TIDE

Tidal River Development

Project part-financed by the European Union (European Regional Development Fund)

The Interreg IVB North Sea Region Programme

‘Chowder Ness’

Measure analysis 33
in the framework of the Interreg IVB project TIDE

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Part 1: Measure description

Measure category: Biology
Estuary: Humber
Salinity zone: mesohaline zone
Pressure: Gross change of the hydrographic regime during the last about 100 years

Country: United Kingdom
Specific location: Chowder Ness, Barton-on-Humber, North Lincolnshire
Responsible Authority: Associated British Ports
Costs: ~£1,500,000
Measure technical factsheet (link):
Downloads:
Links:
http://www.abpmer.net/downloads/download.asp?filename=OMReG%5Ccase%5Fstudies%5Comreg%5F2011%5Fcase%5Fstudy%5Fchowder%5Fness%2Epdf

Map/Picture:

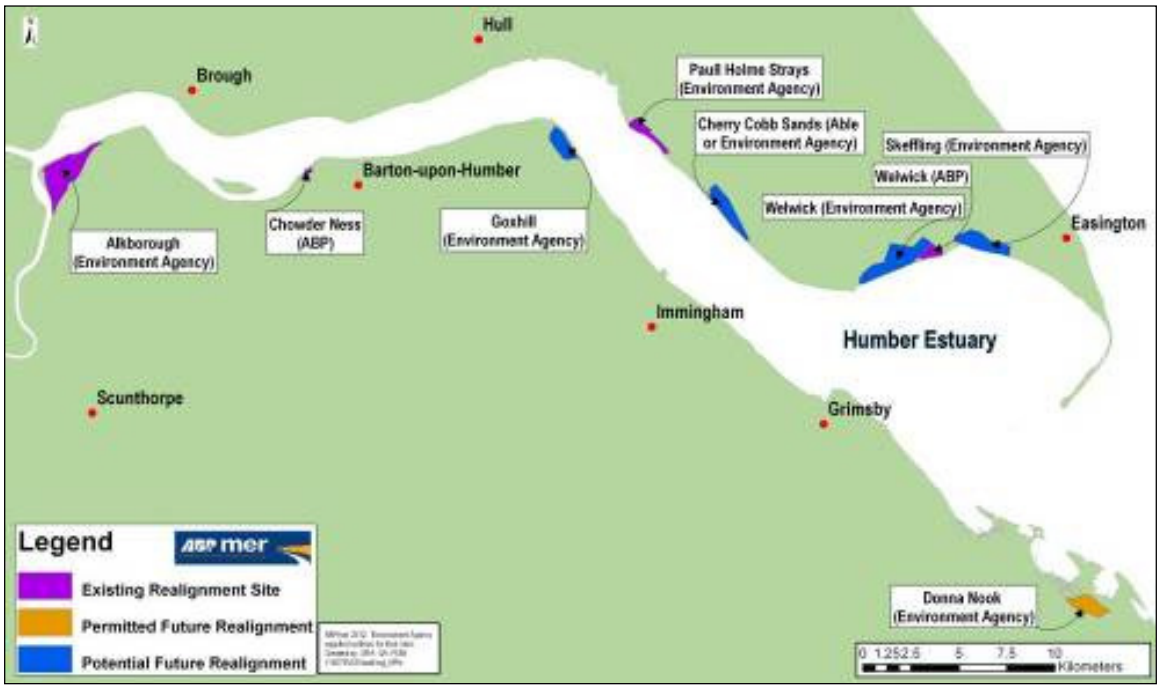

Figure 1: Location of Chowder Ness within the Humber Estuary

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Figure 2: The managed realignment at Chowder Ness - Google Earth derived aerial view

Figure 3: Aerial view of site in December 2006 (5 months post realignment) (taken by ABP)

Figure 4: Panoramic view from easterly corner of site (taken by ABPmer, August 2010)

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Figure 5: View from easterly corner of site (taken by Nigel Pontee, Halcrow)

1.1 Description of the issue and measure

Chowder Ness was undertaken for the same purpose as another realignment on the Humber, Welwick, which is presented in a separate First Analysis Step (FAS) Report. Both schemes were designed and implemented by the same organisations (Associated British Ports (ABP) and ABPmer), and to very similar timescales and principles. To inform the final design of these sites, numerical modelling was undertaken based on LiDAR elevation data. This was to ensure the correct balance of habitats would be achieved. As mudflat creation was the main objective of the schemes, and as the sites were largely too high for this to occur, the land was re-profiled to increase the extent of lower areas where mudflat could develop (i.e. below Mean High Water Neap (MHWN)). These works included the creation of a gentle slope from the fronting, existing, mudflats to the rear of the sites to assist drainage.

At the 15ha Chowder Ness site, new flood defences were created at the rear of the site to a minimum height of 6.7m above Ordnance Datum Newlyn (ODN). Material for these defences was obtained from within the site from a combination of reprofiling and the creation of temporary borrow pits.

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The existing seawall was removed over a length of 570m (some 200m remain), to a level of around 1.6 to 2mODN. This removal, rather than the creation of solitary breaches, was chosen for a number of reasons:

- It improves connectivity with the wider estuary;
- It more closely recreates the type of environments that existed prior to the land claim;
- It enables the whole cross sectional area of the estuary including the realignment site, to respond to estuary wide changes; and
- It increases energy levels within the site, thereby improving the likelihood that mudflat habitat will be maintained (as mudflat creation was the main objective of the site).

The old defence was removed in a series of stages, as follows:

(1) Removing the rear of the embankment;
(2) Removing the concrete wave return, the bitumen and rock face; and
(3) Overall lowering of the embankment (to levels around 1.6 to 2mODN).

As Chowder Ness was considered relatively small-scale in relation to the estuary as a whole any predicted changes to the hydrodynamics and sediment dynamics were expected be extremely localised and relatively small in magnitude (ABPmer, 2004).

1.2 Status of the measure

This measure was breached in July 2006.

1.3 Monitoring

A ten year monitoring programme was implemented to look at changes to sites fronting the realignment (bathymetry, invertebrates, and waterfowl) and to the realignment itself (topography, saltmarsh composition, changes to intertidal invertebrates, and wildfowl usage).

The monitoring results are reported to back and Environmental Steering Committee.

Table 1 displays the parameters monitored at Chowder Ness.

Table 1: parameters monitored

Chowder Ness managed realignment					
Construction	Start Date	Initial frequency	Initial duration	Adaptations to original monitoring	End date
Topographic Survey	1 month before inundation	Annually	5 years post inundation (fronting realignment) 10 years post inundation (within realignment)	Monitored every other year since 2009 Original laser survey also changed to LiDAR survey after initial year.	2011 2016

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Chowder Ness managed realignment					
Construction	Start Date	Initial frequency	Initial duration	Adaptations to original monitoring	End date
Saltmarsh composition	1st summer following inundation	Annually	10 years post inundation (within realignment)		2016
Monitoring of grassland	1st summer following inundation	Annually	5 years post inundation		2011
Changes to intertidal invertebrates	Summer before construction	Annually	5 years post inundation (fronting realignment) 10 years post inundation (within realignment)	Samples were originally collected in triplicate on the mudflat outside the realignment but after first couple of years only one sample has been analysed	2011 2016
Sediments	Summer before construction	Annually	5 years post inundation (fronting realignment) 10 years post inundation (within realignment)		2011 2016
Waterfowl usage of realignment area	Overwinter season before construction	monthly (Sept - Mar)	5 years post inundation (fronting realignment) 10 years post inundation (within realignment)		2011-2012 2016-2017
Breeding birds	1st summer following inundation	April and May	5 years post inundation		2011

1.4 Monitoring results

1.4.1 Accretion

In order for the site to support both mudflat invertebrates and saltmarsh plants, it was important that fine marine sediments would be imported into the site, as these would provide the ideal environment for intertidal flora and fauna. Furthermore such sediment import would ensure that the site would continue to increase in elevation as sea levels rise. Observations from previous managed realignments have shown that sites can accrete relatively rapidly immediately after a breach, but that elevation increases then tend to level off. At Chowder Ness, site elevation monitoring has so far followed a similar trajectory. To date, overall, the site has increased in elevation with the main change in elevation occurring in the initial two years following the realignment.

1.4.2 Invertebrates

The monitoring has shown that invertebrates have colonised this new sediment. In 2009, between 571 and 15,429 specimens were found per m² (belonging to between 2 and 6 species). The abundance, diversity and biomass of species in the mudflat have been increasing since the

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realignment has been implemented, and are now similar to the fronting, pre-existing, mudflat sites; in fact, average abundance within the samples collected in 2008 was greater than the fronting mudflats.

Figure 6: Marsh development in the eastern corner - 1 year on, 2 years on, and 3 years on (bottom pictures demonstrating difference two months can make, with sea aster in bloom in the bottom right picture) (taken by ABPmer, August 2010)

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Part 2: Execution of main effectiveness criteria

2.1 Effectiveness according to development targets of measure

2.1.1 Habitat Area

The specific targets of the Chowder Ness Scheme were to create the following habitats:

- 10.5ha of intertidal mudflat (and maintain this area in the long term, over the 10 year period);
- 0.8ha of saltmarsh (and maintain this area in the long-term, over the 10 year period); and
- 2.3ha of grassland (at least 50% of which should support natural plant communities comparable to local reference areas within 5 years of construction).

Another target with reference to increasing habitat area was to establish the planting of hawthorn in appropriate locations to the rear of the new sea defence and footpath.

Whilst saltmarsh establishment has been much slower and less extensive at Chowder Ness than at other schemes in the Humber , the area of coverage is continuing to expand five years post breach.

2.1.2 Habitat quality

Within 5 years of realignment, the target for habitat quality was for the mudflat that was created to be able to support an invertebrate assemblage of similar species, population abundance and biomass to local reference sites.
In particular, it was hoped to be able support the following key species:

- Ragworm (*Hediste diversicolor*);
- Bristle Worm (*Pygospio elegans*);
- Mud Shrimp (*Corophium volutator*); and
- Baltic tellin (Clam) (*Macoma balthica*).

It was also hoped that invertebrate quality would be maintained over the area of mudflat in the long-term.

Monitoring the success of habitat quality was proposed to be undertaken by including descriptions of the size distribution of individuals (adult/juvenile), tidal height and sediment properties, where samples were taken, in order to determine options for remedial action, if required.

It was also hoped that within 10 years of realignment, the saltmarsh created would show a similar zonation and species composition to existing adjacent saltmarsh, which locally include species such as common reed swamp, sea club rush, red fescue and sea plantain and that saltmarsh quality (species composition) would be maintained in the longer-term.

With regards to the intensity of the actual monitoring that has been undertaken at Chowder Ness, it was felt that little had been gained from the intensive invertebrate monitoring post breach. It was

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identified that invertebrate monitoring every year post inundation did not provide any more valuable information than would have been achieved at a less regular frequency. However, the monitoring has identified that species diversity has continued to rise at Chowder Ness over the five year monitoring period.

2.1.3 Bird Usage

One of the targets of the Chowder Ness scheme was for the creation of intertidal habitats with the ability to provide feeding habitat for in excess of 800 (peak mean over 5 years) feeding water birds with typical species in the following relative proportions:

- 60% dunlin;
- 20% black-tailed godwit;
- 10% redshank; and
- 10% other bird species.

Within ten years of realignment, it was hoped that the mudflat would be regularly used by approximately 607 overwintering waterfowl (peak) (166 average) based on the following species:

- Golden plover;
- Lapwing;
- Dunlin;
- Redshank;
- Black tailed godwit;
- Ringed plover;
- Curlew; and
- Shelduck.

This estimate was based on the assumption that waterfowl would use the realignment area pro rata to the adjacent bird count sector (ISE1). This usage should be maintained in the long-term, taking account of the natural variability through comparison with relevant WeBS data.

Another target was for the creation of terrestrial habitats to support a range of farmland bird species including linnet, goldfinch, blue tit, long-tailed tit, whitethroat, sedge warbler, reed warbler and reed bunting.

Breeding birds have been specifically monitored at Chowder Ness. The number of species of breeding bird observed at these sites has been consistent across the five year monitoring period, with a five year average of seven species (range 6 to 8). Total numbers observed have also remained consistent.

So far the site appears to be developing as expected as predicted in the EIA, and is broadly consistent with the conservation objectives defined as part of the consenting procedures.

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2.2 Impact on ecosystem services

Targeted Ecosystem services

The key objective of this measure was to create intertidal habitat to compensate for that lost through ABP port development. This is linked with ecosystem services 'landscape maintenance' and 'biodiversity', and also 'flood water storage' and 'dissipation of tidal and river energy'. It also provides 'opportunities for recreation and tourism' through becoming a tourist and bird watching attraction.

Table 2: Targeted ecosystem services

Measure	
Food: animals	
Water for industrial use	
Water for navigation	
Climate regulation: carbon sequestration	
Regulation extreme events or disturbance: flood water storage	X
Regulation extreme events or disturbance: water current reduction	
Regulation extreme events or disturbance: Wave reduction	
Water quantity regulation: drainage of river water	
Water quantity regulation: dissipation of tidal and river energy	X
Water quantity regulation: landscape maintenance	X
Water quantity regulation: transportation	
Water quality regulation: transport of pollutants and excess nutrients	
Water quality regulation: reduction of excess loads coming from the catchment	
Erosion and sedimentation regulation by water bodies	
Erosion and sedimentation regulation by biological mediation	
"Biodiversity"	X
Aesthetic information	
Opportunities for recreation & tourism	X
Inspiration for culture, art and design	
Information for cognitive development	

Quality
1 = very high quality
2 = high quality
3 = medium quality
4 = low quality
5 = very low quality

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Involved habitats

Intertidal mudflat, saltmarsh and grassland were created as a result of this measure.

Table 3: Ecosystem service analysis for Chowder Ness: Indication of habitat surface and quality change, i.e. situation before versus after measure implementation

MEASURE		before		after	
		surface (%)	Quality (1-5)	surface (%)	quality (1-5)
Marsh habitat	above mean high water, floods at spring tide	**0**	**0**	**6**	**3**
Intertidal steep habitat	floods every tide, mainly steep zones at marsh edges	**0**	**0**	**0**	**0**
Intertidal flat habitat	floods every tide, flat zones	**0**	**0**	**77**	**3**
Subtidal shallow habitat	never surfaces, less deep than 2m	**0**	**0**	**0**	**0**
Subtidal moderatily deep habitat	never surfaces, 2m-5m	**0**	**0**	**0**	**0**
Subtidal deep habitat	never surfaces, deeper than 5m	**0**	**0**	**0**	**0**
ADJACENT LAND	NON FLOODED LAND	**100**	**3**	**17**	**3**
		100		100	

The measure Chowder Ness in the mesohaline zone of the Humber estuary was about the creation of intertidal habitat by transforming adjacent land into mainly intertidal flat habitat with a moderately high change in the habitat quality.

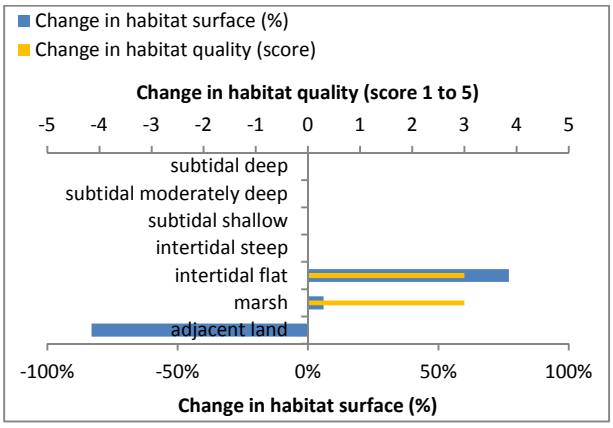

Figure 7: Ecosystem services analysis for Chowder Ness: Indication of habitat surface and quality change, i.e. situation before versus after measure implementation.

From the ES assessment it is concluded that this measure generates overall a positive expected impact for many ES, mainly for:

- "biodiversity"
- Cultural services: Aesthetic information; and Inspiration for culture, art and design
- Some regulating services: Erosion and sedimentation regulation (by water bodies); Water quantity regulation: dissipation of tidal and river energy

The expected impact for the development target "biodiversity" is positive.

The expected impact for the different beneficiary groups is overall slightly positive, with a positive expected impact for future use.

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Table 4: Ecosystem services analysis for Chowder Ness: (1) expected impact on ES supply in the measure site and (2) expected impact on different beneficiaries as a consequence of the measure.

Creation of ~13 ha of intertidal habitat at Chowder Ness

Cat.	Ecosystem Service	Score
S	"Biodiversity"	2
R1	Erosion and sedimentation regulation by water bodies	2
R2	Water quality regulation: reduction of excess loads coming from the catchment	1
R3	Water quality regulation: transport of polutants and excess nutriënts	0
R4	Water quantity regulation: drainage of river water	0
R5	Erosion and sedimentation regulation by biological mediation	1
R6	Water quantity regulation: transportation	0
R7	Water quantity regulation: landscape maintenance	1
R8	Climate regulation: Carbon sequestration and burial	1
R9	Water quantity regulation: dissipation of tidal and river energy	2
R10	Regulation extreme events or disturbance: Wave reduction	1
R11	Regulation extreme events or disturbance: Water current reduction	1
R12	Regulation extreme events or disturbance: Flood water storage	0
P1	Water for industrial use	0
P2	Water for navigation	0
P3	Food: Animals	0
C1	Aesthetic information	2
C2	Inspiration for culture, art and design	2
C3	Information for cognitive development	1
C4	Opportunities for recreation & tourism	1

Beneficiaries:	
Direct users	0
Indirect users	1
Future users	2
Local users	1
Regional users	1
Global users	1

X Targeted ES

Legend: expected impact*	
3	very positive
2	positive
1	slightly positive
0	neutral
-1	slightly negative
-2	negative
-3	very negative

*: Indicative screening based on ES-supply surveys and estimated impact of measures on habitat quality and quantity. Quantitative socio-economic conclusions require local supply and demand data to complement this assessment.

2.3 Degree of synergistic effects and conflicts according to uses

So far the site appears to be developing as expected as predicted and is broadly consistent with the conservation objectives defined as part of the consenting procedures.

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Part 3: Additional evaluation criteria in view of EU environmental law

3.1 Degree of synergistic effects and conflicts according to WFD aims

This measure was all about the creation of new intertidal habitat which provides a much needed habitat in the Humber Estuary to give land back, which can be utilised as natural flood defence and to provide extra space within the Estuary, which in turn can also improve water and sediment quality and reduce sedimentation in the main channel, which in turn reduces dredging requirements.

Table 5: Main pressures of the mesohaline zone of the Humber estuary

Indicator	code	Main pressures **mesohalinel** zone Humber	Effect?					Description
			- -	-	0	+	++	
S.I.	1.1	Habitat loss and degradation during the last about 100 years: Intertidal				X		Development of intertidal habitat.
S.I.	1.5	Gross change of the hydrographic regime during the last about 100 years				X		Opportunity for additional space along the Humber Estuary.
S.I.	3.1/3.2	Decrease of water and sediment chemical quality				X		Intertidal habitat and wetland s have the potential to improve water and sediment quality.
D.I.	1.3	Land claim during the last about 100 years				X		Land given back to the Humber Estuary.
D.I.	1.7	Relative Sea Level Rise				X		Opportunity to provide natural defence against flooding in line with increased sea level rise.
D.I.	2.4	Maintenance dredging				X		Fewer requirements for dredging as sedimentation occurring through accretionary trends in intertidal and saltmarsh habitats.
S.I. = state indicator; D.I. = driver indicator								

3.2 Degree of synergistic effects according to Natura 2000 aims

This measure was all about the creation of new intertidal habitat to compensate losses elsewhere in the Humber Estuary. Therefore, it is considered that this measure contributes to the protection and conservation of intertidal wetlands within the Internationally Designated Humber Estuary.

Table 6: Conservation objectives concerning BHD

Conservation objectives (Humber)	**Specification**	**Effect?**					**Short explanation**
		- -	**-**	**0**	**+**	**++**	
Protected Habitats: Estuary	Intertidal wetland (brackish)				X		Newly created intertidal habitat in Internationally Designated Nature Conservation Site.

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Part 4: Crux of the matter

The "crux of the matter" refers to the basic, central or critical point of an issue. For example, in this context, the main issues relating to the development and progression of the specific measure detailed within this FAS Repost represent the crux of the matter.

Overall there has been an accretionary trend throughout most of the site, with an average difference between 2007 and 2011 of +43cm. The majority of this change took place over the first two years following the breach of the site, however the 2011 survey has also seen an increase in elevation since the 2009 survey.

Between 2007 and 2011 elevations have generally increased by between 10 and 100cm, with maximum height differences in excess of 100cm observed in a few locations.

It should be noted that an apparent error can be observed between the 2007 and 2011 data which shows areas of (non-existent) erosion along the floodbank. Errors appear to occur where vegetation is or has been present. Although vegetation differences should have been filtered out of the LiDAR data it is clear that the accuracy of these measurements may have been affected. However, it is assumed that the overall trends within the data sets are accurate.

Areas of highest accretion between 2009 and 2011 are observed in limited areas in the north-east and south-west corners of the site, although these results need to be reviewed in the context of the accuracy of the LiDAR which is approximately ±25cm. Again these areas coincide with sites of saltmarsh growth and although this should have been filtered out of the LiDAR this may still affect the accuracy of these measurements. Accretion values between 2009 and 2011 throughout the rest of the site ranged from 10 to 60cm.

The lowest accretion rates are thought to be characterised by:

- A wide connection to the estuary (essentially a very wide breach);
- Exposure to significant fetch from the predominant wind direction; and
- Relatively high flows due to its proximity to the main Humber navigation channel and the Humber Bridge (the latter constriction causing higher flows).

It is notable that the lower accretion rates at Chowder Ness occur, despite its location near to the estuary turbidity maximum, which might otherwise have been expected to generate higher accretion rates. Generally, accretion at saltmarsh elevations has been much lower, in the order of a few cm at most over 5 years.

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