The Sizewell C Project

6.14 Environmental Statement Addendum
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Chapter 2 Main Development Site
Appendix 2.15.A Coastal Geomorphology and Hydrodynamics

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APPENDIX 2.15.A COASTAL PROCESSES MONITORING AND MITIGATION PLAN

Sizewell C Coastal Processes Monitoring and Mitigation Plan (CPMMP)

(Ver 1.1)

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Executive summary

This report is a draft Coastal Processes Monitoring and Mitigation Plan (CPMMP) for:

- detecting and reporting impacts of Sizewell C's marine components on coastal geomorphology receptors, both inside and outside of designated conservation sites, and
- monitoring and, where necessary implementing, future mitigation to maintain the longshore shingle transport corridor, thereby minimising or avoiding impacts of an exposed hard coastal defence feature (HCDF).

This first version of the CPMMP is being circulated with the statutory members of the coastal geomorphology subgroup of the Sizewell Marine Technical Forum (MTF) to consult on the initial proposals.

This draft monitoring plan pertains to the monitoring and mitigation of any potential significant effects on coastal geomorphic features (receptors). However, monitoring is also proposed where it is standard procedure (i.e., scour), where there is uncertainty in predicted impacts, and where uncertainty in impact extent could overlap with a statutory designated site. The *annual vegetation of drift lines* habitat (Annex I, habitat type 1210 of the EU Habitats Directive (CD92/43/EEC)) would also be monitored under this plan because it is dependent on coastal geomorphology (i.e., supra-tidal shingle) and is easily monitored using similar measurement techniques.

The SZC components that are considered to require coastal geomorphology monitoring, along with the proposed method and rationale are summarised in Table i.

The suite of monitoring methods which would be used to track changes in coastal geomorphic receptors and annual vegetation, including impacts arising from SZC pressures and activities, is provided in Section 2. The methods combine the use of continuous remote sensing techniques for early warning of any impacts with targeted, high-accuracy, field surveys.

Sections 3 – 5 contain the rationale and monitoring frequency for the SZC components that would be built in the marine environment as part of SZC construction. Specifically, the offshore cooling water infrastructure, nearshore outfalls, and the beach landing facility.

Section 6 pertains to monitoring and mitigation to maintain the shingle transport corridor along the SZC frontage. The monitoring plan in this section differs from the previous sections because it:

- employs *background monitoring* as a watching brief on the slow erosion of the SCDF;
- checks the beach volumes against a threshold trigger;
- initiates mitigation activity to maintain a continuous shingle beach along the SZC frontage, if triggered; and
- undertakes performance assessment on all mitigation activities.

Section 7 is the monitoring plan for the annual vegetation of drift lines habitat (the formations of annuals or representatives of annuals and perennials, occupying accumulations of drift material and gravel rich in nitrogenous organic matter). This section is under development as the proposed monitoring methods are presently being assessed.

Section 8 describes the schedule and content expected for monitoring and mitigation reporting.

Section 9 outlines the expectations of the reporting associated with cessation of mitigation for maintenance of the shingle transport corridor, which is scheduled to take place within the final ten years of decommissioning.

Table i: Summary of the components to be monitored, the rationale (why) and the proposed method.

Report section	Component set	Activities / pressures stimulating monitoring	Rationale	Feature	Method(s)[1]	Frequency	Spatial extent
3	Offshore cooling water infrastructure	Presence of the cooling water structures	Standard procedure: scour monitoring	Local seabed	Bathymetric survey	Pre and post installation	100 x 100 metres (m)
4	Nearshore outfalls	Presence of nearshore outfalls	Precautionary monitoring due to uncertainty around interaction with structures	Shoreline (beach topography)	Terrestrial remote sensing Topographic survey *Background monitoring*	Continuous sampling Pre and post installation See caption	1800 m
				Longshore bars	Terrestrial remote sensing Bathymetric survey *Background monitoring*	Continuous sampling Pre and post installation See caption	1800 m alongshore; seaward to -7 m ODN (approximately 300 m)
			Standard procedure: scour monitoring	Local seabed	Bathymetric survey	Pre and post installation	50 x 50 m sub-area of bathymetry survey above
5	Beach landing facilities	Navigational dredging (reprofiling), vessel traffic (propeller wash), and the presence of piles	Precautionary monitoring due to SPA / SAC proximity	Shoreline (beach topography)	Terrestrial remote sensing Topographic survey	Continuous sampling Pre and post reprofiling	500 m either side of the BLFs
				Longshore bars	Terrestrial remote sensing Bathymetric survey	Continuous sampling Pre and post reprofiling	500 m either side of the BLFs and seaward to -7 m ODN (approximately 300 m)
			Standard procedure: scour monitoring	Local seabed (including subaerial beach)	Topographic and bathymetric surveys	Pre and post installation	50 x 50 m per pile
6	SCDF and HCDF (beach management)	Erosion of the SCDF, beach management activities as determined from monitoring data	Maintain a continuous shingle beach to avoid or minimise the impacts of an exposed HCDF (blockage potential) to longshore shingle transport and downdrift erosion	Shoreline (beach topography)	*Background monitoring:* Terrestrial remote sensing Topographic survey	Continuous sampling Twice yearly	3000 m centred on Sizewell C Thorpeness to Minsmere Outfall
				Longshore bars	*Background monitoring:* Terrestrial remote sensing Bathymetric survey	Continuous sampling Once per five years	3000 m centred on Sizewell C Thorpeness to Minsmere Outfall

[1] Survey techniques are detailed in Section 2. Terrestrial remote sensing refers to area-based, continuously sampling, automated methods of detecting change in features of interest, such as detection of barlines from X-band radar – see Section 2.1 for method details. Topographic surveys provide beach elevation and visual data (substrate classification). See the relevant report section for details on what is being monitoring, the frequency and spatial extent. Background monitoring identified in subsequent sections consists of terrestrial remote sensing, two aerial topographic surveys per year, one bathymetric survey every five years.

1 Context

1.1 Introduction

This report is a draft monitoring plan for:

- detecting and reporting impacts of Sizewell C's marine components on coastal geomorphology receptors, both inside and outside of designated conservation sites, and
- monitoring and, where necessary implementing, future mitigation to maintain the longshore shingle transport corridor, thereby minimising or avoiding impacts of an exposed hard coastal defence feature (HCDF).

This first version of the draft monitoring plan was circulated with the statutory members of the coastal geomorphology subgroup of the Sizewell Marine Technical Forum (MTF) specifically to consult on initial proposals. Written feedback on this version was discussed at a follow up MTF meeting and a written response was received. Where appropriate, MTF feedback will be used to formulate the final monitoring plan. If SZC Co is granted a Development Consent Order (DCO) and a Marine Licence deemed within the DCO approval (DML), it is expected that most, or all, aspects of the monitoring plan would be requirements of the DCO and Conditions on the DML.

MTF consultation on this draft monitoring plan has, so far, been as follows:

- March 26 and 27 2019: Presentation of the outline methods. The same outline methods were proposed in Chapter 20, Volume 2 of the Sizewell C Environmental Statement [APP-311] to [APP-313] (SZC Co. (2020), hereafter referred to as the "ES").
- April 2020: Version 1 of Coastal Processes Monitoring and Mitigation Plan (this report).
- September 23 2020 Written feedback on Version 1 discussed at an MTF (via MS Teams) Where appropriate, MTF feedback will be used to formulate Version 2 of the monitoring plan.

  This Version 1.1 minor update to reflect ES Addendum only

1.1.1 Sizewell Marine Technical Forum

The purpose of the MTF is to facilitate open and transparent dialogue between SZC Co. and the statutory environmental bodies (and their advisors) relating to marine monitoring of the SZC Project. This dialogue will cover the design and delivery of SZC, DCO requirements and/ or ML Conditions and regulatory concerns, and environmental information or outputs such that:

- Operational and environmental monitoring by SZC Co. is informed by feedback from the MTF and can be shaped throughout the construction and operational phases of SZC, and monitoring plans can be modified in the light of knowledge gained or technical issues arising; and
- Relevant information is shared between SZC Co., statutory environmental bodies and the wider community.

The MTF will help facilitate good environmental regulation of the Sizewell C Project by providing all parties with a high level of confidence that the environment is being properly protected in accordance with the DCO and DML. All monitoring plans, reports and proposed amendments to plans (due to monitoring results) will be available to the MTF for discussion and comment (see Section 8 for details). The discharging authority for the final version of this plan, the related requirements under the DCO and DML, and all reporting will be the Marine Management Organisation (MMO). If the MTF is disbanded during the operational life of the station, subsequent reporting will be to the discharging authority and its advisors.

1.1.2 Feedback

It is understood that this draft monitoring report may be shared more widely by some statutory regulators with non-statutory stakeholders and community groups. Their feedback, summarised and agreed by the relevant statutory regulator, is welcome and will be incorporated into the regulatory framework for impact monitoring where suitable and with a scientific rationale.

Where statutory regulators are incorporating feedback from other parties, they should either:

- Assimilate the feedback that they agree with into their own response, acknowledging the parties that have contributed (preferred).
- Vet the feedback and only supply content with which they agree.
- Supply all feedback but explicitly state if they agree or disagree with the comments.

The feedback supplied must be relevant to this plan and the coastal geomorphology receptors – any other comments that are not part of this work cannot be considered and should not be provided. Note that feedback on these initial proposals can only be accepted from the statutory regulators themselves. In order to ensure that all comments and responses are efficiently captured, it is requested that comments are only provided via the SZC Co. supplied Excel tracker form.

Throughout this draft monitoring report, unless otherwise stated, the terms baseline (pre-construction), construction, operation and decommissioning refer to the phases of the proposed development of the SZC Project. Where appropriate, a reference to the DCO also implies the DML.

1.2 Regulatory drivers

Although the MTF have received Chapter 20, Volume 2 of the ES (including Appendix 20A) [APP-311] to [APP-313], the final DCO monitoring and mitigation requirements will not be known until the DCO process has completed. As a result, **this version** (1.1) of the *coastal processes monitoring and mitigation plan* is based upon:

- Outline monitoring proposals presented and supplied (slides) to statutory regulators and the RSPB at the March 2019 meeting of MTF.
- The Coastal Geomorphology and Hydrodynamics chapter of the ES [APP-311], which sets out SZC Co.'s assessment for monitoring and mitigation.
- Changes in designs presented in the ES Addendum.

The final version of the plan will incorporate the actual requirements of the DCO, once granted.

The Sizewell C main development site is situated in an ecologically diverse area and, as a result, is subject to a range of nature conservation designations. Although no likely significant effects relevant to coastal geomorphology were predicted, precautionary monitoring is proposed due to the proximity of some activities (including mitigation) to the following statutory designated sites (see Chapter 20, Volume 2 of the ES, Figure 20.1 [APP-313]):

- Minsmere to Walberswick Heaths and Marshes SAC,
- Minsmere to Walberswick SPA,
- Minsmere to Walberswick Heaths and Marshes SSSI, and
- Leiston to Aldeburgh SSSI.

As a geomorphic feature, supra-tidal shingle is important because it can support the *annual vegetation of drift lines* habitat (Habitats Directive 92/43/EEC Annex I, habitat type 1210; hereafter referred to as *annual vegetation*) and has potential for nesting little tern. The non-statutory Suffolk Shingle Beaches County Wildlife Site features a wide (relative to the surrounding coast) supra-tidal shingle adjacent to Sizewell B. Supra-tidal shingle was also previously recorded on the Minsmere to Walberswick Heaths and Marshes SAC frontage but was destroyed[1] between 2010 and 2011 by natural coastal erosion.

1.3 Sizewell C Project marine components

The Sizewell C Project's marine components are grouped into four sets, based on component type and location:

- Offshore cooling water infrastructure – Four cooling water intakes and two outfall heads;
- Nearshore Outfalls – Fish Recovery and Return (FRR) outfall heads (2) and a Combined Drainage Outfall (CDO);
- Beach Landing Facilities (BLFs); and
- Soft and Hard Coastal Defence Features (SCDF, HCDF).

The location of the marine components is shown in Figure 1. Each of these components is associated with different activities and impacts during the building and usage phases[2]. A summary of each component set and their associated build and usage activities is provided in Sections 3 – 5. Those sections also provide the rationale for any proposed monitoring and its specification (what, how and how often).

1.4 Outline

This monitoring plan pertains to the monitoring and mitigation of any associated Sizewell C Project significant effects on coastal geomorphic features (receptors). However, monitoring is also proposed where it is standard procedure (i.e., scour), where there is uncertainty in predicted impacts and/or where uncertainty in impact extent could overlap with a statutory designated site[3]. The *annual vegetation* of drift lines habitat would also be monitored under this plan because it is dependent on coastal geomorphology (specifically supra-tidal shingle) and is easily monitored using similar measurement techniques (see Section 2.2.3).

The Sizewell C Project components that are considered to require coastal geomorphology monitoring, along with the proposed method and rationale, are summarised in Table 1, and detailed in the following sections.

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[1] As recorded by Natural England condition surveys.
[2] The terms build and use are used to distinguish activities during the build and use phase of individual components. These terms are used to avoid confusion with the terms construction and operation, which are used in the SZC Environmental Statement to describe the construction and operation phases of the power station.
[3] Where monitoring is proposed in response to an uncertainty of predicted impact or impact extent, this monitoring would cease once any such uncertainties are resolved.

The suite of methods used to track changes in coastal geomorphic receptors, including impacts arising from SZC pressures and activities, is provided in Section 2. The methods combine the use of continuous remote sensing techniques for early warning of any impacts with targeted, high-accuracy, field surveys.

Sections 3 – 5 contain the rationale and monitoring frequency for the Sizewell C Project components that would be built in the marine environment as part of the Sizewell C Project's construction. Specifically, the offshore cooling water infrastructure, nearshore outfalls, and the BLF.

Section 6 pertains to monitoring and mitigation to maintain the shingle transport corridor along the Sizewell C Project frontage. The monitoring plan in this section differs from the previous sections because it:

- employs *background monitoring* as a watching brief on the slow erosion of the SCDF;
- checks the beach volumes against a threshold trigger;
- initiates mitigation activity to maintain a continuous shingle beach along the Sizewell C power station frontage if triggered; and
- undertakes performance assessment on any and all mitigation activities.

Section 7 is the monitoring plan for *annual vegetation* – the formations of annuals or representatives of annuals and perennials, occupying accumulations of drift material and gravel rich in nitrogenous organic matter. That section is under development as the proposed methods are presently being assessed.

Section 8 describes the schedule and content expected for reporting of monitoring and mitigation activity.

Section 9 outlines the expectations of the reporting associated with cessation of mitigation for maintenance of the shingle transport corridor.

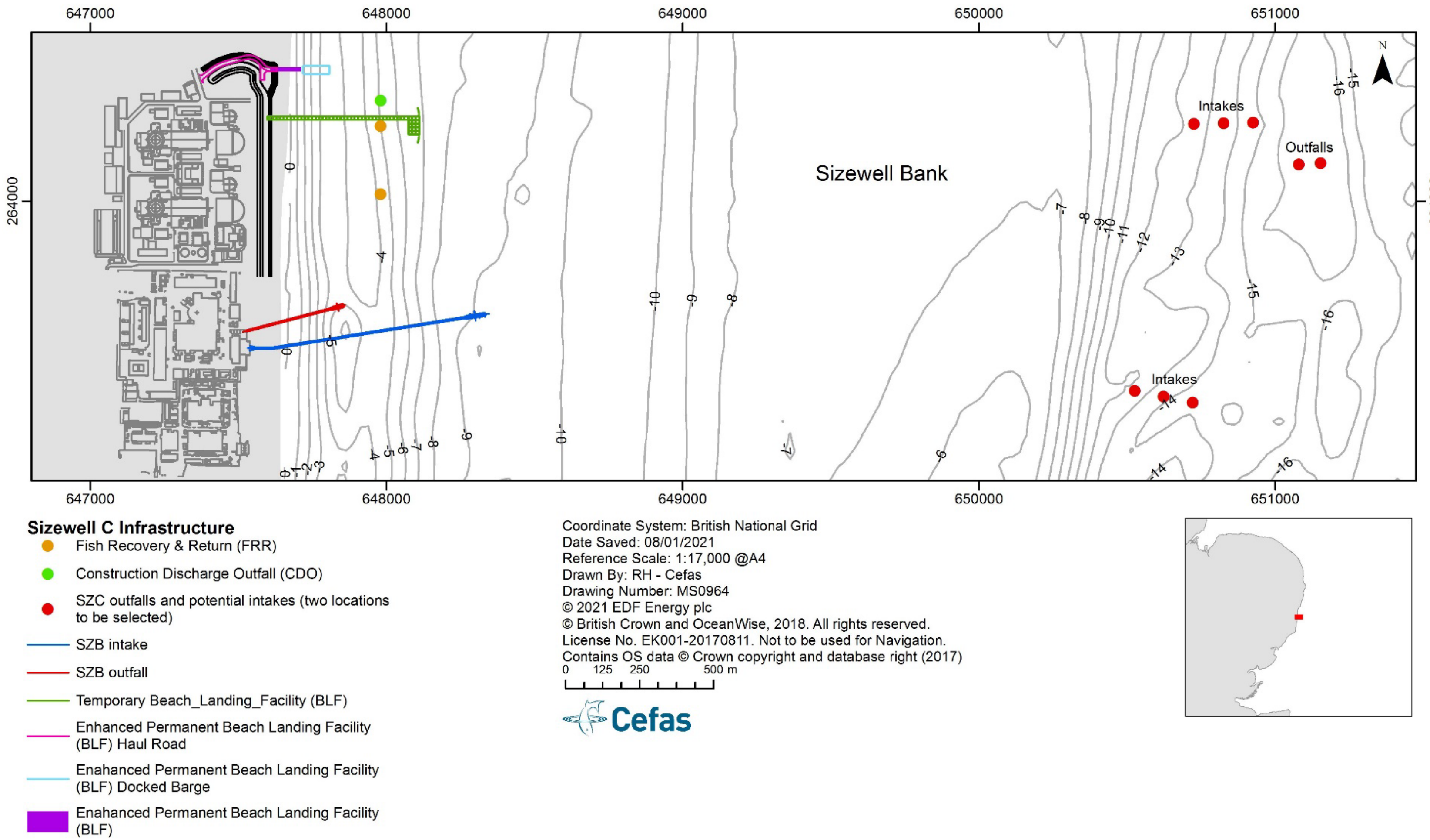

Figure 1: Marine components of SZC and the intake and outfall locations for Sizewell B. The dark black lines east and north of SZC mark the HCDF.

Table 1: Summary of the component to be monitored, the rationale and the proposed method.

Report section	Component set	Activities / pressures stimulating monitoring	Rationale	Feature	Method(s) [1]	Frequency	Spatial extent
3	Offshore cooling water infrastructure	Presence of the cooling water structures	Standard procedure: scour monitoring	Local seabed	Bathymetric survey	Pre and post installation	100 x 100 m
4	Nearshore outfalls	Presence of nearshore outfalls	Precautionary monitoring due to uncertainty around interaction with structures	Shoreline (beach topography)	Terrestrial remote sensing Topographic survey *Background monitoring*	Continuous sampling Pre and post installation See caption	1800 m
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5	Beach landing facilities	Navigational dredging (reprofiling), vessel traffic (propeller wash), and the presence of piles	Precautionary monitoring due to SPA / SAC proximity	Shoreline (beach topography)	Terrestrial remote sensing Topographic survey	Continuous sampling Pre and post reprofiling	500 m either side of the BLFs
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6	SCDF and HCDF (beach management)	Erosion of the SCDF, beach management activities as determined from monitoring data	Maintain a continuous shingle beach to avoid or minimise the impacts of an exposed HCDF (blockage potential) to longshore shingle transport and downdrift erosion	Shoreline (beach topography)	*Background monitoring:* Terrestrial remote sensing Topographic survey	 Continuous sampling Twice yearly	 3000 m centred on Sizewell C Thorpeness to Minsmere Outfall
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[1] Survey techniques are detailed in Section 2. Terrestrial remote sensing refers to area-based, continuously sampling, automated methods of detecting change in features of interest, such as detection of barlines from X-band radar – see Section 2.1 for method details. Topographic surveys provide beach elevation and visual data (substrate classification). See the relevant report section for details on what is being monitoring, the frequency and spatial extent. Background monitoring identified in subsequent sections consists of terrestrial remote sensing, two aerial topographic surveys per year, one bathymetric survey every five years.

2 Monitoring techniques and baseline

This section details the intended monitoring techniques and the specific parameters or features to be monitored under this monitoring plan. Consultation on this plan with the MTF and subsequent discharge of the related DML condition will define which techniques and parameters are formally accepted and approved as elements of the final plan. The details of techniques have been separated from the proposed monitoring plans for each SZC marine component set out in sections 3 – 6 in order to avoid repetition as the techniques proposed could be used to detect impacts from multiple components and activities.

The following monitoring techniques have been selected for their ability to detect and quantify natural change and impacts to geomorphic receptors. In many cases, it is proposed that continuous monitoring systems that facilitate early detection are combined with regular-interval or triggered surveys that provide higher quality results needed for impact confirmation.

Techniques are targeted to the elements of the coastal geomorphology receptor:

- Beach and shoreline position,
- Longshore bars,
- Sizewell-Dunwich Bank,

as well as wide areas of supra-tidal shingle supporting the *annual vegetation of drift lines* habitat (Annex 1, habitat 1210).

As shown in Figure 20.1 of the ES (**Volume 2, Chapter 20**) [APP-313], the coralline crag outcrops that anchor Thorpeness and Sizewell Bank have no pathway to impact from any of the Sizewell C activities, and so will not be monitored. However, a *Sabellaria* Monitoring Plan that will examine the outcropping crag near the southern intakes is a proposed condition on the DML.

The description of each technique that follows is also summarised in Table 2 and Figure 6 (at the end of this section) in terms of the features, survey frequency, and SZC marine components. *Background monitoring* identified in subsequent sections consists of terrestrial remote sensing, two aerial topographic surveys per year, one bathymetric survey every five years (described respectively in Section 2.1, 2.2 and 2.3).

2.1 Terrestrial remote sensing

Terrestrial remote sensing uses imaging techniques, such as X-band radar (Figure 2), to map coastal areas. These techniques have five important advantages as a method for coastal monitoring:

- Area. Moderately large areas (several hundred metres or more) can be consistently monitored.
- Speed. The monitored area is rapidly scanned, providing a snapshot of the whole area that cannot be achieved with field survey methods.
- Frequency. Raw data can be gathered frequently (e.g., hourly), providing an early warning for potential impacts compared to, for example, monthly or quarterly surveys.
- Duration. Background monitoring can be conducted for long durations (years to decades) relatively easily, thereby facilitating a *watching brief* capable of detecting future events of interest, such as natural cycles of erosion and recovery (relevant to mitigation proposed in Section 6) and impacts that may arise between scheduled surveys.

- Cost. Automated monitoring allows data to be collected without the costly deployment of personnel and equipment. This gives more confidence to the field survey plans because measurements are made between the surveys and it allows the survey frequency to reduce with confidence once the specific activity or pressure has past or been sufficiently quantified.

As a result, terrestrial remote sensing is proposed to be carried out as part of a *background monitoring* approach to coastal monitoring throughout the Sizewell C Project's construction and operation phases, alongside scheduled topographic and bathymetric surveys (Sections 2.2 and 2.3). It's temporally continuous nature also makes it suitable as an early warning system, which is utilized in Section 6 for early detection of conditions that could require mitigation.

Terrestrial remote sensing methods have been used at Sizewell to monitor the position of the shoreline, inner and outer longshore bars (barlines), coralline crag and sub-tidal sandwaves. Shorelines and barlines are the primary parameters that would be measured during the Sizewell C Project's construction and operation phases, using methods such as X-band radar and/or video. The advantages of each of these methods and recommendations for the approach to be required by the final monitoring plan are under review. For example, the X-band radar has the operational advantage of being able to detect shorelines and barlines 24 hours a day. In comparison, although cameras are restricted to daylight detection, they may be able to adequately detect changes in additional features, such as substrate and vegetation.

Baseline data using radar has been captured since 2013. Shorter video trials have also been conducted (see Table 2). These methods are being further examined by SZC Co. with recommendations due by the end of 2020.

2.2 Aerial remote sensing for topography and vegetation

2.2.1 Introduction

Small Remote Piloted Aircraft (RPA; see Figure 3) or drones are now commonly used for monitoring coastal environments (e.g., Turner et al., 2016 and BEEMS Scientific Position Paper SPP086). They have been in use for monitoring rock platform erosion, gravel beach volumes, and coastal ecology since 2013 at Hinkley Point. Traditional ground surveys are time and labour intensive, and in many cases offer very sparse data e.g., time consuming beach profiles compared to flights that can be completed in minutes and offer spatially continuous data that are more adept at confident and early identification of impacts.

Using professional RGB and multi-spectral cameras, image data from RPAs can be used to produce orthophotos and topographic elevation models that were previously only possible from manned aircraft. The RPA also has several advantages over manned aerial survey for individual study sites:

- Resolution. Typical RPA resolutions flown by Cefas are 1 mm, 15 mm and 30 mm, compared to 250 – 500 mm commonly available from manned aircraft.
- Responsiveness. Using dedicated RPA and mobilizing from a base close to Sizewell means that event triggered surveys can be readily conducted to capture conditions before and after storms, for example.
- Cloud cover. RPA fly at or below 400 ft, compared to typical manned flights of 3000 ft. As a result, clouds are less likely to obscure the land surface.
- Cost. The costs of manned overflights are prohibitively high, which is understandable given the capital value and running costs. For large regional surveys, manned aircraft are cost-effective, but for individual sites they are too expensive.

2.2.2 Beach elevation and volumes

The RPA method is optical: hundreds of overlapping photos are merged into a single orthophoto (a photo map) and a digital topographic surface, using the Structure from Motion technique.

Structure from Motion is an analytical method whereby the automatic identification of thousands of matching features in multiple overlapping images is used to estimate the relative position of all cameras and points photographed, before iteratively refining those positions. The refined positions are later aligned to a geographic coordinate system using known ground control points. With careful data processing, the result is an accurate high-resolution digital surface model (DSM) (BEEMS Scientific Position Paper SPP086).

The spatially continuous, high-resolution digital surface allows analysis and interpretation of beach volumes, elevation changes, and volumetric changes using standard GIS techniques.

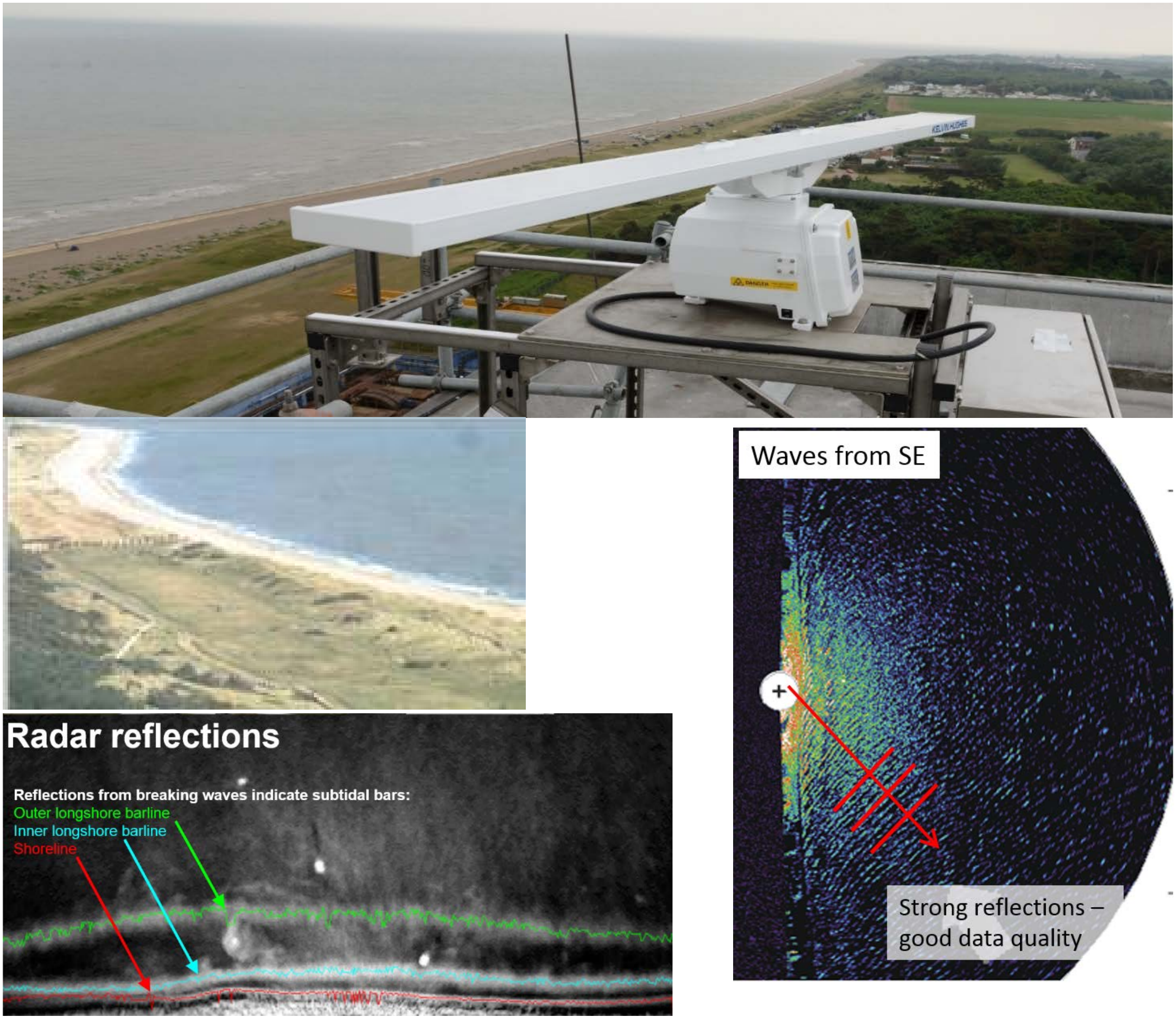

Figure 2: The Sizewell Coastal Processes Radar (SZCPR) and video are two methods of automated terrestrial remote sensing. Images show: the SZCPR (looking south toward Thorpeness from Sizewell A) (top), a video image of the SZC to Minsmere frontage (middle); and radar images showing how wave breaking patterns highlight the shoreline, inner bar and outer bar (bottom-left) and a SE wave field (bottom-right).

Figure 3: Fixed-wing and rotary RPA surveys at Sizewell (top) and Hinkley Point (bottom).

2.2.3 Beach surface substrate and annual vegetation

Alongside the topography, RPA orthophotos allow a deeper, more informed interpretation of the DSM results, and greater confidence in the causes of change. For example, associations can be made between elevation changes and substrate (vegetation or sediment type). Substrate maps have already been produced distinguishing dry and wet sand, shingle, mixed sand and shingle, water and vegetation, from standard RPA imagery. This is likely to be augmented by low-altitude multi-spectral surveys in order to map the *annual vegetation* species growing on supra-tidal shingle, and to distinguish these from dune grasses and other species (see Section 7).

Video methods (Section 2.1) will also be explored for their potential to track substrate and vegetation.

2.3 Bathymetry for bed elevation changes and scour

The primary method for building digital models of the sub-tidal seabed is echo-sounding. In most cases, a swathe (multi-beam) echo sounder would be used to provide accurate sea floor elevation maps at a spatial resolution sufficient to identify small scale scour marks (< 10 m) expected to form around marine structures. Single beam sounders may also be used, for example, for operational reasons along the BLF channel. Small Autonomous Survey Vessels (ASVs) may be used in preference to manned vessels for ease of deployment and improved access to shallow waters. An assessment of ASVs is being conducted in 2020 for consideration in the final version of this monitoring plan.

RPA video and fixed video wave inversion methods for bathymetric estimation, based on the well-known dependence of wave speed (celerity) on depth (e.g., Holman et al., 2013) will also be considered for use in the final version of this monitoring plan. However, these methods are dependent on the presence of waves and yet to be tested at Sizewell.

2.4 Waves and water levels

Waves and water levels are the primary drivers of change for the coastal geomorphology at Sizewell. As such, it is essential to monitor these in order to gather sufficient evidence to explain observations of receptor change and distinguish natural changes from impacts related to the Sizewell C Project.

Waves approaching the Greater Sizewell Bay have been recorded half-hourly since February 2008 (12+ years) by a Datawell Directional Waverider (DWR) Mk **III** buoy just offshore of Sizewell – Dunwich Bank (52°12.62’N 001°41.12’E WGS84; Figure 4). Inshore wave conditions closer to the coast have been recorded by nine aperiodic inshore benthic lander deployments. These data were used to validate numerical hydrodynamic (waves and tides) models and to develop a virtual inshore wavebuoy (VIWB). The VIWB extracts wave data from the X-band radar (BEEMS Technical Report TR514) and inshore waves have now been back calculated to 2013, when the radar was installed, giving a 6+ year long record.

Water levels are being recorded using an OTT Hydrometry Radar Level Sensor (RLS) tide gauge on the Sizewell B cooling water intake structure (648298E, 263643N; Figure 5). The sensor records the tidal elevation at 5 min intervals, calculated as the average of 40 measurements obtained over a 20 s period.

2.5 Baseline monitoring

Coastal processes monitoring has been underway in various forms since 2008 (see **Volume 2, Chapter 20** of the **ES** [APP-311] and **Appendix 20A** [APP-312]). Data were collected for engineering design, nuclear safety and environmental impact assessment. The date fields in Table 2 indicate the data collection periods each technique and measurement parameter. Relevant third-party data that are also used in the baseline include:

- Sizewell Shoreline Management Group (EDF Energy and Magnox) beach surveys.
- Environment Agency beach profiles, aerial photography and lidar.
- Marine Coastguard Agency bathymetric survey.

Figure 4: A Datawell DWR buoy.

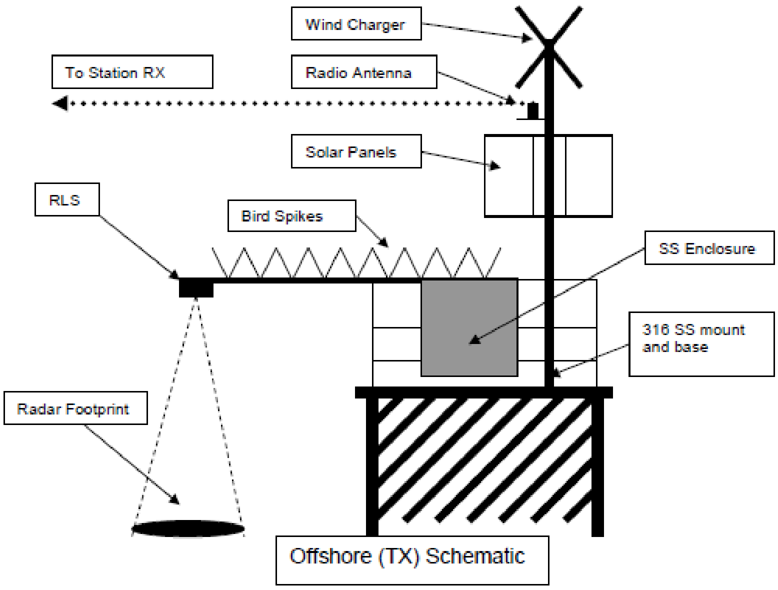

Figure 5: Schematic design and photograph tide gauge mounting and measurement system (OTT, 2016).

Table 2: Summary of method capabilities. Question marks represent measurement parameters that are possible in principle but have not been tested.

Method	Position		Topography			Bathymetry		Hydrodynamics	
	Shoreline	Barline	Elevation	Sediment	Vegetation	Elevation	Scour	Water levels	Waves
X-band radar (October 2013 – present)	✓	✓							✓
Video (April – August 2015; December 2015 – September 2017)	✓	✓		?	?				
RPA (drone) (September 2015 – present)	✓	✓	✓	✓	✓	?	?		
Bathymetric survey[4] (6 BEEMS & MCA surveys 2008 – 2017)						✓	✓		
Tide gauge (July 2016 – present)								✓	
Wavebuoy (February 2008 – present)									✓

[4] Eight historical surveys (1868 – 2007) are also considered in BEEMS Technical Reports TR058 and TR500. Bathymetric surveys may be conducted from manned or autonomous survey vessels.

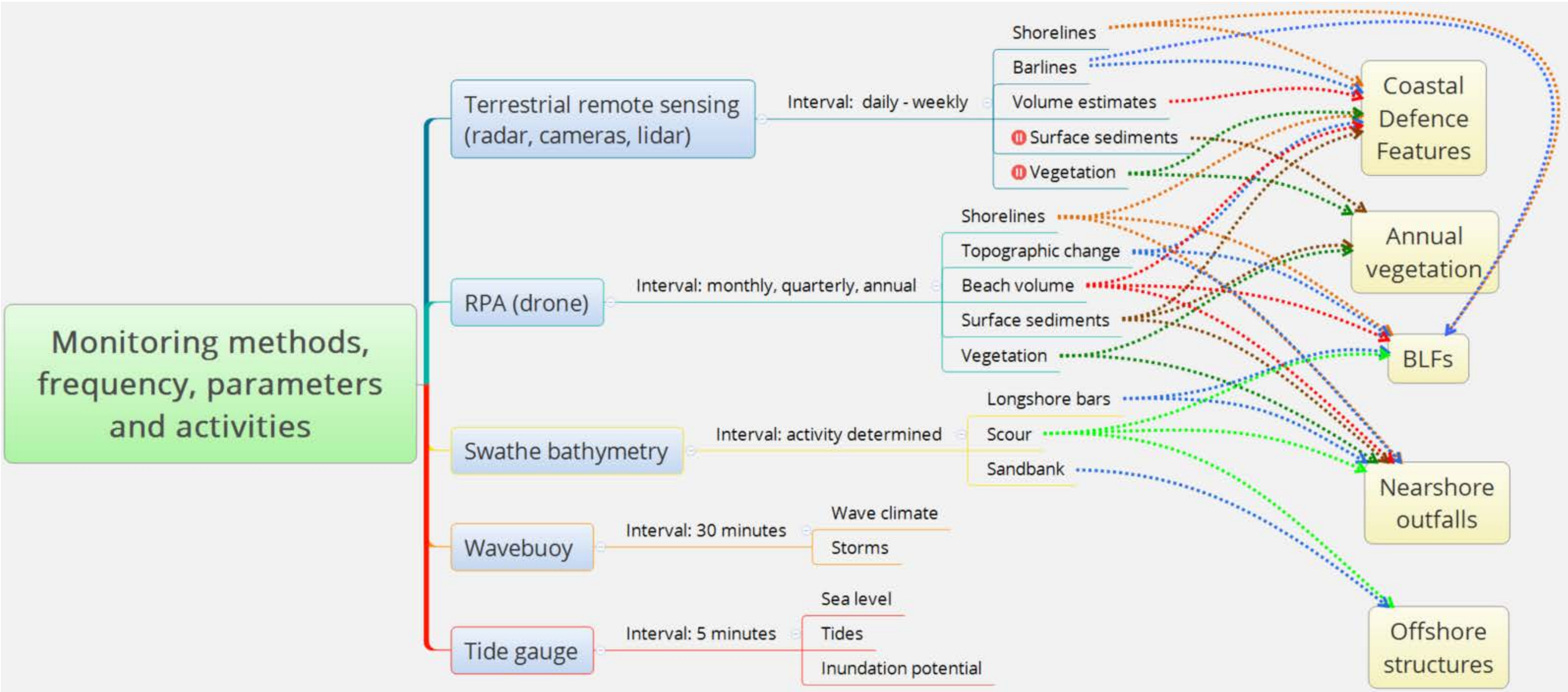

Figure 6: Organogram illustrating the monitoring methods, likely frequency, the parameters or indicators they can track, and the components that could impacts to these parameters. 'Annual vegetation' is also included to illustrate the parameters that would be tracked and how is relates to the monitoring plan.

3 Monitoring: Offshore cooling water infrastructure

3.1 Component description and activities

Two subterranean cooling water intake tunnels and one outfall tunnel, each approximately 3 km long, would be excavated by Tunnel Boring Machines (TBMs) from land. Tunnel construction has no impact on the marine environment or coastal geomorphology because it is subterranean, and its excavated arisings will be transported landward on a conveyor to a muck bay.

Offshore of the Sizewell – Dunwich Bank, two vertical connecting shafts will be driven down to meet each of the three tunnels, giving a total of six shafts that would connect to four intake heads and two outfall heads. The intakes would be 32.5 x 10 metres (m) (length, width) whilst the outfalls would have 16 m x 16 m x 4.9 m (length, width, height) foundation chamber and a 3.2-m-high head. Head structures are expected to protrude 4 m above the bed. It is understood that the outfalls would discharge cooling water at a rate of 66 m^3/s each.

The activities/pressures associated with the offshore structures include preparatory dredging, dredge spoil disposal, drilling, head installation, the use of construction platforms (jack up barges) and the presence of the structures once installed. The Environmental Impact Assessment from the Coastal Geomorphology and Hydrodynamics chapter of the **ES** (see **Volume 2 Chapter 20** [APP-311] of the **ES** and **Appendix 20A** [APP-312]) showed *no significant effects* to coastal geomorphology receptors from the offshore structures.

3.2 Rationale

The building and usage of cooling water intakes and outfalls would not cause any significant effects on coastal geomorphology receptors – the effect level was *negligible, not significant*, for all activities/pressures.

Therefore, the only monitoring proposed for the cooling water intakes and outfalls is for scour, as monitoring around structures to quantify the equilibrium scour is standard procedure in the Southern North Sea. Scour monitoring would also be used to quantify any secondary scour from scour protection (if used), depressions from jackup barge legs and locally deposited drill arisings.

Up to 17-m-long elliptical scour pits are expected to form up and down stream of the structures. Lateral scour would be less than 10 m. Although their size may vary slightly as tidal currents strengthen and weaken over spring-neap cycles, their orientation is expected to remain relatively constant.

3.3 Geographical extent and schedule

High-resolution swath bathymetric survey would be used to survey a 100 x 100 m area centred on each structure. The area proposed is substantially larger than the predicted scour to ensure the full scour extents are captured. Revision of the proposed survey area in the final version of this monitoring plan will be considered if scour protection is used.

A pre-construction survey conducted not more than three months prior to the commencement of works would be followed by post-construction surveys three and six months after works completion. The timing of these surveys would allow scour to develop to an equilibrium state (three months), and confirmation with the follow-up check (six months).

4 Monitoring: Nearshore outfalls

4.1 Component description and activities

Three low-discharge outfalls would be located opposite the Sizewell C power station on the seaward flank of the outer longshore bar. The outfalls would be approximately 3 m x 3 m x 4.5 m (length, width, height) and have a mean discharge of 0.3 m^3/s during commissioning and operation for the FRRs and approximately 0.12 m^3/s for the CDO (during the construction of the Sizewell C Project). The northing of the two FRRs aligns with the forebays of each reactor, thus minimising the required tunnel length and hence the time taken for fish to be returned to the marine environment. The optimal easterly position of the seaward flank of the outer longshore bar was determined by a number of antagonistic factors relevant to fish ecology and minimising impacts to the longshore bars (see **Volume 2 Chapter 20 of the ES: Appendix 20A** [APP-312]).

The tunnels for the nearshore outfalls would be subterranean and have no impact on coastal geomorphology.

The activities/pressures associated with the nearshore outfalls include preparatory dredging, dredge spoil disposal, drilling, the use of construction platforms (jack up barges) and the presence of the structures once installed. The Environmental Impact Assessment from the Coastal Geomorphology and Hydrodynamics chapter of the **ES** (**Volume 2, Chapter 20**) [APP-311] showed *no significant effects* to coastal geomorphology receptors from the nearshore outfalls.

4.2 Rationale

The nearshore outfalls would be placed toward the seaward margin of the nearshore sand transport corridor (i.e., the seaward flank of the outer longshore bar), which is defined by the longshore bars. Although scour marks under tidal flows are expected, they would be intermittent as a result of infilling during wave events. As the scour pits would be small (extending 7.2 m each side of each outfall along the tidal axis (N-S) and to 4.1 m each side E-W) and intermittent, they would not alter outer bar form or block the sand transport corridor. Scour monitoring around structures would be conducted to quantify the equilibrium scour, as is standard procedure in the Southern North Sea.

Despite the EIA effect level of *negligible, not significant* for all activities/pressures, precautionary monitoring is proposed for the nearshore outfalls (with respect to bar and shoreline changes) in addition to scour monitoring around structures (outfalls), which is standard procedure in the Southern North Sea.

The precautionary monitoring is proposed because of analogous changes in the shoreline (accretion) and outer longshore bar (deflection) considered to be caused by the nearby Sizewell B (SZB) outfall. That is, SZB's high outfall discharge (51.5 m^3/s) would inhibit sediment deposition and, therefore, may have caused the inshore migrating outer longshore bar to defect and change shape as it encountered the turbulent waters near the outfall. Subsequent shoreline accretion inshore of the outfall could be due to changes in wave refraction around the altered bar. Although this evidence is inferred, a similar feature was observed opposite the SZA outfall. Both outfalls are close to shore and inshore of the outer longshore bar, compared to SZC's nearshore outfalls which would be seaward of the outer longshore bar.

The proposed monitoring, stimulated by observations at SZB, is highly precautionary because the SZC nearshore outfalls are small, have a substantially lower discharge than those at SZB (> 100 times lower at 0.3 m^3/s), and they would be located seaward of the outer longshore bar crest[5]. These factors mean that the

[5] Meaning that the bar cannot subsequently migrate into these structures as it did at Sizewell B.

nearshore outfalls are unlikely to cause bar deflection and adjacent beach accretion, as appears to be the case at SZB. This monitoring would be conducted until the effect of the nearshore outfalls can be adequately quantified, confirming that the outfalls have no significant impact.

4.3 Geographical extent and schedule

It is expected that the CDO would be installed early in the Sizewell C Project's construction phase, followed by a 3 – 4 year gap before installation of FRR1 and a further 1 – 4 years before FRR2 is installed. All three outfalls would be present for 5 – 6 years before the Sizewell C Project moves into its operational phase. The scheduling below reflects the different timing for these outfalls, but would be able to accommodate changes in the Sizewell C Project's construction schedule.

The extent of changes to the outer longshore bar and shoreline near the SZB outfall are used as a conservative indicator of the extent to be monitored. The outer bar becomes deflected 500 m north and 1000 m south of the SZB outfall, whilst approximately 200 m of shoreline opposite the outfall accreted between 2005 and 2011, forming a salient (and creating a relatively wide area of supra-tidal shingle).

Based on these SZB observations, the proposed monitoring extent for the Sizewell C Project is 500 m north of the CDO and 1 km south of FRR1 (approximately 1800 m; see Figure 1); it would also include 50 x 50 m squares within the survey area examined for scour marks around the outfalls.

Terrestrial remote sensing data will be used to track the shoreline and barline response before, during and after outfall construction. Pre-construction surveys (for each outfall), conducted up to three months prior to commencement of the first nearshore outfall, would include:

- a subtidal swathe bathymetry survey of the outer bar[6] and
- an aerial topographic survey of the beach.

Weather permitting, these surveys should be conducted as close as possible to one another. It is likely that there will be a spatial gap – the white ribbon – between the two datasets. Although this will not invalidate the results, the bathymetric survey should endeavour to scan as close to shore as possible at high water (including consideration of spring tides for this purpose) and likewise aerial surveys should be conducted as close as possible to low tide. This will minimise the white ribbon and aid interpretation of the results.

Surveys would then be conducted at three-, six- and twelve-months after completion of each nearshore outfall. The extra survey (compared to the proposed scour monitoring in Section 3) is warranted because of the potential effects on the longshore bar and shoreline receptors. The proposed monitoring would give a year of data, including observations over a winter period, for each outfall. As the outfalls would be built sequentially, it would also allow for any unexpected interactions[7].

Quarterly aerial topographic surveys, and annual bathymetric surveys, would also be used in the first few years following completion of the last outfall. Evidence of the expected *no significant effect* would result in a decrease in the survey frequency, to a *background monitoring* schedule of two aerial topographic surveys per year, one bathymetric survey every five years and the ongoing terrestrial remote sensing. In contrast, it is proposed that evidence of unexpected impacts predicted to cause a significant effect would stimulate

[6] The inner bar will also be surveyed if possible, however its very shallow depth is likely to limit data that can be safely collected there. The -7 m ODN contour (approximately 300 m offshore) would be used as the seaward extent.
[7] Scour footprints are substantially smaller than the spacing between outfalls, so no significant cumulative effects are expected.

additional surveys. The *background monitoring* of the beach and bars would also allow detection of any impacts lagging the installation (as was observed at SZB).

Changes in the schedule would be evidence based and require approval from the MMO.

5 Monitoring: beach landing facilities

5.1 Component description and activities

5.1.1 Enhanced permanent BLF

The enhanced BLF consists of a 101 m long piled jetty that abuts to the haul road on the 5.4 m ODN platform of the HCDF. The HCDF – BLF abutment protrudes further seaward (see Figure 1 and Figure 7) to accommodate the haul road and the turning radius required for Abnormal Indivisible Load (AIL) vehicles. The last 50 m of the BLF jetty would be seaward of MHWS, and mooring dolphins would be positioned at approximately 81 m and 128 m from MHWS.

The enhanced permanent BLF would consist of 28 permanent piles in total, comprising 24 piles (12 seaward of MHWS) with approximately 1m in diameter and four mooring dolphins or fender piles with approximately 2.5m in diameter. The BLF piles would have an 9.2 m cross-shore spacing and 12 m between each pair. The jetty piles would be 1 m ∅ and the fender/dolphin piles 2.5 m ∅.

Construction of the permanent BLF would commence from the beach and progress out to sea using a cantilever method (Cantitravel). This means that heavy plant on the beach would be minimised or not required. Dolphins would be installed from a standard or walking jack-up barge.

The BLF will be used to import AILs and marine freight during the Sizewell C Project’s construction phase, and occasional AILs during the operational phase. During Sizewell C Project’s operational life, AIL maintenance deliveries will be required for 3–4 weeks once every 5-10 years (approximately). During these maintenance phases, the BLF would be in use for less than four weeks (notwithstanding unexpected poor weather).

When the BLF is in use, barges would transit over the nearshore bars to the end of the BLF pier at high tide and would become grounded as the tide falls; offloading is expected to be completed within one tidal cycle. Finally, a plough dredger would be used to dredge the longshore bars for navigational access and a grounding pocket for docked barges.

The activities/pressures associated with building the BLF include the use of a jackup barges, piling and navigational dredging. Activities/pressures associated with use of the BLF include the temporary presence of a grounded barge when the BLF is in use, vessel traffic and the presence of piles. The Environmental Impact Assessment from the Coastal Geomorphology and Hydrodynamics chapter of the ES (see Volume 2, Chapter 20) [APP-311] showed no significant effects to coastal geomorphology receptors from the any aspect of the BLF – most effects were negligible, but vessel traffic and navigational dredging were classified as minor.

5.1.2 Temporary BLF

To reduce the amount of construction material that would otherwise need to be delivered by land, a temporary BLF is proposed predominantly for the delivery of bulk construction materials, such as aggregate. Other types of material may also be imported through the temporary BLF, such as marine tunnel segments for marine works.

The temporary BLF would be in operation for approximately 8 years and would be approximately 165m south of the permanent BLF. It would be approximately 505m in length and 12m in width for the main pier. An enlarged unloading area would form a BLF jetty head with dimensions of up to approximately 62m by 38m. A single berth (for a single vessel) is assumed at its seaward end.

A temporary conveyor would be installed along the length of the temporary BLF deck and would be the primary method of unloading material. The conveyor would be covered and follow the deck to the Hard Coastal Defence Feature (HCDF) where it would continue into the secure construction area.

A self-propelled vessel typically delivering up to approximately 4,500 tonnes of cargo per delivery is assumed, making up to approximately 400 deliveries between April and October (inclusive) and up to approximately 200 additional deliveries for the remainder of the year, for each year of operation.

The temporary BLF would extend seaward of the outer longshore sand bar. As such, there would be no requirements for dredging and vessels could berth alongside with sufficient under keel clearance. The length of the vessel may be up to approximately 120m

Approximately 114 piles would be required to construct the temporary BLF, of which approximately 12 would be located above Mean High Water Springs. They would each be up to approximately 1.2m in diameter, with the exception of two berthing dolphins and two mooring dolphins (each approximately 2.5m in diameter). Six raking piles are assumed at the seaward end of the unloading platform. Cross braces would be required between some of the piles for stability.

Spacing between piles would be no less than 10m on the BLF pier and no less than 12m on the unloading platform, with the exception of where the dolphins, raking piles and pier adjoin the unloading platform.

With the exception of the mooring dolphins, which would be installed using a jack-up barge, the temporary BLF would be constructed without placing construction vehicles into the sea. A crane, cantilever frame and piling equipment (including generators) would be located on the temporary BLF during construction (Cantitravel). The temporary BLF would be constructed sequentially from the shore.

5.2 Rationale

The enhanced permanent BLF would be built and used during the Sizewell C Project’s construction phase, and used and eventually removed during the Sizewell C Project’s operational and decommissioning phases. The temporary BLF would be dismantled at the end of the construction phase. All BLF effects were classified as *not significant*, although some were *minor* and some *negligible*. *Minor* effects were predicted to arise from the reprofiled navigation channel leading to the permanent BLF jetty and propeller wash from tugboats on the longshore bars. Although the effect of the piles was classified as *negligible*, *not significant*, monitoring around structures to quantify the equilibrium scour is standard procedure in the Southern North Sea.

Seabed reprofiling (dredging) would be required in order to gain safe navigational access to the enhanced permanent BLF jetty. A plough dredger would cast sediment to the sides of the access channel rather than being removed, thereby avoiding any interruption to sediment supply. However, the altered seabed elevation would cause changes in bed shear stress (compared to no reprofiling) greater than +/-5% over 400 m of frontage, including a short (100 m) section at the southern limit of the Minsmere-Walberswick SPA and Minsmere to Walberswick Heaths and Marshes SAC frontage. The altered bed shear stress over this area would:

- only be apparent during storms,
- have a low probability of occurrence as storm frequency is lowest during the season when the BLF would be used - April – October (inclusive), and

- shrink as storms progressed due to simultaneous (storm-induced) infilling of the reprofiled channel.

Hence the impact duration and probability would be low, with the extent shrinking rapidly if a storm did occur. Measurable changes in the beach are very unlikely, especially on the far northern and southern extents, including the SPA and SAC.

Propeller wash from tugboats would locally entrain bed sediments due to the shallow water and small draught between the propeller and the bed. Higher than natural quiescent levels of suspended sediment concentration would be expected for a small duration and extent. These would be directed to the south as barge manoeuvring activities would occur during southward flood tidal flows.

As the BLF is close to the Minsmere-Walberswick SPA and Minsmere to Walberswick Heaths and Marshes SAC, precautionary monitoring associated with BLF-use is proposed in order to confirm the predicted *no significant effect* of bed reprofiling and tugboat propeller wash. This aspect of the beach and longshore bar monitoring would be cease once shown that these activities have no significant effect on the designated sites, however *background monitoring* (two aerial topographic surveys per year, one bathymetric survey every five years and the ongoing terrestrial remote sensing) would continue.

No dredging is required for the temporary BLF.

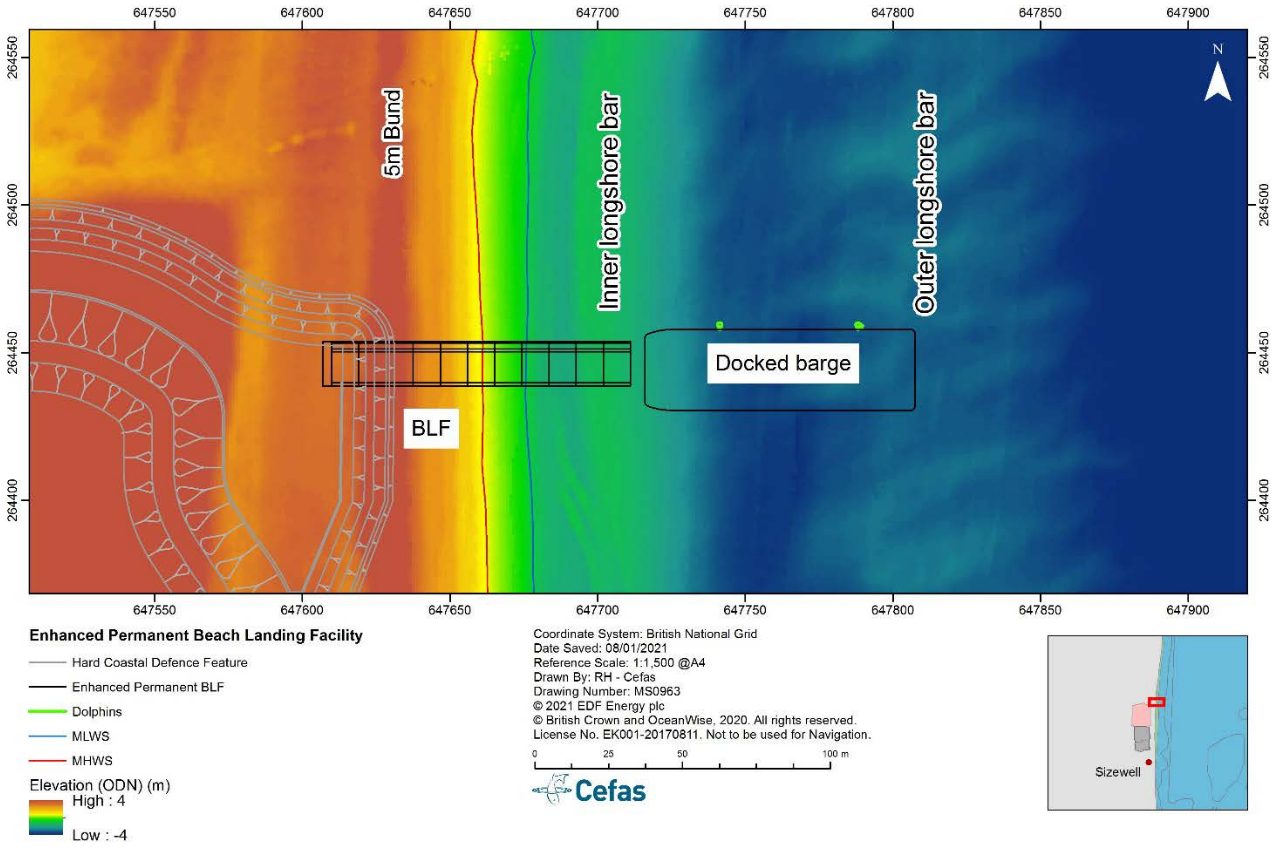

Figure 7: Enhanced Permanent Beach Landing Facility (BLF) shown together with a docked barge

5.3 Geographical extent and schedule

5.3.1 Scour around BLF piles

As the piles of both BLFs are both terrestrial and sub-tidal, RPA topography and swathe bathymetry surveys would be needed to document intertidal and sub-tidal scour. Surveys in both settings would be scheduled not more than three months prior to the commencement of marine BLF jetty works. As scour patterns could be influenced by the presence of grounded barges when the BLF is in use, the assessment to quantify pile scour should only take place when there is a six-month-long scheduled 'BLF not in use' period. During that period, the beach elevations would be assessed at zero, three and six months.

The angle and size/depth of the BLF scour marks is expected to vary according to the dominant antecedent hydrodynamic process – tidal currents or waves. In the transition from one dominant process to another, preceding scour marks will infill whilst new ones, on a different angle, will develop. Horizontal scour extents around jetty piles would be less than 7.1 m for subtidal piles and 4.4 m for terrestrial piles (see **Table 5, Appendix 20A, Volume 2** of the **ES** [APP-312]). A conservative monitoring extent of 50 m around the piles (i.e., 7 – 11 times larger than the largest subtidal and intertidal scour respectively) is proposed for scour quantification.

With sea level rise and shoreline retreat (landward translation of the beach profile), terrestrial piles could become exposed by the receding intertidal beach and intertidal profiles could become subtidal. The *background schedule* of two aerial topographic surveys per year, and one bathymetric survey every five years, would be used to document any changes arising from beach profile translation.

5.3.2 Enhanced permanent BLF in use – reprofiled bed and tugboat propeller wash

The geographical extent to be monitored is 1 km alongshore (500 m either side of the BLF) and to the -7 m ODN contour (approximately 300 m offshore). The alongshore extent has been defined by the area corresponding to +/-5% change in bed shear stress for the BLF with a reprofiled bed, which spans the frontage 200 m either side of the jetty (see **Figure 45, Appendix 20A, Volume 2, Chapter 20** of the **ES** [APP-312]). That is, the monitoring frontage is over twice that predicted.

These extents are conservative because:

- they are larger than the +/-5% change in bed shear stress area,
- the +/-5% area is only evident during storm conditions immediately after reprofiling (storms cause infilling, so the area would shrink during the storm, and
- +/-5% change in bed shear stress for short periods is not considered sufficient to cause a significant change to the bar or shoreline receptors.

The offshore survey extent would be defined by the -7 m ODN contour (hence the exact distance from shore would change), which is substantially seaward of the minor dredge clipping (a few tens of centimetres) of the outer bar for navigational clearance above the -3.5 m ODN contour. The -7 m ODN contour also fully captures the outer longshore bar feature.

Swathe bathymetry would be used for the subtidal area and RPA topography for the subaerial beach. As described in Section 4.3, these surveys should be conducted as close as possible to one another to minimise the white ribbon. ASVs will be considered for inclusion in the final monitoring plan as these may lessen or eliminate the white ribbon.

During the Sizewell C Project's construction phase, surveys would be conducted before and after each dredge event and at least once per month (to track recovery during any periods when the BLF is not in use or long periods between required dredging when it is in use). Where available, the data from any such surveys used to check clearance for safety and barge grounding will be included in monitoring reporting. Once sufficient data has been gathered, revisions to the monitoring schedule will be made. The schedule will be reduced based on any impacts detected and evidence for *no likely significant effect*.

During the Sizewell C Project's operational phase, a pre-dredge survey (less than 3 months before dredging) would be followed by two surveys one and three months after BLF use has ceased. Any additional unplanned dredging would also be accompanied by extra pre- and post-dredge surveys.

Any changes in the monitoring schedule included in the final monitoring plan would need to be evidence based and would require the prior approval of the MMO.

6 Monitoring and future mitigation to maintain the shingle transport corridor

6.1 Rationale and context

BEEMS Technical Report TR403 and the **Volume 2, Chapter 20** of the **ES** [APP-311] identified that, if no further intervention was undertaken, shoreline recession was likely to erode the soft coastal defence feature (SCDF) and expose the hard coastal defence feature (HCDF) within the timeframe of 2053 – 2087 (i.e., within the Sizewell C Project's operational phase). An exposed HCDF, dividing the otherwise continuous shingle beach in two, would partially or fully block the longshore shingle transport corridor. If persistent, shingle starvation and erosion either side of the exposed HCDF would be expected. Consequently, beach management (mitigation) to maintain a shingle beach was proposed in the **ES** (**Chapter 20, Volume 2**) [APP-311].

The rationale for maintaining a continuous shingle beach, is to avoid or minimise the impacts of an exposed HCDF (blockage potential) to longshore shingle transport and downdrift erosion.

The following sections set out:

- 6.1.1: The design and purpose of the SCDF and HCDF.
- 6.2: The beach management framework.
- 6.3: The methods used to determine threshold beach conditions to trigger intervention (mitigation).
- 6.4: The methods used to monitor the beach, including key beach state indicators.
- 6.5: Mitigation options and the broad conditions for their selection.
- 6.6: Mitigation performance assessment.

6.1.1 Component description and activities – SCDF and HCDF

Sizewell C would have a hybrid coastal defence solution that combines hard and soft features. Hybrid systems fulfil the requirements of high levels of protection, adaptability to future challenges related to climate change, sustainability, and pleasing natural aesthetics (Almarshed *et al*., 2019). This intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits is also known as 'Engineering with Nature'. As well as maintaining local aesthetic values, the soft feature is dynamic, can evolve or be replenished and provides an additional source of sediment to the coast.

At Sizewell C the HCDF and SCDF would serve two radically different functions. The HCDF is designed to protect the power station boundary from erosion and the site itself from marine inundation during extreme (high) water levels.

In comparison, the SCDF is a sacrificial sedimentary feature designed to reduce future erosion rates compared to a baseline without the Sizewell C Project, and would episodically supply shingle to the neighbouring coast during erosive storms. Its functions are to extend the life of a natural Sizewell C beach frontage, supply sediment to the neighbouring frontage, and maximise the period requiring no beach management (mitigation) to maintain a continuous shingle beach frontage and longshore shingle transport corridor.

In prolonging the period before any mitigation is needed, a longer evidence base on aspects such as storm erosion and recovery under rising sea levels will be developed, which in turn will lead to more effective mitigation decisions. During this period there may also be advances in our understanding of mixed sand-gravel beaches like Sizewell, and in the models used to predict how they respond in the short and long term, which could be used where appropriate to make further refinements to the final monitoring plan.

6.1.1.1 Hard coastal defence feature (HCDF)

The HCDF would be built from the north, beginning with the development of its 5.2 m ODN platform and haul road, which would connect to the Beach Landing Facility (BLF) jetty (Figure 7). The materials and rock armour to build this first part of the HCDF, and the BLF's haul road, will be supplied from land. Once the BLF has been built and secured, it would be used to bring in the rock armour component of the HCDF, which would be placed along its margins. Storage of unplaced rock armour would be on the SZC Co. estate landward of the 5-m ODN barrier. The HCDF would be built and maintained landward of the current 5-m ODN barrier/dune, and therefore are not in the marine environment as it presently stands. Sheet piling with rock armour would most likely be used around the BLF jetty abutment and the haul road. Coffer dams may be required to place the initial toe of the HCDF, but they would be set further back and are unlikely to be exposed to the sea while the HCDF is built, so long as the present beach width and elevation are maintained.

6.1.1.2 Soft coastal defence feature (SCDF)

The sacrificial SCDF would be made of landscaped beach grade sediments (primarily shingle, to aid longevity) at 5.2 m ODN elevation between the HCDF and the MHWS (a distance of around 35 m) (Figure 7). It would cover any parts of the HCDF below this elevation. Based on the current beach and barrier topography, approximately 120,000 m^3 of sediment would be needed to create the SCDF.

The source of this material would be from a licenced aggregate extraction site or from earth works on the main development site (e.g., the HCDF footings excavation[8]), which would qualify as a form of beneficial re-use. Placement of shingle has been done successfully at sites in the UK such as Dungeness and Horsey Island. At Horsey Island, ABPmer (2016) report that "*benefits can persist over at least two or three decades (including a period which has seen major storm events) and provide a cost-effective flood defence mechanism*".

The sacrificial SCDF would be progressively eroded when elevated water levels were high enough to reach it, and wave run-up fast enough to entrain and drawdown its sediments. If, as expected, the SCDF becomes

[8] Initial investigations suggest that the shingle won from the HCDF footings excavation are of suitable size and quality to provide some, or all, of the source material needed to build the SCDF. This is subject to a further suitability assessment once excavations begin.

largely depleted during the Sizewell C Project's operational phase, mitigation – in the form of maintenance to retain a continuous shingle beach frontage – would be applied in accordance with the final form of this plan (Sections 6.2 – 6.5).

During construction of Sizewell C, the sedimentary material presently in this location will be impacted as required for landscaping, building the SCDF and some aspects of the HCDF or BLF (e.g., the installation of the BLF decking at c. 5.2 m ODN across the 5 m bund and/or SCDF which has the same elevation).

The activities/pressures associated with the use of the SCDF include heavy plant on the beach and introduction of beach-grade sediments to the active beach during storms. **Volume 2, Chapter 20** of the **ES** [APP-311] showed *no significant effects* on coastal geomorphology receptors from the SCDF.

6.2 Beach management framework

The framework for beach management is shown in Figure 8 as a decision tree illustrating the monitoring steps and decisions leading to any implementation of potential mitigation. The framework is informed by the evidence gathered from the *background monitoring* – ongoing terrestrial remote sensing, twice yearly topographic surveys and bathymetric survey once every five years. The steps (see matching numbers in Figure 8) are:

1. The trigger for mitigation (see Section 6.3) would be checked on a monthly basis (using the monitoring described in Section 6.4).

2. If a trigger alert arises from the terrestrial remote sensing data (Section 6.4), a topographic field survey would be required to confirm the trigger. This is because such data provides a more accurate assessment of the beach condition which would be needed for any mitigation specifications. A Trigger Notification Report (as described in Section 8) would be issued if the trigger was confirmed.

3. The evidence of beach condition, including the trigger causes and beach volumes, would be assessed in a Pre-mitigation Assessment Report (as described in Section 8). That report would also make evidence-based recommendations for one of three actions: wait as natural recovery is expected (and less disruptive than mitigation), wait as the low beach volumes are not expected to cause a likely significant effect, or specify the mitigation to take place.

4. If mitigation is proposed and approved by the MMO, it would then be conducted, and its performance monitored. Performance monitoring would be needed in order to assess whether certain aspects of the monitoring set out in the final monitoring plan could be improved.

5. If the mitigation is successful, *background monitoring* would be resumed and a Post-mitigation Assessment Report (as described in Section 8) documenting the activity and results produced. If the mitigation is unsuccessful, the trigger alert would still be active. In this case, the evidence would again be reviewed, in order to understand why the mitigation was not successful and recommendations on its resolution.

All reports would be submitted to the MMO for approval.

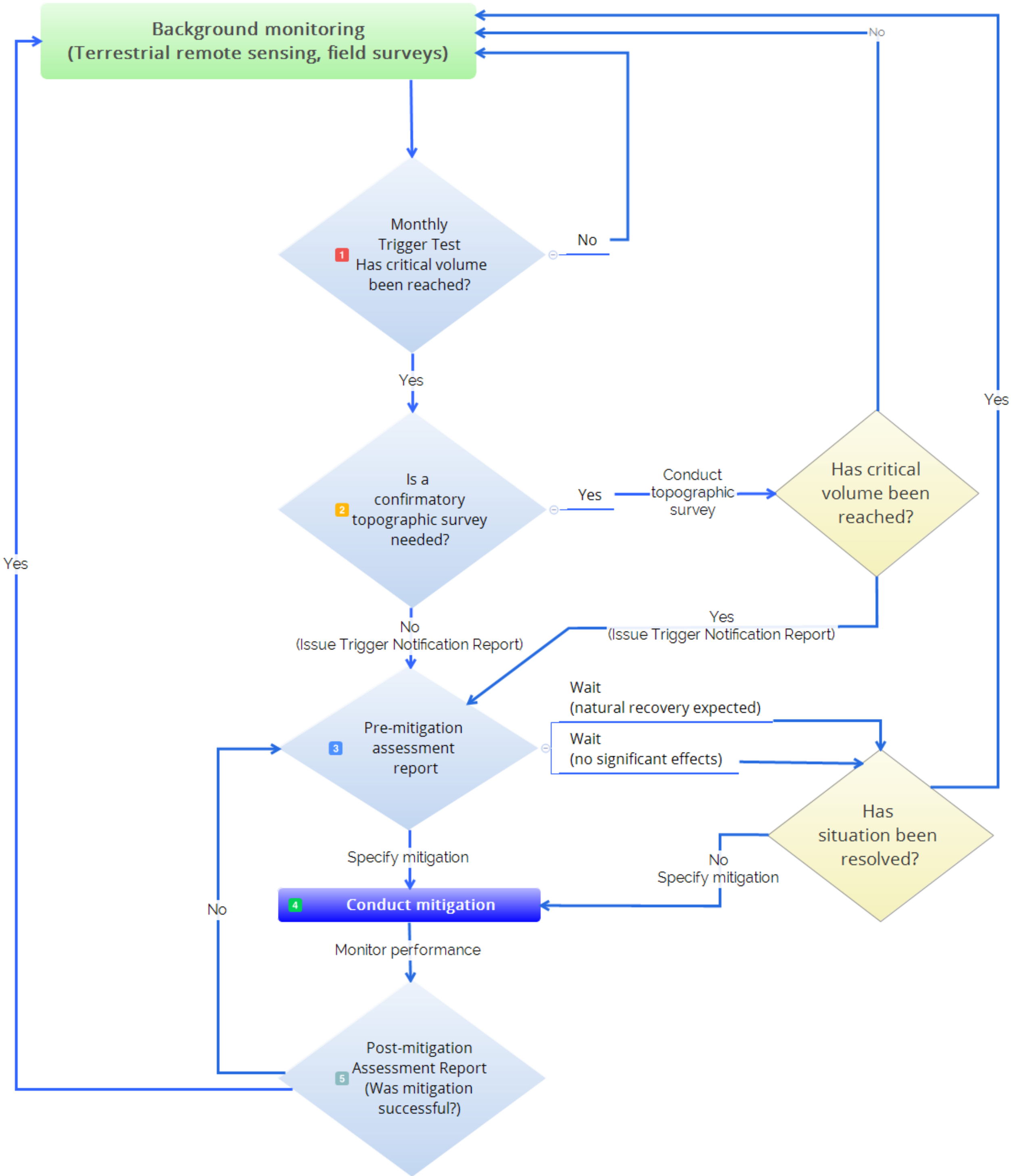

Figure 8: Decision tree illustrating the monitoring and mitigation steps.

6.3 Mitigation trigger (beach volume)

The trigger to carry out mitigation will be determined as the beach volume sufficient to withstand a 1:20 year return interval storm without exposing the HCDF. The 1:20 year interval was selected as it corresponds to the storm that has a probability of occurring once in the approximate interval between the end of the Sizewell C Project's construction and the beginning of the timeframe in which the HCDF is expected to be exposed without mitigation (2053 – 2087).

Two steps are required to determine the trigger volume:

- Quantify the 1:20 year return interval storm.
- Conduct iterative modelling using the 1:20 year storm to determine the volumetric trigger.

The Sizewell wave record will be used to characterise storms, and in particular the cumulative wave Power or Work, which is the hydrodynamic driver of coastal change. The distribution of Work done by storms will be used to estimate the 1:20 year storm. Note that it is the return interval of the 'storm energy'[9] that is of interest here, which is distinct from the exceedance intervals of individual wave heights often computed for flood risk and overtopping purposes (for example). Put another way, it is the energy imparted by the whole storm that drives beach change, not the peak wave height that occurred at one moment during the storm.

The minimum beach volume sufficient to withstand a 1:20 year return interval storm without exposing the HCDF will be determined using the XBeach storm erosion model. This will be done by translating the beach to different landward and seaward positions at the start of each model run. In iteratively cycling through different start positions, the minimum beach and beach volume, without exposing the HCDF, can be determined.

Storm analysis and erosion modelling are due to report in 2020 and will be used to finalise this monitoring plan, following their scrutiny by the MTF. This section will be updated accordingly.

6.4 Monitoring methods

Triggered beach management activity is not expected for some decades to come as erosion rates on the Sizewell C frontage are low. By this time, the monitoring plans described in Sections 3 –5 should have ceased, with data on beach condition then coming from the *background monitoring* terrestrial remote sensing (1 km either side of SZC), twice yearly topographic surveys, and five-yearly bathymetric survey (Minsmere Outfall to Thorpeness).

6.4.1 Early warning – terrestrial remote sensing

The terrestrial remote sensing methods currently being used are X-band radar and video, although the method could change with technological advances. The specification for an early-warning method is regular automated data collection that is able to track shoreline change in order to quantify two beach state indicators – beach width and estimates of beach volume based on beach width (volume is roughly proportional to width for steep beaches).

These indirect estimates of volume will then be used as an early warning of a potential trigger alert, without the need to conduct frequent field work over the station life. They will be checked and reported each month, except for in the two months where a topographic survey is scheduled.

[9] More precisely, the work done by the storm.

6.4.2 Volumetric trigger

As the terrestrial remote sensing methods currently cannot directly measure volume, the definitive trigger for mitigation must be assessed using topographic data. If a monthly trigger alert is raised using terrestrial remote sensing, this would require an RPA flight to take place, for confirmation (step 2 in Figure 8).

The method for topographic data collection needs to be accurate and spatially continuous, in order to identify whether any sections of the beach have fallen below the threshold used to initiate mitigation, and to inform recommendations for the type of mitigation to be undertaken, the volumes of material involved, and precisely where the mitigation activity should take place. Photogrammetry from RPA is the intended method for these field surveys as it creates high resolution spatially continuous results, and has been successfully used at Hinkley Point for impact detection and at Sizewell for recent baseline.

6.5 Mitigation options

The likely timeframe of 2053 – 2087 for HCDF exposure is sufficiently far into the future that the details of which part of the shingle beach might become vulnerable, and its extent, cannot be known. As the precise conditions requiring mitigation cannot be known *a priori*, neither can an individual mitigation plan be specified years or more in advance. This is, of course, the same problem faced by coastal managers (e.g., the Environment Agency) when managing their frontages. Evidence based judgements must be made closer to the time when a beach or defence feature becomes vulnerable and, according to the evidence a specific mitigation plan devised.

It is important to note that changes to the broad coastal regime and coastal processes may occur within the station life. In particular, removal or decay of the Minsmere Sluice and erosion of the Dunwich – Minsmere Cliffs are likely to increase shingle supply and alter the shoreline shape. Such changes would be detected by the *background monitoring* and are likely to reduce or obviate the need for mitigation.

Although the precise beach conditions and matching mitigation actions cannot be known at this stage, there are a limited number of beach conditions that could threaten HCDF exposure. These have been used in the **ES** (**Chapter 20, Volume 2**) [APP-311] and are reiterated here to illustrate the likely mitigation responses.

The method, location, and volumes for each mitigation action would depend on the circumstances at the time – the future monitoring evidence base would be used to identify areas of potential exposure and mitigate them if a likely significant effect is predicted. Specifically, it is intended that areas of low beach volume identified by trigger alerts would receive additional sediments sufficient to close the trigger alert and also to minimise longshore transport by creating a smooth coastline where possible.

The mitigation methods would involve either moving existing beach sediment (bypassing or recycling) or introducing new material (recharge), working with natural processes to ensure a sustainable solution is provided (Rogers et al., 2010). These mitigation methods are viable at Sizewell, initially at least, because:

- the shoreline retreat rates are not especially fast;
- retreating areas typically have a relatively small spatial extents (i.e., spatially localised erosion/accretion patterns following individual events is a strong characteristic of this coast), meaning that mitigation volumes would not be large;
- shingle has a high entrainment threshold (i.e., low mobility, so maintenance activities would have a moderately high resilience); and
- longshore shingle transport rates are low, meaning that deposited sediments would be moved away slowly and have a good longevity.

Hence the environment around Sizewell is considered suitable for bypassing, recycling and, if needed, recharge. Note that beach recycling is a practice that has been employed in the UK at sites with both Hold

The Line (e.g., South Beach, Lowestoft) and Managed Realignment (e.g., Slapton Sands) Shoreline Management Plans.

The broad conditions for method selection are outlined below.

6.5.1 Longshore beach sediment recycling

Longshore beach sediment recycling (beach recycling for short) usually involves the mechanical movement of sediment from the downdrift end of a beach, back to the updrift end, but can be in the opposite direction, which has relevance for beaches like Sizewell where the gross transport directions often reverse. Beach recycling involves no additional sediments, but redistributes native beach material from an accreting borrow area (orange in Figure 9) to an eroding area (green). It can be carried out at relatively short notice. The effect on the shorelines would be accretion or a reduction in erosion rates local to those deposition sites, and the sediment would slowly disperse with time. Should this situation arise (i.e., accumulation and depletion) beach recycling would be applied. Through this approach, a degree of continuity of beach material supply and transport can be achieved along the beach frontage.

Recycling is considered to be well suited for Sizewell because of its low to moderate rates of longshore drift, meaning that volumes required, and dispersion rates, would be relatively small. Rogers et al. (2010) suggest that beaches with longshore drift rates less than 80,000 m^3/yr are suitable for recycling – the rates at Sizewell are around 10,000 m^3/yr and so fall well within this specification. Beach recycling has also been used on nearby South Beach (Lowestoft) by Suffolk County Council and at the UK's largest coastal shingle landform at Dungeness by EDF Energy and the Environment Agency. Dungeness, like the Sizewell – Minsmere area, has several statutory conservation designations.

At Sizewell, monitoring data would be used to take account natural shoreline variation and identify areas lower than the volumetric threshold as well as potential borrow areas. The intention is not to extract sediment from the designated Minsmere sites, however if a case for this did arise it would be subject to any assessments and approvals relevant at that time; as the future environment naturally changes, some designated habitats/features (as described by Natural England's condition assessment reports and DCO/DML monitoring reports from this monitoring plan) may also naturally change in quality or disappear, potentially allowing such an activity.

6.5.2 Sediment bypassing

Similar to beach recycling, sediment bypassing involves moving beach material from areas of accumulation to areas of erosion, but which have resulted from the interception or disturbance of natural longshore transport processes. The effect of bypassing is to manually restore longshore sediment supply and alter the shoreline position local to the extraction and deposition sites. For example, shingle that was temporarily (several months) blocked by sea wall construction material at HPC was detected (using RPA topographic surveys) and successfully bypassed to avoid any impacts to downdrift beaches.

Mechanical sediment bypassing would be used if the HCDF caused persistent updrift sediment accretion and downdrift erosion (Figure 9, middle panel). The potential accumulation sites for bypassing are north of the northern HCDF face (under phases of southerly transport), immediately south of the BLF landing area and in the embayment between the HCDF and the SZB defences (under phases of northerly transport). Given the natural bi-directionality in longshore transport, consideration would be given to the persistence of erosion/accretion patterns so as to avoid unnecessary disturbance and mitigation activity (i.e., mitigation would not be applied if the beach was considered likely to recover naturally without causing any significant effects, which is a commonly applied coastal management practice (Rogers et al., 2010)). As with beach recycling, the intention is not to extract sediment from the designated Minsmere sites, however if a case for this did arise, it would be subject to any assessments and approvals relevant at that time.

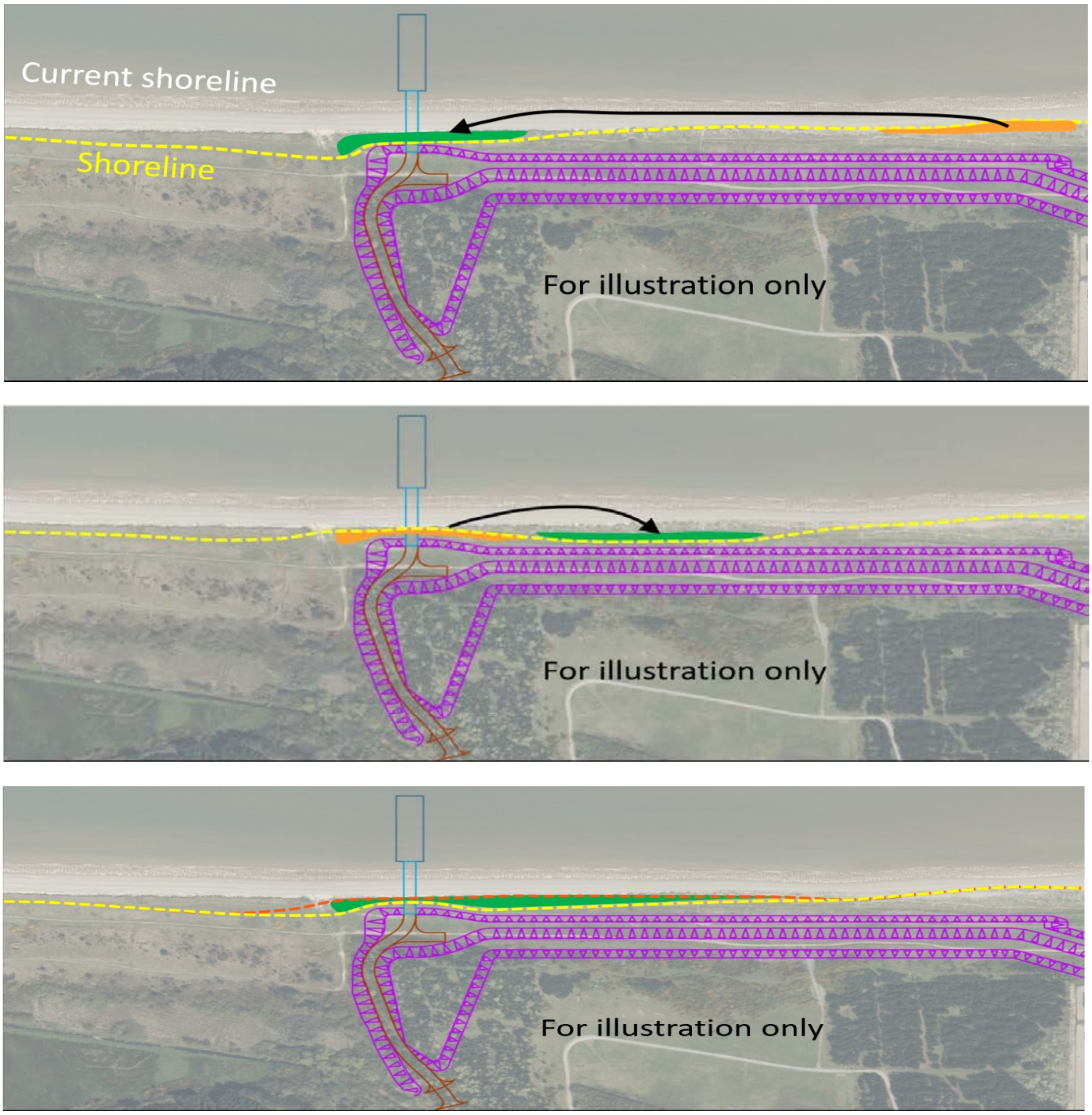

Figure 9: Schematics showing examples of depleted beach sections and the likely mitigation method: beach recycling (top), sediment bypassing (middle) and beach recharge (bottom). The examples assume a net southerly (left to right) longshore drift, but the same principles can be applied in the unlikely event of any persistent reversal in the net transport direction. Orange indicates the borrow area and green the deposition area.

6.5.3 Beach sediment recharge

Beach sediment recharge is the process of actively increasing beach volume using imported material. If a trigger alert indicated that the SZC frontage were depleted in the absence of an obvious or accessible zone of accumulating sediment, beach recharge would be applied (Figure 9, bottom panel). The effect of introducing extra sediment would be to initially decrease, halt or reverse the erosion rate, as well as maintain continuity in the beach and longshore transport system. Over time, the introduced material would slowly disperse. As the length of recharged coast would be short (100 – 200 m), the slow dispersion of additional sediment is unlikely to be distinguished from natural behaviour along the neighbouring coasts. The sediment would be expected to move slowly south in net terms (except where became trapped on the northern side of the HCDF).

The physical characteristics of the material used in any beach recharge are critical (e.g., size and angularity). The use of coarser (and/or more angular) material than the native sediments, or at the coarse end of its distribution, is common as a measure to improve beach recharge longevity (Rogers et al., 2010). For example, the Environment Agency's Lincshore Scheme in Lincolnshire and the Bacton to Walcott Sandscaping Scheme in North Norfolk.

Accordingly, primarily shingle sized material would be used for any Sizewell beach recharge to increase longevity. Subject to performance assessment from any previous beach recharge, the intention would be for the particle size to fall within the range of the natural size distribution. Sand is unlikely to be used because it can be rapidly lost from the subaerial beach through cross-shore sediment exchange during storms[10]. Furthermore, high volumes of sand increase cliffing and can cause mixed sand-shingle beaches to exhibit more dynamic sand-beach behaviour[11], which could lead to rapid post-mitigation HCDF exposure and poor mitigation performance.

As it is not possible to predict depleted areas in advance, it is also not possible to predict the required volumes of sediment to be supplied, as this would depend on the beach condition (volume, extent) warranting intervention. The monitoring results would provide the evidence needed to design the beach recharge, including the particle size specification, deposit location, thickness and volumes.

6.5.4 What are the potential impacts of beach maintenance practices on designated sites?

The beach maintenance / sediment management approaches described above would not have an adverse effect on designated supra-tidal shingle habitats (annual vegetated drift lines and potential little tern nesting sites) as:

- they would not cause erosion;
- they would cause some localised short-term beach accretion, limited in extent by the relatively small volumes being moved or introduced, which may enhance habitat;
- sediment would not be extracted from statutory designated sites (in the cases of bypassing or beach recycling) unless accumulating sediments were a direct effect of the Sizewell C Project (mitigation or presence of the HCDF) and approval was given following demonstration that designated features would not be affected; and
- sediment would not be deposited on the supra-tidal beach within statutory designated sites unless approval was given following demonstration that designated features would not be affected.

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[10] Cross-shore sediment exchange is dominated by sand; in comparison, shingle is retained almost exclusively above low tide.
[11] Mason (1997) suggested that once the sand ratio in a beach was 40% or higher, it would behave more like a pure-sand beach.

Beach maintenance would result in some localised short-term beach accretion, limited in extent by the relatively small volumes being moved or introduced. Were added or moved shingle to subsequently deposit on the supra-tidal, it could increase its elevation and width, and potentially restore lost features such as the annual vegetated drift lines habitat on the Minsmere to Walberswick Heaths and Marshes SAC (i.e., a net ecological gain). This situation is most likely under beach recharge mitigation, as it would add new shingle to the system.

Deposited material would move under natural coastal processes within the active beach, behaving in the same fashion as the rest of the beach material. Therefore, deposited sediments are no different from the material already present. Effort would be made to spread deposited material appropriately, so that unnatural mounds or shapes would not result, thereby allowing the beach to function naturally. Any beach maintenance activity directly on the designated frontage would require assessment and approvals from Natural England. Notwithstanding approvals, sediment extraction from the active beach face (not the supra-tidal zone) could still produce a net ecological gain, if only some of the excess sediments (for example, accumulating sediments against the HCDF) were removed.

The Leiston – Aldeburgh SSSI is too distant to be affected by beach management activity at SZC, as shown by modelled longshore transport and measured shingle movement (BEEMS Technical Reports TR329 and TR420).

6.6 Performance assessment

All mitigation interventions will be monitored to assess their performance and improve the selection and specification of any future mitigation required. The performance assessment would involve a pre-mitigation topographic survey to be conducted less than one month before the mitigation action, preferably less than a week, weather permitting. In some cases, a pre-mitigation survey may not be possible; for example if a very long duration storm, or storm sequence, would otherwise unacceptably delay mitigation. Unless otherwise justified, the topographic survey would be 1 km either side of a beach recharge or 1 km north and south of the northern and southern borrow and deposition areas, respectively.

A second topography survey would be conducted as soon as possible after mitigation, to document the beach state and spatial changes in volumes as a result of mitigation. Three subsequent monthly surveys would be used in a Post-mitigation Assessment Report, to be delivered 3 – 4 months after the mitigation action. As well as assessing performance, this report would recommend whether further topographic surveys were needed (e.g., a period of quarterly topographic surveys) or whether the *background monitoring* (ongoing terrestrial remote sensing, twice yearly topographic surveys and bathymetric survey once every five years) was adequate.

7 Annual vegetation of drift lines

A high-quality annual vegetation of drift lines habitat is considered to be located within the non-statutory Suffolk County Wildlife Site just south of the Sizewell C frontage. Establishing a baseline and distinguishing natural variability in the spatially sparse vegetation, including its natural seasonal growth and die-back, is likely to require methods more sophisticated than traditional ground survey / quadrat approaches. The JNCC recommends the National Vegetation Classification (NVC)[12] to help develop a conceptual basis for understanding the purpose and practice of, and furnish protocols for, monitoring. The proposed method will, therefore, use the NVC as an initial reference.

The proposal for monitoring annual vegetation is to use very high resolution (< 3 cm) multi-spectral (visible and near infra-red) data gathered from an RPA platform to provide a spatially continuous substrate/vegetation map over the annual vegetation habitats. This approach would be used to detect and characterise the annual vegetation to a spatial degree not possible with traditional sub-sampling quadrat approaches, and would aim to distinguish annual vegetation[13] from shingle and other vegetation / habitats (e.g., dunes and dune grasses). Cefas has conducted similar work at Hinkley Point on rock platform algae for EDF Energy and at Two Tree Island (Essex) and Budle Bay (Northumberland) on sea grasses in partnership with the Environment Agency.

The method is under development with final reporting due in 2020. This section will be updated accordingly before the final version of the monitoring plan is issued.

8 Monitoring reports

As indicated by Figure 6, reporting by component would be complex due to the number of components, activities, monitoring parameters, and monitoring techniques. It would also be repetitious as monitored parameters are often used for several different components. To streamline the reporting, four types of report are proposed:

- Baseline Reports (pre-construction). These are the final pre-construction reports. Baseline reporting used for assessing the potential impacts of Sizewell C would be updated to include monitoring data from the period between DCO submission and the start of marine construction. Baseline reports pertaining to any particular station component would be submitted to the MTF before marine construction (per component) commences, including sufficient time for regulatory comment and approval.

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[12] JNCC: https://jncc.gov.uk/our-work/nvc/
[13] formations of annuals or representatives of annuals and perennials, occupying accumulations of drift material and gravel rich in nitrogenous organic matter

- Notification Reports (SZC construction and operation). These are short reports to advise the MMO that scheduled monitoring has taken place, that the data collected are fit for purpose[14], and whether any impacts apparent are within the predicted range. These reports would be delivered within eight weeks[15] of data collection. If unexpected impacts arise that have the potential to cause a likely significant effect, the Notification Report will recommend an Ad Hoc Report to follow up within one month.
  - Trigger Notification Reports. These short notification reports would only be used in conjunction with the monitoring and mitigation to maintain a shingle beach along the SZC frontage. They would be based on topographic surveys needed to indicate the triggered (low beach volume) areas and the potential need to apply mitigation. They would only be produced if beach volume falls below the threshold. [
- Annual Reports (SZC construction and operation). The Annual Report would be a detailed examination of the monitoring data for all activities, with a particular focus on impact detection, mitigation and mitigation performance. It would be issued by the end of September each year and include data up until the end of May (spring). It would also include evidence-based recommendations regarding:
  - any proposed changes to the monitoring schedule, such as frequency increases or decreases, or cessation of individual monitoring components (e.g., some monitoring is specific to construction activities and would not be required *ad infinitum*),
  - proposed additional surveys where unexpected issues may have occurred,
  - proposed changes to the *background monitoring*,
  - method changes due to, for example, changes in measurement technology, and
  - changes in reporting schedules.
- Ad Hoc Reports (SZC construction, operation and decommissioning). These reports are for unexpected circumstances that have the potential to cause a significant effect, such as an impact of unexpected magnitude that may also cause a likely significant effect. These reports would be used where mitigation might be required immediately or before the Annual Report. No Ad Hoc Reports are expected, but they are included to make the monitoring plan robust.
- Mitigation Reports (SZC operation and decommissioning). Mitigation for coastal geomorphology is only proposed with respect to maintaining a continuous shingle beach seaward of the HCDF. Mitigation reports would be triggered and do not have a schedule. There are two types:
  - Pre-mitigation assessment report. These reports would provide a detailed analysis of the monitoring data to confirm the trigger[16]. If mitigation is needed, they would determine which method of mitigation to maintain the shingle beach is most appropriate and

[14] We expect that our experimental design will deliver fit for purpose data, and we will operate rigorous QA procedures to ensure that this is so. However, external factors such as weather could mean that on occasions the data are not fit for purpose. In such circumstances, the notification report will alert the MMO and the survey will be re-scheduled for the soonest possible date.
[15] The delivery period will be assessed for each survey type. Due to the nature of the data collected and data processing requirements, some surveys may require a different post-survey period.
[16] That beach volumes have fallen below the trigger threshold.

- Post-mitigation assessment report. These reports would assess the effectiveness of the mitigation applied by examining the volumetric changes in the area of concern (including the borrow areas for beach recycling and bypassing) and the effects to neighbouring shorelines. It would recommend whether additional monitoring is needed. Specifically, it would document the changes arising as a result of mitigation and accumulate these in the subsequent Annual Reports, to be used to guide any future recommendations based on any failings and successes observed.

All reports will be submitted to the MMO as a condition of the DML. To streamline the reporting process, Notification Reports (except for Triggered Notification Reports) will only be submitted to the MMO,. All other reports will be submitted to the MTF for consultation prior to approval by the MMO.

9 Mitigation cessation report

Toward the end of the Sizewell C Project a cessation of mitigation assessment will be made, as stated in the **ES (Chapter 20, Volume 2)** [APP-311]. It noted that "*Prior to cessation of beach monitoring and mitigation, any remaining residual significant effects would need to be identified, assessed and, if required, compensated. However, the detail required to undertake that assessment cannot be known until much closer to that time, when the nature of the HCDF exposure, the broad geomorphic setting and the locations of designated sites and features are all known with confidence*". It did however set out some plausible geomorphic settings and the potential impacts for context, whilst further noting that they are not suitable for impact assessment and compensation evaluation, due to the very high uncertainty in both the geomorphic setting and designated features. Instead those plausible geomorphic configurations and potential residual effects, which are not reiterated here, would be evolved with many decades of monitoring evidence until, closer to the time, they are fit for purpose to assess the significance of any impacts arising.

Within ten years of the end of decommissioning, a mitigation cessation report will be submitted to the MMO (or equivalent future authority) for their approval. Such a report would be expected to include:

- The condition of Greater Sizewell Bay, its geomorphic elements, coastal processes and sediment transport rates and pathways.
- The status of statutory designated sites and features relevant to potential SZC impacts at that time, and their condition.
- The likely impacts resulting from exposure of the HCDF following cessation of mitigation, including an assessment of any likely significant effects on statutory designated sites.
- Recommendations on any alternative mitigation options, such as structures that could minimise any likely significant effects.

It would be the evidence basis of any subsequent discussions regarding compensation, if needed. The cessation action(s) and potential final measures would reflect policy, the shoreline management plan and statutory designations at that time and cannot be fully evaluated at present.

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