Building with Nature Design Assignment

Case Title & Location:

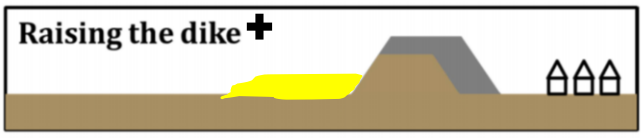
Coastal Protection along the North Holland coast between Camperduin and Petten

Functional Requirements (list at least 4):

- Prevent flooding and coastal erosion
- Maintain the flood protection level
- Net conservation and/or restoration of the existing ecosystems
- Provide opportunities for the ecosystem
- Increase the recreational space and its quality along the coast

Design Sketches:

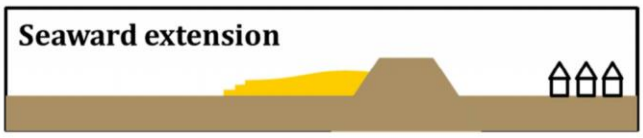
Situation and conventional solution (annotated):



This solution also requires dike heightening and broadening of the base of the dike. Investigations of the strength of the dike core would also be needed, given that it is a very old dike. High costs are associated with this approach. Some houses / properties would be affected and there would be conflicts with the protected dune areas.

In order to strengthen the dike further, sand deposits or “nourishments” for the coast are added, implemented by dredgers in a two to three year interval, each time in a slightly different part of the coast. However, the reoccurring nourishment has a minimal effect, can only be seen as a rather aesthetic try to make look like natural. In fact, such measure would never allow for the establishment of a local ecosystem along the dike.

BwN design (annotated sketch, indicating anticipated changes over time):



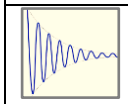
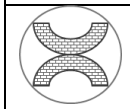
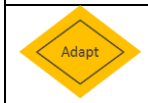
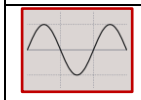
This alternative involves seaward broadening of the dike with a dune field. With this measure the existing dike is retained, but the sharp transition from the dunes to the south to the Hondsbossche-Pettermer Zeewiering is smoothed. This smoothing of the coastline near the weak point is expected to address the problem of concentration of wave energy at the transition point, and so also reduce coastline maintenance requirements.

The design proposal includes a deposit of 10 years' worth of sand at once for giving the local ecosystem enough time to recover. The predominant wave direction is south-westerly and there's a net northward transport of one million cubic meters of sediment per annum, i.e. that means that sand is moving backwards and forward and cross shore, but the residual transport is northward. In other words: Without continuous sand nourishment the coastline will retreat backwards. A deposit with a volume of about ten million cubic meters of sand is needed to cover for ten years.

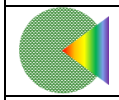
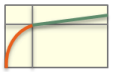
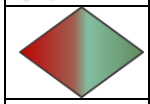
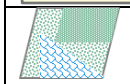
There is a strategic environmental decision regarding sand mining from the seabed on the Dutch continental shelf. Particular areas are designated for sand mining, and there are prescriptions on the manner in which this is undertaken. So there are no practical limitations on the availability of sand.
A quite southern located nourishment is suggested so that the region can benefit from it for as long as possible. A varied naturally hilly shaped peninsula is suggested in terms of shape for the initial design where areas of low water level for some estuarine and freshwater tolerant species could take turn with higher sandy areas encouraging the dynamic transport of sand and the formation of embryonic dunes.

Over time the sand will smooth out along the coast, and it should look something like this in about ten years.

Consider the following principles, then rate (with an X in 1 of the 5 boxes) the extent to which you have taken this principle into account in your new design (remember, this is an exercise in trade-offs, so you will not be able to meet every principle fully). Then explain why you have rated your design accordingly.

Engineering principles		Checkboxes Minimum - Maximum					Explanation
	1. Requisite standard				X		The flood protection standard will be met, and by nourishing the coast with 10 years' worth of sand, additional safety will be added.
	2. Control variability		X				Coastal erosion is combatted but not totally controlled, except for the parts where the dike still holds.
	3. Reasonable costs			X			The cost per cubic meter of sand is lower because of the huge volume but the full cost of 10 years of sand nourishment occurs at once which is double or triple the costs of the 3-5 year nourishment solution.
	4. Structural integrity					X	The issue of structural integrity is accommodated by using a natural sand body and its processes to combat erosion and for coastal defence in addition to the remains of a conventional dike.
	5. Reliability			X			By providing natural material and using natural processes, the new coast should continue to function with limited maintenance. Some intervention might be needed if some of the currents are too strong.
	6. Implementability				X		Having experience with quite a similar project, the Sand Engine, mean that one could rely on the fact that the project can be constructed.
	7. Adaptability				X		The design explicitly considers future needs, taking 10 years as its time horizon.
	8. Resilience					X	The entire design of the coastal protection is based on this principle. By nourishing the beach with a large volume of sand, there is sufficient sediment in the coastal profile to respond effectively to a series of storm events.
	9. Appropriate boundary conditions and loads				X		Based on the Sand Engine, a range of representative wave conditions was used in 3D model runs in the testing phase of the design. In addition, the prescribed Dutch boundary conditions for coastal safety testing were also applied.

As before, consider the following ecological principles and rate the extent to which you have taken this principle into account in your new design, then provide an explanation.

Ecological principles		Check boxes Minimum - Maximum					Explanation
	Continuity				X		The project enhances water and sediment flows and provides more gradual transitions between land and water on the seaward side of the dike.
	No direct human disturbance			X			The proposal reduces the disturbance by recurrent sand nourishment but the new area will attract local people as well as tourists.
	Indigenousness / Endogeneity				X		While the project is providing new physical habitats, there is no precise knowledge which species will colonize which habitat.
	Viability of populations			X			Only through monitoring can its contribution to the viability of populations be determined.
	Opportunity for threathened species					X	It provides opportunity for threatened species, such as the sand Lizard (Lacerta agilis) which is red listed in the Netherlands.
	Trophic web integrity			X			The influence on trophic web integrity will have to be determined through monitoring.
	Opportunity for ecological succession					X	It also facilitates the emergence of pioneer ecosystem stages
	Zone integrity				X		Less abrupt land-water transitions; uninterrupted natural processes towards the northern and southern natural dune landscapes, the Natura 2000 protected area as well as until the edge of the dike.
	Characteristic (in)organic cycles			X			Because the sand deposited by the project derives from the bottom of the North Sea, its chemical composition and interaction with the atmosphere could cause unexpected effects. Needs to be monitored.
	Characteristic physical-chemical water quality			X			The silt content of the deposited sediment may be higher of that of the ambient sediment. Reactions need to be monitored.
	Resilience					X	By reducing the frequency of sediment nourishment, the ecosystem can recover and can potentially achieve dynamic equilibrium. This means that the resilience of the ecosystem is potentially substantially enhanced.

Monitoring and Risk assessment

In a short paragraph, discuss any future monitoring and risk assessment required for your Building with Nature design.

The North Holland coast has many naturally occurring dunes and is strongly influenced by the wind and waves. This sea defense has an extended history of multiple dike upgrades, and further dike heightening is not desirable.

A safe design for the next 50 years (without dike heightening) is a challenging task that requires knowledge on how nature will affect your design. The effects of some natural processes are easier to predict than others, but many are still uncertain or even unknown.

Besides routine coastal monitoring with regard to flood protection and erosion prevention, specialized ecological monitoring is needed due to the uncertain nature of the project performance over time and space.

On the human level, recreational uses as well as perspectives on spatial qualities need to be monitored.

Additionally, experience from the Sand Engine and other interventions along the coast needs to be taken into assessment, as well as currents and water quality.

Trade-offs

Comment on any trade-offs you made in order to introduce more ecological principles. In other words, describe how your Building with Nature sketch differs from the conventional approach (max 200 words).

- By minimizing the disturbance by dredgers, a direct benefit for the ecosystem could be achieved.
- The design indirectly let to the formation of new biotopes with links to a Natura 2000 area.
- This new stretch of land will attract people.
- By limiting the control of variability, adaptability and resilience were gained.
- In terms of the cost issue, the project is being financed by a coalition of stakeholders rather than only the primary client. Although this funding strategy is difficult to achieve, it allows for an innovative project to be realized.