



The Sizewell C Project

9.90 Draft Sabellaria Reef Management and Monitoring Plan

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Sizewell C In-Principle *Sabellaria* Reef Management and Monitoring Plan.

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1 Introduction

SZC Co. has submitted an application for a Development Consent Order (DCO) to construct and operate a new nuclear power station, Sizewell C (SZC), in Suffolk. Potential adverse effects of the proposed development on *Sabellaria spinulosa* reef, a priority habitat under Section 41 of the NERC Act (2006), have been identified as a result of installing the cooling water system (CWS) intakes for Unit 1 (see paragraphs 22.7.210-216, **Volume 2, Chapter 22** of the **Environmental Statement (ES)** (Doc Ref. 6.3) [[AS-035](#)]). It should be noted that any adverse effects on *S. spinulosa* reef would not occur inside designated sites for which *S. spinulosa* reef is a qualifying feature.

As part of the DCO Application, SZC Co. is committed to ensuring that any impacts to *S. spinulosa* reef habitat are avoided or mitigated, where possible. Should *S. spinulosa* reef be present in the vicinity of the Unit 1 CWS intake heads prior to their installation, then ongoing monitoring is required to understand the extent of the reef post-construction into the initial period of operation. The present distribution and extent of *S. spinulosa* reef has been assessed in relation to the proposed headwork locations using a range of multidisciplinary surveys. To verify the extent of *Sabellaria* reef around the headworks, and identify any adverse effects, monitoring is proposed in advance of installation of the headworks and at intervals thereafter. Deemed Marine Licence (DML) Condition 45¹ of the **Draft Development Consent Order** (Doc Ref. 3.1(D)) [[REP5-027](#)] secures this commitment, stating that:

Cooling Water Intake and Outfall Heads, Shafts and Tunnels

45. (1) Work No 2B shall not commence until a *Sabellaria* reef management and monitoring plan has, following consultation with NE, been approved by the MMO. The plan must be in general accordance with the Draft *Sabellaria* Reef Management and Monitoring Plan and must include:

- (a) geographic extent of the monitoring;
- (b) the monitoring methodology, frequency and duration or monitoring, and the format of the monitoring report; and
- (c) demonstration of how the project design reduces the loss of reef, and surrounding area available for reef to develop into, as far as practicable.

(2) Unless a shorter period is agreed with the MMO in writing, the undertaker must use reasonable endeavours to submit the *Sabellaria* reef management and monitoring plan at least 6 months prior to the proposed commencement of Work No. 2B.

(3) The determination date is 6 months from submission of the *Sabellaria* reef management and monitoring plan to the MMO.

The purpose of this report is to provide a draft *Sabellaria* Reef Management and Monitoring Plan summarising the intended approach to fulfil Condition 45 of the DML [[REP2-015](#)]. It proposes measures to avoid, minimise, and offset impacts on *S. spinulosa* reef and the proposed approach for monitoring any potential adverse effects. Consultation with the Marine Management Organisation (MMO) and Natural England (NE) has informed the preparation of this report. Notably, two bilateral meetings between SZC Co./Cefas and NE have guided the draft proposals for mitigation measures (see Section 3) and the approach to monitoring (see Section 4).

¹ DML Condition 45 is currently being amended by the MMO. Therefore, the wording will be updated in the final version of this report in line with the approved DML.

As detailed in Condition 45 (2), it is proposed that the final monitoring plan would be submitted at least 6 months in advance of commencement of works 2B. The final plan would reflect further consultation with statutory bodies (MMO and NE) in relation to the obligations included in Condition 45, and account for the detailed design of the intakes and installation methods. Such detailed information is not available at the present stage. This report therefore addresses the core requirements of the proposed mitigation and monitoring of *S. spinulosa* reef in the vicinity of the proposed Unit 1 CWS intake head positions.

2 Current understanding

2.1 Development footprint and *Sabellaria spinulosa* reef

As part of the proposed SZC development, two concrete headworks for the CWS would be installed at the end of the southern intake tunnel (Unit 1), positioned seaward of the Sizewell-Dunwich Bank in the Greater Sizewell Bay (GSB). Prior to installation of the headworks, small scale capital dredging would remove surficial sediments to expose underlying bedrock and would be followed by ground preparation works (see paragraphs 22.3.85-86, **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) [[AS-035](#)]). The CWS intake heads for Unit 1 would be installed on exposed hard substrate identified as Coralline Crag deposits (BEEMS Technical Report TR087).

There are two areas of Coralline Crag in the GSB: an offshore area, where the southern (Unit 1) CWS intake heads would be installed, and an inshore area (Figure 1). Grab samples have provided occasional records of the Ross worm *S. spinulosa* in the area around inshore Coralline Crag in the GSB (BEEMS Technical Report TR348), suggesting that *S. spinulosa* reef may be present on this habitat. However, confirming the presence of *S. spinulosa* reef (as opposed to individuals of the species) has proved difficult using visual methods (including the use of drop-down video or freshwater lens cameras) due to water turbidity and the physical nature of the substrate. A series of surveys was conducted in 2016 and 2018 at the inshore Coralline Crag and in 2019 at the offshore Coralline Crag. These surveys used multibeam echosounder (MBES) and/or sidescan sonar (SSS) to map the features of the Coralline Crag, with ground-truthing carried out using a high-resolution acoustic imaging camera to overcome the turbidity that precludes the use of traditional light-based camera systems. The evidence collected indicates that *S. spinulosa* reef is likely to be present on the Coralline Crag, but not on adjacent soft sediment (Figure 1). The interpretation of survey data has also allowed the production of maps showing the extent² of potential *S. spinulosa* reef within the GSB (BEEMS Technical Report TR473 and TR512). An area of over 50ha was determined to have at least a moderate probability of supporting *S. spinulosa* reef at the inshore Coralline Crag, which covers about 400ha. In the offshore area, there was 18.5 ha of potential *S. spinulosa* reef over 57.5ha of Coralline Crag.

The presence of *S. spinulosa* reef on the offshore Coralline Crag when Unit 1 CWS intake installation (Work 2B) begins would mean that physical pressures associated with installation would represent an impact pathway for *S. spinulosa* reef (see paragraph 22.7.192, **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) [[AS-035](#)]). Notably, this would lead to a reduction or loss of any *S. spinulosa* reef within the impacted area. However, *S. spinulosa* reef is often ephemeral in nature and can form, disintegrate, and sometimes reappear over several years (Jones *et al.*, 2000; Jackson & Hiscock, 2008; Limpenny *et al.*, 2010). Therefore, the distribution and extent of *S. spinulosa* reef at the offshore Coralline Crag may change between 2019 and the time that the southern CWS intake heads are installed. However, the complexity of the interconnected SZC CWS infrastructure means there is limited scope to select headwork positions to avoid *S. spinulosa* reef, and the lead time for confirming headwork positions is several years due to the detailed geotechnical and hydraulic analyses required (see Section 3.1). Therefore, headwork positioning cannot be altered in response to any changes in *S. spinulosa* reef distribution and extent.

² It should be noted that habitat mapping incorporated the best available techniques for detection of *S. spinulosa* aggregations in the turbid waters and that mapping confidence is limited to interpretation of acoustic signatures and application of expert judgement with respect to the interpretation of high-resolution acoustic images. As such, predicted extents of *S. spinulosa* reef should be regarded as indicative (BEEMS Technical Report TR512).

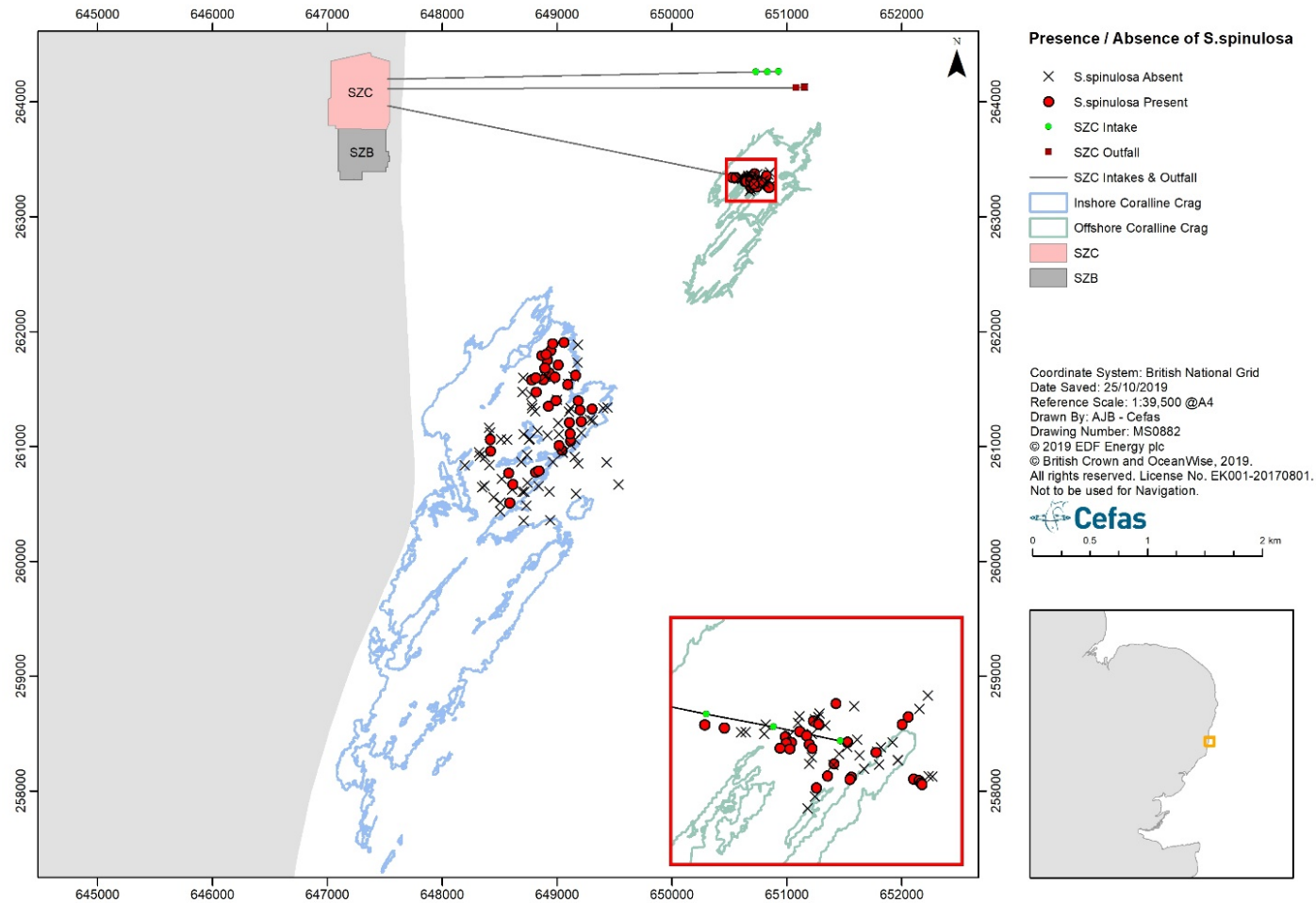


Figure 1: Extent of the inshore and offshore Coralline Crag and the location of ground-truthing sampling stations. *Sabellaria spinulosa* aggregations were identified from the acoustic image footage at both sites (red points).

2.2 Impacts on *Sabellaria spinulosa* reef

The effects on *S. spinulosa* reef of physical pressures associated with the installation of the southern (Unit 1) CWS intake heads at the offshore Coralline Crag have been assessed for the proposed SZC development using survey data collected in 2019 (see paragraphs 22.7.210-216, **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) [AS-035]). The approach for determining effects of installation of the cooling water intakes during the construction phase was to consider a 50m construction buffer zone surrounding the intake headworks as an 'impact area' (see paragraph 22.7.194, **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) [AS-035]). Three possible headwork positions were considered for the two southern intake heads, and all three possible combinations of headwork positions were assessed. It was assumed that all *S. spinulosa* reef would be lost inside the combined impact area across the two headworks.

It was determined that the installation of the two southern CWS intake heads (including ground preparation and substratum extraction activities) would impact up to 2.8ha of Coralline Crag, which equates to less than 5% of the offshore Coralline Crag habitat and less than 1% of the exposed Coralline Crag within the GSB. Impact magnitude was assessed as low based on the limited spatial extent of the impact relative to the total extent of Coralline Crag. A smaller area of up to 1.1ha of *S. spinulosa* reef would be lost due to physical pressures associated with intake head installation based on the distribution and extent of this feature in 2019, which equates to less than 6% of the reef area at the offshore Coralline Crag. It is expected that reef would be able to recover in the 50m construction zones around the headworks, though permanent loss of habitat is anticipated over approximately 0.1 ha of seabed on which the two intake heads would be installed.

Based on the magnitude of the impact and the sensitivity of *S. spinulosa* reef, effects were assessed as minor adverse. However, the conservation value of this receptor was considered when determining effect significance. Specifically, consideration was given to the factors in Table 1, which led to the conclusion that there would be no significant effects of headwork installation on the distribution or functioning of *S. spinulosa* reef. Nevertheless, actions will be taken to mitigate and monitor the effects of pressures associated with CWS intake installation on this receptor.

Table 1: Factors determining the significance of potential effects on *S. spinulosa* reef (NNB Generation Company (SZC) Limited, 2020).

Factor	Considerations for determining significance.
Location	<i>Sabellaria spinulosa</i> reefs at the offshore Coralline Crag are not located within a designated site for which it is a qualifying feature. However, <i>S. Spinulosa</i> reefs are 'habitats of principal importance for the conservation of biodiversity in England' (Section 41 of the NERC Act 2006).
Rarity	<i>Sabellaria spinulosa</i> reefs have been identified along the Suffolk coast as part of the East Coast and Outer Thames Regional Environmental Characterisation (REC) (Limpeny <i>et al.</i> , 2011; Emu Ltd, 2009). Seven major areas of <i>S. spinulosa</i> reefs have been reported with varying extents from 7km ² and up to 50km ² in the East Coast region. One possible site has been identified in the North of the Outer Thames Region. <i>Sabellaria spinulosa</i> has also been identified as amongst the most abundant benthic organisms recorded during REC surveys.
Distribution	The reefs associated with the offshore Coralline Crag are predicted to cover an area of approximately 18.5ha (BEEMS Technical Report TR512). Within the GSB, larger reef formations are located at the exposed inshore Coralline Crag, where an estimated 28.0ha of habitat within the study area was predicted as having a high probability of supporting <i>S. spinulosa</i> reefs and a further 24.5ha of habitat classified as having moderate probability of supporting <i>S. spinulosa</i> (BEEMS Technical Report TR473). Exposed Coralline Crag provides the supporting habitat for establishment of <i>S. spinulosa</i> reefs in the GSB. The exposed area of offshore Coralline Crag is estimated at 57.5ha, whilst the extent of the exposed inshore Coralline Crag is 365.0ha. With a total of approximately 423.0ha within the GSB.

<p>Reef Quality and Ecological Function</p>	<p><i>Sabellaria spinulosa</i> can form dense subtidal aggregations in the form of extensive ‘crusts’ or ‘sheets’, sometimes covering large areas of the seabed, which can act to stabilize sand or gravel habitats (Cooper <i>et al.</i>, 2007; UK Biodiversity Action Plan, 2008; Limpenny <i>et al.</i>, 2010; van der Reijden <i>et al.</i>, 2019). The crust formations are ephemeral in nature and are not considered as true <i>S. spinulosa</i> reef as it does not provide a biogenic habitat for associated species to establish. <i>Sabellaria spinulosa</i> formations increase in mass over time and form elevated reefs structures as new recruits are strongly stimulated to settle by cement construction on established colonies (Holt <i>et al.</i>, 1998). In reef formation, <i>S. spinulosa</i> is an ecological engineer, whereby aggregations form solid biogenic structures on the seabed (Limpenny <i>et al.</i>, 2010; Limpenny <i>et al.</i>, 2011). <i>Sabellaria</i> reefs are known to enhance biodiversity and biomass in comparison with adjacent soft sediment communities). The ecological function of <i>S. spinulosa</i> means that impacts on reefs have potential indirect effects on other benthic taxa. The reefs associated with the offshore Coralline Crag have been assessed as having ‘low’ (2-5cm) to ‘medium’ (5-10cm) elevation (BEEMS Technical Report TR512) according to the Gubbay (2007) criteria, with crusts also considered likely over a wider area (BEEMS Technical Report TR512).</p>
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3 Mitigation

When a potential adverse effect on a valuable ecological feature is identified, it is good practice to attempt to mitigate the effect. NPS EN-1 also expects the applicant to consider opportunities to enhance existing habitats.

The proposed approach to mitigating potential impacts of the southern (Unit 1) CWS intake installation on *S. spinulosa* reef is based on the following steps:

- ▶ **Avoid:** Impacts on ecological features are avoided where possible.
- ▶ **Minimise:** Action is taken to reduce, as far as possible, impacts that cannot be completely avoided.
- ▶ **Offset:** Action is taken to offset residual adverse effects following measures to avoid and minimise impacts. Efforts should focus on the same type of ecological features as those affected, with equivalent functionality, and occur as close to the affected area as possible. However, there will be cases when it is not possible to achieve ecological equivalence. Gains may occur inside or outside the development footprint.

To discuss options to mitigate the impacts of CWS intake head installation on *S. spinulosa* reef at each step of the mitigation hierarchy and receive the guidance of expert statutory advisors, SZC Co. and Cefas have participated in two bilateral meetings with NE on the 18th of January 2021 and the 18th of August 2021. The consultation advice provided by NE, and their earlier Relevant Representations (Appendix A), has been incorporated into the following proposals for mitigating and monitoring impacts of the proposed development on *S. spinulosa* reef.

3.1 Avoid

Survey data from 2019 shows that potential *S. spinulosa* reef overlaps all three of the possible positions for the southern CWS intake heads (including 50 m construction zones) (Table 2; Figure 2). The West and Mid positions have been identified as avoiding the most reef; however, as complete avoidance of reef is not possible the selection of headwork positions is considered below as a measure to minimise the impact (see Section 3.2).

It is possible that the distribution and extent of *S. spinulosa* reef will change between 2019 and the time that the southern CWS intake heads are installed. A pre-construction survey will be conducted one year prior to headwork installation, as advised by NE (see Appendix A, Comment ID NE-443). Evidence on the presence (or absence) of *S. spinulosa* reef in the area surrounding the southern CWS intake head positions will be updated following this survey. However, it would not be possible to make alterations to CWS intake head positions to avoid reef at this stage, as the lead time for confirmation of positioning is several years.

3.2 Minimise

Although *S. spinulosa* reef cannot be completely avoided based on its distribution and extent in 2019, impacts can be minimised by selecting the two possible CWS intake head positions (including 50m construction zones) that overlap with the smallest area of reef. The West and Mid positions would result in the smallest loss of potential reef (0.70 ha; Table 2) and have therefore been selected as the preferred southern CWS intake head positions. This decision is supported by NE (see Appendix A, Comment ID NE-443). Evidence on the area of *S. spinulosa* reef impacted by headwork installation will be updated following the pre-construction (Year -1) survey. However, as with avoidance measures (see Section 3.1), alterations to CWS intake head positions to minimise impacts on reef would not be possible at this stage and repositioning of a nuclear classified structure is not something to be undertaken lightly.

In addition to minimisation through the selection of CWS intake head positions, impacts on *S. spinulosa* reef could be minimised through the planning of construction activities. Specifically, anchors and jack-up barges

used during headwork installation would be positioned to minimise their placement on potential *S. spinulosa* reef, as far as practicable (see Table 12.1 of the **CoCP** (Doc Ref. 8.11) [APP-615]). This would be informed using evidence on *S. spinulosa* reef distribution and extent collected during the pre-construction (Year -1) survey. The construction methods available to install the intake heads (e.g., the type of barge) will also be evaluated with respect to their relative level of seabed disturbance. It may, for example, be practicable to use methods that avoid or reduce impacts on *S. spinulosa* reef. These measures are aligned with advice provided by NE (see Appendix A, Comment ID NE-439, NE-443, and NE-470).

During the operational phase, when maintenance inspections (up to every 18 months) and tunnel inspections (approximately every 10 years) are carried out at the southern CWS intakes, vessels could use anchors rather than using jack-ups to reduce the total area of the seabed disturbed, thus minimising potential impacts on *S. spinulosa* reef at the offshore Coralline Crag. Dynamic positioning of vessels would also be used, where practicable, to prevent potential anchor damage to *S. spinulosa* reef during inspections. These measures are also aligned with advice provided by NE (see Appendix A, Comment ID NE-456).

3.3 Offset

As residual, but non-significant, adverse effects on *S. spinulosa* reef are expected following the above mitigation measures, additional measures would be put in place to offset these effects by producing positive conservation outcomes for this receptor or for the broader biodiversity of the region. Several options were proposed by SZC Co. / Cefas and discussed with NE during the bilateral meeting on the 18th of August 2021.

Natural England advised that measures to reduce anthropogenic impacts and allow *S. spinulosa* reef to recover within its natural habitat are preferable to measures that attempt to introduce new suitable habitat. This could, for example, be achieved by working in collaboration with the Eastern Inshore Fisheries & Conservation Authority (IFCA) to support fishers to reduce impacts. Natural England also welcomed a proposal to remove marine litter, such as ghost nets, as a measure for enhancing the marine environment within the region. Opportunities to collaborate with Eastern IFCA to reduce anthropogenic impacts on *S. spinulosa* reef and to implement a marine litter removal programme will therefore be explored at a local/regional scale.

Table 2: Extent and percentage of potential *Sabellaria spinulosa* reef (18.5 ha) and available hard habitat (57.5 ha) that would be affected by each combination of positions for the two CWS intake heads at the offshore Coralline Crag. The surface area for each combination of CWS intake heads accounts for overlap in their 50 m construction buffer zones (see Figure 2).

	West & Mid	Mid & East	West & East
Reef area (ha), % of offshore reef	0.70 ha, 3.8%	1.10 ha, 5.9%	1.05 ha, 5.7%
Habitat area (ha), % of offshore Coralline Crag	2.76 ha, 4.8%	2.70 ha, 4.7%	2.81 ha, 4.9%

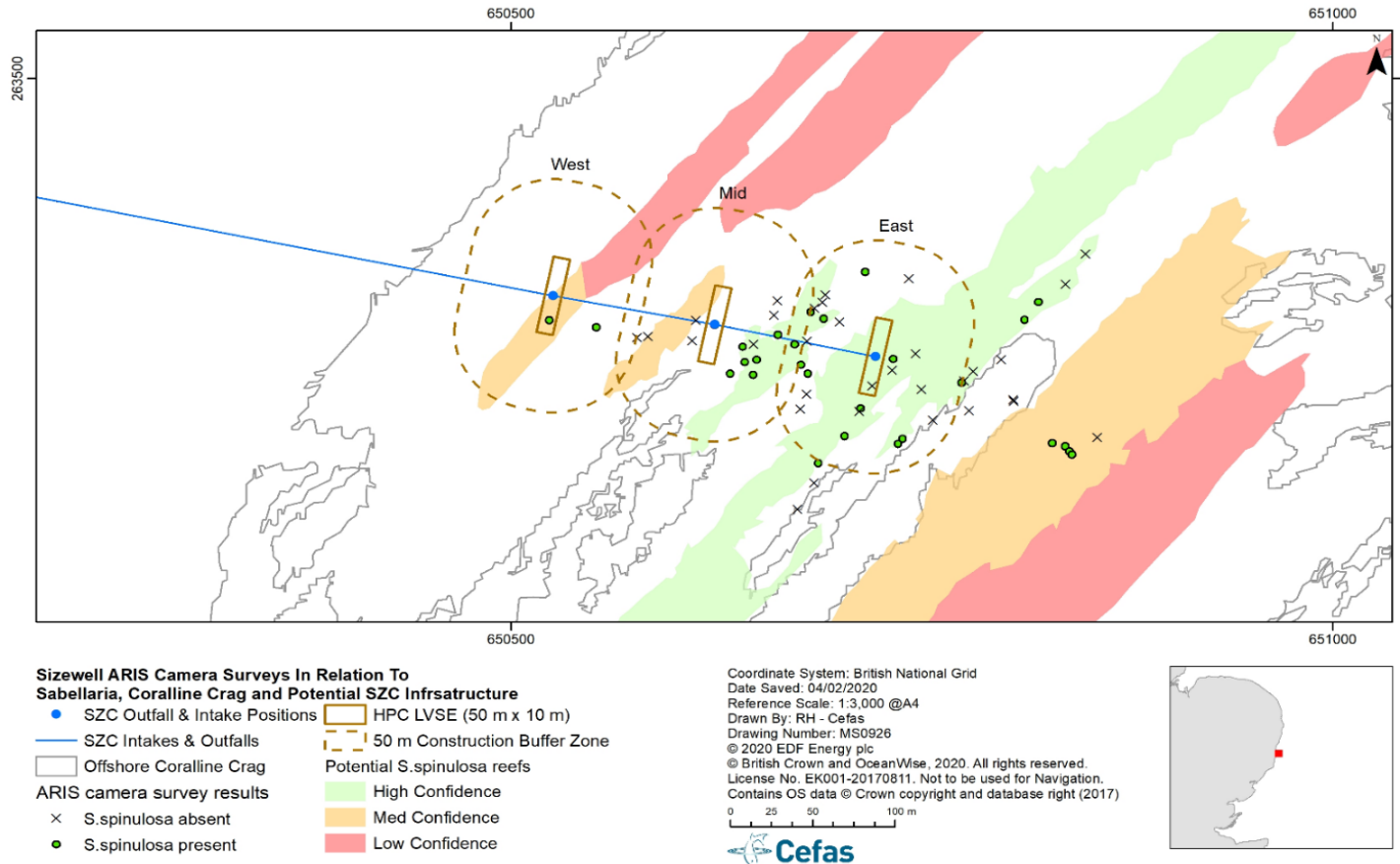


Figure 2: Locations of Unit 1 cooling water intake head position options (two to be installed) at the offshore Coralline Crag. Headworks and a 50m construction buffer zone are shown relative to the predicted extent of potential *S. spinulosa* reef of at least 'medium' quality (BEEMS Technical Report TR512). Confidence is based on a combination of the acoustic signal from side-scan sonar and the amount of ground-truthing support. Reef identified to any confidence level was assumed to be reef for the purposes of the assessment.

4 Monitoring

This section outlines a draft plan to monitor the effects of CWS intake head installation on *S. spinulosa* reef. It is proposed that a more detailed update to this monitoring plan will be submitted to the MMO following the pre-construction (Year -1) survey, at least 6 months prior to the proposed commencement of works associated with the installation of the southern (Unit 1) CWS intake heads and shaft (Work 2B), as secured in DML Condition 45. Monitoring plans will be developed in consultation with the MMO and NE.

4.1 Survey extent and design

The geographic survey extent would include the area of offshore Coralline Crag surrounding the southern CWS intake heads (including 50m construction zones), where impacts on *S. spinulosa* reef would occur (see Figure 2). Given the ephemeral nature of *S. spinulosa* reef (see Section 2.1), its distribution and extent within the GSB may change between the 2019 characterisation survey and the time when the headworks are installed. The results of a pre-construction (Year -1) survey would therefore first be used to determine whether monitoring is required based on the presence or absence of *S. spinulosa* reef around the headwork positions. Subsequently, a series of pre-construction and post-construction monitoring surveys would be conducted. Although the Year -1 pre-construction survey would be conducted primarily to provide an updated assessment of impacts on *S. spinulosa* reef and inform mitigation and monitoring, it is expected that the outputs of this survey would feed into the monitoring time-series.

Options for monitoring were discussed with NE during the bilateral meeting on the 18th of August 2021. A Before–After Control–Impact (BACI) design was proposed but following consultation with NE a transect approach was determined to be more appropriate. The transects would extend from impacted to unimpacted areas within the vicinity of the southern CWS intake head positions. While the specific design is not available at this stage, the objective would be to test the predictions of the ES with respect to the effects of Unit 1 CWS intake installation on *S. spinulosa* reef around the headworks (including 50m construction zones) and the subsequent recovery of *S. spinulosa* reef. A full specification of the survey will be designed in consultation with the MMO and NE and will be provided in a detailed Monitoring Plan.

4.2 Survey methods

As with the 2019 characterisation survey (BEEMS Technical Report TR512), the pre-construction (Year -1) survey and subsequent monitoring surveys would attempt to classify *S. spinulosa* reefs based on criteria proposed by Hendrick & Foster-Smith (2006) and adapted to the specific environmental considerations at the site. This methodology is recommended in the reef assessment guidance by the Joint Nature Conservation Committee (Gubbay, 2007) and uses a multi-criterion scoring system to assess characteristics that determine *Sabellaria* ‘reefiness’, namely spatial extent, elevation, and patchiness (Table 3).

Table 3: Criteria recommended by Gubbay (2007) for the classification of *Sabellaria* reef. The table includes thresholds for qualification as reef and to be classified as having low, medium, and high ‘reefiness’.

Measure of ‘reefiness’	Not a reef	Low	Medium	High
Spatial extent (m ²).	<25	25-10,000	10,000-100,000	>1,000,000
Elevation (cm) (Average tube height).	<2	2-5	5-10	>10
Patchiness (% of spatial extent occupied by worm tube aggregations).	<10	10-20	20-30	>30

Standardised and repeatable data acquisition and analyses are required to monitor the presence and condition (i.e., 'reefiness') of biogenic reefs (Jenkins *et al.*, 2018). Therefore, an approach similar to that used for the 2019 characterisation survey is proposed for the pre-construction (Year -1) survey and subsequent monitoring surveys. Potential reef extent would be assessed using acoustic (e.g., sidescan sonar) surveys and informed by ground-truthing surveys conducted using a high-resolution acoustic imaging camera. Reef elevation and proportional cover can be measured from the high-resolution acoustic images used for ground-truthing; however, following the installation of CWS intake heads, ground-truthing would not be possible in close proximity to the infrastructure due to safety concerns. Predictive mapping can theoretically be used to assess reef characteristics based on the acoustic texture, but this proved difficult in the 2019 characterisation survey as the composition and physical properties of Coralline Crag (cemented sands and biogenic detritus) are similar to those of *S. spinulosa* reef (agglomerated sand) (BEEMS Technical Report TR512). Therefore, it is expected that monitoring would focus mainly on changes to spatial extent rather than reef elevation or patchiness (see paragraph 22.12.25, **Volume 2, Chapter 22** of the **ES** (Doc Ref. 6.3) [[AS-035](#)]). The proposed survey methods are outlined in Sections 4.2.1-4.2.3.

4.2.1 Acoustic surveys

The spatial extent of potential *S. spinulosa* reef would be assessed using remote sensing approaches. When used in combination with ground-truthing data, sidescan sonar (SSS) is considered the most suitable tool for identifying areas of potential reef (Limpenny *et al.*, 2010) and was used for the 2019 characterisation survey (BEEMS Technical Report TR512). It is therefore recommended that this method is used for the pre-construction (Year -1) characterisation survey and subsequent monitoring surveys. The SSS data should be collected and processed to produce a final SSS mosaic, with a minimum of 100% coverage of the area around the southern CWS intake head positions. Bathymetric and backscatter data, which will be collected as part of the geophysical monitoring of seabed changes associated with CWS intake head installation, may help to discriminate reef features from other surfaces when interpreted alongside a SSS mosaic.

4.2.2 Ground-truthing surveys

As the water in the GSB is too turbid to use traditional light-based camera systems (e.g., freshwater lenses), a Sound Metrics Adaptive Resolution Imaging Sonar (ARIS) Explorer 3000 is recommended to capture high-resolution acoustic images for ground-truthing of reef presence and characteristics. A method developed by Cefas is proposed to measure reef elevation and percent cover in acoustic images (see BEEMS Technical Report TR473 and TR512). The acoustic images would be analysed by an expert benthic taxonomist, with a second review recommended for quality checking purposes. Benthic grabs would be used as a backup to ground-truth the presence of *S. spinulosa* reef if there is a failure of the ARIS acoustic imaging camera.

4.2.3 Habitat mapping

It is proposed that the ground-truthing data and SSS mosaic are plotted and explored together using Geographic Information Systems (GIS) such as ESRI ArcMap, with *S. spinulosa* reef identified in the high-resolution acoustic images compared to the corresponding SSS acoustic texture. Data products from an SSS mosaic do not currently allow for analyses using machine learning. Therefore, mapping of *S. spinulosa* reef (and potentially 'reefiness' if this can be determined from the acoustic texture) would be conducted manually based on expert judgement, ground-truthing, and comparison with published catalogues (Foster-Smith and White, 2001; Pearce *et al.*, 2011; Jenkins *et al.*, 2018; Griffin *et al.*, 2020). A quality check process would be used to ensure that decision rules are applied consistently between repeated surveys.

4.3 Survey schedule

It is proposed that monitoring is carried out regularly, starting prior to construction and continuing up to five years post-construction. This is consistent with advice provided by NE (see Appendix A, Comment ID NE-439 and NE-470). Specifically, a pre-construction (Year -1) survey would be conducted to determine reef presence/spatial extent and inform anchor spread design and barge positioning, where feasible, to minimise impacts on *S. spinulosa* reefs present at the time.

A baseline (Year 0) monitoring survey would be undertaken prior to construction followed by three post-construction monitoring surveys in Years 1, 3, and 5 (Table 4). The Year 1 survey is proposed to assess the effects of headwork installation, after which the subsequent surveys are proposed to take place at two-year intervals to give sufficient time for reefs to recover to a degree that would be detectable using the available survey methods (see Section 4.2). The proposed reporting deliverables associated with the surveys are outlined in Table 5.

Table 4: *Sabellaria spinulosa* reef survey schedule and objectives.

Survey	Survey schedule	Objective
Characterisation survey.	August 2019.	Inform the impact assessment and mitigate impacts.
Pre-construction survey.	Year -1	Update the impact assessment; inform mitigation and monitoring approaches; feed into baseline (pre-construction) monitoring.
Monitoring surveys.	Year 0 (pre-construction)	Baseline monitoring.
	Year 1	Assess potential construction effects and subsequent recovery.
	Year 3	
	Year 5	

Table 5: Proposed reporting deliverables for the monitoring of the *S. spinulosa* reefs.

Deliverable	Based on	Objectives	Delivery dates
Reef Management and Monitoring plan.	Year -1 pre-construction survey.	Predict effects on <i>S. spinulosa</i> reef. Inform mitigation measures (see Section 3.2) and determine monitoring requirements. Present a detailed monitoring survey design and methodology.	At least 6 months prior to Unit 1 intake installation works.
Monitoring reports.	Year 0 (baseline) monitoring.	Determine baseline spatial extent of <i>S. spinulosa</i> reef prior to headwork installation. Update the predicted effects on <i>S. spinulosa</i> reef.	Within 6 months of the survey completion.
	Year 1 monitoring.	Determine the effects of headwork installation on <i>S. spinulosa</i> reef.	
	Year 3 monitoring.	Monitor the recovery of <i>S. spinulosa</i> reef following headwork installation.	
	Year 5 monitoring.	Monitor the recovery of <i>S. spinulosa</i> reef following headwork installation.	

5 Proposed next steps and actions

The steps that will be followed in implementing the *Sabellaria* Reef Management and Monitoring Plan and subsequent actions are outlined in Table 6. This outline should be considered as indicative and will be updated with activity timescales post-consent once further project details are available and will be revised to incorporate ongoing consultations with the MMO and NE.

Table 6: *Sabellaria* reef management and monitoring process.

Step	Proposed Actions
1	Submit Draft <i>Sabellaria</i> Reef Management and Monitoring Plan (this report), outlining the measures proposed to avoid, minimise, and offset impacts on <i>Sabellaria</i> reef and the proposed approach for monitoring potential adverse effects. Comments from the Marine Management Organisation (MMO) and Natural England (NE) will be incorporated at a later deadline within the Development Consent Order (DCO) Examination.
2	Consult with Eastern Inshore Fisheries & Conservation Authority (IFCA) post-DCO Examination regarding possible opportunities to collaborate to reduce anthropogenic impacts on <i>S. spinulosa</i> reef and to implement a potential marine litter removal programme.
3	Consult with the MMO and NE on the design of a pre-construction (Year -1) survey that will be used to determine the distribution and extent of <i>S spinulosa</i> reef around the southern cooling water system (CWS) intake head positions (Unit 1) prior to their installation.
4	Conduct the pre-construction (Year -1) survey.
5	Interpret data from the pre-construction (Year -1) survey and, in consultation with NE, use this to assess impacts and inform the mitigation and monitoring of <i>S. spinulosa</i> reef. Specifically, the results of this survey would inform the positioning of barges and anchors used during headwork installation so that their placement on potential <i>S. spinulosa</i> reef is avoided or minimised, as far as practicable.
6	Submit an updated <i>Sabellaria</i> Management and Monitoring Plan to the MMO at least 6 months prior to the proposed commencement of installation of Unit 1 cooling water system intakes (Work 2B), as secured under Deemed Marine Licence (DML) Condition 45.
7	Conduct monitoring of <i>S. spinulosa</i> reef and submit monitoring reports to the MMO following the schedule outlined in Table 4 and Table 5.

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Appendix A Natural England Relevant Representations

Comment ID	Comment
NE-439	<p>Environmental Statement (Doc Ref 6.3) Volume 2 Main Development Site Chapter 22 Marine Ecology and Fisheries</p> <p><i>Sabellaria spinulosa</i></p> <p>The consultation documents indicate that the proposed development site includes <i>Sabellaria spinulosa</i> Reef, a habitat of principle importance, as listed on Section 41 of the Natural Environmental and Rural Communities (NERC) Act 2006. The fact that <i>Sabellaria</i> is listed under section S41 means that the public authorities must, in exercising its duty under section 40 of the NERC Act 2006, have regard to the conservation of this habitat when carrying out their normal functions.</p> <p>Natural England recommends a 50m buffer area be established for works in proximity to <i>Sabellaria spinulosa</i>. It is not clear if the 50m radius has been assessed in relation to dredging and drilling plumes and scour protection.</p> <p>Natural England would not consider any recolonisation of <i>Sabellaria spinulosa</i> on hard substrate to constitute natural reef – please see Natural England’s position statement for Norfolk Vanguard (RR-106, EN010079) and Norfolk Boreas (RR-099, EN010087) and Hornsea Project 3 (RR-097, EN010080) offshore windfarms. Therefore colonisation on artificial structures or scour protection would not be considered <i>Sabellaria</i> Reef</p> <p>Due to the long lead in time of design and construction of a nuclear power station however Natural England recognise that it may not be possible to avoid all areas of <i>Sabellaria</i> Reef which may have formed in the intake outfall location in the interim. However, impacts must be minimised using pre-construction survey data. As per previously requested DCO/DML condition.</p> <p>We would suggest that if <i>Sabellaria spinulosa</i> Reef is found on the outcrop prior to construction that post construction monitoring of the intake and outfall is undertaken at 0, 3 and 5 year intervals to assess recolonization has occurred.</p>
NE-443	<p>Environmental Statement (Doc Ref 6.3) Volume 2 Main Development Site Chapter 22 Marine Ecology and Fisheries</p> <p>Locations of CWS</p> <p>Why is <i>Sabellaria</i> found present from surveys in western location, but not determined to be medium/high confidence in reed?</p> <p>We note Plate 22.5 showing areas of potential <i>Sabellaria</i> reef and confidence levels. Natural England advise that the proposed East Location for Unit 1 cooling water intake, which survey data from 2019 indicated to be in a high confidence area of <i>Sabellaria</i> reef, should be avoided where possible in order to reduce potential impacts to this NERC habitat.</p> <p>NE requests that pre construction survey to identify the presence of reef habitats 12 month prior to construction is undertaken to inform micro-siting to avoid impacts to this habitat. Where this is not possible every effort should be made to minimise the impact. The undertaking of this survey and reporting thereof should be a condition of the DCO/DML</p>

<p>NE-456</p>	<p>Environmental Statement (Doc Ref 6.3) Volume 2 Main Development Site Chapter 22 Marine Ecology and Fisheries</p> <p>Abrasion/physical disturbance maintenance operations</p> <p>We note that maintenance of infrastructure may be needed every 18 months as a WCS from a jack up barge or anchored vessel.</p> <p><i>Sabellaria</i> has a medium/high sensitivity to this pressure, as it would be a recurring pressure and there may be insufficient time for recovery between events. As such, we would welcome monitoring, is any monitoring proposed with a trigger for mitigation to include using vessels with directional positioning in areas of <i>Sabellaria</i> Reef.</p>
<p>NE-470</p>	<p>Environmental Statement (Doc Ref 6.3) Volume 2 Main Development Site Chapter 22 Marine Ecology and Fisheries</p> <p><i>Sabellaria</i></p> <p>Given the potential for jack up barges and anchoring vessels to damage NERC <i>Sabellaria</i> habitat on the Coralline Crag Natural England recommend that regular monitoring of this habitat be included in the CoCP , with limits in habitat change identified to trigger the use of less damaging methods such as directional positioned vessels.</p> <p>We welcome the commitment to a post construction survey. We expect this to be comprehensive, and parameters should include extent, elevation and percentage cover. We would advise surveys at 1, 3 and 5 years post construction of the intake and outfall pipes being installed in order to assess recovery over time. Is this secured in CoCP? DCO /DML?</p> <p>We welcome monitoring general reef extent as part of WDA permit condition at intervals of 3 to 5 years. Monitoring however is not mitigation. It is not clear from the EIA should effects on the reef be determined what mitigation could or would be put in place. Moreover where is the commitment to monitoring and subsequent mitigation secured in relation to the DCO. The WDA permit conditions may not be finalised until after the completion of the Examination for the proposed development so Natural England cannot currently comment on any mitigation that may be agreed and secured under the separate permitting application.</p> <p>Mitigation for <i>Sabellaria</i> as presented in Table 22.156 should include where possible avoiding any works in <i>Sabellaria</i> reef and a 50m buffer.</p>