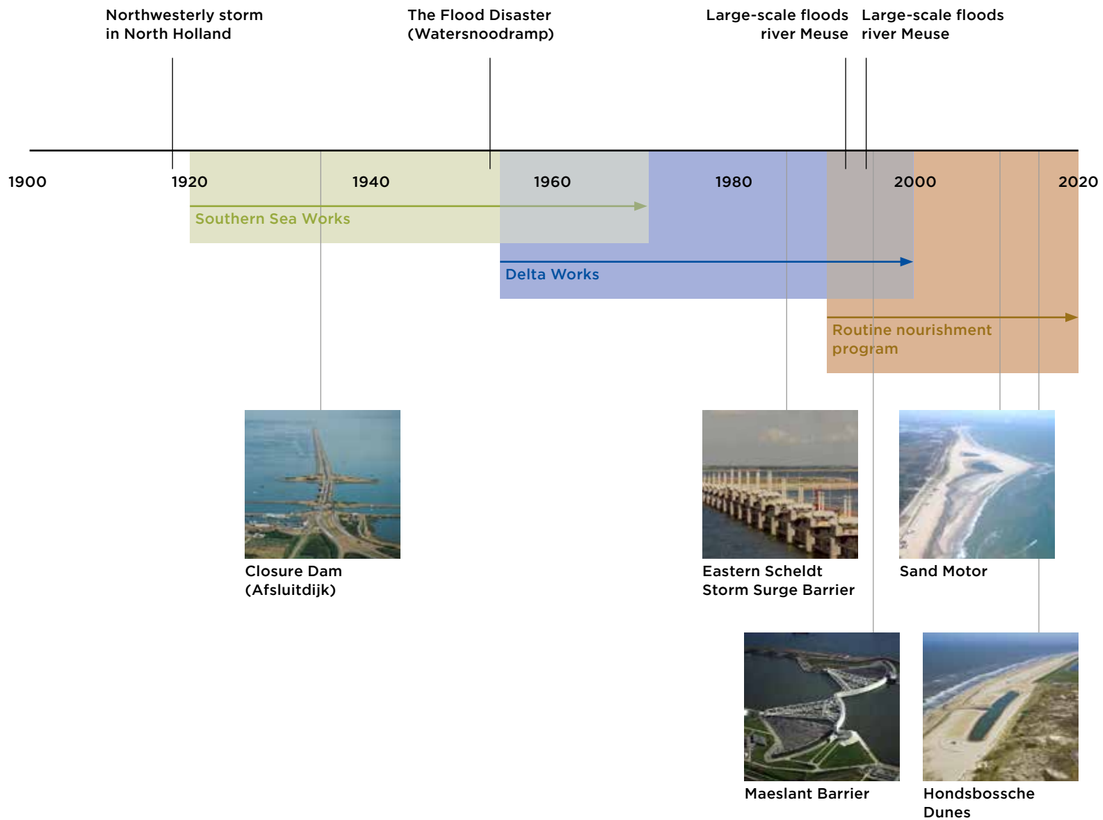
Figure 1.
Timeline of Dutch flood risk management in the 20th century. (Photo credits: Eastern Scheldt, Closure Dam and Maeslant Barrier: beeldbank.rws.nl; Sand Motor: Rijkswaterstaat, Joop van Houdt; Hondsbossche Dunes: Boskalis)



Ewert Aukes

THE SOCIAL AND INSTITUTIONAL CONTEXT OF THE SAND MOTOR

Dutch coastal management history
Historically, socio-economic activities in the Netherlands have been mainly concentrated in the estuaries of the Rhine and Meuse rivers. The urban sprawl resulting from this activity is currently the home to a large share of the Dutch economic productivity, not to mention its population. In an area so close to the North Sea and with such socio-economic importance, coastal protection is a prime requirement. For centuries, the general principle of coastal protection in the Netherlands was building embankments to protect areas in danger of flooding from the sea.

Relying on embankments for coastal management continued in the 20th century (Figure 1). The last large-scale coastal management program in the Netherlands that relied primarily on embankments, were the *Zuiderzeewerken* (Southern Sea Works). As a result, embankments were built and fortified, as protection against nature. Necessitated by major flooding in 1916, this program intended to reduce the coastline of the Netherlands by closing off the *Zuiderzee*, which was subsequently called the *IJsselmeer* (Lake IJssel). Reducing the coastline would simplify maintenance of coastal protection works and decrease the protection needs in closed-off regions. Among other things, the *Zuiderzeewerken* included the construction of the *Afsluitdijk* (Closure Dam), a 32.5 km long causeway through the Wadden Sea connecting the Dutch provinces of Friesland and North Holland. With a main aim of coastal protection, the Southern Sea Works can be viewed as a monofunctional project. Limiting the coastal protection program to monofunctionality was possible, because the flood events triggered a heightened sense of urgency, while population pressure was still low in the first half of the 20th century.

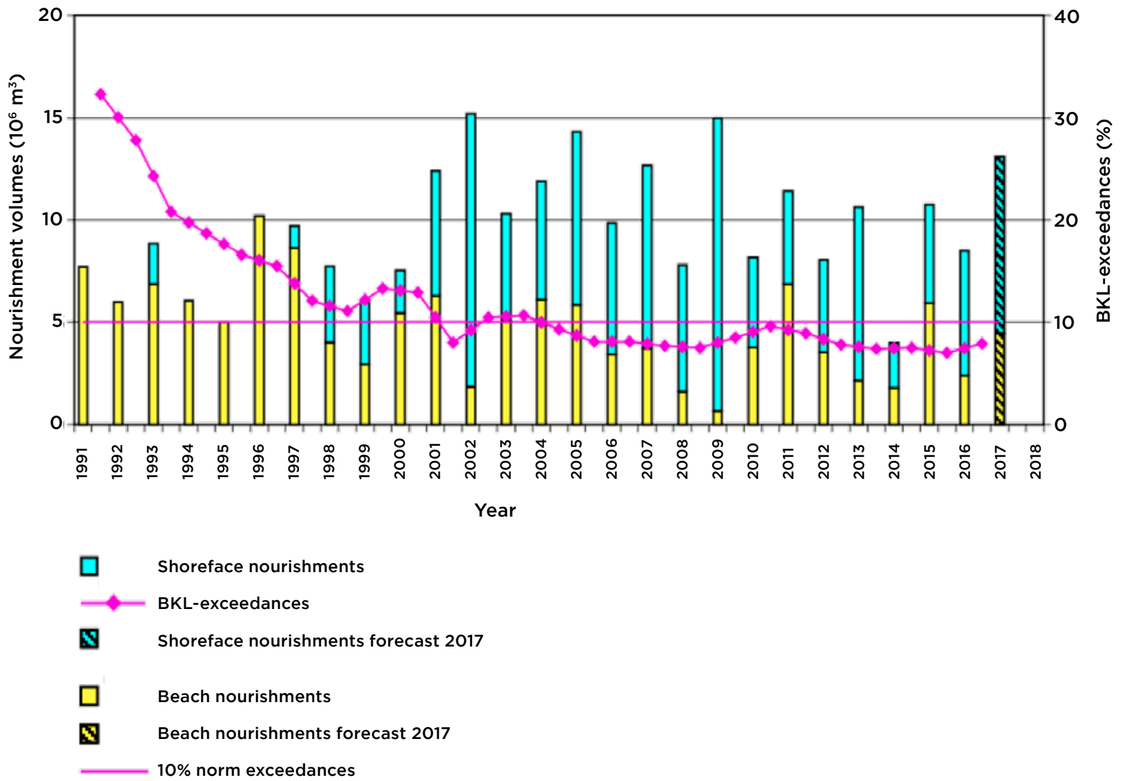
In 1953, the southwest of the Netherlands was struck by another major flood event: a Northwesterly storm combined with spring tide. Embankments in different places succumbed to the ferocity of the storm. As a result, 1,800 inhabitants perished and economic damage was high. The disaster came to be known as *De Watersnoodramp* (The Flood Disaster) and is a pivotal event in modern Dutch history. In the wake of the storm, the Dutch government convened a commission of high-ranking coastal management and civil engineering experts to draft a strategic plan to prevent a similar disaster from ever happening again. This so-called First Delta Committee Plan came to be known as the *Deltaplan*. It proposed closing off additional inland waters utilizing newly available steel-and-concrete engineering technology. Again, these structures were to be built *against* nature and serve the sole function of coastal protection.

Meanwhile, the Netherlands experienced rapid urbanization and population growth. As a result, competition grew among land uses in the increasingly crowded coastal areas. Coastal management could no longer focus exclusively on coastal protection. New ways of integrating land-use functions needed to be explored, sparking interest in land reclamation and integrated policies. From the 1980s onward, the effects of climate change, such as rising sea levels, further complicated the situation. These developments coincided with growing knowledge of ecosystems and their contributions to human wellbeing. Innovations in dredging technologies enabled sand dredging and nourishing beaches on an unprecedented scale. Gradually, a transition began towards more nature-friendly solutions in coastal management. Starting in 1990, *Rijkswaterstaat*, the Public Works Agency of the Ministry of Infrastructure and Water Management began maintaining a reference coastline, based on the Dutch coastline at that time. Annual, small-scale foreshore or beach nourishments became the new standard approach to maintain this *Basiskustlijn* (BKL; reference coastline, brown color in Figure 1).

In the 2000s, multifunctional space was still in high demand. By now, Dutch coastal managers had acquired considerable experience with beach nourishment. A combination of nourishment technology and Building *with* Nature was proposed. This spatial planning philosophy marked a subtle transition from aiming for one function to attempting to include as many functions as possible, moving from monofunctional to multifunctional land use. Building with Nature promotes an ecosystem perspective; not only minimizing ecological damage, but also developing nature and using natural processes for societal aims.

A pilot project was proposed that would experiment with many functions at once. And thus, the idea for a Sand Motor, in some ways a scaled-up version of previous nourishments, was born. The Sand Motor was designed to utilize natural North Sea currents. In that way, it would serve coastal protection on location and, by deliberate erosion and re-sedimentation, at other locations as well. In addition, the Sand Motor provided opportunities for developing nature, recreation and leisure opportunities, as well as promoting economic productivity. The Sand Motor is arguably the first

Figure 2.
Annual sand nourishment volumes in the Netherlands since 1991; the 21.5 million m³ of the Sand Motor is not included in the graph. (Figure by Rijkswaterstaat)



large-scale Building with Nature design put into practice.

It is no surprise that the Sand Motor was developed in the province of South Holland. This province is home to a large part of the urban conglomerate known as the *Randstad*, and the province is faced with significant spatial problems associated with population density. At the time, leisure areas for inhabitants of the growing cities were becoming scarcer. The European Natura2000 legislation required construction projects to include nature compensation, which was becoming more and more difficult to achieve. The Sand Motor offered an opportunity to innovate with spatial policies, and the provincial government seized this opportunity with both hands.

The arena of Dutch coastal management

The overall Dutch coastal management ambitions were stated in the 2009 National Water Plan. First, the coastal foundation is to grow proportionally to sea-level rise. Second, this process is to be stimulated using sand and the natural dispersal of this sand along the coast. Third, in addition to coastal protection, coastal management should focus on a balanced development of nature, economy and recreation.

The 2009 Water Act remains the main water and coastal management policy in the Netherlands. It relates water management to other policy areas, such as nature, environment and spatial planning. The Water Act distinguishes two water authorities. Water authorities manage coasts within their territory, while the State deals with coastal issues that overlap the boundaries of the water authorities. Water authorities have the task of planning, building and maintaining regional coastal management projects, as long as the coastal stretch in question is not a primary defense structure. The national government defines strategic policy and manages supra-regional defense structures.

Rijkswaterstaat is the national executive agency entrusted with the coastal management program. This has been in place since the formulation of a reference coastline in 1990, beyond which the Dutch coastline is not supposed to erode. *Rijkswaterstaat* performs annual inspections of the coastline, leading to nourishment activities, where necessary. Every four years, *Rijkswaterstaat* compiles a long-range nourishment plan, with an annual budget of 12 million m³ sand for immediate nourishment (Figure 2). *Rijkswaterstaat* also oversees applications for integrated water permits, which have to be requested when flood defense structures are constructed or modified. Such projects also need an environmental impact assessment, which evaluates the environmental impact of a preferred solution and compares it to alternative solutions.

Under the Water Act, provincial governments are not considered as water authorities. Nevertheless, they are thoroughly involved in water management, supervising regional water authorities and municipalities and coordinating their activities. Provincial governments have a significant influence on the coastal management process thanks to their role of approving project plans.

Like provincial governments, municipalities do not officially count as water authorities, although they do have certain water management tasks unrelated to coastal management. Although they are not responsible for coastal safety and spatial planning, municipalities are responsible for zoning plans. In the zoning process, other actors who might be affected by coastal management – such as drinking water companies, nature NGOs or knowledge institutes – can influence the decision-making process through the general public participation mechanisms in place. For example, final project plans have to be available to the public at the competent authority, where they can be inspected by everyone.

Besides these annual and multi-annual coastal management activities, the national Delta program is in place to guarantee long-term safety from flooding. The Second Delta committee established this long-term program in its final report in 2008, entitled *"Samen werken met water"* ("Working together with water"). The Second Delta committee advocates a coastal management approach that ensures long-term flood protection and freshwater management strategies.

Although this legal and political structure represents the legal blueprint for coastal management projects, this is certainly not the only way such projects can be organized. While non-experimental projects are generally initiated and managed by water authorities under the Water Act, experimental projects can be carried out by actors who are not water authorities, as was the case with the Sand Motor.