

THE SAND ENGINE – A SUSTAINABLE COASTAL APPENDIX

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What is the Sand Engine

The Sand Engine is an innovative pilot project aimed at protecting the Dutch sandy shores. Along the Delfland coast of the province South Holland, a mega nourishment has taken place, creating a large hook shaped barrier above water perpendicular to the Dutch coast. This peninsula is 128 hectares large and consists of 25 million m³ sand and is an alternative to the common Dutch technique of coastal protection by underwater foreshore nourishment each 5 years. By using natural tidal and wave action, the sand is being distributed along the adjacent coast. Thereby the Sand Engine works according to the principles of 'Building with Nature'. This principle aims at developing sustainable ways of ecologically sustainable coastal zone management in combination with economic profitability.

Goals monitoring

Due to the unique and experimental character of this project, it is the aim to scout the effects of the Sand Engine on its direct surroundings. To closely follow the natural development of the Sand Engine and the near-field effects, a monitoring and evaluation program was developed for at least the next 5 years. This program is currently being carried out in a consortium of various research institutes and consultancy organizations.

The creation of the Sand Engine has four main goals:

1. Stimulating natural growth of dunes in the coastal area of Hook of Holland to Scheveningen for safety, natural and recreational purposes.
2. Generating knowledge and innovation to assess the additional natural and recreational value of this method of coastal protection.
3. Adding an attractive recreational and natural area to the Delfland coast.
4. Collecting enough and adequate information to properly manage the Sand Engine and its surroundings.

Why monitoring the Sand Engine?

Goal of collecting Sand Engine data is to learn about the functionality of mega nourishments in general, to explore the opportunities for future projects.

Creating a large sand barrier perpendicular to a concave coastline will strongly change local currents and wave action, and result in a transport of sand from the Sand Engine along the coast. This is expected to enhance coastal protection. The Sand Engine has been designed to slowly move in northern direction, with in its centre a sheltered lagoon that will eventually be filled up by sand due to wind, waves and current. Thereby the two most important subjects of research are the speed of change and the effect range of the Sand Engine.

As a result of this moving sand barrier, natural habitats and processes in the local area change dramatically. This may also occur in the dunes. The Sand Engine area already is a regular home to shorebirds and common seals. In the early life of the lagoon, a harbor porpoise has been sighted. The lagoon and the sheltered area of the hook are also expected to be an interesting area for benthos and juvenile fish (nursery function). On the Sand Engine itself dune forming may take place, and it is expected that the increased

aerial sand transport influences dune morphodynamics and the development of vegetation.

For the dunes all data will be analysed to answer the central question: "Does the Sand Engine affect protected nature in the Solleveld dune area in a negative way and can these possible effects be prevented or mitigated?" In the existing dunes effects are expected from an increase in sand deposit, whereas salt spray will probably decrease. This can lead to changes in the delicate dune habitats, which are protected by the Habitat Directive (European legislation).

What do we monitor about the Sand Engine?

Data are collected from measurements on local hydrodynamics, morphological developments of the foreshore, the beach and the dunes, including the Sand Engine itself. Data of the changes in vegetation and fauna, both under water and on the beach and dunes is collected. Where is the erosion most severe? And where is the sand deposited? How does the wild life react? What is the effect on the sea bottom? Will there be more or less foraging biotopes? Will the lagoon act as a nursery? But also: are there more possibilities for recreation?

Data is stored in an especially for this project designed data management system, able to cope with data from different sources and making it available for analysis and evaluation.

Next to the hydrological, morphological and ecological developments, also changes in groundwater level and quality and recreational use of the area is followed.

The dunes further inland contain precious vegetation and wild life. It is protected via Natura 2000, the European network of nature preservations. Even though it is thought that the Sand Engine is a sustainable way of protecting the coast, with unique beach nature and beach processes as a result, deterioration of nature elsewhere is unwanted. Therefore the dune area monitoring contains morphological and ecological parameters, such as sand dynamics, wind energy, salt spray, sand spray, the increase of ground water influences, change in vegetation, habitat development and breeding birds. We study these parameters to decide in five years what kind of effect results from the Sand Engine. To learn more about the ecological and geomorphological processes and to evaluate if mega-nourishments are a good as sustainable solution to protect coast lines from eroding. But also for knowing if we should protect vulnerable dune nature against artificial impacts.

What do the parameters tell about the Sand Engine?

The monitoring and evaluation program is directed at answering to what extent the goals above will be reached. With the formulation of such abstract goals, it is of importance that the studies are focused at answering more specific hypotheses. This problem analysis has been carried out to large extent before commencement of the monitoring. The power of the data to give these answers is largely influenced by the spatial and temporal planning of the monitoring operation. However, the power of a sampling scheme is not easy to assess when the variability of the system under scrutiny is not well known.

From start on, the available budget was too limited for applying the desired monitoring scheme. Currently, the emphasis lies on monitoring of hydro dynamical and morphological changes and less on ecological changes. Recently, the program has received additional European funding to increase the quality of monitoring. The Technical University of Delft also has received funding, which will be used to study morphological changes along the coastal area around the Sand Engine. Lastly, a consortium of universities and research institutes have tendered for a project that, if funded, will start a large project studying the natural changes of the Sand Engine in more detail.

How well the monitoring and research programs are able to answer to what extent the above goals will be reached is unknown. There are no clear criteria formulated for where and when such abstract goals are reached. This is a process that can only be started when data become available. Adaptive monitoring may be needed when circumstances change or when the data appear not to give the expected answers. The additionally obtained

funding will be able to pay for a certain level of adaptation in monitoring and of evaluation.

After one year, monitoring showed already obvious changes to the morphology of the Sand Engine; the speed of movement along the coast to the North is dramatic. It is hard to estimate the life expectancy of this barrier, but it appears to be shorter than expected.