

East Channel association

**Regional Environmental
Monitoring & Management
Reporting Programme**

Discussion Paper

The Development and Use of Indicators of Change in the ECR

The East Channel Association (ECA)

The ECA is an association of marine aggregate companies who are permitted, or have applied for permission, to extract sand and gravel from the East Channel Region (ECR). Read more about their plans and operations at www.eastchannel.info

The companies of the ECA are:



Britannia Aggregates Ltd



CEMEX UK Marine Ltd



DEME Building Materials Ltd



Hanson Aggregates Marine Ltd
(now part of the Heidelberg Cement Group)



United Marine Dredging Ltd



Volker Dredging Ltd

The ECA Charter

The companies of the ECA have committed to operate under the terms of a 'code of practice' known as the ECA Charter.

The ECA Charter

The ECA have developed a code of practice to assist management of their activities. The ECA are committed to managing their activities cooperatively in the ECR in order to:

- Implement the results and recommendations of the REA and ensuing studies as appropriate to individual applications.
- Co-operate with and fund future regional environmental studies and research.
- Recognise the results of further environmental studies and respond to recommendations.
- Monitor, mitigate and manage environmental impacts and operational activity on a regional basis.
- Carefully manage dredge areas, with an aim of reducing the dredged area to a minimum.
- Restrict operational dredging areas through zoning of permission areas.
- Only target resources >2m thick.
- Minimise screening.
- Ensure transparency – make all relevant dredging data publicly available through regular company reporting.
- Enable Audit – all relevant data will be made available for analysis by independent experts.

Document Information

This document has been created by MarineSpace Ltd on behalf of the East Channel Association (ECA) to provide an overview of the indicators of change that might be used to determine the nature and extent of impacts arising from marine aggregate extraction in the East Channel Region (ECR).

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Section	Page
1. Introduction	1
2. What are Indicators of Change?	1
3. Dredging Related Indicators of Change in the ECR	1
3.1. Physical Indicators of Change	1
3.1.1. Area of Dredging Activity	1
3.1.2. Intensity of Dredging Activity	1
3.1.3. Tonnage of Resources Extracted	2
3.1.4. Area of Secondary Impact	2
3.2. Biological Indicators of Change	2
3.2.1. Seabed Sediment Composition	2
3.2.2. Benthic Community Composition	2
3.2.3. Biotopes and Habitats	3
3.2.4. Changes to Fish and Shellfish Communities	3
4. Consideration of the Use of Indicators of Change in the Context of Dredging Activity and Other Initiatives	4
5. Conclusions and Recommendations	4

References

1. Introduction

This document provides information related to the East Channel Association's (ECA) Regional Environmental Monitoring and Management Programme. The ECA are a group of 6 companies who have been granted permission, or who are applying, to dredge marine aggregate from the East Channel Region (ECR).

The ECA undertake a coordinated programme of monitoring to determine the effects of their activities on the habitats and species of the ECR. As part of this programme, and in line with the requirements of conditions placed on individual licences to dredge, the ECA have begun to develop a series of indicators of change that can be used to measure the spatial and temporal effects of dredging in the region.

This discussion document provides the rationale for developing and using indicators of change and the progress to date in determining suitable indicators. Use of indicators is considered to be an important part of monitoring the effects of dredging on the habitats and species of the ECR. Determining a suite of indicators that can be used by the ECA at varying spatial scales, will ensure that determining the significance of dredging effects is standardised across all licence areas and will also enable a more coherent view of the effects of dredging in the context of the wider region.

2. What are Indicators of Change?

For the purposes of this document an indicator of change is defined as:

'A quantitative metric that may be compared with similar metrics to determine the scale (temporal and/or spatial), nature and severity of change of an environmental feature, process or state.'

Bearing in mind the above definition, a number of potential metrics have been identified that may be useful when determining the scale, nature and severity of environmental change due to dredging activities in the ECR. The metrics identified, and their utility for the purposes of describing dredging impacts, are described below.

3. Dredging Related Indicators of Change in the ECR

For the purposes of this document the indicators described are divided into two broad categories; physical and biological. This division is for the purposes of description in this document only and it should be borne in mind that some of the physical indicators described will, by their nature, have a direct bearing on the nature of biological community structure and characterising species.

3.1. Physical Indicators of Change

For the purposes of this document a physical indicator of change relates to a metric that allows the nature of a change in the physical environment due to dredging activity to be determined. Reviews of the impact of dredging activity can be informed by such measures. It is well understood that dredging affects the seabed through removal of aggregate resources and also through deposition of fine sediment. In order to quantify the nature of these effects some basic indicators of change have been defined.

3.1.1. Area of Dredging Activity

The simplest spatial indicator of change is the area of dredging activity. This can be determined through the use of EMS data from dredging vessels. This indicator provides a fundamental measure that can, in conjunction with wider region studies, be used to investigate the percentage of seabed of various habitat types influenced by dredging. This indicator essentially provides a measure of the area of direct dredging impact to which changes detected in the structure of faunal communities can be related.

3.1.2. Intensity of Dredging Activity

The intensity of dredging activity is useful information as it provides guidance on the productivity of a site per unit area of impact. This essentially allows a calculation of the efficiency of extraction in the region to be determined. Use of intensity data will enable a determination of the severity of impacts to be determined in the context of their spatial extent.

3.1.3. Tonnage of Resources Extracted

In order for impacts to be properly informed a measure of the amount of aggregate produced from the region will be utilised. The tonnage of aggregate produced, together with dredging intensity data, will allow an assessment of the effects of differing dredging practices to be determined. This will provide guidance on how impacts can most effectively be minimised in future years.

3.1.4. Area of Secondary Impact

Through inference (i.e. granting of a licence to dredge for marine aggregate), it is accepted that there will be an impact on the seabed resulting from dredging in the licensed ECR dredging areas. Understanding of the direct impacts on the seabed is relatively good due to research in other areas and relevant monitoring is being undertaken to detect and describe impacts in the ECR. The nature of secondary impacts resulting from the settling, deposition and transport of fine sediment beyond the boundaries of the licensed dredging areas is less well understood. Monitoring work has been undertaken to address this (e.g. plume, tracer, seabed sediment and biological monitoring surveys) and the results of the work are now being used to describe the nature and extent of secondary impacts.

Sidescan sonar surveys are being undertaken at all dredging areas in the ECR to describe the composition of the seabed surface. The results of these surveys are capable of describing areas of seabed where fine sediment has been deposited and these data will be used to provide a quantitative assessment of the area within the region that has been affected by secondary impacts. Work at the regional 'type site', Area 473 East, has already shown this to be a useful approach and the use of such assessments over the region will provide a spatial measure of the area of seabed that exhibits changes in the seabed surface sediment composition.

3.2. Biological Indicators of Change

The regional biological monitoring programme generates a wide variety of data regarding the nature of seabed habitats in the region and the faunal communities that these habitats support. From the work undertaken to date it is evident that the outputs of the biological monitoring programme are capable of providing several metrics capable of acting as indicators of change. The exact nature and utility of these indicators is still being determined with a view to informing the first regional substantive review of dredging activity.

3.2.1. Seabed Sediment Composition

As dredging progresses, the nature of the seabed sediment within and surrounding a dredging area may change. The nature of changes detected by analysis of Hamon grab samples will depend on the dredging operations that have occurred (tonnage extracted, screening, intensity etc). This, in turn, will influence the faunal communities that the seabed can support (see below). Sediment composition indicators will utilise the particle size distribution data resulting from Hamon grab sample analysis to determine how the relative proportions of the three principle components of the seabed sediment (gravel, sand and silt/clay) have changed. It will also be possible to use statistical measures such as sorting, skewness and kurtosis of the particle size distributions to detect changes in the character of the seabed sediment.

3.2.2. Benthic Community Composition

Benthic communities are affected by dredging. The main reason for changes, beyond the physical removal of animals during dredging, is the change in the seabed sediment composition. Analysis of the composition of faunal communities will provide valuable indicators of dredging impact. Such indicators are being developed and will utilise the results of univariate and multivariate statistical analysis to report changes in the biomass, numbers of species, numbers of individuals and community composition of the monitoring sites targeted. It will then be possible, using dredging activity data to relate recorded changes to dredging in specific licence areas.

Alternatively, through the use of monitoring reference areas, natural changes will also be investigated to provide contextual data that will help to determine the significance of dredging related impacts.

3.2.3. Biotopes and Habitats

The results of regional drop down video surveys are used to describe the seabed habitats and biotopes that exist in the ECR. The work uses the semi-quantitative SACFOR scale to record species abundance and also the nature of the sediment that forms the seabed habitat. Provided that analysis methods are standardised and the result are subjected to careful QC, this work is capable of providing useful indicators that can describe changes in seabed character and faunal communities.

For example, it will be possible to identify areas where the seabed has become significantly more sandy, not only through the changes to the surface sediment, but also through changes in the evident epifauna that exists on the seabed. Several indicator species may possibly be used to provide guidance on the nature of the seabed habitats and these species are being determined by the monitoring programme.

3.2.4 Changes to Fish and Shellfish Communities

The monitoring work being carried out to record and describe regional fish and shellfish communities will provide information that can be used to develop indicators of change. The nature of the data acquired by the this element of the monitoring programme dictates that the indicators developed will provide a broad-region assessment of impacts.

During the development of the monitoring programme, advice from regulatory advisors stated that the results of beam trawl and scallop dredging surveys should be used in a way that identifies broadscale changes to the regional fish and shellfish communities as a whole. With this in mind the following indicators of change are proposed.

Fish Communities

It will be possible, using the data acquired during 4m beam trawl surveys, to describe the regional distribution of individual fish species. Indicators of change will be developed that are based on detecting and describing significant changes in the distribution of fish species. For example, *Aspitrigla cuculus* has been sampled across the entire regional survey array in all surveys from 2005-2008. It is therefore considered safe to assume that this species represents a good indicator species. If, in future surveys, the distribution of this species changes i.e. it appears absent from a number of sampling stations where it had previously been present, this can be considered an indicator of change.

Similarly, flatfish species, *Solea solea* and *Pleuronectes platessa* have been identified as only being present in the sandier eastern part of the region. These species prefer sandier substrates and they may therefore be useful indicators of a change in the composition of the seabed. As with *A. cuculus* changes will need to be identified at a number of stations over repeated surveys to determine that an actual change has occurred rather than temporary, natural variation.

Shellfish Communities

Monitoring of shellfish communities is undertaken using data acquired by 2m and 4m beam trawl and scallop dredge gear. The results of the surveys provide information regarding the distribution of principle commercial shellfish species and also the population structure of the these species. As with the regional fish populations it will possible to monitor regional changes in species distribution that can be used as an indicator of change. With respect to the population structure of shellfish species it should be possible to develop an indicator that utilises the size class data from samples in order to track and describe changes in the make-up of the shellfish populations. As with all biological indicator metrics, ascribing a cause for any such changes will depend on the use of contextual (dredging/fishing activity and reference site) data to ensure that the discussions regarding the reasons for change are properly informed.

4. Consideration of the Use of Indicators of Change in the Context of Dredging Activity and Other Initiatives

Whilst it will be possible to detect change in environmental conditions and the biological communities in the region using the results of the regional monitoring programme, ascribing a cause for such changes will depend on a further consideration of the available information. Contextual data, such as dredging activity data, will be required, along with the results of monitoring undertaken in reference/control areas, to determine if the changes detected are due to dredging, other anthropogenic activities, natural variation or a combination of factors.

It is therefore, necessary to approach the development of indicators of change for the purpose of managing dredging activity with caution, in order to ensure that any indicators chosen are valid for the purpose and suitably informed by relevant contextual data.

It is understood from discussions with regulatory advisors (Ware, 2009, *pers comm*) that work to investigate the utility of a number of measures of ecosystem function is being undertaken as part of wider research initiatives. The results of such work (eg Cooper *et al*, 2008) may be useful when describing dredging impacts and also the recovery of benthic macrofaunal communities following dredging activities. Future work towards the development and use of indicators of change will seek to incorporate relevant findings of work of this nature to ensure that activities in the ECR are properly informed.

Indicators of change for use in the management of dredging the ECR will be further developed in 2009-2010 and reports will begin to make reference to the nature of changes detected in the metrics being monitored. This development will continue up to the first substantive review of dredging at which point a consideration of the utility of indicators of change and the nature of their future use for the purposes of dredging management will be completed.

5. Conclusions and Recommendations

Work towards formalising a set of indicators of change, informed by the results of regional monitoring is ongoing and a preliminary set of potential indicator metrics is presented in this discussion document (Table 1). Work towards formalising a final set of indicators, based on investigations of their utility and value for the purposes of impact description and dredging management will continue in 2009-2010. The findings of wider research initiatives, that have investigated the use of a variety of analysis capable of describing ecosystem function, will now be considered with the intention of applying relevant measures to the ECR monitoring data. It is recommended that work towards development of indicators of change for use in the ECR aims to finalise an initial list of suitable change metrics by the end of 2009.

References

- Cooper, K. M., Barrio Froján, C. R. S., Defew, E., Curtis, M., Fleddum, A., Brooks, L., & Paterson, D. M. 2008. Assessment of ecosystem function following marine aggregate dredging. *Journal of Experimental Marine Biology and Ecology* 366 (2008) 82–9.
- Ware, S. (CEFAS). 2009. *Pers Comm*. Discussion of the use of indicators of change for monitoring the impacts of marine aggregate extraction.

The Development and Use of Indicators of Change

Table 1. Overview of principle indicators of change identified for use in monitoring of dredging activity in the ECR.

Indicator	Data Source(s)	Change Metric(s)	Comments
Dredging activity	EMS records	Intensity of dredging, area of primary impact	
Dredging activity	Landings statistics	Tonnage of resources extracted	
Bathymetric change	Area 473 East seabed sediment survey bathymetric analysis	Water depth increase/decrease	
Seabed sediment composition	Area 473 East seabed sediment survey sediment sample analysis	Folk/Wentworth classification, relative percentage of gravel/sand, sorting, skewness, kurtosis, PSD modal character	
Seabed sediment composition	Area 473 East seabed sediment survey sidescan sonar analysis	Area of primary impact, area of secondary impact	
Seabed sediment composition	Regional Hamon grab survey	Folk/Wentworth classification, relative percentage of gravel/sand, sorting, skewness, kurtosis	
Seabed sediment composition	Regional drop-camera survey	SACFOR metrics of seabed sediment character	
Habitats and biotopes	Regional drop-camera survey	SACFOR metrics for indicator species	Indicator species to be defined
Benthic community composition	Regional Hamon grab and 2m beam trawl survey	Characterising species of community clusters, biomass, richness/abundance/diversity/evenness indices	Ecosystem function metrics to be investigated
Fish populations	4m beam trawl survey	Regional changes in distribution of indicator species	Indicator species to be defined
Shellfish populations	2m & 4m beam trawl and scallop dredge surveys	Regional changes in the distribution and population structure of principle commercial shellfish species	

