Chapter 2
What is Managed Realignment?

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Abstract Many definitions of managed realignment exist. The understanding of what the term actually represents in practice has evolved through time and varies regionally, across sectors and among practitioners. A common understanding of managed realignment is further complicated by the use of other related terms; sometimes synonymous with managed realignment while at other times reflecting different concepts. Terms such as managed retreat, setback, regulated tidal exchange and depoldering have all being used in the literature associated with managed realignment, many times inconsistently. The lack of clarity in the use of terminology has contributed to negative connotations expressed by some stakeholders and the general public. This chapter clarifies the terminology currently in use and proposes a wider definition of managed realignment so it can be applicable to encompass the many forms of implementation adopted worldwide. Within this broader context, managed realignment becomes a general term that can be used to describe collectively the many mechanisms implemented to allow coastlines to evolve more flexibly with the objective of promoting more sustainable flood and erosion risk management.

2.1 Current Definitions

Many definitions of managed realignment exist. The understanding of what the term actually represents in practice has evolved through time and varies regionally, across sectors and among practitioners. A common understanding of the term is further complicated by the use of other related terms; sometimes synonymous with managed realignment while at other times reflecting different concepts. The description that more widely reflects the range of existing definitions (as it indicates different forms of implementation and the associated objectives) is provided below:

> Managed realignment means the deliberate process of realigning river, estuary and/or coastal defences. This may take the form of retreating to higher ground, constructing a setback line of defence, shortening the overall defence length to be maintained, reducing wall

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> or embankment heights or widening a river flood plain. The purpose of managed realignment schemes might be to:
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> - Reduce defence costs by shortening the overall length of defences to be maintained;
> - Increase the efficiency and long term sustainability of flood and coastal defences by recreating river, estuary or coastal habitats and using their flood and storm buffering capacity;
> - Provide other environmental benefits through re-creation of natural habitats; or
> - Provide replacement habitats in or adjacent to a European designated site to compensate for habitat loss as a result of reclamation or coastal squeeze (Defra 2002, p. 1)

This definition has a broad scope in the opening sentence and is not restrictive in the forms managed realignment may take. However, subsequent definitions are more restrictive and explicitly refer to retreat of the shoreline position (i.e. landward realignment of defences), as illustrated by this quote:

> Managed realignment involves the landward movement of a sea defence structure and the promotion of new habitat creation in front of this new line of defence. The land between the old and new defences then forms a new part of the intertidal zone which is more able to respond to coastal processes, and thus reduce the effects of coastal squeeze (French 2004, p. 102).

Through time, the most common understanding of managed realignment became even narrower, including only schemes involving the removal or artificial breaching of flood defences to reinstate tidal flooding into previously defended areas (e.g. French 2006; Wolters et al. 2008; Blackwell et al. 2010; Mossman et al. 2012):

> …managed realignment is a technique which is increasingly used to restore intertidal habitat by the removal or breaching of dikes to restore tidal influence…. (Jacobs et al. 2009, p. 368).

This narrow interpretation has led to the popular perception that managed realignment refers exclusively to the landward realignment of the coastal defences, which sometimes are viewed detrimentally as ‘giving up land to the sea’.

A different perspective is taken by some practitioners, who consider that managed realignment does not necessarily involve flooding of previously defended land. Under this perspective, it is advocated that managed realignment can involve the creation of habitat by advancing the shoreline seawards. Responding to a survey about perceptions of managed realignment (see Chap. 10), a private consultant from east England wrote: “*Please note managed realignment is not necessarily the same as managed retreat. It is about changing or allowing change within the coastal form… forward or backward*”.

The conflicting perceptions about managed realignment and managed retreat result from the inconsistent use of these terms in the literature (see Sect. 2.2). Variations in how managed realignment is interpreted are encouraged by disparities in the definitions presented in Government documents (*cf.* Defra 2002, 2006). The quotation below explicitly refers to realignment of the shoreline forward (i.e. seaward) or backward (i.e. inland), contrasting with other definitions showing a clear focus on concepts of retreat and setback.

> …allowing the shoreline to move backwards or forwards, with management to control or limit movement (such as reducing erosion or building new defences on the landward side of the original defences) (Defra 2006, p. 14).

The understanding that managed realignment involves deliberate alterations to existing coastal defences and, therefore requires planning, is common to all interpretations. It is important to recognise the planning element and the creation of multiple benefits to distinguish managed realignment from other initiatives. In some countries (e.g. France, Spain and Portugal), restoration of coastal habitats is more commonly promoted by the natural failure of abandoned defences than through managed realignment. The rationale for planning how and when defences will be altered are indicated here:

> Managed realignment means the deliberate process of altering flood defences to allow flooding of a presently defended area. Managing this process helps to avoid uncertain outcomes and negative impacts and to maximise the potential benefits. Managed realignment may take many forms, dependent on the reasons for undertaking it…. (Leggett et al. 2004, p. 23)

Realising the wider benefits provided by coastlines that are allowed to evolve more naturally and dynamically is central to the concept of managed realignment and sustainable coastal management. Managed realignment is underpinned by the need to manage coastlines in a more sustainable way. Sustainability here might refer to social, economical, environmental or legal aspects (often a complex mix of these elements). As with other soft engineering approaches, the sustainability of managed realignment is based on the adaptive capacity of dynamically evolving coastal habitats and the natural coastal protection (and other ecosystem services) they offer.

2.2 Confusing Terminology

Regional variations and changes in the preferred use of terms through time (see Sect. 2.2) have resulted in the inconsistent use of the terminology in the literature. The terms most commonly used, sometimes as synonyms of managed realignment, include: managed retreat, setback, de-embankment, depoldering, regulated tide exchange (RTE) and controlled reduced tide (CRT). Note that the spelling of some terms also varies, for example:

> …managed realignment (also known as ‘set back’, ‘managed retreat’, or de-poldering in the Netherlands) (French 2006, p. 409).

> Coastal realignment (or managed retreat) is a soft engineering option that aims at re-creating salt marshes and intertidal mudflats by breaching hard coastal defences…. (Badley and Allcorn 2006, p. 102).

> …managed realignment schemes (also known as de-embankment, de-poldering, set back, wetland mitigation banks, controlled reduced tide (CRT) or flood control area (FCA)) are now in place in many parts of the developed world (Mazik et al. 2010, p. 11).

> The removal of existing flood defences has been variously referred to as managed retreat, managed realignment and habitat creation or restoration, depending on the underlying objectives of the particular scheme. …managed realignment is the form of coastal adaptation that removes a part, or all, of a sea wall in order to allow some additional land area to be subject to tidal action. This may, or may not, require the provision of modified defences, or defences set back on a new line…. (Townend et al. 2010, p. 60).

> Throughout Western Europe and elsewhere, managed realignment schemes (also referred to as depolderisation) are in place…. (Mander et al. 2013, p. 1).

The use of terms is influenced by geographical location and the definition of 'managed realignment' adopted by the author. Although many terms are applied to describe the creation of intertidal areas through artificial restoration of tidal inundation in previously protected land, they are not always recognised as 'managed realignment'. While the term managed realignment is widely used in the UK (and increasingly common in the international literature), it is much less common in other countries.

Outside Europe, managed realignment and its synonyms are not widely used; instead authors may refer to active habitat restoration (e.g. Bowron et al. 2009), tidal hydrology restoration (NOAA 2010) or simply tidal marsh restoration (e.g. Warren et al. 2002; van Proosdij et al. 2010; Brand et al. 2012). However, these terms are not applied exclusively to describe 'managed realignment' projects; it is also used to describe initiatives of habitat restoration purely focused on biodiversity and not related to flood and erosion management.

2.3 Changes in Focus and Terminology Through Time

Pressure from legal requirements to create or enhance intertidal habitat has led to a shift in the focus of managed realignment projects. Initially, sustainable flood risk management seemed to be the primary motivation for managed realignment. However, through time the emphasis has shifted to nature conservation and climate change adaptation. By creating space for coastlines to respond dynamically to changes in environmental conditions, management realignment helps reinstating the natural adaptive capacity of coastal habitats. Therefore, managed realignment is increasingly used as a key mechanism for the restoration of intertidal habitats (e.g. Jacobs et al. 2009) driven by strategic and legislative needs to adapt to sea-level rise, and to compensate for loss and degradation of natural habitats and wildlife.

> Setting back the defences and restoring coastal habitats, known as 'managed realignment', is an important adaptation to rising sea levels. Managed realignment gives coastal habitats space to migrate inland as sea levels rise (Committee on Climate Change 2013, p. 93).

In the UK, the strong emphasis on environmental objectives has created a negative public perception. Public reaction reflects the views that interests and safety of local people and communities are now second to habitat creation, as indicated by the following statements given to the academic survey described in Esteves and Thomas (2014):

> A useful tool has become a plaything for environmentalists (stakeholder from east England, on 1 Aug 2013).
>
> this realignment for the birds, is barmy… (member of the public from east England, on 1 Aug 2013).
>
> Madness!! when we have starving people in the world and we want to flood productive land! (Farmer from east England, on 2 Aug 2013).
>
> …why do various so called environmentalists think that they can 'play God' in deciding that land that is home to a huge variety of land animals, plants and crops, insects and birds is all of a sudden flooded for some wading birds! (Stakeholder from east England, on 2 Aug 2013).
>
> …most sites today, however conceived, will ultimately look like nature conservation sites for birds. This image puts many farmers off, and even causes antagonism (Consultant from south England, on 7 Aug 2013).
>
> …too much emphasis is on habitat creation only approaches and this constrains the opportunities for more societal benefits and sometimes stops projects progressing as it is seen as people v birds. …The approach needs to be remarketed and 'sold' more effectively … so that landowners and the coastal communities want it rather than assuming …it's a bad thing/giving up to the sea (government practitioner from east England, on 6 Aug 2013).

In an attempt to disentangle negative connotations associated with managed realignment, the terminology used by government and practitioners in the UK has evolved through time. Managed retreat and setback were commonly used in earlier documents, but have gradually fallen in disuse for being interpreted as 'giving up land to the sea'. This interpretation was perceived as a government failure or slackness in providing protection against flooding and erosion, as evidenced in the literature:

> …managed realignment... may also be referred to as managed retreat or set back. Increasingly, the term managed retreat is going out of favour as it suggests a negativity in coastal management, 'retreating in the face of the enemy (sea)' which many coastal managers and coastal residents find unacceptable (French 2001, p. 271).
>
> The restoration of tidal wetlands in the United Kingdom was initially referred to as "setback," a pejorative phrase that was rapidly changed, first to "managed retreat" but that is now officially termed "managed realignment" (Pethick 2002, p. 431).

In many locations worldwide, hard engineering has been the type of coastal defence most people expect. Therefore, managed realignment represents a shift from the *status quo*. How people react to change in general depends on the potential threats it might bring to the individual and collective way of life, how and from whom they learn about the change and their level and type of engagement (e.g. Lorenzone et al. 2007; Pidgeon et al. 2008; O'Neill and Nicholson-Cole 2009; Hobson and Niemeyer 2011).

It is much harder for people to accept change if their initial perception is associated with a negative impact or connotation. In the case of government policies, for example, it is important that a clear and consistent message is used to explain the changes they might bring to individuals and society. As importantly, the terminology associated with new policies must be carefully considered to reduce the chances of undesirable interpretations.

The lack of a clear understanding about the definition of terms, policy drivers and outcomes can lead to avoidable misunderstandings among practitioners, researchers and, particularly, the public. 'Negative' terminology is thought to have caused such an impact on the wider perception of managed realignment in the UK that once again the government is assessing whether a new term should be used (see Chap. 8). Therefore, it is possible that managed realignment will be substituted by a new term in future documents.

2.4 Clarifying the Terminology

De-embankment and depolderisation[1] are used, especially in northern Europe, to describe total or partial removal (breaching) of flood defences to create intertidal areas in previously embanked land (e.g. Rupp-Armstrong and Nicholls 2007; Mander et al. 2013). Note that in France[2], term *dépoldériser* is similarly used (e.g. Goeldner-Gianella 2007). De-embankment sometimes refers also to accidental or unplanned breaching of flood defences (e.g. during storms) and adjectives such as 'deliberate' de-embankment might be used to differentiate (e.g. Wolters et al. 2005).

Setback is used as a synonym of managed realignment only by few authors (e.g. French 2006; Ducrotoy and Elliott 2006; Mazik et al. 2010). The term is said to have fallen into disuse owing to its negative connotations (e.g. French 2001; Elliott and Cutts 2004). In the context of managed realignment, setback means realignment of the defence line to an inland position. However, in the literature the term setback most commonly refers to construction control zoning to keep buildings and people away from hazard zones (e.g. Sanò et al. 2011; Portman et al. 2012; Ramsay et al. 2012; Abbott 2013; Mycoo 2013; Reisinger et al. 2014).

Setback lines or areas indicate the minimum distance from the shoreline new development must be built (Fig. 2.1), which can be defined based on fixed distance from a selected shoreline proxy (e.g. high water line, cliff edge, dune toe), historic erosion rates or the extent of extreme flooding. For example, the Article 8-2 of the Mediterranean Integrated Coastal Zone Management Protocol[3] (signed in 2008) establishes that signatory countries should create a setback zone of at least 100 m in width from the highest winter waterline where no constructions are allowed. In Hawaii, the shoreline setback is determined based on the likely shoreline retreat to occur during the life-time of the building (see Chap. 7). Shoreline setback is often implemented as a mechanism to support managed retreat, as illustrated in Chap. 7.

[1] Low-lying areas, reclaimed from the sea and protected by embankments are called *polders*, a word of Dutch origin commonly used in northern Europe.

[2] See, for example, the debate and documents about the project at Hable d' Ault, at the coast of Picardy at: http://www.baiedesomme.org/actu/hable-dault-depolderiser-or-not-depolderiser-424.html.

[3] The text of the protocol and other associated documents are available from: http://www.pap-thecoastcentre.org/itl_public.php?public_id=365&lang=en.

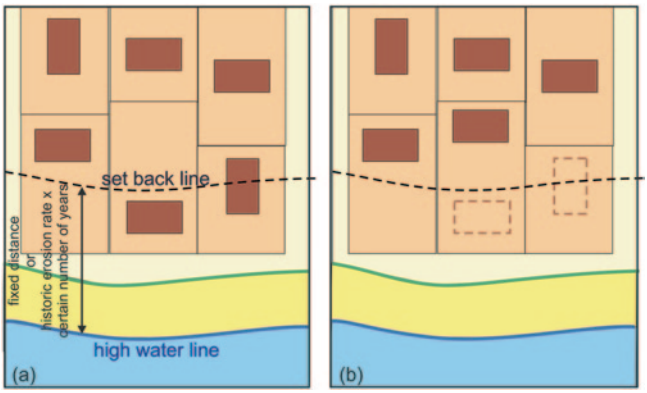

Fig. 2.1 (**a**) A setback line defines an area where constructions are not allowed with the aim to safeguard people and property from erosion and/or flooding. (**b**) If buildings placed seaward of the setback line need to be re-developed (e.g. due to impact of storms), this must only be permitted inland of the setback line, within the same land lot, if space is available, or elsewhere

Managed retreat and managed realignment are used interchangeably in the UK (e.g. Emmerson et al. 1997; Chang et al. 1998; Macleod et al. 1999; French 2001; Pethick 2002; Cooper 2003), more commonly in the literature pre-dating the publication of the policy *Making Space for Water* (Defra 2005). Elsewhere, such as in Spain (Roca et al. 2008), the USA (Siders 2013), Australia (Alexander et al. 2012) and New Zealand (Turbott and Stuart 2007; Reisinger et al. 2014), managed retreat most often refers to the relocation of property at risk and/or allowing the shoreline to move more dynamically (e.g. Jackson and Nordstrom 2013).

> Managed retreat—the relocation of homes and infrastructure under threat from coastal flooding—is one of the few policy options available for coastal communities facing long-term risks from accelerated sea level rise. (Alexander et al. 2012, p. 409)

> Retreat, which works with natural dynamics and leaves more space for water and sediment. Infrastructures are removed and land uses can be abandoned. (Roca et al. 2008, p. 406)

Regulated tidal exchange (RTE) is a term used to describe projects of habitat restoration where a controlled tidal flow (extent and duration) is reinstated into embanked areas through culverts and sluices. This approach is widely used worldwide but the term RTE is most commonly used in Europe. In France, for example, RTE was implemented in 1999 to reinstate tidal flows into the 132 ha of the Polder de Sébastopol, Île de Noirmoutier, Vendée (Fig. 2.2). The area was purchased by the local government in 1986 and a project of nature restoration was started in 1996 to re-create intertidal habitats for the protection of birds. In 2008 the area was designated as Regional Natural Reserve[4] of the Pays de la Loire region.

[4] Information about the Regional Nature Reserve is available at: http://www.reserves-naturelles.org/polder-de-sebastopol.

Fig. 2.2 The Polder de Sébastopol (Vendée, France), reclaimed from the sea in 1856, had tidal flows restored into the embanked area through regulated tidal exchange implemented in 1999 (photo: Jacques Oudin, courtesy of Communauté de Communes de île de Noirmoutier)

As RTE sites will still be protected from wave impact by the flood defence, and tidal flow is controlled, sediment deposition is enhanced thereby maximising the chances for saltmarsh development, especially at low-lying locations (Nottage and Robertson 2005). Culverts can be designed to reduce the flooding height at sites with a low elevation, but the spring-neap variation in water level tends to be greatly reduced, limiting the restoration of the full spectrum of intertidal gradient (Beauchard et al. 2011). In some instances, RTE schemes are excluded from analyses of managed realignment projects (e.g. Rupp-Armstrong and Nicholls 2007; Esteves 2013), while in other cases, although differences are recognised, RTE is considered a form of managed realignment:

> regulated tidal exchange (RTE)… differs from managed realignment in that tidal flooding enters the site through tidal gates or sluices, leaving the sea wall intact (hereafter RTE sites are included as [managed realignment]) (Mossman et al. 2012, p. 1447).

Flood control areas (FCAs) are, in essence, spaces used to 'store' overflow waters with the objective of reducing the risk of flooding elsewhere. Floodplains and coastal plains naturally have the function of flood control; however, development has greatly reduced this natural capacity. Areas that once contributed to flood risk reduction have since lost their capacity to do so and now require protection from flooding themselves. FCAs are designed to create a high storage-capacity to contain floodwater in relatively small areas. Often, FCAs are enclosed by flood defences, which usually have lower embankments or dykes in the section fronting the river

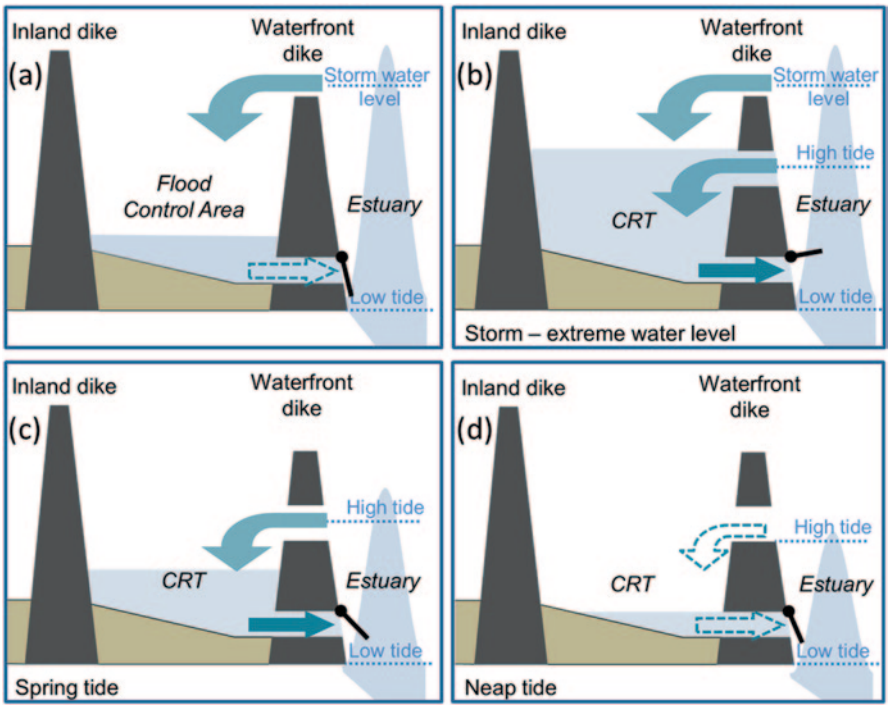

Fig. 2.3 (**a**) Diagram representing the water flow exchange within flood control areas and control reduced tide schemes, (**b**) during storm water levels, (**c**) spring tides and (**d**) neap tides. Depending on the water level, the water enters the site through the upper culvert and/or over the waterfront dike. The water leaves the site through the lower culvert (controlled by an outlet valve) when water level outside is below the water level within the site (Modified from: (**a**) Cox et al. (2006) and (**b**–**d**) Beauchard et al. (2011) and Beauchard (2012))

or coast and higher dykes elsewhere (Cox et al. 2006). During high water events (e.g. river overflow, storm surges), water overflowing from the lower waterfront defences is contained by the higher inland defences (Fig. 2.3a) thereby reducing the risk of flooding further inland and/or upstream (Meire et al. 2005).

Although managed realignment creates space and enhances the capacity for natural flood control, FCAs *per se* do not necessarily represent a mechanism of managed realignment and the term is rarely used in this context. The frequency of flooding in FCAs may be only once or twice a year depending on extreme weather events and therefore the chances for development of intertidal habitat is limited (Cox et al. 2006). Exceptions occur when FCAs are managed to enhance opportunities for the delivery of other benefits through the development of intertidal habitats as currently practiced in Belgium.

Controlled reduced tide (CRT) is an approach similar to RTE, more widely applied in Belgium to describe the use of carefully designed sluices to control tidal flows within FCAs with the objective of promoting intertidal habitat development (Cox et al. 2006; Maris et al. 2007; Jacobs et al. 2009; Vandenbruwaene et al. 2011;

Beauchard et al. 2011; Beauchard et al. 2013). In CRT schemes, as the inland flood defences will still limit the inland progression of the highest water levels, it is the landward edge of intertidal habitats, not the flood defence, line that is realigned.

In a CRT, the water enters the FCA through an inlet culvert built high in the flood defence and flows out of the FCA through an outlet culvert placed lower in the embankment (Cox et al. 2006; Maris et al. 2007; Beauchard et al. 2011), as shown in Fig. 2.1. During storm high water conditions (Fig. 2.3b), the area can work as an enhanced FCA as a larger volume of water can enter the site through the upper culvert and overflow of the waterfront embankment. The lower culvert allows draining of the site when the water level outside is below the water level inside.

This design creates an internal tidal regime that maintains a spring-neap variation (Fig. 2.3c), which can be modulated based on habitat restoration objectives (Beauchard et al. 2011). Inundation depths tend to be reduced and durations increased in comparison with adjacent tidal marsh areas (Cox et al. 2006; Maris et al. 2007). This altered tidal regime allows marshes to develop on land with elevations much lower than would be possible under a normal tidal regime (Beauchard et al. 2011; Vandenbruwaene et al. 2011).

It is evident now that in the literature, many terms have been associated with managed realignment and the context in which they are used is not always clear. The inconsistent use of the terminology has caused confusion, especially when terms are used interchangeably on some occasions, and reflect different meanings on others. To facilitate wider understanding and stimulate consistency in the use of terminology, it is suggested here that the term managed realignment is applied more broadly to indicate a group of approaches that can be implemented to create opportunities for coasts to evolve more dynamically and be managed more sustainably. A revised definition for managed realignment is suggested in the next section.

2.5 Proposing a New Definition

Taking into consideration the various definitions and aspects influencing the general understanding of managed realignment, a less prescriptive but more widely applicable definition may be: managed realignment is a soft engineering approach aiming to promote (socio-economic, environmental and legal) sustainability of coastal erosion and flood risk management by creating opportunities for the realisation of the wider benefits provided by the natural adaptive capacity of coastlines that are allowed to respond more dynamically to environmental change. Therefore, *'managed'* refers to take purposefully actions, to plan, implement and monitor projects; and *'realignment'* refers to the position of the shoreline and/or the line of defences.

Within this broader context, managed realignment becomes a general term that can be used to describe collectively the many mechanisms implemented to allow coastlines to evolve more flexibly. In this regard, creating space for enhancing the adaptive capacity of coastlines can be achieved by either landward or seaward shoreline realignment. Chapter 3 describes five categories of methods that can be

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