ scenario range. This scenario range is a deliberately severe case of change to 2100 beyond the likely range but judged to be within physical plausibility. The intent of application of H++ is analysis of a worst-case change in the long-term planning of large infrastructure projects, including coastal power stations.

4.1.9 The H++ scenario from UKCP09 was not updated as a part of the UKCP18 projections study. Therefore, where appropriate, UKCP09 H++ or other high-end allowances were applied for the credible maximum scenario.

4.1.10 Climate change allowances for the assessment of flood risk at the Sizewell C site have been based on a construction and operational development lifetime between 2022 and 2090, interim spent fuel store being decommissioned at 2140 and theoretical maximum site lifetime of 2190.

4.1.11 As previously discussed in **section 1.2.14** of this **report**, there have been some alteration to the project lifetime since a substantial amount of supporting modelling has been carried out. This has resulted in a variation between the hydraulic model project lifetime considerations and those applied to the FRA. There is a difference of approximately 4 years which relates to the extension of the construction phase period from 2030 to 2034. This does not affect the climate change allowance for the fluvial flood risk as it is still within the same climate change epoch which runs up to 2039.

4.1.12 The difference in sea level rise from 2030 to 2034 is approximately 30mm based on 95th percentile of the RCP8.5 (UKCP18) climate change scenario. There is a minor difference in the sea level rise allowance applied to both the coastal and fluvial models, the overall impact on the modelled results is considered to be negligible. Also, by 2030 key infrastructure of the main development site, such as the coastal defence, SSSI crossing and the main platform would be substantially or fully completed.

4.1.13 The Description of Development (**Volume 2 Chapter 3** of the **ES**) (Doc Ref.6.3) estimate that the coastal defence would be completed by Phase 4 of the construction. The assumed start of construction in 2022, the defence would be raised to the design level of 10.2m AOD by 2030. The results from overtopping for this defence crest for later epoch in 2140 show minor overtopping with sea level rise allowance of 1.5m more than for 2030 epoch. Therefore, it is considered that 30mm would not result in overtopping of the raised defence at 2034.

4.2 Coastal

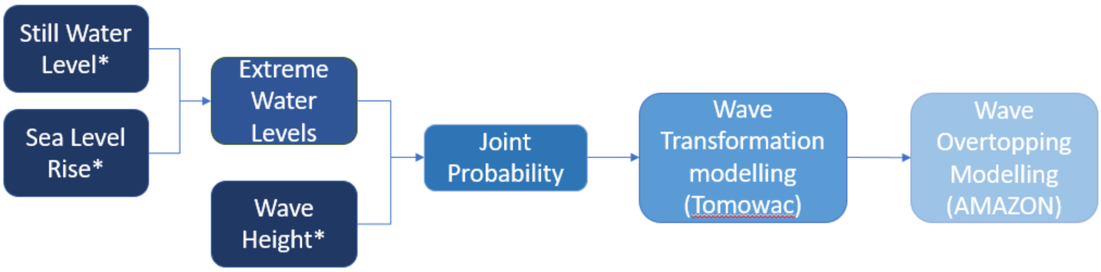
a) Overview

4.2.1 The wave overtopping scenarios for the main hard sea defences required the application of climate change allowances to various parameters to be used in combination. The still water levels and sea level rise predictions were used to calculate the extreme water levels.

4.2.2 The extreme water levels were then used with extreme offshore wave height to undertake a joint probability analysis. The extremes derived from the joint probability analysis were then used as boundary conditions to undertake the wave transformation modelling (TOMOWAC model) to obtain the nearshore wave conditions. These nearshore wave conditions were then used as the boundary conditions for the wave overtopping modelling (AMAZON model) in conjunction with the previously calculated joint probability extreme water levels. A summary of this process can be found in Ref 1.36.

4.2.3 The still water levels and wave heights required the individual application of appropriate climate change allowances to each of them, such as sea level rise, storm surge and increase in significant wave height as appropriate.

Plate 4.1: Summary of inputs into the coastal (wave overtopping) modelling identifying where climate change allowances were applied



*Climate Change allowance applied

b) Sea level rise

4.2.4 The UKCP18 Marine Projections provide estimates of changes in coastal sea level (Ref 1.8). The time-mean sea level projections of UKCP18 are based on updated scientific methods and climate change scenarios, which include ice dynamics in projections of future sea level rise. This approach results in systematically larger values than presented in UKCP09.

4.2.5 UK coastal flood risk is expected to increase over the 21st century and beyond under all climate change scenarios investigated in UKCP18. Therefore, an increase in the frequency and magnitude of extreme water levels around the UK coastline is expected. This increased future flood risk is considered to be most likely dominated by the effects of time-mean sea level rise, rather than changes in atmospheric storminess associated with extreme sea level events. Exploratory time-mean sea level projections up to 2300 suggest that the UK sea levels will continue to rise over the coming centuries under all climate change scenarios.

4.2.6 For this FRA, in accordance with the Environment Agency advice (Ref 1.24), for the reasonably foreseeable climate change scenario regarding sea level rise, UKCP18 Representative Concentration Pathways with radiative forcing level of 8.5 (RCP8.5) projection for 95th percentile were adopted. The 21st century projections were used up to 2125, and the exploratory projections were used up to the theoretical site lifetime of 2190.

4.2.7 As discussed in **Section 2.2f)** of this **report**, in December 2019 the Environment Agency published updated guidance on sea level rise allowances for flood risk assessments based on the UKCP18 results (Ref 1.8). This updated guidance was not available at the time of this FRA and associated hydraulic modelling studies and therefore the UKCP18 allowances for sea level rise were used adopting the RCP8.5 at 95th percentile. Since the updated guidance is based on average of RCP8.5 95th and 70th percentiles, it is considered that the adopted allowances for the Sizewell C study are slightly more conservative.

4.2.8 It was recognised early within the Sizewell C FRA process that no UKCP09 upper-end estimates or H++ scenarios existed beyond the year 2115. It was agreed between NNB, EA and ONR that the British Energy Climate Change working group (BECC) should be used to investigate this. BECC study goes beyond 2100 and provides advice on how to define a credible maximum sea-level rise scenario over the full theoretical lifetime of a new station (160 years) for the UK coast (Ref 1.23). This advice was used in place of UKCP09 H++ scenarios, as it provided more conservative rates of sea level rise. The BECC allowances were used in place of H++ for scenarios beyond 2115. For epochs earlier than 2115, where credible maximum was assessed, the UKCP09 H++ was used.

4.2.9 The 2008 base year was used in the coastal overtopping assessment where more conservative extreme water levels derived for the Sizewell C project relative to 2008 were used. For the tidal breach and inundation modelling, slightly less conservative extreme water levels based on the Environment Agency Coastal Flood Boundary Conditions Dataset with base year of 2017 were used to determine the maximum impact.

4.2.10 Climate change allowances for sea level rise for the wave overtopping assessment up to 2190 are outlined in **Table 4.1**.

Table 4.1: Climate change allowances for sea level rise specifically for wave overtopping (relative to 2008 base year)

Development phase	Year	Climate change scenario	Climate change allowance (m)
End of substantial construction / commissioning	2030	95%ile of RCP8.5 (UKCP18)	0.148
End of operation	2090	95%ile of RCP8.5 (UKCP18) / H++ (UKCP09) with land movement and surge	0.921 / 1.530
Interim spent fuel store decommissioned	2140	95%ile of RCP8.5 (UKCP18) / BECC Upper	1.815 / 3.920
Theoretical maximum site lifetime	2190	95%ile of RCP8.5 (UKCP18) / BECC Upper	2.645 / 4.820

c) Storm surge change

4.2.11 Storm surges are defined as short-lived increases in local water level above that of the astronomical tide, mostly driven by atmospheric pressure gradients and winds, typically in shallow seas.

4.2.12 UKCP18 results suggest relatively small contribution from storm surge changes to the extreme water levels. Currently, there is low confidence in predicting whether storm surges would become more severe, less severe or remain the same.

4.2.13 The previous assessment (Ref 1.25) of storm surge allowances from UKCP09, Environment Agency guidance (Ref 1.7) and other Sizewell related studies were compared for the reasonably foreseeable scenario.

4.2.14 For Sizewell C, the recommended reasonably foreseeable storm surge allowance for flood risk assessment is zero and the credible maximum storm surge allowance ranges from 0.7m to 1.0m beyond 2085. The credible maximum estimates of storm surge are at the very top end of the modelled estimates of UKCP09. For the BECC estimates (Ref 1.23), surge is already integrated into the values presented.

4.2.15 Since UKCP18 does not provide clear guidance on potential changes to storm surge in the future and the approach adopted in the previous assessment has been retained, therefore no surge is applied to the 'reasonably foreseeable' scenario for RCP8.5.

d) Wave height change

4.2.16 The Environment Agency guidance (Ref 1.7) suggests assuming a precautionary increase in wave height of 5% up to 2055 and then 10% from 2055 to 2115. Although the seasonal mean and extreme waves are generally expected to experience little change in the North Sea. There would also be a change in wave climate associated with sea level rise, as waves propagate across slightly deeper water and would break slightly closer to shore.

4.2.17 Significant uncertainties are associated with both the future position of the storm track over the UK and the projections of (wind and) wave climate within UKCP09, therefore currently recommended increases in wave height at Sizewell C for flood risk assessment are 10% for the reasonably foreseeable scenarios and 15% for the credible maximum scenarios with no change in predominant wave direction. These allowances are more conservative than those presented in the guidance (Ref 1.7).

4.2.18 The UKCP18 marine projections estimate changes in surface waves. The UKCP18 used an ensemble of seven global wave models to explore potential changes in mean and mean annual maximum significant wave height (SWH) under the RCP8.5 scenario.

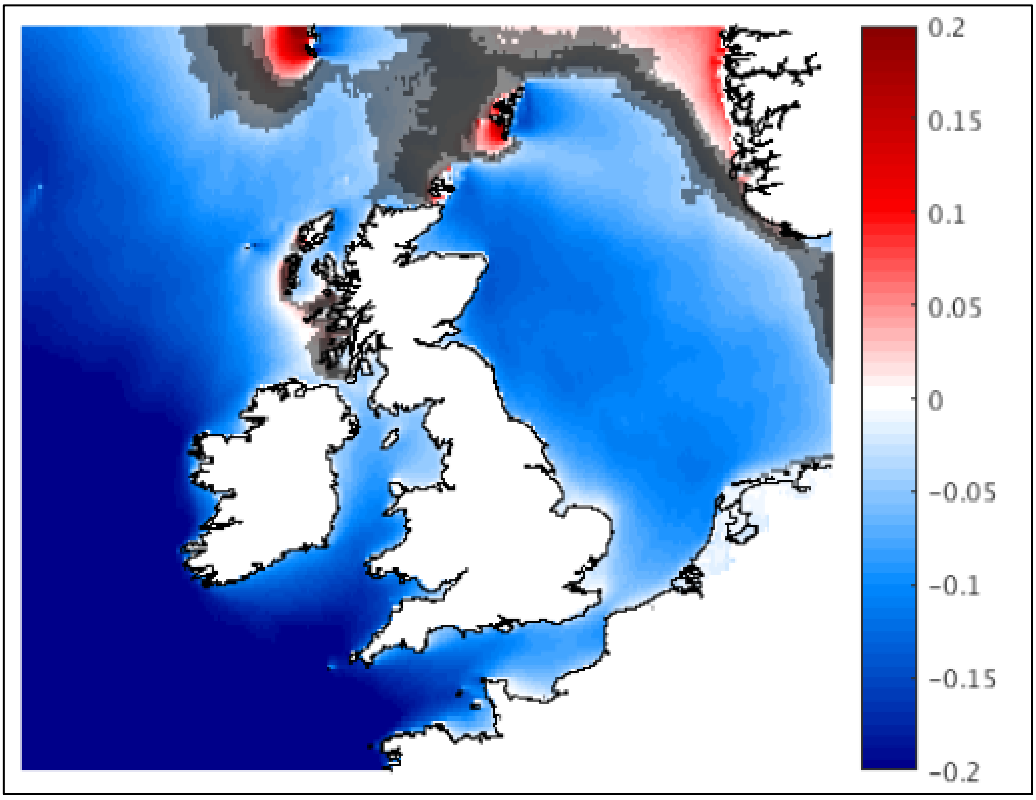
4.2.19 The UKCP18 results from these simulations suggested an overall decrease in mean SWH around most of the UK coastline of 10-20% over the 21st century. However, the change in wave height differs among models and coastal location.

4.2.20 In addition, high resolution regional model projections are presented based on a single model under RCP4.5 and RCP8.5 scenarios showing more consistent changes across the 21st century and RCP for the more exposed coastline, where remote generation of swell waves dominates the SWH.

4.2.21 The projections of changes in wave climate are presented in the UKCP18. However, the associated data is not available in the UKCP18 user interface and it is not possible to investigate wave projections at a local scale relative to the development.

4.2.22 **Plate 4.2** illustrates changes in mean annual maximum significant wave height at the end of the 21st century for the RCP8.5 scenario, derived from the regional wave model. This illustration confirms that annual mean significant wave heights at the development location is likely to reduce with climate change.

Plate 4.2: Change in mean annual maximum significant wave height (m) from UKCP18 regional wave model (Ref 5.2. 8)



4.2.23 As the UKCP18 results indicate a general relative reduction in significant wave height combined with the lack of clear recommendations or data available to derive appropriate allowances from UKCP18, the more conservative UKCP09 wave height assumptions have been applied in this Sizewell C FRA study. Therefore, a climate change allowance of 10% for increase in wave height was applied for all epochs for the reasonably foreseeable scenarios and a 15% for the credible maximum scenarios.

4.2.24 These allowances were applied in joint probability assessments and consequently in wave transformation modelling alongside suitable sea level rise conditions.

e) Summary of climate change applied

4.2.25 The FRA reviewed on-site impacts to the development for four key development timeframes; the construction phase with climate change up to 2030 when the construction phase would be substantially complete, the operation phase up to 2090, the end of interim spent fuel store decommissioning at 2140 and the theoretical maximum site lifetime at 2190.

4.2.26 Climate change has been applied to the three parameters of sea level rise, storm surge and wave height. The sea level rise allowances are summarised in **Plate 4.1**.

4.2.27 The climate change allowance for storm surge involves the application of the 1m surge to epochs beyond 2085 for the credible maximum scenarios only based on the H++ scenarios and no surge allowance for the reasonably foreseeable scenarios.

4.2.28 For the wave height climate change allowance, a 10% increase climate change allowance was applied for all epochs for reasonably foreseeable scenarios and a 15% increase climate change allowance for credible maximum scenarios.

4.2.29 In December 2019, the Environment Agency published updated guidance on sea level rise allowances for flood risk assessments based on the UKCP18 results. This updated guidance was not available at the time of the modelling studies carried out for the Sizewell C project and therefore the UKCP18 allowances for sea level rise were used adopting the RCP8.5 at 95th percentile. Since the updated guidance is based on average of RCP8.5 scenario at 95th percentile and 70th percentile, it is considered that the adopted allowances for the Sizewell C study are slightly more conservative than the revised allowances recently published by the Environment Agency.

4.3 Breach and coastal inundation

4.3.1 UK coastal flood risk is expected to increase over the 21st century and beyond under all climate change scenarios. This results in an expectation that both frequency and magnitude of extreme water levels around the UK coastline will increase.

4.3.2 The UKCP18 marine projections provide estimates of changes in coastal sea level, including extreme water levels that arise from storm surges and surface waves.

4.3.3 Tidal breach analysis was conducted to inform a comprehensive assessment of coastal flood risk. These tested both on-site and off-site risk at the end of construction phase and at the end of site lifetime. For the purpose of this assessment, it is proposed to use the UKCP18 RCP8.5 allowances for all considered epochs.

4.3.4 Sea level rise allowances are presented as an overall rise in metres. The overall sea level rises for the differing development phases are presented in **Table 4.2**, all values are relative to a 2008 baseline year.

Table 4.2: Climate change allowances for tidal / coastal flood risk

Development phase	Year	Climate change scenario	Climate change allowance (m)
End of substantial construction / commissioning	2030	95%ile of RCP8.5 (UKCP18)	0.148
End of operation	2090	95%ile of RCP8.5 (UKCP18)	0.921
Interim spent fuel store decommissioned	2140	95%ile of RCP8.5 (UKCP18)	1.815
Theoretical maximum site lifetime	2190	95%ile of RCP8.5 (UKCP18)	2.645

4.4 Fluvial

a) Overview

4.4.1 The fluvial modelling undertaken contains three aspects of climate change allowance; peak river flows, rainfall intensity and sea level rise at the downstream boundary of the model. Allowances (in %) for increases in fluvial flows and intensity of rainfall were applied to inflow boundary conditions, whereas sea level rise was applied at the tidal boundary at the Minsmere outfall.

4.4.2 The UKCP18 land projections only provide changes in rainfall patterns. In summary, the UKCP18 states that over land the projected general trend of climate change impacts in the 21st century is similar to UKCP09, with a move towards warmer, wetter winters and hotter, drier summers. Rainfall patterns across the UK are not uniform. They vary on seasonal and regional scales and will continue to vary in the future.

4.4.3 The projections show a pattern of larger increases in winter precipitation over southern and central England and some coastal regions towards the end of the century. Summer rainfall reductions tend to be largest in the south of England. These key messages refer to total rainfall over a 3-month season and do not infer information about the intensity of individual rainfall events.

4.4.4 The allowances for peak river flow and peak rainfall intensity in ‘Flood risk assessments: climate change allowances’ (Ref 1.7) have not been updated yet to reflect the changes based UKCP18 results. This is because high resolution rainfall projections were only published recently (September 2019) and research is still underway to assess the impact of the rainfall projections in UKCP18 on peak river flow. It is anticipated that Environment Agency would publish updates to these allowances in late 2020.

4.4.5 Further details on climate change allowances for the downstream tidal boundary at the Minsmere sluice and outfall are given in **section 4.4d)** of this **report**.

4.4.6 The application of climate change allowances to surface water drainage is addressed separately in **section 4.5** of this **report**.

b) Rainfall intensity

4.4.7 The Environment Agency guidance on climate change allowances for FRAs (Ref 1.7) provides peak rainfall intensity allowances in small and urban catchments for the Central and Upper end scenarios. These allowances are applicable across all of England.

4.4.8 Together with overall guidance on climate change allowances for flood risk assessments, the Environment Agency also published guidance on ‘Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities’ (Ref 1.15) that provides further guidance in accordance with NPPF and supporting guidance.

4.4.9 The ‘Adapting to Climate Change’ guidance, provides the Upper End and H++ Scenario allowances for both rainfall intensity and peak river flows. These allowances are based on UKCP09 or research using UKCP09 data undertaken by the Environment Agency.

4.4.10 It is understood the published fluvial and pluvial allowances remain valid. The current guidance suggests that UKCP09 provides useful information on changes to rainfall across the UK, which is robust for more common events such as changes to the wettest day of a season. While typically for flood management purposes, the concern is for rarer events such as the 1 in 20-year or rarer, and for such scenarios the recommendation is to use allowances provided in the guidance.

4.4.11 The Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities guidance (Ref 1.15) states that the rainfall intensity climate change allowances *"should be used for small catchments and urban/local drainage sites. For river catchments over, 5km^2, the peak flow ranges should be used."* The guidance further states that *"no H++ scenario is provided for changes to extreme rainfall."*

4.4.12 Since low-lying catchment area in the Sizewell model where direct rainfall method is applied is larger than 5km^2, climate change allowances derived for peak river flow were used as described in **section 4.4c)** of this **report**.

c) Peak river flow

4.4.13 The Environment Agency guidance on climate change allowances for increase in peak fluvial flows (Ref 1.7) considers the geographical location, lifetime of the proposed development, Flood Zone and vulnerability classification associated with the type of development.

4.4.14 The site is in the Anglian river basin and climate change allowances used are specific to this river basin. The proposed development is 'Essential Infrastructure' under the NPPF criteria. Therefore, the higher central and upper end climate change scenarios are appropriate.

4.4.15 The High++ climate change allowances are to be used where developments are very sensitive to flood risk and with lifetimes beyond the end of the century. The H++ climate change allowance is therefore considered appropriate to be used when assessing the flood risk under the credible maximum scenario.

4.4.16 Summary of climate change allowances applied in the hydraulic model for the increase in rainfall intensity and peak river flow for considered epochs are presented in **Table 4.3**.

4.4.17 For epochs beyond 2115 (2080s epoch) no extrapolation was applied. The 35%, 65% and 80% allowances were used in accordance with the 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk

Management Authorities' guidance (Ref 1.15), which states: *'For changes beyond the 2080s, it is recommended that the 2080s changes are used'.*

4.4.18 **Table 4.3** confirms that post-construction, key development phases are within the same climate change epochs and will not be run separately. Instead, different allowances would be assessed, such as Higher Central and Upper End allowances for reasonably foreseeable scenarios and the H++ as credible maximum scenario.

Table 4.3: Climate change allowances for fluvial flood risk

Development phase	Year	Climate change scenario	Climate change allowance
End of substantial construction / commissioning	2030	Upper End Allowance / H++ Scenario	+25%
End of operation	2090	Higher Central / Upper End / H++ Scenario	+35% / +65% / +80%
Interim spent fuel store decommissioned	2140		
Theoretical maximum site lifetime	2190		

d) Tidal boundary

4.4.19 The Minsmere tidal sluice and outfall structure controls the interaction between the fluvial and tidal hydraulic systems. To account for sea-level rise due to climate change, UKCP18 RCP8.5 allowances at 95th percentile was applied to derived tide levels for appropriate epochs in line with the ONR and Environment Agency advice on 'Use of UK Climate Projections 2018 (UKCP18) by GB Nuclear Industry' (Ref 1.14).

4.4.20 Following review of the 'UKCP18 Review and Proposed Response' technical note (first issued 13 March 2019), the EA provided comments and advice on 'How to extrapolate the UKCP18 dataset for sea level rise allowances beyond 2100' (Ref 1.24). In accordance with this advice, the UKCP18 21st century projections were extrapolated up to 2125. Beyond 2125, the exploratory projections were used.

4.4.21 Derived cumulative sea level rise allowances (relative to 2017 base year) were applied to the tide curve at Minsmere outfall for the considered climate change epochs/ key points in time for the Sizewell C development (**Table 4.4**).

Table 4.4: Derived cumulative sea levels rise allowances (2017 base year) for Sizewell C key development points

Development Key Point	Cumulative Sea Level Rise (m)
2030	+0.094
2090	+0.867
2140	+1.761
2190	+2.591

4.5 Surface water

4.5.1 As previously discussed in **section 2.3 d)** of this **report**, the rainfall intensity allowances are currently under review due to the recent publication of UKCP18. However, it is understood the existing pluvial allowances remain valid at present.

4.5.2 The ‘Adapting to Climate Change’ guidance (Ref 1.15) recommends that the surface water drainage shall use the peak rainfall intensity allowance.

4.5.3 The FRA Climate Change Allowance guidance (Ref 1.7) identifies the peak rainfall intensity allowance in small and urban catchments should be assessed for both the Central and Upper End allowance to understand the range of on-site and off-site impact using the 2060 – 2115 epochs (**Table 4.5**).

4.5.4 The Outline Drainage Strategy has confirmed the drainage design would include a 20% allowance for climate change (**Volume 2, Chapter 2** of the **ES)** (Doc Ref. 6.3). This is based on a low flood risk vulnerability classification and total potential change anticipated for the ‘2080s’ (**Table 4.5**).

Table 4.5: Peak rainfall intensity allowance in small and urban catchments (use 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%

4.6 Groundwater

4.6.1 The groundwater model prepared in FEFLOW (Ref 1.26) has modelled future groundwater behaviour in response to recharge, rainfall projections and evapotranspiration with a provision for climate change for a period up to 2040. The climate change allowances were derived from UKCP18 (Ref 1.8). Beyond 2040, the baseline and ‘with development’ scenarios show the same behaviour. Comparison of sea level rise and topography indicates increasing inundation over time after 2040 (Ref 1.26).

a) Rainfall

4.6.2 The UKCP18 rainfall projections were applied to the soil moisture balance model. The projected rainfall data is provided as absolute values and percentage anomalies relative to a historic baseline dataset. The absolute rainfall values were considered inappropriate for use in this model as the format implies constant daily rainfall values throughout each month in a series of 30-year future epochs. This reduces the dataset variability compared to the historical time series.

4.6.3 The rainfall anomaly projections contain variation in the rainfall. The UKCP18 projections are presented in three historical time series, which are; 1961-1990; 1981-2000; and 1981-2010.

4.6.4 The most recent time series was selected for use as the baseline due to providing the closest match to the original model calibration period of 2010 to 2015, while incorporating climate variability. The daily time series were developed by applying the appropriate monthly anomaly in each decade to a corresponding daily value in the historical record.

b) Evapotranspiration

4.6.5 The UKCP18 climate projections were used to derive recharge time series representing ‘wet’, ‘intermediate’ and ‘dry’ conditions during construction and operation of Sizewell C.

4.6.6 The higher emissions scenarios in UKCP18 are associated with the highest temperature anomalies, although, there is no systematic relationship between temperature and rainfall overall. The following projections were selected for modelling the future scenario of the site:

- **Wet scenario:** RCP6.0 simulation 2379 (giving the 1st percentile of temperature and 99th percentile of rainfall across all scenarios);

- **Intermediate scenario:** RCP6.0 simulation 2350 (50th percentile of both temperature and rainfall); and
- **Dry scenario:** RCP8.5 simulation 2573 (giving the 99th percentile of temperature and 1st percentile of rainfall).

4.6.7 The data from the UKCP18 projections are available as monthly anomalies for a series of 30-year epochs up to 2100 using the 1981-2010 values for:

- mean air temperature at 1.5 m, T [ºC];
- net surface short-wave radiation flux R_{ns} [W m-2];
- net surface long-wave radiation flux R_{nl} [W m-2];
- maximum air temperature at 1.5 m, T_{max} [ºC]; and
- minimum air temperature at 1.5 m, T_{min} [ºC].

4.6.8 The potential evapotranspiration was estimated using known approaches that are further described in the Groundwater Scenario Modelling report (Ref 1.26). The input parameters for radiation, air temperature, air humidity and wind projections were derived using UKCP18. The saturation vapour pressure is dependent on temperature.

4.6.9 Net radiation is calculated using the net incoming and outgoing long wave radiation anomalies with the UKCP18 projections relative to the baseline conditions. While historical radiation observations are not available for Sizewell C model domain. However, an alternative method was applied and is described in detail in the Groundwater Numerical Modelling Report (**Volume 2, Chapter 19 Appendix 19A** of the **ES**) (Doc Ref. 6.3).

4.6.10 The daily maximum and minimum temperature parameters were obtained using monthly UKCP18 anomalies to the daily historical observations for the 1981-2010 baseline period. The wind speed data in UKCP is only available for 10 m above ground level and were converted to wind speed at 2 m above ground level.

4.6.11 The relative humidity projections, necessary for the actual air vapour pressure, were obtained from UKCP18. Analysis of the relative humidity and wind speed projections showed no overall decreasing or increasing trend from 2010-2080, although seasonal and inter-annual variability was observed. Values for these parameters for 2080 onwards were obtained by cycling through the original projection dataset.

4.6.12 Further information on the data used in the evapotranspiration estimate of the groundwater model is available in the Groundwater Scenario Modelling report (Ref 1.26).

c) Applied recharge

4.6.13 The transient soil moisture balance model that is used to generate the long-term recharge time series for the FEFLOW recharge zones applied the climate projections described in evapotranspiration section (**section 4.6b)** of this **report**). The model was run for the 'wet', 'intermediate' and 'dry' scenarios that are described in the evapotranspiration section (**section 4.6b)** of this **report**).

d) Surface water

4.6.14 The surface water network has been allowed for in the groundwater model. The increase in watercourse level at the Minsmere sluice has been allowed for as a time varying increase. This is to account for the different rates of sea level rise that influence the level in the watercourses upstream of the Minsmere sluice.

e) Abstractions

4.6.15 The groundwater and surface water abstraction rates remained the same as were previously modelled. No climate change allowance was made on this aspect of the groundwater model.

f) Sea level

4.6.16 Using the UKCP18 projections, the long-term increases in sea level were applied to each of the climate scenarios:

- **Dry scenario.** The 95th percentile of sea level rise was applied to reflect a high degree of ice melt and thermal expansion of the oceans, in accordance with the associated high temperatures projected. This is equivalent to approximately 12 mm/year on average between 2015 and 2099);
- **Wet scenario.** The 5th percentile of sea level rise was applied, reflecting a lower rate of temperature increase, reduced thermal expansion of the oceans and less ice melt. This is equivalent to approximately 6 mm/year on average between 2015 and 2099;

- **Intermediate scenario.** The 50th percentile of sea level rise was applied. This is equivalent to approximately 9 mm/year on average between 2015 and 2099.

4.6.17 The application of these data provides appropriate boundary conditions for the groundwater and surface water systems near the coast.

5. Baseline (Existing) Flood Risk

5.1 Historical flooding records

5.1.1 The East Suffolk Councils Strategic Flood Risk Assessment (SFRA) historic flood records maps provide location points for historic flood events from fluvial, tidal, sewer, groundwater, highway drainage and surface water sources (Ref 1.28).

5.1.2 The historic flood events maps show the main development site to be located partly within an area affected by the 1953 tidal surge flood event.

5.1.3 The Flood Study of River Minsmere and Leiston Drain (Ref 1.28) suggests that flooding reached Reckford Bridge (approximately 400m downstream of the Middleton village) in 1968 and 1993 during extreme storm surge events.

5.1.4 The BEEMS report TR252 on estimation of extreme sea levels at Sizewell (Ref 1.29) refers to total of four extreme storm surge events:

- 1927 with tide level of 3.10m AOD;
- 1938 with tide level of 3.25m AOD;
- 1949 with tide level of 3.00m AOD; and
- 1953 with tide level of 3.44m AOD.

5.1.5 In the update on estimation of extreme sea levels at Sizewell Report, TR322 (Ref 1.30) an additional extreme storm surge event on 5th December 2013 is mentioned when tide level reached 3.26m AOD at Lowestoft, including a skew surge of 2.06m.

5.2 Existing flood zones

5.2.1 The Environment Agency's Flood Map for Planning shows the site is in Flood Zones 1, 2 and 3 (low to high risk of flooding from rivers or the sea) (Ref 1.31) (**Figure 10**, **Figure 11, Figure 12 and Figure 13**). The outputs of both fluvial and tidal modelling informed the flood zone extents (Ref 1.32).

5.2.2 Previously, the Environment Agency had provided their Flood Map for Planning in May 2019. The Environment Agency has since updated this map in December 2019. A visual comparison of the updated flood map to the previous flood map indicates there are no significant variations identified. The figures within the FRA are based on the March 2019 dataset.

5.2.3 Flood Zone 3b is defined and provided in the East Suffolk SFRA (Ref 1.27). The Flood Zone 3b is shown in (**Figure 15**) in relation to the proposed development redline boundary.

5.2.4 Flood Zones are defined in **Table 2.1.** The extents are defined as undefended flood extents. This means the flood zone extent is drawn without the presences of any flood defences or their standard of protection.

5.3 Coastal flood risk

5.3.1 The present-day coastal flood risk depends on a variety of environmental conditions, notably the combined probability of extreme water levels (astronomical tides and surge) and wave climate (off-shore to near-shore).

5.3.2 The coastal formation of the seabed, shoreline and beach influence the wave climate and the wave transformation process. The flood and erosion risk depend on the position and height of the formal or informal flood defences and their interaction with the water.

5.3.3 The existing secondary coastal flood defences in front of the proposed main platform area have a crest level of approximately between 9m AOD to 10m AOD with two low spots at 6.8m AOD. The sand dunes in front of the defence have a crest of up to 6.2m AOD. Taking into consideration both still water levels and the nearshore wave height, the risk of the existing man-made coastal defences being overtopped is very low for all considered events, i.e. 1 in 200-year, 1 in 1,000-year and the 1 in 10,000-year event.

5.3.4 The existing defences are described in **section 3.5a** of this **report**. All the sand dunes with shingle beach are at risk of being overtopped during considered baseline events of 1 in 20-year, 1 in 200-year and 1 in 1,000-year annual probabilities when taking into consideration nearshore wave heights, still water levels and associated climate change. The wave overtopping could also increase the risk of a breach of these sand dunes with a shingle beach.

5.3.5 The sub-tidal part of the beach along the existing power station complex frontage is sand-dominated with inner and outer longshore bars that run parallel to the shore. The longshore bars are a conduit for longshore sand transport and act to dissipate some wave energy by causing waves to break which reduces the remaining wave energy at the shoreline.

5.3.6 The Environment Agency has recently prepared a coastal inundation 2D-TUFLOW model for the East Anglian coastline (Ref 1.33). The model has divided up the coastline into smaller sections. At each section, the wave overtopping discharges were calculated and then the water was spread across the topography associated with the relevant section. This was undertaken for each discreet model area and their associated section for all the modelled event scenarios.

5.3.7 The Environment Agency's 2D-TUFLOW inundation model was developed for the Leiston, Sizewell and Minsmere area for the defended and undefended scenarios. Three return periods provided by the Environment Agency from their modelling were 1 in 20-year, 1 in 200-year and 1 in 1,000-year events.

5.3.8 The defended scenarios for the present day show the existing flood defences prevent coastal inundation (**Figure 17**). While the undefended scenarios show a significant inundation in absence of the flood defences (**Figure 18**).

5.3.9 Various additional sources of information have been referred to for assessing present day probabilities of extreme still water levels. **Table 5.1** shows the extreme still water level probabilities for an illustrative 2017 baseline. The year 2017 was chosen for an illustration of present-day extremes, as 2017 was the base year of the recently published 2018 Environment Agency Coastal Flood Boundary Conditions Dataset (Ref 1.31) and the UKCP18 (Ref 1.8) datasets.

5.3.10 This FRA focusses predominantly on the 1 in 200 and 1 in 1,000-year events. The Safety Case will also evaluate 1 in 10,000 and 1 in 100,000-year events. The preferred datasets for assessment of coastal overtopping are the BEEMS TR252 and TR322 studies (Ref 1.29 and Ref 1.30). These studies were developed for Sizewell to derive extreme sea levels taking into consideration long records at Lowestoft tide gauge station and additional gauge station installed to monitor sea levels around Sizewell B. Derived extreme sea levels from the BEEMS studies are higher in comparison with the Environment Agency Coastal Flood Boundary Conditions Dataset and are considered to be more conservative.

5.3.11 Since both Environment Agency Coastal Flood Boundary Conditions Dataset (2011) and BEEMS water levels are relative to 2008 base year, they were uplifted to 2017 by applying sea level rise based on UKCP18 95th percentile of RCP8.5 projections.

Table 5.1: Extreme Still Water Levels for 2017 illustrative year

Annual Probability	Coastal Flood Boundary Conditions Dataset 2011 (m AOD)	BEEMS 2014 (m AOD)	Coastal Flood Boundary Conditions Dataset 2018 (m AOD)
1:200	3.18	3.71	3.12
1:1,000	3.60	4.25	3.44
1:10,000	4.26	5.11	3.90

(1) Coastal Flood Boundaries Dataset 2011 study (Ref 5.2. 34)
(2) BEEMS 2014 TR252 study (Ref 5.2. 32) and BEEMS 2014 TR322 study (Ref 5.2. 33)
(3) Coastal Flood Boundaries Dataset 2018 study (Ref 5.2. 31)

5.3.12 For the Sizewell C Project, a study on joint probability for extreme water levels combined with waves was carried out and is presented in the BEEMS Technical Report on derivation of extreme wave and surge events at Sizewell (Ref 1.36). The JOIN-SEA method of calculating the joint probability for combined waves and sea levels was developed by HR Wallingford funded by Defra/Environment Agency Flood and Coastal Defence research and development programme over many years.

5.3.13 The methodology applied to the Sizewell C study is derived from “Use of Joint Probability Methods in Flood Management: A Guide to Best Practice, R&D Technical Report FD2308/TR2” (Ref 1.37). This approach was recommended by the Environment Agency as the best approach at the time of the assessment.

5.3.14 When waves are introduced, slightly lower extreme water levels are applied to maintain the combined probability. A number of wave / water level combinations were derived for each joint probability, including different wind /wave directional sectors.

5.3.15 For the Sizewell C Project, a study was carried out to transform the offshore joint probability scenarios to nearshore conditions, due to the influence of beach shallowing on wave shape and energy. The TOMOWAC model was used for this purpose, as presented in BEEMS Technical Report TR319 (Ref 1.37). The model outputs are available at a range of locations along the shoreline (and at various distances from the beach), for each joint probability water level / wave height and direction scenario. A sample of derived joint probability conditions is presented in **Table 5.3**.

Table 5.2: Baseline Joint probability of Extreme Still Water Level and Nearshore Wave Conditions

Climate Change Scenario*	Annual Probability / JP combination code	Extreme Still Water Level (m AOD)	Nearshore Wave Height (Hs, m)*
2008 Baseline	1:200 / B 3	3.18	2.85
	1:1,000 / F 2	4.02	3.20
	1:10,000 / F 1	4.93	3.61

*Nearshore wave conditions taken for Profile 3 (middle of the Hard Coastal Defence Feature) approximately 200m offshore, sector 1 from 30 degrees north.

5.3.16 As discussed in **section 5.3.5** of this **report**, the presence of the sub-tidal longshore sand bars may contribute to dissipation of some of the wave energy nearshore. There is concern that the sand bars might erode in the future. That would most likely represent greater flood risk as it would result in the greater wave energy nearshore.

5.3.17 An additional series of lowered sand bar scenarios were analysed in the wave transformation model by the lowering of the sand bank by 5m with assumption the sediment is lost from the system entirely. This was to test the effect of the sand bank on nearshore wave conditions. The derived nearshore wave conditions for the baseline (with sand bar) and lowered sand bar scenarios were compared showing that the baseline scenario predicted higher nearshore waves than the lowered bar scenario. Therefore, the baseline scenario was taken forward for wave overtopping assessment for the Sizewell C FRA, as it is more conservative.

5.3.18 The coastal modelling assessment for the Sizewell C project was focused on on-site and off-site flood risk as a result of the development. Therefore, a baseline scenario without development and ‘with scheme’ scenarios were simulated rather than the present-day scenario. The 2018 model was used to demonstrate current flood risk in the area of the proposed development.

5.3.19 In addition, coastal inundation modelling was carried out for the Sizewell C study using overtopping rates calculated for the existing defences using the Amazon model and 2D-TUFLOW model developed for this study. This 2D model was also used for breach modelling discussed in **section 5.4** of this **report**.

5.3.20 The main purpose of the inundation model was to assess impact of the proposed development on the flood risk off-site. Therefore, only 1 in 200-year and 1 in 1,000-year return period events with climate change, i.e. 2030 and 2190 epochs were assessed with no present-day scenario considered. It was assumed that these two scenarios would represent full range of possible impacts and therefore scenarios for epochs in between were not necessary. It is acknowledged that a broader range of simulations might be required at the later stage of the project to explore a wider range of potential impact and provide evidence for such assumption.

5.3.21 The extreme still water levels applied in the inundation model were based on the Environment Agency Coastal Flood Boundary Conditions Dataset 2018 (**Table 5.1**) as more conservative water levels would result in the Minsmere Levels and Sizewell Belts areas being significantly inundated and therefore showing less relative impact of the development. This was confirmed with initial coastal inundation modelling results, where the impact of the most extreme 1,000-year event at 2190 epoch was less than the impact of that event at 2030 epoch (showing lower relative difference in maximum flood levels).

5.3.22 Results from the inundation modelling are discussed further in this section for the baseline scenario and in **sections 7.2**, **8.2**, **9.1** and **10.1** for the considered development areas as appropriate.

a) Main platform

5.3.23 The Environment Agency 2018 coastal model shows the majority of the proposed main platform area is not currently at risk of coastal flooding due to the existing flood defences (**Figure 17**). However, without the flood defences the main platform would be partially inundated in the 1 in 20-year, 1 in 200-year and the 1 in 1,000-year events (**Figure 18**). It is observed that the northern mound and the existing Sizewell complex are beyond the current flood extents. The water levels from this model are presented in **Table 5.3**.

5.3.24 The defended water levels presented in **Table 5.3** are on sea-side of the existing shingle defences at the proposed main platform location, as the platform area is not inundated. Whereas the undefended levels are provided on the landward side of the defences at the proposed main platform location. It should be noted that defended and undefended levels for the 1 in 1,000-year event are the same as in the undefended scenario Sizewell Belts area is inundated up to the extreme sea level.

Table 5.3: Environment Agency present day defended and undefended coastal modelled water levels near the main platform

Modelled Coastal Event Return Period	Defended Modelled Level (m AOD)	Undefended Modelled Level (m AOD)
1 in 20-year (5%)	2.66	2.04
1 in 200-year (0.5%)	3.17	3.10
1 in 1,000-year (0.1%)	3.56	3.56

5.3.25 **Section 3.5a** of this **report** discusses the existing defences in front of the proposed main platform. Based on the information provided by the Environment Agency these defences mitigate coastal flood risk at the area for up to 1 in 1,000-year event. Therefore, it was assumed that no additional modelling for assessment of baseline overtopping risk was required.

5.3.26 The 2D-TUFLOW inundation model results for the 1 in 200-year and 1 in 1,000-year events with climate change up to 2030 show the majority of the main platform area is not at risk of flooding, apart from the north-west corner. This is within the existing Sizewell Drain western floodplain, as illustrated in **Figure 19** and **Figure 20**. These results are similar to the results from the Environment Agency 2018 coastal model.

5.3.27 The beach landing facility is located on the seaward side of the coastal defences and would be exposed to extreme water levels during storm events **Table 5.3**.

5.3.28 To the north of Sizewell Gap in the Pillbox Field, to the north of Rosery Cottages and along the existing Sizewell A and B access road, there are areas of the proposed development site within the 1 in 200-year and the 1 in 1,000-year extents (**Table 5.4** and **Figure 20**). The existing Sizewell A and B platforms are beyond the coastal flood extents.

Table 5.4: Environment Agency present day defended and undefended coastal modelled water levels near Rosery Cottages

Modelled Coastal Event Return Period	Defended Modelled Level (m AOD)	Undefended Modelled Level (m AOD)
1 in 20-year (5%)	2.66	2.04
1 in 200-year (0.5%)	3.17	3.11

1 in 1,000-year (0.1%)	3.54	3.58

b) SSSI crossing

5.3.29 The Environment Agency 2018 coastal model indicates the SSSI crossing area is not at risk of coastal flooding under the present-day scenario due to the existing flood defences (**Figure 17**). However, without the flood defences the SSSI crossing would be inundated in the 1 in 20-year, 1 in 200-year and 1 in 1,000-year events (**Figure 18**). The modelled water levels and flows from this model are presented in **Table 5.5.**

5.3.30 The defended present-day water levels are presented in **Table 5.5** on sea-side of the existing sand dune defences, whereas the undefended levels are provided on the landward side of the defences at the proposed SSSI crossing location.

Table 5.5: Environment Agency present day defended and undefended coastal modelled water levels at the SSSI crossing

Modelled Coastal Event Return Period	Defended Modelled Level (m AOD)	Undefended Modelled Level (m AOD)
1 in 20-year (5%)	2.66	2.30
1 in 200-year (0.5%)	3.18	3.18
1 in 1,000-year (0.1%)	3.56	3.56

5.3.31 The SSSI crossing is set back from the existing coastline by approximately 250m and so is not directly exposed to high sea levels and wave action for up to 1 in 1,000-year present day event, as illustrated by results from the Environment Agency coastal modelling, 2018 (**Figure 17**). On that basis, it was assumed that no additional modelling for assessment of baseline overtopping risk for the SSSI crossing was required.

5.3.32 The 2D-TUFLOW inundation model results for the 1 in 200 year and 1 in 1,000-year events with climate change up to 2030 (**Figure 20**) show the SSSI crossing area is at risk of flooding from both events with maximum water levels at 1.11m AOD and 1.49m AOD respectively.

c) Temporary construction area

5.3.33 The Environment Agency 2018 coastal model shows the temporary construction area is not currently at risk of coastal flooding due to the existing flood defences (**Figure 17**). However, without the current flood defences a small part of the temporary construction area would be inundated in the 1 in 20-year, 1 in 200-year and 1 in 1,000-year events (**Figure 18**).

5.3.34 The eastern boundary near the Goose Hill area is in the 1 in 20-year, 1 in 200-year and 1 in 1,000-year extents. While along the northern boundary near to Dunwich Forest, the 1 in 200-year and 1 in 1,000-year flood outlines extend into the site area. The modelled present-day water levels and flows from this model are presented in **Table 5.6**.

5.3.35 The defended water levels presented in **Table 5.6** below are on sea-side of the existing shingle defences and so the temporary construction area is not inundated. The undefended levels are provided on the landward side of the defences near the eastern and northern boundary of the construction area.

Table 5.6: Environment Agency present day defended and undefended coastal modelled water levels near the temporary construction area

Modelled Coastal Event Return Period	Defended Modelled Level (m AOD)	Undefended Modelled Level: Eastern Boundary (m AOD)	Undefended Modelled Level: Northern Boundary (m AOD)
1 in 20-year (5%)	2.66	2.34	2.39
1 in 200-year (0.5%)	3.18	3.18	3.19
1 in 1,000-year (0.1%)	3.56	3.57	3.58

5.3.36 On the northern site boundary, there is an area of land previously shown as within the Environment Agency's flood map for Planning Flood Zone 3a. However, the baseline coastal inundation modelling for 2030 confirms this area is not at risk of coastal inundation for either the 1 in 200-year or 1 in 1,000-year events.

5.3.37 The proposed off-site sports facilities are in Leiston at the Alde Valley School. The proposed site is in Flood Zone 1 (low risk of flooding). The fen meadow sites and the marsh harrier habitat improvement area are not within a coastal or tidal flood extent.

5.3.38 The 2D-TUFLOW inundation model results for the 1 in 200-year and 1 in 1,000-year events with climate change up to 2030 show the temporary construction area is not at risk of flooding from inundation of coastal defences (**Figure 21**).

d) LEEIE

5.3.39 The Environment Agency coastal modelling indicates that the LEEIE area is not within the 1 in 20-year, 1 in 200-year or the 1 in 1,000-year flood extents (**Figure 14**).

5.3.40 Similarly to the Environment Agency coastal model results, the 2D-TUFLOW inundation model results for the 1 in 200-year and 1 in 1,000-year events with climate change up to 2030 show that the LEEIE area is not at risk of flooding from inundation of coastal defences (**Figure 22**).

5.4 Breach flood risk

5.4.1 The Environment Agency has provided coastal defence breach flood depth and hazard rating maps, based on a single breach to the north of Minsmere Nature Reserve, Leiston 001 (**Figure 17** and **Figure 18**). Two return period events were provided from the breach modelling, 1 in 200-year and 1 in 1,000-year, each for present day at 2015 and climate change epoch at 2115 scenarios.

5.4.2 The Environment Agency breach modelling calculates the depth and velocity within the hydraulic model domain. The hazard rating is then calculated using the flood depth and velocity, and banded into four groups to estimate the danger to people based on depth and velocity as shown in **Table 5.7,** in line with the guidance in FD2320 report (Ref 1.22).

Table 5.7: Environment Agency defined flood hazard rating thresholds

Hazard Rating Threshold	Degree of Flood Hazard	Description
<0.75	Very Low Hazard	Caution – Shallow flowing water or standing water where hazard remains.
0.75 - 1.25	Danger for Some	Danger for children, the elderly and the infirmed.
1.25 – 2.0	Danger for Most	Danger for general public.
>2.0	Danger for All	Danger for emergency services.

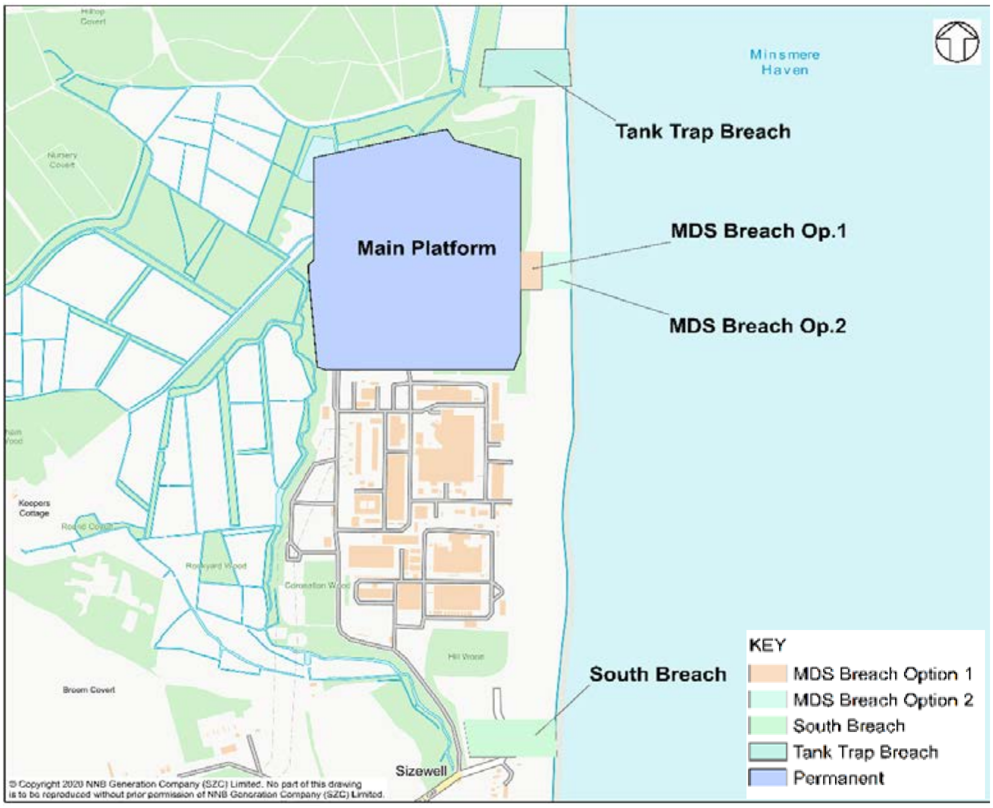
5.4.3 The breach flood extent is largely contained within existing marshlands of the Minsmere Level and Sizewell Belts for the 1 in 200-year (**Figure 23**) and 1 in 1,000-year (**Figure 24**) present day events. This is due to the topography of the area and is consistent with fluvial flood extents. The breach flood extent and hazard rating for the present day are discussed in more detail in **section 5.41.1a)** to **5.41.1d)**.

5.4.4 A bespoke breach model was constructed in 2D-TUFLOW for the Sizewell C Project. A series of breach assessments were reviewed to determine an appropriate breach location near to the main development site (**Plate 5.1**).

5.4.5 The greatest impact upon off-site receptors was assumed to arise from the tank traps breach, as the constriction between the SSSI crossing and the main platform could restrict the flow between the Minsmere Levels and Sizewell Belts areas. Therefore, the water from the tank traps breach could be limited in entering the Sizewell Marshes SSSI, and therefore increase water levels within the Minsmere Levels and neighbouring Eastbridge town where a considerable number of potential receptors are located (Ref 1.49).

5.4.6 As Eastbridge has the greatest number of properties that could potentially be at risk of breach flooding, the tank trap breach was considered to provide the most significant off-site impact compared to the other tested breach locations. In addition, based on the available beach profile data, the coastline in the tank trap area was identified as having the highest breach potential near to the proposed development (Ref 1.49).

Plate 5.1: Adopted breach locations



5.4.7 The selected breach location is close to Goose Hill at the tank traps to the north of the northern mound. Tank traps area were considered the most likely location of a breach close to the SSSI crossing based on the available profile data and is also close to the area identified as most likely to permanently breach (Ref 1.39).

5.4.8 A second breach location has been selected at Sizewell Gap (South Breach in **Plate 5.1**, to the south of Sizewell A, where there is a low spot in existing defences that makes the defences more susceptible to breach. This was conducted as a sensitivity test to determine which breach location has greater impact on flood risk on-site and off-site.

5.4.9 The breach modelling was carried out to assess the impact of the proposed Sizewell C development for the construction at 2030 and theoretical maximum site life at 2190 scenarios. Present day scenario was not assessed as part of this breach modelling.

5.4.10 The breach modelling assessment for the Sizewell C project was focused on on-site and off-site flood risk as a result of the development. Therefore, a baseline scenario without development and 'with scheme' scenarios were simulated rather than the present-day scenario. The 2018 model was used to demonstrate current flood risk in the area of the proposed development. Breach locations were chosen to demonstrate the greatest impact from the proposed development, not to ascertain the greatest present-day baseline impact areas.

a) Main platform

5.4.11 The Environment Agency breach analysis indicates the majority of the proposed main platform site is not within the present-day 1 in 200-year breach extent, however the extent increases greatly for the 1 in 1,000-year breach event. The areas of the site that are at flood risk for both breach events vary in the hazard rating between ‘Low’ and ‘Danger for All’ (**Figure 23** and **Figure 24**).

5.4.12 The most significant area of risk in both events is to the north-west of the existing Sizewell Drain in the area of the main platform which is at ‘danger for most’ in the 1 in 200-year event and rises to ‘danger to all’ for the 1 in 1,000-year event. However, for the platform area to the south-east of the Sizewell Drain, the hazard rating is ‘low hazard’ in the 1 in 200-year event and rises to ‘danger for most’ for the 1 in 1,000-year event.

5.4.13 The analysis for the Sizewell C Project shows the main platform area is at risk of flooding due to breach of coastal defences at both 1 in 200-year and 1 in 1,000-year events in 2030 (**Figure 25** and **Figure 26**) with water levels at 1.83m AOD and 2.05m AOD respectively.

5.4.14 The existing Sizewell Drain divides the proposed main platform area into two parts. To the east of the Sizewell Drain, the depth is up to approximately 0.5m for the 1 in 200-year with a velocity of up to 0.2m/s. While the depth for the 1 in 1,000-year is up to approximately 0.8m with a velocity of up to 0.3m/s. While to the west of the Sizewell Drain, the depth is up to approximately 1.3m for the 1 in 200-year with a velocity up to 0.6m/s. While for the 1 in 1,000-year the depth is up to approximately 1.6m with a velocity up to 0.8m/s.

5.4.15 Similar to the Environment Agency’s results, the hazard ratings from the breach modelling suggests some of the platform area is within ‘danger for most’ and ‘danger for all’ categories for the 1 in 1,000-year event with a breach at tank traps.

5.4.16 To the north of Sizewell Gap in the Pillbox Field, to the north of Rosery Cottages and to the eastern side of the existing Sizewell A and B access road, there are areas of the site within the Environment Agency present-day breach 1 in 200-year and 1 in 1,000-year extents for the Leiston 001 breach scenario. The depths for the 1 in 200-year extents are showing as between 0.25m and 1m. While for the 1 in 1,000-year extents the depths are between 1.5m and 2m.

5.4.17 The analysis of the Sizewell C project in the area to the north of Sizewell Gap, to the north of Rosery Cottages and to the eastern side of the existing Sizewell A and B access road, shows there are areas of the site within both 1 in 200-year and 1 in 1,000-year extents in 2030 (**Figure 26**) and have the same water levels as for the main platform area to the north.

5.4.18 The area to the south of the existing Sizewell Gap near Rosery Cottages has a depth up to approximately 0.3m for the 1 in 200-year with a velocity of up to 0.003m/s, while the depth for the 1 in 1,000-year is up to approximately 0.5m with a velocity of up to 0.009m/s. The hazard ratings suggest the Rosery Cottages area is within ‘danger for most’ category for the 1 in 200-year and the 1 in 1,000-year events with a breach at tank traps in 2030.

5.4.19 The area to the west of the existing access road junction with Sizewell Gap has a local drain. The depth of breach water in the area of the drain is up to approximately 2.2m for the 1 in 200-year with a velocity of up to 0.6m/s, while the depth for the 1 in 1,000-year is up to approximately 2.4m with a velocity of up to 1.3m/s. Away from the drain, the depth and velocities reduce greatly, with the 1 in 200-year depth of up to approximately 0.4m with a velocity of up to 0.04m/s, while the depth for the 1 in 1,000-year is up to approximately 0.6m with a velocity of up to 0.1m/s.

5.4.20 The hazard ratings suggest the area around the drain is within ‘danger for most’ while the drain is at ‘danger for all’ categories for the 1 in 200-year and the 1 in 1,000-year events with a breach at tank traps in 2030 (**Figure 20** and **Figure 21**).

5.4.21 The beach landing facility is located on the seaward side of the coastal defences and would not be exposed to breach flooding.

b) SSSI crossing

5.4.22 The SSSI crossing spans the Leiston Drain. The Environment Agency breach analysis indicates that the majority of the SSSI crossing is within the 1 in 200-year and the 1 in 1,000-year breach extent. The SSSI crossing is at ‘danger for most’ in the 1 in 200-year event and rises to ‘danger to all’ for the 1 in 1,000-year event.

5.4.23 The Sizewell C breach model 2019 results show that the SSSI Crossing area is at risk of flooding from the 1 in 200-year and 1 in 1,000-year events at 2030 (**Figure 26**). The modelled water levels are 2.36m AOD and 2.58m AOD respectively. The depths of flooding from the 1 in 200-year and 1 in 1,000-year events at 2030 are up to approximately 1.4m and approximately 1.9m. The associated velocities for the 1 in 200-year and 1 in 1,000-year events at 2034 are 0.7m/s and 0.9m/s. These result in the hazard rating of ‘danger for all’ for both the 1 in 200-year and 1 in 1,000-year events at 2030 scenarios.

c) Temporary construction area

5.4.24 The Environment Agency present-day breach analysis indicates the majority of the temporary construction area is not in the 1 in 200-year breach extent, however the extent increases for the 1 in 1,000-year breach event. The areas of the site that are at flood risk for both breach events vary in the hazard rating between ‘Low’ and ‘Danger for All’.

5.4.25 The most significant area of risk in both events is along the eastern Goose Hill boundary where there are narrow bands of ‘low hazard’, ‘danger for some’ and ‘danger for most’ in the 1 in 200-year event. In the 1 in 1,000-year modelled event, this narrow band remains but rises from ‘low hazard’ to ‘danger to all’.

5.4.26 In the field to the north-east of Goose Hill, there is no hazard rating for the 1 in 200-year event. Although this rises to between ‘low hazard’ to ‘danger for most’ for the 1 in 1,000-year event.

5.4.27 The developed breach model for Sizewell C Project shows that only two areas of the temporary construction area are at risk of flooding from a breach. These areas are the eastern boundary near Goose Hill (**Figure 27**). The modelled water levels at 2030 are 2.26m AOD and 2.49m AOD for the 1 in 200-year and 1 in 1,000-year events respectively. The velocities for the 1 in 200-year and 1 in 1,000-year events are up to approximately 0.6m/s and 0.8m/s respectively. These areas are in the ‘low’, ‘danger for some’, ‘danger for most’ and ‘danger for all’ hazard ratings depending upon distance from the breach along the eastern boundary of Goose Hill for the 1 in 200-year and 1 in 1,000-year events.

5.4.28 On the northern site boundary, there is a small area of land along the site boundary within the baseline coastal tidal breach modelling for 2030 for the 1 in 200-year or 1 in 1,000-year events.

5.4.29 The proposed off-site sports facilities in Leiston at the Alde Valley School is outside of the breach flood extent (low risk of flooding). The fen meadows and the marsh harrier habitat improvement area are not within a coastal or tidal flood extent.

d) LEEIE

5.4.30 The Environment Agency present-day breach analysis indicates that the LEEIE area is not in the 1 in 200-year or the 1 in 1,000-year breach extent.

5.4.31 Breach modelling carried out for the Sizewell C Project also suggest that the LEEIE area is not in the 1 in 200 year or the 1 in 1,000-year breach flood extent at 2030 (**Figure 28**).

5.5 Fluvial flood risk

5.5.1 Fluvial flood risk is dominated by long duration rainfall in the catchment, which is stored in the extensive low-lying marshlands of the Sizewell Belts and Minsmere Levels. It is influenced by the discharge capacity of Minsmere Sluice (including interaction with tides) and the presence of the shingle embankment / sand dunes that separate the areas from the sea (Ref 1.40).

5.5.2 According to the Environment Agency Product 4 (Ref 1.32), the Flood Zones are partly informed by the 2013 fluvial modelling (Ref 1.28) and the tidal modelling discussed in **section 5.3** of this **report**.

5.5.3 The Environment Agency 2013 fluvial modelling was a 1D ISIS model that has been considered suitable to represent the River Minsmere and Leiston Drain. The modelling strategy employed simplifies the flow pathways observed but retains the level of complexity to represent drainage of the catchment. The model has been run for seven return periods, 1 in 10-year, 1 in 25-year, 1 in 50-year, 1 in 75-year 1 in 100-year, 1 in 100-year with predicted climate change of 20% and 1 in 1,000-year. Further details on the modelling are available in the Flood study of River Minsmere and Leiston Drain Final Report (Ref 1.28).

5.5.4 As shown in **Figure 11**, the main platform, the SSSI crossing and a small area in the east of the temporary construction area are within Flood Zone 2 and Flood Zone 3. To the western edge of the site, a short section of Lover’s Lane in the vicinity of the Leiston Drain crossing is in Flood Zones 2 and 3.

5.5.5 For the purpose of the Sizewell C Project, the 2013 model has subsequently been updated and calibrated to represent an improved understanding of present-day baseline flood risk. Key refinements include:

- Conversion to a 1D-2D linked model schematisation (summarised in report “River Minsmere and Sizewell Belts Model Schematisation Update August 2015” (Ref 1.40);
- Baseline model calibration as presented in Fluvial Modelling Calibration February 2017 (Ref 1.41);
- Updated design event hydrology, including direct rainfall in the lowland portions of the model and updated tide cycles, as summarised in **Appendix 3**;
- Inclusion of Aldhurst Farm habitat creation scheme with additional model refinements, and simulation of updated design events to confirm the critical storm duration (121 hours), as described in report Main Development Site Fluvial Modelling Update (**Appendix 2**); and
- Further refinements to the model schematisation, initial conditions and boundary conditions following initial Environment Agency model review.

5.5.6 The Sizewell C Project hydraulic 1D-2D model of the Minsmere catchment covers the Minsmere south catchment and the Leiston catchment. The key change to the initial 2013 model was to include a 2D model domain (TUFLOW) to replace most of the reservoir units, allowing a better representation of flow paths and attenuation in the low-lying floodplain. Additional changes have been made to the schematisation of the low-lying reaches of the floodplain, where a direct rainfall method was applied instead of point inflows. The updated 1D-2D schematisation was then used for model calibration and validation.

5.5.7 The model was calibrated based on best available gauge data and verified using observations of flood mechanisms described by RSPB and flood trash marks. The model was not fully calibrated due to limited data availability and data quality. However, the model shows good agreement with the available data and visual observations and is considered representative for the Minsmere and Leiston water systems at the rising limb of the flood. For peak flood conditions the model shows an overestimation of the water level for Leiston system by about 200 mm. Overestimation of flood levels is larger in the Minsmere system which can be up to 400mm.

5.5.8 The impact of Sizewell-C developments is expected to be in the order of 10-20mm while the model accuracy is in the order of 50mm for low flow conditions and 100-200mm for high flow conditions. Despite the overestimation of the flood levels, the model is able to represent the typical behaviour of the system well, which makes the model applicable for assessing the relative change in flood risk for this FRA (Ref 1.41).

5.5.9 **Figure 29** shows comparison of modelled fluvial flood extents for the 1 in 5-year (20%), 1 in 100-year (1%) and 1 in 1,000-year (0.1%) with the Environment Agency Flood Zones 2 and 3 outlines.

5.5.10 Modelled flood extents are very similar to the flood zones with slightly smaller flood extents. The smaller extents are most likely due to the Environment Agency's Flood Zones having been produced for undefended scenario of combined fluvial and coastal flood risk, whereas modelled flood extents are for fluvial flood risk only.

5.5.11 Due to characteristics of the catchment topography, the low-lying marshlands are inundated from relatively high probability events, approximately the 1 in 5-year event (20%). As a result of the storage capacity in the marshes and the fact that the low-lying areas are bound by higher grounds, the increase in flood extents for lower probability / higher magnitude events is relatively modest as illustrated in **Figure 29**, whereas change in flood depth is more apparent.

5.5.12 A summary of the water levels from the 1D and the improved 1D-2D model near the proposed Sizewell power station are given in **Table 5.8** and **Table 5.9** respectively.

a) Main platform

5.5.13 The Environment Agency 2013 1D model shows that the majority of the main platform area is not at risk of fluvial flooding. However, the north-west corner of the main platform area is in the 1 in 10-year, 1 in 100-year and 1 in 1,000-year extents (**Figure 30**). The modelled water levels and flows from this model are presented in **Table 5.8**.

5.5.14 Location of the model nodes where the modelled water levels are presented is shown in **Plate 5.2** and **Plate 5.3** for the Environment Agency 2013 1D model and the improved 1D-2D model respectively.

Plate 5.2: Extract from Environment Agency Product 4 (Ref 5.2. 33), Sizewell 2013 Nodes Location Map

Plate 5.3: Location of the improved 1D-2D model node LEIS02_0463

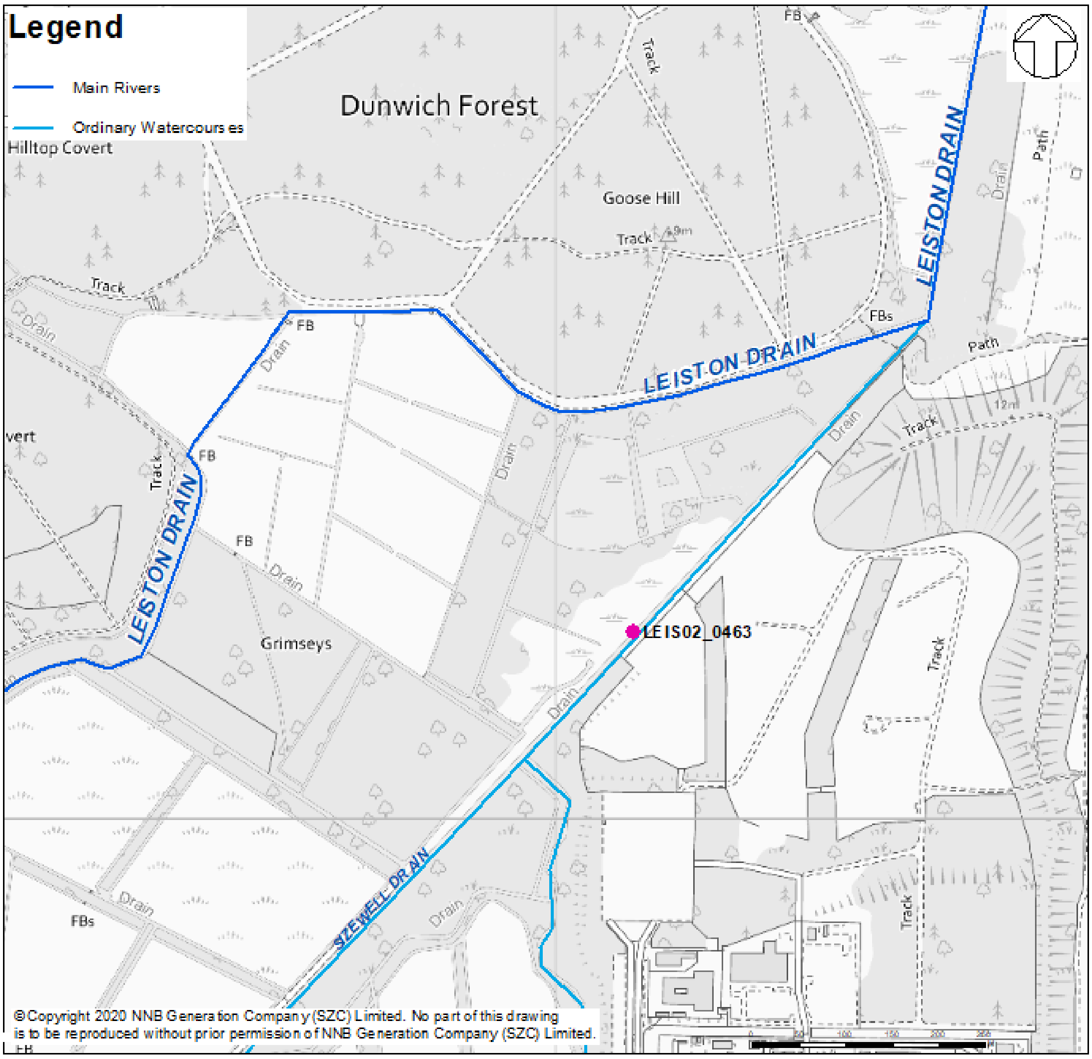


Table 5.8: Environment Agency present day undefended fluvial modelled water levels and flow near the main platform – Middleton and Sizewell, 2013 (Node 40)

Fluvial Event Return Period	Modelled Level (m AOD)	Modelled Flow (m^3/s)
1 in 25-year (4%)	0.61	0.45
1 in 100-year (1%)	0.95	0.61
1 in 100-year (1%) + 20%CC	1.01	0.66
1 in 1,000-year (0.1%)	1.12	0.85

5.5.15 The improved 1D-2D model shows that the majority of the main platform area is not at risk of fluvial flooding up to 1 in 100-year event. The north west corner of the main platform area is in the flood extent for all modelled return periods, which includes the 1 in 5-year, 1 in 20-year, 1 in 100-year and 1 in-1,000 year (**Figure 31** and **Figure 32**). The maximum water levels from this model are presented in **Table 5.9**.

Table 5.9: Modelled fluvial maximum water levels near the main platform – improved 1D-2D model, 2019 (Node LEIS02_0463)

Fluvial Event Return Period	Modelled Water Level (m AOD)
1 in 5-year (20%)	1.19
1 in 20-year (5%)	1.37
1 in 100-year (1%)	1.61
1 in 100-year (1%) + 35%CC	1.99
1 in 100-year (1%) + 65%CC	2.13
1 in 1,000-year (0.1%)	2.01

5.5.16 The Environment Agency 2013 1D model shows the area to the north of Rosery Cottages and to the west of the existing Sizewell A and B access road is at risk of fluvial flooding in the 1 in 10-year, 1 in 100-year and 1 in 1,000-year extents (**Figure 30**). The modelled water levels and flows from this model are presented in **Table 5.10**. These levels are the same as those shown further downstream at Node 40 near the proposed main platform, however, the modelled flow is lower.

Table 5.10: Environment Agency present day undefended fluvial modelled water levels and flow near Sizewell Gap – Middleton and Sizewell, 2013 (Node 46)

Fluvial Event Return Period	Modelled Level (m AOD)	Modelled Flow (m^3/s)
1 in 25-year (4%)	0.61	0.12
1 in 100-year (1%)	0.95	0.25
1 in 100-year (1%) + 20%CC	1.01	0.30
1 in 1,000-year (0.1%)	1.12	0.86

5.5.17 The improved 1D-2D model shows the area to the north of Rosery Cottages and to the west of the existing Sizewell A and B access road is at risk of fluvial flooding in the 1 in 100-year and 1 in 1,000-year extents (**Figure 30).** The north west corner of the main platform area is in the flood extent for all modelled return periods, which includes the 1 in 5-year, 1 in 20-year, 1 in 100-year and 1 in-1,000 year (**Figure 32**). The maximum water levels from this model are presented in **Table 5.9**.

5.5.18 The beach landing facility is located on the seaward side of the coastal defences and would not be exposed to fluvial flooding.

b) SSSI crossing

5.5.19 The Environment Agency 2013 1D model shows the SSSI crossing area in an area at risk of fluvial flooding from the 1 in 100-year through to 1 in 1,000-year extents (**Figure 30**). The modelled water levels and flows from this model are presented in **Table 5.11**.

Table 5.11: Environment Agency present day undefended fluvial modelled water levels and flow near the SSSI crossing – Middleton and Sizewell model, 2013 (Node 43)

Fluvial Event Return Period	Modelled Level (m AOD)	Modelled Flow (m^3/s)
1 in 25-year (4%)	0.61	0.52
1 in 100-year (1%)	0.95	0.70
1 in 100-year (1%) + 20%CC	1.01	0.76
1 in 1,000-year (0.1%)	1.12	1.19

5.5.20 The improved 1D-2D model confirms that the SSSI crossing area is at risk of fluvial flooding from all modelled return period events, from the 1 in 5-year through to 1 in 1,000-year (**Figure 32**). The water levels and associated modelled flows from this model are presented in **Table 5.12**.

Table 5.12: Modelled fluvial maximum water levels near the SSSI Crossing – improved 1D-2D model, 2019 (Node LEIS01_1646d)

Fluvial Event Return Period	Modelled Water Level (m AOD)
1 in 5-year (20%)	1.19
1 in 20-year (5%)	1.37
1 in 100-year (1%)	1.61
1 in 100-year (1%) + 35%CC	1.99

Fluvial Event Return Period	Modelled Water Level (m AOD)
1 in 100-year (1%) + 65%CC	2.13
1 in 1,000-year (0.1%)	2.01

c) Temporary construction area

5.5.21 The Environment Agency 2013 1D model shows that the majority of the temporary construction area is not at risk of fluvial flooding. However, the eastern boundary near Goose Hill area is in the 1 in 10-year, 1 in 100-year and 1 in 1,000-year extents (**Figure 30**). Along the northern boundary near to Dunwich Forest, the 1 in 100-year and 1 in 1,000-year outlines extend into the site area. The water levels and associated modelled flows from this model are presented in **Table 5.13**.

Table 5.13: Environment Agency present day undefended fluvial modelled water levels and flow near the temporary construction area eastern boundary– Middleton and Sizewell model, 2013

Node Number	Modelled Return Period	Modelled Level (m AOD)	Modelled Flow (m^3/s)
Node 16 Middleton and Sizewell 1D Model 2013	1 in 25-year (4%)	0.61	0.82
	1 in 100-year (1%)	0.95	1.03
	1 in 100-year (1%) + 20%CC	1.01	1.13
	1 in 1,000-year (0.1%)	1.12	1.73
Node 17 Middleton and Sizewell 1D Model 2013	1 in 25-year (4%)	0.62	0.83
	1 in 100-year (1%)	0.95	1.03
	1 in 100-year (1%) + 20%CC	1.01	1.13
	1 in 1,000-year (0.1%)	1.12	1.68

5.5.22 Similar to the Environment Agency results, the updated Sizewell C Project model also shows the majority of the temporary construction area is not at risk from fluvial flooding. Only a relatively small area at the eastern boundary near Goose Hill and north-eastern boundary are within the flood extents for all considered events and the proposed water management zone 1 area is at risk from 1 in 1,000-year event and to a lesser extent the 1 in 200-year extent (**Figure 33**).

5.5.23 While on the northern site boundary, there is an area of land shown as within the baseline the 1 in 100-year with 25% climate change allowance or 1 in 1,000-year with 25% climate change allowance events fluvial modelled extent for 2030. The 1 in 100-year with 25% climate change allowance extent remains along the site boundary, while 1 in 1,000-year with 25% climate change allowance intrudes further into the site area.

5.5.24 Modelled maximum water levels are 1.19m AOD, 1.61m AOD and 2.01m AOD for the 1 in 5-year, 1 in 100-year and 1 in 1,000-year return period events respectively.

5.5.25 The Environment Agency flood mapping indicates that the fen meadow sites are within the 1 in 100-year and the 1 in 1,000-year extents.

5.5.26 The proposed off-site sports facilities in Leiston at the Alde Valley School and the marsh harrier habitat improvement area are in Flood Zone 1 (low risk of flooding).

d) LEEIE

5.5.27 The Environment Agency 2013 1D model shows the LEEIE area is not in an area at risk of fluvial flooding (**Figure 30**). Therefore, no modelled water levels and flows from this model are available in **Table 5.8**.

5.5.28 Similar to the Environment Agency’s information, the updated Sizewell C model also shows the LEEIE area is not at risk from fluvial flooding for up to 1 in 1,000-year event with 65% allowance for climate change (**Figure 34**).

5.6 Surface water (pluvial) flood risk

5.6.1 The Suffolk and Waveney SFRA indicates flash flooding caused by surface water run-off from saturated catchments has been a source of historical flooding in the district. Records of surface water flooding incidents in the vicinity of the site are limited to the Leiston urban area. One surface water flooding event is recorded on Valley Road, which forms the northern LEEIE boundary.

5.6.2 The definitions of the Environment Agency surface water flood zones are in **section 2.2iii** of this **report**. The Environment Agency ‘flood risk from surface water’ map identifies the majority of the site is at ‘very low’ risk of surface water flooding (Ref 1.42) (**Figure 35**). However, there are very small localised areas of low to high risk of surface water flooding across the site, which are associated with topographical low points and ordinary watercourses (**Figure 35**).

5.6.3 The minor areas of increased flood risk were identified from national scale modelling and do not appear to coincide with existing property or infrastructure receptors within the site.

a) Main platform

5.6.4 The surface water flood risk to the main platform area is largely very low (**Figure 26**). There are areas of increased surface water flood risk within the main platform area, which are associated either with the existing Sizewell B power station layout or existing watercourses. There is woodland within the main platform area with an increased surface water flood risk that is mostly 'low' risk with a couple of small 'medium' to 'high' risk spots.

5.6.5 To the north of Sizewell Gap in the Pillbox Field, there are areas of 'low' risk surface water flooding associated with the topographical low area. The low-lying area to the north of Rosery Cottages, also has 'low' risk surface water flooding associated with the existing local ordinary watercourses.

5.6.6 The beach landing facility is on the seaward side of the coastal defences and would not be exposed to surface water flooding.

b) SSSI crossing

5.6.7 A small area of 'low' surface water flood risk is associated with the Leiston Drain. The remaining area is at a 'very low' risk of flooding (**Figure 35**).

c) Temporary construction area

5.6.8 A small surface water flow path in the central area of the temporary construction area runs from near Ash Wood Cottages to near Sandling Walk, following the local topography (**Figure 35**). The flow path pools water behind specific landscape features, including access tracks and a woodland strip, before discharging into an area with land drains at the north-east end of the Sizewell Belts.

5.6.9 The proposed off-site sports facilities in Leiston at the Alde Valley School area is mostly at 'very low' risk of surface water flooding. There is one small isolated area of 'low' risk of surface water flooding. The sewer system in Leiston is known to have existing capacity issues around the town. This has led to the preparation of a surface water management plan (SWMP).

5.6.10 The SWMP states that the:

> *"Hydraulic modelling identified that flooding within Leiston is heavily influenced by the fact that the town is situated in a topographic hollow, with the primary road in Leiston, Main Street (B1122) leading to Valley Road, sitting at the base of a "valley". Surface water flowing down this natural flood path impacts a number of properties along its route before also giving rise to flooding at the lower end of the valley".*

5.6.11 Furthermore, the SWMP states:

> *"There are reports from SCC that the surface water drainage system though Leiston has been observed to be heavily impeded during historic flood events."*

5.6.12 The SWMP identified six priority areas in Leiston based on historic flood records. These are:

- Main Street (B1122) at its junction with Park Hill (B1069) and Waterloo Avenue (B1119);
- Valley Road and Leiston Sewage Treatment Works;
- King George's Avenue, Sizewell Road and Sylvester Road;
- Urban Road;
- Haylings Road (B1069), Central Road and the High Street (B1122); and
- Seaward Avenue.

5.6.13 The fen meadow sites are mostly at 'low' surface water flood risk with localised areas of 'medium' to 'high' risk around the local drainage channels. The fen meadow near Benhall has a slightly higher proportion of 'medium' to 'high' risk areas compared to the Halesworth site (**Figure 36**).

5.6.14 The marsh harrier habitat improvement area is at mostly 'very low' surface water flood risk with two localised flow routes of 'low' to 'high' risk that cross the site (**Figure 36**). One flow route is aligned to a local ordinary watercourse running from the north to the south along Wash Lane which is to the east of the site. The other flow route is aligned with a topographical low area.

d) LEEIE

5.6.15 The majority of the LEEIE is at very low risk of surface water flooding. Small localised areas of ‘low’ to ‘medium’ surface water flood risk are present and are associated with topographical low spots (**Figure 35**). The largest of these areas is adjacent to King George’s Avenue on the southern boundary.

5.7 Groundwater flood risk

5.7.1 Groundwater flooding occurs when water levels in the ground rise above surface elevation. Low-lying areas underlain by unconfined aquifers are most susceptible to this source of flooding, especially after a prolonged rainfall event.

5.7.2 The bedrock geology of the site, the Crag, exhibits high permeability with a high water-storage potential. The various superficial geologies overlying the Crag have varying hydraulic conductivities. For example, the Tidal Flat Deposits and Peat are classed as being unproductive strata, while sands and gravels of the Lowestoft Formation are classed as productive strata.

5.7.3 In the Suffolk and Waveney SFRA, the majority of the site was considered as having either ‘no’ or ‘limited’ potential for groundwater flooding.

5.7.4 Ground investigations undertaken as part of the design development process indicate that groundwater levels in the main aquifer in the area, the Crag, are typically in the range of 0m AOD to 1m AOD with a small tidal variation close to the coast (Ref 1.43). These groundwater heads are generally higher than groundwater levels in overlying superficial deposits in the area around the main development site, creating an upward groundwater head gradient.

5.7.5 Topography across the main development site ranges from approximately 19.7m AOD in the west to approximately 0.0m AOD in the east. This means that groundwater flooding is most likely to occur in low-lying ground close to the coast.

5.7.6 Groundwater flooding or ponding has not been observed across the majority of the development site. The exception is the groundwater ponding that occurs in the Sizewell Marshes during the winter, including in the area adjacent to the SSSI crossing being incorporated into the development platform. Groundwater flooding in this area is driven by upward hydraulic gradients from a combination of the underlying Crag and high water levels within the Peat.

5.7.7 The water levels in the Peat are mainly related to the network of surface water channels and partly due to the proximity to the coast. The Sizewell Marshes SSSI is a low-lying area which makes it particularly prone to groundwater flooding. The ponding of groundwater at surface within the SSSI is part of the natural seasonal changes in the ecosystem.

5.7.8 Groundwater levels within the Peat deposits show hydraulic connectivity with the surface water drainage system. The groundwater levels respond quickly to rainfall events and to pumping within the drainage system (Ref 1.46).

5.7.9 A groundwater model has been prepared in FEFLOW to consider the impacts of the proposed development on the groundwater. The baseline model (the scenario with no development included) simulates the conditions between 2015 to 2040. The model has three climate variation scenarios under consideration; ‘wet’, ‘intermediate’, and ‘dry’.

5.7.10 The baseline model includes an output of groundwater seepage, a measure of groundwater volumes lost from the model when groundwater raises above the ground surface, which represents groundwater flooding.

5.7.11 The East Suffolk SFRA (Ref 1.27) groundwater flood map based on the BGS susceptibility to groundwater flooding map confirms there is ‘potential for groundwater flooding at the surface’ for the whole site.

5.7.12 Approximately 65% of the fen meadow at Benhall site area was indicated to have the ‘potential for groundwater flooding at the surface’ and the remaining 35% of the site area away from the watercourse with the ‘potential for groundwater flooding of property below ground level’.

5.7.13 The fen meadow site near Benhall has a slightly higher proportion of ‘potential for groundwater flooding at the surface’ risk compared to the Halesworth site.

5.7.14 Approximately 90% of the marsh harrier habitat improvement area near Westleton is indicated to have the ‘limited potential for groundwater flooding to occur’ and the remaining 10% of the site area along the Wash Lane ordinary watercourse has the ‘potential for groundwater flooding of property below ground level’.

5.7.15 The beach landing facility is on the seaward side of the coastal defences and would not be exposed to groundwater flooding.

5.8 Sewer flood risk

5.8.1 The site is largely greenfield in nature with a number of existing roads and areas of the existing Sizewell power station complex in the site boundary.

5.8.2 At present only one private sewer system has been identified in the near vicinity of the main development platform, which serves the existing Sizewell B power station. The main platform area is located on a mainly undeveloped area of land with no foul sewers. However, the south-western corner has two auxiliary buildings that are served by foul and surface water sewers with a pumping station. These facilities are being relocated as part of the Sizewell B Relocated Facilities proposals.

5.8.3 The off-site sports facilities are on the southern extent of Leiston. The off-site sports facilities are approximately 250m from the eastern end of Seaward Avenue. The site is currently a playing field that is surrounding by roads. The sewer risk is considered to be relatively low, as sewers are possibly within the boundary of the highway network. Seaward Avenue is not along the boundary of the site.

5.8.4 The SFRA records (Ref 1.27) of sewer flooding incidents in the vicinity of the site are limited to the Leiston urban area. The SFRA historic flood records maps identify one ‘foul or surface sewer’ flood event and one ‘highway drainage flood event on Valley Road (northern boundary of the LEEIE).

5.8.5 The fen meadow near Benhall is located adjacent to Benhall water recycling centre, a wastewater treatment plant. While the fen meadow near Halesworth is located adjacent to the Blyth Road Industrial Estate. From the Environment Agency public records, it is understood that there is likely to be a discharge of treated effluent from the wastewater treatment plant to a local watercourse for both these sites. Therefore, it is possible that sewers may be adjacent to the existing site.

5.8.6 The marsh harrier habitat improvement area is undeveloped and is unlikely to have sewers present on the site.

5.8.7 The beach landing facility is on the seaward side of the coastal defences and does not contain any sewers. Therefore, the beach landing facility would not be exposed to sewer flooding.

5.9 Flood risk from reservoirs and other artificial sources

5.9.1 The Flood Risk from Reservoirs Maps identified the maximum extent of flooding from reservoir failure (**Figure 37 and Figure 38**).

5.9.2 Flooding from a breach of Sizewell Walks reservoir is shown to potentially affect the existing access road to the existing Sizewell power station complex, the pill box field and the neighbouring Sizewell Belts (**Figure 37**). The reservoir is sited at a topographical high point. The associated 'maximum flood extent' for the reservoir are to both the north-east and south-west of the reservoir.

5.9.3 Flooding from a breach of the Heveningham Hall reservoir is shown to potentially affect the existing proposed fen meadow site near Halesworth. The reservoir is located in the River Blyth valley and is off-line to the main river that is to the south of the reservoir (**Figure 38**). The associated 'maximum flood extent' for the reservoir covers the proposed site.

5.9.4 No other reservoirs are identified to affect the proposed development site.

5.10 Summary of existing flood mechanisms

5.10.1 A summary of the existing baseline flood risk to the site is presented in **Table 5.14**. Present day flood risk from fluvial, tidal, groundwater, sewers and reservoir sources are assessed to be low.

5.10.2 Flood risk from surface water is assessed to be very low for the majority of the main development site. However, an area of high surface water flood risk is located in the field adjacent to Abbey Road. This increased surface water flood risk is potentially due to an existing field boundary/drainage ditch.

Table 5.14: Summary of baseline flood risk at the development site

Source of flooding	Flood risk
Tidal/coastal	Predominantly low, as most of the site is in Flood Zone 1.
	Areas of exception in Flood Zone 2 (medium risk) and 3 (high risk): the SSSI crossing, two attenuation ponds in the temporary construction area and part of the main development platform. The beach landing facility is on the seaward side of the coastal defences and at high risk of coastal flooding.
Fluvial	Predominantly low, as most of the site is in Flood Zone 1.
	Areas of exception in Flood Zone 2 (medium risk) and 3 (high risk)

Source of flooding	Flood risk
	include: the SSSI crossing, part of the main development platform, an attenuation pond, a small area west of the main platform on Lover's Lane, the existing access road and the pill box field to the north of Sizewell Gap. Off-site, the fen meadows are within Flood Zones 2 and 3. A small area in the north western part of the main development platform, the SSSI crossing and part of the Fen Meadow (near Benhall) are within Flood Zone 3b (functional floodplain).
Surface water (pluvial)	Predominantly 'very low' as defined by the Environment Agency Surface Water Flood Map.
	Isolated areas with 'low' to 'high' risk associated with topographical low points, ordinary watercourses and drainage ditches. One historic surface water flooding event is recorded on Valley Road, the northern boundary of the LEEIE. Off-site, the fen meadows and part of the marsh harrier habitat improvement area are within 'low' to 'high' risk associated with topographical low points, ordinary watercourses and drainage ditches
Groundwater	Low: Some localised evidence of groundwater emergence at surface in low-lying areas of the Sizewell Marshes during winter and the off-site fen meadow sites.
Sewers	Low: majority of the site on rural undeveloped land. Existing sewer system privately managed with a maintenance and management plan. One recorded sewer flooding event and one highway drainage flood event recorded on Valley Road along the northern boundary of the LEEIE. Leiston town has a limited surface water sewer capacity which is known to generate flooding.
Reservoirs	Predominantly not at risk of flooding from reservoirs or other artificial sources.
	Areas within the maximum reservoir flood extent include: existing Sizewell power station complex access road and small undeveloped field east of Sandy Lane. The fen meadow near Halesworth is within the reservoir maximum flood extent in the event of a breach.

6. Application of the Sequential Test and Exception Test

6.1.1 The development is for a nationally significant power generating site. In terms of flood risk and vulnerability the development is classed as 'Essential Infrastructure' in accordance with the NPPF criteria described in **section 2.2d)i** of this **report**.

6.1.2 The proposed main development site is in Flood Zones 1, 2 and 3. A substantial proportion of the site is in Flood Zone 1 with a small area of the main platform, the SSSI crossing and the temporary construction area in

Flood Zones 2 and 3 (**Figure 11**). A small area in the north western part of the main development platform, the SSSI crossing and part of the Fen Meadow (near Benhall) are within Flood Zone 3b (functional floodplain).

6.1.3 In accordance with the Flood Risk Vulnerability and Flood Zone Compatibility table (**Table 2.3**), the proposed development is required to pass the Exception Test. The Exception Test is defined in **section 2.2a** of this **report**.

6.1.4 As previously discussed in **section 2.2d)** of this **report**, the Government has previously undertaken a review of suitable sites for new nuclear power stations in the UK (Ref 1.2). The site suitability assessments were undertaken against Strategic Siting Assessment (SSA) criteria, while reflecting advice received from specialists and regulators including the Environment Agency on flood risk. During this review, the Environment Agency considered that flood risk could be appropriately managed on the site.

6.1.5 The allocation of Sizewell as a new nuclear development is listed in the National Policy Statement for Nuclear Power Generation (Ref 1.1).

6.1.6 In **section 2.2** the NPS confirmed that the Sequential Test has been undertaken in the SSA process and was passed for the site area assessed at the time. Since the SSA assessment, the main development site has been extended to accommodate the temporary construction works areas (**Figure 2**). There is a requirement to ensure that a sequential approach is undertaken for the extended main development site area and at a site-specific scale within this extended area.

6.1.7 The layout of the components within the main development site that is not within the previously agreed development boundary, has been considered using a sequential approach within each of the four development areas. The components within each of these areas for all phases would be positioned sequentially in relation to their vulnerability as far as is practicable (**Figure 1**).

6.1.8 In accordance with NPPF and the supporting guidance in NPPG summarised in **section 2.2c)** of this **report**, the Exception Test must be passed for the development of Essential Infrastructure in Flood Zones 3a and 3b. This requirement is supported by the NPS EN-6 irrespective of the Sequential Test having been passed.

6.1.9 The majority of the extended main development site area is in flood zone 1, however, limited areas are within flood zones 2 and 3 (**Figure 11**). A summary of these areas and the Sequential Testing is provided in **Table 6.1.**

Table 6.1:Summary of Additional sequential testing for areas in the extended main development site

Area	Flood Zone	Proposed Use	Vulnerability classification	Compatibility
Temporary construction area	Flood Zone 1	Accommodation campus, borrow pits, common user facilities, contractor compounds, lay-down areas and various supporting infrastructure including the Sizewell C access road	More vulnerable	**Appropriate**
Land east of Eastlands Industrial Estate (LEEIE)	Flood Zone 1	Workers accommodation, park and ride, HGV parking, stockpile area	More vulnerable	**Appropriate**
Areas of Sizewell A and B power station	Flood Zone 1	Remain as Sizewell A and B power station facilities	Essential infrastructure	**Appropriate**
Off-site sports facilities at Alde Valley School	Flood Zone 1	Multiuse sports pitches	Water compatible development	**Appropriate**
Temporary construction area along the eastern boundary at Goose Hill.	Flood Zones 2 and 3a	Part of the proposed temporary construction area water management zone 1 detention basin.	Water compatible development	**Appropriate**
Temporary construction area to the north and east of Lower Abbey Farm.	Flood Zones 2 and 3a	The habitat compensation area.	Water compatible development	**Appropriate**
Temporary construction area along the existing Lovers Lane at the western extent of the Sizewell Belts.	Flood Zones 2 and 3a	Lover’s Lane culvert connecting Aldhurst Farm to Sizewell Marshes improvement to facilitate the passage of water voles and otters	Essential infrastructure	*Exception Test Required* *Wider sustainability achieved. Further justification given in 6.1.14.*

Area	Flood Zone	Proposed Use	Vulnerability classification	Compatibility
				Appropriate
The western construction access road and supporting area between the Sizewell Gap and Sizewell B power station.	Flood Zones 2 and 3a	A proposed western construction access road to facilitate the separation of construction and site access traffic to Sizewell B at the earliest opportunity.	Essential infrastructure	Exception Test Required. *Wider sustainability achieved. Further justification given in section 6.1.15* ***Appropriate***
The existing southern access road between the Sizewell Gap and Sizewell A power station.	Flood Zones 2	A retained existing access road would have some minor road improvements made.	Essential infrastructure	Exception Test Required *Wider sustainability achieved. Further justification in section 6.1.16* ***Appropriate***
The area to the south-east of Reckham Pits Wood.	Flood Zones 1 and 2	Proposed underground cables would be routed through this area.	Essential infrastructure	***Appropriate***
Fen meadow site - Halesworth	Flood Zones 2 and 3a	Fen meadow habitat compensation. Habitat created on site through water level management structures	Water Compatible	***Appropriate***
Fen meadow site - Benhall	Flood Zones 2, 3a and 3b	Fen meadow habitat compensation. Habitat created on site through water level management structures	Water Compatible	***Appropriate***
Marsh Harrier habitat improvement area	Flood Zone 1	Habitat improvements for the construction phase to provide additional foraging areas.	Water Compatible	***Appropriate***

6.1.10 For the previously defined boundary, the Government has concluded in NPS EN-6, that:

> *“all the sites listed in this NPS are needed in order for the Government to meet its objectives on climate change and for the UK to become a low carbon economy”.*

6.1.11 While for the areas outside of the Government approved previously assessed main development site boundary, the majority of the proposed main development site areas that are in Flood Zone 2, 3a and 3b are either existing features with proposed improvements or are used for compatible purposes.

6.1.12 Two areas require further consideration of the benefits to the wider community with the application of the Exception Test. However, in these areas the existing facilities and infrastructure will remain, and the proposed improvements are to facilitate environmental enhancement or road safety.

6.1.13 As it forms part of Sizewell C development, the wider benefit to the local and national community has been considered in other documents submitted as part of the Development Consent Order application.

6.1.14 The existing culvert improvements under the existing Lover’s Lane between Aldhurst Farm and the Sizewell Marshes are to enhance water vole and otter passage through the culverts. There is expected to be negligible change to flow capacity of the culvert and therefore the associated change to flood risk would be negligible. The culvert improvements would be permanent and benefit the wider community and environment.

6.1.15 The proposed western construction access road and supporting area between Sizewell Gap and the Sizewell B would be to separate construction traffic from the existing site traffic to improve road safety for the site users and operators.

6.1.16 The existing southern access road between Sizewell Gap and the Sizewell A and B would have minor road improvements made to the road to also improve safety. This would not alter the existing layout or extent of the road, and therefore no change to the associated flood risk is anticipated.

6.1.17 All these three areas are seen to provide either environmental enhancements or safety benefits to the wider community and work force.

7. Main Platform Flood Risk On-site

7.1 Coastal

a) Flood risk with climate change

7.1.1 Coastal overtopping modelling was undertaken in 2019 to determine the effects of climate change on sea levels and wave action throughout the lifetime of the development. The modelling considered multiple climate change scenarios and multiple return periods. The coastal modelling considered the effects of waves and storm surges.

7.1.2 Coastal modelling considered derivation of extreme water levels, joint probability assessment of extreme sea level and offshore waves, and wave transformation modelling used to derive nearshore waves, which was then applied in overtopping assessment.

7.1.3 A detailed wave overtopping assessment was undertaken using the AMAZON model to convert nearshore wave conditions into instantaneous and average wave overtopping rates.

7.1.4 More detail on the AMAZON software and the preference for its use in this FRA study is presented in 'Flood Risk Assessment Sizewell C: AMAZON for overtopping prediction' (Ref 1.45) and the Coastal modelling report (Ref 1.44). Overtopping results derived from AMAZON have also been compared to EurOTop methods to confirm its suitability (Ref 1.44).

7.1.5 The relative sea levels at the end of each phase of the development taking into consideration climate change adopted for the overtopping assessment are shown in **Table 7.1**. As discussed in **section 5.3.10** of this **report**, for the overtopping assessment, more conservative extreme still water levels derived in the BEEMS study were adopted.

Table 7.1:Derived relative sea levels with climate change

Development phase	Year	Return period with climate change	Climate Change Scenario	Extreme sea levels with climate change (m AOD)
End of substantial construction / commissioning	2030	1 in 200	95%ile of RCP8.5 (UKCP18)	3.81
		1 in 1,000		4.35
End of operation	2090	1 in 200		4.58
		1 in 1,000		5.12

Development phase	Year	Return period with climate change	Climate Change Scenario	Extreme sea levels with climate change (m AOD)
Interim spent fuel store decommissioned	2140	1 in 200	95%ile of RCP8.5 (UKCP18)	5.48
		1 in 1,000		6.02
		1 in 200	BECC Upper	7.58
		1 in 1,000		8.12
Theoretical maximum site lifetime	2190	1 in 200	95%ile of RCP8.5 (UKCP18)	6.31
		1 in 1,000		6.85
		1 in 200	BECC Upper	8.48
		1 in 1,000		9.02

7.1.6 For the coastal inundation modelling only the reasonably foreseeable climate change scenario has been considered, as more conservative scenarios would result in lower relative impact of the development as indicated by preliminary model results. Adopted extreme still water levels for the two return periods and climate change epochs considered are presented in **Table 7.2**. These were derived based on the Coastal Flood Boundary Dataset 2018 as discussed in **section 5.3.20** of this **report**.

Table 7.2: Inundation Modelling Extreme Still Water Levels

Year	Climate Change Scenario	Return Period Event	Extreme Still Water Level (m AOD)
2030	UKCP18 95%ile RCP8.5	200 year	3.20
		1,000 year	3.52
2190		200 year	5.70
		1,000 year	6.02

b) Embedded design

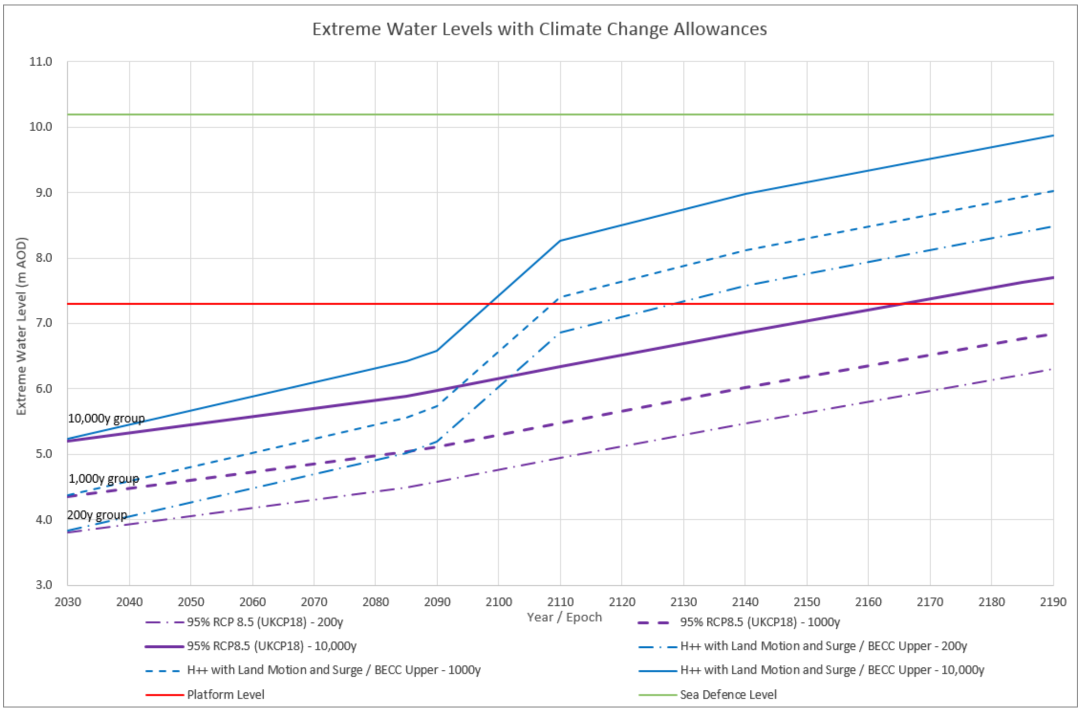
7.1.7 The development incorporates flood defences works and a raised platform for the main development site to a level of 7.3m AOD. The new coastal flood defence crest level would be 10.2m AOD with adaptive design to potentially raise the defence up to 14.2m AOD in the future.

7.1.8 The main platform level of 7.3m AOD would not be exceeded by the still water levels for the 1 in 200-year and 1 in 1,000-year return period events for the theoretical maximum lifetime for the reasonably foreseeable scenario.

7.1.9 The main platform level would be exceeded by the 1 in 10,000-year event around 2165. The credible maximum climate change shows the platform level would be exceeded for all considered return period events at some point following completion of the operation phase (**Plate 7.1**).

7.1.10 The existing sand dunes with a shingle beach is sufficient to withstand still water levels up to 1 in 1,000-year event with climate change up to 2030 (**Plate 7.1**). The designed 10.2m AOD new hard coastal defence is sufficient to withstand the 1 in 200-year, 1 in 1,000-year and 1 in 10,000-year events extreme still water levels throughout the whole site lifetime for the reasonably foreseeable climate change scenarios and the credible maximum scenario (**Plate 7.1**).

Plate 7.1: Extreme Still Water Levels with Climate at the Hard Coastal Defence Feature



i. Construction

7.1.11 The existing coastal flood defences would be removed before the new coastal flood defences could be constructed. For a short time, the sand dunes with a shingle beach with a crest level of approximately 5.2m AOD would provide defence against coastal flooding. Modelling was based on the lowest cross section within this reach of 4.36m AOD.

7.1.12 During initial stage of construction phase, a temporary reinforced coastal flood defence with crest level of 7m AOD would be built to form a haul road used for remaining construction period, until the main platform is completed. The slightly narrower main coastal defence (HCDF) will be initially constructed to a level of 10.2m AOD in front of the haul road, that would then be widened to is final design at the end of construction period once the construction of main platform is completed.

7.1.13 The coastal inundation modelling using 2D-TUFLOW model shows the main platform is not at risk of flooding for up to 1 in 1,000-year event with climate change up to end of construction phase at 2030 (**Figure 39** and **Figure 40**) with maximum water level around the platform approximately 2.0m AOD.

7.1.14 The proposed beach landing facility is a water compatible semi-demountable coastal structure as described in **Volume 2, Chapter 3** (Doc Ref. 6.3) and would enable the delivery of very large loads to site, such as Abnormal Indivisible Loads (AIL). These would be delivered to the beach landing facility by barge at high water in suitable summer conditions. The structure would remain in the sea and would be exposed to all storm conditions both during the summer and winter seasons. The beach landing facility would be served by a re-enforced access road across the beach between the northern mound and the beach landing facility.

ii. Operation

7.1.15 The operational coastal defences would have a designed crest level of 10.2m AOD. The defence would have an adaptive design with the potential to raise the crest up to 14.2m AOD in the future if required to address sea level rise and change in wave conditions due to climate change.

7.1.16 The coastal inundation modelling using 2D-TUFLOW model shows that the main platform is not at risk of flooding for up to 1 in 1,000-year event with climate change up to theoretical maximum site lifetime at 2190 (**Figure 43** and **Figure 44**) with maximum water level around the platform area of 6.02m AOD.

7.1.17 The beach landing facility use would continue into the operation phase, although at a reduced amount of usage of approximately once every 5 years in suitable summer sea conditions.

7.1.18 The Sizewell B relocated facilities are mostly located outside of the modelled 1 in 200-year with climate change and 1 in 1,000-year with climate change coastal inundation flood extents. The design life of these facilities is to 2055. Therefore, the future water extents, depths and velocities in 2055 are expected to be closer to those modelled in 2030 rather than 2190.

7.1.19 Using the 2030 coastal inundation modelled extents, the proposed vehicular access road to Pillbox Field is within the 1 in 200-year and 1 in 1,000-year extents. Therefore, the shorter design life of the relocated facilities provides embedded design mitigation.

c) Residual risk management

i. Construction

7.1.20 For a short period while the temporary flood defence is being constructed, the construction-site of the main platform would be at risk of wave overtopping from 1 in 200-year event (assessed at 2030 with UKCP18 RCP8.5) with resulting overtopping rates 140 l/s/m (**Table 7.4**). Such overtopping rate would pose risk to safety to people at the construction site of the coastal defences.

7.1.21 The completion of the temporary haul road and temporary flood defence raises the defence level to 7.0m AOD and reduces the wave overtopping rates from 1 in 200-year event (assessed at 2030 with UKCP18 RCP8.5) to 0.03 l/s/m (**Table 7.4**). This significantly reduces the wave overtopping risk.

7.1.22 An appropriate Flood risk emergency plan would be in place for the initial stages of construction while the temporary coastal defence is being constructed as this is when the construction-site is most exposed. The flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note (Ref 1.3) would include procedures to ensure people on site are safe in the event of a flood.

7.1.23 A weather monitoring system would be in place to monitor extreme sea level and storm conditions and, if necessary, construction would need to be halted and the site temporarily evacuated.

7.1.24 The beach landing facility is designed to be used in the summer months during suitable sea conditions. The decking of the beach landing facility would be temporarily removed in the winter months and stored on the main development site.

ii. Operation

7.1.25 The mean overtopping rates at the Hard Coastal Defence Feature, the northern mound and the SSSI crossing were modelled for the 1 in 200-year and 1 in 1,000-year.

7.1.26 Where appropriate, the over topping rates for the 1 in 10,000-year events for the reasonably foreseeable climate change scenarios were also modelled.

7.1.27 The credible maximum climate change for the 1 in 1,000-year and 1 in 10,000-year events were carried out. Further details of the modelling are in the Coastal Modelling Update Report (**Appendix 1**).

7.1.28 The overtopping modelling for the defence at the northern mound showed no overtopping for up to the 1 in 1,000-year event, while the 1 in 10,000-year event shows a minimal mean overtopping rate of 0.64l/s/m for the northern mound (**Table 7.3**). Such overtopping rate is considered not significant for people at the platform behind the northern mound defence and would be easily manageable by trained staff. Also, the overtopping would be associated only with a storm event and would be limited to relatively short duration at high tide.

7.1.29 Assessment of risk to the northern mound was carried out in 2018, prior to UKCP18 climate projections being published. Considering results obtained based on the UKCP09 projections it was assumed that relative difference in sea level rise allowances (of less than 0.2m at 2090, **Appendix 5**) would not change conclusions of flood risk to the northern mound and therefore the assessment was not revised.

Table 7.3: Modelled mean overtopping results (l/s/m) for the northern mound defence

Return period (years)	Epoch – climate change scenario	Defence crest (m AOD)	Water level (m AOD)	Inshore wave height (Hs, m)	Mean overtopping rates (l/s/m)
1 in 200	2110 - 95% Medium Emissions (UKCP09)	10.2	4.40	9.52	0.00

Return period (years)	**Epoch – climate change scenario**	**Defence crest (m AOD)**	**Water level (m AOD)**	**Inshore wave height (Hs, m)**	**Mean overtopping rates (l/s/m)**
1 in 1,000	2110 – 95% High Emissions (UKCP09)	10.2	5.03	11.40	0.00
1 in 10,000	2110 – H++ with Land Motion plus 1m Surge	14.2	8.13	12.20	0.64

7.1.30 The northern mound has been considered to have a low risk of overtopping and further effects on flood risk to the main platform have not been considered.

7.1.31 Overtopping modelling for the Hard Coastal Defence Feature provides mean overtopping rates for three return periods, climate change scenarios and development phase epochs shown in **Table 7.4**. The modelled results for a defence with design crest at 10.2m AOD show a relatively small overtopping rate for the 1 in 200-year and 1 in 1,000-year events at 2140 epoch. This suggests no overtopping is likely for the earlier development phases.

7.1.32 The modelled results at the new Hard Coastal Defence Feature for the 1 in 10,000-year event predicted higher mean overtopping rates in 2140 of 36.42 l/s/m.

7.1.33 The adaptive defence design (as stated in the Description of the Development) with crest at 14.2m AOD was modelled to assess the overtopping risk for the reasonably foreseeable scenario for the two development phases at 2140 and 2190 epochs and the credible maximum scenario at 2140 (**Table 7.4**). The credible maximum scenario at 2190 was not assessed at this stage of the study as it was assumed that the site would not be in operation and only limited activity would be taking place at the main development site that would not require everyday presence of staff at the site. Once details are developed of the specific activities and staffing proposed to be at the site between the 2140 and 2190 epochs, further assessment would be carried out to inform the Flood risk emergency plan.

7.1.34 The results presented in **Table 7.4** show the risk of overtopping up to 2140 are below the safe for vehicles threshold of 5 l/m/s stated in the EurOtop Manual (**Appendix 4**). Such overtopping threshold is for safety of vehicles immediately behind the coastal defences. Available guidance on tolerable overtopping rates does not provide specific thresholds for people behind the defences, especially considering that the main platform would be set back from the new hard coastal defence. Therefore, the referenced threshold of 5 l/s/m should be considered very conservative as it does not account for energy dissipation between overtopping of the defence and water reaching the main platform area.

7.1.35 The overtopping rates for the 2190 epoch are above the threshold for the design defence crest at 10.2m AOD and below this threshold with the adaptive defence constructed to 14.2m AOD for return period events up to 1 in 10,000-year. Results for the 1 in 10,000-year and the H++ scenarios provide an indication of the risk to the main platform operation with overtopping in more extreme scenarios.

Table 7.4: Modelled mean overtopping rates for the Hard Coastal Defence Feature

Return period (years)	Epoch – climate change scenario	Defence crest (m AOD)	Water level (m AOD)	Inshore wave height (Hs, m)	Mean overtopping rates (l/s/m)
1 in 200	2030 – RCP8.5 (UKCP18)	4.36 / 7.0*	3.33	2.85	140.36 / 0.03
	2140 – RCP8.5 (UKCP18)	10.2 / 14.2	5.00	3.73	0.30 / 0.00
	2190 – RCP8.5 (UKCP18)	10.2 / 14.2	5.83	4.03	4.50 / 0.00
1 in 1,000	2030 – RCP8.5 (UKCP18)	10.2	4.13	3.25	0.00
	2140 – RCP8.5 (UKCP18)	10.2 / 14.2	5.84	3.94	3.79 / 0.00
	2190 – RCP8.5 (UKCP18)	10.2 / 14.2	6.67	4.10	23.17 / 0.02

Return period (years)	Epoch – climate change scenario	Defence crest (m AOD)	Water level (m AOD)	Inshore wave height (Hs, m)	Mean overtopping rates (l/s/m)
	2140 – BECC Upper	14.2	7.94	4.11	2.29
1 in 10,000	2090 – RCP8.5 (UKCP18)	10.2	5.85	4.15	5.80
	2090 – H++ with Land Motion plus 1m Surge	10.2	6.46	4.34	21.05
	2140 – RCP8.5 (UKCP18)	10.2 / 14.2	6.75	4.42	36.42 / 0.29
	2190 – RCP8.5 (UKCP18)	10.2 / 14.2	7.58	4.77	153.62 / 4.41
	2140 – BECC Upper	14.2	8.85	4.96	41.83

* Defence crest levels based on known minimum levels during removal and construction of new coastal flood defences.

7.1.36 Overtopping for the credible maximum scenario for the 200-year and 1,000-year events at 2190 have not been specifically modelled. Sea level rise allowance for the credible maximum scenario at 2190 (based on the BECC Upper climate estimates) would be 4.82m giving an extreme water level for the overtopping assessment of 8.0m AOD and 8.84m AOD for the 200-year and 1,000-year respectively. An extreme water level of 8.85m AOD was assessed for the 10,000-year return period scenario (with more conservative nearshore wave height).

7.1.37 The impacts of climate change and the associated changes in the sea levels would be monitored and assessed at set intervals (minimum 10 years) to determine the trajectory of the projections and consider whether there is any change from currently considered projections. This would aid the decision-making process on whether or when to raise the sea defences from construction crest of 10.2m AOD to the adaptive crest of 14.2m AOD.

7.1.38 The residual flood risk due to wave overtopping would be managed on the main platform with site management protocols, warning system and weather forecasting. An appropriate response team would manage the clean-up operation and the removal of potential debris accumulated on the platform. The sea defence would be inspected after an event to ensure to the structure has not been damaged.

7.1.39 The beach landing facility would continue to be at risk of storm events. Usage of the facility would most likely be during the low wave energy season (between 31 March to 31 October) and would probably be used once every 5 years during the operation phase.

iii. Decommissioning

7.1.40 The main platform would be present up to the end of the theoretical maximum site lifetime (2190). The main platform sea defences without the adaptive defences, would remain above the water level in the 1 in 1,000-year reasonably foreseeable climate change scenario. There would be some overtopping (**Table 7.4**), although the rate of overtopping would remain manageable for the staff working on-site for the 1 in 200-year event up to the end of theoretical site lifetime.

7.1.41 For the 1 in 1,000-year event the overtopping rate of the new Hard Coastal Defence Feature without the adaptive defences would be significant.

7.1.42 The adaptive sea defences would be constructed as necessary based on monitoring of the trajectory of the climate change projections. This will significantly limit the risk of wave overtopping up to the theoretical maximum site lifetime.

7.2 Breach

a) Flood risk with climate change

7.2.1 Breach modelling was conducted for the Sizewell C Project to assess the risk to the proposed development were the coastal defences to fail. As discussed in **section 5.4** of this **report**, two main breach locations were considered, with a third breach on the main platform being added at a later point. The breach modelling focused on two return period events and two climate change epochs based on the assumption that they will provide a sufficient range of scenarios to assess potential maximum impact of the development on flood risk. The maximum still water levels used in the modelling were the same as in the coastal inundation modelling (**Table 7.2**).

7.2.2 While there is a significantly lower probability of a breach in the new hard sea defence occurring than of a breach in natural sand dunes / shingle banks, a potential breach of the Sizewell C Hard Coastal Defence Feature was considered to inform flood risk on-site. This breach was modelled with a more conservative, credible maximum climate change scenario with BECC Upper allowances at 2140 epoch for both the 1 in 200-year and the 1 in 1,000-year events with extreme still water levels of 7.03m AOD and 7.35m AOD respectively. This confirms the credible maximum scenario extreme water level at 2140 is higher than that of the reasonably foreseeable scenario at 2190. Further discussion can be found in in the residual risk sub-section.

7.2.3 The modelled results for the end of the construction phase with a breach at the tank traps show the maximum water levels for the 1 in 1,000-year event with climate change up to 2030 are approximately 3.2m AOD and would not pose flood risk to the main platform (**Figure 25** and **Figure 26**).

7.2.4 The modelling results for the 1 in 1,000-year event with climate change up to 2190 show the maximum water levels around the platform area are 5.7m AOD and 5.9m AOD for the 1 in 200-year and 1 in 1,000-year events respectively (**Figure 47** and **Figure 48**). This is below the platform elevation of 7.3m AOD with a negligible risk of platform being inundated (**Table 7.5**).

7.2.5 The initial breach assessment conducted in 2015 (Ref 1.47) identified the tank traps locations as the worst breach location. The narrowing created around Goose Hill caused by the proposed main platform and the SSSI crossing increases the water levels within the Minsmere Levels.

7.2.6 The analysis of the Sizewell C project in the area to the north of Sizewell Gap, to the north of Rosery Cottages and to the eastern side of the existing Sizewell A and B access road, shows that there are areas that are in both 1 in 200-year and 1 in 1,000-year events in 2030 and in 2190 and have the same water levels as for the main platform area to the north (**Figure 26** and **Figure 48**).

7.2.7 A summary of the depth, velocity and hazard rating across this sub-area is shown in **Table 7.5**.

Table 7.5: Breach of tank traps results – modelled maximum water depth, velocity and hazard rating in the main platform area

Location	Event	2030			2190		
		Depth (m)	Velocity (m/s)	Hazard	Depth (m)	Velocity (m/s)	Hazard
Proposed main	1 in 200-	1.0	1.1	Danger to Most	5.1	0.6	Danger to All

Location	Event	2030			2190		
		Depth (m)	Velocity (m/s)	Hazard	Depth (m)	Velocity (m/s)	Hazard
platform	year						
	1 in 1,000-year	1.2	0.95	Danger to All	5.3	0.6	Danger to All
Rosery Cottages	1 in 200-year	0.14	0.002	None	4.2	0.12	Danger to All
	1 in 1,000-year	0.34	0.003	Danger to Some	4.4	0.12	Danger to All
Sizewell Access Road and Sizewell Gap Junction	1 in 200-year	0.5	0.04	Danger to Some	4.6	0.09	Danger to All
	1 in 1,000-year	1.0	1.1	Danger to Most	5.1	0.6	Danger to All

7.2.8 Further details on all the breach modelling and detailed results are available in the Breach Modelling Report (Ref 1.46).

b) Embedded design

7.2.9 The construction of the temporary coastal defence in the construction phase would reduce the probability of a breach occurring at tank traps location as defined in **section 5.4** of this **report** and shown in **Plate 5.1**. Further information for the layout of the sea defences are given in the Description of Development in **Volume 2, Chapter 3** of the **ES** (Doc Ref. 6.3)**.**

7.2.10 The proposed main platform would be raised to 7.3m AOD with a cut-off wall around the platform. On the seaward side, there would be a newly constructed reinforced coastal defence with a crest height of 10.2m AOD and the existing defence further down the beach would remain in place. The coastal defence could facilitate an adaptive design to raise the crest level to 14.2m AOD, when required. Access to the beach landing facility would be at 5.0m AOD on the seaward side of the northern mound defence.

7.2.11 The outage car park at Pillbox Field proposed as part of Sizewell B relocated facilities would be constructed on the ridge outcrop area, with the low topographic area along the Sizewell Gap being used for planting to screen the site as described in the Description of Development in **Volume 2, Chapter 3** of the **ES** (Doc Ref. 6.3).

7.2.12 The Sizewell B relocated facilities are mostly located outside of the modelled 1 in 200-year with climate change and 1 in 1,000-year with climate change breach flood extent. The design life of these facilities is to 2055. Therefore, the future water extents, depths and velocities in 2055 are expected to be closer to those modelled in 2030 rather than 2190.

7.2.13 Using the 2030 breach modelled extents, the proposed vehicular access road to Pillbox Field, and the landscape planting to the south of the outage car park are within the 1 in 200-year and 1 in 1,000-year extents. Therefore, the shorter design life of the relocated facilities provides embedded design mitigation.

c) Residual risk management

i. Construction

7.2.14 As assessed in **section 7.2c)** of this **report**, the existing secondary defence would be removed to undertake ground improvement works for the construction of Hard Coastal Defence Feature. Therefore, for a short period, the main platform site would be at risk of inundation from still water levels and wave overtopping.

7.2.15 An appropriate risk management strategy would be in place for this short period in the early stages of construction when the site is most vulnerable to flood risk. The weather monitoring system would be in place to monitor extreme sea level and storm conditions before work starts on-site to remove the defences. Should the weather conditions be inclement and, if necessary, in line with the risk management strategy, then construction works on-site would need to be temporarily ceased and the site evacuated while the poor weather passes.

ii. Operation

7.2.16 As discussed in **section 7.2a)** of this **report**, the breach of main coastal defences was also assessed. This model was run for the credible maximum climate change scenario (BECC Upper) at the end of interim fuel spent store (2140) for the 1 in 200-year and 1 in 1,000-year return period with extreme still water levels at 7.03m AOD and 7.35m AOD respectively. This scenario is more conservative than the reasonably foreseeable scenario up to 2190, with extreme still water levels at 5.70m AOD and 6.02m AOD for the 1 in 200-year and 1 in 1,000-year events respectively.

7.2.17 Due to the characteristics of the site, initially two breach options were considered. Option 1 is where the defence is breached to the platform elevation of 7.3m AOD with a slope to the existing ground levels. Option 2 is where the sea defence is breached down to pre-construction elevation of 3.0m AOD. In both options, the platform is assumed to remain undamaged due to presence of the cut-off wall, although the ground is eroded on the seaward side of the cut-off wall.

7.2.18 As mentioned in **section 7.1b** of this **report**, the defence design assumes a crest level of 10.2m AOD with potential to raise it in the future up to 14.2m AOD. As the timing of adapting the defence is not yet confirmed, the impact of breach of sea defence on the main platform flood risk was assessed for both heights of the defence.

7.2.19 The preliminary results found that Option 1 with defence breached to the platform level resulted in greater depths on the platform. This is attributed to the fact that in Option 2, the exposed vertical cut-off wall reflects more waves. While in Option 1, the sloping profile causes more wave runup and associated overtopping.

7.2.20 Using the preliminary results, Option 1 was taken forward for the final assessment. The resulting maximum water depths on the platform for the modelled scenarios for Option 1 are presented in **Table 7.6**.

7.2.21 For the purpose of the breach model, the main platform was conservatively assumed to be flat with no drainage system in place.

Table 7.6: Breach of Hard Coastal Defence Feature results – modelled maximum water depth at the main platform (Option 1, middle of the main platform)

Return Period Event	Sea Defence Crest Level (m AOD)	Max Water Depth (m)
1 in 200-year	10.2	0.33
	14.2	0.32
1 in 1,000-year	10.2	0.46
	14.2	0.37

7.2.22 The breach of the 10.2m AOD defence would result in approximately 0.5m water depth on the platform for the 1 in 1,000-year event. This water depth on the platform is likely to be above the 200mm threshold of the buildings. Therefore, this scenario would pose flood risk to the operation of the buildings (**Figure 51**). With the defence raised to 14.2m AOD, the water depth on the platform as a result of breach of sea defence is reduced. However, the water depth would still above the proposed buildings thresholds of about 200mm with a risk to safe operation.

7.2.23 Using the Option 1 scenario results, the time to initial inundation has been assessed for four locations on the platform. These locations are at the front of the site between the two pump houses, outside of each of the reactor buildings and the spent fuel storage zone. The northern reactor is shown to begin flooding at about 35 hours into the simulation. The flooding then expands to cover the whole platform at approximately 36 hours into the simulation. The modelled breach occurs at about 37 hours in to the simulation, when the platform is already flooded from overtopping. Once the breach occurs it actually allowed the peak water levels to decrease via the breach gap.

Table 7.7: Breach of Hard Coastal Defence Feature time to inundation results in hours from the start of the model (Option 1, middle of the main platform)

Scenario	Event	Front – between pump houses	Reactor North (Zone 1A-2)	Reactor South (Zone 1A-2)	Spent Fuel storage (Zone 1A-7)
Baseline	200-year	No flooding	10	11	12
	1,000-year	No flooding	10	11	12
Option 1	200-year	10	35	15	15
	1,000-year	8	25	13	13

7.2.24 An appropriate maintenance schedule for the main coastal defence would be put in place to monitor structural integrity and overall asset condition to minimise the likelihood of breach during an extreme storm event.

7.2.25 Forecasting and warning systems will be linked to emergency plans during the operation phase. Planned climate change impact monitoring should ensure the sea defence is raised to its adaptive crest of 14.2m AOD, when necessary, to limit volume of overtopping and risk of breach occurring. The probability of a breach occurring will remain very low with the higher and more robust sea defence structure as compared to the other stretches of the coastal defences away from the main platform.

7.2.26 To manage the breach of the main defences, suspension of operation for the short time required during a breach during a very extreme sea level will be part of the flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note (Ref 1.3) to ensure people on site are safe in the event of a flood.

7.2.27 In the worst-case scenario, this would lead to up to about 70-170mm of internal flooding for up to three hours during the extreme tidal cycle. Managing such a low probability event through a temporary shut-down of operations is considered adequate.

iii. Decommissioning

7.2.28 The assessment of the main hard coastal defence breach was run for the credible maximum climate change scenario (BECC Upper) at the end of interim fuel spent store (2140) for the 1 in 200-year and 1 in 1,000-year return period with extreme still water levels at 7.03m AOD and 7.35m AOD respectively. The results indicate a maximum water depth on the platform that exceeds the assumed building thresholds (**Table 7.6**). The assessment applied the more conservative credible maximum climate change scenario and can be used as indication of risk from reasonably foreseeable scenario up to 2190.

7.2.29 The same risk management activities discussed in the operation phase would be required for decommissioning phase. The site would be vacated during an extreme storm event that could result in breach of the HCDF.

7.3 Fluvial

a) Flood risk with climate change

7.3.1 The platform construction would result in the diversion of the Sizewell Drain around the main platform (**Plate 7.3**), and the slight loss of floodplain and associated flood storage.

7.3.2 Hydraulic modelling was undertaken to assess fluvial flood risk to the main development areas and impacts of the development on flood risk to the off-site receptors. The model was run for four return period events, with climate change allowances for increase in fluvial flow, rainfall intensity and sea level rise applied to three epochs.

7.3.3 In addition, the assessment for theoretical maximum site lifetime was carried out up to 2190 with climate change as per ‘2080s’ epoch with no extrapolation in accordance with the Environment Agency guidance (Ref

1.7) (**Table 4.3**). The resulting modelled peak flows derived for the Minsmere River and corresponding sea levels applied at the downstream model boundary for the different return period events and scenarios is provided in **Table 7.8**. The joint probability of fluvial flow and sea levels was derived with focus on fluvial flow, meaning for a 1 in 100-year joint probability event a 100-year flow was used with corresponding sea levels.

Table 7.8: Boundary conditions used in the Sizewell C fluvial model

Climate Change Epoch	Return Period Event	Peak Flow at Minsmere (m^3/s)	Sea Level (m AOD)
Present Day (2017)	5-year	10.26	1.52
	20-year	14.00	1.52
	100-year	18.64	1.69
	1,000-year	27.95	1.91
2030 (+25%)	5-year	12.82	1.61
	20-year	17.50	1.61
	100-year	23.30	1.78
	1,000-year	34.94	2.00
2140 (+65%)	5-year	16.93	4.11
	20-year	23.10	4.11
	100-year	30.76	4.28
	1,000-year	46.12	4.50
2190 (+80%)	5-year	18.462	4.11
	20-year	25.206	4.11
	100-year	33.558	4.28
	1,000-year	50.314	4.50

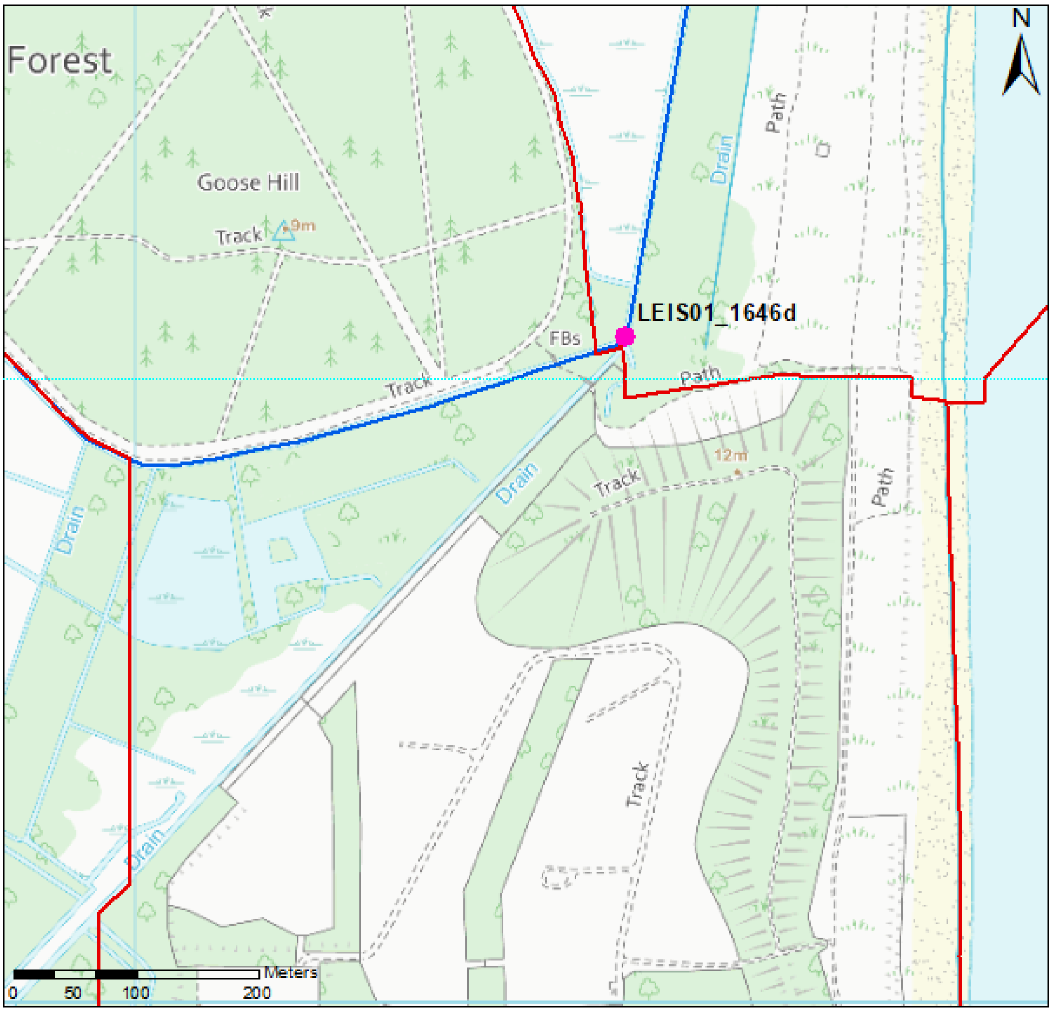
7.3.4 The fluvial model runs are applicable to assessment of flood risk to all considered development areas and will be referred to in **sections 8.3, 9.2 and 10.2** of this report.

7.3.5 The modelled maximum water levels around the platform area (point within the floodplain next to the north-west corner of the main platform – model node LEIS01_1649d illustrated in **Plate 7.2**) for all considered return period scenarios and climate change allowances are presented in **Table 7.9, Figure 52, Figure 53, Figure 56,** and **Figure 57.**

Table 7.9: Modelled maximum water levels around the main platform

Climate Change Epoch	Return Period Event	Maximum Water Level (m AOD)
2030 (+25%)	5-year	1.333
	20-year	1.571
	100-year	1.858
	1,000-year	2.136
2090 (+35%)	5-year	1.458
	20-year	1.724
	100-year	2.004
	1,000-year	2.187
2140 (+65%)	5-year	1.860
	20-year	2.021
	100-year	2.135
	1,000-year	2.271
2190 (+80%)	5-year	1.926
	20-year	2.059
	100-year	2.169
	1,000-year	2.291

Plate 7.2. Location of the improved 1D-2D model node LEIS01_1649d

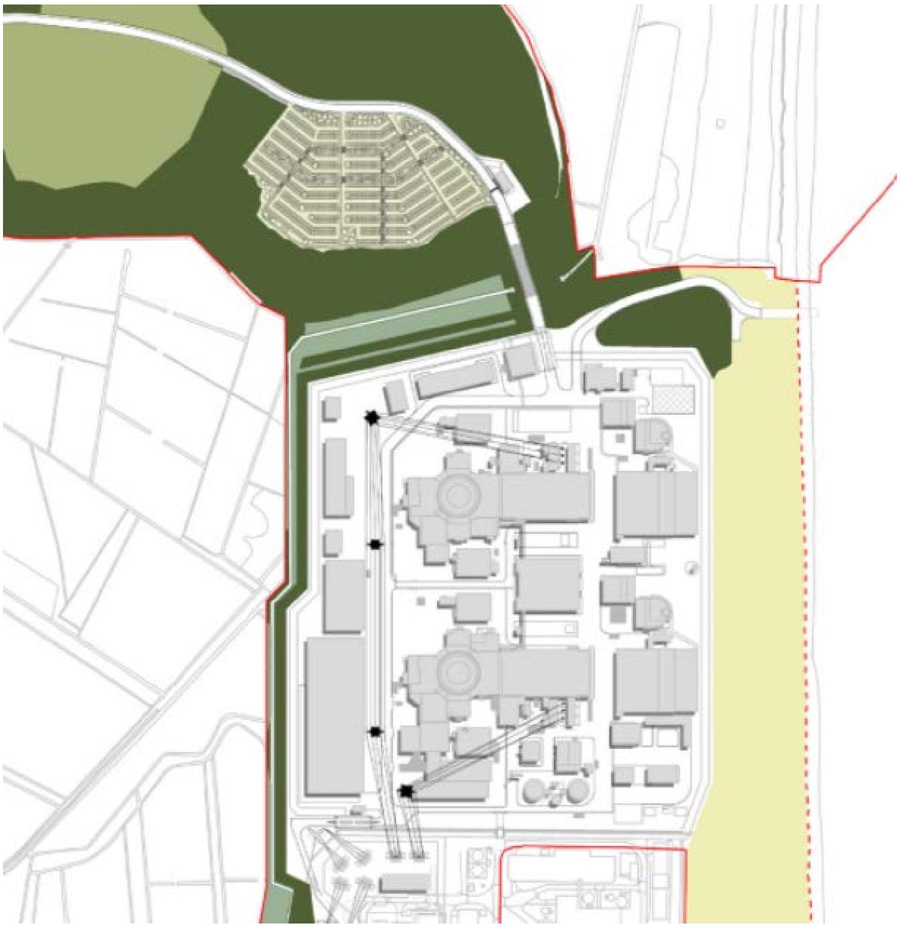


b) Embedded design

7.3.6 The main platform would be raised to 7.3m AOD with a cut-off wall and sloping banks around the main platform. The Sizewell Drain would be realigned to run along the western platform edge and reconnect with Leiston Drain to the north (**Plate 7.3**). The realigned Sizewell Drain channel would be sized to at least match or exceed the existing drain size to ensure the existing flow capacity is retained.

7.3.7 Since the Aldhurst Farm Scheme has already been implemented, this model schematisation has adopted the scheme as part of the baseline model. Previous assessments showed that the Aldhurst Farm scheme had a localised impact that provided a minor reduction of fluvial flood risk in the area of less than 10mm.

Plate 7.3: Extract from Sizewell C Environmental Statement Figure 2.3 - main development site operation masterplan - Realignment of the Sizewell Drain



7.3.8 The Sizewell B relocated facilities are mostly located outside of the modelled 1 in 200-year with climate change and 1 in 1,000-year with climate change fluvial flood extent. The design life of these facilities is to 2055. Therefore, the future water depths in 2055 are expected to be closer to those modelled in 2030 rather than 2190.

7.3.9 Using the 2030 fluvial modelled extents, the proposed vehicular access road to Pillbox Field , and the landscape planting to the south of the outage car park are within the 1 in 200-year and 1 in 1,000-year extents. Therefore, the shorter design life of the relocated facilities provides embedded design mitigation.

c) Residual risk management

i. Construction

7.3.10 During the early stage of the construction works, the platform area would be constructed to a level of 3m AOD to enable a uniform level to build the cut-off wall. At this stage, the construction area would be most exposed to fluvial flood risk. The modelling results for a 1 in 100-year event with 25% climate change allowance from 2022 until the end of construction show the maximum water levels around the platform area are approximately 1.86m AOD. These water levels are below the initial construction level. Therefore, the fluvial flood risk during construction is considered to be low.

7.3.11 Construction works for activities, such as the watercourse realignment, would employ weather monitoring to predict potential extreme events and halt initial construction works, if required.

ii. Operation

7.3.12 The modelling results show the maximum water levels for up to 1 in 1,000-year event with 65% allowance for climate change for 2090 until the end of operation are less than 3m AOD (**Figure 56**). This maximum water level is well below finished platform level of 7.3m AOD and therefore fluvial flood risk to the platform is low.

7.3.13 While the Sizewell Drain is owned by SZC Co., the management of the watercourse and the Sizewell Belts is delegated to Suffolk Wildlife Trust to manage on behalf of SZC Co.. This arrangement would continue after the proposed Sizewell Drain realignment. An appropriate monitoring and maintenance schedule will be in place for the re-aligned Sizewell Drain, the associated embankments and the platform embankments.

iii. Decommissioning

7.3.14 The main platform at 7.3m AOD would be above the 1 in 1,000-year fluvial reasonably foreseeable and credible maximum climate change scenarios water level (2.29m AOD) up to the theoretical maximum site lifetime of 2190 (**Figure 56**).

7.4 Surface water

a) Future flood risk

7.4.1 The construction of the platform, access road to Pillbox Field and the outage car park would raise, smoothen and alter the surface level and form.

This would limit the potential for surface water to collect in the existing locations.

7.4.2 The proposed development would lead to an increase in the impermeable area. The majority of the surface of the platform would be impermeable and limit the potential for surface water infiltration. The surface water run-off from impermeable areas would be removed through a positive permanent drainage system with a suitable allowance for climate change.

7.4.3 The platform construction will involve a deep excavation and the construction of cut-off walls down to the clay bedrock around the site perimeter. The cut-off walls would hydraulically isolate the platform from the surrounding environment to limit the impacts of dewatering during the construction phase and would remain in place.

7.4.4 An Outline Drainage Strategy has been prepared to inform the surface water drainage design (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3). This report defines the drainage approach and the design standards and principles.

7.4.5 An Extreme Rainfall Assessment has been undertaken for the proposed Sizewell C power station as part of the safety case. The safety case considers the 1 in 10,000-year event, which is beyond the scope of this FRA. However, the Extreme Rainfall Assessment provides an indication of the surface water impacts on the platform.

7.4.6 The modelled rainfall events considered two phases; the end of operation for Sizewell B and the end of interim spent fuel storage for Sizewell C. In both phases the baseline would cause some surface water flooding at Sizewell B. With the construction of Sizewell C and embedded design, the maximum water depths are below the minimum building thresholds. Therefore, for the less extreme rainfall events such as the 1 in 1,000 year would be significantly within the embedded design parameters.

7.4.7 The future surface of the platform would remain at a similar low to medium surface water flood risk dependent on embedded design of a surface water management system.

b) Embedded design

i. Construction phase

7.4.8 The construction phase surface water Outline Drainage Strategy creates three discrete drainage catchments around the platform. Two sub-catchments, known as Water Management Zones (WMZ) 7 and 8, are located around the outside perimeter of the main excavation cut-off wall. A third catchment, WMZ 9, forms the deep excavation within the cut-off wall area. The proposed sub-catchments are available in **Figure 2.4** of **Volume 2, Chapter 2, Appendix 2A** of the **ES** (Doc Ref. 6.3).

7.4.9 The construction phase surface water drainage design would have a design capacity to manage rainfall from a 1-year event without surcharging above the outfall soffits and a 1 in 30-year rainfall event without surface water flooding occurring. In a 1 in 100-year rainfall event, the drainage design would ensure that no buildings would be flooded, and no untreated surface water would flow beyond the site boundary. A 20% allowance for climate change is to be incorporated into the construction drainage system.

7.4.10 An initial consideration of attenuation has been undertaken, however, it has been considered unrealistic given the space constraints around the main development platform during construction. Therefore, surface water would not be attenuated. All three catchments would drain directly into the Combined Drainage Outfall (CDO) before discharging into the North Sea at the north-east corner of the main platform (**Volume 2, Chapter 2** of the **ES**) (Doc Ref. 6.3). The CDO would be designed to consider the potential for coincidental peak output and also any tidal influence.

7.4.11 The water management zones 7 and 8 are around the outside of the cut-off walls, where the haul roads would be positioned. The surface water run-off from the land and the haul roads in both water management zones would discharge to a proposed ditch around the perimeter of the platform. Resilience methods to cope with a 100-year return period storm plus climate change are required and the ditch would store and convey the flow to the CDO in exceedance events.

7.4.12 The proposed large capacity of the CDO means that storage will not be required for exceedance events up to the 1 in 200-year event, however consideration would be given to harvesting surface water for re-use on site where practicable (**Volume 2, Chapter 2** of the **ES**) (Doc Ref. 6.3).

7.4.13 Prior to the construction of the CDO, surface water would be conveyed to neighbouring water management zones. Treated runoff may be conveyed to the attenuating features within water management zone 1 and water management zone 2, and would be sized accordingly.

7.4.14 In water management zone 9, there are two distinct construction phases of the main platform within the cut-off walls; excavation and backfilling. The removal of surface water from the deep excavation is required as precipitation falling into the deep excavation may soak into the ground in permeable areas. However, some surface water run-off and pooling would be inevitable. It is anticipated that surface water from the main platform excavation would require pumping up to platform level.

7.4.15 The surface water system for the excavation could consist of collector drains discharging to sumps, before being pumped off-site. The surface water removed from the excavation is likely to contain suspended solids and would require treatment prior to discharge. This would be undertaken in accordance with requirements of an Environmental Permit.

7.4.16 The outage car park and the access road would apply the same surface water management principles outlined in the Outline Drainage Strategy (**Volume 2, Chapter 2** of the **ES**) (Doc Ref. 6.3) with the aim to drain by infiltration where possible, before seeking alternative discharge options. The outage car park would be a surface level car park constructed with a grass reinforcement system base. The grass reinforcement system would provide a high strength structure of which a large proportion of the surface could be infilled, enabling the system to be visually unobtrusive and is a form of sustainable drainage.

7.4.17 The Sizewell B relocated facilities that are within the existing Sizewell B power station perimeter (such as the Outage Store and facilities within the outline development zone) would be drained to the existing below ground surface water drainage network.

7.4.18 While for facilities located outside of the existing Sizewell B power station perimeter (such as the facilities within Coronation Wood and Pillbox Field areas, as described above) would be drained principally by infiltration techniques. The infiltration drainage would be independent from the existing surface water drainage system on the Site. An exception to this is the temporary location of the visitor centre, which comprises a refurbishment of the existing technical training centre. Therefore, the temporary visitor centre would follow the existing drainage principles in that location.

ii. Operation and decommissioning phase

7.4.19 Within the footprint of the main platform, it was necessary to consider the transition with construction drainage being replaced by the permanent site drainage. It was originally intended that where possible permanent drainage would be installed and used during construction. However, given the initial main platform ground levels during construction and later raising the use of the permanent drainage system during the construction phase was not viable.

7.4.20 The Outline Drainage Strategy at **Volume 2, Chapter 2, Appendix 2A** of the **Environmental Statement** (Doc Ref. 6.3) aims to mimic the natural environment and to return the water to ground or local drainage systems using local source control techniques. These techniques include both permeable paving and impermeable surfacing and in the latter case are supplemented with infiltration trenches and/or swales.

7.4.21 The surface water drainage design would have sufficient capacity to discharge to the sea while ensuring:

- In a 1 in 200 annual probability rainfall event, critical site access and transport links to Sizewell C would be capable of operating safely and that staff operating the power station could do so without surface water flood risk. For events up to this magnitude, the platform would drain to the sea through the main cooling water infrastructure.
- In a 1 in 1,000 annual probability rainfall event, staff and visitors to Sizewell C site would remain safe from the effects of surface water flooding, though design of surface water exceedance flow paths.
- In a 1 in 10,000 annual probability rainfall event, no flood water that builds up within the site would reach a level where it could flow into safety classified buildings. Any surface water drainage network relied upon to achieve this would be safety classified.

7.4.22 Buildings on the main platform would be built with a flood resistant design to prevent water ingress during extreme rainfall events or minor wave overtopping during extreme coastal events.

7.4.23 Sizewell C would have a separate surface water drainage network. There would be no interaction between the surface water drainage networks of Sizewell B and Sizewell C.

c) Residual risk management

i. Construction

7.4.24 Prior to the construction of the CDO, surface water would be conveyed to neighbouring water management zones. At times of high surface water inundation, there may be a necessity to construct additional attenuation storage within the main construction area as temporary measures, where practicable.

7.4.25 There is a residual risk of the surface water pumps' failure due to mechanical or electrical reasons. These would be designed with sufficient fail-safe capacity to mitigate in the event of unit failure. An appropriate maintenance schedule of activities for the surface water pumps would be undertaken to prevent the pumps failing at a critical moment. The surface water pumps are most likely to be used in periods of rainfall and inclement weather. The daily and weekly weather should be monitored to identify periods when the surface water pumps are likely to be used. Risk relating to surface water would be managed through the Flood risk emergency plan, which will be developed to ensure safe access and evacuation in the event of flooding.

7.4.26 In addition, the pumps may be moved to allow site works to continue unimpeded during the construction phase. This could possibly lead to surface water pumps not being in an operational position and could require a lead-in time to position and set up the equipment appropriately. Therefore, it is appropriate for the pump power supply, position and general readiness for use to be checked before periods of inclement weather.

7.4.27 The pump sumps would be maintained adequately to avoid a reduction in pump capacity and effectiveness. Any change in site conditions that could affect the sumps would lead to additional initial sump checks.

ii. Operation

7.4.28 Once the main platform is operational, there would be a requirement for scheduled maintenance and cleaning of the surface water drainage network to ensure operation at the design capacity throughout the lifetime of the site to prevent the deterioration of the network and maintain the design capacity.

7.4.29 Risk relating to surface water would be managed through the Flood risk emergency plan, which will be developed to ensure safe access and evacuation in the event of flooding. Overall, safety aspects would be managed through the Nuclear Site Licence.

iii. Decommissioning

7.4.30 An Extreme Rainfall Assessment has been undertaken for the proposed Sizewell C power station as part of the safety case. The safety case considers the 1 in 10,000-year event, which is beyond the scope of this FRA. However, the Extreme Rainfall Assessment would provide an indication of the surface water impacts on the platform for lower return periods such as the 1 in 1,000-year event.

7.4.31 The modelled rainfall events considered the end of operation for Sizewell B and end of interim spent fuel storage for Sizewell C. In both phases, the baseline would cause some surface water flooding at Sizewell B. With the construction of Sizewell C and the embedded mitigation, the maximum water depths are below the minimum building thresholds. Therefore, for the less extreme rainfall events such as the 1 in 1,000-year would be significantly within the embedded design parameters.

7.5 Groundwater

a) Future flood risk

7.5.1 The groundwater model covers the period from 2015-2040 for three climatic scenarios, dry, wet and intermediate. The model covers the phases leading up to and during construction, and eight years of operation following construction.

7.5.2 The drawdown effect of the groundwater dewatering for the construction of the main platform has been modelled for both the wet and dry scenarios. The magnitude, duration and extent of drawdown are similar for both the dry and wet scenarios. This suggests the impacts are not particularly sensitive to climatic conditions.

7.5.3 After the dewatering ceases, groundwater levels within the platform area are predicted to recover to be equivalent to those outside the platform (approximately 0.5m AOD) within a period of 2 years (Ref 1.26). This is based on an assumption of no recharge occurring within the platform area.

7.5.4 The Sizewell B relocated facilities on the Sizewell B platform, Coronation Wood development area and in the Pillbox Field would be unaffected by the groundwater variation associated with the construction and operation of the Sizewell C main platform.

7.5.5 The FEFLOW model developed to predict impacts on groundwater levels during construction dewatering of the main platform site is not designed to simulate potential coastal flooding and does not incorporate current or future coastal flood defences (Ref 1.43).

b) Embedded design

i. Construction phase

7.5.6 A groundwater control strategy is required to manage the groundwater flood risk to the site during construction and this would be developed in conjunction with the flood risk emergency plan.

7.5.7 The proposed development platform has a groundwater management approach that has the following key features (refer to **Volume 2, Chapters 3** and **19** of the **ES**) (Doc Ref. 6.3):

- A low permeability cut-off wall, penetrating from surface down to the very low permeability London Clay at approximately 50m below ground level (mbgl), installed to form a barrier to groundwater flow around the complete external perimeter of the excavations.
- An array of pumped deep wells to lower groundwater levels within the area enclosed by the cut-off walls;
- An array of monitoring wells inside and outside the area enclosed by the cut-off walls; and
- A proposed Monitoring and Response Strategy, plus a monitoring plan to be prepared in consultation with stakeholders, to set the parameters for operating control structures in the realigned Sizewell Drain and other watercourses, to maintain groundwater levels.

7.5.8 The cut-off wall will hydraulically limit the connection between the platform area and the surrounding environment. This will enable groundwater levels in the platform area to be lowered without affecting the surrounding area and protected habitats off-site. In addition, the cut-off wall will reduce the amount of dewatering necessary during excavation of the site and throughout the construction phase.

7.5.9 A similar strategy was used during construction of the Sizewell B power station. While there was a localised leak in the Sizewell B cut-off wall, related to a construction issue, the groundwater control strategy was successful.

7.5.10 There are two distinct sub-phases of the main platform construction within the cut-off walls; the excavation, and the backfilling.

7.5.11 The construction within the main development platform involves deep excavation. The associated cut-off wall allows dry working conditions to be maintained throughout. The staged construction of work within the cut-off wall will be facilitated by internal dewatering. Dewatering would be undertaken through a series of wells mostly positioned around the inner perimeter of the cut off wall.

7.5.12 The wells would be drilled down into the Crag to a depth sufficient to lower the water table below the deepest excavation depth, to prevent groundwater flooding. The groundwater drawdown initially would be undertaken at a higher flow rate to lower the groundwater level over an 8 to 12-week period. Subsequent maintenance pumping would then be undertaken for the remainder of the construction period, with dewatering flow rates reduced significantly. The dewatering discharge would be conveyed through a ring main ultimately discharging to the Combined Drainage Outfall.

7.5.13 Individual dewatering wells would be temporarily taken out of service as excavation activities take place in adjacent ground.

7.5.14 As the platform deep excavation nears completion, the groundwater level would require further localised lowering in discrete areas of the site to enable the construction of the marine launch chamber and boring of intake and outfall tunnels from within the main platform. Once the marine launch chamber is complete, the backfilling of the platform in conjunction of the construction of the below ground level structures would be undertaken.

7.5.15 The backfilling within the cut-off wall would continue up to foundation level of the permanent buildings and the installation of the permanent drainage system.

ii. Operation

7.5.16 The cut-off wall would remain in place after construction is complete. The cut-off wall would continue to isolate groundwater within the site from that outside. There would be nominal groundwater leakage into the platform area which would allow water levels to recover following the end of dewatering until they are equivalent to those outside the cut-off (**Figure 64**). The groundwater modelling shows that this occurs within two years of the system being switched off, even with no infiltration from surface (Ref 1.26).

7.5.17 As the main platform will be covered in hardstanding with drainage installed, it is anticipated that infiltration within the platform area will be very limited. Where infiltration does occur, it would cause a gradual increase in groundwater levels within the cut-off wall. Although the cut-off wall and the underlying London Clay are low permeability, they are not completely impermeable. This means that if groundwater heads within the cut-off wall become higher than heads outside, then groundwater will gradually flow out from the platform area.

7.5.18 It is unlikely the water levels within the cut-off wall would reach the top of the cut-off wall without significant recharge within the cut-off wall. Should levels reach the top of the cut-off wall they would not rise further as groundwater would flow over the top of the cut-off wall.

7.5.19 The final level of the cut-off wall is not confirmed but will be below the ground level of the platform. In the event that external groundwater levels rise enough to over-top the cut-off wall, groundwater flooding could pose a risk to underground structures and basements. These structures would be designed to account for this risk.

c) Residual risk management

i. Construction

7.5.20 During the construction, a residual risk would remain should the failure of the groundwater pumps occur. These would be designed with sufficient fail-safe capacity to mitigate in the event of unit failure. The failure of the pumps could be due to mechanical, electrical or poor maintenance reasons. An appropriate maintenance schedule of activities for the groundwater pumps would be undertaken to prevent the pumps failing, and sufficient pumps would be installed to allow contingency if failures occur.

7.5.21 During construction activities some of the groundwater pumps will be temporarily taken out of service while works take place in the immediate area around those pumps. While the pumps are taken out of service temporarily, they may not be able to be returned quickly to operation. Therefore, should another groundwater pump fail while a pump is already out of service this could lead to the groundwater level within the construction area not being managed appropriately and having a limited effect on the progress of the works.

7.5.22 The pump power supply, position and general readiness for use will be checked and maintained for any temporary out of service pumps to enable rapidly returning a groundwater pump to service should the need arise. Sufficient redundancy will be included in the dewatering design to mitigate this risk.

ii. Operation

7.5.23 The groundwater modelling has shown the water table within the cut-off wall would recover to pre-development levels, equivalent to those outside the cut-off wall, before 2040 (Ref 1.26). Further groundwater modelling of future scenarios with climate change indicate there is no incremental effect with the climatic variations.

7.5.24 Once the main platform is operational, there are no changes to the groundwater inputs, and water levels will likely be controlled by any small amount of infiltration, and leakage through the cut-off wall. As discussed in

section 7.5b) of this **report**, there is a low risk of groundwater flooding to underground structures within the platform and these will be designed to account for this risk.

iii. Decommissioning

7.5.25 Groundwater modelling of future scenarios extends only to 2040. After 2090, seawater ingress is anticipated to occur across low-lying areas, with the land behind the sea defences in a fully saturated state the groundwater model would provide no meaningful information and groundwater flooding would not be a risk due to the inundation of seawater.

7.6 Reservoir

a) Future flood risk

7.6.1 The proposed development platform is not at risk of reservoir flooding, however, the access road to the south of Sizewell A is partially within the maximum flood extent of the Sizewell walks reservoir (**Figure 37**). Alternative access through the SSSI crossing exists as an alternative if this very low probability of reservoir breach occurs, making this a low risk overall to Sizewell C. It is not known whether the reservoir would still be present in the future as it is under a third-party ownership.

7.6.2 Should the reservoir remain, the volume of water held by the reservoir is likely to remain the same unless the reservoir is increased in capacity. Therefore, the maximum flood extent is unlikely to increase.

b) Embedded design

7.6.3 The overall design of the proposed development already ensures access to the main development site through the SSSI crossing which is not at risk from reservoir, fluvial or surface water flooding. This provides an alternative route if needed.

7.6.4 The proposed water resource storage area will be designed to mitigate any risk of escape of water to as low as reasonably practicable.

c) Residual risk management

7.6.5 In the unlikely event of any escape of water from the proposed water resource storage area, this resulting peak water levels are very likely to be much lower than the proposed development platform due to its elevation being much higher than the adjacent floodplain.

7.6.6 As the potential flood risk derived from the water resource storage area would affect the temporary construction area, further details regarding flood risk are given in **section 9.5**.

7.7 Sewer

a) Future flood risk

7.7.1 There is a requirement for a foul water sewer provision to be installed on-site as the main platform is constructed and the once the platform becomes operational. The foul water provision would serve the workforce on-site, although the requirement is likely to fluctuate considerably through the course of the Sizewell C Project. Therefore, a flexible approach would be applied.

7.7.2 As there are no sewers currently within the proposed main platform site area or the Pillbox Field, the introduction of a sewer network would increase the presence of foul water and the associated flood risk.

7.7.3 There is a sewer network available within the Sizewell B site. These sewers have no known flood history and would continue to be maintained to ensure operation. The relocated facilities would not place an additional use on system as previously the facilities being relocated were connected into the sewer network elsewhere.

b) Embedded design

i. Construction

7.7.4 During the construction stages of the main platform, a temporary sewage treatment plant and supporting foul water drainage network would be required. A temporary sewage treatment plant would be constructed on the eastern side of the temporary construction area. The foul water would be pumped from the main platform and the campus area to the temporary sewage treatment plant. The foul water drainage network would run beneath the construction roads before discharging the treated effluent through the CDO to the sea.

7.7.5 The temporary foul water drainage network would consist of an underground piped gravity network with pumping stations as necessary in order to limit depth of network and assist with provision of self-cleansing velocities.

7.7.6 All the temporary foul water pumping stations and the temporary sewage treatment plant inlet pumping station are to be interlinked with controls to prevent any upstream pumping station operating when a downstream pumping station fails. Where it is identified that there is a risk of septicity within the network, the design would make provision for facilities or operational measures to remove or mitigate the risk.

7.7.7 Towards the end of the construction phase of the main platform, it would be possible for the foul water from the main platform and the campus area to be pumped to the sewage treatment plant.

ii. Operation

7.7.8 The proposed main platform would host the permanent sewage treatment plant (building: HXE) in the south east corner of the operational platform. The sewage treatment plant would receive and treat all domestic foul water generated within the power station site.

7.7.9 The treated effluent is pumped to the cooling water outfall tunnel from where it is disposed to sea. Disposal to sea was selected because the dilution of the treated effluent is much greater than for a watercourse and would reduce the environmental impact of the discharge.

c) Residual risk management

7.7.10 During both the construction and operation phases, the foul water drainage network would consist of both gravity and pumped networks. It is possible for both the gravity sewer and rising mains to experience a blockage within the pipe due to inappropriate items being disposed of in the system.

7.7.11 The pumped networks would have a residual risk that the system controls could fail due to either a mechanical, electrical, or electronic or control software failure.

7.7.12 An appropriate maintenance and cleaning schedule of the foul water drainage network and pumping stations would be undertaken to prevent the deterioration of the network and the maintenance of the network's design capacity

7.7.13 Beyond the operation phase, there will still be facilities and structures on the main platform. The workforce presence on the main platform is likely to have reduced compared to the operation and construction phases. The foul sewer infrastructure would be maintained to retain a functioning foul system. This combined with the likelihood of reduced foul flows would lead to the beyond operation foul water flood risk being remaining low.

8. SSSI Crossing Flood Risk On-site

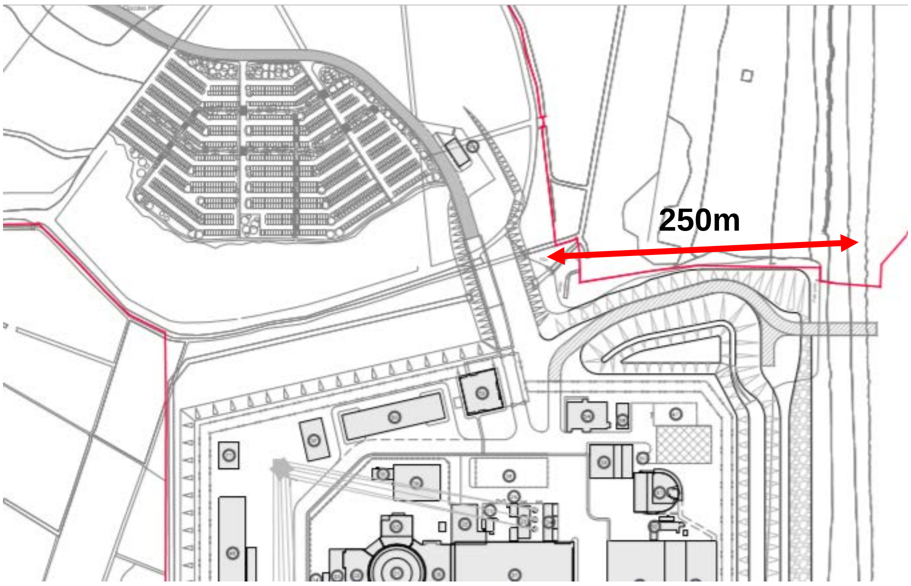
8.1 Coastal

a) Flood risk with climate change

8.1.1 In the future with sea level rise, the SSSI crossing could be at risk from still water levels and/or wave action once the existing shingle defences are inundated and sea waters propagates further inland. The proposed crossing is set back from the coast by approximately 250m (**Plate 8.1**).

8.1.2 Coastal overtopping modelling was undertaken to determine the effects of climate change on sea levels and wave action and their impact on the safe construction and operation of the SSSI crossing. Further details on the modelling are available in the coastal modelling report (**Appendix 1**). As discussed in **section 7.1** of this **report**, the extreme water levels used for the model runs are presented in **Table 7.2**.

Plate 8.1: Extract from Sizewell C Environmental Statement Figure 2.4 - main development site indicative site layout – Location of the SSSI Crossing and the distance from the current coastline



b) Embedded design

8.1.3 The Sizewell Marshes SSSI separates the main power station platform and the temporary construction area. SZC Co. established at an early stage of consultation that the main development site would need to be accessed from the north, from a new access road linking the site to the B1122.

8.1.4 Alternative design options were developed and taken through the consultation stages by SZC Co. and the current design provides the preferred option based on a range of environmental requirements, including impacts on the SSSI. Further details are set out in **Chapter 6, Volume 2** of the **ES** (Doc Ref. 6.3).

8.1.5 There would not be any significant differences between the final shortlist of four options assessed in the extent of flooding in the event of coastal inundation or a breach of coastal defences. The SSSI crossing restricts flow between the Minsmere Levels and the Sizewell Belts when the whole system is significantly inundated, with water depth increase occurring in the Minsmere Levels, and a slight reduction in Sizewell Belts. However, there is not a significant effect in terms of depth, duration or extent.

8.1.6 The culvert size requirements are based on width of current watercourse, flood levels, ecological connectivity, plus safe access for inspection and maintenance. The combination of these factors results in a culvert that is much larger than just dictated by flood flow capacity. The culvert would accommodate more than the fluvial 1 in 100 annual probability plus climate change flows without a significant throttling effect.

8.1.7 The proposed SSSI crossing would be raised to 7.3m AOD to match the main platform level and provide access to the site. The crossing would comprise pre-cast portal concrete culvert over the existing Leiston Drain. Material would be backfilled over the culvert to construct the road.

8.1.8 During the initial stages of construction, temporary access to the main construction area would be provided using a short-term bridge of a proprietary type designed to cater for lighter site traffic and material deliveries.

8.1.9 Once the construction phase crossing has been constructed, two access routes would be provided to enable segregation of traffic. On completion of the construction phase, the haul road would be decommissioned and only the permanent side of the crossing would be used for access to the main platform area. The embankment built for the haul road would remain in place to act as a coastal defence for the SSSI crossing with adaptive design to raise the embankment to 10.5m AOD were the extreme climate change projections of sea level rise realised.

8.1.10 Coastal inundation modelling undertaken for the main platform was built to facilitate the assessment of other development areas and was suitable to assess flood risk to the SSSI crossing. Further details on the inundation modelling are in **section 5.3** of this **report**. The adopted extreme still water levels for the two return periods and climate change epochs considered are presented in **Table 7.2**.

c) Residual risk management

i. Construction

8.1.11 During initial construction a short-term bridge of a proprietary type would be in place from bank top to bank top. The level of the temporary crossing is not currently known and has been assumed to be at the minimum above the existing ground levels. The crossing would be at risk of flooding from a 1 in 1,000-year event when the existing shingle defences are inundated and sea water propagates inland.

8.1.12 During the construction phase once the SSSI crossing has been built for site access and haulage, the causeway would no longer be at risk from coastal flooding. Therefore, overtopping assessment for such scenario was not carried out. The extreme still water levels (**Plate 7.1**) are below the crest of the existing shingle defences for the 1 in 200-year event.

8.1.13 The 1 in 1,000-year extreme still water level, at a level of 4.35m AOD in 2030, is above the shingle crest. However, the risk of overtopping the road is considered low as the water level is below the completed road levels of 7.3m AOD and there will be dissipation of the wave energy between the shingle defences and the crossing. This is supported by the coastal inundation modelling results that show a maximum water level around the crossing of 1.65m AOD for the 1 in 1,000-year event (**Figure 40**).

8.1.14 As in **section 7.1c)** of this **report**, the development of appropriate site management preparedness and recovery protocol would be undertaken. If necessary, construction worked would be halted and the site evacuated.

ii. Operation

8.1.15 An overtopping assessment was conducted for three return period events and three climate change epochs. The results from the overtopping modelling are presented in **Table 8.1**.

Table 8.1: Modelled mean overtopping rates for the SSSI Crossing

Return period (years)	Epoch – climate change scenario	Defence crest (m AOD)	Water level (m AOD)	Inshore wave height (Hs, m)	Mean overtopping rates (l/s/m)
1 in 200	2110 – 95% Medium Emissions (UKCP09)	7.3	3.92	3.21	0.01
	2140 – RCP8.5 (UKCP18)	7.3 / 10.5	5.00	3.73	3.72 / 0.00
	2190 – RCP8.5 (UKCP18)	7.3 / 10.5	5.83	4.03	37.01 / 0.01
1 in 1,000	2090 – RCP8.5 (UKCP18)	7.3	4.94	3.73	2.95
	2140 – RCP8.5 (UKCP18)	7.3 / 10.5	5.84	3.94	36.04 / 0.00
	2190 – RCP8.5 (UKCP18)	7.3 / 10.5	6.67	4.08	216.54 / 0.47
	2140 – BECC Upper	10.5	7.94	4.09	28.34
1 in 10,000	2090 – RCP8.5 (UKCP18)	7.3	5.85	4.14	45.64
	2140 – RCP8.5 (UKCP18)	7.3 / 10.5	6.75	4.41	289.23 / 1.40
	2140 – BECC Upper	10.5	8.85	4.92	192.55

8.1.16 The results in **Table 8.1** show that by the end of operation in 2090, the crossing would be at low risk of overtopping. There is no risk of overtopping from the 1 in 200-year event at 2090, while the overtopping rates for the 1 in 1,000-year are below the safe for vehicle operation threshold of 5 l/s/m (Ref 1.49) implying safe access and egress from the site. For the 1 in 10,000-year return period event with the design crossing crest at 7.3m AOD, the modelled overtopping rate exceeds the safe for vehicle operation threshold of 5 l/s/m. Such overtopping would only be associated with extreme storm event and relatively short duration at peak tide. Appropriate weather monitoring, warning system and evacuation procedures during such extreme events would be set out as part of the ONR safety case.

8.1.17 In addition, a flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note (Ref 1.3) to ensure people on-site are safe in the event of a flood will be developed.

8.1.18 For the 2140 climate change epoch with the crossing embankment crest at 7.3m AOD the overtopping rate for the 1 in 200-year event is below the safe for vehicle operation threshold of 5l/m/s (Ref 1.49).

8.1.19 However, the overtopping rates for the 2140 epoch with the crossing embankment at 7.3m AOD are above the safe for vehicle operation threshold for the 1 in 1,000-year and 1 in 10,000-year events.

8.1.20 With the SSSI crossing adaptive defence crest at 10.5m AOD there would be no risk of overtopping for the 1 in 200-year and 1 in 1,000-year events.

8.1.21 With the adaptive defence crest at 10.5m AOD, the overtopping rates in the 1 in 10,000-year event the overtopping rates are below the safe for vehicle operation threshold allowing safe access and egress.

8.1.22 The extreme still water levels extents (**Plate 7.1**) for the reasonably foreseeable scenarios for the 1 in 200-year and 1 in 1,000-year events are below the 7.3m AOD level of the crossing.

8.1.23 The crest of the proposed SSSI crossing is exceeded for the 1 in 10,000-year event beyond 2160. Considering the credible maximum climate change scenarios, the extreme still water levels are higher than the proposed crossing level making it vulnerable to inundation. The risk from still water levels with the SSSI crossing adaptive defence at 10.5m AOD is removed, with the embankment being tied into the higher defence at the northern mound.

8.1.24 Coastal inundation modelling also shows the SSSI crossing is not at risk from flooding from a 1 in 1,000-year event with climate change up to 2190 considering the reasonably foreseeable scenario (**Figure 44**).

8.1.25 An appropriate maintenance schedule would be in place for the crossing embankment. Following an event, an appropriate inspection should be undertaken be in place to assess potential damaged and ensure structural integrity of the embankment is still intact.

8.1.26 Climate change would be monitored and assessed at least every 10 years to determine the projections trajectory and identify any alterations. This would inform the decision of when to construct the adaptive defences.

8.1.27 As in **section 7.1c)** of this **report**, the development of appropriate site management preparedness and recovery protocol would be undertaken.

iii. Decommissioning

8.1.28 The SSSI crossing would be present up to the end of the theoretical maximum site lifetime. The level of the SSSI crossing without the adaptive defences would remain slightly above the coastal water level in the 1 in 1,000-year reasonably foreseeable climate change scenario in 2190. However, the 2190 overtopping rate would be high and would present a danger to staff and vehicles crossing the causeway during storm conditions (**Table 8.1**).

8.1.29 Considering the credible maximum scenarios at 2140 overtopping rates for the 1 in 1,000-year and 1 in 10,000-year events are significant, the risk of overtopping associated with an extreme surge event only lasts a few hours.

8.1.30 With the adaptive defence at 10.5m AOD, overtopping rates for all considered return period events at 2190 for the reasonably foreseeable climate change scenarios are below the safe for vehicle operation threshold of 5 l/s/m to allow safe access to site.

8.2 Breach

a) Flood risk with climate change

8.2.1 Assessment of flood risk due to breach of coastal defences and its impact on the SSSI crossing was undertaken together with analysis for the main platform. Details on considered extreme events and climate change scenarios are laid out in **section 7.2a** of this report.

8.2.2 The breach modelled ‘with scheme’ results for the end of the construction phase with a breach at the tank traps show the maximum water levels for the 1 in 1,000-year event with climate change up to 2030 are approximately 3m AOD and would not pose flood risk to the SSSI crossing.

8.2.3 The breach modelling results for the maximum water levels around the crossing area are 5.7m AOD and 6m AOD for the 1 in 200-year and 1 in 1,000-year events at 2190 respectively. This is below the SSSI crossing elevation of 7.3m AOD. (**Figure 48** and **Table 8.2**).

Table 8.2: Breach of the tank traps results – modelled maximum water depth, velocity and hazard rating for the SSSI crossing area

Location	Event	2030			2190		
		Depth (m)	Velocity (m/s)	Hazard	Depth (m)	Velocity (m/s)	Hazard
SSSI crossing	200-year	1.35	0.87	Danger to All	5	0.5	Danger to All
	1,000-year	1.5	0.8	Danger to All	5.25	0.52	Danger to All

8.2.4 Further details on breach modelling are available in Breach Modelling Report (**Appendix 4**).

b) Embedded design

8.2.5 The features of the embedded design for the SSSI crossing are described in **section 8.1b** of this **report**. These include early stages of construction and the completed crossing with adaptive design to potentially raise the embankment in the future.

8.2.6 A breach at tank traps for the completed crossing at the end of construction phase (2030) was conducted. The modelled results show the maximum water levels with climate change are approximately 2.73m AOD and 3.0m AOD for the 1 in 200-year and 1 in 1,000-year events at 2030 respectively (**Figure 26**) and are below 6m AOD for the 1 in 200-year and 1 in 1,000-year events at 2190 (**Figure 48**). Therefore, this scenario does not pose a flood risk to the crossing.

c) Residual risk management

i. Construction

8.2.7 At the initial stage of construction, the temporary bridge will be installed. Should a breach of existing shingle defence at tank traps occur, then the proposed temporary bridge would be at risk of flooding from 1 in 200-year and 1 in 1,000-year extreme sea level events.

8.2.8 As in **section 7.1c)** of this **report**, the development of appropriate site management preparedness and recovery protocol would be undertaken. If necessary, in line with the protocol, construction worked would be halted and the site evacuated.

ii. Operation

8.2.9 As discussed in **section 7.2** of this **report**, the results show that maximum water levels around the SSSI crossing with climate change allowance up to 2190 for up to the 1 in 1,000-year events are below the crossing level. Therefore, the SSSI crossing is not considered to be at risk of flooding in such a breach scenario.

8.2.10 As in **section 7.1c)** of this **report**, the development of appropriate site management preparedness and recovery protocol would be undertaken.

iii. Decommissioning

8.2.11 The SSSI crossing would be present up to the end of the theoretical maximum site lifetime. The level of the SSSI crossing without the adaptive defences would remain above the coastal water level in the 1 in 1,000-year reasonably foreseeable climate change scenario in 2190.

8.3 Fluvial

a) Flood risk with climate change

8.3.1 Fluvial flood risk with climate change has been assessed using a 1D-2D hydraulic model and derived boundary conditions for the Sizewell C Project, as described in **section 7.3** of this **report**.

8.3.2 The modelled maximum water levels and flows near the crossing (1D model node on the Leiston Drain immediately downstream of the crossing) for all considered return period scenarios and climate change allowances are shown in **Table 8.3**.

Table 8.3: Modelled maximum water levels at the SSSI Crossing (model node LEIS01_1646d)

Climate Change Epoch	Return Period Event	Maximum Water Level (m AOD)
2030 (+25%)	5 year	1.33
	20 year	1.57
	100 year	1.86
	1,000 year	2.14
2090 (+35%)	5 year	1.46
	20 year	1.72

Climate Change Epoch	Return Period Event	Maximum Water Level (m AOD)
	100 year	2.00
	1,000 year	2.20
2140 (+65%)	5 year	1.86
	20 year	2.02
	100 year	2.14
	1,000 year	2.30
2190 (+80%)	5 year	1.93
	20 year	2.06
	100 year	2.18
	1,000 year	2.32

8.3.3 Further details on model schematisation and detailed results are available in the Fluvial Modelling Report (**Appendix 2**).

8.3.4 A Flood Risk Activity Permit is likely required for the permanent and temporary works for the crossing of the main river and other associated works that fall in, under, over or within 8m of the main rivers.

b) Embedded design

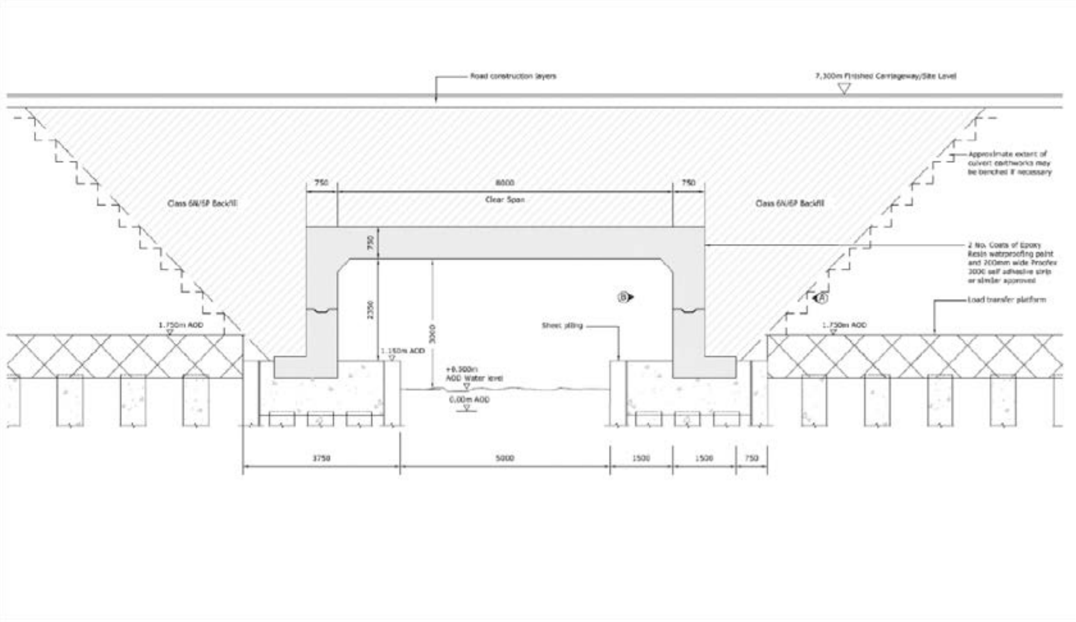
8.3.5 The design of the SSSI crossing in the construction and operation phases of the development are discussed in **section 8.1b** of this **report**. The associated assessment of fluvial flood risk also applies.

8.3.6 During initial stages of construction, access would be made using a short-term temporary bridge to provide initial site access to reduce traffic across Sizewell B. The modular bridge would have a span of circa 15m.

8.3.7 The construction of the main crossing would be a staged approach with the use of a pre-cast concrete culvert to complete the SSSI crossing. The culvert would have a clear span width of circa 8m. On both sides of the river channel sheet piling would be in place and so the width of the culvert up to 1.15m AOD would be 5m. Soffit of the culvert would be set to 3.5m AOD.

8.3.8 The culvert would be constructed from pre-cast culvert design to ensure the natural river bed is preserved. The indicative cross-section of the SSSI crossing is presented in **Plate 8.2.**

Plate 8.2: Indicative cross-section SSSI crossing



8.3.9 During construction of the main platform, two access routes would be provided to enable segregation of general site traffic from heavy earthmoving plant for site safety purposes. Following completion of all construction works at the main platform site, the haul road would be decommissioned with only the embankment left in place to provide a basis for installing adaptive flood defences in the future, if necessary.

c) Residual risk management

i. Construction

8.3.10 During the early stage of construction, the crossing would tie into the slightly higher ground on each side of the Leiston Drain. The modelled water levels are 1.86m AOD for a 1 in 100-year with a 25% climate change allowance at 2030 (construction phase) with extent shown in **Figure 53**. Should the road level of the temporary bridge be at 2m AOD, considering modelled water levels are lower the bridge would be at low risk of flooding under such scenario.

8.3.11 Once the SSSI crossing for the construction phase has been built with a finished road level of 7.3m AOD and a culvert soffit of 3.5m AOD, the crossing would not be at fluvial flood risk.

8.3.12 As in **section 7.1c)** of this **report**, the development of appropriate site management preparedness and recovery protocol would be undertaken. Construction works will employ weather monitoring to predict potential extreme events. If necessary, construction worked would be halted and the site evacuated.

ii. Operation

8.3.13 The modelled results show the maximum water levels for up to 1 in 1,000-year event with 35%, 65% and 80% allowance for climate change are below the 3.5m AOD soffit level of the culvert and the road level at 7.3m AOD (**Figure 57**). Therefore, the fluvial flood risk to the crossing is minimal.

8.3.14 An appropriate maintenance schedule would be in place for the SSSI crossing embankments, clearance of any debris accumulated in the culvert during high flow events. Regular inspections would be scheduled to monitor the condition of the structure and the channel.

iii. Decommissioning

8.3.15 The SSSI crossing would be present up to the end of the theoretical maximum site lifetime in 2190. The SSSI crossing would remain above the fluvial water levels up to the 1 in 1,000-year reasonably foreseeable and credible maximum climate change scenario in 2190 (**Table 8.3**).

8.3.16 The same maintenance activities would be carried out in the decommissioning phase as previously discussed in the construction and operation phase.

8.4 Surface water

a) Future flood risk

8.4.1 The construction of the SSSI crossing would result in both a temporary and permanent access road over Leiston Drain.

8.4.2 The road surface and causeway construction would lead to an increase in the surface water run-off from the increased impermeable area. The installation of a positive drainage system to manage the surface water run-off would be required.

8.4.3 While there is an increase in impermeable area, the future surface water flood risk is considered to be relatively low. The installation of surface water drainage would lower the surface water flood risk further.

b) Embedded design

i. Construction phase

8.4.4 The road surface would be drained into a swale in the temporary construction area to the north of the SSSI crossing. Water in the surface would infiltrate into the ground. The surface water drainage serving the permanent crossing would remain in place after the construction phase. Further information regarding infiltration rates and drainage strategy is given in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

ii. Permanent

8.4.5 The permanent surface water drainage would collect water from the road and discharge to the north into a swale in the temporary construction area. The water in the swale would infiltrate into ground.

c) Residual risk management

i. Construction

8.4.6 During the construction phase, the site traffic is likely to transfer loose sediment onto the vehicles. This sediment may be washed off into the swale and may reduce the volume capacity and the infiltration potential of the swale. This may lead to a minor increase the associated flood risk.

8.4.7 Appropriate road cleaning and surface water drainage maintenance schedule of activities would be undertaken to maintain the swale volume and infiltration capacity. Further information regarding SuDS maintenance requirements are given in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

ii. Operation

8.4.8 The possibility of the sediment being transferred to the road surface and washed off into the swale remains, albeit at a lower rate than the construction phase. The same management requirements would apply in the operation phase as the construction phase.

iii. Decommissioning

8.4.9 The level of the SSSI crossing would continue to be served by a maintained surface water drainage network until the end of the theoretical maximum lifetime. This infrastructure would face the same residual risks as in the construction and operation phases. Therefore, the same management requirements would apply in the decommissioning phase as the construction and operation phases.

8.5 Groundwater

a) Future flood risk

8.5.1 The SSSI crossing is next to the main platform. Under baseline conditions this area has been observed to experience groundwater flooding in winter.

8.5.2 Groundwater levels in this area at the end of the groundwater modelling period show a slight reduction compared to current observed water levels. Groundwater heads in the Crag are predicted to be between 0.6m AOD and 1.0m AOD by 2040 for the wet scenario (Ref 1.26).

8.5.3 There are no notable differences in predicted groundwater levels in this area by 2040 between the baseline and construction models. Therefore, there is no evidence the construction of the SSSI crossing or adjacent platform affects groundwater levels in this area by 2040, following completion of construction works and into the operation phase (**Figure 63**).

8.5.4 Ground levels in the SSSI crossing will be raised during construction to 7.3m AOD, so predicted groundwater levels of below 1m AOD suggest the risk of groundwater flooding to the crossing is low.

8.5.5 As the SSSI crossing is near to the coastline, future flood risk from groundwater flooding is considered to be negligible as the groundwater modelling doesn't contain any coastal defences. Therefore, the model considers the low-lying areas would be below the future sea levels and would experience coastal inundation.

b) Embedded design

8.5.6 The SSSI crossing has sheet pilling at the toe of each of the embankments that extends into the underlying Crag to enable construction of the crossing.

8.5.7 On completion of the SSSI crossing, the causeway would have an impermeable area served by a drainage network discharging to a swale to the north of the crossing.

c) Residual risk management

8.5.8 The sheet piling associated with the SSSI crossing design would locally reduce the groundwater flow between the west and east and have a more limited impact in the groundwater flow between the north and south. However, as the sheet pile walls are spatially limited, and as groundwater flow is within the permeable Crag, this is not likely to have any significant impacts on wider groundwater flow behaviour.

8.5.9 Groundwater modelling suggests that groundwater levels in this area will be reduced during the construction phase by less than 0.2 m as a result of the dewatering associated with construction of the adjacent platform (Ref 1. 27). There is very limited opportunity for groundwater recharge across the SSSI crossing area. The future groundwater heads in this area are projected to remain below 1m AOD, which is significantly below the increased ground level of 7.3m AOD.

8.5.10 The Leiston Drain would continue to pass underneath the SSSI crossing. The SSSI crossing would be constructed as a porthole culvert that retains a permeable channel base to enable some groundwater recharge to occur in the vicinity of the causeway.

8.5.11 Should the ground be fully saturated or under water by 2190, then the groundwater flood risk in the decommissioning phase would be negligible.

8.6 Reservoir

a) Future flood risk

8.6.1 The proposed SSSI crossing is not at risk of reservoir flooding (**Figure 37**). It is not known whether the reservoir would still be present in the future as it is under a third-party ownership.

8.6.2 Should the reservoir remain, the volume of water held by the reservoir is likely to remain the same unless the reservoir is increased in capacity. Therefore, the maximum flood extent is unlikely to increase.

8.7 Sewer

a) Future flood risk

8.7.1 As there are no other sewers currently within the proposed SSSI crossing area, the introduction of a foul sewer rising main network would increase the presence of foul water and the associated flood risk.

8.7.2 The temporary and permanent foul water raising main is likely to use the SSSI crossing as a structure to facilitate crossing the Leiston Drain. The use of the foul water rising main is likely to fluctuate through the course of the construction phase.

b) Embedded design

i. Construction

8.7.3 A temporary sewage treatment plant and supporting foul water drainage network would be built to the north of the crossing area to treat the foul water pumped from both the campus area and the main platform. The foul water rising main would run beneath the construction roads and cross over at the SSSI crossing location before discharging the treated effluent through the CDO to the sea.

8.7.4 Towards the end of the construction phase of the main platform, it would be possible for the foul water from the main platform and the Campus Area to be pumped to the permanent sewage treatment plant while the temporary buildings and infrastructure are being removed. Therefore, the flow direction across the SSSI crossing would be reversed, taking sewage to the permanent treatment plant in the south-east corner of the main platform.

ii. Operation

8.7.5 No permanent buildings on the main platform would remain in the former temporary construction area that would be connected to the permanent sewage treatment plant on the main platform. Therefore, no foul sewers would cross the operational SSSI crossing.

c) Residual risk management

8.7.6 During the construction phase, the foul water rising main would cross over the SSSI Crossing. It is possible for the rising main to be damaged should the SSSI crossing become damaged during an extreme fluvial or coastal event. As rising mains are pipes that operate under pressure, any damage incurred in the pipe structure would eventually lead to a failure of the rising main and potential leakage. Any pollution incident would be management in accordance to the local site emergency plans.

8.7.7 To prevent any leakage, an appropriate inspection, maintenance and cleaning schedule of the foul water rising main would be required and undertaken to prevent the deterioration of the pipe.

8.7.8 No sewers are present in the operation and decommissioning phases.

9. Temporary Construction Area Flood Risk On-site

9.1 Tidal / coastal

a) Flood risk with climate change

9.1.1 The temporary construction area is largely located outside of the modelled inundation flood extent. The coastal inundation modelled flood extents were contained within the same maximum flood extents as the fluvial modelling. Flood risk on-site has been assessed for the 1 in 200-year and 1 in 1,000-year events in 2030 and 2190 climate change epochs. These epochs are representative of the end of construction / beginning of operation and the theoretical maximum site lifetime respectively.

9.1.2 The modelled results from the coastal inundation model for the 1 in 200-year and 1 in 1,000-year events at 2030 epoch show there is negligible coastal flood risk to the vast majority of the temporary construction area (**Figure 41**). Although along the eastern and southern boundaries, there are some locations where the flood extents slightly encroach onto the site.

9.1.3 The effect of tidal / coastal flood risk on the development would change throughout the development phases.

9.1.4 Topographic levels across the temporary construction area vary from approximately 18.6m AOD to 0.71m AOD. In the later phases of the development, the modelling results for 2190 show the low topographic areas are at risk of flooding from coastal sources in areas associated with the Sizewell Belts and Minsmere Levels (**Figure 11**).

9.1.5 As the temporary construction area is not positioned directly behind sea defences, the risk from overtopping of sea defences was not assessed. The coastal flood risk was analysed based on inundation modelling, which was also used for assessment of flood risk to the main platform (**section 7.1** of this **report**) and the SSSI crossing (**section 8.1** of this **report**). The modelled extreme still water levels for the 1 in 200-year and 1 in 1,000-year events in 2030 and 2190 are presented in **Table 7.2**.

9.1.6 The breach modelling with a breach at tank traps that was carried out for the main platform and the SSSI crossing was also used to assess breach flood risk at the temporary construction area (**Table 9.1**). The Goose Hill eastern site boundary area has some future breach flood risk that has been identified by the breach modelling.

9.1.7 The breach modelled ‘with scheme’ results for the end of the construction phase with a breach at the tank traps show the maximum water levels for the 1 in 1,000-year event with climate change up to 2030 are approximately 3m AOD and would not pose flood risk to the SSSI crossing.

9.1.8 The breach modelling results for the maximum water levels in 2190 around the area are 5.7m AOD and 6m AOD for the 1 in 200-year and 1 in 1,000-year events respectively (**Figure 49** and **Table 9.1**).

Table 9.1: Breach of the tank traps results – modelled maximum water depth, velocity and hazard rating for the Goose Hill area

Location	Event	2030			2190		
		Depth (m)	Velocity (m/s)	Hazard	Depth (m)	Velocity (m/s)	Hazard
Goose Hill eastern boundary	1 in 200-year	2.05	0.4	Danger to All	5	0.3	Danger to All
	1 in 1,000-year	2.35	0.35	Danger to All	5.3	0.31	Danger to All

9.1.9 The coastal inundation modelling and tidal breach modelling at the tank traps shows that the temporary water resource storage area would not be flooded in 2030. Both the coastal overtopping and breach modelling for 1 in 200-year event, while not equivalent to an undefended modelled scenario, does show the impacts of overtopping or breaching of the coastal defences.

9.1.10 The proposed temporary water resource storage area on the northern boundary of the temporary construction area is within the Environment Agency’s Flood Zone 3. As a result further assessment of flood risk has been carried out using outcomes of the fluvial, coastal and tidal breach modelling.

9.1.11 The tidal breach and coastal overtopping modelling show the temporary water resource storage area is not within the flood extent for the 1 in 200-year return period with climate change allowance to 2030.

9.1.12 While the tidal breach and coastal overtopping modelling results do not exactly represent the undefended coastal extent used for Flood Zone 3 mapping, they do present the most likely flood extent that would occur in the future as the coastal defences are already in place. The modelling results include allowance for climate change up to the end of the construction phase. The results are considered appropriate to represent the impact of flooding from coastal and tidal sources. As a result the temporary water resource storage area is considered as being out of the coastal Flood Zone 3 extent. It is considered there would be no impact on flood risk elsewhere as a result of the temporary water resource storage area during its expected lifetime for the 1 in 200-year return period with climate change allowance. The temporary water resource storage area will be removed on completion of the construction phase.

9.1.13 The off-site sports facility, the rail route extension in the temporary construction area, the two fen meadows and the marsh harrier habitat improvement area are not affected by tidal, coastal or breach flooding.

b) Embedded design

9.1.14 Coastal flood defences at the main platform area would be raised to 10.2m AOD as part of the proposed development. The existing coastal defences along the Minsmere frontage have a varying crest level of 4.1m AOD to 6.8m AOD.

9.1.15 A sequentially minded development layout, where components with greater vulnerability, such as the accommodation campus have been located in areas of the lowest flood risk, would mitigate the flood risk posed to the development during construction.

9.1.16 The low area on the southern temporary construction area boundary with the Sizewell Belts is likely to be used as a landscaped area around car parking and concrete batching and prefabrication facilities. These areas are beyond the 1 in 200-year and 1 in 1,000-year coastal flood risk (**Figure 45**).

9.1.17 The compensatory habitat to the north of the temporary construction area would be designed as a wet woodland area. The lowest areas of the site to the west of the existing woodland would be developed through the localised shallow ground lowering to create a wetland reed habitat as shown in **Main Development Site, Landscape Masterplan (Operational),** provided in the **Main Development Site Plans** (Doc Ref. 2.5). This could potentially provide some minor flood storage benefits.

c) Residual risk management

i. Construction

9.1.18 The breach modelling results for the end of construction phase identify a small area along the edge of the main development site boundary leading to the water management zone 1 detention basin would be at risk of flooding. The structure would be set back from the boundary and so would not be at direct risk of flooding.

ii. Operation

9.1.19 The majority of the temporary construction area development would be removed at the end of the construction phase and return to the pre-development use. However, the access facilities associated with Sizewell C power station would remain in the operation and decommissioning phases. The access facilities would consist of the access road, staff car park, SSSI crossing and the associated supporting infrastructure.

9.1.20 The maximum water levels around car parking facilities along the southern boundary for the 1 in 200-year and 1 in 1,000-year events are 5.6m AOD and 6.0m AOD respectively, with reasonably foreseeable climate change up to 2190 (**Figure 49**). The breach modelling showed very similar results.

9.1.21 Only permanent parking would be at risk, however there are plans for these areas to be landscaped. The habitat compensation would not be adversely affected by temporary flooding.

9.1.22 Residual risk posed to the remaining permanent developments within the former temporary construction area from breach and inundation events up to the 1 in 1,000-year storm event up to 2190 would be managed through the site emergency flood and evacuation plans. A flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note (Ref 1.3) to ensure people on-site are safe in the event of a flood event. A weather monitoring system would be in place to identify and monitor potential extreme weather events.

iii. Decommissioning

9.1.23 The coastal extent for the 1 in 1,000-year event reasonably foreseeable climate change scenario at the theoretical maximum site lifetime would encroach upon the boundaries of the staff car parking and two areas along the eastern end of the road (**Figure 45**).

9.1.24 Risk management activities for the operation phase are applicable and would remain for the decommissioning phase.

9.2 Fluvial

a) Flood risk with climate change

9.2.1 The Minsmere River and associated Levels are located to the north and north east of the temporary construction area. The Sizewell Belts including the Leiston Drain are to the south of the temporary construction area.

9.2.2 Fluvial modelling was undertaken to determine the effect the main development site would have on-site and off-site flood risk for four return periods (1 in 5-year, 1 in 20-year, 1 in 100-year and 1 in 1,000-year events), and with various allowances for climate change (25%, 35%, 65% and 80%).

9.2.3 The fluvial modelling took into consideration the proposed development at the main platform, the SSSI crossing and Aldhurst Farm wetland habitat works. A summary of this model is included in **section 7.2** of this **report** and detailed are within the (**Appendix 2**).

9.2.4 The construction area is largely located outside of the modelled inundation flood extent. The fluvial inundation modelled flood extents were contained within the same maximum flood extents as the coastal modelling.

9.2.5 Analysis of the modelled results shows (**Table 7.9**) the majority of the temporary construction area would not be at fluvial flood risk for up to 1 in 100-year and 1 in 1,000-year events with the 25% climate change allowance (2030).

9.2.6 It is noted that the proposed temporary water resource storage area on the northern boundary of the temporary construction area is within the Environment Agency’s Flood Zone 3 as a result further assessment of its flood risk has been carried out using outcomes of the fluvial, coastal and tidal breach modelling.

9.2.7 The fluvial modelling shows the temporary water resource storage area is not within the flood extent for the 1 in 100-year with 25% for climate change flood extent appropriate for the end of construction phase. It would however by partly flooded in the 1 in 1,000-year with 25% for climate change event.

9.2.8 As the fluvial flood modelling is representative of the 1 in 100-year flood extent with no defences and with climate change allowance for the construction phase, the temporary water resource storage area is considered as being out of the fluvial Flood Zone 3 extent. As a result, there would be no impact on flood risk elsewhere and no requirement to provide compensatory storage as a result of the temporary water resource storage area. he detailed modelling 2030 results are considered appropriate for the construction stage when the temporary water resource storage area would be in use. The temporary water resource storage area would be removed on completion of the construction phase.

9.2.9 Fluvial flood risk during operation phase was assessed for the considered return period events three climate change allowances (35% as higher central, 65% as Upper End and 80% as H++ allowance). The derived flood extents for the 1 in 100-year event and all climate change allowances are presented in **Figure 58**.

9.2.10 The fen meadow site near Halesworth is in Flood Zones 2 and 3a, while the fen meadow near Benhall is in Flood Zones 2, 3a and 3b. The future fluvial flood risk to these sites would alter in accordance with the climate change projections for peak river flow. The use of these sites is for water compatible habitat purposes.

9.2.11 The off-site sports facilities rail route extension in the temporary construction area and the marsh harrier habitat improvement area are not affected by fluvial flooding.

b) Embedded design

9.2.12 The same design approach discussed is **section 9.1** of this **report** to manage the coastal/tidal flood risk would apply to the temporary construction area to manage the fluvial flood risk.

9.2.13 Water management zone 1 basin is positioned in an area where fluvial flood risk from the 1 in 200-year and 1 in 1,000-year extents for 2030 encroaches on the site boundary (**Figure 54**).

9.2.14 The fen meadow sites would involve the permanent development of the sites as fen meadows, which would involve either the installation or repositioning of structures required to maintain water levels to develop the fen meadow habitat. These fen meadows locations have been purposefully selected due to the proximity of the watercourse and wet land conditions required for the creation of this habitat (**Figure 16**).

c) Residual risk management

i. Construction

9.2.15 The WMZ1 detention basin has a slight encroachment into the fluvial flood extent along the boundary. As the structure would not extend up to the boundary, it is not considered to be at flood risk. The basin has been set back from the redline boundary to reduce the flood risk from the 1 in 200-year event, however, the basin would still be at risk from the 1 in 1,000-year extent (**Figure 36**).

ii. Operation

9.2.16 There would be some access facilities and infrastructure remaining in place after the construction phase (**section 9.1** of this **report**). There is a localised fluvial flood risk to the access road and staff car park boundaries. Any residual risk would be manageable with control procedures being developed within the site emergency flood plans. A flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note (Ref 1.3) to ensure people on-site are safe in the event of a flood would be developed.

9.2.17 The fen meadow sites are designed for habitat compensation and would not be adversely affected by temporary flooding.

iii. Decommissioning

9.2.18 The fluvial extent for the 1 in 1,000-year event reasonably foreseeable climate change scenario at the theoretical maximum site lifetime would potentially encroach upon the boundaries of near the staff car parking and at two areas along the eastern end of the road.

9.2.19 Risk management activities for the operation phase are applicable and would remain for the decommissioning phase.

9.3 Surface water

a) Future flood risk

9.3.1 The surface water flood risk to the temporary construction area would be impacted by both an increase in impermeable areas and climate change.

9.3.2 The temporary construction area would change the ground levels in various areas of the site, such as the borrow pits, stockpiles and water management zones. These local ground level variations would alter the potential location of surface water flood risk. The water management zone would have an increased surface water flood risk due to the very nature of the design and function. The water management zones 2, 3 and 4 have been positioned along the existing surface water flow paths.

9.3.3 Water management zone 1 basin is positioned in an area where fluvial flood risk from the 1 in 200-year and 1 in 1,000-year extents for 2030 encroaches on the basin’s perimeter (**Figure 54**). The majority of the flood risk is posed by the 1 in 1,000-year extent for 2030 which extends into the area of the basin. While the coastal flood extents for the 1 in 200-year and 1 in 1,000-

year for 2030 show only a minor encroachment on the south-eastern corner (**Figure 54**).

9.3.4 The proposed sub-catchments are shown in **Figure 2A.4** of **Volume 2, Chapter 2, Appendix 2A** of the **ES** (Doc Ref. 6.3).

9.3.5 The construction of the borrow pits would create a natural low spot for surface water to drain to and therefore the borrow pits would be at an increased risk of surface water flooding.

9.3.6 The construction of the off-site sports facilities would create a surface that could lead to a potential minor increase in surface water run-off and the associated risk of surface water flooding.

9.3.7 The proposed temporary construction area would increase the impermeable surface which in turn would potentially increase the surface water run-off from the site.

9.3.8 The proposed rail route extension would largely be a permeable development with limited additional surface water run-off.

9.3.9 The fen meadow sites are expected to remain at mostly ‘low’ surface water flood risk with localised areas of ‘medium’ to ‘high’ risk around the local drainage channels.

9.3.10 The marsh harrier habitat improvement area is expected to remain at mostly ‘very low’ surface water flood risk with two localised flow routes of ‘low’ to ‘high’ risk that cross the site. One flow route is aligned to a local ordinary watercourse to the east of the site along Wash Lane.

b) Embedded design

i. Construction phase

9.3.11 The temporary construction area would be served by a surface water drainage system to manage the run-off from the increase in impermeable surfaces. While the majority of the impermeable areas would only be present during the construction phase, some areas would remain in the operation and decommissioning phases. Climate change would be allowed for in accordance with the Environment Agency climate change guidance for flood risk assessment (Ref. 1.7).

9.3.12 The proposed surface water drainage system would operate based on sustainable drainage principles, where possible.

9.3.13 A shallow perimeter ditch and a low bund would be built around the temporary construction area site during the early construction phase to prevent untreated surface water run-off from leaving the site for up to a 1 in 100-year event.

9.3.14 Infiltration testing conducted in 2015 and 2017 has confirmed the ground conditions are generally permeable. The Outline Drainage Strategy provides further information about the results and locations of the infiltration testing (see **Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3). The construction area would make use of surface water infiltration in areas where the run-off water quality does not pose a significant risk of pollution.

9.3.15 The temporary construction area is divided into seven discreet water management zones (WMZ) for surface water disposal. The WMZs are designed to operate either to:

- Treat water to a standard compliant with the Environmental Permit prior to it discharging to watercourse;
- Attenuate surface water run-off and control the discharge to the watercourse at the greenfield run-off rate for up to the 1 in 30-year event. These would be lined attenuation ponds that would retain some water for alternative uses such dust suppression; or
- Attenuate surface water run-off and infiltrate it into the ground. The infiltration WMZs would comprise an infiltration pond with bunded boundaries and a separate treatment facility.

9.3.16 The WMZs for the temporary construction area are divided into two groups:

- Group 1: WMZ 1, 2, 3 and 6 both discharge to a watercourse and infiltrate to ground; and
- Group 2: WMZ 4, 5 and 10 discharge through infiltration to ground.

9.3.17 Further information regarding the details of the proposed surface water drainage system for each of the WMZ is provided in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

9.3.18 It is considered possible to discharge the roads to local swales. For compounds with hard standing and roofs of most buildings, the surface water would continue to be drained via a piped drainage network to attenuation ponds, referred to as Water Management Zone basins.

9.3.19 Excavated borrow pits are proposed to allow rainfall run-off to gather in the base of the excavation and, in more extreme events, may cause local ponding. However, given the permeability of the strata any ponding would infiltrate to ground.

9.3.20 For the proposed railway within the temporary construction area, the majority of the track is located mainly on level ground. The remaining area is a short length within a cutting and on an embankment. All surface water drainage provided for the railway is to discharge either to a WMZ or infiltrate to the ground. Where cuttings are excavated, a collector ditch is proposed at the top of the higher side of the cutting to intercept overland flow. Where embankments are constructed, either a collector ditch or filter drain is proposed on the higher side of the embankment in order to intercept surface water overland flow.

9.3.21 Treatment of the surface water run-off in the construction phase may include the use of treatment lagoons if required.

9.3.22 The surface water drainage design would also consider exceedance flow routes to limit excessive depths and maintain safe site operation during major rainfall events. Any surface water flooding under extreme storm conditions would be directed to locations that avoid damage to critical structures or buildings.

9.3.23 The fen meadow sites would be permanently developed for fen meadows, which would involve either the installation or repositioning of structures required to maintain water levels to develop the fen meadow habitat. These fen meadows locations have been purposefully selected due to the proximity of the watercourse and wet land conditions required for the creation of this habitat. These sites are permanent and would continue through the operational and decommissioning phases.

9.3.24 The marsh harrier habitat improvement area is a temporary site to provide foraging areas for the marsh harriers in the construction period. There are only land management practices that would be altered during this period to encourage small mammals to inhabit the area to provide for the marsh harriers.

ii. Operation

9.3.25 The permanent access road would be drained to a suitably sized swale beside the length of the road. No water from the private access road would flow onto the public highway at Abbey Road.

9.3.26 Any permanent buildings remaining in the former construction area would discharge roof water run-off via downpipes to individual underground soakaways. The car park would be drained using infiltration techniques through a combination of permeable paving direct to ground and channel drains, underground land drainage perforated pipe system and an infiltration pond clear of the car park. Bypass interceptors would be used where necessary. The combination of infiltration drainage facilities will be developed further in the detailed drainage design.

9.3.27 The construction of the off-site sports facilities would have a permeable surface that could require an appropriate drainage approach. Further information is provided in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3). These facilities are intended to become permanent and would have a longer design life than other parts of the site.

c) Residual risk management

i. Construction

9.3.28 The site traffic is likely to transfer loose sediment on the vehicles that may be washed off into the swales and could reduce the volume capacity and the infiltration potential. In addition, any surface water treatment facility may also fill up with sediment. This may lead to a minor increase in the associated flood risk due to the loss of attenuation capacity.

9.3.29 In addition, a review of the exceedance flow routes would be necessary to consider the surface water flow routes and any impacts around the remaining permanent buildings and facilities as part of the drainage design.

9.3.30 An appropriate surface water drainage maintenance and cleaning schedule would be undertaken to maintain the swale design capacity and capability. Further information regarding SuDS Maintenance Requirements is given in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **Environmental Statement)**.

ii. Operation

9.3.31 The access facilities and infrastructure to Sizewell C power station would remain in place after the construction phase. The possibility of the sediment being transferred to the road surface and washing off into the swale, albeit at a lower rate, would remain.

9.3.32 There is the residual risk for the surface water drainage of the off-site sports facilities to become blocked or silted up and operate below the design capacity.

9.3.33 The maintenance requirements would be applied in the operation phase as where discussed in the construction phase.

iii. Decommissioning

9.3.34 This infrastructure in the former temporary construction area would face the same residual risks as in the construction and operation phases. Therefore, the same management approaches in the construction and operation phases would apply.

9.4 Groundwater

a) Future flood risk

9.4.1 The groundwater model covers the period from 2015-2040 for three climatic scenarios, dry, wet and intermediate. The model covers the phases leading up to and during construction, and the early years of operation following construction.

9.4.2 The modelled activities in the temporary construction area show changes to groundwater levels as a result of modified ground levels and recharge distribution. In the area of the borrow pits, where natural material would be excavated, and the void backfilled with material from the platform area. The differences in permeability are predicted to cause changes in groundwater levels.

9.4.3 Groundwater modelling has shown that in the intermediate and wet scenarios groundwater levels increase locally by up to 0.3m in certain parts of the temporary construction area (Ref. 1.26), particularly around the borrow pits. Increases in groundwater levels are also predicted around several of the water management zones infiltration drainage structures where more focussed infiltration would occur.

9.4.4 In the wet scenario groundwater levels around the borrow pits are predicted to reach a maximum of 2.3m AOD during the construction phase (Ref. 1.26). Ground level in the areas of the borrow pits are more than 12m AOD so the increase in groundwater levels does increase the risk of groundwater flooding in this area.

9.4.5 In the wet scenario groundwater levels around water management zones 2, 3, 4 and 6 increase by approximately 0.2 m. This equates to maximum groundwater levels of 2.0m AOD at water management zones 2, 3 and 4, and 3.0 m AOD at water management zone 6 (Ref. 1.26). Around water management zones 2, 3 and 4 ground levels are approximately 5m AOD, and at water management zones 6, approximately 10 m AOD, so increased groundwater levels do not increase the risk of groundwater flooding at any of these locations.

9.4.6 The area underneath the car parking areas north of the SSSI crossing in the temporary construction area, the groundwater levels reduce by up to 0.3m for the wet scenario, reducing the risk of groundwater flooding.

9.4.7 In the dry scenario, no increases in groundwater level are predicted in the temporary construction area.

9.4.8 There are no changes expected to the rail route extension, fen meadows and marsh harrier habitat improvement area that would alter the groundwater flood risk in the future.

b) Embedded design

9.4.9 The development of the temporary construction area would increase the area of impermeable surfaces. The water management zones, as discussed in **section 9.3.10b**, would drain the surface water run-off to detention or infiltration basins before discharging the collected surface water to either the ground or a combination of the ground and a watercourse.

9.4.10 The borrow pit area would have the topsoil removed before excavation of material for use elsewhere commences, with the maximum excavation depth kept 2 metres of above rest groundwater level. As a result, all excavation would be in dry conditions, other than temporarily during rainfall events when rainfall would gather and infiltrate in the base of excavation. In more extreme events localised ponding within the excavations may occur. The borrow pits will be backfilled with material excavated from the main platform which will locally change permeability and recharge patterns in this area.

9.4.11 For the proposed railway within the temporary construction area, the majority of the track is located on the level with only a short length within a cutting and on an embankment. Within cuttings and on the level surface water run-off would discharge to the ground through infiltration. This approach would apply except if there is a risk of groundwater reaching the level of the base of track formation .

c) Residual risk management

9.4.12 During the construction phase the impermeable area associated with the proposed temporary construction area would reduce the area available for groundwater recharge. This would occur to a significantly lesser extent in the operation and decommissioning phases due to the reduction in spatial extent of remaining infrastructure from the temporary construction area.

9.4.13 During both the construction phase and to a lesser extent in the operation and decommissioning phases, the use of infiltration as a method of surface water disposal across the temporary construction area would provide areas of localised infiltration to assist with the groundwater recharge. The risk from groundwater flooding as a result of these changes has been discussed in 9.4 (**Figure 63**) and is considered to be low for all phases of the development.

9.4.14 During operation, the water management zones will be removed and groundwater levels under these areas will recover back to be in line with modelled baseline conditions. Under the borrow pits, groundwater levels are likely to remain high during operation and decommissioning, as changes to the ground here are permanent. However, as discussed, the risk from these elevated groundwater levels is low, due to the elevation of ground surface here.

9.5 Reservoir

a) Future flood risk

9.5.1 The temporary construction area is located outside of the maximum reservoir flood extent of the Sizewell Walks Reservoir and not at risk of reservoir flooding (**Figure 37**).

9.5.2 A breach of the Heveningham Hall reservoir maximum flood extent would continue to affect the fen meadow site near Halesworth for as long as the reservoir exists. It is not known whether the reservoir would still be present in the future as it is under a third-party ownership (**Figure 38**).

9.5.3 Should the reservoir remain, the volume of water held by the reservoir is likely to remain the same unless the reservoir is increased in capacity. Therefore, the maximum flood extent is unlikely to increase.

9.5.4 The introduction of the temporary water resource storage area in the northern area of the site would present a new reservoir flood risk. A temporary water resource storage area would be constructed, with an expected volume of less than 25,000m^3 of non-potable water for use in the construction process. Water would be stored above groundwater level to ensure it is hydrologically separate and does not cause adverse effects to groundwater levels on-or off-site. The temporary water resource storage area would collect and store water over the winter period, typically for use during the summer months.

9.5.5 The water resource storage area is likely to be partly below the existing ground level and partly above the existing ground level. The raised embankments would be constructed as necessary up to approximately 3m in height. The temporary water resource storage area would be removed on completion of the construction phase and the land returned to its former use. Water from within the water resource storage area would be transported directly to parameter zone C3 through a trenched water supply pipe.

9.6 Sewer

a) Future flood risk

9.6.1 As there are no sewers currently within the proposed temporary construction area, the introduction of a sewer network would increase the presence of foul water and the associated flood risk.

9.6.2 There is a requirement for a foul water sewer system to be installed on temporary construction area. The foul water provision would serve the workforce on-site and in the accommodation area. However, the requirement is likely to fluctuate considerably through the course of the construction phase. Therefore, a flexible approach would be applied.

b) Embedded design

i. Construction

9.6.3 During the construction stage, a temporary sewage treatment plant and supporting foul water drainage network would be built. The temporary sewage treatment plant would be erected on the eastern side of the temporary construction area. The foul water would be collected in a gravity network that discharged to a local pumping station. The foul water would be pumped from the campus area and the main platform to the temporary sewage treatment plant.

9.6.4 The main foul water drainage network would run beneath the construction roads before discharging to the treatment plant. From there the treated effluent would be discharged through the CDO to the sea.

9.6.5 The temporary foul water drainage network would contain pumping stations as necessary to limit the network depth and assist with provision of self-cleansing velocities.

9.6.6 All the temporary foul water pumping stations and the temporary sewage treatment plant inlet pumping station are to be interlinked with controls to prevent any upstream pumping station operating when a downstream pumping station fails. Where it is identified that there is a risk of septicity within the network, the design would make provision for facilities or operational measures to remove or mitigate the risk.

9.6.7 Towards the end of the construction phase of the main platform, it would be possible for the foul water from the main platform and the Campus Area to be pumped to the permanent sewage treatment plant while the temporary buildings and features were being removed. Further information about the design is available in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **Environmental Statement**).

ii. Operation

9.6.8 The construction of the off-site sports facilities would create low permeability surfaces that would require appropriate drainage approach. These facilities are intended to become permanent and would use a longer design life than other parts of the site. Further information about the design is available in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

c) Residual risk management

9.6.9 During the construction phase, the foul water and surface water drainage network would consist of both gravity and pumped networks. It is possible for both the gravity sewer and rising mains to experience blockage within the pipe due to inappropriate items being disposed of in the system. This is also possible for any surface water system serving the off-site sports facilities.

9.6.10 In addition, the pumped networks would have a residual risk that the system controls could fail due to either a mechanical, electrical, or electronic or control software failure.

9.6.11 An appropriate maintenance and cleaning schedule of the foul water drainage network and pumping stations would be required and undertaken to prevent the deterioration of the network and the maintenance of the network's design capacity.

9.6.12 The temporary construction area sewers would be removed at the end of the construction phase and therefore would not be of concern in the operation and decommissioning phases.

10. Land East of the Eastlands Industrial Estate Flood Risk On-site

10.1 Tidal / coastal

a) Flood risk with climate change

10.1.1 As discussed in **section 5.3d)** of this chapter, the LEEIE is not at risk of tidal / coastal flooding and this does not change in the future (**Figure 42**, **Figure 46** and **Figure 50**). The LEEIE would be removed at the end of the construction phase and therefore would not be of concern in the decommissioning phase.

10.2 Fluvial

a) Flood risk with climate change

10.2.1 As discussed in section 5.5 d, the majority of the LEEIE is not at risk of fluvial flooding and this does not change in the future (Figure 59D). Only a small area along the southern boundary of the Keepers Cottage area is at fluvial flood risk in the 1 in 100-year and 1 in 1,000-year for the 2030 and 2190 scenarios. The temporary nature of the LEEIE means the 2030 scenario flood extents were applied to the assessment of flood risk for the proposed detention basin during the construction phase. The fluvial flood risk does not enter the detention basin area for either the 1 in 100-year and 1 in 1,000-year events. Therefore, the basin in not considered to be at flood risk.

10.2.2 The LEEIE would be removed at the end of the construction phase and therefore would not be of concern in the decommissioning phase.

10.3 Surface water

a) Future flood risk

10.3.1 The site would only be in use for the construction phase and is likely to have minimal change in flood risk over the lifetime of the construction phase. The temporary use of the LEEIE would place stockpiles in areas where these minor topographic low spots are.

10.3.2 There is a lack of capacity in the local surface water sewer network which would prevent the site from being connected unattenuated to the public drainage network.

b) Embedded design

10.3.3 In order to minimise the possible surface water run-off, the caravan pitches and the car park would use permeable surfaces infiltrating into geo-cellular storage.

10.3.4 The surface water run-off would be attenuated on-site before being discharged. The topsoil stockpile areas are permeable and would have some infiltration ability.

10.3.5 Surface water interception along the LEEIE site boundary adjacent to Valley Road would be in place to collect surface water run-off. The surface water run-off would be conveyed to the surface water attenuation feature before being discharged.

10.3.6 Any pollutants within the run-off from the laydown and trafficked areas will be managed using SuDS techniques or proprietary products as considered appropriate.

10.3.7 The foul water on-site would be conveyed to an on-site foul water treatment plant before being discharged.

10.3.8 At the end of the construction phase, the site would be returned to the pre-development greenfield state. This would involve the removal of any site structures and the majority of the drainage infrastructure.

10.3.9 There is the potential for some surface water drainage infrastructure to remain in place to limit surface water run-off from the restored greenfield site to the adjacent roads.

c) Residual risk management

10.3.10 During the construction phase topsoil stockpiles are likely to transfer loose sediment into any attenuation feature. This sediment would reduce the volume capacity and the infiltration opportunity of the swale, which may lead to a minor increase the associated flood risk.

10.3.11 An appropriate cleaning and surface water drainage maintenance schedule would be undertaken to maintain the design capacity and capability. Further information regarding SuDS Maintenance Requirements are given in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

10.3.12 The LEEIE would be removed at the end of the construction phase and would not be of concern in the operation and decommissioning phases.

10.3.13 A review of the exceedance flow routes would be necessary to consider the impacts and surface water flow routes and address this within the drainage design.

10.4 Groundwater

a) Future flood risk

10.4.1 The groundwater model covers the period from 2015-2040 for three climatic scenarios, dry, wet and intermediate. The model covers the phases leading up to and during construction, and eight years of operation following construction.

10.4.2 In the LEEIE area, the groundwater model does not predict any changes in groundwater levels as a result of the construction or operation of the development site (Ref. 1.26).

10.4.3 In the LEEIE area, groundwater levels in the wet scenario are approximately 1m higher than in the dry scenario in the period up to 2040 (Ref. 1.26). In this area ground surface is at approximately 15 m AOD, approximately 13 m above current observed groundwater levels therefore risk of groundwater flooding is low.

b) Embedded design

10.4.4 In order to minimise the possible surface water run-off, the caravan pitches and the car park use permeable surfaces. At the end of the construction phase, all site structures will be removed to return the site to the pre-development greenfield state.

c) Residual risk management

10.4.5 During the construction phase, the impermeable area associated with the proposed LEEIE area would reduce the area available for groundwater recharge. The use of infiltration as a method of surface water disposal across the LEEIE area, in conjunction with the reducing the impermeable areas, would enable some amount of groundwater recharge.

10.4.6 The LEEIE would be removed at the end of the construction phase and would not be of concern in the operation and decommissioning phases.

10.5 Reservoir

a) Future flood risk

10.5.1 The proposed LEEIE is located outside of the maximum reservoir flood extent of the Sizewell Walks reservoir and therefore it is not at risk of reservoir flooding (**Figure 37**).

10.5.2 Should the reservoirs remain in place, the volume of water held by the reservoir is likely to remain the same unless the reservoir is increased in capacity. Therefore, the maximum flood extent is unlikely to increase.

10.6 Sewer

a) Future flood risk

10.6.1 As there are no sewers currently within the proposed temporary construction area, the introduction of a sewer network would increase the presence of sewers and the associated flood risk while the site is in use.

10.6.2 There is a requirement for a foul water and surface water sewer provision to be installed in the LEEIE area. The foul water and surface water provision would serve the workforce on-site and in the accommodation area.

10.6.3 At the end of the construction period, the whole LEEIE area would be returned to its pre-development state and all sewers and associated infrastructure would be removed.

b) Embedded design

10.6.4 The LEEIE would have a moderate foul water disposal requirement due to the Mobile Site Welfare Units proposed to serve the temporary accommodation units. A packaged treatment plant would serve the LEEIE and discharge the treated effluent to the surface water outfall. Further information regarding the drainage design is provided in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

c) Residual risk management

10.6.5 The foul water and surface water drainage network and the package treatment plant or pumping station could experience a blockage within the network due to inappropriate items being disposed of in the system.

10.6.6 In addition, the package treatment plant or pumping station could experience a control system failure due to either a mechanical, electrical, or electronic or control software failure.

10.6.7 During the construction phase, an appropriate maintenance and cleaning schedule of the foul water drainage network and pumping stations would be required and undertaken to prevent the deterioration of the network and ensure maintenance of the network's design capacity.

10.6.8 The LEEIE would be removed at the end of the construction phase and therefore would not be of concern in the operation and decommissioning phases.

11. Off-site Impacts and Mitigation

11.1 Impacts on coastal flood risk

a) Main platform

11.1.1 An assessment of the impact of coastal flood water on off-site receptors was undertaken for two return period events (1 in 200-year and 1 in 1,000-year) and two climate change epochs (2030 for the construction phase and 2190 as the theoretical maximum site lifetime). The climate change allowances were applied for the reasonably foreseeable scenario. These two scenarios were adopted as considered to provide a sufficient range of events to determine potential maximum impact of the development of off-site receptors.

11.1.2 The 2190 modelled results indicated a lower impact compared to the 2030 epoch due to Minsmere Levels and Sizewell Belts floodplains being inundated to a higher level for both baseline and with development scenarios making the relative difference/impact smaller. Therefore, the impact assessment was based on the 2030 epoch results, as a conservative approach.

11.1.3 Change in flood depth was assessed using developed 2D-TUFLOW model for the coastal inundation modelling discussed in **section 5.3** of this **report**.

11.1.4 The modelling was conducted considering all features of the development that would impact the flood extent. There was no separate assessment carried out for each of the development areas.

11.1.5 A comparison of maximum water depths from the baseline (pre-development) and 'with scheme' (post-development) from the coastal inundation model results shows a maximum difference of 0.07m for the 1 in 200-year (**Figure 61**) and 0.1m for the 1 in 1,000-year event at 2030 with water depth in the Minsmere Levels of approximately 1.5m.

11.1.6 The Minsmere Levels and Sizewell Belts would be significantly inundated (to a depth of approximately 5-6m) due to extreme still water levels exceeding the crest of the shingle defences along the frontage at 2190. On review of the modelled results showing the change in water level for the baseline and the 'with scheme' scenario, it is apparent the platform makes little difference. This is due to the significant inundation of the Minsmere levels in 2190 for both scenarios. Therefore, the relative water level difference is marginal. The modelled increase in maximum flood depth for the 1 in 1,000-year event reasonably foreseeable scenario of 0.01m around Sizewell Belts area at 2190.

11.1.7 Total number of residential and non-residential properties at risk at 2030 and 2190 epochs for both the 200-year and 1,000-year event has not changed as a result of the proposed Sizewell C development (**Table 11.1**).

Table 11.1: Properties at risk of flooding from coastal inundation in 2030 and 2190

Year	Event	Baseline number of properties at flood risk	'with scheme' number of properties at flood risk	Difference in the number of properties at risk
2030	200-year	9	9	0
	1,000-year	10	10	0
2190	200-year	139	139	0
	1,000-year	148	148	0

11.1.8 Assessment of the modelling results shows that the increased flood levels relate to peak tide levels and therefore do not impact overall duration of flooding for considered events.

11.1.9 There is a slight change in flood extent that is limited to low-lying areas within Minsmere Levels where the flood extent is slightly higher and within Leiston Belts where the extent is slightly smaller due to water being held up by the SSSI crossing. That difference diminishes for the most extreme events, where the whole Minsmere system is severely inundated and the proposed Sizewell C development does not make significant difference.

11.1.10 **Figure 62** shows the difference in flood velocity for the 1 in 200-year at 2030 coastal inundation modelling. There are areas within the Minsmere Levels where a minor increase occurs while the majority of the area remains unchanged. In the Sizewell Belts, there is a decrease in the velocity in the vicinity of the Sizewell Drain. For the majority of the floodplain, the hazard rating has not changed as a result of the proposed Sizewell C development.

11.1.11 Although there is some change in flood risk as a result of the development, is it considered that the impacts of that change are not significant. Change in flood levels of 0.1m, when considering flood depth of more than 5m, would have negligible overall impact of flooding in the area without the development in place under such extreme scenario.

11.1.12 Further details on modelling results and comparison of the baseline and ‘with scheme’ scenarios are provided in the Tidal Breach and Coastal Inundation Modelling Report (**Appendix 4**).

b) SSSI crossing

11.1.13 As mentioned in **section 11.1 a** of this **report**, coastal inundation modelling considered all development areas and their impact together. From the results**,** it can be seen there is an area of greater change in the vicinity of the SSSI crossing.

11.1.14 The SSSI crossing acts as a throttle for flow between the Minsmere Levels and the Sizewell Belts.

11.1.15 Although the crossing’s portal culvert is sized above existing dimensions of the Leiston Drain channel under peak flow conditions, the crossing slightly restricts the flow when the whole area is inundated most likely due to the raised ground around the crossing (embankment tying in higher ground on each side of the crossing). Therefore, there is slightly less interaction between Minsmere Levels and Sizewell Belts during flooding due to the presences of the SSSI crossing. This impact of the crossing is most apparent in the 2030 epoch where the resulting maximum levels increase by up to approximately 0.1m within the southern area of the Minsmere Levels (**Figure 60**).

11.1.16 **Figure 60** shows where an increase in the flood depth has occurred in the Minsmere Levels and a reduction in the flood depths in Sizewell Belts. The results suggest the SSSI crossing has a larger impact on change in flood depth than the main platform. The number of residential properties at flood risk (total of 5 for 2030 epoch and 146 for 2190 epoch) has not changed due to the proposed development.

11.1.17 Overall impacts of the SSSI crossing on flood risk to off-site receptors are linked to the impacts of the main platform, discussed in **section 11.1a** of this report.

c) Temporary construction area

11.1.18 As discussed in section 9.1, four areas within the temporary construction area are within the flood extents (**Figure 41** and **Figure 45**). The Goose Hill eastern boundary encroaches slightly onto the flood extents however, this area is only in use during the construction phase. The habitat compensation to the north of the temporary construction area has the potential to provide some flood storage benefits. The results from the coastal inundation modelling are discussed in **section 11.1a**.

d) Land east of the Eastlands Industrial Estate

11.1.19 The LEEIE is not within the coastal inundation flood extent (**Figure 42** and **Figure 46**).

11.2 Impacts on flood risk from breach of defences

a) Main platform

11.2.1 An assessment of the off-site impact of the proposed development in a breach scenario for two return period events and two climate change epochs was undertaken.

11.2.2 The two return periods selected were the 1 in 200-year and the 1 in 1,000-year events. The climate change epochs were for the end of the construction period in 2030 and for the end of decommissioning phase in 2190. For the purpose of the breach assessment, the UKCP18 RCP8.5 climate change scenario for all epochs was considered. The two scenarios were considered as two key points in the Sizewell C development lifetime. It was assumed that any risk between the two epochs would be already addressed with results from the 2190 epoch.

11.2.3 The 1 in 200-year and 1 in 1,000-year events for 2030 epoch comparison of model results shows the breach flood risk is reduced at the off-site receptors within the Sizewell Belts by up to approximately 0.16m and 0.19m respectively. While the 1 in 200-year and 1 in 1,000-year events for 2190 epoch ‘with scheme’ model results in an increase depth of 0.001m and 0.007m over the baseline (**Figure 67** and **Plate 6.11** of **Appendix 4**). This change is considered to show a negligible impact. The climate change allowances were applied for the reasonably foreseeable scenario. The 2190 modelled results indicated a minor impact. Therefore, it was assumed smaller impacts would be observed in the earlier phases of the development as a conservative approach.

11.2.4 In addition, a breach of the Sizewell C sea defence in the 2140 epoch with credible maximum climate change was assessed for the 1 in 200-year and 1 in 1,000-year scenarios. The model results show no change in flood risk to off-site receptors (**Figure 51**).

11.2.5 The change in flood depth was assessed using the developed 2D-TUFLOW model for the breach modelling, as discussed in **sections 5.4** and **7.2** of this **report**.

11.2.6 The breach modelling results with a breach at tank traps shows the greatest difference in maximum flood depth in the Sizewell Belts is located to the west of the proposed platform. The reduction in the maximum water depth (**Table 8.2**) for the 1 in 1,000-year event at 2030 climate change epoch was 0.19m. While the reduction in the velocities was 0.001m/s. This resulted in a reduction of the hazard from ‘danger to some’ to ‘very low hazard’ (**Plate 6.21** of **Appendix 4** and **Figure 65**).

11.2.7 For the theoretical maximum site lifetime in 2190, the results show less change in maximum water depth. This is due to Minsmere Levels and Sizewell Belts being significantly inundated when the shingle defences are overtopped by waves and inundated once the extreme still water level exceeds their crest levels.

11.2.8 Another potential breach location was tested at Sizewell Gap, south of Sizewell A. The modelled results for the 1 in 200-year event at 2190 show more impact locally than from a breach at tank traps. However, this reduces the maximum water depth by 0.025m at the Rosary Cottages

(**Plate 6.14** of **Appendix 4**) and therefore scenario with breach at tank traps was used as the main breach location for the analysis.

11.2.9 The results from a breach at the Sizewell C sea defence show no change in impact to off-site receptors. Total number of residential and non-residential properties has not changed, and the maximum flood levels were not increased for any of the receptors (**Figure 66**). This is due the properties at flood risk being located within the Leiston Belts where the flood levels were slightly reduced in the 'with scheme' scenarios as water was held more within the Minsmere Levels.

11.2.10 **Figure 65** shows difference in flood hazard rating, indicating that only very limited areas at the edge of the flood extent have change in flood hazard rating. For the majority of the floodplain, the hazard rating has not changed as a results of the proposed Sizewell C development.

11.2.11 Assessment of the modelling results shows that the increased flood levels relate to peak tide levels and therefore do not impact overall duration of flooding for considered events.

11.2.12 Further details on the breach modelling and results are provided in the Breach Modelling Report (Ref. 1.46).

b) SSSI crossing

11.2.13 The results of the breach modelling that are discussed in **section 11.2a** of this **report** also apply to impact of the SSSI crossing. **Figure 47** demonstrates the SSSI crossing slightly restricts flow between the Minsmere Levels and the Sizewell Belts when the whole system is significantly inundated. The results show the maximum water depths for the 1 in 200-year and 1 in 1,000-year for 2030 increase occurs in the Minsmere Levels, while there is a slight reduction in Sizewell Belts.

11.2.14 The greatest change in water levels occurs in the modelled 2030 epoch. The SSSI crossing restricts the flow of water during a breach scenario and reduces maximum levels significantly within the Sizewell Belts and increases them slightly in the Minsmere Levels.

11.2.15 The maximum impact on off-site properties identified in the National Receptors Database occurs during the 1 in 1,000-year event for the 2030 epoch and causes an increase of 0.046m at one residential property in Eastbridge (postcode IP16 4SG) from depth of 0.078m to 0.124m. There is a change of 0.05m/s in the velocity and the hazard remains as 'danger to all' (**Plate 6.11** and **Plate 6.13** of **Appendix 4**).

11.2.16 While in the southern area of the Minsmere Levels, the 1 in 200-year event for 2030 shows an increase in the maximum water levels from 1.47mAOD to 1.6mAOD, a rise of approximately 0.13m, within an overall flood depth of approximately 3m. There is no change in the velocity and the hazard remains as ‘very low hazard’ (**Figure 68** and **Figure 65**).

c) Temporary construction area

11.2.17 The majority of the temporary construction area is outside of the breach flood extent (**Figure 67**). The Goose Hill eastern boundary area encroaches slightly onto the flood extents. However, this area is only in use during the construction phase. The habitat compensation area to the north of the temporary construction area provides some flood storage benefits. The results from the coastal inundation modelling are discussed in **sections 11.2a** and **11.2b** of this **report**.

d) Land east of the Eastlands Industrial Estate

11.2.18 The LEEIE is not in the breach flood extent.

11.3 Impacts on fluvial flood risk

a) Main platform

11.3.1 The proposed main platform involves raising the ground levels within areas of fluvial flood risk. This would result in a slight reduction of the flood storage available during a fluvial event. An assessment of the floodplain storage loss was undertaken. The fluvial modelling results confirm that the change in the maximum water levels within the Minsmere catchment area is less than 15mm for all the considered scenarios, including 100-year and 1,000-year events with 65% and 80% climate change allowances.

11.3.2 **Table 11.2** presents comparison of modelled maximum water levels for the baseline and ‘with scheme’ scenarios for all considered return period events and climate change allowances at the 1D model node located downstream of the proposed main platform and the SSSI crossing (LEIS01_1646d) as shown in **Plate 7.2**.

11.3.3 The results in **Table 11.2** show for the construction phase, the maximum change in flood levels is 14mm for the 1 in 100-year return period event with 25% climate change allowance. Whereas for the operation and decommissioning phases, the maximum differences in flood levels is 11mm for the 1 in 20-year return period event with climate change allowance of 35% allowance.

11.3.4 The results for the runs with reasonably foreseeable and credible maximum climate change allowances (Upper End scenario with 65% and H++ scenario with 80% increase in fluvial flows respectively) in **Table 11.2** show the maximum difference in flood levels is 13mm (5 year event with 80% climate change), which is less than difference for the 100 year event with 25% climate change for the reasonably foreseeable scenario. This is caused by Minsmere Levels and Sizewell Belts being flooded to higher levels in both baseline and 'with scheme' scenarios, leading to lower relative differences.

Table 11.2: Difference in maximum water levels at node LEIS01_1646d downstream of SSSI crossing.

Return Period	Climate change allowance	Max Water Level (m AOD)		Difference (m)
		Baseline	'with scheme'	
5 year	25%	1.325	1.332	0.007
	35%	1.449	1.458	0.009
	65%	1.847	1.859	0.012
	80%	1.912	1.925	0.013
20 year 1.1.1.	25%	1.562	1.570	0.008
	35%	1.711	1.722	0.011
	65%	2.010	2.020	0.010
	80%	2.047	2.059	0.012
100 year	25%	1.843	1.857	0.014
	35%	1.992	2.002	0.010
	65%	2.130	2.137	0.007
	80%	2.168	2.177	0.009

Return Period	Climate change allowance	Max Water Level (m AOD)		Difference (m)
		Baseline	'with scheme'	
1,000 year	25%	2.129	2.138	0.010
	35%	2.187	2.196	0.009
	65%	2.287	2.297	0.010
	80%	2.311	2.323	0.012

11.3.5 Comparison of the timeseries water levels between the baseline and 'with scheme' scenarios (Ref. 1.40) shows that duration of increase in flood levels is limited to the peak time and therefore the overall duration of flooding is not increased.

11.3.6 Plots illustrating difference in flood depth and velocity are provided in Appendix E of the Fluvial Modelling Update report (**Appendix 2** to this report). These plots illustrate that overall the difference in fluvial flood risk is low, with maximum increase in flood depth by 15mm and very localised increase in velocity by less than 0.1m/s and so the overall change in flood hazard rating is minor.

11.3.7 Modelling results for residential and non-residential receptors show that maximum change in flood depth for all affected residential properties is less than 15mm. The total number of residential properties at flood risk has not changed in the 1 in 100-year due to the proposed Sizewell C development, all these are located within the Leiston area.

11.3.8 Flood hazard rating has increased for four residential properties during the 1 in 100-year event with 35% climate change allowance. Of these four properties, only one property has changed from 'Danger for some' to 'Danger for most' hazard rating class in the 1 in 100-year with 35% climate change allowance.

11.3.9 Total number of non-residential properties at flood risk has increased by 5 for up to 1 in 1,000-year event with 35%CC and 6 for the two most extreme events (1,000-year with 35% and 80%CC). However, the flood depth for those additional properties is less than 5mm (8mm for the most extreme event) with close to zero velocity and therefore very low (to no) hazard.

11.3.10 Overall, for non-residential properties the maximum change in flood levels is 15mm with almost no change in velocity. Hazard rating class has increased from ‘Danger for most’ to ‘Danger for all’ for one non-residential property (post code IP16 4SP) for the 1 in 100-year event with 80%CC.

11.3.11 Summary table with difference in flood depth, velocity and hazard for all properties at flood risk from all considered return period events and climate change scenarios are provided in Appendix E of the Fluvial Modelling Update report (**Appendix 2** to this report).

11.3.12 The modelling results show very little difference in flood extent (**Figure 69**) for the 1 in 100 year and 1 in 1,000 year with 35% climate change allowance scenarios.

11.3.13 The Environment Agency advice confirms that floodplain compensation or flood mitigation is not usually required when the change in flood depth is less than 30mm and the overall impact of change in flood risk to off-site receptors is insignificant. The 15mm additional flood depth from the development platform has an insignificant impact on the floodplain and any off-site property. Therefore, fluvial flood storage mitigation to compensate change in fluvial flood risk is judged as not being required for the current proposed development in accordance with the current Environment Agency guidance.

11.3.14 The realignment of the Sizewell Drain would involve the temporary disconnection and permanent reconnection of tributaries along the affected watercourse during the early construction phase. This work would involve the temporary diversion of local flows with no associated change in the catchment or the associated floodplain.

b) SSSI crossing

11.3.15 The main platform the SSSI crossing involves raising the ground levels within areas of fluvial flood risk resulting in a slight reduction of the flood storage. The change in the maximum water levels is less than 15mm for the considered scenarios up to 100-year event with 65% climate change allowance and the impact is not significant. Therefore, floodplain compensation or flood mitigation is judged not to be required for the current proposed development.

11.3.16 Change in flood risk to off-site receptors due to SSSI crossing is the same as for the main platform and is discussed is **Section 11.3a)** of this **report**.

11.3.17 The SSSI crossing discharges surface water to the north of the causeway in the temporary construction area. A small amount of surface water that would have been drained to the Leiston Drain would be transferred off-site to discharge to ground. The quantity of water and the scale of the transfer from surface water to ground discharge is minimal. There is likely to be a negligible change in the associated level of fluvial flood risk.

c) Temporary construction area

11.3.18 The temporary construction area is surrounded by fluvial floodplains served by a network of local ordinary watercourses. These are the Minsmere Levels on the northern boundary and the Sizewell Belts on the southern boundary. The temporary construction area would be served by a surface water management system that would retain a significant proportion of surface water run-off on-site.

11.3.19 The surface water in WMZs 1,2,3 and 6 would discharge to both ground and surface water drains. The primary discharge would be to ground. However, a controlled discharge to a local ordinary watercourse would be feasible, when required. The controlled discharge would be limited to greenfield run-off rate. There is considered to be no change in the off-site fluvial flood risk.

d) Land east of the Eastlands Industrial Estate

11.3.20 The LEEIE is not in the vicinity of a fluvial watercourse and its associated floodplains. Therefore, there are no known impacts from the construction of the LEEIE on fluvial flood risk.

11.4 Impacts on surface water flood risk

a) Main platform

11.4.1 The construction of the main platform would reduce the permeable area for groundwater recharge to occur across all phases of the development. The surface water run-off from the construction phase would be collected and discharged to sea through the CDO.

11.4.2 While in the operation phase, surface water run-off would be collected and discharged to the power station forebays where it would mix with the cooling waters before being discharged to sea.

11.4.3 The increase in impermeable area would increase the flood risk on the platform. The discharging of the surface water to the sea would reduce the surface water flood risk to the surrounding onshore areas.

11.4.4 The use of infiltration drainage for the relocated facilities outside of the Sizewell B area would retain the surface water run-off on the proposed site.

b) SSSI crossing

11.4.5 The SSSI crossing discharges surface water to the temporary construction area. Therefore, a minor amount of water that would have drained into the Leiston Drain locally would be transferred off-site to discharge to ground. The scale of the transfer from surface water to ground discharge is minimal. Therefore, there is likely to be a negligible change in the associated level of surface water flood risk.

c) Temporary construction area

11.4.6 The temporary construction area would have considerable temporary works that would increase the impermeable area across site. The surface water run-off would be discharged at source where possible and the remaining would be attenuated before being discharged to ground, or to ground and ordinary watercourse.

11.4.7 The surface water run-off remains mostly on-site. However, some minor flows are discharged off-site at a controlled greenfield run-off rate. Therefore, there is no change to the off-site surface water flood risk up to the 1 in 100-year plus climate change event.

11.4.8 Exceedance flows greater than the design flows are anticipated to cause localised pooling on-site, which would be considered further in the Outline Drainage Strategy (**Volume 2, Chapter 2, Appendix 2A** of the **ES**) (Doc Ref. 6.3).

11.4.9 The off-site sports facilities would increase the surface water run-off in an area where surface water flooding is potentially interlinked with sewer flooding. An appropriately designed drainage system would prevent any increase in off-site surface water flood risk. In an exceedance event, there is the possibility of surface water flooding extending beyond the site boundaries and interacting with the sewer flooding.

d) Land east of the Eastlands Industrial Estate

11.4.10 The LEEIE temporary works activities would increase the impermeable area across site which would increase the associated surface water run-off.

Therefore, to minimise the surface water run-off the impermeable area would be kept to a minimum where possible. However, there is limited space available on the site for SuDS features and it may not be possible provide enough attenuation on-site. The surface water run-off would be discharged off-site to a watercourse at a controlled rate. In order to accommodate the larger volumes of runoff from longer return period storms the land to the east of the LEEIE would be used. This area would store surface water in extreme events.

11.4.11 Exceedance flows greater than the design flows are anticipated to cause localised pooling on-site, which would be considered further in the Outline Drainage Strategy (**Volume 2, Chapter 2** of the **ES)** (Doc Ref. 6.3).

11.5 Impacts on groundwater flood risk

a) Main platform

11.5.1 The construction of the main platform would include the emplacement of a cut-off wall that would limit hydraulic connection between the main platform and the surrounding environment. The cut-off wall would reduce the impact of the construction dewatering on the surrounding environment. The key area of concern is the adjacent Sizewell Marshes SSSI which currently experiences periods of groundwater flooding during winter.

11.5.2 The dewatering activities during construction are predicted to reduce groundwater levels compared to baseline conditions in some areas of the Sizewell Marshes SSSI by approximately 0.1m in all model scenarios (Ref. 5.2.27). This results in a reduction in groundwater flooding in this area.

11.5.3 Groundwater flooding can be estimated in the groundwater model by examining groundwater seepage. The seepage volume of water lost from the model when the groundwater level rises above the ground surface.

11.5.4 **Figure 63** shows the total annual groundwater seepage across the Sizewell Marshes SSSI during each phase of the development for both the wet and dry scenarios. The figure compares seepage under baseline conditions (without the development) with seepage when the development is present.

11.5.5 During the preliminary and enabling phases, there is negligible difference in groundwater seepage with and without the development for both scenarios.

11.5.6 During the construction phase, there is significantly less seepage with the development compared to baseline conditions as a result of reduced water levels within the Sizewell Marshes.

11.5.7 During the operation phase, seepage is reduced between development and baseline models for the first two years, when groundwater levels are still recovering from the end of the dewatering. By 2030 the difference between the estimated seepage for the baseline and development models is minimal, as groundwater levels within the vicinity of the platform have recovered to pre-development levels so long-term changes to groundwater flooding in this area are therefore considered to be negligible.

11.5.8 The groundwater model runs extend until 2040 so impacts to groundwater levels and flooding off-site from the development can only be directly assessed until then. However, as part of the modelling process, recharge time series were prepared for the various climate scenarios until 2100. Recharge for the dry and wet scenarios are shown in **Figure 63**. For the wet scenario, which is most likely to cause increases in groundwater flooding, it can be seen that there are no significant differences between the recharge up until 2040, and the recharge for the period 2040 to 2100. As such it is not anticipated that any further increases in groundwater flood risk will occur off-site than are already seen in the model up to 2040.

b) SSSI crossing

11.5.9 The SSSI crossing drains surface water to the north of the causeway. Therefore, a minor amount of water that would have previously discharged into the Leiston Drain would be transferred off-site to discharge to ground. The quantity of water and the scale of the transfer from surface water to ground discharge is minimal. There is strong hydraulic connectivity between Leiston Drain and shallow groundwater, and there is likely to be a negligible change in the associated level of flood risk.

11.5.10 The sheet piling at the toe of the embankments would locally alter the groundwater flow in the surrounding area of the SSSI crossing.

11.5.11 Groundwater levels in the Sizewell Marshes SSSI adjacent to the SSSI crossing do change during the construction period. This is as a result of the main development construction activities as discussed in **section 11.5a** of this **report**.

c) Temporary construction area

11.5.12 The temporary construction area would have considerable temporary works activities on the site which affect current groundwater levels under the temporary construction area.

11.5.13 The majority of the surface water run-off increase would be discharged on-site to ground with only a minor proportion going to watercourses. Therefore, while there would be a reduced amount of groundwater recharge, this would be minimal as the amount of water leaving the site is limited.

11.5.14 Groundwater modelling does not show any impacts on groundwater levels off-site as a result of these changes (Ref. 1.26). It is likely that the reduction in groundwater recharge in the car parking area north of the SSSI crossing also contributes to reduced water levels in the Sizewell Marshes SSSI discussed in **section 11.5a)** of this **report**.

d) Land east of the Eastlands Industrial Estate

11.5.15 The LEEIE area would have temporary works activities that may affect the current groundwater recharge by collecting surface water run-off and discharging it off-site at a controlled rate. This impact is likely to be low as discharge is likely to be released to existing watercourses, which in this area, where the geology is sand and gravel, are likely to be in hydraulic continuity with groundwater.

11.6 Impact on reservoir flood risk

11.6.1 The proposed main development platform, SSSI crossing, and LEEIE do not alter any influencing features or factors that would change flood risk from reservoirs. Therefore, there is no change in the off-site flood risk from these areas.

11.6.2 The temporary water resource storage area on the northern boundary of the temporary construction area introduces a flood risk to the downstream area if it were to breach. Detailed breach assessment has not been carried out for the water resource storage area. However, a review of the local topography and the modelled coastal inundation, tidal breach and fluvial flood extents for the 1 in 200-year and 1 in 1,000-year extents in 2030 was used for high level identification of areas that could be affected from its breach.

11.6.3 Given the limited volume of water that would be able to escape from a breach of the water resource storage area compared to the size of the receiving floodplain, one property has been identified downstream of the reservoir in the Minsmere Levels within the RSPB reserve as having the potential to be affected by the breach. More detailed assessment of the potential impact on this property will be carried out as part of the detailed design and appropriate management measures as part of the site's wider safety procedures.

11.7 Impact on sewer flood risk

a) Main platform

11.7.1 The main platform sewers do not interact with any off-site external sewer networks in the area. The foul sewers serving the main platform would treat the effluent on the platform. Both the surface water and treated effluent from the sewage treatment plant would be discharged to the power station forebays, where it would mix with the cooling waters before being disposed of to sea.

11.7.2 The relocated facilities within the Sizewell B site would continue to use the Sizewell B sewer network that the facilities previously used. Therefore, there would be no change in the off-site flood risk these sewers would pose.

b) SSSI crossing

11.7.3 The construction phase sewers crossing the causeway do not interact with any off-site external sewer networks. The treated effluent would discharge as discussed in **section 11.7a)** of this **report**. Therefore, the foul sewers on the SSSI crossing area are not considered to increase the off-site sewer flood risk.

c) Temporary construction area

11.7.4 The foul water sewer arrangements discussed in **section 11.7a** and **11.7.2b** also apply to the temporary construction area. Therefore, the foul sewers are not considered to increase the off-site sewer flood risk as the interactions are limited.

11.7.5 The off-site sports facilities would increase the surface water run-off in the area where surface water flooding is interlinked with sewer flooding in Leiston. An appropriately designed drainage system would prevent any increase in off-site surface water / sewer flood risk. In an exceedance event there is the possibility of surface water flooding extending beyond the site boundaries and interacting with the sewer network in Leiston.

d) Land east of the Eastlands Industrial Estate

11.7.6 The foul water sewer arrangements discussed in **section 11.7a**, **11.7.2b** and **11.7.2c**, also apply to the LEEIE and are not considered to increase the off-site sewer flood risk.

12. Summary and conclusions

12.1 Main platform and SSSI crossing

a) Construction

12.1.1 The main platform and SSSI crossing are in an existing area of high coastal, breach and fluvial flood risk. The main platform and SSSI crossing areas are at a low risk of surface water, sewer and reservoir flood risk. The groundwater flood risk is nominal for above ground works. The deep excavation works have a low risk of groundwater flooding during construction due to the presence of the cut-off wall and internal dewatering system.

12.1.2 The embedded design and construction methods of the proposed main platform and SSSI crossing manages the risk of flooding from coastal, fluvial, groundwater, surface water and sewers. However, the residual risk of flooding from a breach of the sand dunes with a shingle beach during the early phases of construction is limited but present. Once the new Hard Coastal Defence Feature is built in the later phases of construction, the flood risk to the main platform and SSSI crossing area resulting from a coastal breach would be reduced to low.

12.1.3 Overall the main platform and SSSI crossing areas are currently at a low level of flood risk. During the early part of the construction phase, there is a risk of coastal flooding to both the main platform and SSSI crossing areas while the new HCDF are still under construction. A flood emergency plan will be developed to manage this risk.

12.1.4 The main platform and access via the SSSI crossing are designed for a safety case of a 1 in 10,000-year storm event and will remain dry during a 1 in 200-year and 1 in 1000-year event during the construction phase.

12.1.5 The Sizewell B relocated facilities are to be moved from the proposed Sizewell C main platform area on to either the existing Sizewell B site or the pillbox field to the south of Rosary Cottages and the Sizewell A and B platforms. The facilities relocated on to the Sizewell B site are at low risk of coastal inundation, tidal breach, fluvial, surface water, groundwater, reservoir and sewer flooding. The design life of the relocated facilities is up to 2055. Therefore, the future water extents, depths and velocities in 2055 are expected to be closer to those modelled in 2030 rather than 2190. Therefore, the proposed vehicular access road crossing and the pedestrian footbridge crossing are within the 1 in 200-year and 1 in 1,000-year extents for coastal inundation, tidal breach and fluvial flooding in 2030.

12.1.6 The relocated facilities would not alter any off-site flood risks. These on-site and off-site flood risks would continue from the construction phase into the operation phase of the Sizewell C project.

b) Operation

12.1.7 The SSSI crossing design is safe for use up to a 1 in 1,000-year coastal event at the end of the operation phase, after which there would be a high risk of coastal overtopping that would make crossing dangerous during storm conditions. This would trigger the construction of the adaptive flood defences on the SSSI crossing to reduce this risk through the remaining lifetime of the proposed site.

12.1.8 Groundwater modelling of future scenarios with climate change indicate there is no incremental effect with the climatic variations. Groundwater modelling has shown the water table outside the cut-off wall would recover to pre-development levels by 2040 and there are no incremental changes associated with the development. Groundwater modelling of the future scenarios beyond 2090 has not occurred due to the likelihood of seawater ingress to the low-lying land if the surrounding coastal defences beyond the site boundaries remain unchanged.

12.1.9 At the end of the operation phase, the SSSI crossing could be at a gradually rising risk of coastal overtopping, which would begin to pose a danger to people and vehicles using the crossing during an extreme storm event. The adaptive flood defence at the SSSI crossing would be constructed at an appropriate point in time to ensure safe vehicle operation on the causeway throughout the lifetime of the site.

12.1.10 A flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note (Ref 1.3) would be developed to ensure people on-site are safe in the event of a flood.

c) Decommissioning

12.1.11 At the end of the decommissioning phase, the coastal flood probability would have increased on the main platform. The conditions in an extreme storm event would be manageable for trained staff to operate in up to 2190 in the reasonably foreseeable climate change scenarios.

12.1.12 At the end of the decommissioning phase, the fluvial flood risk would have increased in accordance with the climate change scenarios. However, both the main platform and the SSSI crossing would be operable during an extreme fluvial event. With the adaptive flood defences in place, the SSSI crossing would be safe for vehicles crossing the causeway until the end of the decommissioning phase.

12.1.13 The main platform in the decommissioning phase would be at low flood risk. While the flood risk associated with breach to the platform is low, the off-site water depths during a breach would increase along with the associated flood risk.

d) Summary

12.1.14 A summary of the mitigated flood risks from all sources to the main platform area site is provided in **Table 12.1**.

Table 12.1: Summary of overall post development flood risk to the main development site and SSSI crossing

Source	Flood risk summary for the main platform and SSSI crossing
Coastal	**Construction Phase:** **Main platform: Medium: For a short period in the early stage** **SSSI crossing: Low:** The crossing is set back from the coastline and above the 1 in 1,000-year water level. **Operation Phase: Main platform and SSSI crossing: Low:** The platform and crossing are above the 1 in 1,000-year water level. Wave overtopping is low due to the coastal defence. **Decommissioning Phase:** **Main platform: Low** The finished platform level is above the 1 in 1,000-year water level. Wave overtopping would be limited by the coastal defence and the adaptive defence. **SSSI crossing: Medium:**The finished road level is above the 1 in 1,000-year water level. Once required, wave overtopping would be limited by the construction of the adaptive defence. **Construction / Operation / Decommissioning: Beach landing facility: High:** The beach landing facility is on the seaward side of the coastal defences within the sea. It will only be used during periods of low coastal risk
Breach	**Construction and Decommissioning Phase: Main platform and SSSI crossing: Medium:** While the maximum breach water levels do not pose a risk to the main platform, the breach flooding would increase off-site flood risk. **Operation Phase: Main platform and SSSI crossing: Low:** Maximum breach water levels do not pose a risk. Breach flood risk has not been considered for the beach landing facility as the structure is on the seaward side of the coastal defences.

Source	Flood risk summary for the main platform and SSSI crossing
Fluvial	**Construction / Operation / decommissioning Phases:** **Low:** The finished platform and SSSI crossing levels are above the 1 in 1,000-year water level.
Surface Water	**Construction / Operation / Decommissioning Phases:** **Low:** The temporary and the permanent surface drainage systems would be designed to appropriate parameters to meet the requirements of the different phases.
Ground Water	**Construction Phase:** **Low:** The dewatering activities in the construction would lower the groundwater levels and the associated potential for groundwater flooding. **Operation / Decommissioning Phases: Low**: After construction completion, the groundwater levels would re-equilibrate fully by operation phase by would remain as ‘limited’ potential of flooding.
Reservoir	**Construction / Operation / Decommissioning Phases:** **Low**: the main platform, SSSI crossing and beach landing facility are not affected by reservoir flood risk. **Medium to High:** The western access road and existing Sizewell power station access road from Sizewell Gap are within the maximum flood extent that is anticipated not to change. Alternative access through the SSSI crossing exists as an alternative if this very low probability of reservoir breach occurs, making this a low risk overall to Sizewell C.
Sewer	**Construction / Operation / Decommissioning Phases:** **Low:** Temporary sewers would use the SSSI crossing during construction phase. An appropriate design, installation and management of sewers would retain a low flood risk.

12.2 Temporary construction area

a) Construction

12.2.1 The majority of the temporary construction area is at low risk of flooding from surface water, groundwater, reservoirs, sewers, fluvial, coastal and breach. There is an existing limited coastal flood risk to the eastern main platform construction area end at Goose Hill. There is also a limited fluvial flood risk along the south-eastern boundary of the temporary construction area.

12.2.2 The proposed development activities on the remaining area of the temporary construction area would marginally raise the risk of flooding from surface water and sewers. The risk of groundwater flooding would be unaltered. However, the embedded design approach provides suitable mitigation to maintain a low flood risk while the site is in use during the construction phase before returning the area to the former land use.

12.2.3 The introduction of the temporary water resource storage area in the northern area of the site would present a new reservoir flood risk. A temporary water resource storage area would be constructed, with an expected volume of less than 25,000m^3 of non-potable water for use in the construction process. Water would be stored above groundwater level to ensure it is hydrologically separate and does not cause adverse effects to groundwater levels on-or off-site. The temporary water resource storage area would collect and store water over the winter period, typically for use during the summer months.

12.2.4 The water resource storage area is likely to be partly below the existing ground level and partly above the existing ground level. The raised embankments would be constructed as necessary up to approximately 3m in height. The temporary water resource storage area would be removed on completion of the construction phase and the land returned to its former use.

b) Operation and decommissioning

12.2.5 The majority of the temporary construction area would not be in use in the operation phase, having been returned to their former usage. The site access road, the staff car park and the associated infrastructure serving the site would remain in use.

12.2.6 The permanent access infrastructure would serve the proposed Sizewell C power station throughout the operation phase. The embedded design would reduce the risk to the proposed development from coastal, breach, fluvial, surface water, sewer and groundwater flooding until the end of the operation phase. There would be residual risk of flooding were the new Hard Coastal Defence Feature to fail, although management approaches would be in place to reduce the likelihood of this and the associated impact. Therefore, the mitigated flood risk remains low.

12.2.7 A flood emergency plan in accordance with the standards set out in Appendix D of the Environment Agency and ONR Joint Advice Note to ensure people on-site are safe in the event of a flood would be developed.

c) Summary

12.2.8 A summary of the mitigated flood risks from all sources to the temporary construction area site is provided in **Table 12.2**.

Table 12.2: Summary of overall post development flood risk to the temporary construction area

Source	Flood risk summary for the temporary construction area
Coastal	**Construction / Operation / Decommissioning Phases:** **Low:** The majority of the area is beyond the 1 in 1,000-year extent except for two small areas. One area on the eastern boundary with a temporary water management basin during the construction phase and the other area on the south-eastern boundary with landscaping. **Medium:** The beach landing facility would be at a medium mitigated flood risk throughout the lifetime of the development. It will only be used during periods of low coastal levels
Breach	**Construction / Operation / Decommissioning Phases:** **Low:** The majority of the area is beyond the 1 in 1,000-year extent except for two small areas. One area on the eastern boundary with a temporary water management basin during the construction phase and the other area on the south-eastern boundary with landscaping. The majority of the site is not at risk in the operation and decommissioning phases. The remaining permanent infrastructure would be at a low mitigated risk.
Fluvial	**Construction / Operation / Decommissioning Phases:** **Low:** The majority of the area is beyond the 1 in 1,000-year extent except for two small areas. One area on the eastern boundary with a temporary water management basin during the construction phase and the other area on the south-eastern boundary with landscaping. The majority of the site is not at risk in the operation and decommissioning phases. The remaining permanent infrastructure would be at a low mitigated risk.
Surface Water	**Construction / Operation / Decommissioning Phases:** **Low:** The majority of the area is at ‘very low’ flood risk. The site has a small area with an increase surface water flood risk, which is used only in the construction phase for surface water management features. The majority of the site is not at risk in the operation and decommissioning phases. The remaining permanent infrastructure would be at a low mitigated risk.
Ground Water	**Construction / Operation / Decommissioning Phases:** **Low:** Some localised evidence of groundwater emergence at surface in low-lying areas of the Sizewell Marshes during winter would remain throughout all phases. Not at risk in the operation and decommissioning phases.
Reservoir	**Construction / Operation / Decommissioning Phases:** **Low:** Not at risk of flooding from reservoirs.
Sewer	**Construction / Operation / Decommissioning Phases:** **Low:** Temporary sewers would use the SSSI crossing during construction phase. An appropriate design, installation and management of sewers would retain a low flood risk. The majority of the site is not at risk in the operation and decommissioning phases. The remaining permanent infrastructure would be at a low mitigated risk.

12.3 Land east of Eastland Industrial Estate

a) Construction

12.3.1 The LEEIE is considered to be at low risk of flooding from surface water, groundwater, reservoirs, sewers, fluvial, coastal and a defence breach. However, the development of the site would marginally increase the localised risk of flooding from surface water and sewers. The embedded design approach for surface water and foul water provides suitable mitigation to maintain a low flood risk while the site is in use in the construction phase.

b) Operation and decommissioning

12.3.2 The LEEIE would not be in use in the operation and decommissioning phase, having been returned to the site's former usage at the end of the construction phase.

c) Summary

12.3.3 A summary of the mitigated flood risks from all sources to the LEEIE site is provided in **Table 12.3**.

Table 12.3: Summary of overall post development flood risk to the LEEIE

Source	Flood risk summary for the LEEIE
Coastal	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from coastal or tidal flooding.
Breach	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from breach flooding.
Fluvial	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from fluvial flooding.
Surface Water	**Construction / Operation / Decommissioning Phases:** **Low:** The area would remain at 'very low' flood risk throughout the construction phase, due to management of surface water run-off. Not at risk in the operation and decommissioning phases.
Ground Water	**Construction / Operation / Decommissioning Phases:** **Low:** 'Limited' potential for flood risk would remain throughout all phases.
Reservoir	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from reservoirs.
Sewer	**Construction / Operation / Decommissioning Phases:** **Low:** Temporary sewers would be on-site during construction phase. An

Source	Flood risk summary for the LEEIE
	appropriate design, installation and management of sewers would retain a low flood risk. Not at risk in the operation and decommissioning phases.

12.4 Off-site sports facilities

a) Construction

12.4.1 The off-site sports facility is considered to be at low risk of flooding from groundwater, reservoirs, fluvial, coastal and breach.

12.4.2 The development of the off-site sports pitches would marginally increase the localised risk of flooding from surface water and sewers. The embedded design approach for surface water and sewers water provides suitable mitigation to maintain a low flood risk while the site is in use. Therefore, the mitigated surface water and sewer flood risk is considered to be low.

b) Operation and decommissioning

12.4.3 The off-site sports facilities are a permanent development in Leiston town and would remain in use throughout the operation and decommissioning phases. The level of mitigated flood risk would remain unchanged due to the inclusion of climate change allowances in the design.

c) Summary

12.4.4 A summary of the mitigated flood risks from all sources to the off-site sports facility site is provided in **Table 12.4**.

Table 12.4: Summary of overall post development flood risk to the off-site sports facility

Source	Flood risk summary for the off-site sports facility
Coastal	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from coastal or tidal flooding.
Breach	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from breach flooding.

Source	Flood risk summary for the off-site sports facility
Fluvial	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from fluvial flooding.
Surface Water	**Construction / Operation / Decommissioning Phases:** **Low:** The area would remain at ‘very low’ flood risk throughout all the phases, due to management of surface water run-off.
Ground Water	**Construction / Operation / Decommissioning Phases:** **Low:** ‘Limited’ potential for flood risk would remain throughout all phases.
Reservoir	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from reservoirs.
Sewer	**Construction / Operation / Decommissioning Phases:** **Low:** The area would remain at a low flood risk throughout all the phases, due to the appropriate design and maintenance of the sewers.

12.5 Fen Meadow compensation sites and Marsh Harrier habitat improvement area

a) Construction

12.5.1 The fen meadow compensation sites are permanent water compatible sites and considered to be appropriately located in accordance with the sequential test.

12.5.2 The fen meadow sites are on low lying ground adjacent to the main rivers of the River Blyth and the River Fromus. The fen meadow sites are at a medium to high risk of flooding that will remain throughout the lifetime of the Sizewell C project. Due to the low topography the surface water flood risk on both sites varies from low to high and would remain in the future. Groundwater flooding has the potential to reach the surface on both fen meadow sites that would also remain unaltered.

12.5.3 The fen meadow site near Halesworth is within the maximum flood extent of Heveningham Hall Reservoir and would continue to be so in the future for as long as the reservoir was present. The fen meadow near Benhall and the marsh harrier habitat improvements sites are not at risk of reservoir flooding.

12.5.4 The fen meadow sites and the marsh harrier habitat improvement areas are considered to be at low risk of flooding from sewers, coastal and breach. The marsh harrier habitat improvement area is not at fluvial or reservoir flood risk.

12.5.5 The phased construction of the main platform, SSSI crossing and other operational infrastructure is supported by a large temporary construction area that are to be returned to the former land use once the construction is complete. The marsh harrier habitat improvement area is a temporary site that would be returned to its former agricultural use at the end of the construction period.

b) Operation and decommissioning

12.5.6 The fen meadow sites would remain as permanent developments and are a water compatible land use. There are no planned alterations to the sites created in the construction phase in the operation and decommissioning phases. Therefore, the only anticipated change to flood risk is associated to the predicted climate change projections associated. The flood risk would remain similar to the construction phase depending of the sensitivity of the source of flood risk to climate change.

c) Summary

12.5.7 A summary of the mitigated flood risks from all sources to the fen meadow compensation sites and marsh harrier habitat improvement area is provided in **Table 12.5**.

Table 12.5: Summary of overall post development flood risk to the fen meadow compensation sites and marsh harrier habitat improvement area

Source	Flood risk summary for the fen meadow and marsh harrier areas
Coastal	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from coastal or tidal flooding.
Breach	**Construction / Operation / Decommissioning phases:** **Low:** Not at risk of flooding from breach flooding.
Fluvial	**Construction / Operation / Decommissioning phases:** **Low**: The marsh harrier area is not at risk of fluvial flooding. **Medium to High**: Halesworth and Benhall fen meadows are anticipated to remain at fluvial flood risk in Flood Zones 2 and 3, with a part of Benhall Fen in Flood Zone 3b.

Source	Flood risk summary for the fen meadow and marsh harrier areas
Surface Water	**Construction / Operation / Decommissioning Phases:** **Medium to High**: Halesworth and Benhall fen meadows are anticipated to remain at 'low' to 'high' surface water flood risk.
Ground Water	**Construction / Operation / Decommissioning Phases:** **Low:** Some localised evidence of groundwater emergence at surface in low-lying areas would remain throughout all phases.
Reservoir	**Construction / Operation / Decommissioning phases:** **Low**: Benhall fen meadow and marsh harrier area are not at risk of flooding from reservoirs. **Medium to High**: Halesworth fen meadow maximum flood extent is not anticipated to change due to the proposed development.
Sewer	**Construction / Operation / decommissioning phases:** **Low**: The fen meadow and marsh harrier areas are rural areas with no sewers crossing them and not at risk of sewer flooding.

12.6 Sizewell B relocated facilities

a) Construction

12.6.1 The proposed relocation of the Sizewell B from the proposed Sizewell C main platform area to either the existing Sizewell B site or the Pillbox Field. The facilities relocated on to the Sizewell B site are at low risk of coastal inundation, tidal breach, fluvial, surface water, groundwater, reservoir and sewer flooding.

12.6.2 The design life of the relocated facilities is up to 2055. The future water extents, depths and velocities in 2055 are expected to be closer to those modelled in 2030 rather than 2190. Therefore, the proposed vehicular access road crossing are within the 1 in 200-year and 1 in 1,000-year extents for coastal inundation, tidal breach and fluvial flooding in 2030.

12.6.3 The relocated facilities would not alter any off-site flood risks.

b) Operation

12.6.4 The on-site and off-site flood risks would continue from the construction phase into the operation phase of the Sizewell C project.

12.7 Off-site impacts and mitigation

a) Coastal flood risk

12.7.1 Minsmere Levels and Sizewell Belts area benefit from existing coastal defences comprising of the sand dunes with a shingle beach that are at risk of being overtopped from relatively low (20-year) return period storm events. To assess the risk of coastal inundation in the area, 2D-TUFLOW model was developed with input of overtopping rates calculated using in-house developed wave overtopping tool (Amazon).

12.7.2 The risk of coastal inundation was assessed for two key return period events, i.e. 1 in 200-year and 1 in 1,000-year with allowances for climate change up to key epochs, i.e. construction at 2030 and end of theoretical maximum site lifetime at 2190 that are most relevant for the FRA study.

12.7.3 Due to characteristics of the catchment area and topography, the coastal inundation flood extent spreads across the low-lying area of Minsmere Levels and Sizewell Belts, with maximum modelled still water levels of 6m AOD for the 1 in 1000-year event at 2190 epoch.

12.7.4 Modelling results show that difference in maximum water depths from the baseline (pre-development) and ‘with scheme’ (post-development) scenarios is a maximum of 0.07m for the 1 in 200-year and 0.1m for the 1 in 1,000-year event at 2030. The Minsmere Levels and Sizewell Belts would be significantly inundated due to extreme still water levels exceeding the crest of the shingle defences along the frontage at 2190.

12.7.5 Total number of residential (total of 5 for 2030 epoch and 146 for 2190 epoch) and non-residential properties at risk at 2030 and 2190 epochs for both the 200-year and 1,000-year event have not changed as a result of the proposed Sizewell C development.

12.7.6 The flood risk to some of the properties (mostly located within the Leiston area) was reduced for the higher event, due to slight reduction in flood levels in the Leiston Belts in the ‘with scheme’ scenario.

12.7.7 Although the crossing portal culvert is sized above existing dimensions of the Leiston Drain channel under peak flow conditions, the crossing restricts the flow when the whole area is inundated. Therefore, there is slightly less interaction between Minsmere Levels and Sizewell Belts during flooding due to the presence of the SSSI crossing. This impact of the crossing is most apparent in the 2030 epoch where the resulting maximum levels increase by up to approximately 0.1m within the southern area of the Minsmere Levels.

12.7.8 Assessment of the modelling results shows that the increased flood levels relate to peak tide levels and therefore do not impact overall duration of flooding for considered events. There is a slight change in flood extent that is limited to low-lying areas within Minsmere Levels where the flood extent is slightly higher and within Leiston Belts where the extent is slightly smaller due to water being held up by the SSSI crossing.

b) Breach of defences flood risk

12.7.9 The area benefits from coastal defences in the form of shingle beach and sand dunes with varying crest levels along the frontage. In an event of coastal defence breach the flood extent is largely contained within existing marshlands for the 1 in 200-year and 1 in 1,000-year present day events due to the topography of the area. This is consistent with the coastal inundation and fluvial flood extents.

12.7.10 The Environment Agency has recently prepared a coastal inundation 2D-TUFLOW model for the East Anglian coastline that assessed risk of breach north of the Minsmere Sluice. For the purpose of the Sizewell C project, a full 2D-TUFLOW model was developed (same model as used in assessment of coastal inundation flood risk). In that study a breach location at the tank traps located immediately north of the proposed main platform was assessed due to its proximity to the development and potential greater impacts of the development on flood risk to off-site receptors.

12.7.11 The modelling of pre and post development scenarios was carried out for two key return period events, i.e. 1 in 200 year and 1 in 1,000 year with allowances for climate change up to key epoch for the FRA, i.e. construction at 2030 and end of theoretical maximum site lifetime at 2190.

12.7.12 Results of the modelling show some increase in maximum flood levels within the Minsmere Levels (up to 190mm) and reduction in flood levels at Sizewell Belts. This is caused by flooding mechanism where breach water ingress north of the platform and the SSSI crossing is constricted by the raised ground and therefore propagates less toward the Sizewell Belts but more towards the Minsmere levels. There is no change in the velocity and the hazard remains as ‘very low hazard’.

12.7.13 With regard to off-site receptors, the results show maximum increase in flood level of 46mm for one property in Eastbridge (postcode IP16 4SG) for the 1 in 1,000-year event at 2030 epoch. There is a change of 0.05m/s in the velocity and the hazard remains as 'danger to all'.

12.7.14 There is no change in overall number of properties at risk of breach flooding as a result of the proposed Sizewell C development.

c) Fluvial flood risk

12.7.15 Fluvial flood risk in the area is dominated by long duration rainfall in the catchment, which is stored in the extensive low-lying marshlands of the Sizewell Belts and Minsmere Levels and influenced by the discharge capacity of Minsmere Sluice.

12.7.16 Due to catchment characteristic and low-lying areas within Minsmere Levels and Sizewell Belts, there are number of receptors at fluvial flood risk, including residential properties and environmentally sensitive areas. To quantify the flood risk, a 1D-2D hydraulic model was developed and used to simulate flood levels pre and post development for a number of return period events and climate change scenarios.

12.7.17 Construction of the development requires raising of the ground that is partly located with the floodplain. Also, diversion of the Sizewell Drain would be required to re-align the watercourse around the main platform and connect to the Leiston Drain before reaching the SSSI crossing comprising a road on embankment over a culvert.

12.7.18 Results of the modelling show that, despite a slight reduction in available flood storage, the overall impact of the development on fluvial flood risk is very low, with maximum change in flood levels of 15mm up to a 1 in 1,000-year event with 80% climate change allowance on increase in fluvial flows. This suggests that the proposed design of the SSSI crossing is sufficient for conveyance of extreme fluvial flows.

12.7.19 Change in flood risk to residential properties is very low, with no increase of total number of residential properties affected (total of 5 for the 100-year with 35%CC and 9 for the 1,000-year with 65%CC) and only one property with an increase in flood hazard rating from the 'Danger for some' to 'Danger for most' hazard rating class.

12.7.20 There are 5 more non-residential properties identified at flood risk in the 'with scheme' scenario, however the increase in flood level is less than 3mm for up to 1,000-year event with 35% climate change allowance and only 8mm for the two most extreme events and therefore change to flood risk to those properties is considered very low.

12.7.21 Overall change in flood velocity and hazard within the Minsmere catchment is minimal and the change in flood extent in negligible.

12.7.22 Slight increase in flood levels corresponds to the time of peak flow only and overall does not increase duration of flooding. Since the change in fluvial flood risk from the proposed Sizewell C development is low, in accordance to the latest Environment Agency guidance, there is no requirement for flood storage compensation to offset loss of floodplain within the main platform area.

d) Surface water flood risk

12.7.23 Records of surface water flooding incidents in the vicinity of the site are limited to the Leiston urban area. The majority of the area within the site boundary is at ‘low’ surface water flood risk with localised areas of ‘medium’ to ‘high’ risk around the local drainage channels within fen meadows.

12.7.24 The increase in impermeable area following construction of the main platform would result in a surface water flood risk on the platform. The discharging of the surface water to the sea would reduce the surface water flood risk to the surrounding onshore areas.

12.7.25 The discharge from the SSSI crossing to the temporary construction area would result in some of that surface water being locally drained off-site to discharge to ground. The scale of the transfer from surface water to ground discharge is minimal. Therefore, there is likely to be a negligible change in the associated level of surface water flood risk from the SSSI crossing.

12.7.26 Within the temporary construction area, the surface water run-off remains mostly on-site. However, some minor flows are discharged off-site at a controlled greenfield run-off rate. Therefore, there is no change the off-site surface water flood risk up to the 1 in 100-year plus climate change event.

12.7.27 The off-site sports facilities and LEEIE temporary works activities would increase the surface water run-off. In an exceedance event, there is the possibility of surface water flooding extending beyond the off-site sports facilities site boundaries and interacting with the sewer flooding. The surface water run-off from LEEIE would be discharged off-site to a watercourse at a controlled rate.

e) Groundwater flood risk

12.7.28 The groundwater levels in the main aquifer in the area are typically in the range of 0m AOD to 1m AOD with a small tidal variation close to the coast. The groundwater flooding is most likely to occur in low-lying ground close to the coast however no groundwater flooding or ponding has been observed across the majority of the development site, with exception of the low-lying Sizewell Marshes, including in the area adjacent to the SSSI, where ponding is part of the natural seasonal changes in the ecosystem.

12.7.29 The dewatering activities during construction would result in a reduction of groundwater flooding within Sizewell Marshes SSSI by approximately 0.1m. Overall, there is strong hydraulic connectivity between Leiston Drain and shallow groundwater, and therefore there is likely to be a negligible change in the associated level of ground water flood risk as a result of the development.

f) Reservoir flood risk

12.7.30 There is limited risk of flooding from reservoir failure in the area, with only two reservoirs, namely the Sizewell Walks reservoir and the Heveningham Hall reservoir, which have ‘maximum flood extents’ within or in the vicinity of the development site.

12.7.31 The proposed main development platform, SSSI crossing, and LEEIE do not alter any influencing features or factors that would change flood risk from reservoirs. Therefore, there is no change in the off-site reservoir flood risk for these areas.

12.7.32 The proposed temporary water resource storage area on the northern boundary of the temporary construction area introduces a flood risk to the downstream area. While it is in the Environment Agency’s Flood Zone 3 map, detailed fluvial, tidal breach and coastal overtopping modelling has shown that it is not at risk during a 1 in 100-year fluvial event or 1 in 200-year tidal/coastal overtopping event. Therefore, it does not increase flood risk downstream, except if a breach of the associated raised defences were to occur.

12.7.33 Based on the local topography and the volume of water held by the temporary water resource storage area it is considered that one property downstream in the Minsmere Levels within the RSPB reserve could be at a residual risk of flooding from a breach of the raised defences associated with the temporary water resource storage area. This risk will be explored further as part of detailed design and appropriate management measures put in place as part of the site’s wider safety procedures. .

g) Sewer flood risk

12.7.34 The site is largely greenfield in nature with a number of existing roads and areas of the existing Sizewell power station complex in the site boundary. The main platform area is located on a mainly undeveloped area of land with no foul sewers. However, the south-western corner has two auxiliary buildings that are served by foul and surface water sewers with a pumping station. These facilities are being relocated as part of the Sizewell B Relocated Facilities proposals.

12.7.35 The main platform sewers and construction phase sewers crossing the causeway do not interact with any off-site external sewer networks in the area and therefore are not considered to increase the sewer flood risk to any off-site receptors. This also applies to the foul water sewer arrangements for the temporary construction area and LEEIE.

The off-site sports facilities would increase the surface water run-off in the area where surface water flooding is interlinked with sewer flooding in Leiston. The proposed Outline Drainage Strategy would prevent any increase in off-site surface water / sewer flood risk. In an exceedance event there is the possibility of surface water flooding extending beyond the site boundaries and interacting with the sewer network in Leiston.

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