

REPORT

Goodwin Sands Aggregate Dredging Scheme

Preliminary Monitoring Plan

Client: Dover Harbour Board

Reference: I&BPB2107R001D01

Revision: 01/Final

Date: 07 October 2016

HASKONINGDHV UK LTD.

2 Abbey Gardens
Great College Street
London
SW1P 3NL
Industry & Buildings
VAT registration number: 792428892

+44 207 2222115 **T**
info.london@uk.rhdhv.com **E**
royalhaskoningdhv.com **W**

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Author(s): Reinier Zoutenbier

Drafted by: Reinier Zoutenbier

Checked by: David Cook

Date / initials: 28th September 2016 / DC

Approved by: Adam Pharaoh

Date / initials: 7th October 2016 / AP

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Acronyms

Acronym	Description
DHB	Dover Harbour Board
DWDR	Dover Western Docks Revival
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEIR	Further Environmental Information Report
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
MESL	Marine Ecological Surveys Limited
MMO	Marine Management Organisation
PIZ	Primary Impact Zone
PSA	Particle Size Analysis
PSD	Particle Size Distribution
RSMP	Regional Seabed Monitoring Programme
SIZ	Secondary Impact Zone
ToR	Terms of Reference
WSI	Written Scheme of Investigation
ZOI	Zone of Influence

1 Introduction

1.1 Background

In May 2016 Dover Harbour Board (DHB) submitted a Marine Licence application to the Marine Management Organisation (MMO) to undertake aggregate dredging at South Goodwin Sands (application reference MLA/2016/00227). The supporting Environmental Statement (ES) acknowledged the requirement for environmental monitoring during the scheme and committed to preparing a detailed monitoring plan following issue of a Marine Licence.

The MMO issued a letter to DHB on 5th August 2016 in relation to the Marine Licence application. In this letter, the MMO provided their comments, following consultation, on the MLA application and requested further information on a number of topics included in the ES. On 23rd September 2016 DHB submitted a Further Environmental Information Report (FEIR) to the MMO to address the MMO comments and provide the required further information.

In the letter received from the MMO on 5th August 2016, the MMO advised that a Preliminary Monitoring Plan would need to be agreed with the MMO prior to a Marine Licence determination. This document has therefore been produced to provide this information to the MMO. The advice provided by the MMO has been copied below for ease of reference:

Changes Required

- 9.1. *It is indicated that a monitoring plan will be deferred until a licence has been issued. A monitoring plan will need to be agreed with the MMO prior to the issue of a marine licence.*
- 9.2. *The monitoring plan must use the 'limits of acceptable change' methodology adopted by the wider marine aggregate industry as defined by Cooper (2012).*
- 9.3. *It is proposed that seabed monitoring/surveys will be undertaken after the cessation of dredging, in Phase 3. Monitoring/survey work needs to occur throughout the life of the project to ensure that any adverse impacts are observed early and in time for adaptive management or mitigation to be employed. Monitoring should occur after Phase 1 or potentially Phase 2. The decision on when the next survey should occur will depend on the quantities likely to be removed in each phase and agreed as part of a monitoring plan.*

It is anticipated that dredging will take place between September 2017 and July 2019 in three stages corresponding to the relevant Dover Western Docks Revival (DWDR) construction stages for which the aggregate is required. The licence duration applied for is 23 months (September 2017-July 2019).

1.2 Purpose of this Document

This document provides a Preliminary Monitoring Plan for agreement with the MMO. It covers the following monitoring areas:

- Coastal processes;
- Benthic ecology; and
- Marine mammals.

Archaeological monitoring is addressed within the separate Archaeological Written Scheme of Investigation (WSI), which has been issued to the MMO for agreement alongside this Preliminary Monitoring Plan. The scope of the geophysical monitoring proposed within this plan aligns with that proposed within the WSI, with only the nature of the data interpretation differing, as appropriate.

2 Monitoring proposals

2.1 Introduction

The following sections set out the proposed monitoring in relation to the receptors identified in **Section 1.2**. Each section describes the monitoring that DHB intends to undertake prior to, during and post dredging and outlines the aims of the monitoring activities. Where appropriate reference has been made to specific sections within the ES (Royal HaskoningDHV, 2016a) and FEIR (Royal HaskoningDHV, 2016b) in which monitoring commitments were made.

2.2 Coastal Processes

2.2.1 Overview

As stated in Section 6 of the FEIR, DHB has committed to maintaining a minimum average sediment depth of 1m *in situ* overlying bedrock to facilitate the re-colonisation and recovery of benthic communities. In accordance with MMO Standard and Model Conditions for Marine Licence (MMOAGG3A) (MMO, 2014) it is proposed that this sediment coverage will be measured over a 250m by 250m grid centred on 125m nodes.

This section describes the geophysical monitoring DHB is proposing to undertake to monitor the bathymetry and morphology of the sandbank and seabed within the dredge area and the surrounding area. Details on the baseline environment prior to dredging can be found in ES Section 6.5.

The aims of the proposed monitoring are as follows:

- To monitor the bathymetry and morphology of the sandbank within and surrounding the dredge area both before and after each dredging stage;
- To monitor the seabed surrounding the sand bank for any changes post dredging; and
- To provide up to date information on water depth pre and post each dredging stage to inform dredging operations.

2.2.2 Surveys undertaken to date

EGS (2015)¹ collected bathymetric data across South Calliper and South Goodwin Sands to provide a broad characterisation of the water depth and seabed topography over the exploration area. The survey was carried out between July 2015 and August 2015 and deployed multi-beam echo sounder, side-scan sonar and sub bottom profiler, covering 100% of the sea bed in the exploration area. DHB proposes to use this survey data as a baseline against which monitoring results can be compared.

2.2.3 Proposed coastal processes monitoring

As discussed above, it is anticipated that dredging will take place between September 2017 and July 2019 in three stages corresponding to the relevant DWDR construction stages for which aggregate is required.

Monitoring surveys will take place before and after each stage of dredging and will comprise full coverage of high resolution multibeam bathymetry data across the area illustrated in **Figure 2.1**. The extent of the monitoring area has been established to comprise:

¹ EGS (2015). *Goodwin Sands Geophysical Survey 2015. Interpretative Report. November 2015.*

- The proposed dredge area.
- A 1km buffer around the proposed dredge area, which incorporates the protected area of the *Admiral Gardner* (for more detail on archaeological monitoring and mitigation, see the WSI).
- The Zone of Influence (ZOI) defined from the outputs of the wave, tidal current, sediment transport and sediment plume modelling undertaken for the EIA and presented in the ES. The ZOI incorporates the 10mg/l suspended sediment plume footprint and the footprint of the maximum extent of 2cm change in significant wave height. Changes smaller than 2cm would be insignificant and virtually unmeasurable in reality. The Secondary Impact Zone (SIZ) also captured the extent of predicted changes to tidal currents and sediment transport which were more local to the proposed dredge area.
- The protected areas around *Northumberland* and *Restoration* wrecks, located to the north of the ZOI (for more detail on archaeological monitoring and mitigation, see the WSI).

The decision to undertake only high resolution multibeam surveys has been made for the following reasons:

- A full coverage side scan sonar survey was undertaken to inform the ES. This survey identified archaeological anomalies only in areas where sand coverage is lower. In the event that a feature with archaeological potential is identified during either the dredging operations or the multi beam survey, a side scan sonar survey will be undertaken to further investigate the anomaly, during which time dredging activities will cease in that area.
- No evidence of any biogenic reef features or mussel bed was found during the grab survey, trawl survey and analysis of the side scan sonar data acquired for the ES. The multi-beam survey is anticipated to be of comparable quality and will be entirely sufficient to monitor any changes in seabed morphology.

The position of the proposed dredge area within the original exploration area is such that, while the proposed dredge area has full coverage of side scan sonar and multibeam bathymetry data, this is not inclusive of a buffer zone on all sides. Although the majority of the proposed dredge area is inclusive of a buffer, the southernmost edge, north eastern edge and north western edge of the proposed dredge area are directly adjacent to the extents of the existing geophysical survey coverage, although extended cross lines beyond the immediate exploration area were acquired at intervals.

Work to date for the ES has confirmed that the mobility of the sands is high. The pre-dredge assessment will facilitate the identification of any changes that have taken place between the acquisition of the 2015 data and the pre-dredge survey. This is of particular relevance within the southern point of the proposed dredging area and south west corner of the northern section where sand levels are lower than those recorded in 1846. This will also provide full coverage of the proposed dredge area inclusive of a 1km buffer zone around the extents of the area.

Post-dredge monitoring will inform understanding of the nature and extent of the dredging impact on coastal processes.

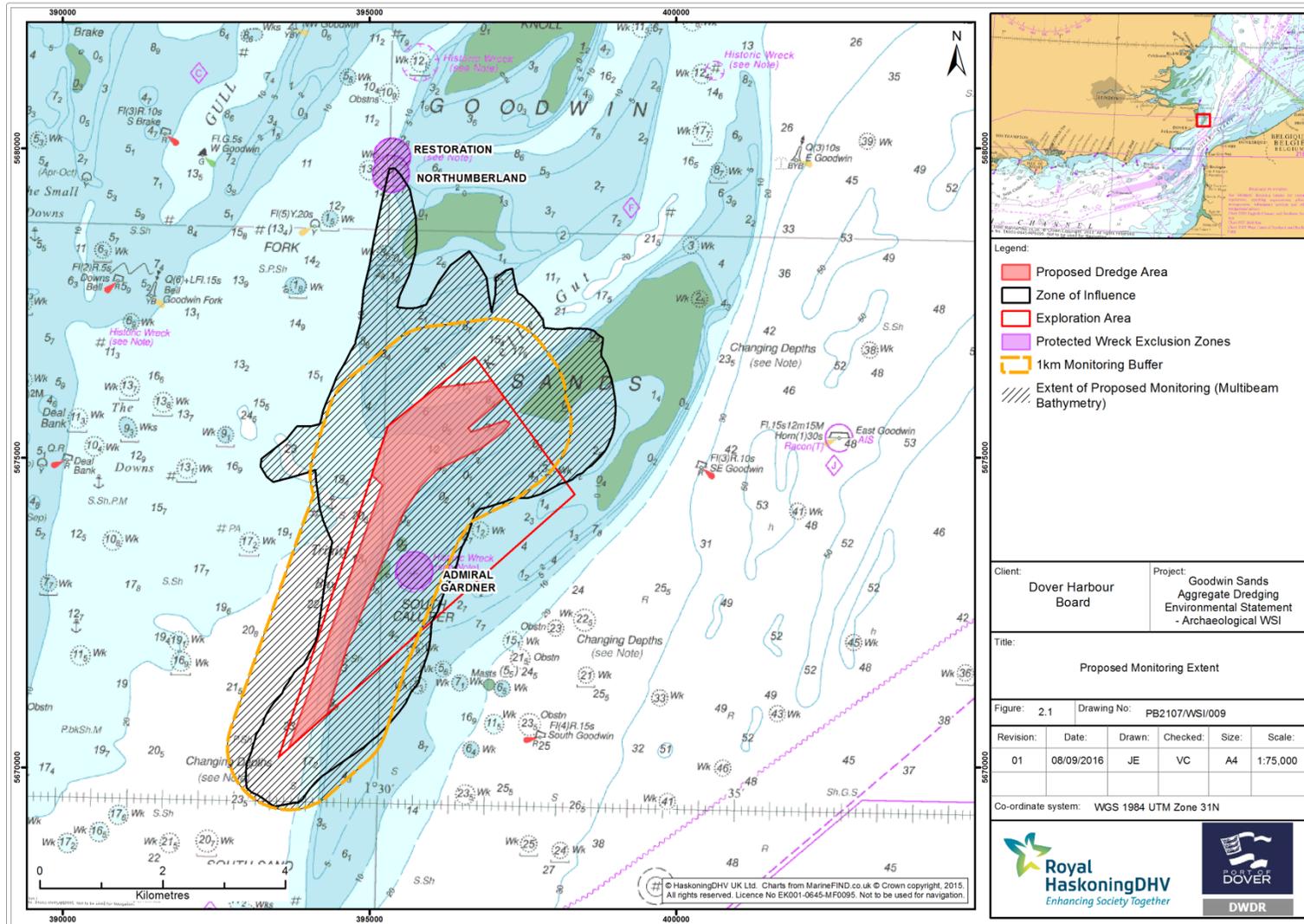


Figure 2.1 Proposed monitoring extent

2.3 Benthic ecology

2.3.1 Introduction

In August 2015 a survey was carried out to characterise the benthic and epibenthic ecology within the Goodwin Sands exploration area and surroundings and to provide data to inform the site selection process and Environmental Impact Assessment (EIA) for aggregate extraction on South Goodwin Sands. Due to the short time period between August 2015 and the planned start of the dredging scheme in September 2017, it has been agreed with the MMO that the 2015 survey will also serve as the pre-dredge monitoring survey.

Marine Ecological Surveys Limited (MESL) has prepared a Terms of Reference (ToR) for the benthic monitoring survey at Goodwin Sands. This ToR has been appended to this document (see **Appendix A**). **Appendix A** outlines the monitoring specifications for the benthic monitoring survey, providing detail on the proposed sampling locations, methodologies, analysis techniques and reporting as well as on the required consents and recommended timing of the survey. A summary of the proposed monitoring surveys outlined in the ToR is provided below.

2.3.2 Summary of planned benthic monitoring

The benthic monitoring survey at Goodwin Sands will focus on determining whether sediments in the area of interest fall within acceptable change limits for sediment particle size. The limits for acceptable change will be calculated following the methods outlined in Cooper (2012)².

To detect any change in sediment composition and associated faunal communities that may occur as a result of dredging activity at Goodwin Sands, it is proposed that a single post-dredge survey is conducted.

During the 2015 baseline survey and following a review of side scan data and Defra rMCZ survey datasets (Defra, 2015) (see ES Section 8.4), no Annex I reef habitats were recorded or identified within the proposed dredge area or SIZ. Therefore based on this and the short dredging programme duration (23 month Marine Licence - see **Section 1.1**), a single post-dredge survey will be conducted after all dredging has been completed (i.e. after Stage 3, currently scheduled to end in July 2019). Furthermore, a single survey following the cessation of dredging is considered to be sufficient as the likelihood of changes to the benthic habitats as a result of the dredging works is deemed to be low based on the predominantly fine sandy habitats and faunal complement that were reported from the 2015 baseline survey, and as discussed at length in the ES.

The principal objectives of the benthic monitoring survey are as follows:

- To describe the distribution of sediment types in the survey area;
- To determine if sediment types fall within acceptable change limits for the area; and
- To determine any notable changes in the benthic faunal communities in the context region as a result of dredging activity.

The post-dredge survey at Goodwin Sands will comply with the methodology set up for the Regional Seabed Monitoring Programme (RSMP) by Cefas and the aggregates industry. The licence area (PIZ), SIZ³, reference and context areas will all be taken into account during the survey.

² Cooper, K. C. 2012. *Setting limits for acceptable change in sediment particle size composition following marine aggregate dredging. Marine Pollution Bulletin*. 64: 1667-1677.

In order to achieve the objectives listed above, appropriate methodologies for benthic sediment surveys of the licence area and the surrounding area are set out in the ToR. In brief they will comprise of the following:

- Sediment particle size distribution (PSD) samples will be collected across all areas to enable the detection of changes in seabed sediment composition following ground-truthing. Following this any changes beyond the limits of acceptable change will be established. The sediment limits will be defined as % gravel, % sand and % silt/clay following the methods of Cooper (2012).
- It is proposed that 71 grab samples will be collected for sediment PSD only from across the PIZ, SIZ, reference and context areas (**Figure 2.2**). Faunal samples will be collected from 7 stations. The collection of faunal samples will allow for the observation of any natural variability which has occurred at Goodwin Sands. Particle Size Analysis (PSA) will also be undertaken for each PSD sample.
- Epibenthic monitoring will not be undertaken as part of the post-dredge monitoring. The data gained by epibenthic beam trawling is considered to be semi-quantitative at best and more appropriate for site characterisation rather than ongoing monitoring, and as such is of limited value. It is recognised that Goodwin Sands is a known habitat for sandeels which display an affinity for sediment of certain grain sizes. A review of any changes in sediment composition and how these changes may have effected sandeel population present at the site, is therefore, considered to be a viable alternative to an epibenthic survey which may provide minimal data that is temporally comparable.
- Upon completion of the data analysis, a technical report will be produced including details of the survey and data processing as well as interpretation of the ecological data.

³ The PIZ has been assumed to be the entire license area. The SIZ is the region where indirect impacts from dredging may result in marked changes in faunal and sediment composition as a result of the deposition of fines. The SIZ at Goodwin Sands has been estimated using tidal information. One hour of flow in each relevant vector for each hour of tide (taken from tidal diamond information) has been applied to the vertices of the dredging area boundary in order to estimate the maximum likely SIZ.

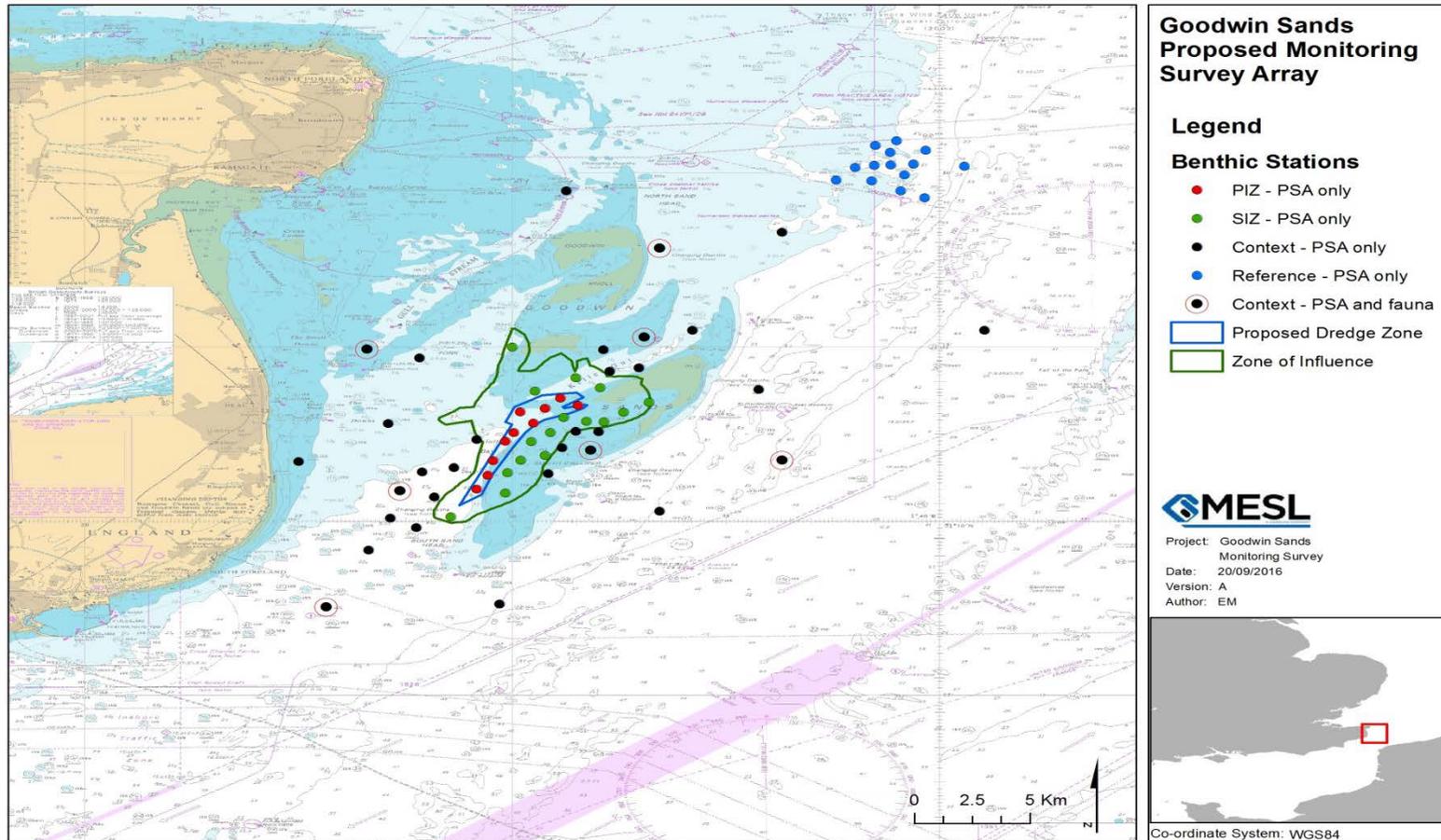


Figure 2.2 Locations of proposed stations for post-dredge benthic survey at Goodwin Sands. Stations within the licence area PIZ are shown in red, and stations in the predicted SIZ in green, context area stations are shown in black and reference stations are in blue. Samples to have macrofaunal samples retained are circled in purple.

2.4 Marine mammals

2.4.1 Visual monitoring of marine mammals

It is proposed that the dredger(s) will have a Marine Mammal Observer on board for the first and second dredging periods. The Marine Mammal Observer will have completed a Joint Nature Conservation Committee (JNCC) approved Marine Mammal Observer course and will undertake visual monitoring for marine mammals around the vessel during dredging. The Marine Mammal Observer will undertake marine mammal observations throughout the dredging process, where conditions allow (i.e. sea state ≤ 3 and good visibility).

The visual monitoring records (marine mammal recording forms) will be reviewed regularly in order to determine the ongoing requirement for a Marine Mammal Observer to be on board, and whether any additional mitigation is required.

Any marine mammal sightings will be recorded on marine mammal observation forms. These forms will include start and finish time of observations, conditions during observations (e.g. sea state, visibility, weather, etc.). The Marine Mammal Observer will complete the relevant JNCC marine mammal recording form(s) (example form included as **Appendix B**) and write up a report as per the JNCC guidelines. It is intended that the JNCC form will be amended so it is relevant to dredging activities as the original form was prepared to record marine mammals during seismic surveys. This amended form will be agreed with the MMO and JNCC prior to its use on Goodwin Sands.

The Marine Mammal Observer will also alert the crew if there is any potential risk of a collision so that, where possible, suitable actions can be taken if required. Actions might include, for example, reducing speed, not intercepting the animal's travel path or approaching the animal head on, stopping works or alerting other vessels. These actions will be undertaken to avoid collisions or risk of injury to marine mammals.

2.4.2 Maintaining of pre-determined distances from haul-out sites

It is agreed that the dredger(s) would avoid known seal haul-out sites at Goodwin Sands (based on data presented in Figures 10.7 and 10.9 of the ES) by maintaining a minimum distance of 1km between the dredger(s) and the exposed sandbanks. This 1km exclusion zone around known seal haul-out sites will not remain static but move relative to the area of exposed sand and will be maintained when the dredger(s) are undertaking dredging activity and when in transit to and from the site. **Figure 2.3** of this document shows an indicative 1km exclusion zone in relation to exposed sand at known seal haul-out sites. This indicative zone is based on the extent of intertidal area shown on the latest available Admiralty Chart (as of 22/09/16), which shows depths reduced to Chart Datum, which is approximately the level of Lowest Astronomical Tide (LAT)⁴. It is highlighted that this presents a worst case exclusion zone extent as it is based on LAT. In addition, the exclusion zone has been drawn from the edge of the intertidal (shown in green on the Admiralty Chart) not from the point locations where seals have been sighted.

In addition, it is proposed that during the sensitive times of the year (June to July for the harbour seal breeding season and August for the harbour seal moult period) the dredger(s) would avoid known seal haul-out sites at Goodwin Sands (based on data presented in Figures 10.7 and 10.9 of the ES) by maintaining a minimum distance of 1.5km between the dredger(s) and the exposed sandbanks. This

⁴ The UK Hydrographic Office defines LAT as the lowest level which can be predicted to occur under average meteorological conditions, and under any combination of astronomical conditions; these levels will not be reached every year. See <http://www.ukho.gov.uk/Easytide/easytide/Support/faq.aspx>

seasonal 1.5km exclusion zone will not remain static but move relative to the area of exposed sand and will be maintained when the dredger(s) are undertaking dredging activity and when in transit to and from the site during June, July and August. **Figure 2.3** of this document shows an indicative 1.5km exclusion zone in relation to exposed sand at known seal haul-out sites. As outlined above this is based on the extent of intertidal shown on the latest available Admiralty Chart (as of 22/09/16), which shows depths reduced to Chart Datum, which is approximately the level of LAT. It is highlighted that this presents a worst case exclusion zone extent as it is based on LAT. In addition, the exclusion zone has been drawn from the edge of the intertidal (shown in green on the Admiralty Chart) not from the point locations where seals have been sighted.

The proposed 1.5km exclusion zone around known haul-out sites during sensitive times of the year (harbour seal breeding and moulting periods in June, July and August) will provide additional and effective mitigation for the potential disturbance of seals at known haul-out sites. It is also envisaged that these minimum distances would be easy to maintain and would not compromise the efficiency of dredging activities because the proposed dredge area is more than 1km distant from the haul-out sites.

The dredger(s) will have a suitable trained person on board (as identified in **Section 2.4.1**) who will visually monitor any reaction or disturbance of seals at haul-out sites, including the type of reaction, number of animals and distance from the vessel. The visual monitoring records will help to determine if the proposed minimum distance between the dredger(s) and hauled-out seals is adequate. The observations will also provide valuable information on the reactions of seals to dredging vessels and dredging activities.

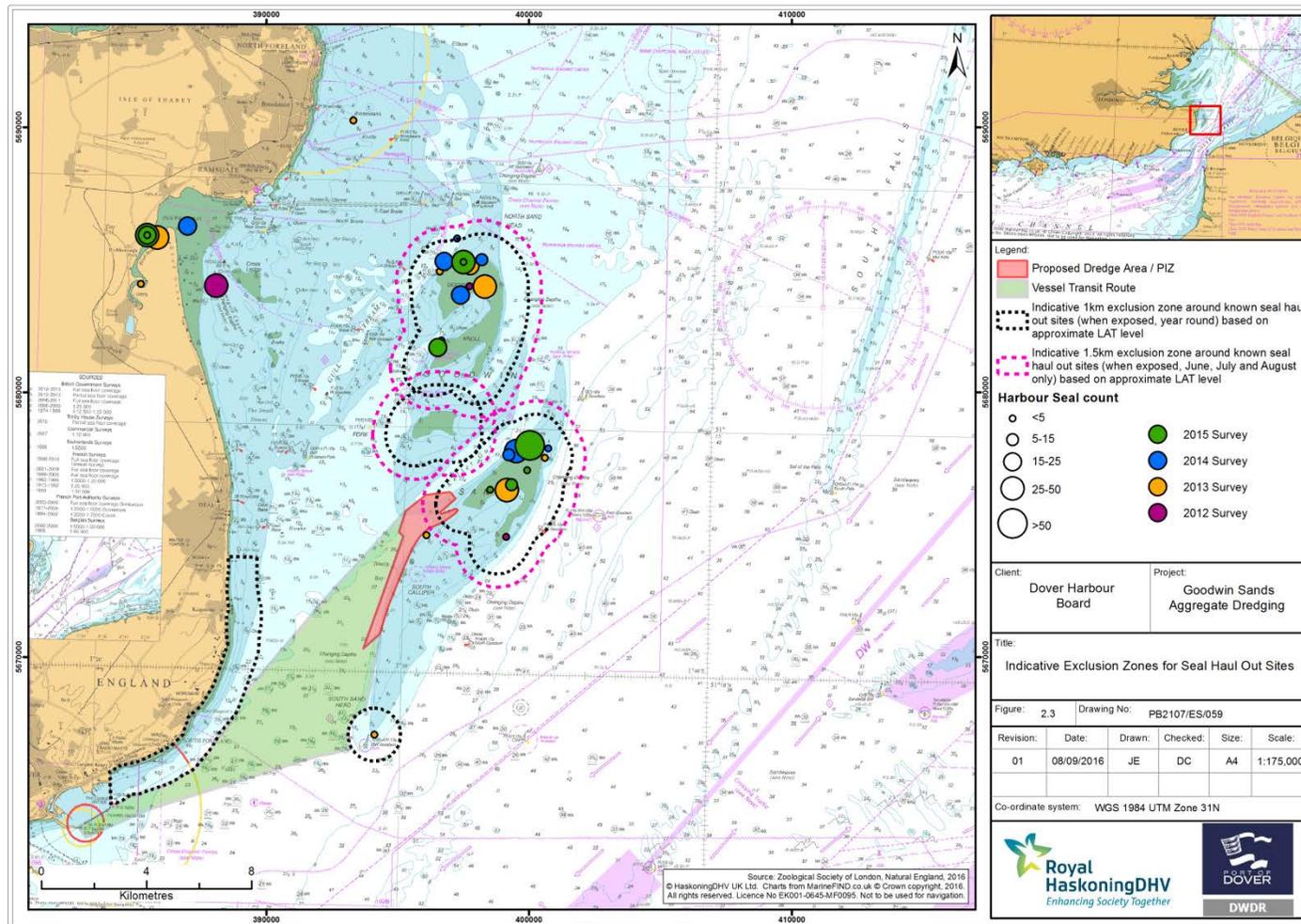


Figure 2.3 Indicative exclusion zones for seal out sites (based on intertidal extent at LAT)

References

Department for Environment, Food and Rural Affairs (2015). Goodwin Sands rMCZ Post-survey Site Report – Defra Marine Protected Areas Data and Evidence Co-ordination Programme. Defra Report No. 35.

MMO (2014). MMOAGG3A Standard and Model Conditions for Marine Licence - New Applications v1.1.

Royal HaskoningDHV (2016a). Goodwin Sands Aggregate Dredging Environmental Statement. May 2016.

Royal HaskoningDHV (2016b). Goodwin Sands Aggregate Dredging Scheme Marine Licence Application – Further Environmental Information Report. September 2016.

Appendix A - Draft Terms of Reference (ToR) for the ecological survey prepared by MESL

GOODWIN SANDS AGGREGATE EXTRACTION AREA

Benthic Ecology Monitoring Terms of Reference

September 2016

Prepared for

Royal HaskoningDHV

On behalf of Dover Harbour Board

By

Marine Ecological Surveys Limited



Report Warranty

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PREPARED FOR
Royal HaskoningDHV
CONTACT DETAILS:
David Cook 2 Abbey Gardens Great College Street Westminster London T: +44 (0) 20 7340 9696 David.cook@rhdhv.com

PREPARED BY
Marine Ecological Surveys Limited
CONTACT DETAILS:
3 Palace Yard Mews Bath U.K. BA1 2NH T: +44 (0) 1225 442211 marine@mesltd.co www.mesltd.co

Goodwin Sands Aggregate Extraction Proposed Post-dredge Survey		
TERMS OF REFERENCE		
Project Manager	David Alexander	
Report Author(s)	Elena Maher	
GIS	Elena Maher	
Report Proofing and Editing	David Alexander	
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A. Introduction

Marine Ecological Surveys Limited (MESL) has been commissioned by Royal HaskoningDHV on behalf of Dover Harbour Board (DHB) to prepare the Terms of Reference for the operational stage/post-dredge monitoring requirements at Goodwin Sands (Area 521).

Goodwin Sands has not previously been licensed for regular aggregate extraction. However extraction for specific infrastructure projects has been allowed in the past. Material has been taken off both the North and South Goodwin sites and extraction occurred in the late 1970s, from 1984 to 1990 and in 1998, which was the last time extraction occurred.

DHB have applied for a 3 year licence to dredge a proposed total of 3,750,000 tonnes to be extracted using a trailer suction hopper dredger. The proposed licence area lies approximately 6km off the coast of Deal in Kent, and covers an area of approximately 3.9km².

Prior to the dredging licence application being submitted, MESL conducted a marine benthic and epibenthic characterisation study in the Goodwin Sands area in order to inform the Environmental Impact Assessment (EIA) which supported the application. This survey identified the benthic and epibenthic communities present within the exploration area at Goodwin Sands and the sediment types with which they are associated. Following consultation and agreement with the MMO the characterisation survey followed the Regional Seabed Monitoring Programme (RSMP) approach to benthic studies, and served as both the characterisation study to inform the EIA and the pre-dredge baseline. A full summary of the survey results is located in Section B.

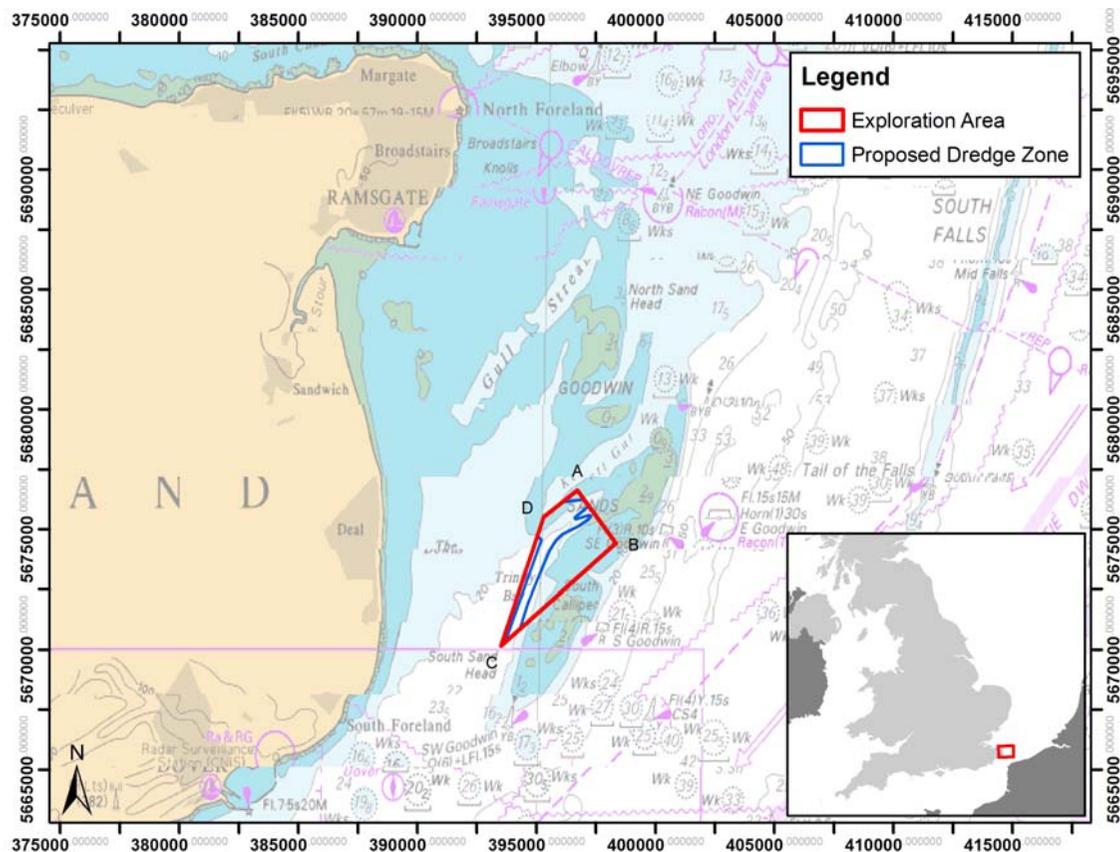
It is understood that as part of the marine licence application process DHB need to be able to demonstrate that consideration has been given to the next scheduled monitoring at the Goodwin Sands extraction site. This Terms of Reference document therefore sets out the monitoring specification for the next benthic ecological monitoring survey.

Following the RSMP approach, acceptable limits of change in sediment composition between the baseline and the next monitoring survey will be prepared by Keith Cooper of Cefas. Keith Cooper has been consulted in the preparation of these Terms of Reference. The post-dredge survey will comprise a repeat of the baseline array in line RSMP protocols, and subsequent analysis will assess compliance with the limits of acceptable change.

It is proposed that given the short term nature of the marine licence applied for (approximately 3 years), the next survey to be undertaken at Goodwin Sands will be conducted after the cessation of dredging and it will therefore serve as a post-dredge survey.

This document therefore sets out a summary of the characterisation work conducted in 2015 and the proposed specification for the post-dredge monitoring survey at the site.

The Goodwin Sands extraction area is shown in Figure 1. Coordinates of each vertex of the area are presented in Table 1.



		Marine Ecological Surveys Ltd 3 Palace Yard Mews Bath BA1 2NH +44 (0)1225 442211 Tel +44 (0)1225 444411 Fax www.mesltd.co		<h2 style="margin: 0;">Goodwin Sands</h2> <h3 style="margin: 0;">Proposed Dredge Area</h3>	
Project	Area 342 Goodwin Sands	0 2.5 5 km 		1:250,000	
Date	28/09/2016				
Version	C				
Comments					
Author	DA	Coordinate System		UTM31N	

Figure 1. The location of Goodwin Sands and the licence area (red) showing the vertices indicated in Table 1. Also shown in the proposed dredge zone (blue). ARCS Chart 1406-0 used under license from the UK Hydrographic office.

Table 1. The boundary co-ordinates of each vertex of the licence area of Goodwin Sands (decimal degrees WGS84).

	Latitude	Longitude
A	51.23168 N	1.52071 E
B	51.21201 N	1.54464 E
C	51.17296 N	1.47676 E
D	51.22140 N	1.50072 E

B. Characterisation Survey Summary

In August 2015 an investigation was carried out to characterise the marine ecology within the Goodwin Sands area of interest and to provide data to support an Environmental Impact Assessment (EIA) for aggregate extraction on South Goodwin Sands. The study also served to establish baseline environmental conditions prior to the start of dredging activity.

A total of 71 benthic grab stations were sampled. A sediment particle size distribution (PSD) sample was taken from each recovered grab and 50 samples were preserved for macrofaunal analysis. A sub-sample of sediment to be analysed for chemical contaminants was also taken from 70 samples. In addition, four epibenthic trawl samples were undertaken across the survey area.

As depicted in Figure 2 the survey area was split into the Primary Impact Zone (PIZ; the boundary of the exploration area), the Secondary Impact Zone (SIZ; the immediate tidal footprint around the exploration area), the Context Zone (sampled to give supporting information on the surrounding benthic environment), and a

Zone (located outside the range of any potential impacts, sampled to provide a comparison site). Impact zones are further defined in Section C.2.

B.1 Summary of 2015 Survey Data

A summary of the key results of the study are presented below:

1. Sediments throughout the survey area were generally characterised by sandy substrates, although relatively high proportions of gravel existed at some stations, particularly those in the SIZ to the south-west of the exploration area. Within the exploration area, sediments were almost exclusively sandy, with very little silt content. There was some degree of variability between sediment composition in the exploration area, the SIZ, the context zone and the reference zone.
2. Chemical contaminants analysis indicated that almost the entire suite of contaminants tested were below Cefas Action Level 1. Arsenic was the only contaminant to exceed this level, and no contaminants were present in concentrations above Action Level 2.
3. Benthic community composition across the survey area was dominated by Annelida in terms of contribution to total abundance and species richness. Echinodermata dominated contribution to total biomass. A total of 301 taxa were sampled during the course of the benthic biological survey.
4. The most abundant species recorded was the annelid worm *Spirobranchus lamarcki* and the crustacean *Pisidia longicornis*.

5. Greatest benthic abundance, species richness and biomass were typically concentrated in the SIZ to the south-west of the exploration area. Values for each index within the exploration area were comparatively low.
6. No reef habitats protected under Annex I of the EU Habitats Directive were observed during the benthic survey. Individuals of *Sabellaria spinulosa* and Mytilidae were recorded, however not in sufficient densities to reflect the presence of biogenic reef features. This was confirmed by review of acoustic data which did not reveal any habitats of conservation importance in the vicinity of the study site.

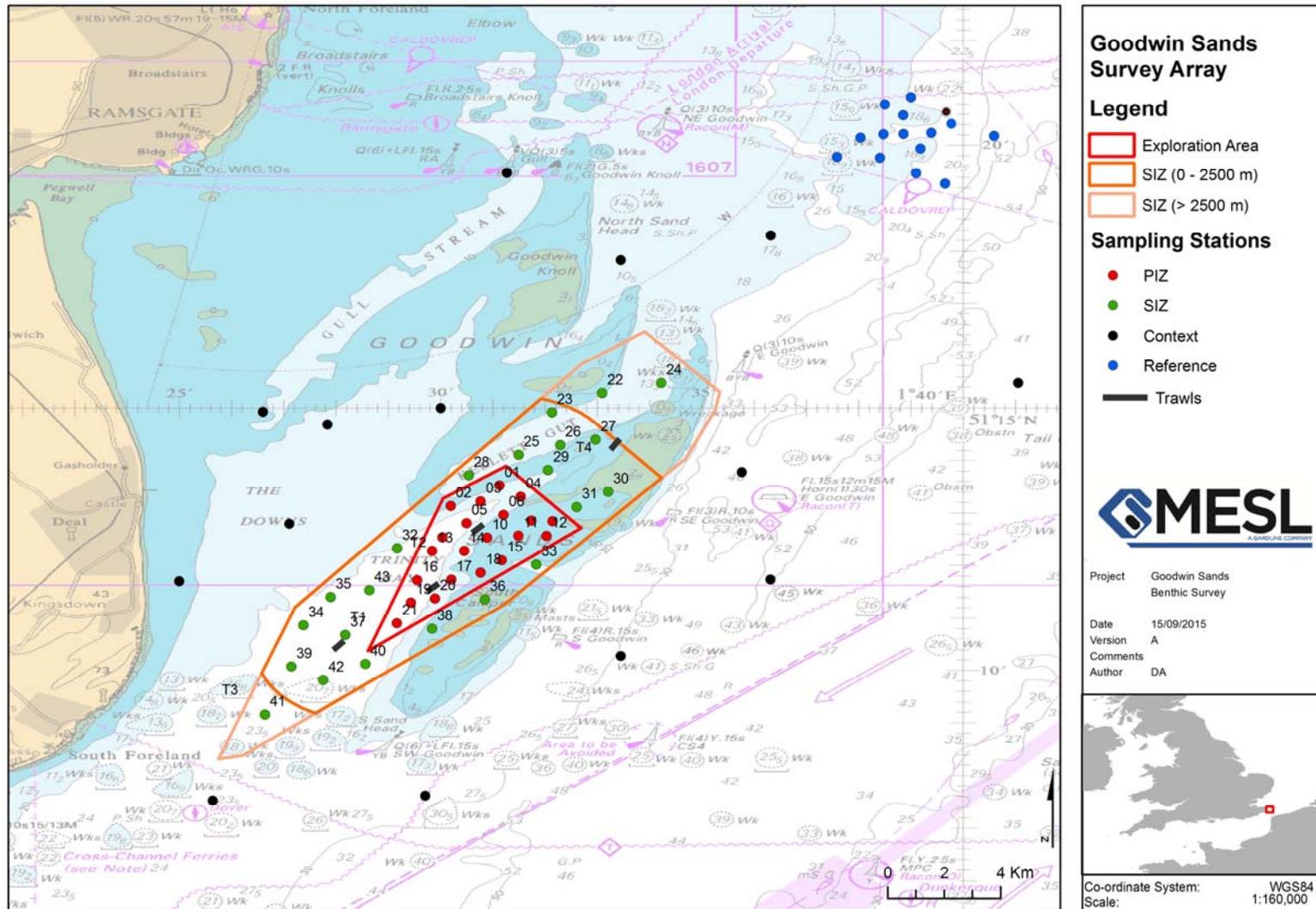


Figure 2. Goodwin Sands 2015 characterisation survey array.

C. Post-dredge Phase Monitoring

Following completion of the pre-dredge survey at Goodwin Sands, data from the site was submitted to Cefas. Keith Cooper will utilise this data to calculate the limits of acceptable change in sediment particle size composition for the course of the dredging period in line with the RSMP methodology. The next monitoring survey at Goodwin Sands will therefore focus on determining whether sediments in the area of interest fall within acceptable change limits for sediment particle size to be published by Keith Cooper in late 2016 (Pers. Comm.). The limits for acceptable change will be calculated following the methods outlined in Cooper (2012)¹.

To detect any change in sediment composition and associated faunal communities that may occur as a result of dredging activity at Goodwin Sands, it is proposed that a single post-dredge survey is conducted, especially given that the marine licence applied for is of short duration (3 years). A single survey at the point of cessation of dredging is considered sufficient as risk of change to the benthic habitats within this time frame is deemed to be low based on the predominantly fine sandy habitats and faunal complement documented during the baseline survey.

The RSMP approach for operational stage and post-dredge monitoring requires that only seabed sediment particle size distribution is sampled at the majority of stations. This approach uses the concept that the macrofaunal assemblages of the survey area were characterised during the pre-dredge survey, and thus if sediment composition remains within

¹ Cooper, K. C. (2012) Setting limits for acceptable change in sediment particle size composition following marine aggregate dredging. *Marine Pollution Bulletin*. **64**: 1667-1677.

the limits of acceptable change, then macrofaunal communities should not have undergone significant dredging related change. Faunal samples are required from a selection of context stations in line with the RSMP protocol.

C.1 Survey Objectives

The principal objectives of the proposed post-dredge monitoring survey at Goodwin Sands are as follows:

1. To describe the distribution of sediment types in the survey area;
2. To determine if sediment types fall within acceptable change limits for the Goodwin Sands area; and
3. To determine any notable changes in the benthic faunal communities in the context region as a result of dredging activity.

In order to achieve these objectives, appropriate methodologies for benthic sediment surveys of the licence area and the surrounding vicinity are detailed over the following sections.

C.2. Survey Design

The post-dredge survey at Goodwin Sands will comply with the methodology set up for the RSMP by Cefas and the aggregates industry^{2,3}.

² Cooper, K.M. (2013) Marine aggregate dredging: a new regional approach to environmental monitoring. PhD Thesis. University of East Anglia.

³ Cooper, K. M and Mason, C. Mason (CEFAS). (2015) Regional Seabed Monitoring Plan (RSMP). Protocol for Sample Collection and Processing. Version 4.0.

The RSMP approach was designed to develop a characterisation for macrofauna and sediments in five aggregate extraction regions around the UK, including the East Coast.

It is anticipated that the post-dredge survey will be carried out following the completion of the 3 year licence term when dredging activity has been completed. To ensure that the data resulting from the survey is robust and comprehensive, it is proposed that the PIZ, SIZ, reference and context areas are all taken into account during the survey. This follows the general RSMP approach whereby the reference stations add information on natural variability in the survey area and context stations provide information on the wider survey area.

It should be noted that following completion of the characterisation survey in 2015 the proposed dredge zone was revised to the area shown in Figure 3. This area now represents a small proportion of the original prospecting area that was originally put forward for survey in 2015. Correspondingly the SIZ was also revised based in the information presented below.

It is considered that in the PIZ (the Proposed Dredging Area), direct impacts from dredging will result in the removal of organisms from the area thus changing the composition and structure of benthic marine communities.

The SIZ is the region where indirect impacts from dredging may result in marked changes in faunal and sediment composition as a result of the deposition of fines. The SIZ was defined using the outputs of the wave, tidal current, sediment transport and sediment plume modelling carried out to support the EIA and presented within the ES. The SIZ incorporates

the 10mg/l suspended sediment plume footprint and the footprint of the maximum extent of 2cm change in significant wave height. Changes smaller than 2cm would be insignificant and virtually unmeasurable in reality. The SIZ also captured the extent of predicted changes to tidal currents and sediment transport which were more local to the proposed dredge area.

Sediment PSD samples will be collected across all areas (as previously sampled during the 2015 survey) following the methods outlined in Cooper and Mason (2015). The collection of PSD samples will allow for the ground-truthing of geophysical datasets which will enable the detection of changes in seabed sediment composition. Following this, the distribution of sediment types will be determined and any changes beyond the limits of acceptable change will be established. The sediment limits will be defined as % gravel, % sand and % silt/clay following the methods of Cooper (2012).

Samples will be collected from the same stations targeted in 2015 to ensure that direct comparisons can be drawn should changes in sediment beyond the acceptable change limit be observed. Following the 2015 array, it is proposed that 71 grab samples will be collected for sediment PSD only from across the PIZ, SIZ, reference and context areas (Figure 3). Faunal samples will be collected from 7 stations in the context region where faunal samples were previously collected in 2015. The collection of faunal samples from a selection of well distributed context stations will allow for the observation of any natural variability which has occurred in the Goodwin Sands region over the licence term.

All sample collection will comply with the RSMP methodology protocols (version 4) (Cooper and Mason, 2015). A single grab sample will be acquired from each station in the survey array.

It is proposed that epibenthic monitoring will not be undertaken as part of the post-dredge monitoring. The data gained by epibenthic beam trawling is considered to be semi-quantitative at best and more appropriate for site characterisation rather than ongoing monitoring, and as such is of limited value.

It is recognised that Goodwin Sands is a known habitat for sandeels; sandeels display an affinity for sediment of a particular grain size (Holland *et al.* 2005⁴; Jensen *et al.* 2011⁵). It is therefore considered that a review of any changes in sediment composition and how these changes may have affected the sandeel population present at the site would be a viable alternative to costly epibenthic surveys which may yield little information that is temporally comparable.

To this extent, it is proposed that assessments of any changes in sediment particle size distribution (as will be defined by the monitoring programme) are discussed and related to potential changes in sandeel numbers. Should there have been a general coarsening or fining of sediment in the survey area then it could be said that there will have been possible impacts on sandeels present at the site.

⁴ Holland G.J., Greenstreet S.P.R., Gibb I.M., Fraser H.M., and Robertson M.R., (2005) Identifying Sandeel *Ammodytes marinus* sediment habitat preferences in the marine environment. *Mar Ecol Prog Ser.*, 303: pp. 269–282.

⁵ Jensen, H., Rindorf, A., Wright, P. J., Mosegaard, H. (2011) Inferring the location and scale of mixing between habitat areas of lesser sandeel through information from the fishery. *ICES Journal of Marine Science* (2011), 68(1), 43–51. doi:10.1093.

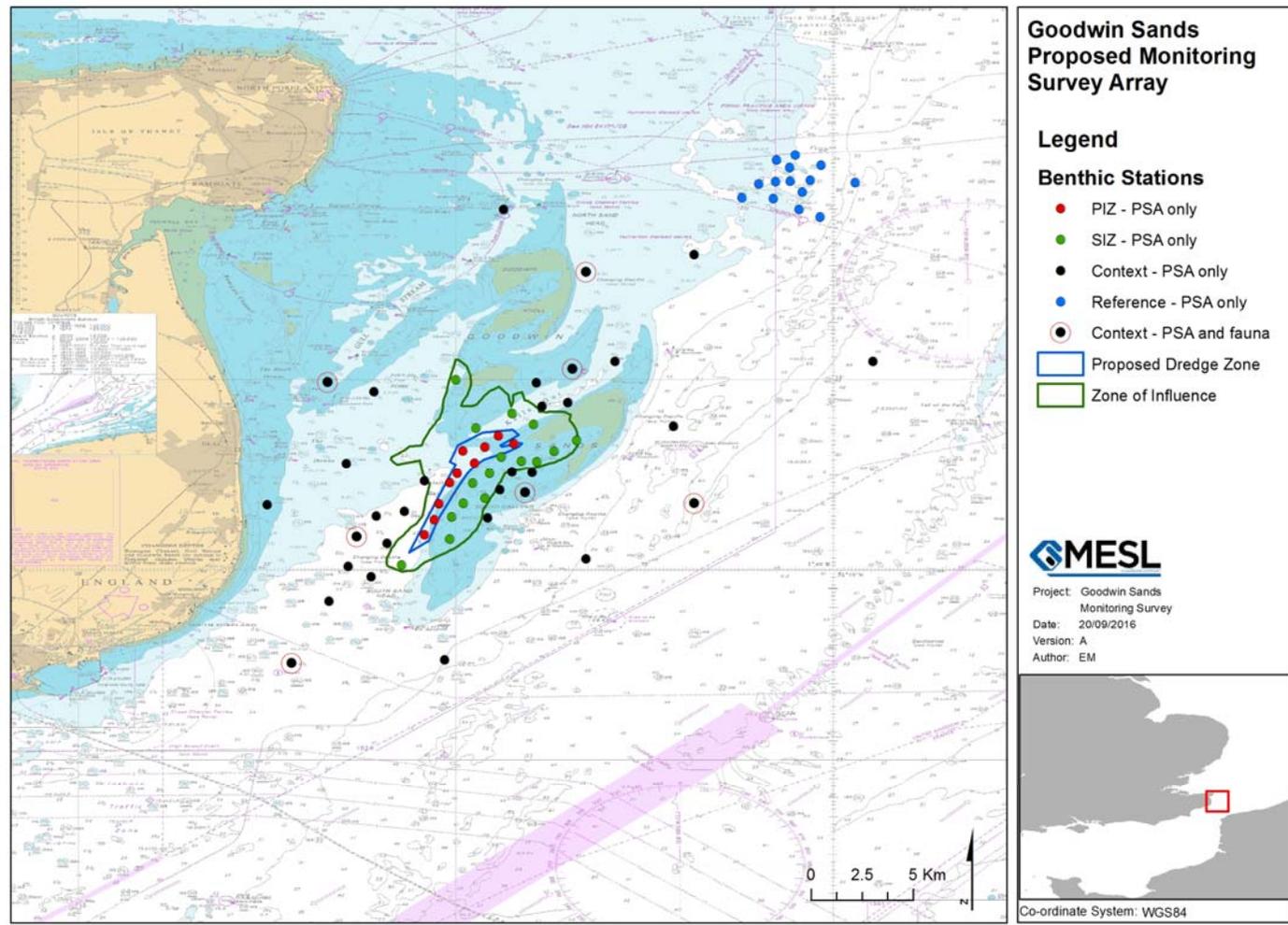


Figure 3. The locations of proposed stations for the post-dredge benthic survey at Goodwin Sands. Stations within the licence area PIZ (Proposed Dredge Area) are shown in red, stations in the modelled SIZ in green, context area stations are shown in black and reference stations are in blue. Samples to have macrofaunal samples retained are circled in red. ARCS Chart 1406-0 used under Licence from the UK Hydrographic Office.

D. Sampling Protocol

D.1 Proposed Survey Station Locations

The locations of the proposed benthic grab samples to be taken during the post-dredge survey of Goodwin Sands are shown in Figure 2. These are taken from the survey array designed by Keith Cooper at Cefas for the characterisation survey in 2015, in accordance with the RSMP survey design protocols. A summary table with station information and coordinates is presented in Table 2.

Table 2. Benthic grab sample coordinates for the post-dredge survey at Goodwin Sands (WGS 1984).

Label	Latitude	Longitude	Zone	Required sample
1	51.22550000	1.51870000	Primary	PSA
2	51.21900000	1.50315000	Primary	PSA
3	51.22046667	1.51270000	Primary	PSA
4	51.22193333	1.52548333	Primary	PSA
5	51.21353333	1.50821667	Primary	PSA
6	51.21615000	1.52003333	Secondary	PSA
7	51.21438333	1.52881667	Secondary	PSA
8	51.21416667	1.53561667	Secondary	PSA
9	51.20906667	1.50048333	Primary	PSA
10	51.20901667	1.51478333	Secondary	PSA
11	51.20963333	1.52471667	Context	PSA
12	51.20948333	1.53368333	Context	PSA
13	51.20476667	1.49726667	Primary	PSA
14	51.20475000	1.50745000	Secondary	PSA
15	51.20185000	1.51946667	Context	PSA

Label	Latitude	Longitude	Zone	Required sample
16	51.19558333	1.49248333	Primary	PSA
17	51.19571667	1.50335000	Secondary	PSA
18	51.19795000	1.51270000	Secondary	PSA
19	51.18845000	1.49046667	Primary	PSA
20	51.18973333	1.49810000	Secondary	PSA
21	51.18185000	1.48601667	Primary	PSA
22	51.25475000	1.55145000	Context	PSA & Macrofauna
23	51.24860000	1.53540000	Context	PSA
24	51.25795000	1.57023333	Context	PSA
25	51.23523333	1.52480000	Secondary	PSA
26	51.23830000	1.53806667	Context	PSA
27	51.24003333	1.54930000	Context	PSA
28	51.22873333	1.50893333	Secondary	PSA
29	51.23040000	1.53418333	Secondary	PSA
30	51.22348333	1.55331667	Secondary	PSA
31	51.21870000	1.54333333	Secondary	PSA
32	51.20561667	1.48608333	Context	PSA
33	51.20051667	1.53045000	Context	PSA & Macrofauna
34	51.18116667	1.45616667	Context	PSA & Macrofauna
35	51.19013333	1.46485000	Context	PSA
36	51.18941667	1.51401667	Context	PSA
37	51.17810000	1.46955000	Context	PSA
38	51.18005000	1.49720000	Secondary	PSA
39	51.16798333	1.45236667	Context	PSA
40	51.16876667	1.47590000	Secondary	PSA
41	51.15271667	1.44395000	Context	PSA
42	51.16360000	1.46253333	Context	PSA

Label	Latitude	Longitude	Zone	Required sample
43	51.19233333	1.47723333	Context	PSA
44	51.17133333	1.55738333	Context	PSA
45	51.25000000	1.50000000	Secondary	PSA
46	51.32478333	1.52108333	Context	PSA
47	51.19516667	1.41663333	Context	PSA
48	51.22970000	1.59596667	Context	PSA
49	51.25791667	1.68405000	Context	PSA
50	51.30493333	1.60516667	Context	PSA
51	51.24881667	1.44330000	Context	PSA & Macrofauna
52	51.12698333	1.49508333	Context	PSA
53	51.29716667	1.55733333	Context	PSA & Macrofauna
54	51.24481667	1.46386667	Context	PSA
55	51.21340000	1.45168333	Context	PSA
56	51.12546667	1.42731667	Context	PSA & Macrofauna
57	51.19570000	1.60510000	Context	PSA & Macrofauna
58	51.32141667	1.66076667	Reference	PSA
59	51.33646667	1.67635000	Reference	PSA
60	51.33245000	1.65283333	Reference	PSA
61	51.33700000	1.64105000	Reference	PSA
62	51.33745000	1.65633333	Reference	PSA
63	51.32468333	1.65146667	Reference	PSA
64	51.32981667	1.62626667	Reference	PSA
65	51.33595000	1.63375000	Reference	PSA
66	51.32956667	1.64000000	Reference	PSA
67	51.34308333	1.64740000	Reference	PSA
68	51.33711667	1.64748333	Reference	PSA
69	51.34406667	1.66108333	Reference	PSA

Label	Latitude	Longitude	Zone	Required sample
70	51.34871667	1.64990000	Reference	PSA
71	51.34641667	1.64156667	Reference	PSA

D.2 Benthic Sample Collection

All sample collection and processing should be undertaken in line with the RSMP protocols (Cooper & Mason, 2015). Single seabed samples should be taken at each station with a standard 0.1m² Hamon grab deployed from the survey vessel. Samples should be obtained as close as possible to the target station coordinates, and within 50m of the target location. Four attempts should be made to retrieve a sample of at least 5L in volume at each station. If this is not possible, the station will be relocated within a 100-200m radius of the original target location for the fifth attempt. When small samples of less than 5L in volume are recovered during the attempts, they should be kept to one side and the largest of the small samples will be processed if a suitably large sample cannot be obtained.

Following deployment, the grab should be brought aboard the survey vessel and the sample discharged into a plastic box below the grab stand. A photograph of each sample must be taken and included as an appendix to the technical report as evidence of collection.

Detailed field notes should be taken including as a minimum the grab coordinates, time of sampling (in UTC), depth, sample volume, sediment type, weather conditions and any notes on the fauna present within the grab. This information should be recorded as an appendix to the report.

Subsamples of approximately 0.5L should be taken for PSA from each sample. Each sediment subsample should be placed in sealed and secured containers with appropriate internal and external labels.

D.3 Sediment Particle Size Analysis

Each PSD sample will be air dried and sieved over the range 64mm down to 0.063mm on the Wentworth scale in line with the RSMP protocols. The results should be expressed as cumulative percentage passing and converted to absolute percentage retained on each sieve size.

In accordance with the RSMP protocol, any samples that contain greater than 5% fine material (<63µm) should be subjected to further analysis by laser diffraction at ½ Phi units.

D.4 Benthic Sample Processing

All macrofaunal sample processing will be undertaken in accordance with the RSMP protocol (Cooper & Mason, 2014).

In keeping with the 2015 benthic macrofaunal sample processing methods, excess fixative (formalin) should be removed from the sample and poured through a 1mm mesh sieve and collected for licensed disposal. Each sample will then be gently eluted with tap water through graduated sieve sizes to separate fractions the smallest of which will be 1mm. The low-density components in the sample (crustaceans and polychaetes) will be separated and combined with the material initially separated from the formalin in the sample. The larger macrofauna should then be removed from the eluted material.

The sediments will then be sorted beneath a stereomicroscope with the aim of extracting any fauna. The entire sample of separated fauna must next be preserved in industrial methylated spirit (IMS) for subsequent analysis.

Each of the extracted samples will subsequently be sorted into major faunal groups before being analysed to species level by experienced taxonomists. A log sheet of each sample processed should be completed following the analysis of each individual sample. Taxonomic identification will be checked throughout the process and should follow a strict Quality Assurance (QA) process. A reference collection should be created and held by the successful contractor for ease of use in the analytical laboratory.

E. Data Analysing and Reporting

E.1 Statistical Data Analysis

All data generated as a result of the post-dredge survey should be entered into an appropriate database for secure long term storage and be statistically investigated.

To assess the compliance with licence conditions, sediment data should be analysed in relation to the limits of acceptable change. These will be determined by Keith Cooper of Cefas for Goodwin Sands in 2016. Comparisons of the means of each fraction (% gravel, % sand, % silt/clay) within the samples should be made to assess whether sediment composition exceeds the acceptable limits of change. Standard deviation and confidence intervals for the post-dredge data in comparison to the limits of acceptable change should be determined in order to assess any degree of change in sediment composition.

Faunal data will be compared to the data collected in 2015 to allow temporal comparisons in faunal community composition. Any statistical analyses for the macrofaunal data should follow the procedures recommended in the *Guidelines for the Conduct of Benthic Studies at Marine Aggregate Sites* (Ware & Kenny, 2011⁶). Any multivariate analysis for this data from the limited faunal stations should be carried out using

⁶ Ware, S.J., & Kenny, A.J. (2011) *Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites* (2nd Edition). Marine Aggregate Levy Sustainability Fund. MALSF project: MEPF 08/P75. 80pp. ISBN 978-0-907545-70-5

the PRIMER V6 software package^{7,8} or similar. All data should be analysed using appropriate methods by fully trained marine ecologists.

E.2 Reporting

Upon completion of the data analysis, a technical report will be produced by the contractor. The Report should include details of the survey and data processing as well as interpretation of the ecological data.

The report should be fully illustrated and should include details of relevant methodology, interpretation of the results and appendices with the complete data upon which the report is based. The report should include details on any sediment parameters which exceed the limits of acceptable change in sediment particle size composition⁹ for the biological assemblages in the licence area at Goodwin Sands. It should also contain an overview of the impacts of dredging on the benthic habitats in the licence area over the course of the licence, making reference to the baseline conditions.

E.3 Thematic Maps (GIS)

Any thematic maps produced to illustrate sediment distribution should be produced using ArcGIS version 10 as a minimum.

⁷ Clarke, K. R and Warwick, R. M. (2001) *Change in Marine Communities: An Approach to Statistical Analysis and Interpretation*. Second Edition. PRIMER-E: Plymouth.

⁸ Clarke, K. R & Gorley, R. N. (2006) *PRIMER v6: User Manual/Tutorial*. PRIMER-E: Plymouth.

⁹ Cooper, K.M. (2013) Setting limits for acceptable change in sediment particle size composition: Testing a new approach to managing marine aggregate dredging. *Marine Pollution Bulletin* 73, 86-97.

F. Resources of Conservation Importance

The extraction area is located partially within the boundary of the Goodwin Sands recommended Marine Conservation Zone (rMCZ). The Goodwin Sands rMCZ is known to be populated by *Mytilus edulis* (blue mussel) beds and *Sabellaria spinulosa* (Rossworm) reefs¹⁰. The proposed survey array is shown in relation to the rMCZ boundary in Figure 3.

Sabellaria spinulosa can cause significant alteration to the seafloor by turning large volumes of sand into intricate tube structures. In their most prolific forms these structures are classified as biogenic reefs and are protected under Annex I of the EU Habitats Directive. Mussel beds, such as those formed by the edible mussel *Mytilus edulis*, also fall under the protection of Annex I.

The Goodwin Sands post-dredge survey should take note of any resources of conservation importance which are observed during the survey. Descriptions of any potential Annex I habitats made during the survey should take into consideration the methods discussed in Gubbay (2007¹¹) and Hendrick & Foster-Smith (2006¹²).

¹⁰ JNCC Selection Assessment Document:

http://jncc.defra.gov.uk/PDF/BS_FinalRecommendationsSites_Part3.pdf [Accessed 28/09/16].

¹¹ Gubbay, S. (2007) Defining and managing *Sabellaria spinulosa* reefs: Report of an inter-agency workshop. 1-2 May, 2007. JNCC Report No. 405. Joint Nature Conservation Committee (JNCC). 22 pp.

¹² Hendrick, V.J. & Foster-Smith, R.L. (2006) *Sabellaria spinulosa* reef: a scoring system for evaluating 'reefiness' in the context of the Habitats Directive. *Journal of the Marine Biological Association of the United Kingdom*. **86** 655-677.

It thought that the Goodwin Sands benthic survey will not impact upon any of the features of the rMCZ or the recommended Reference Area (rRA) given the small footprint of the sampling gear and the position of the survey stations along the Goodwin Sands sand bank. Results of the benthic characterisation survey and the acoustic data interpretation undertaken at the characterisation stage (MESL, 2015¹³) indicated no presence of any Annex I habitats at any of the sampling stations previously.

Furthermore, the licence area has been designed to avoid reef habitat locations which have been mapped and identified in the JNCC Potential Annex I reef habitat data set¹⁴.

¹³ MESL (2015) Goodwin Sands Exploration Area Sidescan Sonar Interpretation Report. Prepared for Royal HaskoningDHV on behalf of Dover Harbour Board. Document number HASGWS1215.

¹⁴ <http://jncc.defra.gov.uk/page-3054>. Accessed 27th May 2015.

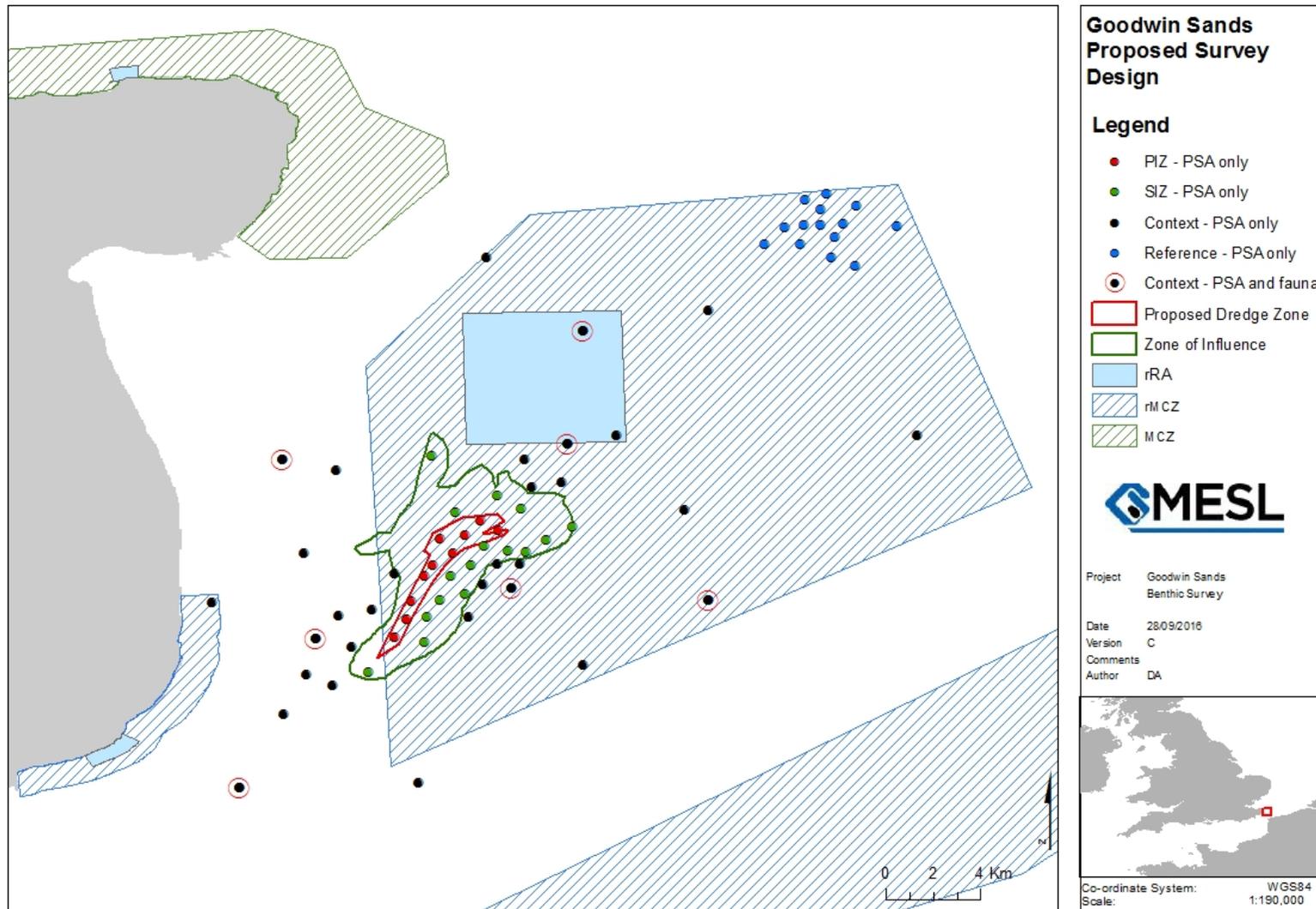


Figure 3. The position of the licence area and the proposed survey array in relation to the boundary of the Goodwin Sands rMCZ (central hashed area) and rRA. Other MCZs/rMCZs shown include the Thanet Coast MCZ (top left), Dover to Deal rMCZ (bottom left) and the Offshore Foreland rMCZ (bottom right).

accurate comparisons of faunal data without seasonal variation influencing the results.

G. Survey Planning

G.1 Permits and Consents

The contractor responsible for conducting the post-dredge survey must ensure that all relevant consents and permits for the survey are secured ahead of mobilisation. This includes providing a notice for an exempt activity (grab sampling involving the removal of seabed material of less than 1m³ per sample) to the MMO, submitting an application to The Crown Estate for a Small Works Consent and an associated seabed users conflict check. The contractor will also be required to issue Notices to Mariners to inform other sea users of the survey works. The method for issuing these notices will be agreed in advance with DHB.

G.2 Timing of the Surveys

It is anticipated that the post-dredge survey at Goodwin Sands will be conducted following the cessation of dredging activity, which is currently programmed to cease in summer 2019. However, as dredging activity has not yet commenced, it is not yet possible to confirm the exact timing of the post-dredge survey. It is advisable to conduct the survey in the summer months when weather conditions are favourable and on peak spring tides to ensure that there is sufficient water and that survey conditions are safe at Goodwin Sands due to the shallow nature of the seabed in the area.

It is recommended that any future surveys are undertaken at a similar time of year to the August 2015 characterisation survey to allow for

Appendix B Example Marine Mammal Recording Form

MARINE MAMMAL RECORDING FORM - COVER PAGE

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	Country	Location	Ship/ platform name
Client	Contractor	Survey type	
Start date	End date	<input type="checkbox"/> site <input type="checkbox"/> VSP <input type="checkbox"/> 2D <input type="checkbox"/> WAZ <input type="checkbox"/> 3D <input type="checkbox"/> piling <input type="checkbox"/> 4D <input type="checkbox"/> explosives <input type="checkbox"/> OBC <input type="checkbox"/> other <input type="checkbox"/> 4C	

Number of source vessels	Type of source (e.g. airguns)	Number of airguns (only if airguns used)	Source volume (cu. in.)
Source depth (metres)	Frequency (range in which peak energy is emitted, in Hz)	Intensity (primary peak-to-peak amplitude in dB re. 1µPa or bar metres)	Shot point interval (metres)
Method of soft start			
<input type="checkbox"/> increase number of guns <input type="checkbox"/> increase frequency (where permitted) <input type="checkbox"/> increase pressure (where permitted) <input type="checkbox"/> increase number and frequency <input type="checkbox"/> increase number and pressure <input type="checkbox"/> other			

Visual monitoring equipment used (e.g. binoculars, big eyes, etc.)	Magnification of optical equipment (e.g. binoculars)	Height of eye above water surface (metres)	How was distance of animals estimated?
			<input type="checkbox"/> by eye <input type="checkbox"/> with laser rangefinder <input type="checkbox"/> with rangefinder stick/ callipers <input type="checkbox"/> with reticle binoculars <input type="checkbox"/> by relating to object at known distance <input type="checkbox"/> other
Number of dedicated MMOs		Training of MMOs	
		<input type="checkbox"/> JNCC approved MMO training course for UK waters <input type="checkbox"/> PSO training course for the Gulf of Mexico <input type="checkbox"/> MMO training course for Irish waters <input type="checkbox"/> MMO training course for New Zealand waters <input type="checkbox"/> other <input type="checkbox"/> none	

Was PAM used?	Number of PAM operators	
<input type="checkbox"/> yes <input type="checkbox"/> no		
Description of PAM equipment		
Range of PAM hydrophones from airguns (metres)	Bearing of PAM hydrophones from airguns (relative to direction of travel)	Depth of PAM hydrophones (metres)

MARINE MAMMAL RECORDING FORM - SIGHTINGS

Regulatory reference number (e.g. DECC no., BOEM permit no., OCS lease no., etc.)	Ship/ platform name	Sighting number (start at 1 for first sighting of survey)	Acoustic detection number (start at 500 for first detection of survey)	
Date		Time at start of encounter (UTC, 24hr clock)	Time at end of encounter (UTC, 24hr clock)	
Were animals detected visually and/ or acoustically? <input type="checkbox"/> visual <input type="checkbox"/> acoustic <input type="checkbox"/> both	How were the animals first detected? <input type="checkbox"/> visually detected by observer keeping a continuous watch <input type="checkbox"/> visually spotted incidentally by observer or someone else <input type="checkbox"/> acoustically detected by PAM <input type="checkbox"/> both visually and acoustically before operators/ observers informed each other			
Observer's/ operator's name	Position (latitude and longitude)		Water depth (metres)	
Species/ species group		Description (include features such as overall size; shape of head; colour and pattern; size, shape and position of dorsal fin; height, direction and shape of blow; characteristics of whistles/ clicks)		
Bearing to animal (when first seen or heard) (bearing from true north)	Range to animal (when first seen or heard) (metres)			
Total number	Number of adults (visual sightings only)	Number of juveniles (visual sightings only)	Number of calves (visual sightings only)	Photograph taken <input type="checkbox"/> yes <input type="checkbox"/> no
Behaviour (visual sightings only)				
Direction of travel (relative to ship) <input type="checkbox"/> towards ship <input type="checkbox"/> away from ship <input type="checkbox"/> parallel to ship in same direction as ship <input type="checkbox"/> parallel to opposite direction to ship <input type="checkbox"/> crossing perpendicular ahead of ship			Direction of travel (compass points) <input type="checkbox"/> N <input type="checkbox"/> W <input type="checkbox"/> NE <input type="checkbox"/> NW <input type="checkbox"/> E <input type="checkbox"/> variable <input type="checkbox"/> SE <input type="checkbox"/> stationary <input type="checkbox"/> S <input type="checkbox"/> unknown <input type="checkbox"/> SW	
Airgun (or other source) activity when animals first detected <input type="checkbox"/> full power <input type="checkbox"/> not firing <input type="checkbox"/> soft start <input type="checkbox"/> reduced power (other than soft start)	Airgun (or other source) activity when animals last detected <input type="checkbox"/> full power <input type="checkbox"/> not firing <input type="checkbox"/> soft start <input type="checkbox"/> reduced power (other than soft start)	Time animals entered mitigation/ exclusion zone (UTC, 24hr clock)	Time animals left mitigation/ exclusion zone (UTC, 24hr clock)	
		Closest distance of animals from airguns (or other source) (metres)	Time of closest approach (UTC, 24hr clock)	
If seen during soft start give: First distance Closest distance Last distance during soft start (metres)	What action was taken? (according to requirements of guidelines/ regulations in country concerned) <input type="checkbox"/> none required <input type="checkbox"/> delay start of firing <input type="checkbox"/> shut-down of active source <input type="checkbox"/> power-down of active source <input type="checkbox"/> power-down then shut-down of active source		Length of power-down and/ or shut-down (if relevant) (length of time until subsequent soft start, in minutes)	Estimated loss of production (if relevant) due to mitigating actions (km)