Case study 50. Medmerry Managed Realignment

Author: Robert Harvey

Main driver: Improved defences and habitat creation

Project stage: Completed 2013

Photo 1: Medmerry managed coastal realignment site, 10 October 2013 (source: © Environment Agency and John Akerman ABPmer)

Project summary:

The Medmerry Managed Realignment scheme in West Sussex (Photo 1) was identified in the Pagham to East Head Coastal Strategy (2009). The project came about through a combination of the need to improve flood risk management and the requirement of the Environment Agency's Regional Habitat Creation Programme to create intertidal habitat. The Environment Agency purchased most of the land required for the project and constructed 6.2km of new retreated sea defences, tied into the existing shoreline with rock revetments. Additional land was contributed by RSPB.

The project provides a 1 in 100 year standard of defence in year 100 (increased from 1 in 1 year standard prior to implementation) to 348 properties, the road serving Selsey and a waste water treatment works. It has created 183ha of intertidal habitat and 80ha of transitional grassland. Mitigation was also provided for 50ha of freshwater Site of Special Scientific Interest (SSSI) within and around the realignment area. The project has increased recreation and tourism, creating new amenity and providing both new and replacement footpaths, cycleways and bridleways. Most of the land within the project area has been leased by the Environment Agency to RSPB for management as a nature reserve.

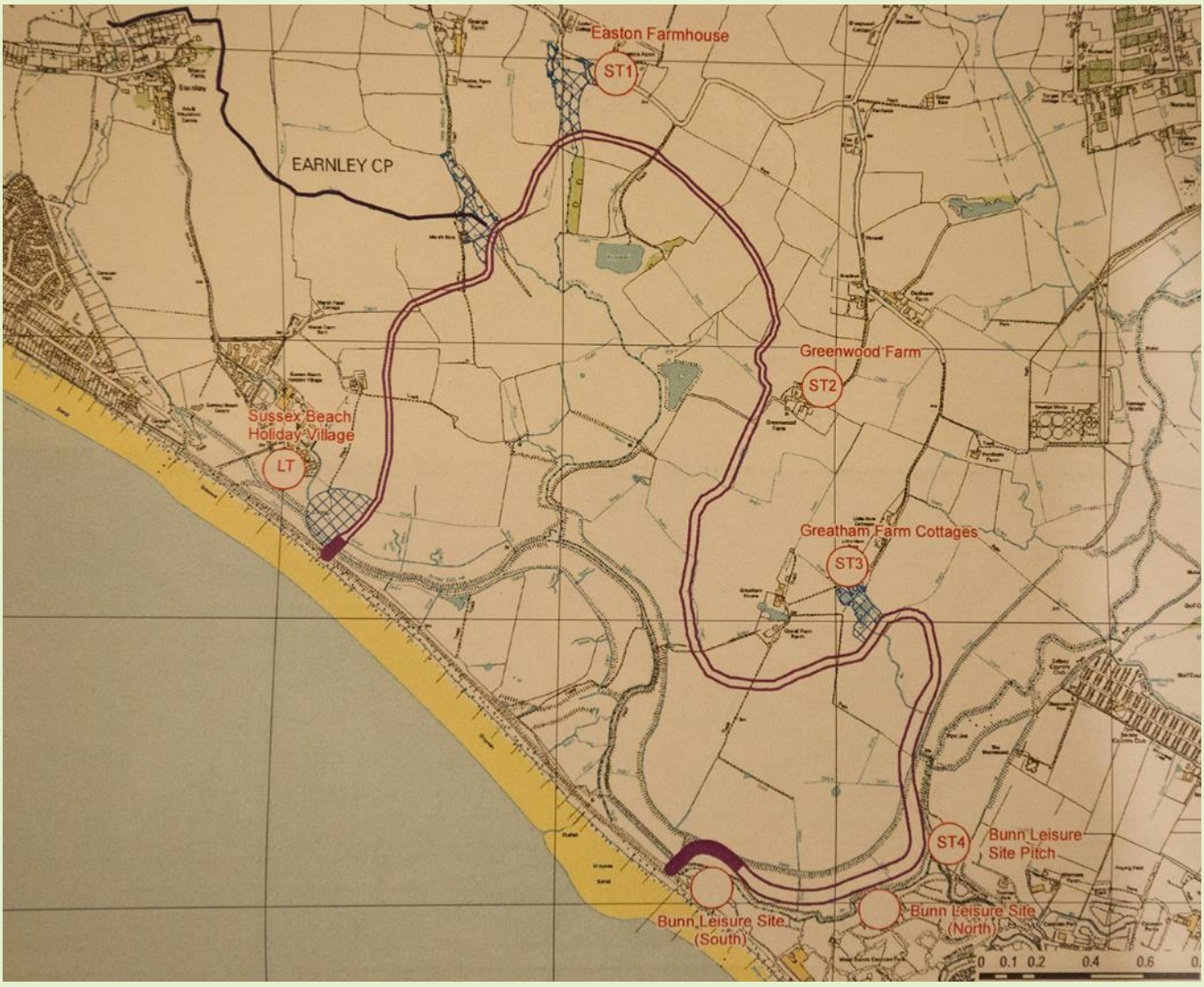
Project summary (continued):

Project costs were ~£30 million including £10 million of land purchase costs. Economic benefits were estimated in the project appraisal report at £91.3 million (including £13.5 million of environmental benefits) (Environment Agency 2010a).

Key facts:

Medmerry is the largest managed realignment project on the open coast undertaken in Europe. The project has provided:

- cost-effective flood risk management to 348 residential and commercial properties
- a more sustainable shoreline
- 183 ha of intertidal habitat
- an enhanced environment for recreation and access



Map 1: Location of Medmerry

1. Contact details

Contact details	
Names:	Pippa Lewis (Environment Agency), Tim Callaway (RSPB)
Lead organisation:	Environment Agency
Partners:	RSPB
e-mail address:	Pippa.lewis@environment-agency.gov.uk

2. Location and coastal/estuarine water body description

Coastal/estuarine water body summary	
National Grid Reference:	SZ 830950
Town, County, Country:	Selsey, West Sussex, UK
Regional Flood and Coastal Committee (RFCC) region:	South East
Transitional and coastal water body size (km^2):	Not available
Transitional and coastal water body and location:	Not available
Water Framework Directive water body reference:	Not available
Land use, geology, substrate, tidal range:	Formerly Grade 3 agricultural land (arable and grazing); now nature reserve, including areas of tenanted arable and grazing SSSI comprising 50ha of coastal grazing marsh and 5ha of geological SSSISolid geology comprises Palaeogene deposits of the Reading Formation, London Clay Formation and the Bracklesham Group, resting unconformably on Cretaceous chalk beds. The frontage itself comprises shingle beach. Tidal range (Selsey Bill): 5.8m

3. Background summary of the coastal/estuarine water body

Socioeconomic/historic context

The project area was previous Grade 3 agricultural land divided between 4 different farming enterprises. It is relatively remote, with a feeling or 'wildness' that is rare on the Sussex coast. There were few footpaths across the land and so public access was limited.

Flood and coastal erosion risk management problem(s)

The shingle beach provided a low standard of flood risk management, estimated at 1 in 1 year annual event probability. Breaching presented flood risk to:

- 348 residential and commercial properties
- The B2145 road, which is the only access to Selsey
- Sidlesham waste water treatment works
- 5 holiday parks with over 3,000 static caravans and chalets
- features of the Bracklesham Bay SSSI

A significant flood event in March 2008 caused over £5 million in damage to local businesses and required evacuation of some areas due to risk to life.

Other environmental problems

A contribution to the government target to get 95% of SSSIs into favourable or recovering condition by December 2010 could not made by getting the Solent SSSI complex into recovering condition, to which the Medmerry project was an agreed contribution.

The Environment Agency needed to meet its targets for intertidal habitat creation, for which there are few available sites in the Solent.

4. Defining the problem(s) and developing the solution

What evidence is there to define the flood and coastal erosion risk management problem(s) and solution(s)

The Pagham to East Head Coastal Defence Strategy (2009) recommended managed realignment at Medmerry. The core objectives of the scheme were:

- provide a sustainable reduction in flood risk
- maximise opportunity for creating new habitat
- encourage community participation in new scheme development.

The approved strategy for the frontage was managed realignment to deliver a defence standard of 1 in 100 years in year 100 and to create 183ha of intertidal habitat. Had the delivery of intertidal habitat not been an objective, it is likely that managed realignment would still have been undertaken but on a smaller scale.

What was the design rationale?

The managed realignment was implemented by constructing clay embankments on a retired alignment, tying into high ground where possible and defending all residential and commercial properties in the hinterland. The seaward ends of the embankment are protected and tied in with rock. The scheme links to adjacent private defences built around the same time by Bunn Leisure's holiday park. New outfalls were provided within the clay bank, along with fluvial flood storage landwards of bank to ensure that fluvial flood risk does not become worse. Provision of green infrastructure includes footpaths, cycleways, bridleways and disabled access. The existing coastal access route was replaced with footpaths on a retreated line (to accord with Marine and Coastal Access Act). The design sought to achieve a balance between conservation and recreation by allowing some areas of the site to remain relatively undisturbed. Extensive stakeholder and community engagement was required.

Project summary	
Area of transitional and coastal water body or length benefiting from project:	New defences 6.8km in length
Types of measures/interventions used (Working with Natural Processes and traditional):	Managed realignment
Numbers of measures/interventions used (Working with Natural Processes and traditional):	One principal measure – managed realignment Rock revetment to tie ends of new embankment into adjacent existing sea defence where line is being held
Standard of protection for project as a whole:	1 in 100 years in year 100
Estimated number of properties protected:	348

How effective has the project been?

The project has met its objectives for flood defence, biodiversity gain, public access and stakeholder engagement.

Wildlife use of the site has increased, for example:

- teal, wigeon and lapwing increased in numbers in year 1, responding to a flush of invertebrates
- grey plover and ringed plover will increase as intertidal invertebrates colonise the site
- breeding avocet up from 2 pairs to 25 pairs in 2016
- breeding oystercatcher, ringed plover and little ringed plover have all done well since 2013
- black-winged stilt nested on spit in lagoon area in 2014
- breeding lapwing, redshank and corn bunting have done less well, possibly because food sources have been reduced
- fish are benefiting from feeding in site at high tide, for example, a large influx of smoothhound sharks was observed
- reptiles translocated from construction areas are doing well on new banks
- 7km of new ditches created for water vole
- 2 new sites for great crested newts
- 1 new site (2ha) for European eel

5. Project construction

How were individual measures constructed?

All the clay required for the embankment construction was sourced locally by excavating scrapes, lagoons and ditches. Although this added to the biodiversity gain of the site, much of the available material was found to be of poor quality and so the volume of excavation turned out greater than originally anticipated.

Significant archaeology (bronze age and medieval) and evidence of Palaeo-shorelines was discovered during construction.

Rock was imported from Norway by barge (Photo 2).

Outfalls were constructed from concrete by traditional techniques (Photo 3).

Construction was hampered by poor weather in summer 2012.

Poor weather, the archaeology and the poor quality material led to an increase in construction costs from £17 million to £20 million.

How long were measures designed to last?

The design life of the project is 100 years.

Were there any landowner or legal requirements which needed consideration?

Most of the land required for the project was acquired through the voluntary purchase by the Environment Agency of 3 complete farms (excluding farmhouses) at a cost of around £10 million. One parcel of land within the project area, belonging to a fourth farm, has yet to be acquired though negotiations to acquire this through a land swap are at an advanced stage. This swap depends on provision being made to replace a freshwater reservoir that is located on the land being acquired, which is used for agricultural irrigation.

Some of the land purchase was subject to overage. The RSPB owned part of the land used for the project and contributed it. Following completion, the land acquired by the Environment Agency has been leased to the RSPB, most of it on a 99 year lease, to manage as a nature reserve.

6. Funding

Funding summary for Working with Natural Processes (WWNP)/Natural Flood Management (NFM) measures	
Year project was undertaken/completed:	Project was substantially completed and the existing defences breached in 2013.
How was the project funded:	100% funded through Flood Defence Grant in Aid
Total cash cost of project (£):	£30 million including studies, design, construction and land acquisition
Overall cost and cost breakdown for WWNP/NFM measures (£):	Economic appraisal costs as detailed in Project Appraisal Report (Environment Agency 2010a): • Project Appraisal Report: £1,360,000 • Project Appraisal Report to construction: £862,000 • Construction: £11,686,000 • Maintenance: £5,536,000 • Risk contingency: £1,701,000
WWNP/NFM costs as a % of overall project costs:	100%
Unit breakdown of costs for WWNP/NFM measures:	The managed realignment project cost approximately £30 million including land acquisition.
Cost–benefit ratio (and timescale in years over which it has been estimated):	The Medmerry Managed Realignment Project Appraisal Report (Environment Agency 2010a) estimated the scheme costs at £19.7 million (it is not clear whether this included land purchase costs) and the economic benefits at £91.3 million (including £13.5 million of environmental benefits). The benefit–cost ratio was assessed as 4.6. Flood and coastal risk management (FCRM) considerations alone would probably have resulted in a more limited realignment and a smaller area of intertidal habitat created.

Photo 2: Rock revetment at seaward end of new embankment (source: Robert Harvey)

Photo 3: Outfall through new embankment and intertidal habitat (source: Robert Harvey)

7. Wider benefits

What wider benefits has the project achieved?

The project has created new habitat and led to biodiversity gain (Photo 4). It has also increased recreation and tourism opportunities (including additional amenity to existing holiday home parks) and led to the creation of new green infrastructure such as 10km of new and replacement footpaths, cycleways and bridleways.

Atkins recently made an ecosystem services assessment of the scheme to build on the figures included in the original business case (Atkins 2017). This identified that, for a cost of £28 million, the scheme would achieve £91.5 million of additional benefits.

An initial qualitative assessment was performed to look at the different ecosystem services achieved through the managed realignment. Food, climate regulation, recreation and tourism, and existence values were taken forward for more detailed quantitative assessment. The other ecosystem services were not taken forward for a range of reasons, with some having already been assessed as part of the business case process. Table 1 indicates which ecosystem services were shown to have made an impact. Table 2 shows the summary values from the quantitative assessment for food, climate regulation, recreation and tourism and existence values.

Table 1: Different ecosystem services achieve through the Medmerry management realignment scheme

Provisioning services	**Impact?**	**Regulatory services**	**Impact?**
Fresh water	x	Air quality regulation	x
Food	✓	Climate regulation	✓
Fibre and fuel	x	Water regulation	✓
Genetic resources	x	Natural hazard regulation	✓
Biochemicals, natural medicines, pharmaceuticals	x	Pest regulation	x
		Disease regulation	x
Ornamental resources	x	Erosion regulation	✓
Water for non-consumptive use	x	Water purification and waste treatment	✓
		Pollination	x
		Noise and light regulation	X
Cultural services	**Impact?**	**Supporting services**	**Impact?**
Cultural heritage	x	Soil formation	✓
Recreation and tourism	✓	Primary production	x
Aesthetic value	✓	Nutrient cycling	✓
Spiritual and religious value	x	Water recycling	✓
Intellectual and scientific, educational	✓	Photosynthesis	✓
Inspiration of art, folklore, architecture etc.	x	Provision of habitat	✓
Existence values	✓		
Social relations	x		

Table 2: Summary values from quantitative assessment

Ecosystem services category	Annual value (£2016)	Present value over 100 years (2016)	% total benefits
Climate regulation	£49,200	£3,222,400	3%
Recreation and Tourism	£210,100	£6,265,900	7%
Existence	£2,781,000	£82,917,000	90%
Food (fish)	£1,700	£50,600	0%
Total	£3,000,000	£92,455,000	

The present value (PV) benefits were then sensitivity tested (Table 3).

Table 3: Summary values from sensitivity test

Sensitivity test	New PV benefits (£2016)	% change in total PV benefits
Use of upper bound visitor estimate (44,000)	£94,252,400	0%
Use of lower bound carbon sequestration value	£95,596,600	1%
Use of upper bound carbon sequestration value	£92,908,200	-1%
Use 25km buffer zone for existence value	£35,662,700	-62%
Use of Woodward and Wui (2001) non-use value	£12,426,200	-87%
Exclusion of existence value	£11,335,700	-90%

The following findings were obtained from the study.

- The most significant benefit is associated with existence (non-use) values, which account for 90% of benefits. There is a high level of uncertainty surrounding this value.

- Fish assessment is also highly uncertain, as the method for scaling up sample data is not robust.
- The assessment method can be replicated for other managed realignment sites where similar habitat and visitor data are available.
- Carbon and fish values are likely to change as habitats develop.
- There is potential for further work to assess health/education/air and water quality benefits.

How much habitat has been created, improved or restored?

A total of 183ha of intertidal habitat and 80ha of transitional grassland was created. By year 100, it is anticipated that there will be 263ha of intertidal habitat due to rising sea levels. Mitigation was also provided for 50ha of freshwater SSSI within and around the realignment area. The areas of created habitat logged in the Environment Agency's Conservation Database for 2013 to 2014 are as follows:

- coastal saltmarsh 130ha
- intertidal mudflat 45ha
- saline lagoon 8.3ha
- reedbed 2.95ha
- coastal and flood plain grazing marsh 41ha
- lowland fen 9.75ha
- lowland meadow 43ha
- pond 1.1ha

Photo 4 shows the perimeter access track alongside new wetland area.

Photo 4: Perimeter access track and new freshwater–brackish wetland landward of new defences (source: Robert Harvey)

8. Maintenance, monitoring and adaptive management

Are maintenance activities planned?

Adjustments have been required to the rock revetment and further maintenance may be needed in future.

New outfall culverts have to be cleaned/maintained.

Ditches require cutting/clearing.

Embankments need to be mowed.

The Environment Agency has leased the land to the RSPB to manage as a nature reserve, mostly on 99 year lease. RSPB has leased much of it to tenants (some of whom are former owners) for conservation grazing and arable use, both landward and seaward of the new sea wall, creating a mosaic of land use and habitat.

Is the project being monitored?

Coastal morphology is monitored by the Channel Coastal Observatory, which has identified radical changes driven by tides and storms. These are in line with predictions but have occurred more quickly than expected.

Sedimentation monitoring by the University of Brighton has shown how the new habitats are highly dynamic in the years immediately following breach of the defences and the ability of the new defences to absorb tidal energy.

Habitats, birds and invertebrates are monitored by RSPB. Saltmarsh plants are colonising the new site and the rate of colonisation depends on nutrient status of the substrate. Important breeding populations of avocet and ringed plover and wintering wildfowl have increased. Water voles have successfully colonised new receptor habitats, as have reptiles.

Fish are monitored by the Inshore Fisheries and Conservation Authority (IFCA), which after 3 years, has found a fish diversity index comparable with long-established sites.

Water voles have been monitored by the University of Brighton and the Manhood Wildlife & Heritage Group.

Archaeological finds continue to be made as a result of erosion at the breach.

Has adaptive management been needed?

Construction had to be modified to take account of ground conditions, material quality and archaeological discoveries.

Adjustments have been required to the rock revetment and further maintenance may be needed in future.

9. Lessons learnt

What was learnt and how could it be applied elsewhere?

- Value of effective stakeholder engagement – external facilitators were used to ensure effective participation by the local community.
- Value of early involvement of conservation partner (RSPB)
- Flood defence and habitat creation can be cost-effectively achieved together in the right circumstances.

10. Bibliography

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Project background

This case study relates to project SC150005 'Working with Natural Flood Management: Evidence Directory'. It was commissioned by Defra and the Environment Agency's Joint Flood and Coastal Erosion Risk Management Research and Development Programme.