

Date: 06 June 2024
Our ref: 475460
Your ref: TR030001



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Dear Sir/Madam,

Consultation: Proposed application under Article 7 for the extension of time for completion of work associated with the Able Marine Energy Park DCO - TR030001

Thank you for your consultation on the above dated 02 May 2024 which was received by Natural England on 09 May 2024.

Natural England's comments are in relation to the following documents:

- Able Marine Energy Park (Article 7 Extension of Time) Environmental Review report and appendices (dated October 2023).
- Able Marine Energy Park (Article 7 Extension of Time) Habitats Regulations Assessment Report - Part 1: Likely Significant Effect (LSE) Test (dated February 2024).
- Able Marine Energy Park (Article 7 Extension of Time) Habitats Regulations Assessment Report - Part 2: Information to Inform an Appropriate Assessment (dated February 2024).

We note that the Environmental Review report states that Natural England did not provide a consultation response previously. For clarification, Natural England received a request from Able UK Limited for our Discretionary Advice Service (DAS) on this proposal as a non-statutory consultation on 05 September 2023. We did offer this service; however, this offer was later declined by Able UK Limited. We did provide high level comments on 08 November 2023, these are further detailed below.

We are unsure of the process of amending article 7 and therefore wish to highlight a number of environmental risks that may arise as a result of a 7-year time extension to inform your decision-making. This is a complex project, both in terms of the environmental impacts but also in terms of the numerous permissions and consents required, and therefore our advice is based on the case history and our current understanding of the situation, particularly where there are matters that are still to be resolved/ finalised.

- 1. Compensation and overcompensation site habitat has not yet been delivered. If a time extension were granted, there is opportunity to reduce the environmental risk of time lag in compensation habitat becoming functional. Detail should be provided to demonstrate that the minimisation of these environmental risks has been considered within the proposed new timescales for the project.**

As Natural England set out in its advice on the Able Marine Energy Park Material Change 2 application, we continue to reiterate our concerns that we had at the time of examination around the importance of creating the compensation, as well as the overcompensation (of which there appears to be no mention within the Environmental Review (ER) report) as early as possible. The site location plan also does not include the boundary of the overcompensation sites at Cherry Cobb Sands and Halton Marshes or the mitigation site at Halton Marshes.

As agreed in the Statement of Common Ground (SoCG) (dated August 2012), *“The benthic communities on the intertidal compensation site will take approximately three years to mature and hence there is a need for further overcompensation for black-tailed godwit to supplement their foraging whilst the intertidal site matures.”*

And

“The overcompensation will require the provision of an area of wet grassland, the size and timely provision of which is appropriate to provide the necessary functional support for foraging black-tailed godwit. This grassland will be accessible from the intertidal compensation site.”

There is little mention of this within the Environmental Review report. Paragraph 1.2.18 of the ER, refers to planning permission obtained for the creation of wet grassland and a wet roost adjacent to the compensation site. However, it fails to explain that this habitat creation is a compensation measure as agreed by the Secretary of State.

As part of the Material Change 2 application, the SoCG between Natural England and the applicant (dated 08 March 2022) set out matters which were fully agreed between the parties, including that Cherry Cobb Sands Wet Grassland overcompensation should be created as soon as practically possible and, in any event, well in advance of the quay construction. This is to ensure that the overall coherence of the National Site network remains protected. Natural England highlights that this should be at the latest commenced 7 months prior to the construction of the quay, in accordance with the timescale in Clause 6 of the Management Agreement between Natural England and Able UK.

With the proposed time extension, it is currently unclear what the proposed timescales are for completing the creation of the compensation habitats and how these timescales compare to those that were originally assessed as part of the examination and referred to in the Secretary of State’s decision letter (dated 18 December 2013). Natural England considers that there has, and if a 7-year extension is granted, will be opportunity to reduce the environmental risks set out around the time lag in habitat being lost and the compensation habitat becoming functional. We consider that detail should be provided to demonstrate that the minimisation of these risks has been considered within the proposed new timescales for the project.

2. Potential delay in provision for any compensation habitat required for works currently being undertaken associated with the pumping station.

Natural England has recently been consulted on a Marine Licence application (MLA/2023/00436) for changes to the pumping station and outfall construction methodology, associated with the Able Marine Energy Park DCO. These works may result in temporary and permanent loss/ change of SAC/ SPA/ Ramsar habitat. It is our understanding that at the time of examination the original phasing of the works was that the quay would be constructed first and then the pumping station and outfall channel would be created following this. Therefore, the habitat compensation requirement would have been triggered, prior to the loss of habitat from the pumping station works. This is indicated through Schedule 8 Deemed Marine Licence Requirement 7 (2) *“Works outside the cofferdam must be undertaken using land-based plant operating from a berm formed within the south-eastern return wall of the quay”*.

It is our understanding that the habitat affected by the pumping station works is accounted for within either the compensation provision for habitat that will be lost when the quay is built, or the

compensation provision for the area of habitat that will be functionally lost for birds. We are currently uncertain which this would be, as it is our understanding that the impacts of habitat loss/ change from the pumping station works have not been assessed separately from the wider project.

Based on the assessment in the original HRA, we consider that there is potential that compensation habitat at Cherry Cobb Sands is required for aspects of the pumping station design. As mentioned above, no compensation habitat has been provided yet. Natural England's view is that the Cherry Cobb Sands compensation sites should be created as soon as practically possible to ensure that the time lag in providing compensatory habitat is minimised. Natural England considers that there are environmental risks that if a 7-year extension is granted, the provision of compensation for the habitat loss associated with the pumping station works could potentially be significantly delayed, unless further assurances are provided by the applicant. In addition, we advise that your authority should satisfy itself that, in the event that the quay is never constructed, sufficient assessment of the impacts of the pumping station have been undertaken to ensure that any appropriate compensatory measures will be provided, if required.

3. Uncertainties remain around the ability to commence works on the overcompensation habitat as soon as practicably possible, as planning permission for the re-design of Cherry Cobb Sands overcompensation site has not yet been granted.

In the Secretary of State's decision letter (dated 18 December 2013) a number of risks are identified and discussed (page 23 onwards). To follow on from the section on "Quality of roost and wet grassland habitat at Cherry Cobb Sands", we highlight that due to a lack of freshwater available to keep the site wet, the overcompensation wet grassland habitat has been re-designed to enable the site to use brackish water instead of freshwater. Natural England has supported the applicant in the re-design of the site. However, we note that the planning permission (reference 23/01384/STPLF) has not yet been determined. There are points of clarification in our consultation response to the planning application that we consider could be easily overcome. We would encourage the applicant to provide these clarifications in a timely manner, as without planning permission there remains a level of uncertainty around the ability to commence works on the overcompensation habitat as soon as practicably possible. The Compensation Environmental Management and Monitoring Plan (CEMMP) will also need to be updated in light of the changes to the design of the site, to ensure that the objectives and targets remain relevant and achievable. We consider that evidence should be provided to demonstrate that the CEMMP will remain fit for purpose in the context of the proposed time extension and will be updated in a timely manner.

4. Outstanding matters to be agreed remain regarding the criteria for success of the compensation site (benthic invertebrate prey targets).

Whilst the CEMMP has been approved by Natural England in December 2015, we highlight that there are still significant outstanding matters to be agreed. As stated at 1.2.2 of the CEMMP, it requires "undertaking a complete review of the EMMP every five years". This has not been updated since December 2015. We have included a copy for ease of reference. In particular, the benthic SPA bird prey targets need to be agreed. 1.3.1 explains why they were not agreed when the CEMMP was originally approved, "*It is understood that the targets can only be finalised once the baseline benthic surveys at NKM and Cherry Cobb Sands (CCS) have been completed. This will occur prior to the start of any work on AMEP that involve the loss of mudflats at the NKM foreshore, or disturbance to SPA birds that use it*". Between November 2020 - March 2021, Natural England received the benthic invertebrate surveys, however, concluded these were too limited and too out of date to be the only source of data used for target setting in this highly dynamic area. We were of the opinion that alone, these surveys would not be adequate to generate robust targets. We suggested two options to progress:

1. Undertake additional benthic invertebrate surveys to provide both additional, and more up to date, data, of which we provided further detail.
2. We recognise that due to the time constraints of the project that this might not be desirable, and therefore we strongly recommend a complimentary individual-based modelling approach, irrespective of whether new benthic surveys are commissioned. Whilst the

invertebrate data are limited and out of date, we do have more accurate bird count data. It is possible to calculate the energetic requirements of the birds due to be displaced from the development site and, consequently, how much food they eat. This information can then be used to develop benthic prey targets for the compensation site. This would be a desk-based exercise using bird counts from the development site, instead of requiring additional benthic survey data.

This type of modelling approach is highly specialised. However, Natural England had a preliminary discussion with Professor Richard Stillman at Bournemouth University, the UK's leading academic expert in this field, who agreed the work is feasible. Natural England advised the applicant that the individual-based model was its preferred approach, however, we have received no further assessment following those discussions. Therefore, the environmental assessment and agreement on the benthic prey targets remain outstanding.

- 5. The proposed extension creates uncertainties around whether there could be further potential changes in the habitats and species that require compensation, since the examination. We advise that Appendix UES11-2 Change in Habitat Losses Within the Designated Site (dated 21 June 2021), set out for material change 2 should be updated to reflect the proposed 7-year extension. The CEMMP should also be re-assessed to ensure that it remains fit for purpose.**

As identified in the material change 2 of AMEP DCO, there has been changes in habitat type and number of birds present on the Killingholme foreshore since the assessments in the original Environmental Statement. Appendix UES11-2 Change in Habitat Losses Within the Designated Site (dated 21 June 2021), set out the updated assessment. We note that no detail has been provided within the application documents, on whether this assessment will need to be further updated if a 7-year extension is granted. We advise that this should be provided. In addition, we advise that consideration should be provided on whether the CEMMP requires further updates in light of the proposed time extension to demonstrate that it will still be fit for purpose.

Habitats Regulations Assessment Screening

We advise that an in-combination assessment with the applications for Project Gigastack (PA/SCO/2022/13), Immingham Eastern Ro-Ro Terminal NSIP and Immingham Green Energy Terminal NSIP should also be undertaken within the Habitats Regulations Assessment.

Advice related to the Environmental Review Report

Main site

Chapter 11 - Terrestrial Ecology

We welcome that 2022/23 daylight and nocturnal bird surveys have been carried out to update the baseline for intertidal bird usage.

We note from paragraph 11.1.6 of the ER that WeBS core counts from 2014/15-2019/20 are used in the assessment. It is not clear why more recent WeBS data have not been used. We advise the latest available WeBS core count data are used (2022/23 for whole estuary and 2023/24 for individual sectors).

We note that paragraph 11.1.15 of the ER states that 'the status of Black-tailed Godwit in and around the AMEP site may require future update over the longer-term.' It is not clear what this means and what implications this may have for the current application.

Compensation site

Chapter 32 – Hydrodynamic and Sedimentary Regime

We note paragraph 32.2.8 of the ER states that the majority of works will be behind the floodbank, however, there is no detail provided on the construction works in the context of the breaching of the sea wall to create the compensation site and whether there are any potential changes due to accretion of saltmarsh on the foreshore.

Chapter 34 – Aquatic Ecology

We note from paragraph 34.4.4 that there is a change in the area of saltmarsh to be removed. Whilst this is a natural shift in the type of habitat affected and Natural England acknowledges that the compensatory habitat at Cherry Cobb Sands will remain adequate, it is important to have an accurate audit trail of habitat losses and gains related to the development. Therefore, we advise that an updated table of habitat losses and gains should be provided. In addition, all the relevant documents need to be consistent in this respect to assist with future consultations.

Chapter 35 – Terrestrial Ecology and Birds

We note that paragraph 35.4.69 of the ER states ‘the boundary of the [Cherry Cobb Sands compensation] site will be much closer to Cherry Cobb Sands Road than the original ES suggested’. We advise clarity is provided around the changes that have occurred to the Cherry Cobb Sands compensation site.

We welcome that paragraph 35.5.3 of the ER states that a site management plan and a monitoring strategy for Cherry Cobb Sands compensation site is still required, which will be developed in consultation with Natural England.

Chapter 38 – Noise

We note that Chapter 38 of the ER relates to human noise receptors only. It should be noted that potential impacts to ecological receptors were assessed through a Discharge of Requirements application made to East Riding of Yorkshire Council (application reference 20/30250/CONDET).

If you have any queries relating to the advice in this letter, please contact ██████████@naturalengland.org.uk. For any new consultations please send your correspondences to consultations@naturalengland.org.uk.

Yours sincerely

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COMPENSATION ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

DECEMBER 2015

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REVISION	COMMENTS	DATE
A	Revised Layout	14-09-2015

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1 INTRODUCTION

1.1 GENERAL

1.1.1 The development of the Able Marine Energy Park (AMEP) east of North Killingholme on the Lincolnshire Coast will partly affect the Humber Estuary Special Area of Conservation (SAC) and the Special Protection Area (SPA) / Ramsar site. Measures to both compensate and mitigate for the effects of AMEP on these European sites have been identified, and will be implemented as part of any future development.

1.1.2 This document is a Compensation Environmental Management and Monitoring Plan (CEMMP) for the compensation sites and it has been drawn up taking account of guidance on management planning produced by the Conservation Management System (CMS) Consortium (www.cmsconsortium.org). It describes the compensation measures that are required and lists specific objectives which are fundamental to their delivery. Further it includes targets and management actions which support the objectives and the monitoring which will be undertaken to confirm progress towards the objectives, and ultimately confirming that they have been achieved. Limits of acceptable change are defined and any necessary remedial actions which will be undertaken should the monitoring show that these limits have not been met.

1.2 PROCESS OF FINALISING OUTSTANDING TARGETS

1.2.1 The compensation proposals for AMEP are complex, and the objectives and targets / management options included in this version of the CEMMP have been subject to extensive discussions with stakeholders.

1.2.2 The CEMMP is a live working document which will be in place for as long as it is deemed necessary to achieve the agreed objectives set out in it. Updates to it will be overseen by the Steering Group (see Paragraph 1.6), whose role is explained below and includes undertaking a complete review of the EMMP every five years.

1.3 PRINCIPLE FOR REVIEW OF BENTHIC SPA BIRD PREY TARGETS

1.3.1 The benthic target protocol set out in this CEMMP is based on the current understanding of the benthic communities at North Killingholme Marshes (NKM) foreshore. It is understood that the targets can only be finalised once the baseline benthic surveys at NKM and Cherry Cobb Sands (CCS) have been completed. This will occur prior to the start of any work on AMEP that involve the loss of mudflats at the NKM foreshore, or disturbance to SPA birds that use it. The following considerations will need to be taken into account when reviewing the targets:

- The compensation site needs to function like the mudflats on NKM foreshore for black-tailed godwits and other waterfowl, and must support the benthic prey that the birds require. The review of the evidence will assess the presence of patches of high prey density and appropriate size classes associated with the numbers of foraging black-tailed godwits it has to support. The findings of the annual benthic monitoring will be set

in context within the agreed target range, taking account of natural changes at the control site(s).

- The ability of univariate and multivariate analysis techniques along with biotope mapping to adequately characterise the necessary functional aspects of Killingholme so they can be replicated within the compensation area will need to be considered; not just peak areas of prey density but also biomass of specific key prey species, only a proportion of which will represent those individuals within a suitable size range to be consumed by specific birds.
- The benthic targets will be set taking account of the energetic requirements of the black-tailed godwits. These will be defined through a combined assessment of the baseline benthic surveys of the mudflats on the NKM foreshore and the identified feeding locations of the birds.
- One of the key concerns is to avoid a situation where benthic targets are met in a single year, but with additional years' survey effort are shown to be consistently at the bottom end of the target range. This could provide sub-optimal habitat for supporting the peak numbers of black-tailed godwits, which are currently using the NKM foreshore in internationally important numbers. The regular review process will focus on benthic distribution, density, size classes and feeding requirements of black-tailed godwits, along with the numbers of birds using the site (see Annex 3 – Target Setting Protocol). This will identify sub-optimal performance early, and allow remedial management actions to be undertaken. Targets will be reviewed and the effectiveness of management actions monitored.

1.3.2 As the CEMMP is a live document it allows the current targets to be re-evaluated and adjusted as and when necessary, including once the baseline benthic surveys have been completed. The Steering Group will oversee the review of the baseline benthic survey findings, and the revision of the benthic targets based on the review findings. The Group may also agree to draw on additional external expertise if required. The cost implications to Able Humber Ports Limited (AHPL) of any changes, or additional support, will be subject to reasonable agreement between AHPL and the Steering Group.

The Benthic SPA Bird Prey Targets will be set-out in a separate document once the baseline benthic surveys at NKM and Cherry Cobb Sands (CCS) have been completed and the results analysed. This document will be made available in early 2016.

1.4 THE STEERING GROUP

1.4.1 AHPL will have overall responsibility for the implementation and delivery of the CEMMP. However, the involvement of other stakeholders is essential for the effective working of the CEMMP, and hence AHPL will establish a Steering Group whose members and terms of reference are set out in a 'Deed in Relation to the Able Marine Energy Park', between Able Humber Ports Limited and Natural England.

1.4.2 An agenda will be drawn up in advance of each Steering Group meeting by AHPL and minutes will be produced after the meeting by AHPL for agreement.

- 1.4.3 Unless otherwise stated, the default duration for the ecological survey work (e.g. saltmarsh intertidal and subtidal benthos and fish communities described within this document is 10 years. Continuance of any of these components beyond that period will be determined through discussion on findings etc. by the Steering Group. It is expected that some components of the compensation and the mitigation will require on-going management to ensure that the objectives continue to be met.

2 ENVIRONMENTAL BASELINE AND IDENTIFIED IMPACTS

2.1 INTERTIDAL HABITATS

Baseline North Killingholme Marsh (NKM)

- 2.1.1 The baseline is described in EX28.3 Part 2 in terms of historical trends, mud type, benthic community and bird populations. This identified that the shore was eroding but has entered a phase of accretion since 2000 after the construction of the Humber International Terminal. As a result, over the last 10 years the intertidal area that lies between the Mean High Water Neaps (MHWN) and Mean High Water Springs (MHWS) elevations has increased from 3.27 ha to 18.95 ha, an increase of 15.68 ha. The sediments are composed of a high proportion of fine silts giving soft and sloppy mud. The upper shore is subject to colonisation by *Spartina anglica* (Common Cord-grass) dominated saltmarsh. Table 1 summarises the benthic population (details of the methodology are given in Annex 10.1 of the Environmental Statement (ES). Biomass is wet (blotted) weight in grams. Further data is provided in the Marine Environmental Management and Monitoring Plan (MEMMP).
- 2.1.2 Further invertebrate sampling work will be undertaken in Autumn 2015 and Spring 2016 to provide a new preconstruction baseline and identify targets for the compensation site.

Table 1: Intertidal Abundance and Biomass of Principal Species

Abundance								
species	(12 x 0.01m ² samples)	per m ²	species	(12 x 0.01m ² samples)	per m ²	species	(12 x 0.01m ² samples)	per m ²
<i>Tubificoides benedii</i>	268	2233	<i>Tubificoides benedii</i>	271	2258	<i>Streblospio shubsolii</i>	91	758
<i>Hediste diversicolor</i>	114	950	<i>Corophium volutator</i>	202	1683	<i>Corophium volutator</i>	88	733
<i>Corophium volutator</i>	109	908	Nematoda	93	775	Nematoda	21	175
<i>Streblospio shubsolii</i>	50	417	<i>Streblospio shubsolii</i>	50	417	<i>Tubificoides swirencoides</i>	16	133
Nematoda	49	408	<i>Macoma balthica</i>	47	392	<i>Tubificoides benedii</i>	15	125
Biomass								
Upper Shore			Mid Shore			Lower Shore		
species	(12 x 0.01m ² samples)	per m ²	species	(12 x 0.01m ² samples)	per m ²	species	(12 x 0.01m ² samples)	per m ²
<i>Hediste diversicolor</i>	2.86	23.83	<i>Macoma balthica</i>	1.55	12.92	<i>Macoma balthica</i>	0.21	1.75
<i>Corophium volutator</i>	0.42	3.50	<i>Corophium volutator</i>	0.45	3.75	<i>Corophium volutator</i>	0.13	1.08
<i>Macoma balthica</i>	0.27	2.25	<i>Tubificoides benedii</i>	0.2	1.67	<i>Hediste diversicolor</i>	0.07	0.58
<i>Tubificoides benedii</i>	0.17	1.42	<i>Hydrobia ulvae</i>	0.02	0.17	<i>Mysella bidentata</i>	0.06	0.50
<i>Streblospio shubsolii</i>	0.01	0.08	<i>Streblospio shubsolii</i>	0.01	0.08	<i>Streblospio shubsolii</i>	0.03	0.25
Total biomass per m²		31.08			18.58			4.17

Note: once target abundance has been agreed from benthic survey work, abundance and biomass will be combined to provide suitable prey sizes/quality targets for the compensation site.

Impacts

2.1.3 Details of agreed impacts are provided in the Statement of Common Ground (SoCG) on the Shadow Habitat Regulations Assessment (sHRA). Habitat losses are detailed in Annex B and the amount of compensatory habitat that will be delivered is summarised in Table 2.

Table 2: Compensatory Habitat to be delivered (ha)

	Habitat Type			
	Saltmarsh	Intertidal Mudflat	Sub-tidal (Estuary)	Total
SPA	0	88	13.5	101.5
SAC	0	73.4	21.2	94.6

2.1.4 A combination of direct and indirect losses associated with the site together with long term losses in the Humber identified by the Environment Agency provide a requirement to replace a long term loss of 101.5 ha of habitat of which 88 ha is intertidal and 13.5 ha is sub-tidal. This total reflects the SPA habitat losses which are higher than those of the SAC (21.2 ha of estuarine and 73.4ha of intertidal) as they include functional loss of use to birds

through disturbance. They also reflect the requirement to replace intertidal habitat on 2:1 basis (due to uncertainty) and other habitats on a 1:1 basis. Sub-tidal habitat can be replaced by other estuarine habitats such as saltmarsh.

- 2.1.5 Nine species of bird were identified as likely to be displaced by direct habitat loss and functional disturbance to the extent that an impact on site integrity was anticipated. This assessment was based on peak counts. These peaks were all recorded from the Through the Tide Counts (TTTC) reported in Annex 11.9 Marine Energy Park Bird Survey Results April 2010 to April 2011 of the ES. These peaks were all higher than the five year mean peaks reported from WeBs counts for the period 2004/05-2008/09.

Table 3: Bird Species

Species	Humber Qualifying Population	Humber Min & Max Peaks (WeBS 2004/5-2008/09)	NKM Peak & % of Humber population represented by Peak	% Foraging during peak count
Avocet (breeding)	493	374-652	4 (0.8%) TTTC	100
Bar-tailed Godwit	5926	1490-5926	123 (3.2%) TTTC	98
Black-tailed Godwit	3887	2435-5323	2566 (66%) TTTC	49
Curlew	4440	3071-5180	158 (3.6%) TTTC	49
Dunlin	21518	14733-26305	1029 (4.8%) TTTC	99
Lapwing	18756	11700-27421	325 (1.7%) TTTC	0
Redshank	5445	3886-8494	540 (9.9%) TTTC	98
Ringed Plover	2168	781-2168	210 (9.7%) TTTC	88
Shelduck	5314	2892-5804	109 (2.0%) TTTC	95

- 2.1.6 Effects arising from piling on marine mammals and sea lamprey are dealt with in the MEMMP.

Baseline Cherry Cobb Sands Saltmarsh

- 2.1.7 The baseline is recorded in Annex 35.1 of the AMEP Environmental Statement (ES). A description of the saltmarsh that will be affected by the works is included in Annex 34.1 of the ES, and briefly summarised below.
- 2.1.8 The upper saltmarsh in the vicinity of Cherry Cobb Sands varies in width from five metres seaward from the base of the existing sea defences at Stone Creek in the south of the site, up to 330m at the Outstray in the north of the site (2010 data). In a similar manner, the width of the mid saltmarsh zone also varies from 60 m in the south to around 300m in the north of the site.
- 2.1.9 There is dense saltmarsh vegetation cover in the upper and mid saltmarsh zones, with little or no signs of erosion, which indicates that the habitat quality is good. These zones are dominated by sea couch grass *Elytrigia atherica* (*Elymus pycnanthus*) with other species of note including sea plantain *Plantago maritima*, red fescue *Festuca rubra* and Orache *atriplex* sp. A network of saltmarsh creeks runs through these zones, allowing water to

drain off following high tide as well as allowing freshwater from the land to discharge into the estuary.

- 2.1.10 The lower saltmarsh zone is extensive, stretching up to 800m from the edge of the mid saltmarsh zone. It is thought that this zone is gradually accreting. The lower saltmarsh is dominated by 'pioneer' species including annual glasswort *Salicornia europaea* agg. and common cord grass *Spartina anglica*.

Impacts

- 2.1.11 Creation of the compensation site will require the removal of 2ha of saltmarsh for the channel in the immediate term.
- 2.1.12 Compensation for saltmarsh losses will be provided in the managed re-alignment (MR) component of the compensation site.

Baseline for Cherry Cobb Sands Intertidal

- 2.1.13 Bird surveys (EX35.14) that were undertaken between August 2010 and April 2011, in an area which covered both the intertidal habitats at CCS and the farmland which will form the compensation site, showed that the foreshore was used by important numbers of one or more of the qualifying interest species of the SPA/Ramsar site throughout the period August to April. Species such as shelduck, grey plover, curlew, redshank, knot and dunlin were present in numbers usually well in excess of 1% of the Humber Estuary SPA/Ramsar population at both high and low tides in almost all the months surveyed. Curlew was also present on the compensation site fields in important numbers over the autumn passage period (September – October). Other species such as teal, lapwing and golden plover were present in numbers exceeding 1% in October and December to March, with black tailed godwit present in December and January, and bar-tailed godwit in most months between November and April. Passage interest included ringed plover and greenshank both of which were present on the foreshore in important numbers in August, ruff in September, and little egret on the foreshore in October. WeBS counts (see Section 35.7.9 of the ES) show that important numbers of some species can occur even over the summer months (e.g. ringed plover in May and dunlin in July).
- 2.1.14 EX34.2 provides some information on the temporal and spatial distribution of benthic communities within the Humber estuary, including abundance data for the Cherry Cobb sands area. This is summarised in the Table 4 below;

Table 4: Prey Abundance at Cherry Cobb Sands

Mean per m2	2000	2001	2002
<i>Abra tenuis</i>	1367	937	0
<i>Corophium volutator</i>	51	51	0
<i>Crangon crangon</i>	0	25	0
<i>Cyathura carinata</i>	51	0	0
<i>Enchytraeidae</i>	10937	83443	8759
<i>Eteone longa</i>	228	76	152
<i>Hediste diversicolor</i>	582	1367	1190
<i>Hydrobia ulvae</i>	152	0	329
<i>Macoma balthica</i>	3165	4557	6203
<i>Manayunkia aestuarina</i>	3823	25	0
<i>Nematoda</i>	0	39595	0
<i>Nephtys</i>	0	25	0
<i>Nephtys hombergii</i>	0	0	51
<i>Paranais litoralis</i>	101	0	0
<i>Pygospio elegans</i>	0	51	1975
<i>Scrobicularia plana</i>	0	0	456
<i>Streblospio shrubsolii</i>	0	51	0
<i>Tubificoides benedii</i>	14532	6582	1215
TOTAL	34987	136785	20329

- 2.1.15 Key prey species for black-tailed godwit are highlighted in yellow and occur in higher abundance than south shore sites during the same period.

Impacts

- 2.1.16 Works to create the compensation site are not predicted to have significant effects on the SPA bird species. This is largely due to the visual and acoustic screening of the works which is expected from the existing sea defence wall, the diversion inland of the coastal footpath which will remove a source of disturbance to birds on intertidal habitats (which may be having effects at present) without increasing the effects on birds on inland fields, and the timing of the works to cover predominantly the summer months. This is a period when the intertidal habitats are typically less well used by waterbirds, the birds have more choice of location in which to forage and roost, and there is more daylight and good benthic invertebrate food availability across the intertidal mudflats. In addition the creation of the new embankment is several hundred metres away from the edge of the intertidal habitat which is very extensive.
- 2.1.17 Mitigation to reduce impacts includes timing of the work so that potentially disturbing activities closest to intertidal bird populations occur April to October.

3 TERRESTRIAL HABITATS

3.1 BASELINE FOR THE COMPENSATION SITE

3.1.1 The compensation site comprises the Regulated Tidal Exchange (RTE) and Managed Re-alignment (MR), together with the Cherry Cobb Sands Wet Grassland (CCSWG) and is described in EX28.3 Parts 3 & 4. The existing baseline is provided in Chapter 35 of the ES but updated in EX28.3 Part 6 EIA Review, to reflect the movement of the wet grassland and roost site from Old Little Humber Farm to CCSWG. The current use of the area is arable farmland. The landscape was assessed as having low ecological value. No water voles were present, but colonisation by transient animals cannot be ruled out.

3.1.2 A badger survey is reported in Annex 35.8 of the ES and updated by EX35.13. It found two main social groups associated with two main setts and a number of outlying and subsidiary setts, with some evidence of a decline in use between surveys.

Impacts

3.1.3 These are described in EX28.3 Part 6 EIA Review and it is concluded that ecological impacts will be largely the same as those predicted in the original ES and be negligible or of minor adverse significance only.

3.1.4 Badger surveys indicated the proposals would result in the loss of 4 outlying setts associated with the group of badgers based at Sett 28, and 5 outlying setts associated with the group of badgers based at Sett 11. None of the affected setts received high levels of use from badgers in either 2011 or 2012, and none were located close to a key seasonal food source or other resource likely to be crucial to the badgers' survival. Given the availability of alternative setts elsewhere within their range, this loss would be unlikely to have a detrimental impact on badgers. A licence to close outlier setts will be required but overall the increase in foraging habitat will be beneficial.

3.1.5 Minor construction impacts could occur for reptiles without mitigation.

3.1.6 The greatest change in impacts related to the Compensation Scheme is apparent during the operation of the scheme, where there will be minor changes to views from a nearby property (Fair View) because of the widened embankment around the RTE scheme, and a minor change to the landscape as a result of the wind pumps at the wet grassland site.

Baseline for North Killingholme Haven Pits (NKHP)

3.1.7 Operational impacts are dealt with in the Terrestrial Environmental Monitoring and Management Plan (TEMMP).

3.1.8 Baseline information on NKHP is in Chapter 11 of the ES and in the sHRA. The site holds significant numbers of the Humber bird population, and those species which are present in numbers of 1% or more of the Humber Estuary SPA populations are summarised in Table 5.

Table 5: NKHP TTTC & WeBs Peaks

Species	Humber Population	Peak/mean of Peak Count	Proportion of Humber Population (%)	Month	Data Source
Assemblage	140197	4112	2.9	Aug	TTTC
		3787	2.7	Sep	WeBS
Avocet	493	16	3	Mar	TTTC
		27	5.5	Mar	WeBS
Black-tailed godwit*	3887	3 800	97.8	Aug	TTTC
		3 338	85.9	Sep	WeBS
Common sandpiper	(46)	1	2.2	Jul, Aug	TTTC
		-	-	-	WeBS
Dunlin	21518	270	1.3	Oct	TTTC
		380	1.8	Nov	WeBS
Grey heron	74	3	4.1	Oct	TTTC
		3	4.1	Sep, Oct	WeBS
Lapwing*	18756	5	<0.1	Oct	TTTC
		276	1.5	Nov	WeBS
Little egret	38	1	2.6	Jun, Jul	TTTC
		-	-	-	WeBS
Little ringed plover	6	2	34	Apr	TTTC
		-	-	-	WeBS
Mallard	2096	34	1.6	Oct	TTTC
		71	3.4	Sep	WeBS
Moorhen	146	4	2.7	Jul	TTTC
		2	1.6	Sep	WeBS
Redshank	5445	249	4.6	Aug	TTTC
		215	3.9	Aug	WeBS
Shoveler	145	61	42.1	Oct	TTTC
		29	20	Dec	WeBS
Smew	2	1	50	Jan	TTTC
		-	-	-	WeBS
Snipe	118	6	5.1	Oct	TTTC
		4	3.4	Oct	WeBS
Teal	2865	46	1.6	Oct	TTTC
		30	1.0	Nov	WeBS
Water rail	7	2	28	Jun	TTTC
		-	-	-	WeBS

Table Legend

Humber Population – Population taken from Mean of Peak data from 5 Year WeBS Core Count Data between 2004/05 – 08/09 for Sector 38950 the Humber Estuary. () indicates mean calculated from an incomplete 5 year data set.

Peak count – The highest species count recorded within North Killingholme Haven Pits from TTTC data or Mean of Peak Count taken from WeBS data (datasets expanded below).

WeBS – Mean of Peak Count derived from WeBS 5 Year Core Count Data from 2004/05 - 08/09 for Sector 38201 North Killingholme Haven Pits (TA166196).

TTTC – Through the Tide Count, Waterbird Surveys undertaken at Killingholme Marshes by Institute of Estuarine Coastal Studies (IECS) between April 2010 – April 2011

Month – For TTTC data the month(s) refers to when the peak count per species was recorded from the Peak Count column. For WeBS data the month still refers to when the peak count was recorded although the corresponding Peak Count figure for WeBS is a mean of peak rather than a peak of peaks.

Species written in red are those which are individual qualifying interests of the Humber Estuary SPA.

Species with a * by their name are listed as UKBAP species.

Impacts

- 3.1.9 No direct impacts are predicted but the loss of intertidal feeding arising from the development may reduce the attractiveness of NKHP as a roost site and lead to displacement resulting in an effect on site integrity.

4 OBJECTIVES**4.1 CONSTRUCTION*****Rationale & Objectives***

- 4.1.1 Construction impacts at NKM are dealt with in the MEMMP, and those at NKHP in the TEMMP.
- 4.1.2 Impacts have been identified during the construction of the compensation site (RTE/MR and CCSWG) and objectives to ensure appropriate mitigation and legal compliance during construction are required.
- 4.1.3 Impacts requiring mitigation have been identified for intertidal birds, breeding birds, reptiles, badgers (licensing of sett closures will be required), and water voles (probably not present but pre-survey required given records of transient populations in locality).
- 4.1.4 The agricultural fields that form the proposed compensation site are only used by curlew in any significant numbers on a regular basis. It has been agreed with Natural England that the birds currently supported on the agricultural fields that comprise the compensation site can be supported in adjacent fields. Much of the work on the inland embankment will have been completed prior to the main period of use during the autumn passage, and construction work will not be ongoing across the whole 3 km of the new embankment all at once. Hence there will be adjacent fields that will not be subject to disturbance from the works that will be available for the birds to use throughout the period they are likely to be present.
- 4.1.5 The intertidal area was surveyed as described in EX35.14. However this data represents peak counts only over a single non-breeding season. Targets based on WeBs data are difficult to use as the WeBs count area extends from Paull to Cherry Cobb Sands. One option may be to take the peak counts recorded in EX35.14 and apply a natural variability test derived from the standard deviation of the WeBs count data for Autumn (22% of the 5 year mean peak) and winter (42% of the 5 year mean peak). Further discussions with NE will take place to establish a suitable reference point against which disturbance can be measured– see Objective C4: Minimise construction disturbance to SPA populations, page 16
- 4.1.6 The construction of RTE sluices may require piling. As AHPL develop detailed planning for the construction of the sluices, if required construction is to be undertaken between April and July, then auger piling will be used in conjunction with a method statement agreed with Natural England.
- 4.1.7 Good construction practice and adherence to Pollution Prevention Guidance will be embedded into any works undertaken on site.

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Objective C1: Construction will comply with legal requirements and best practice with regard to reptiles and water voles.

Target	No killing or injuring of protected species
Management	<ul style="list-style-type: none"> • Strim habitat fortnightly to ensure habitat remains unsuitable for colonisation • Ecological briefing for workforce (including recognition, contact procedures, action to be taken)
Monitoring	<ul style="list-style-type: none"> • Undertake pre-construction survey of suitable habitat for reptiles and water voles
Who	<ul style="list-style-type: none"> • Survey by suitably experienced surveyor • Briefing by Environmental manager/ Ecological Clerk of Works
When	<ul style="list-style-type: none"> • Pre-construction
Limits of Acceptable Change	<ul style="list-style-type: none"> • N/A
Remedial Action	<ul style="list-style-type: none"> • Cease work if animals found in work area and consult with Environmental Manager
Notes	Likelihood of either reptiles or water voles being present is low given habitat. If habitat has been colonised since the original CCS ES suitable alternative habitat would need to be created.

Objective C2: Prevent Harm to breeding birds

Target	No damage to nests or eggs, or killing or injuring of chicks of wild birds.
Management	<ul style="list-style-type: none"> • Remove suitable nesting habitat to north of existing sea wall (i.e. protected from disturbance to birds on intertidal area) during September-March. • Strim areas fortnightly to reduce suitability. • Ecological briefing for workforce (including recognition, contact procedures, action to be taken) • Where potential nesting habitat remains (e.g. close to intertidal) and works take place during April-August site to be checked for nesting birds.
Monitoring	<ul style="list-style-type: none"> • Undertake pre-construction survey of suitable habitat for nesting birds
Who	<ul style="list-style-type: none"> • Survey by suitably experienced surveyor • Briefing by Environmental manager/ Ecological Clerk of Works
When	<ul style="list-style-type: none"> • Pre-construction
Limits of Acceptable Change	<ul style="list-style-type: none"> • N/A
Remedial Action	<ul style="list-style-type: none"> • Cease work if nesting birds found in work area and consult with Environmental Manager. • Any active nests not to be disturbed until young have fledged and capable of sustained flight.
Notes	

Objective C3: Ensure construction is legally compliant in relation to badgers

Targets	<ul style="list-style-type: none"> • Safe and licensed exclusion of badgers from setts. • Provision of suitable foraging habitat • Provision of 10 earth mounds for sett building at base of RTE northern bund and/or around CCSWG site
Management	<ul style="list-style-type: none"> • Undertake repeat survey to inform licence application. • Licence application (licences are usually only issued for period 1st July-30th November). • Closure of setts under licence. • Adherence to mitigation in licence and EX35.13
Monitoring	<ul style="list-style-type: none"> • Pre-construction to validate 2012 survey • Post construction walkover survey to check colonisation of earth mounds and sett and latrine usage.
Who	<ul style="list-style-type: none"> • Monitoring by suitably experienced consultant • Environmental Manager responsible for licensing issues and adherence to conditions.
When	<ul style="list-style-type: none"> • Repeat survey for licence application June-July 2015 • Licence application September 2015. • Creation and planting of mounds, planting of fruit and berry bearing shrubs at wet grassland from winter May-August 2016. At RTE this process to take place in winter 2016. • Sett closure November - December 2015. • Post construction surveys annually for five years to cease after 3 years if population stable.
Limits of Acceptable Change	<ul style="list-style-type: none"> • 10% reduction in total number of subsidiary or outlying setts used within three years. • 5% reduction in annex setts used within two years • Cessation of use of any main sett within one year
Remedial Action	<ul style="list-style-type: none"> • Bait survey to inform analysis • If declines associated with foraging resource introduce supplementary feeding during periods of drought or other hardship • Increase foraging resource (further planting)
Notes	<p>Vegetation on mounds, particularly that at CCSWG should be unsuitable for raptors and corvids (i.e. should comprise weak stemmed and low growing cover such as raspberry and bramble). No planting should be undertaken on top of any bunds to avoid providing hunting perches for raptors and corvids.</p> <p>Habitat enhancement for badgers would be on Northern slopes (but below top of bund) of RTE site and North East part of wet grassland.</p>

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Objective C4: Minimise construction disturbance to SPA populations

Targets	No disturbance to feeding or roosting birds on the intertidal area
Management	<ul style="list-style-type: none"> • Construction work will begin with sea wall area and bunds nearest to proposed CCSWG roost site to provide visual and acoustic screen. This will be carried out during April-October. • Piling will be undertaken between April-July (or if this cannot be achieved augur piling will be used). • During November-March all work will take place within screen provided by sea wall. • All piling will be conducted in accordance with the Code of Construction Practice (CoCP), which is required under DCO Schedule 11, Requirement 22 and will include controls to minimise waterbird disturbance.
Monitoring	<ul style="list-style-type: none"> • Numbers of birds within the compensation site and intertidal area will be counted on a monthly basis. The reference target will be agreed with NE.
Who	<ul style="list-style-type: none"> • Suitably experienced surveyor for monitoring. • Ecological manager/ Ecological Clerk of Works to manage construction.
When	<ul style="list-style-type: none"> • Monitoring during construction
Limits of Acceptable Change	<ul style="list-style-type: none"> • To be agreed with NE (see discussion under rationale)
Remedial Action	<ul style="list-style-type: none"> • Review construction methods
Notes	See Rationale regarding reference data issues

4.2 REGULATED TIDAL EXCHANGE & MANAGED REALIGNMENT

Rationale & Objectives

- 4.2.1 It has been agreed with the Regulators that compensation must be put in place to recreate 94.6 ha of habitat (73.4 ha of intertidal mudflat, and 21.2 ha of sub-tidal (estuary)) for the SAC, and 101.5 ha for the SPA.
- 4.2.2 The RTE & MR will be constructed to provide initially 88 ha of mudflat and a long term mudflat resource of at least 44 ha. The MR component of the scheme will comprise 30.6 ha of which up to 27 ha is anticipated to revert to saltmarsh. SAC targets for the saltmarsh component are that it recreates typical saltmarsh and mudflat characteristics in terms of topography, zonation and species to that of the middle Humber.
- 4.2.3 Targets for the mudflat relate to its sediment quality and benthic communities. In turn these underpin its ability to provide functional feeding habitat for displaced bird species (see objective B1)
- 4.2.4 Long term sustainable mudflat will require managing to maintain principal parameters, and the construction of the four cell RTE structure reflects the need to maintain sufficient mudflat habitat even when being managed.

- 4.2.5 Benthic targets will be derived from pre-construction surveys and set in agreement with Natural England (NE) as detailed in Annex 3: Target Setting Protocol.
- 4.2.6 The managed realignment offers potential for biodiversity gains particularly for estuarine fish. A fish survey that is as far as possible WFD compliant (EA Operational Instruction 328_07) will be implemented and agreed with the EA. Targets are based on delivering monitoring and therefore numerical targets and limits of acceptable change are not required. There are some practical difficulties in complying with WFD guidance in that whilst fyke nets could be used within the MR, seine nets could not. It may be possible to substitute a small hand hauled epibenthic sledge as a second form of sampling particularly suitable for juvenile fish. This would be dependent on it being safe to do so, and this method is not WFD compliant although it is used on other MR sites. Similarly Fyke nets may be used to sample the RTE components of the site by setting them outside the RTE sluice(s) on the outgoing tide subject to health and safety considerations.
- 4.2.7 Management will be targeted to produce suitable sediment types and maintain wetness both to assist feeding birds and reduce saltmarsh encroachment within the RTE. Natural processes will be allowed to develop within the MR part of the site.
- 4.2.8 The warping up phase will be used to inform future management and allow the operations manual to be augmented based on experience of the live system.
- 4.2.9 A basic manual of operations will be provided prior to the system going live. As part of the ongoing learning process all significant management interventions (e.g. dredging, bed levelling) will be logged (date & time) and photographed from fixed reference points so that they can be referenced against ecological survey data.

Objective COMP1: Construction of site and sluices

Targets	<ul style="list-style-type: none"> • Delivery of site to include four RTE fields each of 18ha size, with ponds and channel areas of about 1.5ha per field, operational sluices to enable impoundment of a field at near peak spring tide level and operational sluices to enable drainage of impounded water from one field to another. • Leakage into underlying soils to be less than 200mm over a 10 day period from an initial impounded depth of water of 1,000mm.
Management	<ul style="list-style-type: none"> • Construction to be undertaken by appointed contractor, managed by APHL
Monitoring	<ul style="list-style-type: none"> • Topographic survey to define extent of site • Engineering analysis to confirm sluice performance and leakage into underlying soils and through bund
Who	<ul style="list-style-type: none"> • Survey by suitably qualified surveyor • Analysis by suitably qualified engineer
When	<ul style="list-style-type: none"> • Prior to and during the construction period
Limits of Acceptable Change	<ul style="list-style-type: none"> • The RTE part of the site must provide a minimum of 66ha of mudflat area. This could be provided in three or more fields. Sluices to be sized accordingly. • Initial level of the RTE fields to be between +1.9m OD and +2.0m OD.
Remedial Action	<ul style="list-style-type: none"> • Over consolidation of field surface to reduce leakage.

Objective COMP2: Warping up of RTE fields

Targets	<ul style="list-style-type: none"> • Warping up of RTE fields by an average of 100mm depth of marine muds
Management	<ul style="list-style-type: none"> • By site managers: <ul style="list-style-type: none"> ○ After construction inlet sluices for the RTE fields are in general to be operated fully open to facilitate rapid accretion of muds across the RTE fields. ○ After the first winter period following breaching of the realignment site the sluices are to be operated in normal operational mode to avoid extended drying of the mudflat resource over the neap tide period.
Monitoring	<ul style="list-style-type: none"> • Levels over the RTE fields are to be monitored using a combination of water level monitoring, marked stakes and LiDAR or other monitoring techniques. Method statement to be prepared for the surveying.
Who	<ul style="list-style-type: none"> • Survey by suitably qualified surveyor
When	<ul style="list-style-type: none"> • Basic survey of field levels at monthly intervals during warping-up, LiDAR surveys on opportune basis of 1 to 3 year interval
Limits of Acceptable Change	<ul style="list-style-type: none"> • If average mud levels in the field achieve 100mm before the end of the first winter period after breaching sluices are to begin to be operated in normal operational mode.
Remedial Action	<ul style="list-style-type: none"> • If warping up is seen to be occurring very slowly the three additional outlet sluices could be opened up to increase exchange.
Notes	<ul style="list-style-type: none"> • On initial breaching the fields will be operated with the inlet sluices fully open (as per EIA assessment) and the rates of warping up in the fields and scour potential in the breach and Cherry Cobb Sands Creek assessed. If the rate of warping up in one or more of the fields would appear to benefit from increased exchange a trial period of operating the field with the outlet sluices fully open will be instigated. The erosion potential will continue to be examined. A decision will then be made regarding whether to continue exchange with the outlet sluices open. • Changes to the sluice openings from those agreed, would need to be notified to all parties prior to this trial being undertaken. Any longer-term changes to the exchange within the Regulated Tidal Exchange scheme to that currently assessed would need to be discussed with the Environment Agency, due to the potential issues with additional erosion that would occur during this period of time

Objective COMP3: Operating Manual for water level management

Targets	Operating Manual for water level management by site managers
Management	<ul style="list-style-type: none"> • By site manager and suitably qualified engineer: <ul style="list-style-type: none"> ○ During the initial warping up phase sluice operation, impoundment and flushing are to be trialled ○ Operating Manual to be developed and used as the basis for operational management of site during remainder of warping up period. ○ Operational Manual to be reviewed after first year of operations.
Monitoring	<ul style="list-style-type: none"> • Water level monitoring • Recording of sluice settings
Who	<ul style="list-style-type: none"> • By site managers assisted by suitably qualified surveyor
When	<ul style="list-style-type: none"> • Basic Operating Manual to be prepared prior to site being breached. • Revised operating manual to be prepared within 6 months of site being breached taking into account experience of managing live system • Operating Manual to be reviewed within 18-24 months of site being breached. • Operating Manual to be reviewed every 24 months thereafter.
Limits of Acceptable Change	<ul style="list-style-type: none"> • Operating Manual provides the basis for adaptive management of water levels within the RTE fields. In combination with the sediment management plan for the RTE fields this provides the means of maintaining the sustainable compensatory mudflat resource.
Remedial Action	<ul style="list-style-type: none"> • Review of Operating Manual and modification of operating procedures

Objective COMP4: Sediment Management for RTE fields

Targets	<ul style="list-style-type: none"> • Development and implementation of sediment management plan for RTE fields
Management	<ul style="list-style-type: none"> • By site manager and suitably qualified engineer: <ul style="list-style-type: none"> ○ To be developed following observation of rates and patterns of mud accretion in the RTE fields. ○ To be optimised over time to optimise mudflat functionality in the RTE fields based on the results of other monitoring. • Dredging and bed levelling to be undertaken by suitably experienced organisation
Monitoring	<ul style="list-style-type: none"> • Bed level monitoring • Photographic records • Particle size and density of accumulating material • Accumulation in channels and pond areas
Who	<ul style="list-style-type: none"> • By site managers assisted by suitably qualified surveyor
When	<ul style="list-style-type: none"> • Sediment management plan to be developed within 24-36 months of site being breached. • Implementation of plan, possibly involving initial trials, to be undertaken 5-10 years after breaching of site. • Sediment management plan to be reviewed every 24 months thereafter.
Limits of Acceptable Change	<ul style="list-style-type: none"> • Sediment management provides the basis for adaptive management of mudflat levels within the RTE fields. In combination with the water level management this provides the means of maintaining the sustainable compensatory mudflat resource.
Remedial Action	<ul style="list-style-type: none"> • Trialling and implementation of sediment management measures earlier than expected. • Methods and techniques expected to evolve over time. Could involve floating and/or land based techniques.

Objective COMP5: Monitoring of bathymetry outside the RTE fields

Targets	<ul style="list-style-type: none"> • Topographic monitoring of realignment site, Cherry Cobb Sands Creek, entrance to Stone Creek and wider Foul Holme Sands environment
Management	<ul style="list-style-type: none"> • By site manager
Monitoring	<ul style="list-style-type: none"> • Survey by LiDAR of local and wider area at 1-3 year intervals • Regular (3 monthly) photographic surveys of realignment site, Cherry Cobb Sands Creek and Stone Creek form fixed points. • Topographic surveys at. four sections across Cherry Cobb Sands and one section in the entrance of Stone Creek
Who	<ul style="list-style-type: none"> • Site manager and suitably qualified surveyor
When	<ul style="list-style-type: none"> • At regular intervals as outlined above. • Photographic record and topographic surveys to commence at time of consent to establish baseline conditions
Limits of Acceptable Change	<ul style="list-style-type: none"> • Changes in Cherry Cobb Sands channel cross section to be within limits assessed in EX28.3 on compensation site or recorded natural variability whichever is the greater. • Siltation in the entrance to Stone Creek that can be attributed to development or operation of the compensation site to be assessed for removal by AHPL.
Remedial Action	<ul style="list-style-type: none"> • Modifications to monitoring locations as required and in agreement with Steering Group • Bed levelling or dredging in the entrance to Stone Creek.

Objective COMP6: The RTE & MR site will contain similar infaunal communities to those found at NKM as defined by characteristic species in abundance and biomass.

Targets	<ul style="list-style-type: none"> • Similar faunal biotope(s) to that found at North Killingholme Marshes based on preconstruction surveys undertaken in and Autumn 2015 and Spring 2016 any additional surveys or information provided by EA • This biotope to be provided within 88ha of mudflat of which a minimum of 44ha will always be available. • Quantitative targets are to be defined and agreed following completion of full baseline (pre-construction) surveys. The Survey design for this is set out in Annex 2 and the target setting protocol in Annex 3.
Management	<ul style="list-style-type: none"> • Breach of sea defence to be made if possible within the peak benthic larval recruitment phase (March – May) • Bed levelling to be conducted post spawning/recruitment phase of key species;
Monitoring	<ul style="list-style-type: none"> • Sampling of the RTE & MR areas is detailed in Annex 2 and replicates the methods used at NKM & CCS • Samples to be taken with hand held corer (0.01 m²), sediment sampled to a depth of c.15 cm. 3 replicate benthic samples should be collected at each station (with one additional core sample collected per station to characterise the sediment). • A topographic survey will be used to inform the stratified systematic design. • Analysis will be as stipulated in Annex 2. • Particle size analysis, organic content and water salinity will also be measured.
Who	<ul style="list-style-type: none"> • Environmental Manager and suitably qualified surveyor
When	<ul style="list-style-type: none"> • Monitoring to be undertaken annually in August-September (with the optimal time being the last week of August to first week of September) for the first ten years. • Any subsequent change in monitoring to be reviewed and agreed by the Steering Group.
Limits of Acceptable Change	<ul style="list-style-type: none"> • Community must be characterised by the biotope and AFDW biomass/ individuals per square metre within the tolerance limits identified from the baseline survey to be undertaken in Autumn 2015 & Spring 2016 and other relevant data. See target setting protocol in Annex 3 • Intertidal mudflats across 60 ha
Remedial Action	<ul style="list-style-type: none"> • Alter sluice management to ensure adequate larval transport and suspended sediment transportation into the cells.

Objective COMP7: The RTE site post warping up will contain similar sediment distribution patterns to those found at NKM as defined by Particle Size Distribution (PSD)

Targets	<ul style="list-style-type: none"> • Sediment distribution to provide Sandy mud and mud as found at Transect 3 of the characterisation survey. • (79%-95% mud, 4.5%-20% sand) to provide the envelope of Particle Size Distribution
Management	<ul style="list-style-type: none"> • Management of warping up and sluice gates to maintain desired sediment and fluidity of sediment • However, the mud levels within the fields will continue to rise and some maintenance to clear excess sediment will be required
Monitoring	<ul style="list-style-type: none"> • Samples taken to support the sediment monitoring programme will be collected by means of hand coring, • When the full distribution has been constructed and the warping up phase is complete the sample should be assigned a description based on the Folk classification system (Folk, 1974) and/or the Wentworth classification system (Wentworth, 1922). • Guidelines to be used in the design and subsequent reporting of benthic monitoring are the Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites (Ware and Kenny, 2011) and the Marine Monitoring Handbook (Davies et al, 2001) unless statutory agency advice indicates an alternative approach. • The sediment will not build up uniformly across the site. High points will be identified by visual inspection, using the water level to identify 'islands', or observing the beginnings of saltmarsh formation.
Who	<ul style="list-style-type: none"> • Environmental Manager and suitably qualified surveyor
When	<ul style="list-style-type: none"> • Annually in autumn for the first five years • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains materially unchanged. • Any changes in monitoring to be reviewed and agreed by the Steering Group
Limits of Acceptable Change	<ul style="list-style-type: none"> • A shift of 2 classifications within the folk system i.e. from mud to sand; OR a shift outside of the desired sediment envelope as defined by the NKM PSD data.
Remedial Action	<ul style="list-style-type: none"> • Sluice gate management • The high points will be removed using terrestrial based excavation plant with low ground bearing tracks, which will access the fields via ramps from the cross banks. High points will be pushed into perimeter ditches around the site or towards the control structure. • The ditches will be first cleared by holding back water within the fields on a spring tide, then releasing quickly to 'flush' the ditches. If additional assistance is required to clear the ditches, this would be done using a crane mounted suction dredging pump, which would operate from the top of the embankments.

Objective COMP8 (SAC): Provide 21.2 ha of saltmarsh habitat of similar zonation and species composition to that of the middle Humber.

<p>Targets</p>	<ul style="list-style-type: none"> • Deliver a minimum of 21.2 ha of saltmarsh of a composition typical of the middle Humber estuary to replace estuary and sub-tidal habitat loss. • Within 10 years pioneer and lower saltmarsh community to have established over 10 ha with a minimum of 70% of plant species found within similar communities on Humber • Within 15 years zonation to include middle saltmarsh community. Minimum of 70% of the plant species present over similar zonation patterns in Humber. • Within 20 years Saltmarsh extent to be equal to or greater than 21.2 ha
<p>Management</p>	<ul style="list-style-type: none"> • Natural processes to occur in MR section of compensation site to allow accretion and establishment of saltmarsh.
<p>Monitoring</p>	<p>Saltmarsh extent, community, zonation and diversity will be ascertained following EA WFD guidance e.g OI 200_07 or any subsequent relevant revisions.</p> <p>In advance of each annual survey the most recent available aerial images will be requested from the EA (although it is noted that not every year will be updated by the EA), this information providing additional data and informing the survey process. Where the data are current (e.g. the year of image is current to the year of survey, then depending on coverage, it may be unnecessary to undertake an additional survey flight.</p> <p>When such images are unavailable, then a survey flight will be undertaken, with aerial colour images captured. These images will be:</p> <ul style="list-style-type: none"> • of resolution of at least 25cm • 3 band red green blue (RGB) imagery • taken in daylight at low water around a spring tide • taken under stable lighting conditions (little or no cloud shadow) • taken between June and September each year, with timing to be standardised to a single month per year where possible • taken on an annual basis for a minimum of 10 years, the requirements for subsequent surveys to be determined by the Steering Group <p>In addition to the annual aerial image survey, field survey of the saltmarsh habitat will be undertaken on an annual basis, again following guidelines in the EA's OI 200_07</p> <p>This will include a series of transects of sufficient frequency to adequately describe the communities, their zonation and extent (see OI 200_07 for details). Each transect will cover both the seaward and landward extent of the saltmarsh. Transition points will be mapped and two quadrat samples taken to characterise the major community changes, recording species, cover, sward height etc. following OI 200_07 procedures.</p>

	<p>The saltmarsh will then be therefore assessed for the following metrics in accordance with the WFD Saltmarsh Index Tool:</p> <ul style="list-style-type: none"> • saltmarsh extent as proportion of "historic saltmarsh" • saltmarsh extent as proportion of the intertidal • change in saltmarsh extent over two or more time periods • proportion of saltmarsh zones present (out of five) • proportion of saltmarsh area covered by the dominant saltmarsh zone • proportion of observed taxa to historical reference value or proportion of observed taxa to 15 taxa
Who	Environmental Manager and suitably qualified surveyor in consultation with the Environment Agency
When	<ul style="list-style-type: none"> • Aerial survey data obtained annually • Annual fixed point photographic surveys of MR site (at same time as vegetation monitoring) for first 10 years • Vegetation monitoring June to September (to aid species identification) for first 10 years. • After 10 years date frequency to reviewed by steering group
Limits of Acceptable Change	<ul style="list-style-type: none"> • Less than 10ha of saltmarsh and mudflat formed within first 10 years • Absence of lower saltmarsh within 10 years or middle saltmarsh within 15 years • Species composition of zones is less than 70% that of Humber reference sites (e.g. Cherry Cobb sands saltmarsh)
Remedial Action	<ul style="list-style-type: none"> • Beneficial use of sediment from within RTE to aid saltmarsh formation in MR • Planting up of saltmarsh/removal of undesirable species • Creation of artificial creek system within MR to improve dewatering
Notes	Natural England have indicated that other estuarine habitat (e.g. mudflat) would be acceptable if the full extent of saltmarsh was not achieved. If the mix of estuarine habitats equalled 21.2 ha no remedial action would be required.

Objective COMP9 (SAC): Ensure Compensation site delivers 73.4 ha of SAC intertidal habitat of acceptable depth to ensure no decrease in SAC extent

Targets	<ul style="list-style-type: none"> • Deliver a minimum of 73.4 ha of intertidal mudflat in the immediate term and a minimum of 44 ha of sustainable mudflat in the long term • Deliver a minimum average depth of 100 mm marine mud including a minimum of 50 mm within the first year • Ensure that shore profile is developing in line with the established baseline elsewhere in the SAC, ie a shallow profile that allows regular tidal inundation providing 3 -5 hours of tidal movement over the mudflat
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Management	<ul style="list-style-type: none"> • Inlet sluices for the RTE fields are in general to be operated fully open to facilitate rapid accretion of muds. • After the first winter period following breaching of the realignment site the sluices are to be operated in normal operational mode to avoid extended drying of the mudflat resource over the neap tide period. • Sediment Management Plan to optimise mudflat functionality to be developed within 24-36 months of site being breached
Monitoring	<ul style="list-style-type: none"> • Accretion monitoring in RTE fields to identify change in mudflat extent and elevation • LiDAR, bed level monitoring, marked stakes and photographic records to determine extent, elevation and change over time
Who	Site managers assisted by suitably qualified surveyor
When	bi-annually during first 2-3 years and thereafter at 1-3 year intervals
Limits of Acceptable Change	If average mud levels in the field achieve 100 mm before the end of the first winter period after breaching sluices are to begin to be operated in normal operational mode.
Remedial Action	<ul style="list-style-type: none"> • Variation in number of sluices operated to control exchange • Implementation of sediment management measures • Sediment management provides the basis for adaptive management of the mudflat levels
Notes	It is anticipated that bed levels will normally exceed 100mm due to accretion. Where bed levelling or dredging is required this will retain a minimum average of 100mm over the managed area.

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Objective COMP10 (SAC): Ensure non-faunal attributes of compensation mudflat habitat are consistent with those of the area of SAC mudflat habitat to be lost

Targets	<ul style="list-style-type: none"> • PSA of accreted substrate should not differ significantly from that of the SAC area to be lost, i.e. sediment distribution to provide sandy mud and mud, with grain size varying between 0.01-0.3mm • (79%-95% mud, 4.5%-20% sand) to provide the envelope of Particle Size Distribution • High average organic carbon content of accreted sediment- this should not deviate significantly from the established SAC baseline in the area to be lost • Ensure that excessive nutrient enrichment is not taking place, as indicated by development of macroalgal mat cover in excess of the established baseline found in the SAC area to be lost
Management	<ul style="list-style-type: none"> • Management of sluice gates to maintain desired sediment characteristics • Expected that the sediments which settle will have similar organic content to those which have settled elsewhere in the SAC
Monitoring	<ul style="list-style-type: none"> • Hand-coring within RTE fields followed by PSA and analysis of organic content • Photographic record and recording of surface conditions- character and composition of surface sediments, evidence of drying, macroalgal cover
Who	Environmental Manager and suitably qualified surveyor
When	<ul style="list-style-type: none"> • Annually in autumn for the first five years • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains materially unchanged. • Any changes in monitoring to be reviewed and agreed by the Steering Group
Limits of Acceptable Change	<ul style="list-style-type: none"> • A shift of 2 classifications within the Folk classification system i.e. from mud to sand • A shift outside of the desired sediment envelope for all parameters listed
Remedial Action	Sluice gate management and dredging of material

Objective COMP 11: Monitor Fish within Compensation Site

Targets	To monitor fish using WFD compliant methods as far as possible with reference to Operational Instruction 328_07 Data requirements for WFD transitional fish surveillance monitoring
Management	N/A
Monitoring	<ul style="list-style-type: none"> • Use of Fyke nets in main MR channel in May-June (Spring WFD) and September-October (Autumn WFD)

	<ul style="list-style-type: none"> • Use of epibenthic sledge (0.9m opening width, dragged for 50m) subject to safe method of work being possible to sample juvenile fish • Fyke nets to be deployed at RTE sluice twice per annum in May-June (Spring WFD) and September-October (Autumn WFD) on outgoing tide. • Results to include following data in line with 328_07 <ul style="list-style-type: none"> ○ fish species present; ○ abundance of each species; ○ length measurements (freshwater and migratory species – fork length, marine species – total length). For large catches only the first 50 lengths for each species during each netting occasion are required, the rest can be counted; ○ for exceptionally large catches sub-sampling techniques will be used ; ○ supporting water quality information: dissolved oxygen (% sat), salinity, temperature ○ GPS position at approximate mid-site location (12 figure NGR); • date, time, trawl duration and tide state.
Who	Suitably qualified surveyors in liaison with Environmental Manager and EA
When	<ul style="list-style-type: none"> • Every two years in spring & autumn for the first ten years • Any changes in monitoring to be reviewed and agreed by the Steering Group
Limits of Acceptable Change	N/A
Remedial Action	N/A
Notes	The epibenthic sledge is not WFD compliant but experience at other MR's has shown it to be a useful tool in providing additional sampling of juvenile fish not monitored by Fyke nets.

Objective COMP 12: Monitor Fish Fatalities within RTE Fields

Targets	To monitor for fish fatalities on a regular basis in accordance with Standard Operating Procedures.
Management	N/A
Monitoring	<ul style="list-style-type: none"> • Visual check of RTE fields for dead fish • Recording of observations on check list • Reporting of any significant fish kills to Environmental Manager • Taking of photographic evidence
Who	RTE Sluice operators
When	• Every day that RTE sluices are being operated



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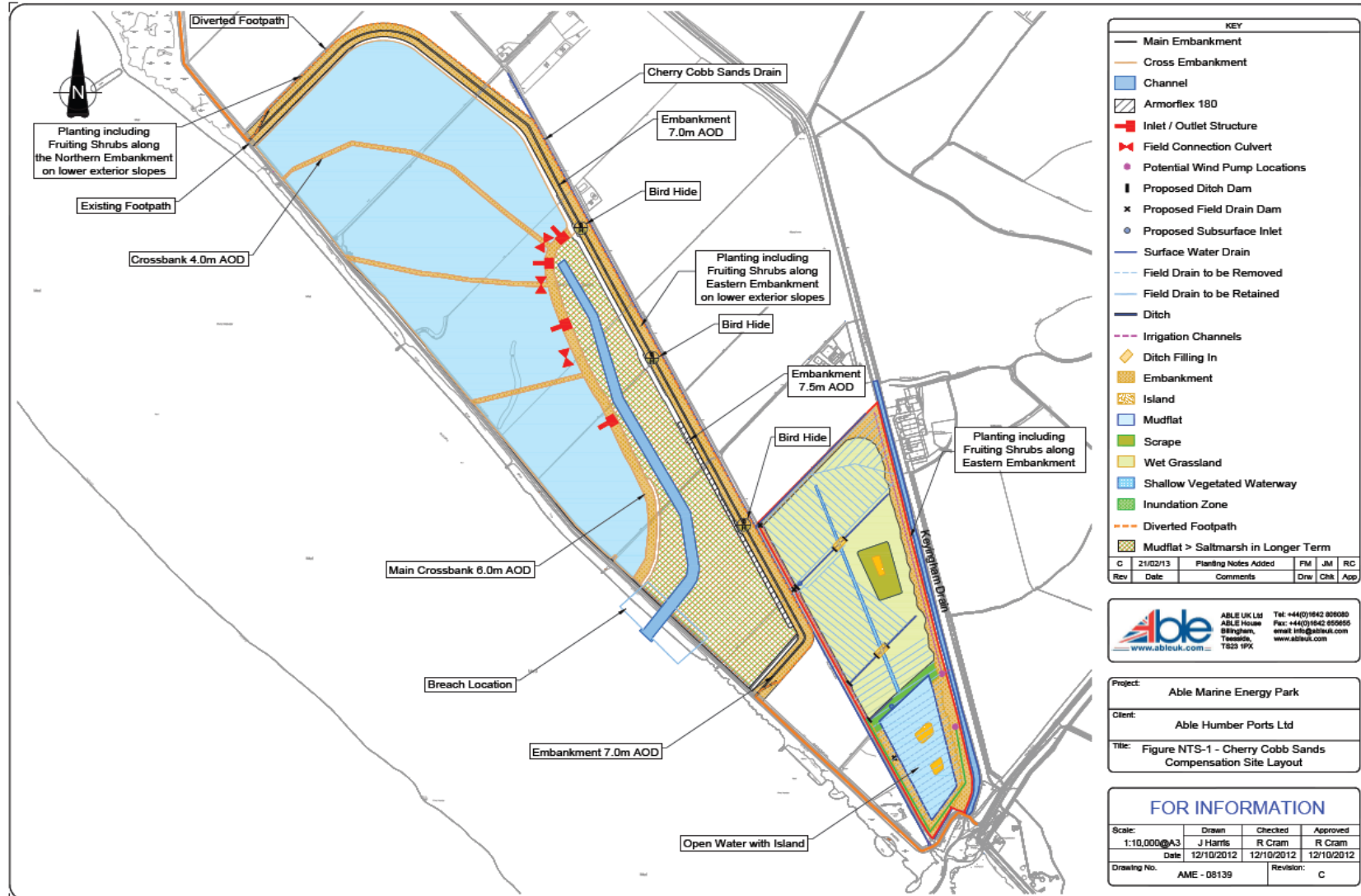
	<ul style="list-style-type: none"> Any changes in monitoring to be reviewed and agreed by the Steering Group
Limits of Acceptable Change	<ul style="list-style-type: none"> More than five dead fish in RTE fields at any one time; and/or More than two dead fish on consecutive days
Remedial Action	Investigation of reasons for fish mortality
Notes	Fish fatalities will be monitored routinely as part of daily operational activities. Records will be reviewed regularly by Environmental Manager.

4.3 WET GRASSLAND & OPEN WATER AREA

Rationale & Objectives

- 4.3.1 There are no similar sized RTE schemes which have been created, and especially ones designed to support birds.
- 4.3.2 Creation of wet grassland is a well-established process, and hence there is greater certainty about the ability to develop it, and also about the biomass that will be available as a result for shorebirds and especially black-tailed godwits.
- 4.3.3 Wet grassland is a habitat type which is known to be used by foraging black-tailed godwits, especially as the winter progresses and intertidal food resources can become depleted. There is little grassland around the Humber Estuary at present and its provision will provide a valuable additional food resource, which will also be available to the birds at high tide.
- 4.3.4 The provision of the roost site (formed by islands in the open water area at the southern end of the wet grassland site) close to existing mudflats at CCS will mirror the close proximity of NKHP to the mudflats at NKM. The close proximity between a secure roost site and feeding resources is thought to be important in the use of the NKM foreshore by black-tailed godwits, especially during the autumn moulting period. The roost site at CCS is expected to facilitate more extensive use of CCS by black-tailed godwits.
- 4.3.5 The wet grassland and open water areas at CCS are therefore included as part of the compensation package to provide additional foraging and roosting habitat in case of any under performance of the RTE.
- 4.3.6 Objectives are therefore based around the construction, management and maintenance of both the roost site and wet grassland to deliver suitable functionality for black-tailed godwits in particular.

Figure 1 Indicative Layout of Wet Grassland



Objective WG1: The site will contain wide, open expanses of wet grassland habitat with unobscured views of the surrounding area – TARGET 1

Target 1	Wet or damp grassland vegetation community across 26ha of the CCSWGS
Management	<ul style="list-style-type: none"> • Sowing with an appropriate seed mix (for example EG8 Wet Grassland Mix from Emorsgate Seeds) and leaving uncut and ungrazed for 3 to 6 months, as appropriate • 0.2 livestock units per hectare per year in April to June inclusive in Year 1; AND • 0.3 livestock units per hectare per year in April to June inclusive in all subsequent years; OR • Equivalent management by cutting the grassland • No fertilisers to be used except if needed to boost earthworm biomass • No herbicides to be used except if needed to control problem plant species. These to be applied with a weed wipe or via spot control.
Monitoring	<ul style="list-style-type: none"> • 60 permanent quadrats to be established measuring 1m x 1m within the wet grassland area • Plant species and abundance to be recorded for each quadrat
Who	Contractors under supervision of Environmental Manager
When	<ul style="list-style-type: none"> • Monitoring to undertaken annually in June for the first five years • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains unchanged subject to the agreement of the Steering Group.
Limits of Acceptable Change	<ul style="list-style-type: none"> • At least one species characteristic of wet or damp grasslands must be present in 50 permanent quadrats • Wet grassland vegetation community across 20ha of the CCSWGS
Remedial Action	Raise sluice heights to increase soil moisture content, providing incidence or extent of flooding does not exceed limits of acceptable change

Objective WG1: The site will contain wide, open expanses of wet grassland habitat with unobscured views of the surrounding area – TARGET 2

Target 2	No scrub (including bramble) or trees across the entirety of the CCSWGS
Management	<ul style="list-style-type: none"> • 0.2 livestock units per hectare per year in April to June inclusive in Year 1; AND • 0.3 livestock units per hectare per year in April to June inclusive in all subsequent years; OR • Equivalent management by cutting the grassland
Monitoring	Visual assessment of scrub
Who	Environmental Manager
When	<ul style="list-style-type: none"> • Monitoring to undertaken annually in June for the first five years • Monitoring to occur in June once every three years thereafter if limits of acceptable change have not been exceeded in the first five years subject to the agreement of the Steering Group
Limits of Acceptable Change	No more than 5% scrub or trees across the entirety of the CCSWGS
Remedial Action	Cutting down vegetation and treatment of stumps with herbicide

Objective WG2: The site should contain open water with at least one island suitable for roosting black-tailed godwits at high tide

Target 1	An open water area of 4 to 5ha in size and an average depth of 0.35m to 0.7m in depth, according to season
Management	<ul style="list-style-type: none"> • Topping up with water from external drains to maintain water level and extent to target levels, as and when required • Adjustment of sluice height to retain water at the appropriate depth, during the winter period • Adjustment or cessation of irrigation rate to keep extent and depth of open water within target levels, during the late summer/autumn period
Monitoring	<p>Visual assessment of the extent of the open water area</p> <p>Recording the depth of the water within the open water area</p>
Who	Environmental Manager
When	<ul style="list-style-type: none"> • Monitoring of water extent and depth to occur a minimum of twice weekly during the first year; and • Monitoring of water extent and depth to occur a minimum of twice monthly, and more frequently during periods of irrigation, in the next four years; • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains unchanged
Limits of Acceptable Change	<ul style="list-style-type: none"> • No less than 3ha of open water extent • No less than 0.25m average depth
Remedial Action	<ul style="list-style-type: none"> • Topping up with water from external drains and cessation of irrigation subject to protocols being agreed with the Environment Agency • Re-instating the integrity of the slowly or impermeable lining of the open water area, if necessary
Notes	The Environment Agency carries out periodic maintenance of the Keyingham Drain that requires the maintenance of a head of water for flushing purposes. An abstraction licence will be required and a protocol agreed with the EA

Target 2	No more than 10% dense stands of rushes (<i>Juncus</i> spp), tall sedges (<i>Carex</i> spp), reeds (<i>Phragmites australis</i> , <i>Phalaris arundinacea</i> , <i>Glyceria maxima</i> , <i>Typha</i> spp) within the open water area
Management	Cutting dense stands of rushes, sedges and reeds in late summer/Autumn, if present
Monitoring	Visual assessment of rushes, tall sedges and reeds within the open water area
Who	Environmental Manager
When	<ul style="list-style-type: none"> • Monitoring to undertaken annually in June for the first five years • Monitoring to occur in June once every three years thereafter if limits of acceptable change have not been exceeded in the first five years subject to the agreement of the Steering Group
Limits of Acceptable Change	No more than 20% dense stands of rushes, tall sedges and reeds within the open water area.
Remedial Action	Cutting or excavating and removal of stands of rushes, tall sedges and reeds to give a maximum of 5% cover within the open water area
Notes	Cutting and removal of swamp vegetation to be undertaken outside the bird breeding season

Target 3	The open water area is to contain freshwater for the purpose of irrigation
Management	Only extracting freshwater from the external drains to top up the open water area, which may require adjustments in the extraction point and timing
Monitoring	<ul style="list-style-type: none"> • Measuring salinity within the external drains (subject to agreement with EA and Drainage Boards) • Measuring salinity within the open water area
Who	Environmental Manager
When	<ul style="list-style-type: none"> • Monitoring of salinity to occur continuously using data loggers during the first year within the Keyingham drain. • Monitoring of salinity to occur continuously during the late summer/autumn period for the next four years • Monitoring can cease if the limits of acceptable change have not been exceeded in the first five years, subject to the agreement of the Steering Group
Limits of Acceptable Change	Salinity of the open water area less than 1‰
Remedial Action	Adjust extraction regime to return salinity of the open water area to within acceptable limits

Target 4	Two vegetation free islands within the open water area
Management	<ul style="list-style-type: none"> Islands to be capped with butyl rubber and shells/cobbles/gravel to limit vegetation growth Removal of vegetation annually in June, if limits of acceptable change are exceeded
Monitoring	Mapping of the extent of the vegetation on each island
Who	Environmental manager
When	<ul style="list-style-type: none"> Monitoring to be undertaken annually in June for the first five years Monitoring to occur in June once every three years thereafter if limits of acceptable change have not been exceeded in the first five years, subject to the agreement of the Steering Group
Limits of Acceptable Change	Up to 25% short perennial or ephemeral vegetation but no shrubs, trees or tall ruderal vegetation in the period July to March
Remedial Action	<ul style="list-style-type: none"> Cut and treat shrubs, trees or tall ruderal vegetation as appropriate; OR Remove and replace shells/cobbles/gravel cap if islands are repeatedly colonised and management becomes difficult

Objective WG3: The soil will be moist throughout the months of August to April to concentrate invertebrates at the surface and to ensure that the soil remains soft enough to be probed by waders

Target 1	Soil penetration resistance less than 6kg on average in each month from July to March using a soil penetrometer
Management	Maintenance of damp but unflooded grassland through appropriate sluice management and irrigation
Monitoring	Monitoring to be undertaken at 100 standard sample locations spread across CCSWGS
Who	Environmental manager
When	<ul style="list-style-type: none"> Monitoring to occur once per month from July to November annually for 5 years; and Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains unchanged, subject to the agreement of the Steering Group.
Limits of Acceptable Change	Soil penetration resistance less than 8kg on average in each month from July to March
Remedial Action	<ul style="list-style-type: none"> Increase irrigation rate in order to increase soil moisture content and reduce soil penetration resistance Raise sluice heights to increase soil moisture content and reduce soil penetration resistance
Notes	<ul style="list-style-type: none"> Soil resistance is based on data from Ausden et al 2001

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	<ul style="list-style-type: none"> • Soil resistance to be sampled using a soil penetrometer details of which can be found at http://www.cemml.colostate.edu/assets/pdf/TPS_04-1_Sampling_Compaction.pdf (see Annex 4).
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Target 2	Soil moisture content greater than 100% of dry weight on average in each month from July to March
Management	Maintenance of damp but unflooded grassland through appropriate sluice management and irrigation
Monitoring	Monitoring to be undertaken at 100 standard sample locations spread across CCSWGS
Who	Environmental manager
When	<ul style="list-style-type: none"> • Monitoring to occur once annually in the month of September for 5 years; and • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains unchanged, subject to the agreement of the Steering Group.
Limits of Acceptable Change	Soil moisture content greater than 80% of dry weight on average in each month from July to March
Remedial Action	<ul style="list-style-type: none"> • Increase irrigation rate in order to increase soil moisture content • Raise sluice heights to increase soil moisture content

Objective WG4: The site should be largely free of winter flooding to prevent floodwaters from killing soil invertebrates.

Target	Less than 10% flooding across the wet grassland area at any time (excluding the scrape and open water area)
Management	Appropriate sluice height and irrigation flow rate adjustment
Monitoring	Visual assessment of extent of flooding
Who	Environmental manager
When	<ul style="list-style-type: none"> • Minimum of twice weekly during the first year; and • Minimum of twice monthly, and more frequently during periods of irrigation, in the next four years; • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains unchanged, subject to the agreement of the Steering Group.
Limits of Acceptable Change	Less than 20% flooding across the wet grassland area at any time (excluding the scrape and open water area)
Remedial Action	Appropriate sluice height and irrigation flow rate adjustment to enable flood waters to drain away

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Objective WG5: The site will have a high density of macro-invertebrate fauna to provide food for wading birds.

Target	Average earthworm biomass levels of 65gm ⁻² (wet weight) in less than 5 years and maintained thereafter
Management	Maintenance of damp but unflooded grassland through appropriate sluice management and irrigation
Monitoring	Annual collection of 100 soil samples measuring 25 x 25 x 10cm at standard sample locations, with subsequent soil biomass calculations
Who	Environmental manager
When	<ul style="list-style-type: none"> • Annually in September until target is achieved and then for three years thereafter • Monitoring may cease if earthworm biomass levels greater than target levels for more than three consecutive years. Any changes in monitoring to be subject to the agreement of the Steering Group
Limits of Acceptable Change	Minimum average earthworm biomass levels of 50gm ⁻² (wet weight) after 3 years
Remedial Action	<ul style="list-style-type: none"> • Addition of organic matter as a top dressing to promote biomass increase • Adjustments to soil moisture content or extent of flooding as appropriate
Notes	Biomass target is derived from approximate average of natural, unflooded wet grasslands (Ausden et al, 2001)

Objective WG6: The wet grassland will be managed to give a suitable sward for wading birds throughout the months of August to March

Target 1	Average sward height of 10cm across the CCSWGS each month from July to March
Management	<ul style="list-style-type: none"> • 0.2 livestock units per hectare per year in April to June inclusive in Year 1; AND • 0.3 livestock units per hectare per year in April to June inclusive in all subsequent years; OR • Equivalent management by cutting the grassland
Monitoring	Measurement of sward height at 100 sampling points
Who	Environmental manager
When	<ul style="list-style-type: none"> • Monitoring to occur once per month from July to November annually for 5 years; and • Monitoring can cease if the target is achieved for three consecutive years after the first five years of monitoring provided that the management regime remains unchanged, subject to the agreement of the Steering Group.
Limits of Acceptable Change	Average sward height of 15cm across the CCSWGS each month from July to March

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Remedial Action	<p>Increase livestock density to achieve shorter swards at the end of June; OR</p> <p>Increase length of time livestock are present on CCSWGS to end July; OR</p> <p>Introduce rotational grazing/cutting from July to September across the CCSWGS; OR</p> <p>Cut grass once in August/early September.</p>
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Target 2	<p>No more than 10% dense stands of rushes (<i>Juncus</i> spp), tall sedges (<i>Carex</i> spp), reeds (<i>Phragmites australis</i>, <i>Phalaris arundinacea</i>, <i>Glyceria maxima</i>) or tall ruderal vegetation (thistles, docks etc) in the North and Middle Fields (including the scrape)</p>
Management	<ul style="list-style-type: none"> • 0.2 livestock units per hectare per year in April to June inclusive in Year 1; AND • 0.3 livestock units per hectare per year in April to June inclusive in all subsequent years; OR • Equivalent management by cutting the grassland
Monitoring	<p>Visual assessment of the extent of the species listed above</p>
Who	<p>Environmental manager</p>
When	<ul style="list-style-type: none"> • Monitoring to undertaken annually in June for the first five years • Monitoring to occur in June once every three years thereafter if limits of acceptable change have not been exceeded in the first five years • Return to annual monitoring for three years following exceeding the limits of acceptable change • Any changes in monitoring to be reviewed and agreed by the Steering Group.
Limits of Acceptable Change	<p>No more than 15% cover of dense stands of rushes, tall sedges, reeds or tall ruderal vegetation in the North and Middle Fields (including the scrape)</p>
Remedial Action	<ul style="list-style-type: none"> • Flailing the areas dominated by unwanted vegetation twice in the year that the limit of acceptable change is exceeded; OR • Herbicide application for severe infestations of rushes

4.4 BIRDS

Rationale & Objectives

4.4.1 The objective is to maintain populations of displaced birds. Previous sections describe objectives, management actions, and monitoring of the compensation package required to achieve this.

4.4.2 The compensation package is centred on a secure wet roost that will allow birds to exploit existing mudflat resources on the north shore immediately as well as the new wet grassland and RTE/MR as these develop functionality.

- 4.4.3 The development of the full package will be incremental and how birds respond to it will require monitoring of all potential resources available to them.
- 4.4.4 These resources include the mudflat remaining at NKM. The total mudflat area is 77ha of which 31.5ha will be directly lost to AMEP and 11.6ha predicted to be functionally lost to disturbance. Use of the remaining area will need to be part of the monitoring programme.
- 4.4.5 Early provision of the roost at CCS will require monitoring of the existing mudflat between Paull and Cherry Cobb for evidence of increased use and potential competition effects.
- 4.4.6 The area monitored for bird numbers will therefore include not only the developing RTE/MR and wet grassland but also the remaining mudflat at NKM, the existing intertidal area between Paull and Cherry Cobb Sands, and NKHP.
- 4.4.7 As the compensation site develops functionality it will be required to support the peak count (see Table 3) of the birds displaced from NKM within the range of national trends. Functionality from construction for the CCSWG will be reached within 2-4 years and up to 6 years for the RTE.
- 4.4.8 As there is a danger that rapid declines could be masked by natural variability as expressed by the national population trend then a review would be required after any one year where declines exceeded any negative change in the national trend, or after two years of consecutive decline even where this was within the range of changes in the national trend.

Objective B1: The Compensation site supports peak counts of displaced species (see Table 3) with the same levels of foraging activity.

Targets	<ul style="list-style-type: none"> • When RTE/MR & CCSWG reach full functionality (i.e. when biomass and physical targets are met) they support peak counts of each species as identified in Table 3. It is anticipated the RTE will reach full functionality within 4-6 years and the CCSWG within 2-4 years. • Foraging use reflects that recorded in Table 3 (an exception is allowed for avocet as numbers are small).
Management	<ul style="list-style-type: none"> • Provide secure roost in first instance at CCS • Develop RTE/MR and CCSWG
Monitoring	Through the Tide Counts at NKM, CCS, CCSWG and RTE/MR and NKHP
Who	Suitably experienced surveyors
When	Twice monthly on a spring and a neap tide
Limits of Acceptable Change	<ul style="list-style-type: none"> • Any one year where declines exceeded negative changes in the national trend • Two years of consecutive decline even where this was within the range of negative changes in the national trend
Remedial Action	<ul style="list-style-type: none"> • Review data to ascertain if population is being maintained within Humber • Review data on national population to ascertain if population maintained within UK • If evidence of range decline provide additional compensation where this is achievable
Notes	If the area of functional disturbance is less than predicted and birds continue to use areas of NKM these may be counted toward the peak bird target identified for the compensation site

**ANNEX 1: DECISION MATRIX FOR ASSESSMENT OF SUCCESS OR FAILURE OF
COMPENSATION SITE FOR BLACK-TAILED GODWIT**

Bird Targets	Invertebrate Targets (Benthic and Wet Grassland)	Outcome	Management Required
Met	Both met Roost Provided	Fully Met	Maintain
Met	Not met Roost Provided	Partially Met	Improve RTE/MR & WG management to meet invertebrate targets.
Met	Benthic met WG not met Roost Provided	Partially Met	Improve WG management to meet invertebrate targets.
Met	Benthos met WG met Roost Provided	Partially Met	Improve RTE/MR management to meet invertebrate targets.
Not met	Benthos met WG met Roost Provided	Partially Met	Determine if other reasons for birds not being present, and if numbers in SPA maintained. Identify management requirements.
Not met	Benthos met WG met Roost Provided	Partially Met	Determine if other reasons for birds not being present, and if numbers in SPA maintained. Identify management requirements. Improve WG management.
Not met	Benthos not met WG met Roost Provided	Partially Met if overall biomass acceptable	Determine if other reasons for birds not being present, and if numbers in SPA maintained. Identify any additional management requirements.
Not met		Not Met if overall biomass not acceptable.	Determine if other reasons for birds not being present, and if numbers in SPA maintained and Improve RTE/MR management to meet benthic invertebrate targets. Identify any additional management requirements. If the compensation continues to fail then this will be reported through the Steering Group to the Secretary of State.

Bird Targets	Invertebrate Targets (Benthic and Wet Grassland)	Outcome	Management Required
Not met		Partially Met if combined sub-optimal biomass is acceptable.	Determine if other reasons for birds not being present, and if numbers in SPA maintained. Identify any additional management requirements. and Improve RTE/MR and WG management to meet invertebrate targets.
Not Met		Not Met	Determine if other reasons for birds not being present, and if numbers in SPA maintained. Identify any additional management requirements. and Management of RTE/MR and wet grassland to improve invertebrate biomass. If the compensation continues to fail then this will be reported through the Steering Group to the Secretary of State.

Notes:

The outcome column describes targets as fully met if they meet both bird and invertebrate targets; partially met if they achieve some but not all of the target but do so in such a way that either bird targets are met or sufficient mix of the invertebrate targets are met. Where targets have failed they are recorded as not met.

The management column is colour coded. Green indicates management is correct and should be maintained. Amber indicates a partial failure of one or more targets and indicates that action is required to address this and should be implemented for all the failing components. Red indicates a failure of the compensation site and that if remedial action is unable to reverse this failure this will be reported through the Steering Group to the Secretary of State.

Bird targets would be based on the peak numbers presented during the Appropriate Assessment and Panel process. Higher counts of birds using NKM could occur subsequent to that process and it is acknowledged that the compensation design is based on the Appropriate Assessment figures only.

The only circumstances in which bird targets can be lowered is where there has been a significant (>1%) decline in the relevant biogeographical populations.

Where the benthic target is a mixture of RTE (including the MR component) and WG it is acknowledged that WG is a buffer against failure rather than the principle feeding resource. Therefore in assessing success or failure based on any mix of sites greater weight will be given to RTE/MR populations. Therefore any combined invertebrate target must represent a combined minimum of 150% of the theoretical 200% (based on 100% of RTE/MR & WG invertebrate targets) subject to the RTE/MR component of that mix never falling below 75%. If the RTE/MR invertebrate population falls below 75% of the target value then the whole invertebrate target fails even where this exceeds a combined value of 150% (e.g. 75% RTE/MR & 75% WG= 150% would be compliant whereas 65% RTE/MR & 100% WG= 165% would not).

ANNEX 2: SURVEY DESIGN FOR BENTHIC INVERTEBRATES

Survey rationale: the survey is designed to monitor the status of the intertidal benthic component at the compensation site (RTE and managed realignment) to be assessed against established targets as the site develops overtime. In particular, two aims have been identified for the survey:

- 1) to provide a good estimate of the community and target species densities in order to be assessed against the target defined at NKM;
- 2) to assess the development of the compensation site over time and its ability to provide intertidal habitat that is comparable to the natural mudflats in the area.

Effort has been put into devising a survey design that fulfil both aims, although it should be noted that there is not a single survey design that can be optimal for both aims. In addition, it is noted that the target assessment (aim 1) is a priority over the site development assessment (aim 2), in agreement with the importance placed by Natural England on the ability of the compensation site to meet the feeding requirements for Black-tailed Godwit. Therefore any modification of the survey design (e.g., following the revision of methods as described in Appendix 3) will be towards an improvement of the design to fulfil the target assessment, even if these modifications might involve a decrease in the power of the analysis for the site development assessment.

The survey design and methods have been devised based on existing guidelines (Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites - Ware and Kenny 2011; the Marine Monitoring Handbook, Davies et al 2001).

Sampling method: hand held corer (0.01 m²), sediment sampled to a depth of c.15 cm.

Sampling period: monitoring to be carried out annually, in late summer-early autumn (preferably between the last week of August and first week of September, to allow direct assessment against the target defined for this season).

Sampling design: the distribution of the intertidal stations in the compensation site is dependant on the extent and distribution of the inundated habitat within the site, a factor that is expected to change over the years during the sites development. It is not possible to identify a priori the number of stations and their location without knowledge of the habitat distribution within the site. In order to allow a detailed survey design a topographic survey will be undertaken soon after breaching and the resulting map will be used to guide the location of the stations within the RTE and MR site.

Although the details of the survey design cannot be defined yet, some general criteria can be identified to guide the choice of the survey stations.

As at NKM, a stratified systematic design is devised as the best way to estimate population size of clustered (patchy) populations (Mier & Picquelle 2008 and references therein). Strata would be defined in order to cover the different sections of the compensation site (four RTE fields and MR site) as well as the different intertidal habitats (e.g., with different degree of inundation). In addition, the even coverage of the available intertidal habitat within the site will provide data for spatial analysis, which will allow biotope mapping as well an assessment of performance against benthic targets (see appendix 3).

Sampling stations will be positioned at regular intervals on the available intertidal habitat, their location being chosen on a pre-defined criterion that will be followed whenever new stations need to be added.

It is of note that the ability of the sampling design to provide good estimates of the benthic species populations (considering the variability in their spatial distribution) will depend on

the spatial resolution of the sampling grid (i.e. on the number of stations) rather than on the replication of sampling at each station, as indicated by Ware and Kenny (2011 - Guidelines for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites). It is suggested that a similar spatial resolution to that one used in the target setting survey at NKM is used in the compensation site (1 station every 0.7 ha ca.).

As a control for the benthic community development within the site, natural mudflats outside the site should also be sampled. It is suggested that 9 stations are located in correspondence of each of the 6 transects identified within the two control sites for the impact monitoring at CCS (north and south of the breach; see Marine EMMP for details), with a total of 54 faunal samples collected. This will allow monitoring of temporal (seasonal and inter-annual) variability in natural mudflats adjacent to the compensation site, thus allowing temporal revision of the targets if required (see Annex 3 on setting and assessing targets).

One sediment sample will be taken at each station for faunal analysis and an additional sample will be collected for PSA and organic matter analysis. Sample locations will be recorded using DGPS.

Sample processing: Samples from different replicates should be kept separate. Benthic samples are to be sieved through a 0.5mm sieve. Laboratory analyses will include species (identified to highest taxonomic detail), abundance, size class and biomass (WWTB), with standard AFDW conversion factors applied (using, for example, Rumohr et al., 1987; Ricciardi and Bourget, 1998; and Eleftheriou and Basford, 1989) for comparison with targets.

Supporting parameters: Sediment particle size analysis (PSA) and organic content will also be measured in the additional sediment sample. Also sediment water content is a relevant parameter that should be measured in the sediment samples. Additional supporting parameters recorded on site will include the recording of the character and composition of surface sediments (type, colour, smell), depth of RPD layer, texture and presence of surface features. A photographic record of the sampling station and of the sediment will be also collected. It is recommended also that, during the benthic sampling, a visual estimate of the vegetation coverage and its height is derived within a 10x10 m square area around each benthic station, in order to allow a better characterisation of the wider habitat the benthic station falls within.

Supporting parameters derived from other surveys: As highlighted before, the initial topographic (LIDAR) survey, as well as regular surveys over the years will be important, not only to inform the setting and modification of the stations' location, but also to allow the characterisation of the different benthic stations based on their elevation and derived parameters (e.g., accretion, inundation frequency).

Water salinity measured within the compensation site will be relevant, particularly within RTE fields, as the water retention combined with particular conditions may lead to changes in salinity (e.g. the potential for hypersaline conditions during dry periods with high temperatures) that may affect the benthic community.

Data analysis: With the purpose of characterising the benthic community at the compensation site towards the assessment of the targets derived for NKM (see Appendix 3 for details on these targets setting and assessment), multivariate analysis will be carried out using cluster analysis (combined with similarity profile routine, SIMPROF) and ordination techniques (e.g., MDS, PCO) in order to identify different community types and gradients in the assemblage distribution/variation, as well as applying the SIMPER routine to identify the species which contribute most to the differentiations between groups. Multivariate statistical analysis (e.g., ANOSIM, PERMANOVA) will be applied to detect changes in community structure and composition. Bio-Env routine and linkage trees

(BEST) in Primer will be used to explore the relationship between biotic (community) patterns and substrate characteristics.

Benthic fauna in the compensation site will be characterised also based on the main community descriptors (e.g., abundance, richness, biomass, evenness, diversity and biomass-to-abundance ratio) as well as abundance and biomass distribution of target species. Based on these analyses, the main biotope(s) present in the site will be identified and their distribution over the compensation site will be presented in a biotope map to highlight the broad scale homogeneity in terms of MNCR biotopes. Also GIS methods will be used to present maps of the distribution of biomass/abundance/species diversity (e.g., using kernel density interpolation) in order to provide information on the spatial extent of what may be the hotspots of each parameter (biomass etc). Analysis will also be integrated with the findings of the intertidal LiDAR surveys as elevation change can influence benthic community structure hence food availability to bird species.

With the purpose of addressing the compensation site development over time towards conditions reflecting adjacent natural mudflats (aim 2), an analysis of variance will be carried out similarly to that described for the MEMMP (on a BACI-type approach, but there will be no "before" in this case). It is of note that stations within the strata defined by the different intertidal habitats present in the site (e.g. based on shore level) as well as by the distinction between the compensation site and the control areas outside will be considered as replicates of the strata for the purpose of the analysis.

The null hypotheses that will be tested during site development is that the mudflat community in the compensation site is developing over time, becoming more and more similar to the community in the control areas outside the site. Therefore an interaction between time (years) and treatment (compensation site/controls) will be expected, with the difference between the compensation site and the controls reducing year after year. The trajectory of change can be visualised also for the community structure through multivariate ordination techniques (e.g., MDS, PCO, in Primer), showing a decreasing dissimilarity between the compensation site and the control areas over the time during development. In turn, when the mudflat community will become established inside the compensation site, then the null hypothesis would be that its changes over the years are in line with the variability observed in the natural mudflat (control sites), hence in this case, the interaction term between time and treatment is expected to be non-significant.

ANNEX 3: TARGET SETTING PROTOCOL

Target

Targets will be set for metrics measured for the whole benthic community (community target) as well as for specific elements of the community that characterise the observed prey resource for Black-tailed Godwit (BW) at NKM (species targets, e.g., *Macoma balthica*, *Hediste diversicolor*).

The community target will be set as the average benthic community recorded at NKM.

Species targets will be set as the average abundance and biomass density (ind/m², g/m² the latter then being converted to AFDW g/m² using standard conversion factors) recorded at NKM.

Target assessment criteria

The values recorded at the compensation site will be compared with the target under the management objective set for the compensation site (i.e., they should be equal or higher than the target range). However, in order to take into account the inherent natural variability of estuarine mudflat benthic fauna, an acceptable level of change (ALC) will be identified.

The ALC will be defined taking into consideration the natural levels of temporal variability associated to the specific metric. These can be quantified in different ways (or a combination of them), depending of on the data availability:

- Based on pre-construction monitoring in Autumn 2015;
- Based on Autumn 2015 survey with additional context provided by the 2010 characterisation survey.
- Based on the inter-annual variability observed in control areas in mudflats at NKM and CCS; it is of note that, as this information will be only available over the years of monitoring of the sites, it will be useful for periodical revisions of the ALC;
- Based on existing data (e.g., EA data) on mudflat benthic communities in the middle estuary in the last decade;

Data from autumn observations will be the primary source of data for the purpose of target setting, and will be under-pinned by the long term data for NKM provided by EA.. Intra-annual/seasonal variations will enable the identification of prey depletion during the winter period and provide valuable analysis of the intra-annual increase in biomass at NKM when compared to other sites, and the compensation site.

The data will be reviewed after each annual monitoring survey and as outlined within the Target assessment review section below.

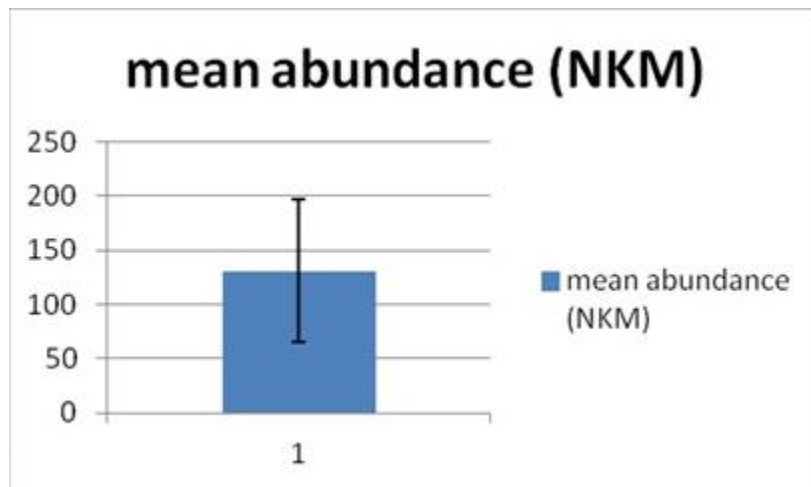
Hotspot analysis:

A suggested method for the presentation of the baseline results is to interpolate the biomass/abundance utilising a GIS method such as kernel density thus allowing the illustration of the spatial extent of what may be the hotspots of each parameter (biomass etc.) using an objective approach. As described below the target standard deviation would then be adjusted based on all data points which fall within these areas of high density infauna (hotspots).

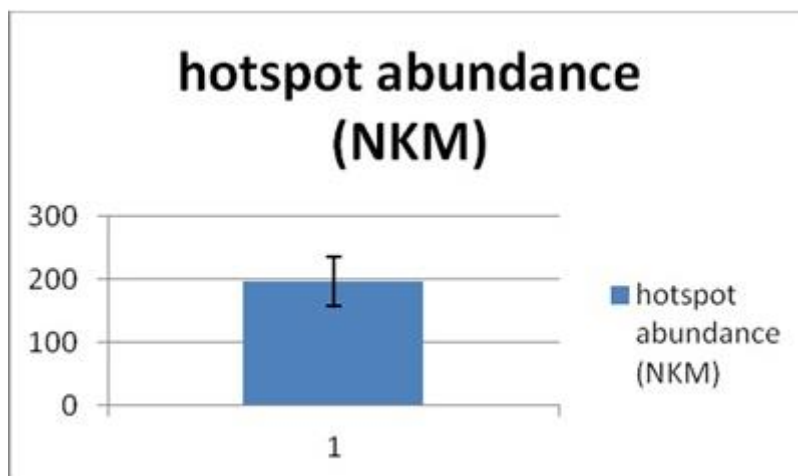
Species targets on NKM:

The target will be set using the mean value (e.g., abundance, biomass) obtained during the NKM baseline survey(s), within a range defined by the standard deviation from the mean abundance of the preferred BW foraging area.

The following numbers are randomly generated for the purpose of illustration, and should not be taken as indicative of proposed targets, or target ranges. In an example dataset of 144 samples of random numbers (within a range of 20-250 individuals per metre square) the mean is 131.0, with a standard deviation of 65.7 giving a potential target of 131 individuals within a range of 65.3-196.7; displayed graphically below.

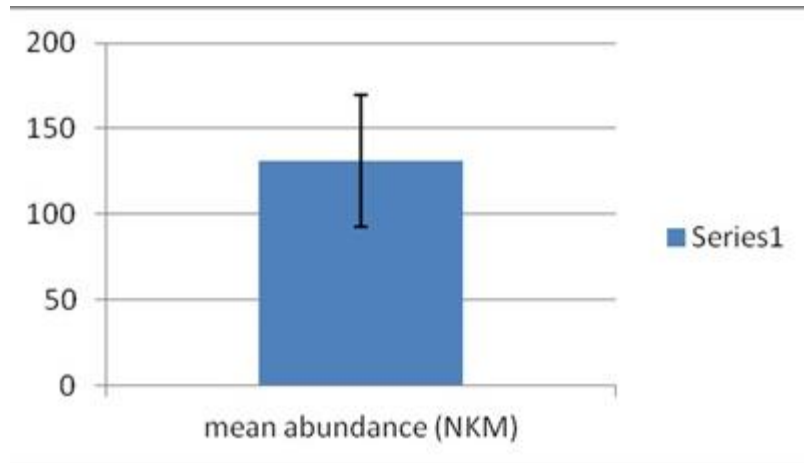


Within the preferred foraging area for BW (hotspots), assuming a number of samples (44) with a generally less variable, higher mean abundance (randomly generated numbers within a range of 120-250) the mean is 197 individuals with a standard deviation of 38.7; displayed graphically below.

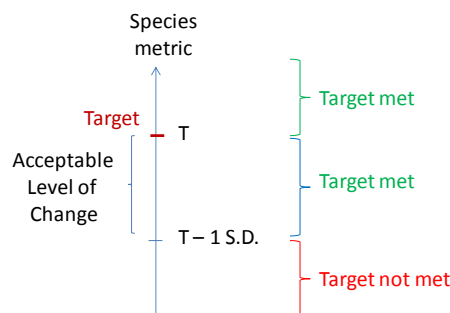


In compensating for the loss of intertidal habitat by providing comparable intertidal habitat the appropriate target is the mean abundance (or alternative metric such as biomass) across the site. However in order to provide for a level of precaution, and to reduce the risk associated with the use of the wider variability at NKM which may mask the higher density prey requirements of BWs, the range of variability is to be reduced to reflect the standard deviation from the mean biomass found within the preferred foraging area "hotspots".

Using the random generated numbers above this then provides for a mean of 131 with a standard deviation of 38.7, resulting in a target range of 92.3-169.7, again presented graphically below.



The target will be considered as met if the value measured at the compensation site is equal or higher than the target, or, if lower, it is within the ALC, i.e. higher or equal to the target minus 1 SD (calculated as described above). The initial target in the above scenario for abundance would therefore be 131 individuals per metre square at the RTE/MR with an ALC of 92.3 individuals per metre square.



Schematic representation of assessment for species targets.

Inter-annual Development targets:

It is recognised that over the longer term there may be a risk of the target being met in terms of comparable habitat but in the lower end of the range, thereby risking failure of providing bird prey. To monitor this risk it is considered that after the community has reached the point of proposed stabilisation (i.e. 5 years post breach) the long term mean biomass/abundance should be equal or greater than the target mean within a range that is linked to the inter-annual variation (measured by Standard Deviation) at the NKM control site.

A simplified representation of this would be that over 5 years from stabilisation (i.e. years 5 onwards) the annual Parameter X (e.g. abundance) may fluctuate within the target range, the target mean being 5 individuals. The data for these years are:

Year 5 =4 individuals, year 6 =5, year 7 =3, year 8 =5, year 9 =7, with a mean of 4.8. During the same period of time the Parameter X at the control site is 5, 5, 6, 4, 4.8, with a standard deviation/variation between years of 0.71.

The long term target mean is therefore 5 individuals +/- 0.7 which means the long term mean of 4.8 indicates a success of the compensation site.

Community target on NKM:

The MNCR biotopes present at NKM will be identified based on the community analysis at the study sites; allowing for ready comparison in terms of the target of providing comparable intertidal habitat (currently considered to be LS.LMu.MEst.HedMac (Hediste diversicolor and Macoma balthica in littoral sandy mud) in the upper and mid shore at NKM, and LS.LMu.MEst.NhomMacStr (Nephtys hombergii, Macoma balthica and Streblospio shrubsolii in littoral sandy mud) in the lower shore at NKM. Similarly, community data at the compensation site will inform a biotope analysis, and the results will be compared to those at NKM in order to ensure that the dominant biotopes occur in both sites. The biotopes will be mapped both at the NKM and compensation site.

The target would be that the main biotopes in NKM are to be present at the compensation site and the dominant biotope at NKM has to be also dominant at the compensation site.

Target assessment review

The targets will be set according to the methodology defined previously and agreed with the relevant authorities with recognition that the target must be validated against not only the primary objective of providing compensatory estuarine habitat, but also the provision of prey resource for the BW.

With this in mind the initial target will undergo a sensitivity analysis after the pre-construction survey data has been collated for year 1 pre-construction (PC-1) and if available year 2 pre-construction (PC-2). The PC-1 and PC-2 data will be analysed for inter-annual variation with the longer term data provided by the EA to ensure that both the target (i.e. mean biomass) and the range within which the mean target will sit (i.e. standard deviation around the mean set according to standard deviation found within preferred foraging habitat for BW) is representative of NKM as observed within the long term dataset and appropriate. This will provide the first tier of confidence in the target itself, and will be subject to review by the steering group and where appropriate the SNCBs in a special meeting held as soon as possible after the survey and data analysis has been conducted.

A second tier of confidence will also be applied whereby the understanding of the foraging behaviour in terms of preferred sediment type and giving up density of key prey species of the BWs will be used as a benchmark against which the target and range is assessed for suitability. Again this will be subject to review by the steering group and where appropriate the SNCBs in a special meeting held as soon as possible after the survey and data analysis has been conducted.

Additional methods of analysis may also be employed which may include an analysis of taxonomic distinctness within a funnel plot as has been suggested by Natural England. The use of this method is that it has the potential to identify areas which are in greater fluctuation than others – habitats under greater levels of perturbation are considered to have lower taxonomic distinctness than stable, established habitats. Whilst an advantage of using taxonomic distinctness is that it is independent of sampling effort, which can strongly influence the values of other commonly used diversity indices owing to the influence of sampling effort on species richness, given the objective to provide comparable habitat and key prey species it is not considered appropriate to use the TD analysis as a specific target setting measure. Rather these forms of analysis may be applied as an ongoing form of validation within the review periods to enable discussion of progression of the community present within the compensation site from settlement to a stable community.



**COMPENSATION ENVIRONMENTAL
MANAGEMENT & MONITORING PLAN**

**DECEMBER
2015**

The assessment of targets will be carried out initially during the 10-years post-construction monitoring, at years 0 as highlighted above, year 5 and year 10. The end of the first 5 years is considered to be a key review period as it is at this point that the initial settlement should be reaching the proposed target and the collected data allows for the monitoring design to be adjusted, in order to ensure that sufficient data are collected at the compensation site to capture the site variability and patchiness. Within the 5 year review relevant information will be incorporated to ensure that not only the objective is on target to be met in terms of providing comparable habitat to that observed at NKM, but also that it is suitable to supporting BWs. Again the relevant information that could be included might be inter alia the giving up density of key prey items such as *Macoma balthica* and *Hediste diversicolor*



ANNEX 4: GUIDE TO USING PENETROMETER

THE CENTER
for Environmental Management of Military Lands

Guide to Sampling Soil Compaction Using Hand-Held Soil Penetrometers

CEMML TPS 04-1

CENTER FOR ENVIRONMENTAL MANAGEMENT OF MILITARY LANDS
Colorado State University
Fort Collins, CO 80523-1490

January 2004

