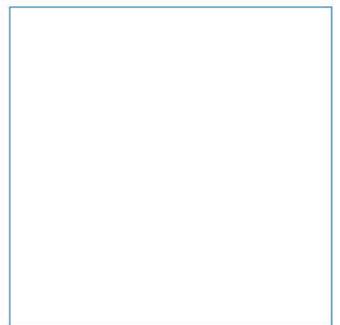
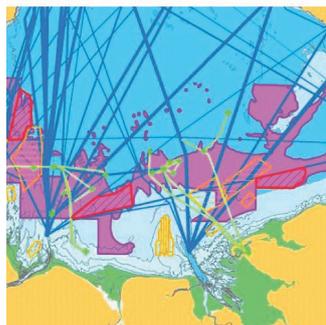
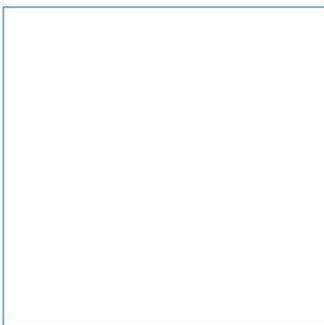
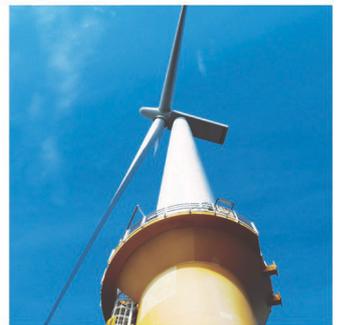
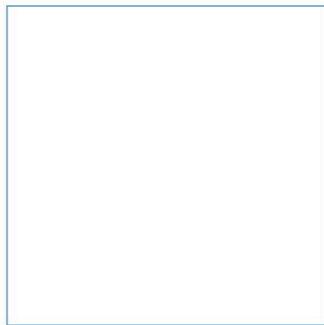


White Paper

UK Marine Habitat Creation Schemes

A summary of completed managed realignment and regulated exchange projects (1991-2016)

March 2017



Innovative Thinking - Sustainable Solutions

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UK Marine Habitat Creation Schemes

A summary of completed managed realignment and regulated exchange projects (1991-2016)

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1 Introduction

This ABPmer 'White Paper' provides a high-level overview of the marine habitat creation projects that have been undertaken in the UK up to the end of 2016. It is designed to provide an up-to-date 'audit' of the current situation with respect to coastal and estuarine habitat restoration by describing the number of completed initiatives and the extent of the habitats created. It also provides some extra information about the costs of selected schemes as well as summarising some of the many benefits that can accrue from these projects. This information is provided to clarify and highlight past achievements as well as to help understand future needs.

This review has been prepared using information within our freely available online project database (accessed at www.omreg.net). This database collates information on completed coastal/estuarine habitat creation projects as well as other shoreline adaptation initiatives both nationally and internationally (see Image 1). Currently the database contains information on over 230 projects. The database is regularly updated by ABPmer, with help and advice from a wide range of project managers and experts working in this field¹



Source: www.omreg.net/view-maps

Image 1. Online map of the northern European projects within the OMReg database

It is hoped that the online database is a useful resource in its own right for a wide range of interested parties. However it is also recognised that there is a lot of information in this database and that it is helpful to occasionally distil some of the overall findings and conclusions for dissemination. This audit has therefore been prepared to provide a record of schemes completed to date and also summarise some of the key findings for UK schemes.

This paper focusses particularly on marine habitat creation projects that are undertaken via the following two main techniques:

¹ ABPmer is very grateful for the continuing assistance provided by these specialists and we always welcome any new comments, questions or suggested additions for this database.

- Managed Realignment.** This is a Shoreline Management Plan (SMP) policy term² which indicates that the shoreline should be allowed “to move naturally, but managing the process to direct it in certain areas”. In the UK this term has generally come to be adopted as a way of describing projects that specifically involve the landward movement of tidal waters and sea defences (also called ‘managed retreat’ in other countries). This is achieved through the deliberate breaching, or removal, of existing seawalls, embankments or dikes (see Image 2). In most instances, the newly flooded land is low-lying coastal flood plain and therefore a new seawall is often needed to clearly define the inundated area and protect the hinterland behind.
- Regulated Tidal Exchange (RTE).** In the same way as managed realignment, this involves the ‘landward movement of tidal water’. The distinction is that this is achieved through the controlled exchange of estuarine or coastal waters using a variety of possible exchange structures (e.g. pipes, culverts and weirs) (see Image 2). This intertidal habitat creation option constrains the volume of tidal water exchanged with the coast or estuary and, frequently, this approach removes the need for new embankments to be constructed to the rear (landward side) of a newly inundated site. However, because the old seawalls remain *in situ*, this approach tends to require at least continued maintenance, if not upgrading, of the existing defences.



Source: © Defra 2006 and RSPB 2006

Image 2. Examples of seawall breach at Allfleet's Marsh (left) and regulated tidal exchange sluice at Goosemoor (right)

In addition to these two main techniques, there are several other approaches that can be adopted for intertidal habitat restoration, biodiversity enhancement and/or shoreline adaptation. These include using dredge sediment to ‘recharge’ deteriorating habitats or removing redundant coastal defences and allowing the coast to adjust naturally. There are also novel techniques such as creating artificial reefs or modifying marine structures.

In particular dredged sediment recharge projects can achieve major gains for intertidal restoration and these are also listed on the [OMReg website](#) (see Image 1). However, only a limited number of such projects that have been realised in the UK and those projects which have been completed are relatively small in scale. This is in direct contrast to managed realignment and RTE projects which are

² See Environment Agency, 2013 - <http://apps.environment-agency.gov.uk/wiyby/134834.aspx>

more numerous and have, in general, become larger and more ambitious over time (as lessons are learned from their successful implementation).

The reasons why there has been limited implementation of sediment recharge projects for habitat creation were discussed at a recent ABPmer conference on the beneficial use of dredge sediment (ABPmer, 2016). This subject will be reviewed in greater detail within a separate ABPmer white paper. Therefore recharge projects are not discussed further within this document.

2 Marine Habitat Restoration Review

2.1 Number and scale of completed projects

Last year (2016) marked 25 years since the first UK managed realignment was carried out (the Northey Island project on the Blackwater Estuary in 1991). In that time at least 74 different intertidal habitat creation projects have taken place in the UK³. Of these projects, 50 involved managed realignment (i.e. with the breaching or removal of seawalls as described above) while the remaining 24 were RTE schemes (using a variety of different culvert and sluice designs). These projects are listed in Tables 1 and 2 and their locations are illustrated in Figure 1.

Tables 1 and 2 also include details about when these projects were completed and their overall size in hectares (ha). The year of completion is based on the moment tidal waters were introduced to the site (or, in many cases, 'reintroduced' following a period of land-claim). The size of the sites is generally defined as the area between the old sea wall (that was either breached or within which a regulated tidal structure was installed) and the new counterwall which has been constructed to the rear of/around the project site⁴.

Over the 25 years between 1991 and 2016, 74 intertidal habitat creation projects have been undertaken in the UK. Of these, 50 were managed realignments and 24 were regulated tidal exchange schemes. These cover a total area of just under 2,500 ha.

Collectively these schemes cover an area of just under 2,500 ha, which is now mostly intertidal habitat (see Section 2.2 for further details about the habitats created). The majority of this area (2,200 ha, or 88% of the total) has been created through managed realignments, which are often much larger projects as well as being more numerous. The completed RTE schemes are generally smaller in scale as well as being less frequent; these have collectively created the remaining 300 ha (12%) of the total.

The bulk of the habitat creation total though is achieved through just a few of the larger schemes and in recent years a number of particularly large-scale projects have been completed. In the past 5 years alone there have been three landscape-scale schemes at Medmerry, Steart and Wallasea. On their own these have delivered just over 1,000 ha (40%) of the total. Further details about these projects are presented in the next section.

³ There have also been 57 other managed realignments (48) or RTE projects (nine) across the rest of Northern and Western Europe which are also included within the OMRreg database.

⁴ In rare cases, such as the Abbots Hall project, there is no need for a new large counterwall to be constructed around a managed realignment because of the topography of the site. In such cases the extent of the site is generally defined as the area across which tidal waters inundate

Table 1. Managed Realignment projects completed in the UK between 1991 and 2016

Name	Size (ha)	Location	Year	Name	Size (ha)	Location	Year
Abbotts Hall	84	Blackwater	2002	Man Sands	3	South Devon	2004
Alkborough	370	Humber	2006	Medmerry	300	Sussex Coast	2013
Allfleet's Marsh	133	Crouch	2006	Millennium Terraces	0.5	Thames	1998
Alnmouth 1	8	Aln	2006	Montrose Basin	0.3	Montrose Basin,	1997
Alnmouth 2	20	Aln	2008	Nigg Bay (Meddat Marsh)	25	Cromarty Firth	2003
Annery Kiln	3.8	Torridge	2000	Northey Island	0.8	Blackwater	1991
Barking Creek (A13)	0.04	Barking Creek	2006	Orplands	38	Blackwater	1995
Barking Creek (Barrier)	1	Barking Creek	2006	Paull Holme Strays	80	Humber	2003
Bleadon Levels	13	Axe	2001	Pawlett Hams	4.8	Parret	1994
Brancaster West Marsh	7.5	North Norfolk	2002	Pillmouth (1 & 2)	13	Torridge	2001
Brandy Hole	12	Crouch	2002	Salt Fleet Flats	65	Thames	2016
Castles Dike	8	Coquet	2011	Stanford Wharf	27	Thames	2010
Chowder Ness	15	Humber	2006	Stear Marsh	262	Parrett	2014
Cobnor Point	6.5	Chichester Harbour	2013	The Saltings	1	Rother	2014
Cone Pill	50	Severn	2001	Thorness Bay	7	The Solent	2004
Cwm Ivy	39	Loughor	2014	Thornham Point	6.9	Chichester Harbour	1997
Devereaux Farm	15	Hamford Water	2010	Titchwell Marsh	11	Norfolk Coast	2011
Fingringhoe Wick	22	Colne	2015	Tollesbury	21	Blackwater	1995
Freiston	66	The Wash	2002	Trimley Marsh	16.5	Orwell	2000
Greatham	40	Tees	2013	Tutshill	2	Congresbury Yeo	2011
Halvergate	0.5	Yare	2005	Jubilee Marsh (Wallasea)	165	Roach	2015
Havergate Island	8.1	Ore	2000	Washington	1.2	Wear	2012
Hesketh Out Marsh	180	Ribble	2008	Watertown Farm	1.5	Yeo	2000
Kennet Pans	8.2	Firth of Forth	2007	Welwick	54	Humber	2006
Lantern Marsh	29	Ore	1999	Ynys-hir	6	Dyfi	2010

For projects see ABPmer OMReg database: <http://www.omreg.net>.

Table 2 Regulated Tidal Exchange projects completed in the UK between 1993 and 2016

Name	Size (ha)	Location	Year	Name	Size (ha)	Location	Year
Black Devon Wetlands	28	Forth/Black Devon	2000	Ryan's Field	6.2	Hayle	1995
Black Hole Marsh	6	Axe	2009	Rye Harbour Farm	17	Rother	2011
Bowers Marsh	10	East Haven Creek	2012	Saltram	4.2	Plym	1995
Chalkdock Marsh	3.3	Chichester Harbour	2000	Seal Sands	9	Tees	1993
Clapper Marshes	10	Camel	2011	Skinflats	11	Firth of Forth	2009
Glasson	6.4	Conder	2005	South Efford Marsh	17	Avon	2011
Goosemoor	6.3	Clyst	2004	Treraven Meadows	14	Camel	2007
Goswick Farm	4.5	South Low River	2010	Vange Marsh	1	Thames	2006
Horse Island	1.2	Hamford Water	1995	Walborough	4.5	Axe	2004
Lepe	4	Dark Water	2006	Pool Marsh (Wallasea)	29	Roach	2016
Lymington Estuary	21	Lymington	2009	Warkworth	0.4	Coquet	2009
Otterhampton Marsh	84	Parrett	2014	West Wittering	6	Chichester Harbour	2013

For projects see ABPmer OMReg database: <http://www.omreg.net>.

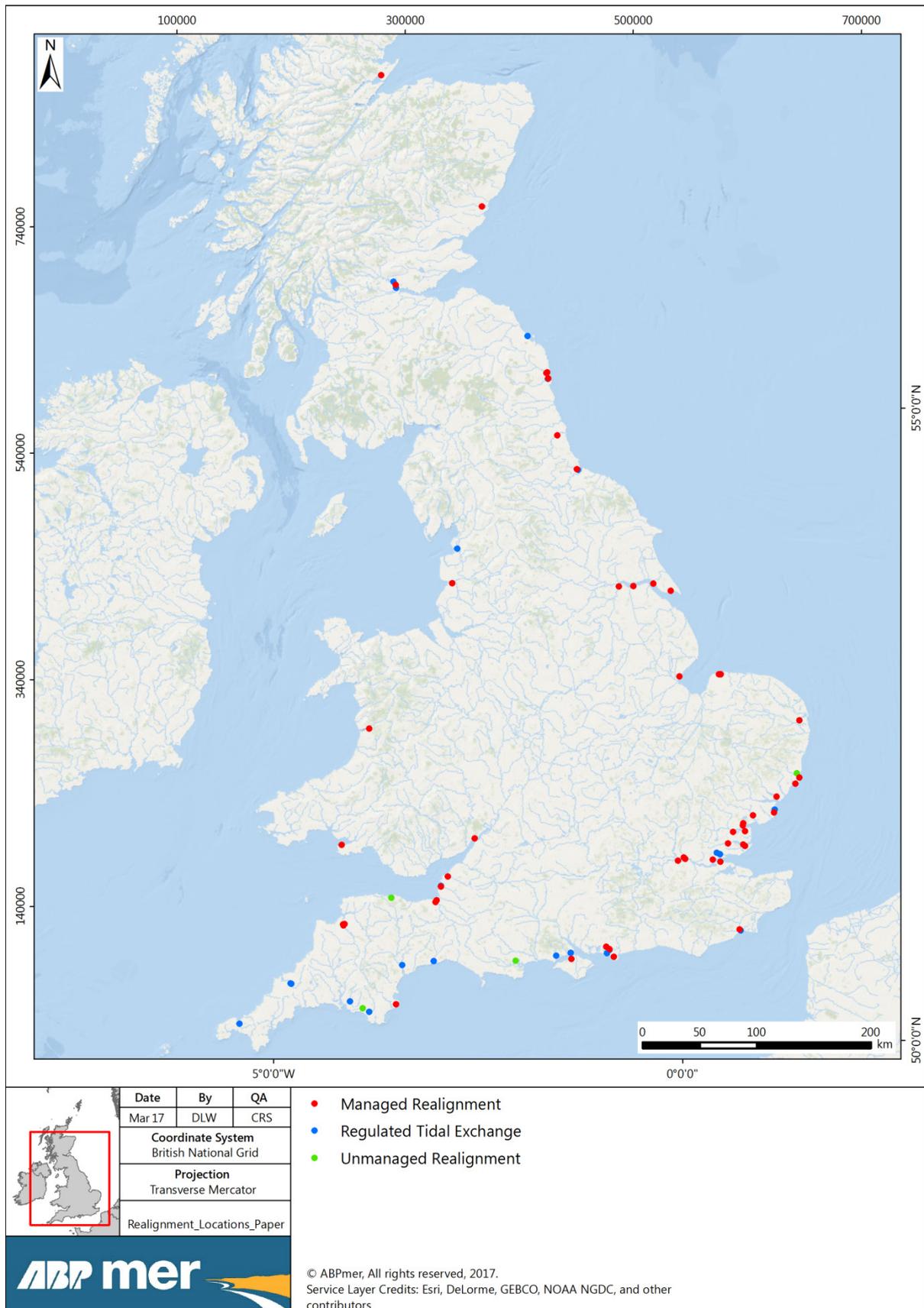


Figure 1 Location of Managed Realignments, Regulated Tidal Exchanges and (recent) 'Unmanaged' Realignments in the UK

2.2 Recently completed schemes

The **Medmerry** scheme in West Sussex was implemented by the Environment Agency in 2013 (see Image 3). This was the first major managed realignment scheme on the open coast in the UK and the first to involve a deliberate breach through a mobile shingle barrier. It created nearly 190 ha of intertidal habitat, together with a further 110 ha of transitional marsh/grassland within the confines of the new seawall (which is some 6.8 km long). It also included around 150 ha of terrestrial/freshwater habitat landward of the new seawall. Medmerry is now being managed by the RSPB, as part of their 'Pagham Harbour and Medmerry' reserve.



Source: © J Akerman, October 2015

Image 3. The Environment Agency Medmerry scheme showing new seawall alignment in red

The **Stear** scheme in Somerset (see Image 4) was undertaken by the Environment Agency in 2014. It is now a reserve that is managed by the Wildfowl and Wetlands Trust (WWT) on the Environment Agency's behalf. It is a large site that has the highest tidal exchange volume of any managed realignment at 4.2 million m³ (McGrath, 2015) and is split into three distinct areas or 'compartments'. The Steart Marsh realignment area measures just over 260 ha.

To the south of this realignment is an 84 ha RTE area (called 'Otterhampton Marsh') with the tidal exchange occurring into and out of this site through a single pipe. Between, and to the west of, these managed realignment and RTE areas there are terrestrial and freshwater habitats. The whole of this scheme with all these habitats included covers 475 ha.

On Wallasea Island, at the junction of the Crouch and Roach Estuaries (Essex), two key phases of the RSPB's ongoing flagship **Wallasea Island Wild Coast Project** were completed in 2015 and 2016 (see Image 5). In July 2015, the 165 ha Jubilee Marsh managed realignment was finished following three years of construction. This involved unprecedented land-raising and landscaping work using over 2 million m³ of imported fill material. The majority of these landscaping materials (1.65 million m³) were tunnelling excavations derived from the London Crossrail project while the remaining materials were relocated from habitat creation excavations on the island itself.



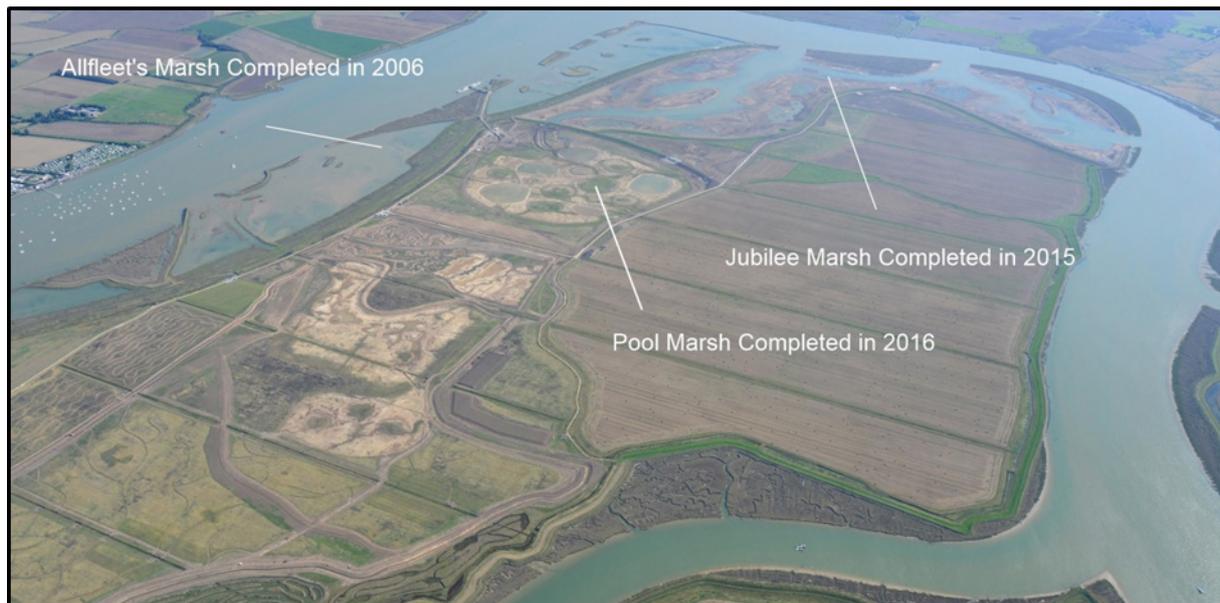
Source: © Sacha Dench, WWT ,September 2014

Image 4. The Environment Agency/Wildlife Trust managed realignment scheme at Steart

Some of the within-island excavations at Wallasea were used to create Pool Marsh behind Jubilee Marsh and in early 2016 this part of the site was opened up to modest tidal inundation (via culverts in the new Jubilee Marsh seawall). This created a further 29 ha of lagoon habitat. These two initiatives represent the first two phases of the larger scale (677 ha) coastal habitat restoration initiative that is taking place on this island.

It is proposed that the remainder of the Wallasea Island site will be completed through the implementation of further 40 ha saline lagoon wetland (Phase 3) and an innovative RTE initiative that will be nearly 300 ha in size and the largest such scheme ever in the UK (Phase 4). This final phase is designed to create a unique attraction for visitors and the largest complex of shallow (but also periodically dried out and re-flooded) bird-rich saline lagoons in Northwest Europe. This wetland will be distinctive in the UK and reminiscent of Mediterranean salinas and parts of the Camargue in southern France. It is, therefore, expected to also provide suitable breeding habitat for future 'southern colonist' species such as Spoonbill, Black-Winged Stilt or Kentish Plover that may well move into the UK from mainland Europe over coming decades in response to climate change (ABPmer, 2017, Ausden *et al.*, 2014).

Of the other recent projects, the newest is the **Salt Fleet Flats** managed realignment scheme which was completed in autumn 2016. This work was undertaken by DP World primarily as compensation for London Gateway. This project involved the construction of a new 2.4 km-long seawall and a large 700 m breach/seawall removal to flood the hinterland area. This created around 65 ha of intertidal habitat of which 59 ha is mudflat. This site is managed in partnership with the RSPB and was part funded by the Environment Agency in order to claim some of the newly constructed habitat for its compensatory requirements (i.e. to offset coastal squeeze effects attributed to coastal protection works) (DP World, 2016).



Source: © RSPB, September 2015

Image 5. The RSPB/Crossrail Jubilee Marsh and Pool Marsh projects, and the Defra Allfleet's Marsh scheme, on Wallasea Island

Over the last few years there have also been a number of other notable initiatives. These include the **Fingringhoe Wick** managed realignment which was completed in autumn 2015 (see Image 6). This is a 22 ha site on the Colne Estuary that was created on the Environment Agency in partnership with the Essex Wildlife Trust and is part of (and became an extension to) the Trust's Fingringhoe Wick nature reserve (BBC, 2015). Also, in South Wales, the **Cwm Ivy** site was formed when a seawall breach was opened up in August 2014. This created 39 ha of mainly marsh and grassland. Other smaller schemes continue to be implemented such as The **Saltings** which is a small 1 ha site in the Rother Estuary. This was created in 2014 when two breaches were made and two creeks excavated.

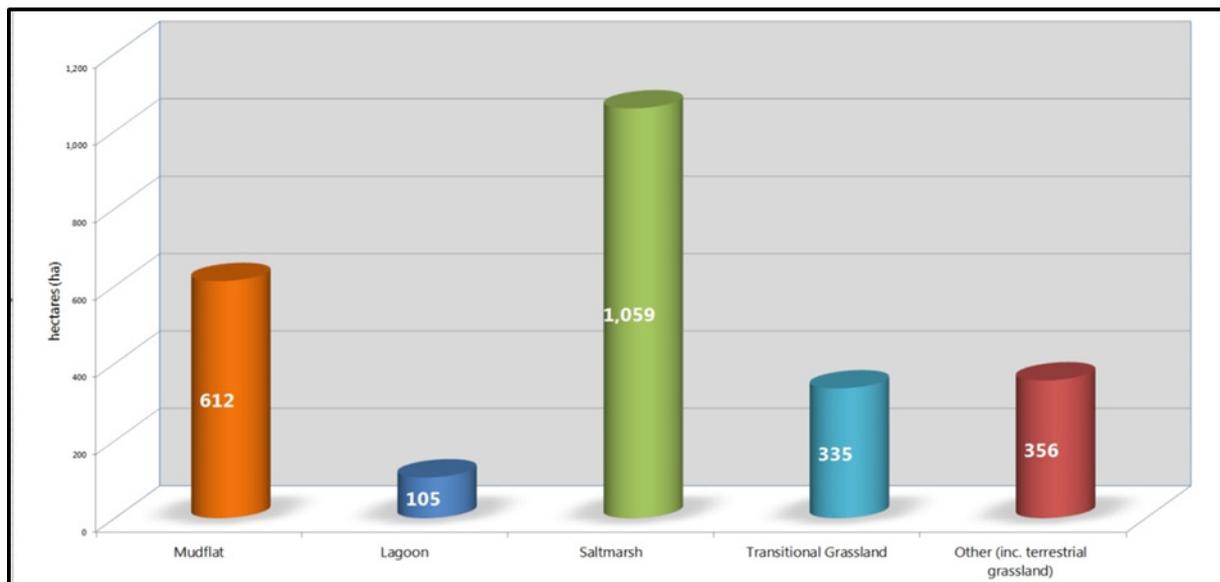


Source: © J Pullen, 2015

Image 6. View of Fingringhoe Wick Managed Realignment taken day after first breach

2.3 Extent of restored habitats

The extent of coastal habitat created (~2,500 ha) is calculated based on the area between the old and the new seawalls of the managed realignment or RTE schemes. From the [OMReg database](#) it is possible to clarify and calculate the extent of the different key habitats within this area. The resulting values are shown in Image 7 and summarised later in this section. As shown in Image 7, the coastal habitat that has been created is not always regularly inundated by the tide. Indeed many sites (especially the larger ones) include substantial areas of transitional habitat at higher elevations as well as terrestrial habitat at greater elevations.



Source: www.omreg.net

Image 7. Breakdown of coastal habitats created over the last 25 years (total 2,467 ha)

Equally, there are also sites where the amount of coastal habitat that is created is just a relatively small component of a much larger and more complex wetland. At **Bowers Marsh**, for example, there is a large 260 ha mosaic of freshwater lagoons, scrapes, ditches, reedbed and wet grassland, whereas the amount of saline lagoon created by the RTE is 10 ha at this site.

There is also one example in the database of a project that did not create or restore any new habitat but it does represent a valuable example of how existing habitats can be maintained through adaptive management. This was the small-scale **West Wittering** scheme undertaken by the Environment Agency in Chichester Harbour. This involved creating a relatively simple RTE structure that preserved the functionality of an existing, but damaged and leaking, culvert gate which had been supporting a 6 ha complex of designated coastal lagoon habitat behind an existing sea wall. For this project the wall was upgraded and a controllable culvert gate installed that functions like the previously damaged structure (thus no new habitats were created per se), but in a way that will allow for future adjustments of the tidal exchange volume (see Image 8).

Landward of new seawalls there are often large areas of terrestrial or freshwater habitat which can form part of the official scheme area and provide substantial ecological value in their own right⁵. Good examples of projects which include significant areas of transitional and terrestrial habitats

⁵ Within the OMReg database, this hinterland habitat beyond the seawall is generally not included within the quoted total area (in hectares) of each scheme

include **Alkborough** and **Paul Holme Strays** on the Humber, **Medmerry** in West Sussex and **Stear** in Somerset.



Source: Arup and ABPmer 2013

Image 8. Small 'RTE culvert gate' at West Wittering (left) and the saline lagoons behind the seawall (right)

Bearing these differences between-projects in mind, around 1,776 ha (72% of the nearly 2,500 ha total extent) is now intertidal. This includes mudflat, saltmarsh and saline/brackish lagoons which are subject to regular tidal exchange (see Image 7). A further 671 ha (28 % of the habitats created) are either transitional or terrestrial in nature.

These figures generally represent habitats at the point of implementation; many of these habitats will have altered since implementation and will be continuing to change. This is because the majority of sites exhibit net sedimentation. For example, at **Allfleet's Marsh (Wallasea)**, a series of deep low-level lagoons (which were essentially 'borrow pits' from the new sea wall material excavations) filled up with sediment over the first five years after implementation.

Of the nearly 2,500 ha of habitat created over the last 25 years, around 72% is intertidal (mudflat, lagoon and saltmarsh). The remainder is transitional or terrestrial habitat.

The intertidal habitats are often subject to ongoing change as a result of sedimentation.

In the four implemented schemes on the Humber Estuary, large percentages of the mudflats that were initially created have changed into saltmarsh over the years. This is due to the high suspended sediment loads and high accretion rates experienced in this estuary. This process of accretion and marsh colonisation has the benefits of increasing the level of wave energy absorption and reducing tidal inundation over time. It therefore results in progressive improvements to the levels of hinterland flood protection. This process also traps substantial amounts of carbon (e.g. Chmura, 2009).

Of the 50 implemented schemes, 14 were undertaken with a view to creating habitat for compensatory purposes (i.e. to offset losses of intertidal habitat elsewhere that have occurred or will occur, mostly, as a result of port development or flood/erosion risk management⁶). These 14 schemes have led to the creation of just under half of the cumulative total area created to date (i.e. just over 1,200 ha). The approximate breakdown of compensatory habitats, as initially created, is shown in Table 3. When compared to Image 7, this demonstrates that slightly more intertidal habitat is created within the compensatory schemes and these schemes have a higher percentage of mudflat.

Table 3. Extent (ha) of compensatory and non-compensatory habitat created up to the end of 2015

Habitat	Mudflat	Lagoon	Saltmarsh	Transitional Grassland	Other	Total
Compensatory	406	30	473	152	151	1,211
Non-Compensatory	206	75	585	184	205	1,255
Total	612	105	1,059	335	356	2,467

2.4 Length of sea wall realigned

Using the details within the [OMReg database](#) it is possible also to calculate the total length of seawall that has been realigned. For the purposes of this paper, this has been measured for the managed realignment schemes⁷ as listed in Table 1. In total almost 60 km have been realigned in this way across the 50 projects.

This compares with a value of 46 km which had been realigned up to the end of 2012. At that time the UK Adaptation Sub-Committee (2013) used outputs from the [OMReg database](#) and other analyses to conclude that the rate of managed realignment would need to increase five-fold to meet policy goals for the year 2030. These goals were set out in SMPs which propose setting back nearly 10% of the English coastline by 2030, rising to nearly 15% by 2060.

The defence-length metrics used by the Committee are slightly different to those in the [OMReg database](#) and are based more on ratio relationships between the extent of habitat created and defence length.

However, they concluded that around 1% of the English coastline had been realigned since the 1990s and that projects in the pipeline (between 2013 and 2016) should realign an additional 0.8% up to 2016. This rate of increase in the length of the defences realigned has not been realised. However, the same study also anticipated the total area of managed realignment would be 2,200 ha by 2016 and that has been slightly exceeded (as described above).

Almost 60 km of seawall have been breached, removed and realigned by the 50 managed realignments that were completed between 1991 and 2016. There will also have been a further realignment of the tides (as opposed to the seawall) from the 24 regulated tidal exchange schemes.

⁶ In the UK, any flood risk management measures which lead to coastal squeeze of habitats designated under the Birds and Habitats Directives tend to be compensated for (Defra, 2005). Most of the schemes implemented by the Environment Agency over the past decade or so have in large part been motivated by the need to compensate for coastal squeeze caused by the maintenance and upgrade of coastal defences in designated estuaries

⁷ There will also, technically, have been further realignment from the 24 regulated tidal exchange schemes but this is not as readily quantifiable and in a number of these cases the old sea wall still needs to be maintained.

2.5 Project costs and benefits

ABPmer has previously produced a 'white paper' that reviews the costs incurred for undertaking managed realignment projects. That paper is available as a free download from the OMReg website⁸. In summary, it described how managed realignment and RTE projects can be fairly, and increasingly, costly and complex to achieve. This is contrary to the way such projects were perceived and implemented in the early 1990s. At that time when they were first being undertaken they were envisioned as a low cost way of providing flood defence (Burd, 1995). Further updates to this previous ABPmer cost review are presented below.

The costs incurred for habitat restoration are very much dependent on the location and scale of the works as well as the extent of any engineering and ongoing intervention requirements that are required. Average managed realignment unit costs were found to have been some £35,000 (in today's money) but costs have varied widely, from £790 to £145,000/ha (excluding one particularly costly outlier⁹). These values were based on data from 45 projects and, since that document was published, more schemes have been implemented and more data obtained for 'old' schemes. This additional cost data has been collected for three further schemes of varying sizes. These are the landscape-scale **Wallasea Island Wild Coast** project; the 10 ha **Skinflats** RTE (Forth Estuary) and the 1.2 ha **Washington** saline lagoon scheme (on the Wear Estuary).

The Washington project is quite small scale and cost some £120,000 (WWT, 2013) while the larger Skinflats project cost just under £218,000. By contrast the very much bigger (several hundred hectare) Wallasea Island Wild Coast Project has cost several £10s millions.

Obtaining a precise cost figure for the Wallasea project is difficult because of the many complexities associated with this unique project. However an estimated value of around £50 million is considered to be appropriate¹⁰. This corresponds to around £128,000/ha to date. This figure excludes the costs of shipping the Crossrail materials to Wallasea, the inclusion of which would approximately double the costs. This element has been excluded to take account of the fact that, had Wallasea not been available, the 1.65 million m³ of material from the Crossrail project would have had to have been disposed elsewhere at equivalent if not greater cost.

Based on data from 48 sites, the 'per hectare' project cost for habitat creation schemes is very variable but is on average £38,000 in today's money. These implementation fees should however be viewed in the context of the long-term cost savings and Ecosystem Services provided (e.g. Medmerry has estimated benefits of over £90 million, compared with implementation costs of £28 million).

The Wallasea Island Wild Coast Project is still being implemented in a phased manner. Phase 1 (Jubilee Marsh) is now completed; Phases 2 and 3 are at or nearing completion and Phase 4 is likely to be finished over the next two years. When the

⁸ www.omreg.net/published-reports

⁹ This outlier is the 0.4 ha urban managed realignment at Barking Creek in London, which cost £370,052 (at 2014 prices). Due to its small size this equates to a per-hectare unit cost of £925,130/ha. Also it is noted that the Trimley Marsh scheme cost (calculated to be some £122,000/ha in 2015 prices) only included the first two years of leasing costs. The leasing costs could amount to up to £35 million over 70 years (Brien, 2016). Only including the leasing costs to date, well over £300,000/ha has probably been incurred for Trimley so far.

¹⁰ This refers to the completion of the Jubilee Marsh realignment at Wallasea, the Pool Marsh Lagoon and a large saline lagoon within the hinterland/mitigation area (which also contains and extensive freshwater/brackish wetlands). This amounts to some 392 ha of restored habitat.

whole 677 ha project is complete the final per-hectare costs will be different to (and possibly lower than) the values quoted above.

The Wallasea Island Wild Coast Project and Washington saline lagoon scheme are each relatively high cost (in per hectare terms). By including these (and Skinflats) in the overall cost calculation and accounting for (quite minor) inflation between 2014 and 2015, this raises the average unit costs of managed realignment and RTE schemes to date to £38,000/ha (across 48 different sites).

Thus the total project costs can be well over £100,000/ha for managed realignment and RTE schemes, particularly where significant engineering is required (which it often is for habitat compensation schemes). However, lower cost schemes are still implemented, though rarely along more developed/urbanised estuaries. It therefore continues to be the case that economies of scale are often not realised, and bigger schemes frequently incurred higher unit costs. With the exception of **Freiston** (the Wash) and **Alkborough** (Humber estuary), all other schemes which are bigger than 50 ha have incurred above-average unit costs (see Image 9), with the Wallasea Island Wild Coast Project to date having the highest unit costs of the bigger schemes, followed by **Paul Holme Strays** (Humber estuary) and another scheme on Wallasea, Allfleet's Marsh.

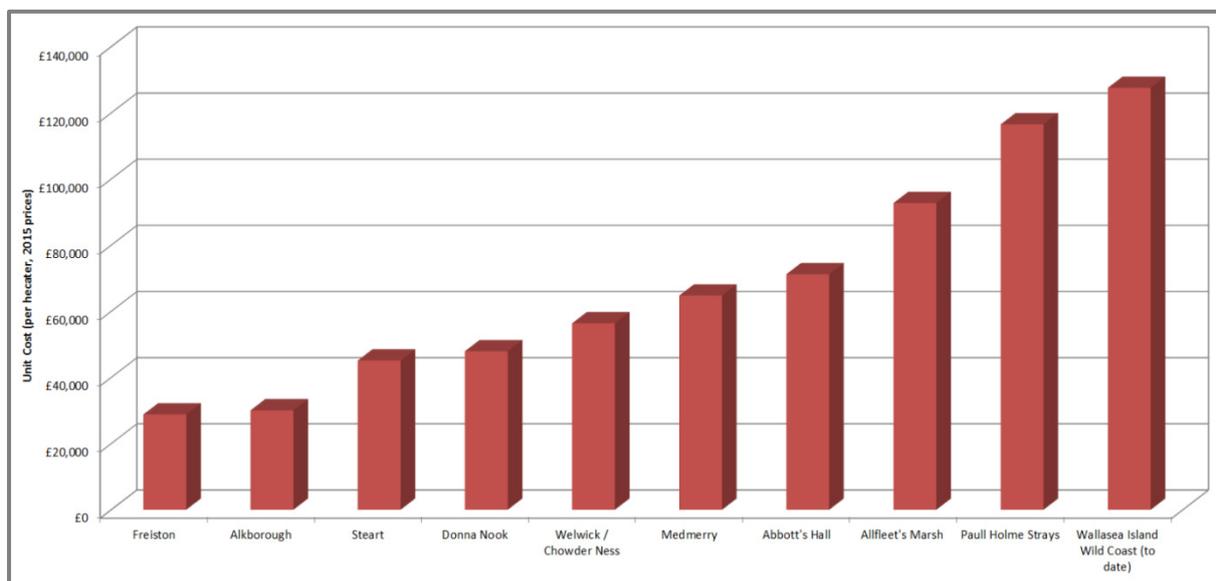


Image 9. Unit (per-hectare) costs of large-scale coastal habitat creation schemes

It should be emphasised however that managed realignment projects generally lead to long-term cost savings in flood risk management terms, particularly where a given embankment is in a poor state of repair. For example, prior to the Medmerry scheme being undertaken, the fronting shingle ridge required annual re-profiling at costs of around £300,000/year but still only achieving a much lower standard of defence than what is now provided. This annual fee would have been much greater after the winter 2013/14 storms which immediately followed the breaching of this site and the damage that would have been incurred from flooding of the arable fields and residential and holiday properties would have been considerable. As a result, a recent study for the Natural Capital Committee (eftec *et al* 2015) concluded that the project had estimated benefits of over £90 million, compared with implementation costs of £28 million.

In the short-term therefore managed realignment can clearly often be a more costly option when compared to maintenance and upgrade of existing defences. However, the numerous other benefits and Ecosystem Services provided by managed realignment often help to make, or support, clear long-term investment cases for such initiatives (e.g. Adaptation Sub-Committee, 2013). In this context it is

notable also that, while no real economies of scale come with implementing larger scheme, such projects do have the potential to deliver much larger and more varied ecological, social and economic value.

2.6 Unmanaged realignment

In addition to considering managed realignment initiatives, it is also valuable to understand the lessons from, and distinctive issues associated with, 'unmanaged realignment'. Technically unmanaged realignment occurs when a seawall is weakened and ultimately breached during periods of adverse weather and/or storm surges. The term 'unmanaged' can, however, be misleading given the fact that a conscious coastal management decision might be made not to repair such a breach in advance or that such sites often require significant management measures (e.g. footpath diversion) following a breach. Dozens of such sites have been documented in the UK. For example, Burd *et al.* (1994) listed and reviewed 23 realignment schemes in Essex, many of which were breached (and not repaired) during notable storm surges (e.g. in 1953). Recent notable examples have also been incorporated into ABPmer's [OMReg database](#). These include, from the most recent to oldest, Hazlewood Marshes; Lytchett Fields; Great Orcheston Fields and Porlock Bay.

The **Hazlewood Marshes** unmanaged realignment (see Image 10) occurred on the Alde Estuary during the 2013/14 surges (Suffolk Wildlife Trust, 2015). Measuring around 69 ha, this wetland site represents the only location where a breach occurred (ultimately the wall breached at a number of points) during the 2013/14 winter, but where the wall was not ultimately repaired¹¹. Also relatively recently, in late 2012, two small breaches developed in the embankment surrounding **Lytchett Fields** in Lytchett Bay/Poole Harbour (see Image 11). Shortly thereafter, the metal tidal flaps at the outlet sluice at this site were also stolen (and not replaced), and water is thus exchanged through pipes as well as the two breaches. Some 23 ha of intertidal habitats are developing at this (brackish) location. This unmanaged realignment has attracted many notable birds since breaching, and has developed into a popular birding location. The RSPB manages this site and carries out regular reed cutting as well as grazing with cattle to control the vegetation (pers. comm. RSPB (Dorset reserves)).



Source: © ABPmer, 2014

Image 10 Seawall breached in several places at Hazlewood Marshes (October 2014)

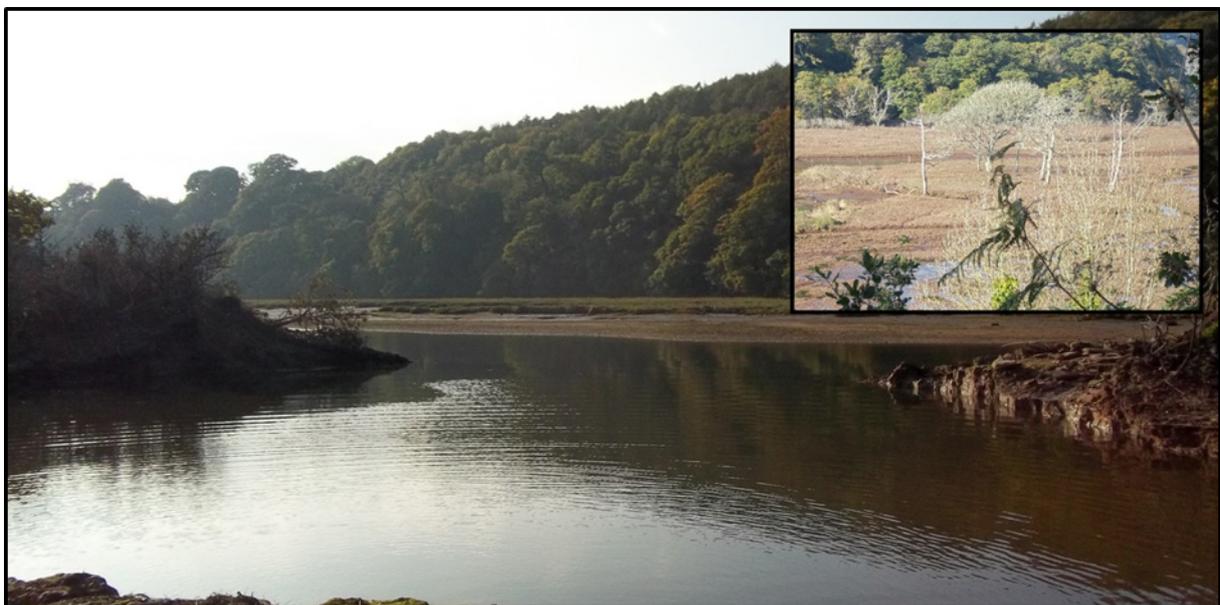
¹¹ This is to the best of ABPmer's knowledge - dozens of seawall breaches did occur during this winter, most notably during the December 2013 surge; see, for example, Blakeney Parish Council, 2013; Bird Guides, 2013; BBC, 2014.



Source: © ABPmer, 2015

Image 11 Main inundated area of the Lytchett Fields site (October 2015)

In 2007, a breach developed along 'Great Orcheton Fields' on the Erme estuary in Devon during a period of extreme high tides which coincided with a storm surge and sustained rainfall (White, 2014). The landowner decided not to repair the relatively small breach, thus enabling the creation of around 24 ha of saltmarsh, mudflat and transitional habitats (see Image 12).



Source: © ABPmer, 2010

Image 12. The Great Orcheton Fields unmanaged realignment (main image shows the breach, inset shows the site itself)

At **Porlock Bay**, in Somerset, a 75 ha site was created when a natural breach formed in the shingle ridge during a major storm in October 1996. This breach was not unexpected, as the management (recycling and forming) of the ridge was discontinued in the early 1990s owing to concern over the long-term sustainability at Porlock. Since then the breach and barrier have been well-studied (Bray and Duane, 2001; Orford, 2003; and Cope, 2004)). The breach has remained in place and is around 80 m wide with a deeper channel that is approximately 15 m wide (ABPmer, 2009).

3 Conclusions

Managed realignment and RTE projects have an important role to play in coastal habitat creation and restoration and deliver multiple socio-economic benefits. This role is expected to continue into the future in response to the ongoing challenges posed by changing coastlines and the effects of climate change and sea level rise. There are other creation/restoration techniques which are also available which can help to sustainably manage our shorelines (most notably the beneficial use of fine sediment as described in Section 1). A continuing process of lesson learning will be needed to enhance the way in which we can implement such schemes into the future

In preparing this 'audit' of marine habitat creation schemes it is clear that there is already a great wealth of information available to describe the lessons from such projects. The analysis presented above represents only a snapshot of the available data contained in ABPmer's database (e.g. only data for the UK is presented here) and yet it is also true that there is much more data and information 'out there'. More often than not this information is contained in internal monitoring reports which too rarely are written up into publicly available reports and papers.

ABPmer is always keen to help disseminate and collate such data and reports, and are very grateful to the numerous project implementers who have contributed, and continue to help with, the population of the [OMReg database](#). Our intention is to continue to provide free access to the database via the website and we will be grateful for any and all information that can be provided in the future. Further papers and audits will then be prepared in response to the information provided.

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5 Abbreviations/Acronyms

BBC	British Broadcasting Corporation
OMReg	Online Marine Registry
RSPB	Royal Society for the Protection of Birds
RTE	Regulated tidal exchange
SMP	Shoreline Management Plan
WWT	Wildfowl and Wetlands Trust
UK	United Kingdom

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SI units are used unless otherwise stated.

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