An ecocentric mindset
to slow down climate change

Eco-centric Architecture

AR3TT015 Transitional Territories - Research Module
MSc Architecture, Technical University Delft

Anneloes van Slooten

Student number: 4655230

August 2020

Tutors:
1st mentor - Jacques Vink
2nd mentor - Sjap Holst
3nd mentor - Taneha Bacchin

KEYWORDS

Ecocentricity, Sustainability, Ecosystems, Symbiosis, Ecological architecture

ABSTRACT

Human activities are speeding up normal climate fluctuations on the planet, while this is taking away the time to adapt to new living conditions, for the whole biosphere. Climate influences human activities, which influences again the climate. It is a loop that will never stop if humans do not change their way of living. To slow down climate change, mankind has to change the way they think and behave: they need an ecocentric mindset. Humans need to live in symbiosis with ecosystems to let the biosphere grow, instead of depleting it. With the build environment we can influence the users and passers-by. Therefore, ecocentric architecture has a key role in working towards the ecocentric mindset.

For this document are the fonts Ryman-eco and a compressed version of Century Gothic used, to save ink when printed.

Human activities are speeding up normal climate fluctuations on the planet, while this is taking away the time to adapt to new living conditions, for the whole biosphere. Climate influences human activities, which influences again the climate. It is a loop that will never stop if humans do not change their way of living. There is so much time, money and energy spend on fighting against natural phenomena, while it is now proven that, with the taken actions against nature, humans are depleting and disturbing important ecosystems. Instead of spending so much to fight against nature, we should use this to adapt to the changing environment. Adapting, without depleting or disturbing the ecosystems of which all the living depends on. To slow down climate change, mankind has to change the way they think and behave: they need an ecocentric mindset. Humans need to live in symbiosis with ecosystems to let the biosphere grow, instead of depleting it.

INDEX

1. PLANET EARTH - A GLOBAL PERSPECTIVE

THE NEWEST GEOLOGICAL FORCE

Evolution is always extant. For planet Earth, it started with a geosphere and its magnetosphere, followed by a hydrosphere and an atmosphere. After roughly a billion years, a biosphere of life was formed. After three and a half billion years, humans, with their thoughts and activities, started a new sphere: the noosphere.[1] According to Vernadsky (1945), the geologist A.P. Pavlov (1854-1929) described the current period as the anthropogenic era, emphasizing: "… that man is becoming a mighty and ever-growing geological force." (p. 8). The noosphere is this ever-growing geological force on planet Earth. This newest geological force, is for example, visible in the climate fluctuations on the planet. Human activities are speeding up the normal climate fluctuations: climate change is happening faster, and the effects of this are becoming quickly more extreme and severe for the biosphere. One of the effects, is the acceleration in sea level rise. The graph of figure 3 shows the normal fluctuation of the sea level. Since sea level rise is one of the causes for many problems in our man-made environment, and since it is known that human activities are accelerating these changes, there are some predictions to get an idea of what the changes could possibly bring in the future. Those future predictions are based on the different emission-scenarios of the IPCC synthesis report (IPCC, 2014), the so-called RCP's (Representative Concentration Pathways). RCP 2.6 is the most ambitious scenario where many measures are needed to reduce the human induced CO_2 emissions. RCP 8.5 is a scenario where only a few measures are taken. (fig. 4). Those future predictions show the small, but defining, impact human activities have on the normal fluctuations of the planet.

CHANGED NATURE

The world can be seen as one big, self-regulating organism, a living system. Lovelock talks about the Gaia Theory, in which he proposes that all cycles of the planet together, regulate the conditions on Earth to make it habitable. Living organisms and the inorganic of the planet, form together this self-regulating, complex system. The health of the Earth should be primary, because we completely depend on this living planet.[2] Unless we find a (technical) replacement for every element we need to live. Mankind, that can be seen as the process of the planet of becoming self-conscious through technology, is unbalancing the conditions on Earth. Gaia, as a living planet, keeping everything in the right balance, is being changed by its noosphere. Nowadays, humans altered so much of the old world, that there is almost no untouched nature left. Everything the humans altered and made, like plants for food, fuses with or is even replacing the untouched nature. The developments are so far, that technology and nature are switching places. Nature is being controlled and governed, while technology is complex and becoming uncontrollable.[3] Take for example the banana, the ones we eat today, can hardly be called a product of the original nature. This cultivated banana comes from a combination of the two wild species: Musa acuminate and Musa balbisiana. Both are not an ergonomical or tasty fruit. The manipulation of this old nature, started at least 7000 years ago and resulted in a tasty, ergonomic and seedless banana. Through this, it became highly vulnerable for diseases.[4,5]

Figure 1 Inside a wild-type banana. (W. Roonguthai, 2007)

Figure 2 The banana as we know it

1 The term noosphere – from the Greek nous "mind" and sphaira "sphere" – is proposed by Vladimir Vernadsky and Teilhard de Chardin. Mensvoort, K. and Grievink, H. (2012). *Next nature: Nature changes along with us.* Barcelona/New York: Actar. Page 10, 140.

2 James Lovelock is a scientist looking at evidence from the Earth, through his formed Gaia theory. "…a self-regulating Earth with the community of living organisms in control…" Lovelock, J. (2009). *The Vanishing Face of Gaia: a final warning.* New York: Basic Books. Page 36, 159, 195.

3 The book 'Next Nature', explains that humans desire for nature unspoiled by their selves. However, this old nature is not what it used to be. The human impact on the planet changed everything: "the 'made' and the 'born' are fusing." Mensvoort, K. and Grievink, H. (2012). *Next nature: Nature changes along with us.* Barcelona/New York: Actar. Page 2-4.

4 Venkataramana, R. K., Sampangi-Ramaiah, M. H., Ajitha, R., Khadke, G. N., & Chellam, V. (2015). Insights into Musa Balbisiana and Musa acuminata species divergence and development of genic microsatellites by transcriptomics approach. *Plant Gene, 4, 78–82.* https://doi.org/10.1016/j.plgene.2015.09.007

5 The cultivated banana is here described as: "…the result of thousands of years of domestication by people." Mensvoort, K. and Grievink, H. (2012). *Next nature: Nature changes along with us.* Barcelona/New York: Actar. Page 38.

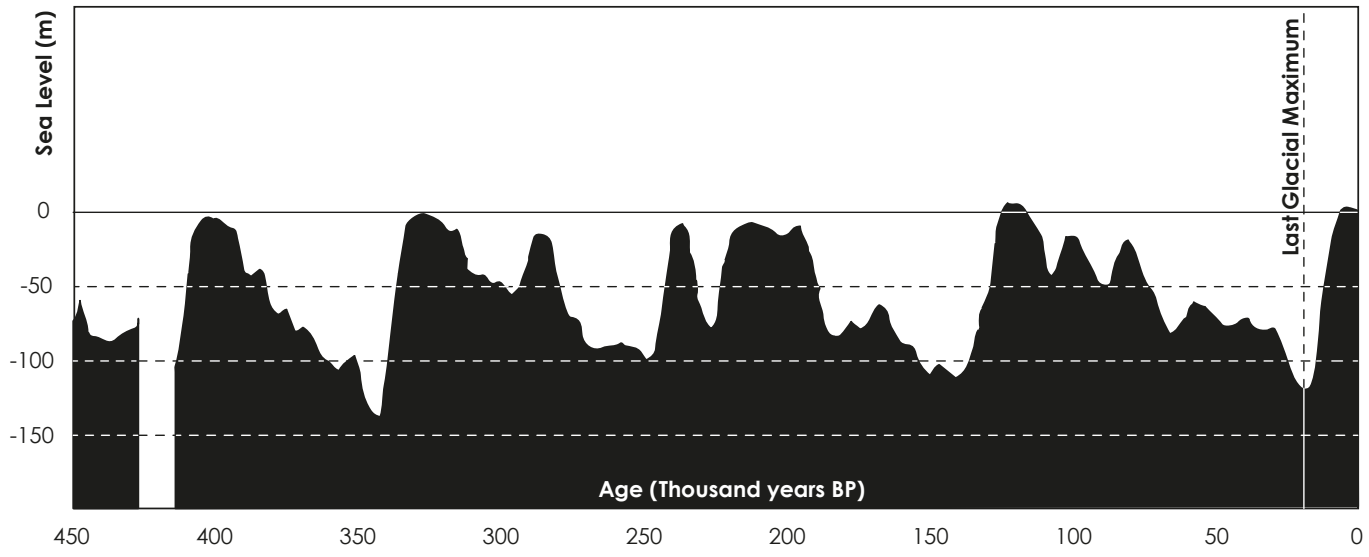


Figure 3 Normal fluctuation of the sea level on planet Earth

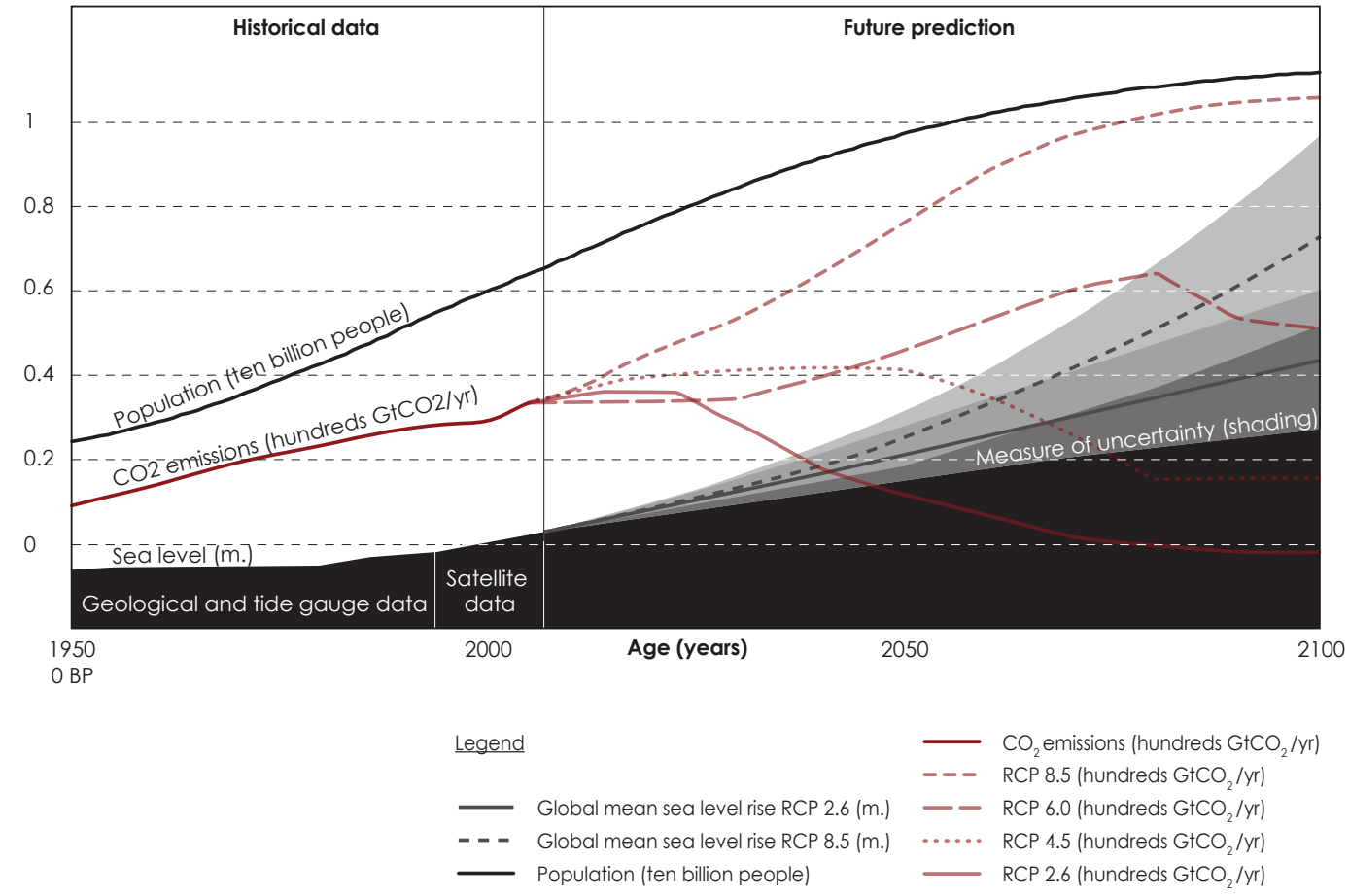


Figure 4 Future scenarios of Sea level rise, according to human induced CO_2 emissions.

This has happened to (almost) everything that humans eat. That technology is becoming complex and uncontrollable is evident in viruses, Malwarez, on computers. The chaos they create with spam, is beyond our control. The DNA for this virtual organism exists of code – like viruses, spyware code and worms – and has an algorithm to grow, just like an independent lifeform.[6]

SELF-DESTRUCTION

The noosphere, is not created by the human strength from its matter. When the whole of mankind is put together, the area they occupy is insignificant. It is the brain that is giving strength. As soon as humans stop using their brains and their works for self-destruction, there can be an immense future ahead of them.[7] Altering nature products to improve their yields, is saving lots of space, but controlling nature by fragmenting it, is part of the self-destruction. Waste production is another type of self-destruction. Why would so much plastic been thrown away, while plastic is such a durable, light and strong material? It can be rigid and flexible, and it could easily be molded into a new product. Humans design their environment with an anthropocentric mindset, while it should be designed with an ecocentric mindset. This anthropocentric mindset has caused a collective ignoring of the principles and limitations of the ecosystems on this planet.[8] It has led to the current state of habitats, in which the ability of the biosphere progressively is diminished. According to Yeang (2020) this happened due to:

- The natural habitats that are destroyed, displaced and fragmented by human interventions
- The biosphere that has been used as a garbage bin (an environmental 'sink').
- The biodiversity that has been declined through both of the above processes.
- The unsustainable exploitation of natural materials and the unsustainable modification of hydrogeochemical cycles.

This alteration of the old world, in which nature and technology are switching places, is disrupting the cycles on the planet we need to survive. To let this designed world survive for humans to inhabit, major interventions are necessary. Mankind has to change the way they think and behave. With an ecocentric mindset, it is possible to transform the man-made environment into a habitat for humans and nature. Ecological designs will form our future habitats.

ECOLOGICAL DESIGN

Ecological design is a way of thinking and working while designing. It is an ecocentric design approach, in which all of the design thinking, Nature is always at the center: ecocentricity. It is to conserve, protect and benefit ecosystems and habitats, the design is informed by ecology.[9] This design approach requires knowledge of the ecosystems and ecological processes of the project location, to be able to respond on the surrounding nature. The designed systems need to minimize and eliminate negative impacts on the environment, including its flora and fauna. This approach can contribute to preserve and restore nature and its biodiversity. Ecological design is the newest step in the concept of sustainability. In the 1970's there where already attempts towards sustainable architecture, but this was mainly about energy savings. Better insulation and technology to seal and regulate the air and light

---

6 Mensvoort, K. and Grievink, H. (2012). *Next nature: Nature changes along with us.* Barcelona/New York: Actar. Page 47.

7 Vernadsky takes an example of the economist L. Brentano to explain how small humanity will be when all put together. The whole mankind together would not even occupy the area of the small Lake of Constance between the borders of Bavaria and Switzerland. Vernadsky, W. I. (1945). The Biosphere and the Noösphere. *American Scientist, 33 (1), 8.* Retrieved from https://monoskop.org/images/5/59/Vernadsky_WI_1945_The_Biosphere_and_the_Noosphere.pdf

8 It is important to design and work within the limits of Nature, in order to prevent an ecosystem to collapse. Yeang, K. (2020). *Saving the planet by design.* New York: Routledge. Page 7-9, 19.

9 Science of ecology must be the basis of all human acts and activities impacting the planet's systems. Yeang, K. (2020). *Saving the planet by design.* New York: Routledge. Page 19.

of the buildings, became a barrier between humans and nature.[10] Today, the concept of sustainability evolved towards a more holistic approach, with an immense size and scope, and the main goal to minimize the ecological impact. It is not only about the ecology and the environment, but also about the more global interrelations. For example, about where the resources come from and how they are processed.

"To be green in more than a token fashion is to have some commitment to containing or reducing the environmental impact of humans on the Earth or regions of it. . . . [That] means commitment in the immediate future term to either:
- *human population reduction, or*
- *less impacting lifestyles for many humans, or*
- *improvements in technology to reduce overall impact."*

(Sylvan and Bennett, 1994, p. 23)

This great, but slow progress of the sustainability concept, has a new direction: towards ecological designs. Right now, it is still an anthropocentric design approach, in which the human beings are central. Now it is of course the case, that buildings are designed for humans, but the space people take is not only theirs. Humans share this world with lots of other biotic and abiotic matter. Sustainability should not only be about minimizing the ecological impact, but it should be about creating opportunities for ecosystems to grow. The world, Gaia, must function as one whole to survive, therefore it is important to keep improving the concept of sustainability. An ecocentric design approach is the newest addition for sustainability, to form an ecological designed environment, and create a world where the whole of nature can thrive.

AQUATIC ECOSYSTEMS

With an ecocentric design approach, it is important to understand the world and its ecosystems as good as possible, and to know the effect of the concerned human activities. It is always necessary to know for who the design is, and in the case of an ecocentric design approach, it will not only be for humans, but also for the surrounding ecosystems.

The planet consist of many different ecosystems. When splitting them up in terrestrial and aquatic ecosystems, majority of the planet will be catagorized under aquatic ecosystems. The surface of planet Earth, is filled with more water than land. Approximately 75% of the surface is water, in liquid and frozen forms.[11] 71% of Earth's surface is covered with oceans and seas, and according to 'The Sea First Foundation' the world's water is 99% of the biosphere.[12] Even if it is less than 99%, it is a fact that the planet has a larger water surface, than land.

The ocean is the place where life started, and it also maintains life. It regulates the temperature of the planet, it provides life with oxygen, food and drinking water, and humans also benefit of energy, raw materials, medication and even recreation and culture. Of the world population lives more than a third in coastal areas. People are depending, directly and indirectly, on the ecosystem services of the ocean for food, survival and general wellbeing.

10 Hsia, M. (n.k.). *An Intersection Between Architecture and Nature.* (Unpublished master dissertation). Texas Tech University, Lubbock, Texas, USA. Page 5.

11 Graham, S., Parkinson, C. and Chahine, M. (2010, October 1). *The Water Cycle*. Earth observatory, NASA. Retrieved 01-01-2020 from https://earthobservatory.nasa.gov/features/Water/page1.php

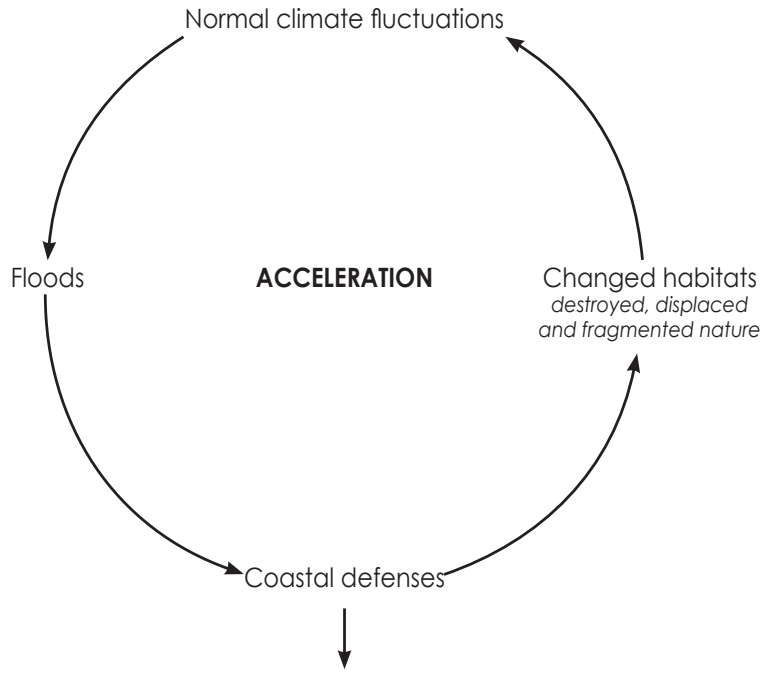
12 The Sea First Foundation (n.k.). *Importance of the sea.* Retrieved 01-01-2020 from https://www.seafirst.org/themas/importance-of-the-sea/?lang=en

2. TERRITORY - NORTH SEA

2.1. IDENTITY - HISTORICAL PRECEDENTS

Most of the world's precious water, is found in oceans and seas. The North Sea is relatively a small body of salt water. With its 570.000 km^2, it is approximately 0,16% of the total world ocean. This "small" marginal sea of the Atlantic Ocean, is surrounded by Great Britain, Denmark, Norway, Germany, the Netherlands, Belgium and France. The English Channel and the Norwegian Sea, connect the North Sea with the ocean. This epeiric sea might be small, but it is already for a long time of great importance for the shipping, fishery and recreation industry. It contains lots of usable sediments and minerals, and around 1970 it became a rich source of energy resources. While is started with fossil fuels, it is now expanded with renewable energy from the wind and the waves. The use of the North Sea, changed with the development of people. Human activities are based on desires, conflicts and their knowledge. Through the history of the North Sea, there are clear changes in activities and in the size of those activities (fig 5). A simple example is the Viking Age. During the Vikings' rise, the North Sea was the center for their search for trade, raids, colonization and conquest.[1] Thereafter many tried to dominate the sea, to be able to use the world's markets and resources, and during both World Wars the sea continued to be strategically important. With technical developments, the activities started to focus more on extraction of large amounts of matter (biotic and abiotic) or energy, and the recreation industry. The changes became more peaceful for humans, but more catastrophic for the North Sea.

The built environment is based on human demands, but not only to give life more luxury, it also functions as protection. Many human activities are happening to create protection against natural phenomena. In figure 6 it is clearly visible how floods led to big coastal defenses to keep the land and people from drowning. The accelerating climate change is driving people to build more and bigger defenses. It is a constant loop that only the behavior of humanity can break.



1 Griffiths, D. (2019). Rethinking the early Viking Age in the West. *Antiquity Publications Ltd, 93, 368, pp. 468-477.* https://doi.org/10.15184/aqy.2018.199 Page 470-471

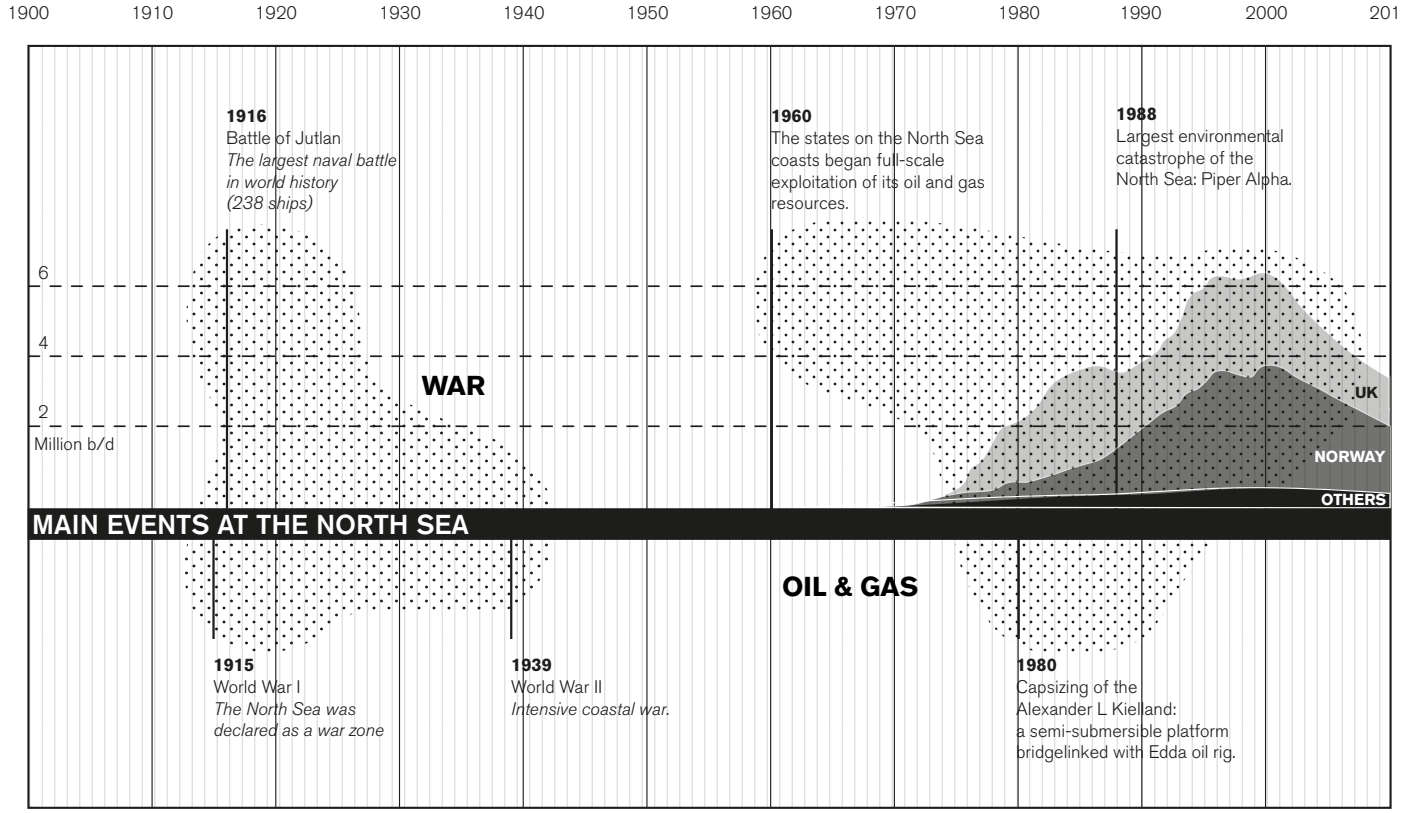


Figure 5 Timeline Main Events at the North Sea
The shaded "mountains" UK, Norway and others, show the increase and decrease of oil extraction.

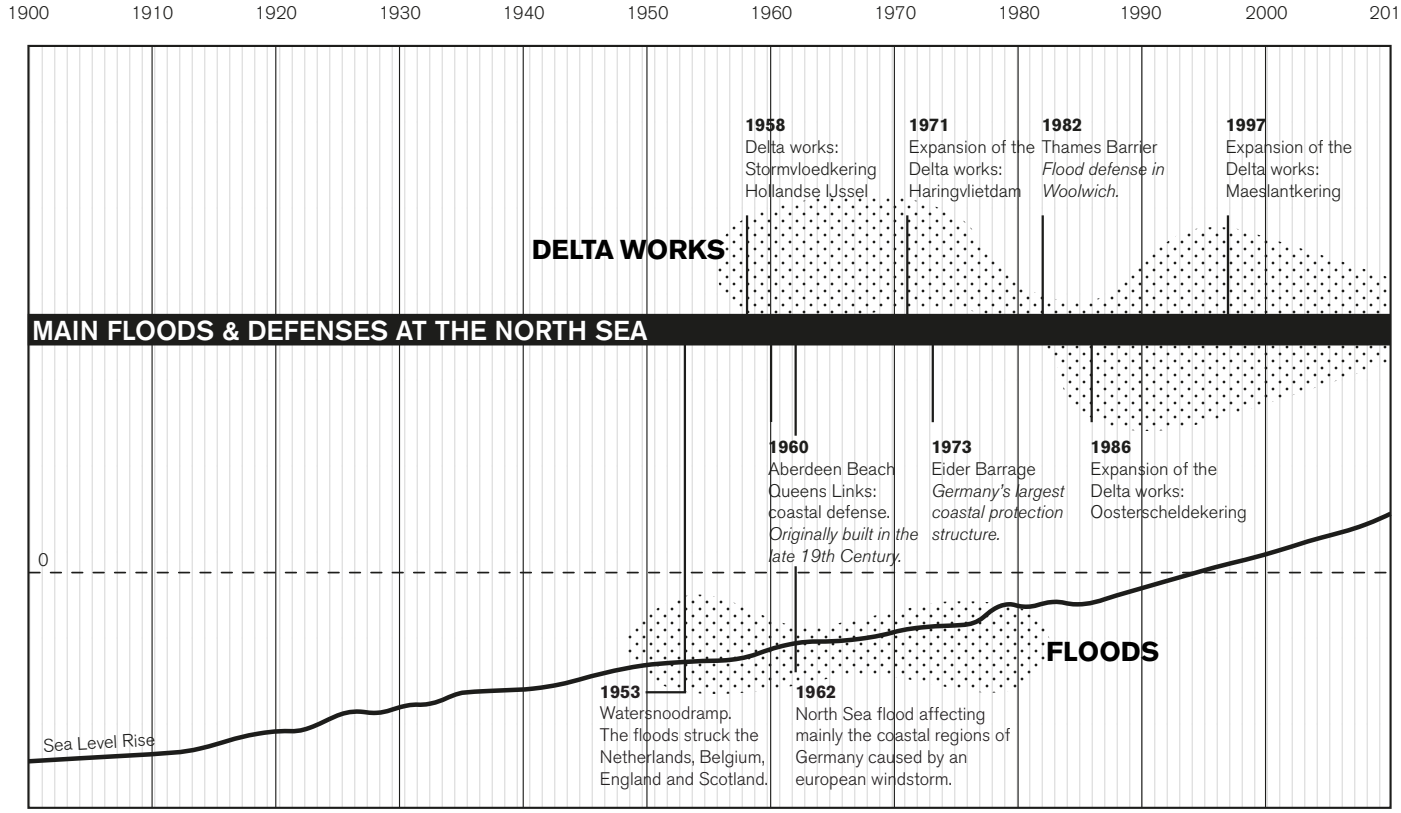
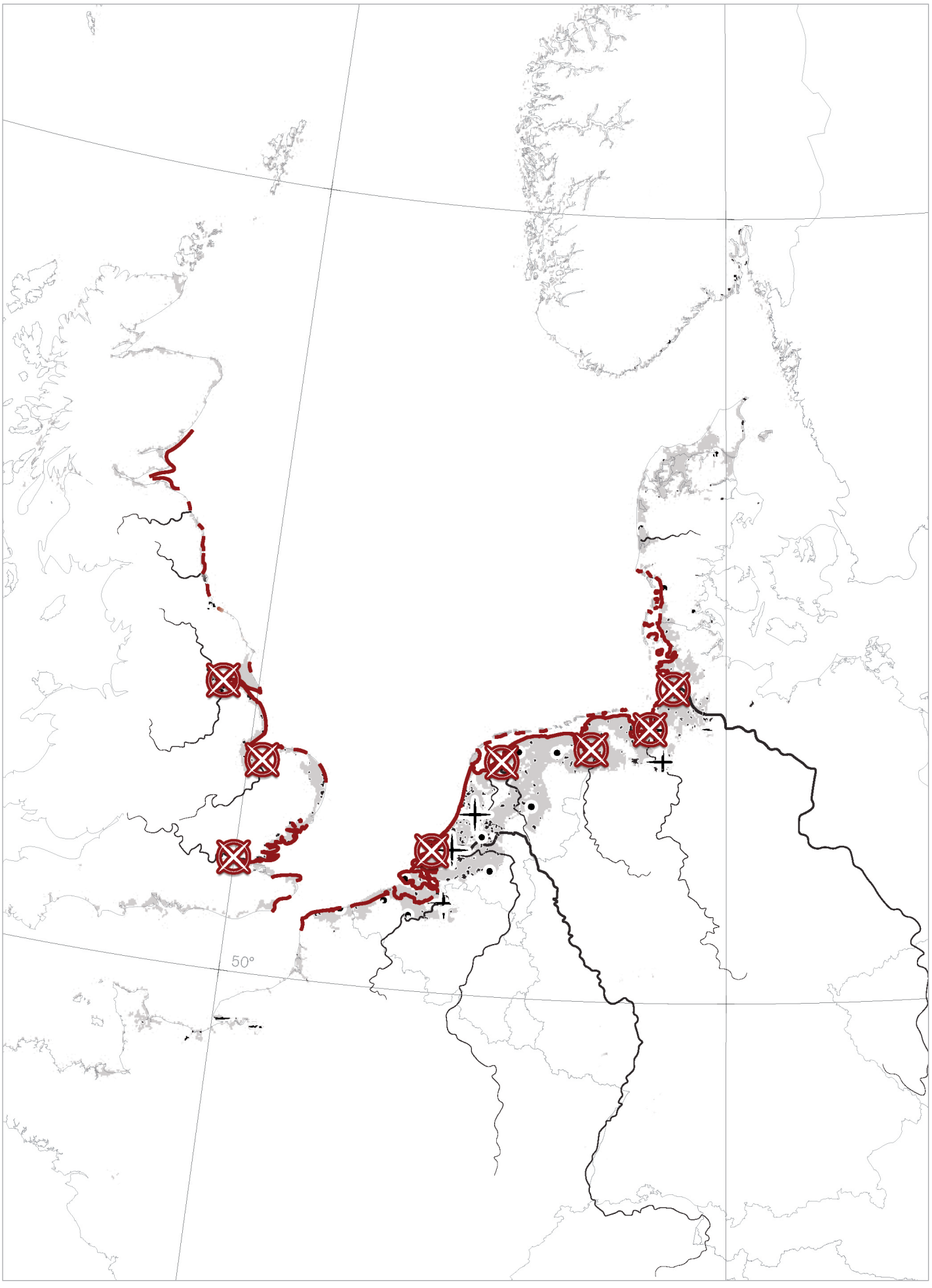


Figure 6 Timeline Main Floods & Defenses at the North Sea

Coastal Defenses

(2019) Flux, Erasure &
Terraforming, Armour

~ Rivers
Areas prone to floodrisk
— Hold the line policy
⊗ Vulnerable crosspoint river/sea
+ Affected ports
● Affected cities


50°

2.2. PROBLEM STATEMENT

From the global and territorial analysis is clear that climate change is a normal fluctuation on the planet. After it became known that human activities are speeding up the climate change, many tried to find sustainable or eco-friendly solutions. Nevertheless, the effects of climate change keep getting more extreme and severe. The sea level keeps rising, threatening to drown by humans occupied land. As a reaction, coastal protections are built, and many people are searching for new solutions and technologies to protect the man-made world. Climate influences human activities, which influences again the climate. It is a loop that will never stop if humans do not change their way of living.
Speeding up changes in the ecology, is taking away the time to adapt to new living conditions, for the whole biosphere. There is so much time, money and energy spend on fighting against natural phenomena, while it is now proven that, with the taken actions against nature, humans are depleting and disturbing important ecosystems. Instead of spending so much to fight against nature, we should use this to adapt to the changing environment. Adapting, without depleting or disturbing the ecosystems of which all the living depends on.
To slow down climate change, mankind has to change the way they think and behave: they need an ecocentric mindset. With ecocentricity, it is possible to conserve, protect and benefit ecosystems and habitats (Yeang, K. 2020). Humans need to live in symbiosis with ecosystems to let the biosphere grow, instead of depleting it.

2.3. RESEARCH QUESTION - TERRITORIAL

What kind of sustainability principles can be applied to the North Sea Waterscape?

Sub-questions

1. How can the general sustainability principles be summarized?

2. Which human activities are unbalancing the ecosystems of the North Sea waterscapes?

Figure 7 From an anthropocentric to an ecocentric mindset

3. SUSTAINABILITY PRINCIPLES

3.1. ECOSYSTEMS

The whole planet, forms with its spheres – the geosphere, hydrosphere, biosphere, etc. – a large variety of ecosystems. Ecosystems are biotic communities together with their abiotic environment, where different factors interact with each other. They are largely based on the present climate. Ecosystems have a conservation of matter – matter tends to go from one form to another – and a flow of energy. Energy enters in the form of light, after which it gets transferred from one organism to another (sometimes, involving the abiotic elements), and eventually it turns into heat.

Major types

None of the existing ecosystems are the same, therefore it is difficult to classify them. This large variety on earth, causes that biomes not always perfectly fit within a certain classification scheme. Nevertheless, many classification schemes are made, trying to get an overview of ecosystems and their relation with climate. Miklos D.F. Udvardy made a classification of biogeographical provinces, to view the biosphere in a systematic way.[1] The provinces are based on dominating major biomes or biome-complexes of a certain area. An even broader classification of his biogeographical provinces, are some recognized Biogeographic realms:

The Nearctic Realm
The Palaearctic Realm
The Africotropical Realm
The Indomalayan Realm
The Oceanian Realm
The Australian Realm
The Antarctic Realm
The Neotropical Realm

Despite the difficulty of classifying ecosystems, David W. Goodall has made an extensive overview of the most important ecosystem types or biomes.[2] His classification starts with a basic devision between terrestrial, aquatic, and underground ecosystems (fig. 8).

Energy flow

Most ecosystems get their energy from the sun, another possibility could be geothermal energy. The flow of energy through an ecosystem is a highly inefficient process, lots of energy gets released as heat.

1. The energy flow, that is needed for an ecosystem to function (to grow, reproduce and live), starts with primary producers, plants for example. Primary producers, also called autotrophs, store the energy from the sun in their biological molecules. This energy is used to create bonds or connections between carbons, to fix carbon from a gas into a solid form. This carbon gets fixed into their biological molecules to store the energy.
2. Primary consumers (herbivores) eat the primary producers to get energy from the carbon bonds in the biological molecules. Some of that energy, is stored in its own biomass.
3. Secondary consumers (carnivores) eat the primary consumers to gain some of the stored energy.
4. This chain goes on with tertiary consumers,
5. and the quaternary consumers (Apex consumer or predator). This is when they are at the top of the food chain: when no one wants to consume

1 Miklos D.F. Udvardy prepared this report as a contribution to UNESCO's Man and Biosphere Programme Project No. 8. He mentioned four approaches to view the biosphere in a systematic way: Taxonomic order (based on similarity or difference of characters), ecological order (based on interrelations), phylogenetic order (based on origins and history), and the biogeographic order (grouping on geographic or palaeogeographic basis). Udvardy, M. D. F. (1975). A Classification of the Biogeographical Provinces of the World. *IUCN Occasional Paper, No. 18. Morges, Switzerland*. Retrieved from https://www.fnad.org/Documentos/A%20Classification%20of%20the%20Biogeographical%20Provinces%20of%20the%20World%20Miklos%20D.F.%20Udvardy.pdf Page 5, 11.

2 Goodall, D. W. (1974). Ecosystems of the World. *Elsevier, Amsterdam, 36 (11)*. Archived 2016-09-18 at the Wayback Machine.

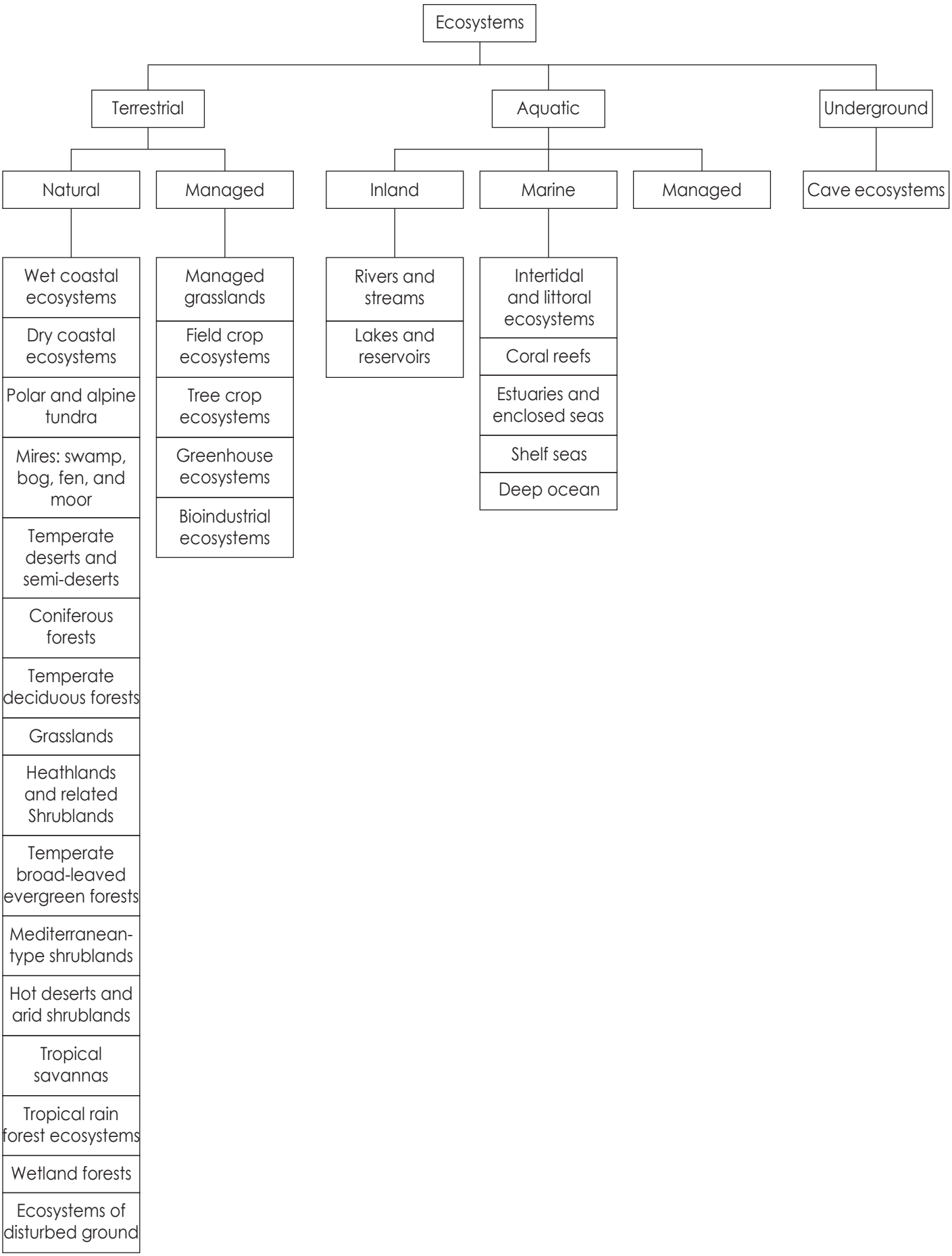


Figure 8 Classification of ecosystems according to David W. Goodall.

them.

6. Left over energy from died producers or consumers, or from the consumer's poop, goes to the decomposers. They break down the energy, into simple inorganic molecules, which releases lots of nutrients (matter) used by plants.

Recycled Matter

Energy flows through ecosystems and gets released as heat, while chemical elements are cycled through ecosystems. Most of the matter was there already when planet Earth was first formed. All elements and molecules, including where humans are made of, exist already for ages: they have been recycled over and over again. The biogeochemical cycles that are important to living organisms, are the water, carbon, nitrogen, phosphorus and sulfur cycles. Unbalancing one of those cycles, could have catastrophic effects on the ecosystem.

Water:	contains hydrogen and oxygen
Carbon:	is found in all organic macromolecules and it is a key component of fossil fuels.
Nitrogen:	is needed for our DNA, RNA, and proteins. It is also critical to human agriculture.
Phosphorus:	it is a key component of DNA and RNA. It is also one of the main ingredients in artificial fertilizers in agriculture.
Sulfur:	it is a key to protein structures, and it gets released to the atmosphere by burning of fossil fuels.

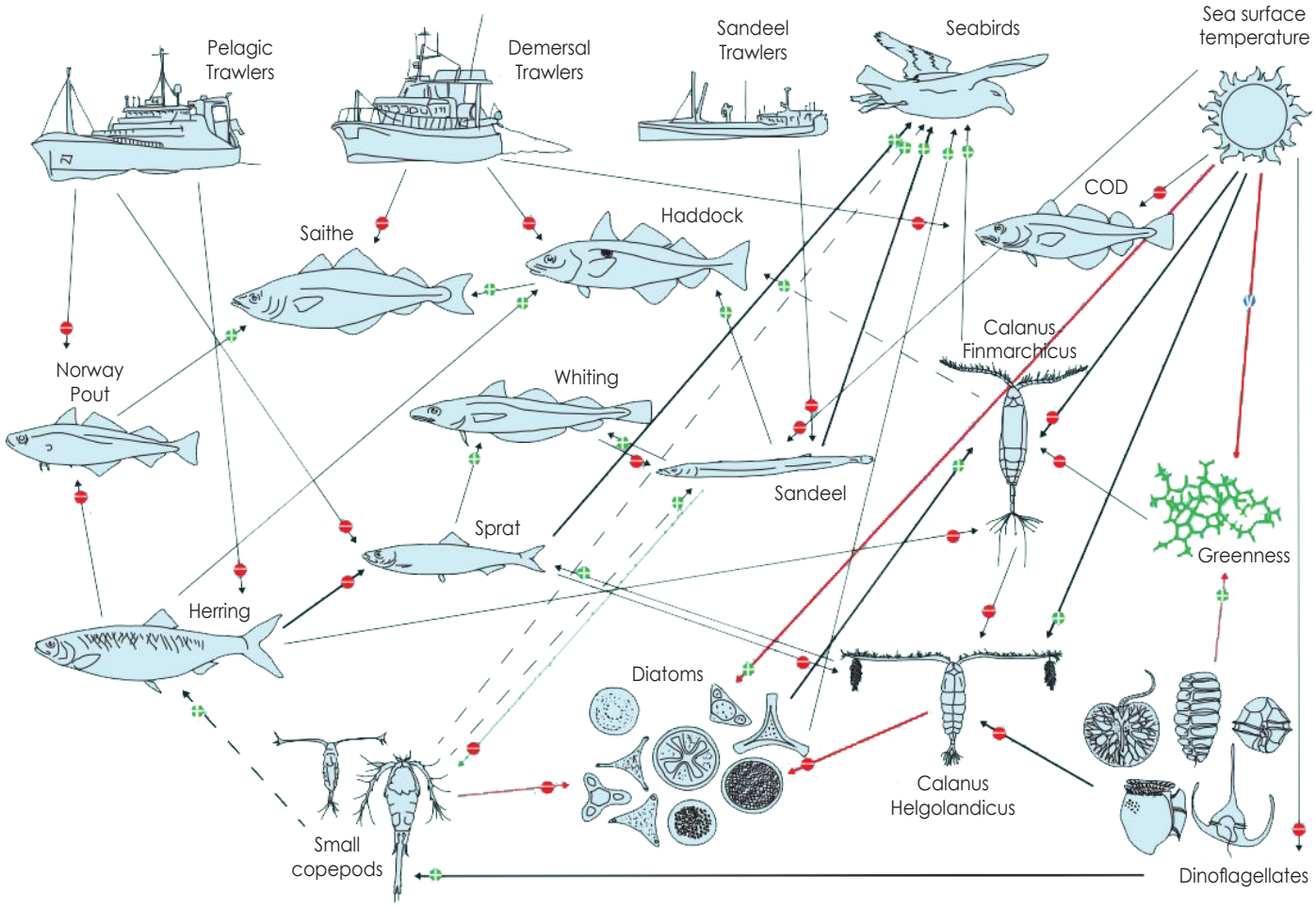
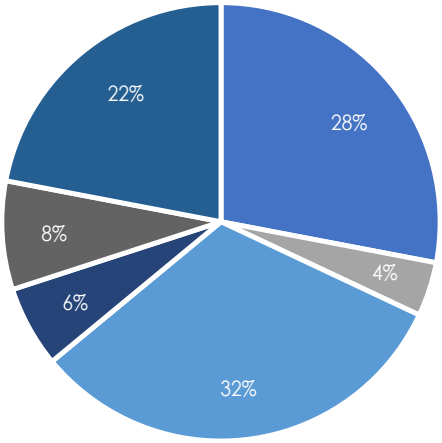
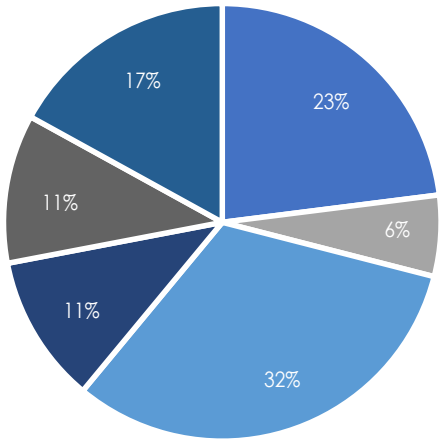


Figure 9 Significant interactions in the North Sea ecosystem
(Bayliss-Brown, G. and Lynam, C. (n.k.), edited by author)



6% Construction materials manufacturing
8% Non-residential
22% Residential
28% Transport
4% Other
32% Other industry

Figure 10 Global energy use of buildings 2017
Derived from the International Energy Agency (2018, page 11).



11% Construction materials manufacturing
11% Non-residential
17% Residential
23% Transport
6% Other
32% Other industry

Figure 11 Global energy-related CO_2 emissions of buildings 2017
Derived from the International Energy Agency (2018, page 11).

3.2. HUMAN INFLUENCES

Human activities are accelerating climate change, by unbalancing the Earth's energy and biogeochemical cycles.[1] It is not always directly clear which activities have negative effects. For example, fertilizers containing phosphorus helps plants to grow bigger. At first, this looks like something positive, but after a while it became known that it created dead zones somewhere else. Water, from rain or irrigation, takes the phosphorus into streams, rivers and lakes, causing eutrophication: once a waterbody has an excess of those fertilizers, it will grow algae all over, because the algae gets over-nourished. As soon as the algae dies, it will float down and become food for bacteria. The problem with those bacteria, is that they need oxygen. They will deplete the oxygen in the water, what creates dead zones: a lack of oxygen will kill the ecosystem of the waterbody. Ecosystems, with its flow of matter, creates a cooperating whole. It is important to realize what happens at the end of the chain.

Human activities unbalance ecosystems by:

- Land-use change
  While mining resources and urbanizing areas, natural landscapes are being destroyed and fragmented. This results in habitat loss for other biotic communities. Of all the changed land-uses, 60% is caused with direct human activities, and 40% is caused by indirect drivers, like climate change.[2] Less than 0,5% of the world's total land area is occupied by cities, but when caunting all man-made constructions, it will be more than 50% (excluding patches of vegetation, like parks).[3] Counting agriculture with urban settlements already reaches 42% of the global land cover (fig. 12). Despite the only 0,5% global land cover of urban areas, they have a huge impact on climate, biogeochemistry, and hydrology.[4]
- Pollution
  Land pollution: from runoff or disposal of chemical substances
  Noise and light pollution: from energy sources
  Air pollution: released greenhouse gases
  Water contamination: This can be caused by waste disposal, oil spills, runoff from agriculture, etc.
  In 2017, building constructions and operations were liable for 36% of the global energy use, and 39% of the energy-related CO_2 emissions.[5]
- Resource exploitation
  Consuming resources for own needs.
  Biotic: hunting and fishing
  Abiotic: mining coal, wood, metals, etc., but also degradation of water resources.

With a growing population and growing demands, it is likely to expand and intensify further.[6] Therefore, ecological design is also about designing how activities can become ecological, in which the built environment can play an important role.

1 Song, X. et al. (2018). Global land change from 1982 to 2016. *Nature 560, 639-643.* http://doi.org/10.1038/s41586-018-0411-9 Page 1.
2 Song, X. et al. (2018). Global land change from 1982 to 2016. *Nature 560, 639-643.* http://doi.org/10.1038/s41586-018-0411-9 Page 1.
3 Schneider, A., Friedl, M. A., and Potere, D. (2009). A new map of global urban extent from MODIS satellite data. *Environmental Research Letters, 4, 044003.* http://doi.org/10.1088/1748-9326/4/4/044003 Page 2.
4 Schneider, A., Friedl, M. A., and Potere, D. (2009). A new map of global urban extent from MODIS satellite data. *Environmental Research Letters, 4, 044003.* http://doi.org/10.1088/1748-9326/4/4/044003 Page 1.
5 International Energy Agency and the United Nations Environment Programme (2018). *2018 Global Status Report: Towards a zero-emission, efficient and resilient buildings and construction sector.* Retrieved from https://www.worldgbc.org/sites/default/files/2018%20GlobalABC%20Global%20Status%20Report.pdf Page 11.
6 Lawrence, D. M. et al. (2016). The Land Use Model Intercomparison Project (LUMIP) contribution to CMIP6: rationale and experimental design. *Geoscientific Model Development, 9(9), 2973-2998.* http://doi.org/10.5194/gmd-9-2973-2016 Page 2973.

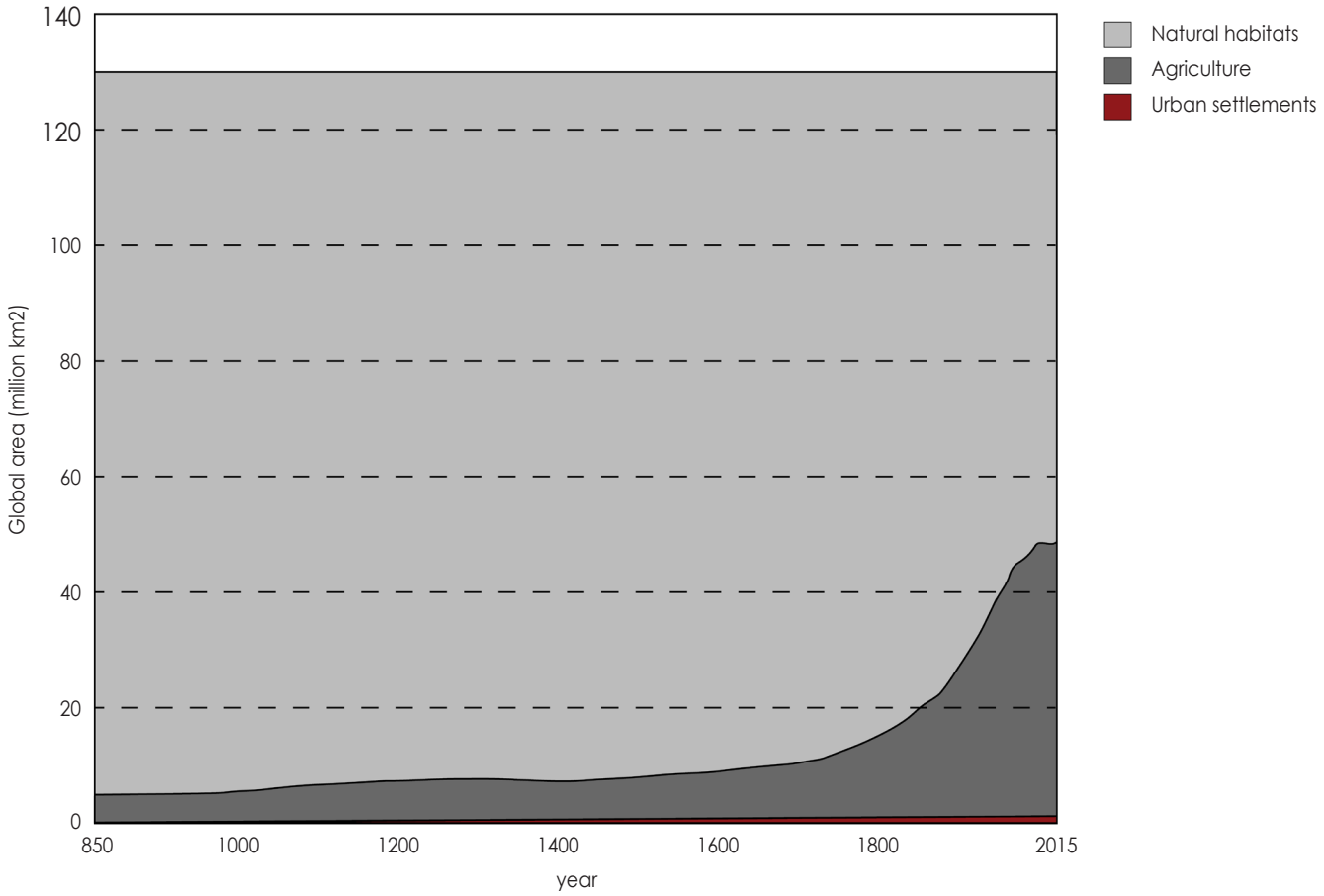


Figure 12 Simplified overview of global land area occupied by nature, agriculture or urban settlements.
Derived from Lawrence, D. M. et al. (2016, page 2976).

3.3. NORTH SEA WATERSCAPE

The ecosystems of the North Sea waterscapes are, like other ecosystems, unbalanced by land-use (or sea-use) change, pollution and resource exploitation. For the North Sea it is through activities like shipping, fishery, aquaculture, energy production, resource extraction (like sand and oil) and coastal protection.[1]

Coastal protection

Flood defenses are closing off natural habitats from each other, which can have enormous consequences for some species. For example, in the North of Scotland, hydro-electric dams are blocking the salmon migration routes, which causes a decrease of salmons.[2] There are also techniques to protect the coast, that are not seperating certain areas from each other. Like beach nourishment, a less impacting technique and a nature based solution.[3] Unfortunately it is a short-term solution to beach erosion, and there are also some negative ecological effects. Water offshores can become muddy, and the new sand - which maybe differs in grain size or chemical makeup - will cover the sand that is already there, where many animals depend on. For example, it disturbs breeding birds and it buries benthic communities.[4] Most of the macroinvertebrate fauna will not survive the thick layer – more than 1 meter – of sand applied on the beach.[5] Depending on the frequency of the sand nourishments and the recovery time of the benthic fauna (which takes place within a few years), the sand nourished beaches will almost never be in an undisturbed state. Also animals that start their lives as free-floating larvae, like sand crabs or shrimps, can be affected. When the nourishment coincides with a period where the free-floating larvaes are drifting around to recolonize a beach, they will not have the chance to repopulate the sand nourished beach until the next year.[6] Besides the effects of the sand, there is also the fact that the heavy machinery that is used, disturbs wildlife with its noise, and the mining of the new sand alters the environment where it is mined. Enough negative effects to find new solutions for protecting our beaches.

Recreation

It is important to be careful with recreation. It can have a negative influence on the beach ecosystem[7], for example by disturbing and trampling the beach fauna, or leaving litter on the beach. Mechanical beach cleaning is not the right solution for the litter problem, it disturbs the sand by raking and sieving it – seedlings, and sometimes also mature plants, are taken out – and it removes wrack[8] – an important resource for crustaceans and insects. A more effective solution, could be to create awareness and a sense of responsibility.

---

1 NIOZ Royal Netherlands Institute for Sea Research (n.k.). *Key area North Sea: balancing human use and healthy ecosystems in one of the busiest seas.* Retrieved from https://www.nioz.nl/en/research/north-sea

2 Carrell, S. (2019, April 27). *Scotland's salmon crisis: 'Anglers only want one. But it's just not happening'*. The Guardian. Retrieved from https://www.theguardian.com/environment/2019/apr/27/scotlands-salmon-crisis-anglers-only-want-one-but-its-just-not-happening

3 The Sand Motor in the Netherlands is a good example of a successful beach nourishment. Luijendijk, A. and van Oudenhoven, A. (2019). *The Sand Motor: A Nature-Based Response to Climate Change: Findings and Reflections of the Interdisciplinary Research Program NatureCoast.* Delft: Delft University Publishers - TU Delft Library.

4 In chapter 2 'Status and Trends', subchapter 'Threats: beach nourishments and beach recreation', is explained how beach nourishment also has negative effects. De Groot, A. V. et al. (2017). *Wadden Sea Quality Status Report: Beaches and dunes.* Edited by: Kloepper, S. et al., Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Last updated 21-12-2017. Retrieved 06-01-2020 from http://qsr.waddensea-worldheritage.org/reports/beaches-and-dunes

5 Leewis, L., et al. (2012). *Does beach nourishment have long-term effects on intertidal macroinvertebrate species abundance?* Estuarine, Coastal and Shelf Science, 113, 172-181.

6 Explore Beaches (2020). *Beach Nourishment.* The Regents of the University of California. Retrieved from http://explorebeaches.msi.ucsb.edu/beach-health/beach-nourishment

7 Defeo, O., et al. (2009). Threats to sandy beach ecosystems: A review. *Estuarine, Coastal and Shelf Science, 81 (1), 1-12.*

8 Nordstrom, K. F., et al. (2012). Effects of beach raking and sand fences on dune dimensions and morphology. *Geomorphology, 179 (0), 106-115.*

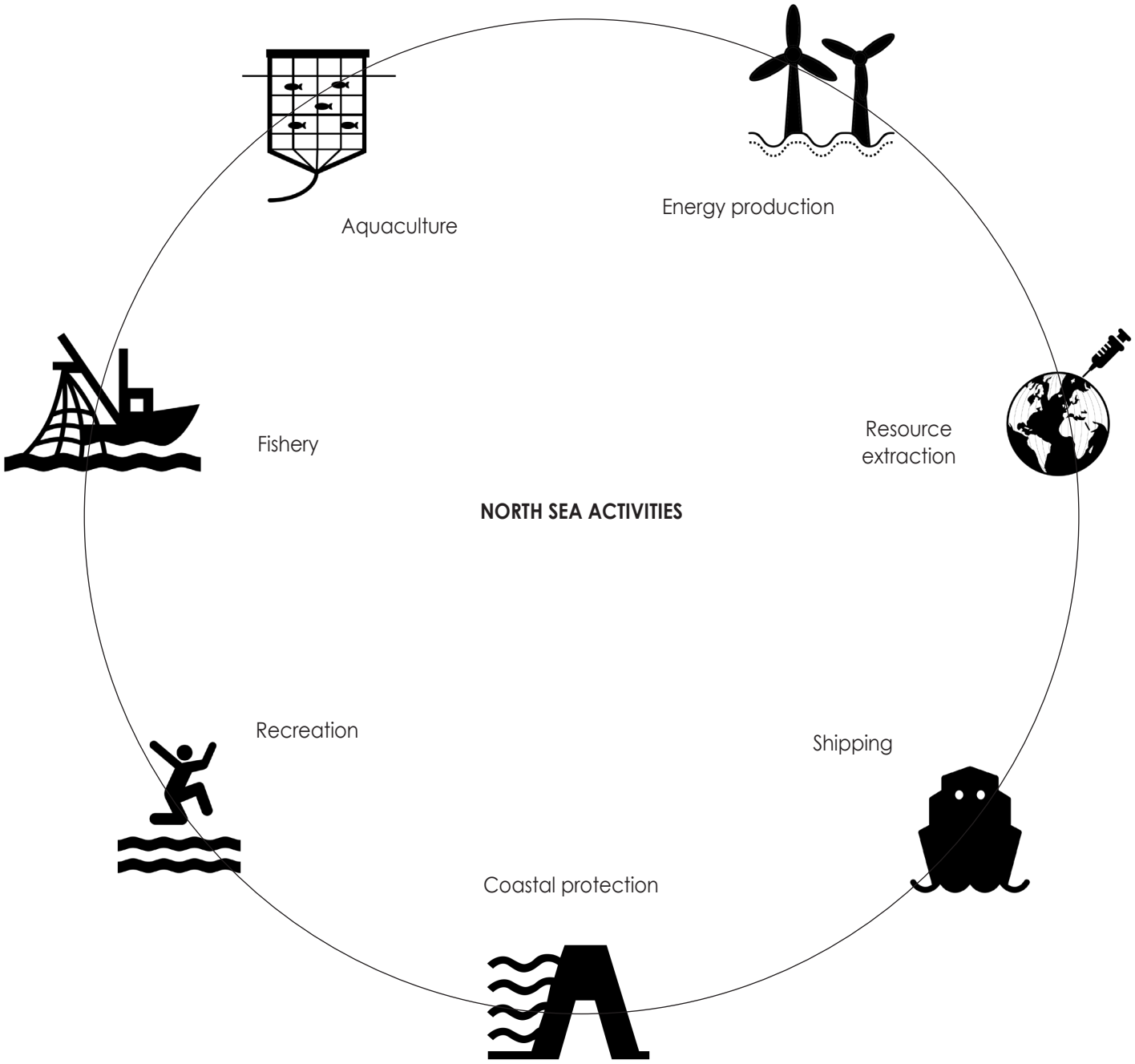


Figure 13 Human activities on the North Sea

These activities resulted in:

- Land-use (or water-use) change
- Pollution
  - *Land pollution*
  - *Air pollution*
  - *Noise and light pollution*
  - *Water contamination*
- Resource exploitation
  - *Biotic: hunting and fishing*
  - *Abiotic: mining coal, wood, metals, etc., degradation of water resources*

3.4. CONCLUSION

What kind of sustainability principles can be applied to the North Sea Waterscape?

To let the whole of nature – which includes humans – thrive, a balanced world with balanced ecosystems is needed. This means: balanced energy and material cycles, without any waste to unbalance the system. To reach this, it is important to stay within the limits of the ecosystem cycles. Multiple changes of the lifestyle of humankind, are needed to stay within those limits.

First of all, it is important to **stop producing waste**. This will prevent any kind of pollution, resource exploitation, and part of the land use changes. In short: it prevents contamination and depletion of land and water.

Second is to **consume less**, only take what is necessary. This saves the amount of material, food, transport and surface humans use. It is not necessary to have a new phone every year or to eat too much, to have a good live.

Third is to **stop nature fragmentation**. This habitat fragmentation prevents certain species to travel elsewhere when needed, which can have serious consequences. Mixed-use for humans and nature can help to prevent fragmented habitats.

All of the above actions, helps in **minimizing the land use change**. Consuming less, no waste production, and no fragmented nature, will reduce the land occupied by humans. Besides those changes, there is also the possibility to reduce the occupied land by only using what is really needed. Empty buildings or too much impenetrable surfaces for example, are unnecessary.

These necessary changes, are for the whole world, including the ecosystems of the North Sea waterscapes.

In short: stop fighting nature and start living together, functioning as one whole. Spoiled people are not happier and are not needed to let humankind thrive. With an ecocentric mindset, we can let the whole of nature thrive.

4. ARCHITECTURAL SCALE

To stop fighting nature and start living together (fig 14), architecture can play an important role. Buildings can become mixed-use objects and give space to humans and nature (fig 15). Besides functioning in an ecocentric way, architecture can also play its part towards an ecocentric mindset. Designing with an ecocentric mindset will set an example and spread the idea, and with the designs, users and passers-by will be influenced in their daily life (fig 16). A maximized symbiosis between man-kind and ecosystems, can be reached with the help of the built-environment.

4.1. RESEARCH QUESTION - ARCHITECTURAL

How to create a symbiosis between architecture and its surrounding ecosystems?

Sub-questions

1. What methodologies are used towards the start of a symbiosis between architecture and its surrounding ecosystems?

2. Which projects are a successful start towards a symbiosis between architecture and its surrounding ecosystems?

Figure 14: Stop fighting against nature

A l'ouest de Cherbourg
Antoine Josse (2013)

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."
- Richard Buckminster Fuller

Figure 15: Structural blending of the natural and built environment.

Arboreal Office
Rob Gonsalves (2014)

"The choice between city and nature is a false choice and an unnecessary and outdated dichotomy."
- Timothy Beatley

Figure 16: The senses create reality. Thus aimingly stimulating the senses, is molding reality.

Allez, encore 5 minutes et je rentre!
Antoine Josse (2016)

"...as I settle in a space, the space settles in me. I live in a city and the city dwells in me. We are in constant exchange with our settings; simultaneously we internalize the setting and project our own bodies, or aspects of our body schemes, onto the setting."
- Juhani Pallasmaa

4.2. METHODOLOGIES

A maximized symbiosis between man-kind and ecosystems, can be researched with an ecosystem methodology.[1] It is a style of research that implies that the research needs to be placed in broader environmental context. The ecosystem concept was already attractive in the environmental movements of the 1960's and 1970's: "keen to utilize the morally-inspired metaphors of holism and Mother Earth, and to managers and industrialists, keen to deploy its technical and mechanistic dimensions with a view to manage and control natural systems." (Vito De Lucia, 2014, p.12). In the history of ecology, there were always two different views: an anthropocentric view – for human profit only – and an ecocentric view – where humans and ecosystems both flourish. Donald Worster also mentioned this division in 1977 as two different views of nature: the "imperial" view (the anthropocentric) and "arcadian" view (the ecocentric).[2] Since before 1920, this was described with utilitarianism, till 1945 there was an important transition towards a preservation policy based on ecology.[3]

Many architects worked, and are still working, towards ecocentric designs. Frank Lloyd Wright is one of the best-known architects that integrated his designs with nature. He can be seen as the precursor of the movement of sustainable design. An example of his developments, are climate responsive houses built in the 1920's. He wrote how centralization (cities) have overbuilt the value of earth and described the folding tent as a more adaptable and elusive dwelling and the nomad, or adventurer, as someone following the law of change.[4] Nowadays, architects like Ken Yeang try to bring this ecocentric view of the ecosystem methodology to a next level. Research and design should not only be based on some elements of nature, but they should take everything into account: the whole planetary 'spheres'.[5]

With this ecocentric progress, the approach of architects becomes more like the approach of landscape architects. They work with larger regional scales, but also recognize the smaller scale as part of the larger framework. Surfaces are not just patterns, but mutable and thickened topographies, systemic and alive, with answers on questions about place, time and process.[6]

---

1 Lucia, V. (2014). *The Ecosystem Approach between Ecocentrism and Anthropocentrism*. UiT Arctic University of Norway. Page 12.

2 Donald Worster described the "moral ambivalence" of ecology in his book with the "imperial" and the "arcadian". Worster, D. (1977). *Nature's Economy: A History of Ecological Ideas.* Cambridge: Cambridge University Press. Page 29, 75.

3 Worster, D. (1977). *Nature's Economy: A History of Ecological Ideas.* Cambridge: Cambridge University Press. Page 256.

4 Wright, F.L. (1945). *When Democracy Builds.* Chicago: University of Chicago Press. Page 1, 4.

5 A book about changing our future, by designing through ecomimesis and ecocentricity. Yeang, K. (2020). *Saving the planet by design: reinventing our world through ecomimesis.* London and New York: Routledge. Page 44.

6 Wall, A. (n.k.) *Programming the Urban Surface. In Recovering Landscape: Essays in Contemporary Landscape Architecture.* Edited by Corner, J. New York: Princeton Architectural Press. Page 247.

Design methodologies that are used towards the start of a symbiosis between architecture and its surrounding ecosystems are:

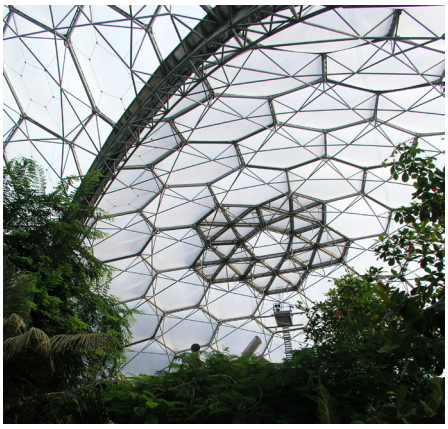


Figure 17 The Eden Project. (Carmen_seaby, 2007)

Biomimicry

Mimicking of biological forms, processes, and ecosystems to find (new) solutions for all kind of problems. It can be an unsustainable solution, but it can also be used to make ecological designs.
An example, is the Eden Project (fig 17). The light weighted structure emerged from multiple biological examples. For instance, soap bubbles helped to generate the building form, regardless of the ground level, and polygranular, Radiolaria and carbon molecules helped towards the most efficient structure possible by using hexagons and pentagons. The weight of the superstructure, is even less than the air inside. Instead of glass, ETFE (a high strength polymer) is used, which is based on pressurized membrane. The lightweight structure resulted in savings in the foundation, and more light inside which reduces the amount of heating needed in the winter. The cost where only a third of the costs of a conventional steel glass roof and it uses half of the amount of energy than a normal greenhouse.

Figure 18 The Amazon Spheres by NBBJ. (Damonte, B., 2019)

Biophilic architecture

The combination of nature, life and architectural theory to make a lively habitat for people and the natural environment. It focusses on using natural materials, living things, air, sun and water in designs. Biophilia is to describe the extent to which humans need connection with nature. Biomorphism is an often used component within biophilic architecture. It is kind of similar with biomimicry, but biomorphism only mimics natural forms and patterns. Biomorphic designs are often not sustainable.
The Amazon Spheres in Seattle, is an example of bringing nature into the workplace for productivity and well-being. The Architecture follows biomorphism, and in this case not with the goal to create an ecological design. It is only used as a formgiving tool: circles are an important geometric form in nature.

Figure 19 Top view from Living Root Bridge in Mawlynnong. (Bandyopadhyay, S., 2016)

Biodesign

The fusion of the human-made world with Nature, by designing with biology. Living organisms or ecosystems are incorporated as essential components of the design, improving the finished work. It goes further than mimicking, to integration. The boundaries between the built environment and nature dissolve, and new hybrid typologies appear. As Salvador Dali said in response to Le Corbusier about the future of architecture: "...*architecture would become "soft and hairy.*"" [7] The Root Bridges of Meghalaya show a functioning fusion of nature and the built environment.

Bioclimatic architecture

The design of buildings and spaces that use the surrounding natural forces – the local climate – to create the optimal physical human comfort.

Bio-utilization

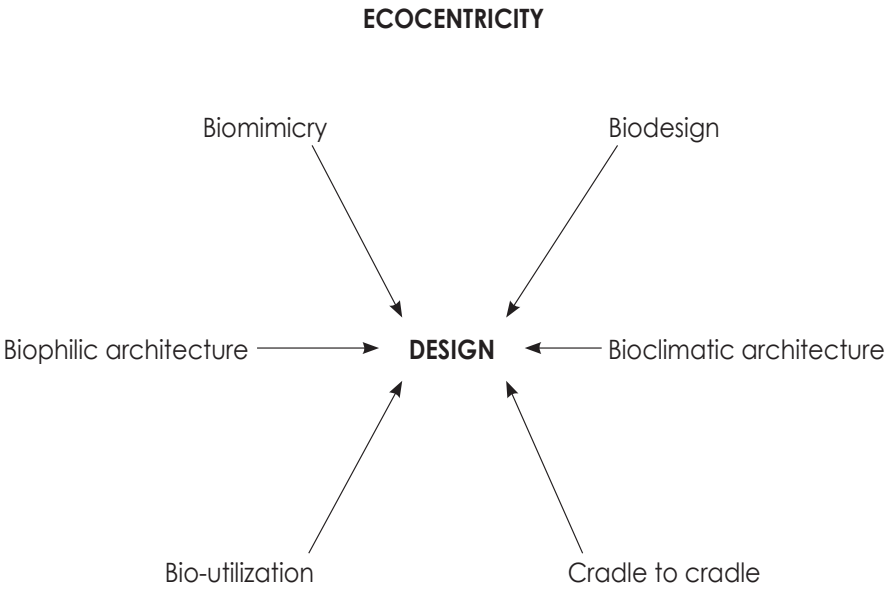
The direct use of nature, like the usage of plants to produce evaporative cooling or the production of eco-friendly materials with fungal mycelium.

Cradle to cradle

A design in which materials and products go from a linear process into a circular process. It is about creating systems that are efficient and waste free. A circular process in which everything can be endlessly recycled. Waste is turned into food for nature (biological) or for industry (technical). In architecture are cradle to cradle designs demountable, and often are locally produced materials used.

7 Dali, S. (1996). *Dali on Modern Art: The Cuckolds of Antiquated Modern Art.* New York: Dover Publications. This is a reprinted edition from the english translation from the bilingual edition published by the Dial Press in 1957. Page 29-31.

Not only one methodology should be used for a design, but multiple methodologies should be applied. It is about combining strategies until the needed ecocentricity is found, that is needed to change the world.



5. SITE

5.1. IDENTITY - HISTORICAL PRECEDENTS / THE WADDEN SEA AND ITS ISLANDS

The Wadden Sea Islands are a natural barrier that protect the mainland against high waves.[1] The Wadden Sea - the water between those islands and the mainland - consists of very shallow waters, with strong tidal currents. With approximately 8000 km^2 of sheltered waters, it is one of the biggest tidal areas in the world: it runs from the Dutch Den Helder till the Danish Esbjerg, along the Dutch, German and Danish coast. High and Low tide alternate every six hours, which causes a constantly changing waterscape: from an underwater landscape or an extensive system of channels, to dry sandbanks. The coastal polders and the islands together, have a large variety of landscapes on a small surface. From south to north there are the following landscapes: clay polders, embankment, salt marsh, mud flats, mud flats ditches, mud flats, salt marshes, island embankment, island polder, forest, dune, beach and coastal sea. This variety makes the Wadden Sea a unique habitat for more than 10.000 often rare plant and animal species, producing an exceptionally large food wealth. To survive, it is important to adapt. Beside this, it is an essential stopover for millions of birds during their migration.

Hydrologically speaking, the Wadden Sea consist of 39 tidal basins. Each of them consists of salt marshes, mud flats, channels, barrier islands and low tide deltas. They depend on the barrier islands and the high sandbanks. The tidal current gets compressed between the tidal basins, which creates sea holes up to 30 m. deep and strong currents.[2] Most of the sea holes split up after the barrier islands in large gullies, that in turn split into smaller ones. The fluctuating sea level and storms are constantly changing the geomorphology of the Wadden Sea. Sometimes new islands appear (Norderoog in Germany) or islands disappear (Bosch in The Netherlands; Buise in Germany; Jordsand in Denmark). With high tide, 15 km3 of seawater enters through sea holes and channels the tidal basins. At moments with a strong sea wind (mostly from the west), this can be even more. This can cause the water level to be 4 meters higher than normal and when the wind persists, the mud flats could stay underwater for multiple days. Strong offshore winds from the East are less common, but they can get the water level 1,5 meter lower than normal. Higher sandbanks and mud flats that are usually submerged, can remain dry for days.[3]

Lower Saxon Wadden Sea National Park

This constantly changing natural habitat is under threat by dyke building, agriculture, fishing, tourism, recreation and pollution from the North Sea and nearby rivers. To protect this coastal environment, it is designated as protected national park: the Lower Saxon Wadden Sea National Park (fig. ...). The Danish, German and Dutch governments started a number of research stations and projects, to study the hydrology, geomorphology and biology of the area, as well as the impact of human activities on this fragile environment.

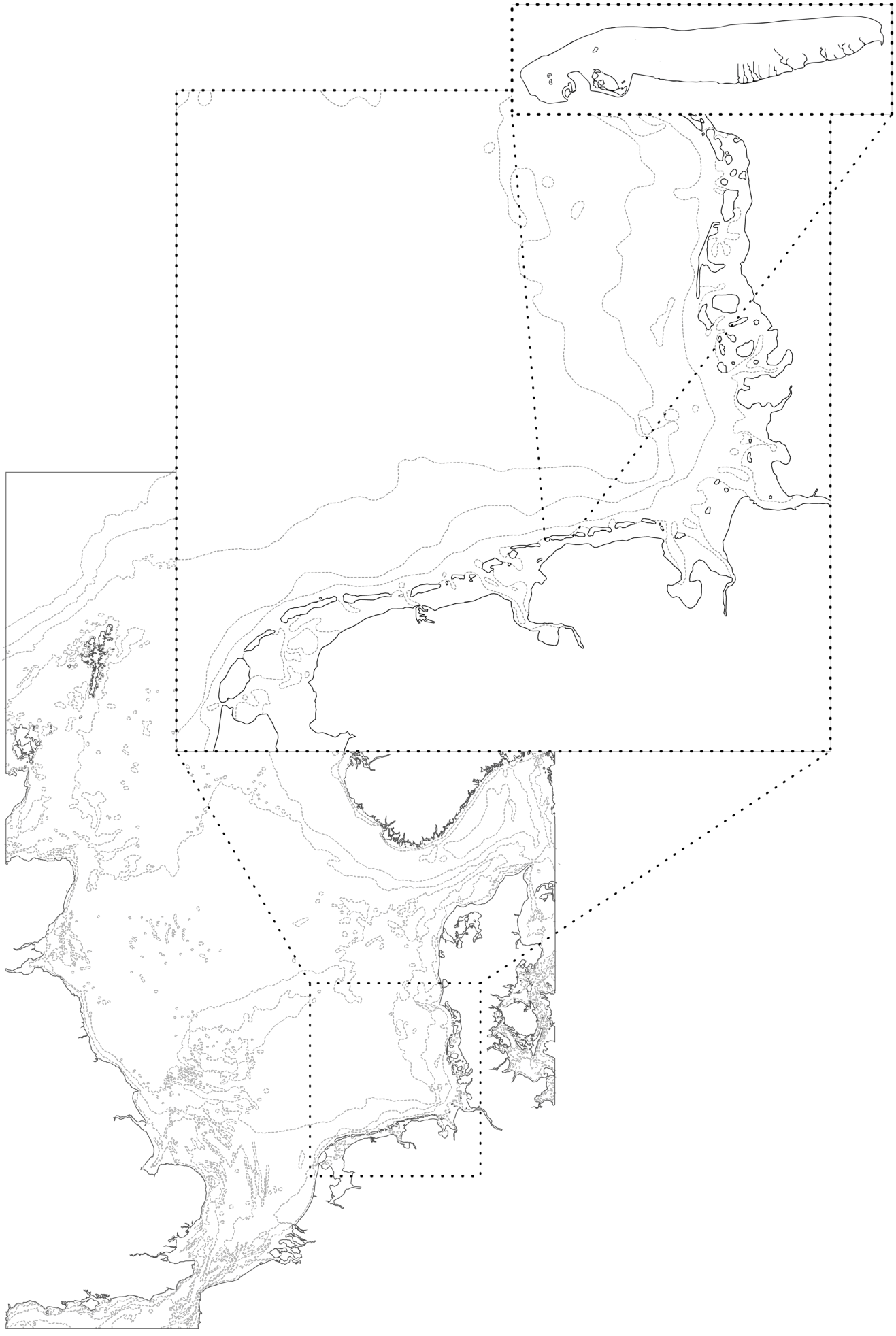
History of origin

The Wadden islands and the Wadden sea are a result of tides, waves, wind, and the rising sea level since the last ice age. During the last ice age (at the end of the Pleistocene), a large part of the North Sea was dry. Between Denmark and the Netherlands were probably giant steppes, empty and cold. Sun, wind, sand and water formed the land, which was mainly overgrown with hard, stiff grass. Only along rivers and lakes, grew some trees. Rivers, on their way to the sea, created deep valleys in the sediments, deposited during the Pleistocene. Hilly landscapes emerged, that later partly would be submerged. Once the climate became warmer, land ice started melting and the Holocene

1 Kunz, H. (n.k.). *Shoreline Protection of the East Frisian Islands of Norderney and Langeoog.* American Society of Civil Engineers. Retrieved from https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0051792

2 Waddenzee Werelderfgoed (n.k.). *Contouren ontstaan*. Retrieved from https://www.waddensea-worldheritage.org/nl/contouren-ontstaan

3 Waddenzee Werelderfgoed (n.k.). *Contouren ontstaan*. Retrieved from https://www.waddensea-worldheritage.org/nl/contouren-ontstaan



began. The rising sea level filled the North Sea more and more with water, with the deep valleys first to be flooded. This drowning landscape, formed during the last ice age, is still decisive for the formation of the Wadden landscape. By a combination of waves and currents, a series of islands with an active tidal area behind it where formed, similar to the current Wadden region. The processes are still ongoing, but now influenced by humans. In the last centuries, humans made some radical changes, which led to a reduction in the dynamics of the landscape:

- From the middle ages, the first small dikes were built on the Wadden Islands. From approximately 1900 dikes became longer, higher and stronger. This concerned dikes on the Wadden Sea side and constructions of sand-drift dikes (in dutch: stuifdijken) along the North Sea side. Land reclamation, forestry, water systems (ditches) and the extraction of groundwater for the drinking water supply, limited the natural flowing water and drifting sand. Because of this, the dunes became gradually drier and the vegetation increased.
- Around 1900, the direct use of the dunes and salt marshes decreased. Activities such as fuel extraction, winning helmet for roofing and grazing of cattle stopped, and led to a decrease in the large surfaces of drifting dunes.
- Around 1950, direct precipitation of nitrogen from the air increased, this was mainly due to the intensification of agriculture. This has led to a larger and faster vegetation growth on low dunes and salt marshes, high grass vegetation and even forest development. These chemical deposits reached around 1980 a maximum. Various environmental measures resulted in a decrease of the nitrogen concentrations in the precipitation, but the concentrations are still considerably higher than in the first half of the 20th century.

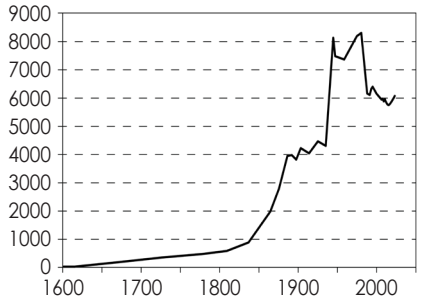


Figure 20 Population

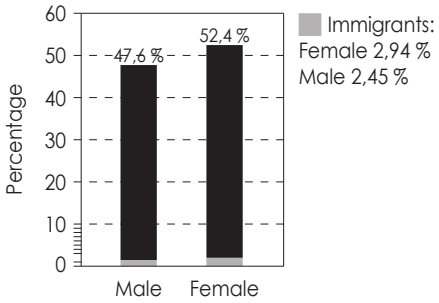


Figure 21 Gender

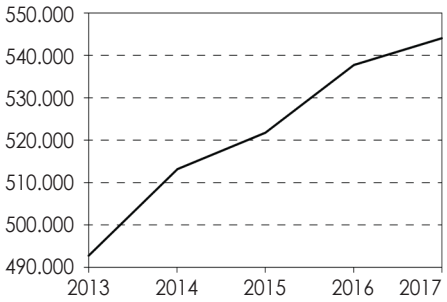


Figure 22 Toerism

History of existence

Norderney is different than the other islands. It came into existents by sand deposited by the Wadden Sea. Therefore, the island does not consist of a solid surface, with the result that the soil was infertile: only a number of pioneer species grew there. Wind created a row of dunes on which the first plants started to grow. The formation of the dunes also created different habitats, where different kind of flora and fauna could survive. White, grey and brown dunes, and dune valleys are now the formation of the island.

Lower Saxon Wadden Sea National Park

Since 1986, the Lower Saxon Wadden Sea National Park came into existence. It consists of the East Frisian Islands, and a large area of mudflats and salt marshes. Together with the Schleswig-Holstein Wadden Sea and the Dutch Wadden Sea, it has become a UNESCO World Heritage Site since June 2009. The national park is divided in three zones (fig 24):

Zone I the quiet zone (60,7%). Only a few areas are accessible, mostly as part of guided mudflat walks, and some along certain paths.

Zone II the intermediate zone (38,7%). With the exception of some bird reserves, those areas may always be entered on designated routes.

Zone III the recreation zone (0,6%).

The settlements and infrastructure on inhabited islands are not part of the national park's protection, only some recreational areas have protection under Zone III.

Coastal protection

Especially the west side of the island, is prone to flooding. With seawalls, groins and beach nourishment is tried to stop coastal erosion.[1]

Economy

Fishing, including shellfish harvesting, and tourism are important to the island economy.

Norderney became the first German resort on the North Sea in 1797.

Nowadays, land is no longer used for agriculture due to its location in the national park. East of the city are only some pastures for grazing horses and pastures in the polders on which Galloway cattle are kept.

1 Kunz, H. (n.k.). *Shoreline Protection of the East Frisian Islands of Norderney and Langeoog.* American Society of Civil Engineers. Retrieved from https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0051792

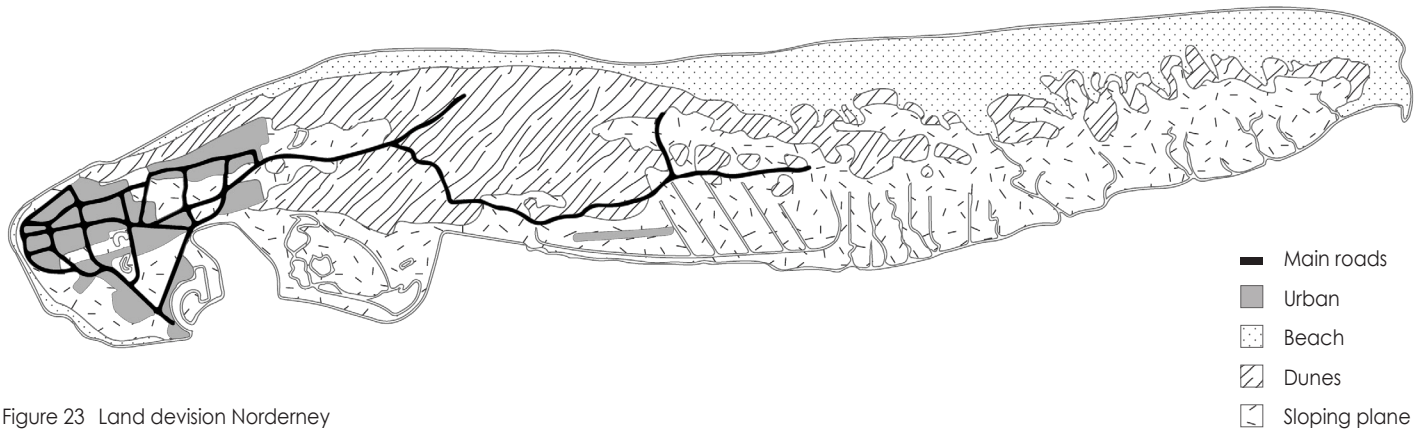


Figure 23 Land devision Norderney

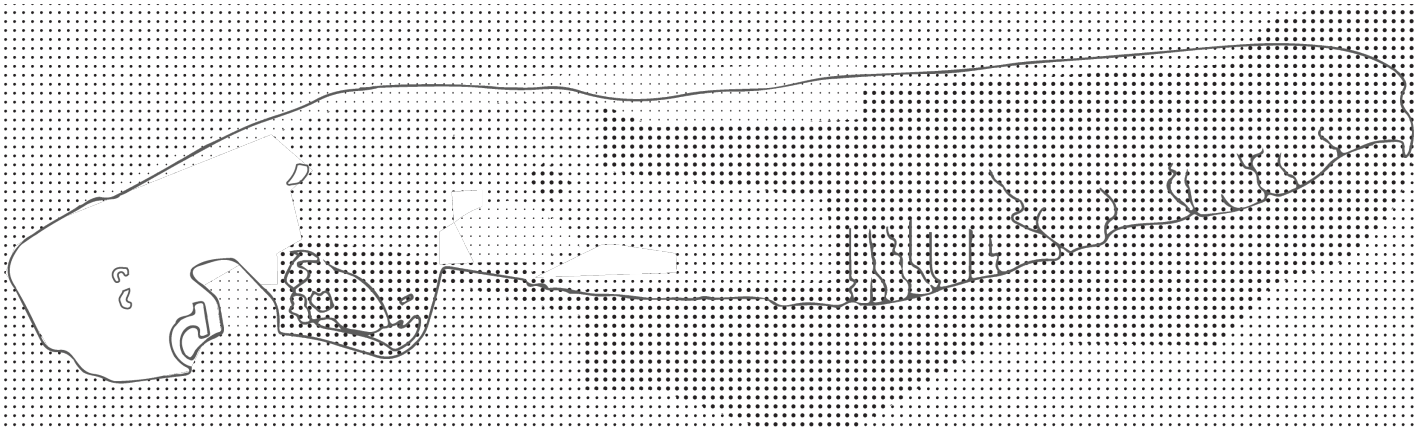


Figure 24 National park zones: protection status.

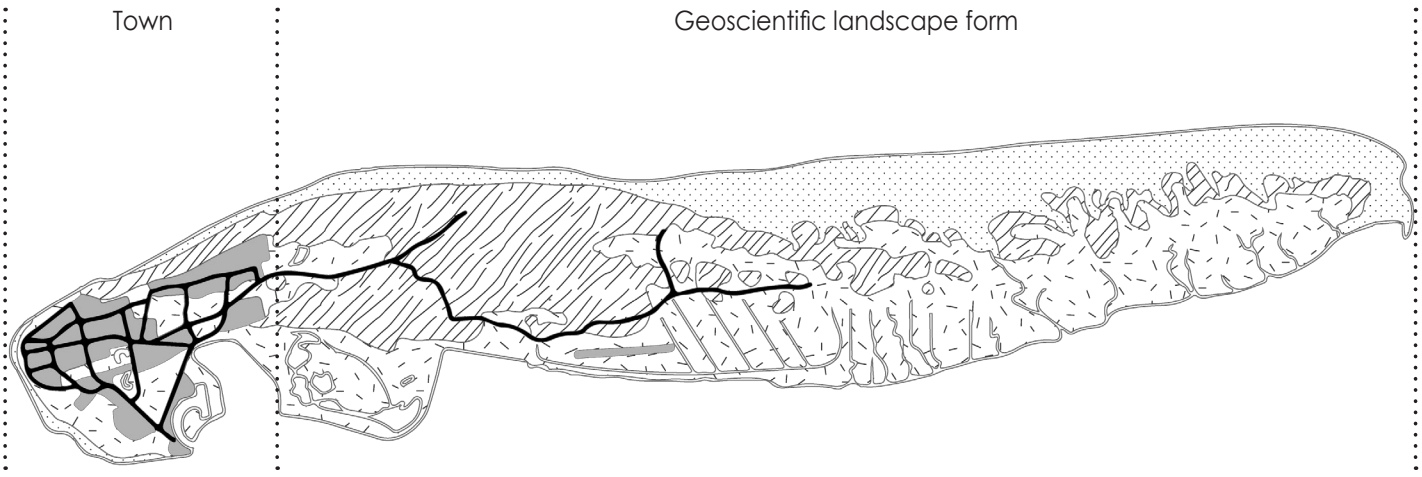


Figure 25 The town and the geoscientific landscape as two parts of the island

SUSTAINABLE NORDERNEY

Norderney is since 2013, as the only German destination, on the list of Quality-Coast-Destinations and in the Sustainable Destinations Global Top 100.[1] It is a progressive island where they appreciate their natural environment. Around the 80% of the terrestrial area and 100% of the marine area is protected. The public road network indicates exactly where it is allowed to walk and where not. In this way, visitors are directed on specific paths and the untouched nature can remain untouched. Natural beauties are preserved with this sustainable experience of nature.[2] Besides all the protected nature, Norderney tries to be more sustainable as a city:

- Renewable energy
  The usage of renewable energy is promoted by the municipality. Green energy and CO2-neutral gas is being used by 99% of the public buildings and services.[3]
- Circular economy
  Since 1990 construction rubble and garden waste is processed on the island. Broken construction rubble serves as a foundation for the construction of roads and paths. Soil extracted from green waste is used as an additional source of nutrients on the sandy island.
  Other garbage is since 1984 compressed and shipped to the mainland to be recycled.[4]
- Waste water treatment
  Used water goes to the purification plant, which is completely organic. It is one of the most modern factories in Germany. Due to the large volume of dirty water, especially in the summer months, it is designed for a capacity of up to 49,500 equivalent residents.[5] Downstream from this sewage treatment plant, is al complete ecological process for sewage sludge soil developed by EKO-Plant.[6] Since 1990, the sludge has been grounded in reed basins.

This circular economy and the protected nature are characteristics of Norderney. But, these important characteristics can cenrtainly be improved. The island can for example, be more self-sustaining. In order to live on the island, a lot needs to be imported from the mainland: like food, building materials and utensils .

1 In 2019, Norderney was once again chosen as one of the most sustainable tourist destination in the world. The Green Destinations Award is a recognition and tribute for innovative and entrepreneurial policy in the tourism sector. German National Tourism Board (2019). *De Duurzaamste Bestemming Ter Wereld: Norderney.* Travel 360°. Retrieved from https://travel360benelux.com/nl/german-national-tourism-board/norderney-duurzame-bestemming-itb/

2 Stadt Norderney (n.k.). *Weltnaturerbe Wattenmeer.* Retrieved from https://www.stadt-norderney.de/publish/172cb26f_7e90_43c1_766ed4cbda0e4326.cfm?m_id=42872

3 Sustainable Destinations Top 100 (n.k.). *Norderney.* Retrieved from http://sustainabletop100.org/dest/norderney-juist/

4 Stadt Norderney (n.k.). *Natur und Umwelt auf Norderney.* Retrieved from https://www.stadt-norderney.de/publish/c515e8ea_7e90_43c1_7e0c7a3ca135a1fd.cfm?m_id=42871

5 Stadt Norderney (n.k.). *Kläranlage.* Retrieved from https://www.stadt-norderney.de/publish/172cb2ec_7e90_43c1_7d040636d0f71038.cfm?m_id=42874

6 Stadt Norderney (n.k.). *Klärschlammvererdung durch das EKO-Plant - st- Verfahren.* Retrieved from https://www.stadt-norderney.de/publish/05ff1bba_7e90_43c1_7a9ac460e0fc3cf4.cfm?m_id=42930

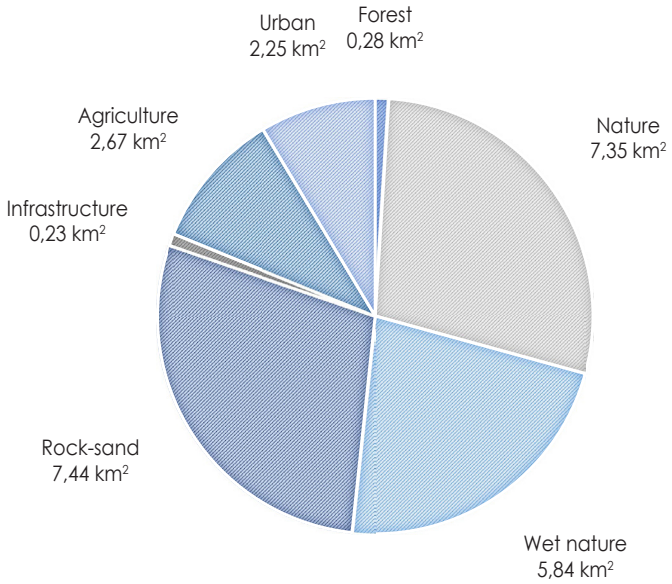
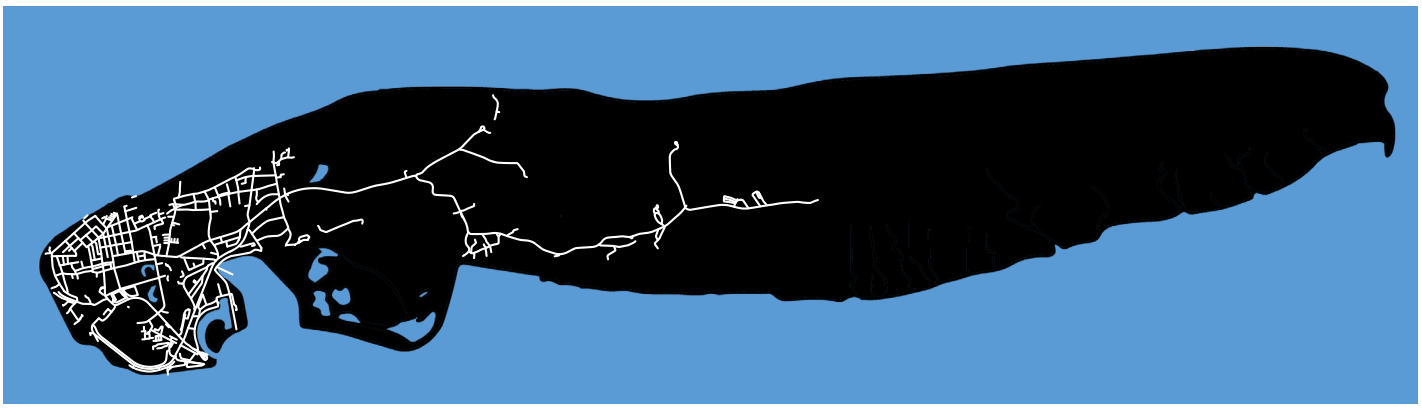


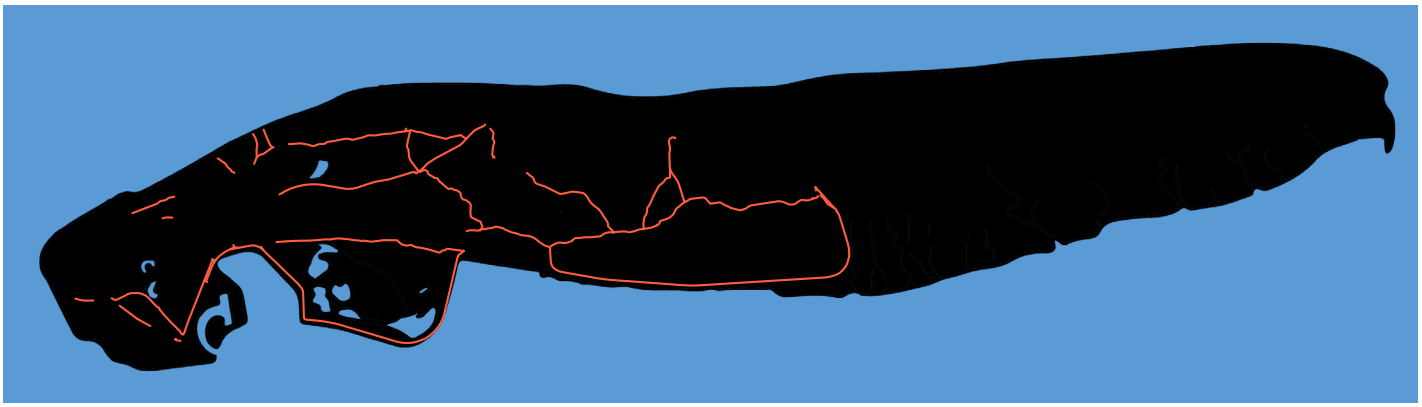
Figure 26 Land use Norderney
Derived from Eilanden info.

Infrastructure

Roads

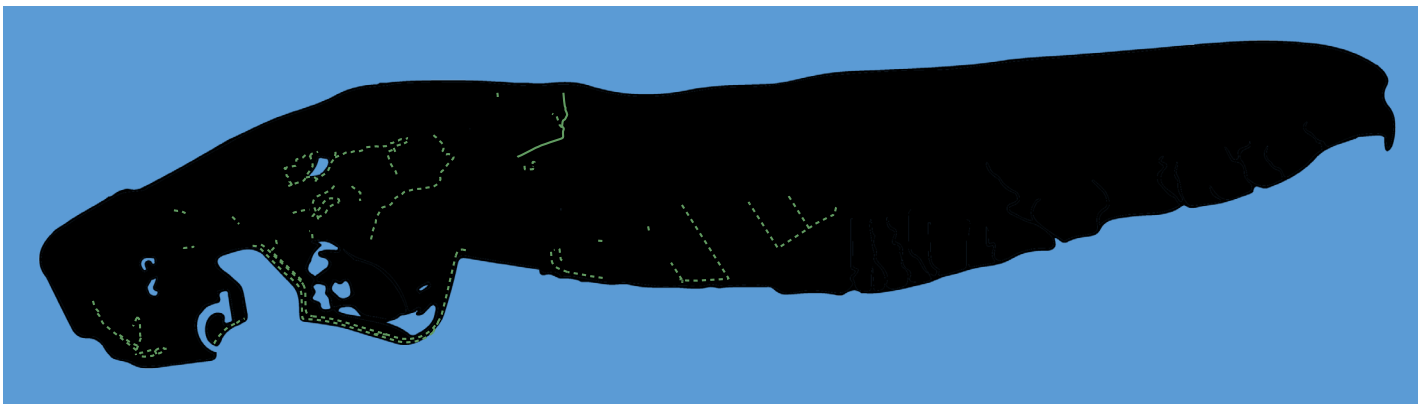


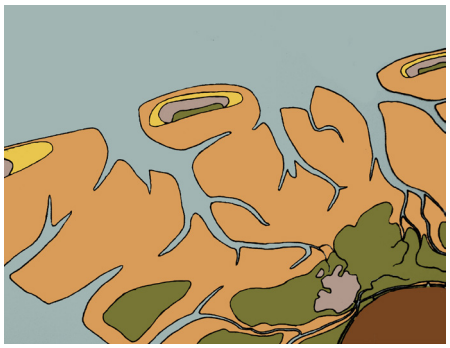
Bicycle paths

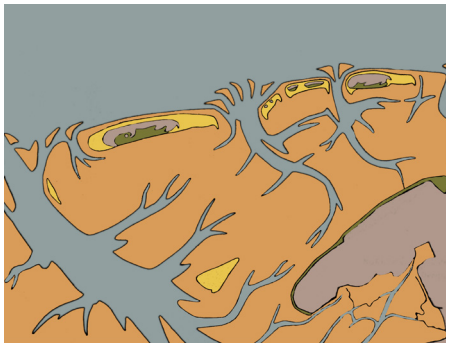


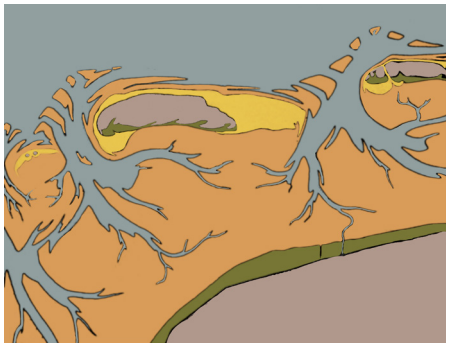
Pedestrian paths

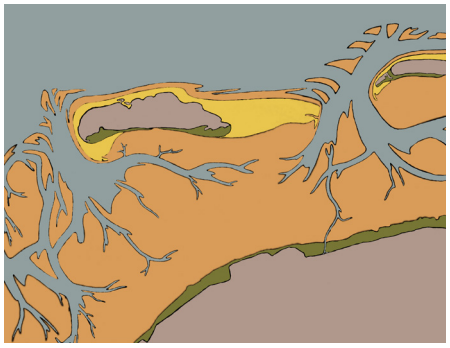
Dirt roads

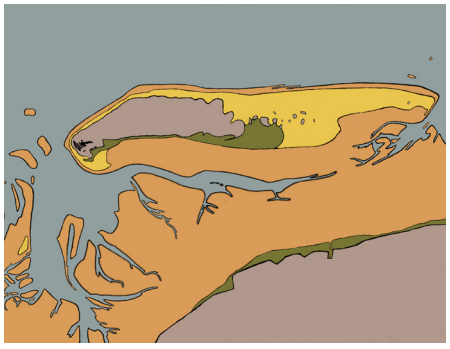












Constant changing
Figure ... shows how Norderney changed over time

Polders
The island has two polders, the Grohdepolder and Südstrandpolder. Nowadays used for birds, but initially meant for human activities, like an airport.

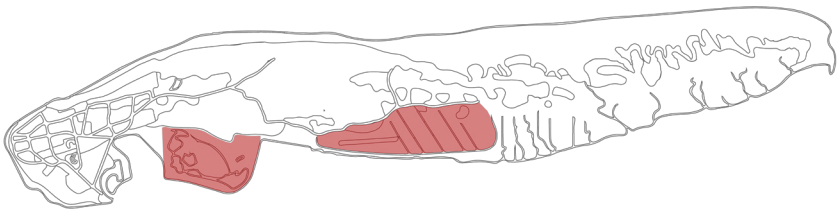


Figure 27 Grohdepolder and Südstrandpolder

Beaches

There are multiple beaches, each with their own function. The east (right) side of the island are natural beaches. Sand nourishment is needed to keep the beaches on the west (left) side.

Data used from:
Zijlstra, R., et al. (2017). *Coastal risk management*. In: Wadden Sea Quality Status Report. Common Wadden Sea Secretariat. Retrieved from https://qsr.waddensea-worldheritage.org/reports/coastal-risk-management

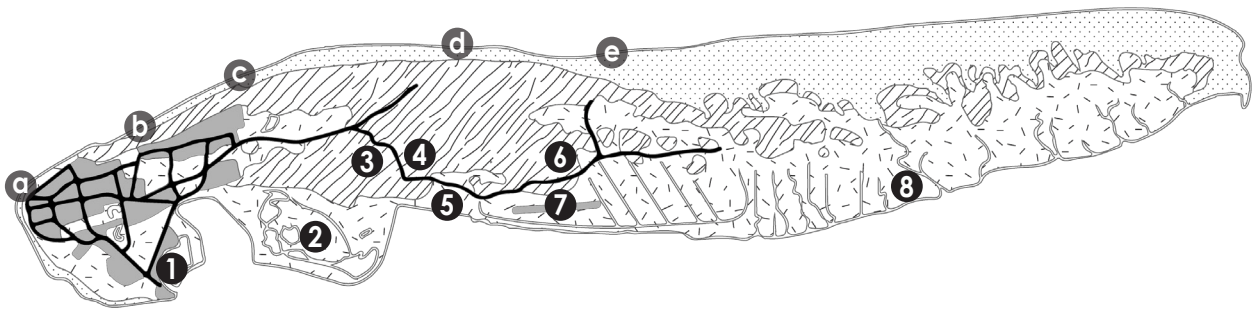


Figure 28 Highlighted locations

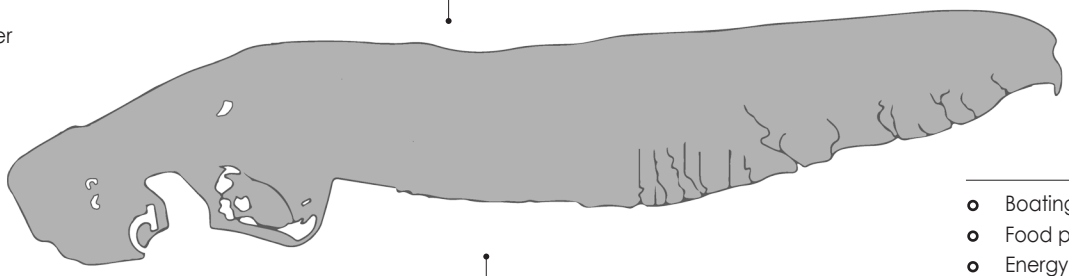
1. Harbor
2. Bird sanctuary
3. Youth hostel
4. Camp
5. Golf course
6. Lighthouse
7. Airport
8. Bird ranger

a. Norderney Westbadestrand
b. Norderney Nordbadestrand - *(wind)surfing*
c. Lippestrand
d. Weiße Düne - *beach sports*
e. Oase Strand - *family & nudist beach*

+ Opportunities
o Ecosystemservices
– Conditions

o Boating, swimming, etc.
o Food production (algaes)
o Energy production (waves)
+ Coastal protection
– Sailing route
– Zone II on water

o Boating, swimming, etc.
o Food production (algaes)
o Energy production (waves)
– Beach and marine ecosystems
– Zone II or III



o Boating, swimming, etc.
o Food production (algaes)
o Energy production (waves)
– Sailing route
– Zone I
– Restricted access

o Food production (oysters)
+ Constant changing environment
– Wadden Sea ecosystems
– Zone I or II

CLIMATE

Figure 29 Überfluteter Deich.
(Hans Carstens, 1962)

Figure 30 Kleine Sturmflut.
(Nomo Norderney, 2017)

Figure 31 Heute vor 2 Jahren (28.10.13) - Orkan Christian. (Wetterkanal, 2015)

Norderney is overall a windy island, with a temperature that typically fluctuates between the 1 and the 20 °C. Comfortable, windy, partly cloudy summers, are alternated by long, cold, extremely windy, mostly cloudy winters. The graphs on the right page, show the average weather on the island, but of course there are also sometimes extreme weather circumstances. Sometimes, this extremer weather causes natural events like floods or hurricanes (fig 29, 30, 31).

Rain, wind and cloud cover

As can be seen in fig 34, the rainiest day is around November 15. The average total accumulation is 58 mm. Around April 19, falls the least rain, with an average total accumulation of 28 mm.
The average windspeed on the island, is between the 5.5 m/s (30.2 km/h) and the 8.4 m/s (19.9 km/h). In extremer weather circumstances the wind speed can be higher. During Hurricane Christian the maximum wind gusts where even 136.44 km/h.
The percentage of the sky covered by clouds are, just like other weather conditions, varying per season. From April 1 till October 9 the sky is 55% of the time clear, mostly clear of partly cloudy. The other 45% of the time the sky is still overcast or mostly cloudy. From October 9 till April 1, the sky is 71% of the time overcast or mostly cloudy.

Daylight and solar energy

On Norderney, the length of the day in summer and winter varies extremely. The shortest day, 7 hours and 26 minutes, is in December. The longest day, 17 hours and 5 minutes, is in June. Shortwave solar energy is mainly depending on the length of the day. From April 27 till August 13, when the days are longer, there is an average daily incident shortwave energy of 5.1 kWh/m^2 or higher. From October 22 till february 22, this average daily incident shortwave energy is only maximal 1.6 kWh/m^2.

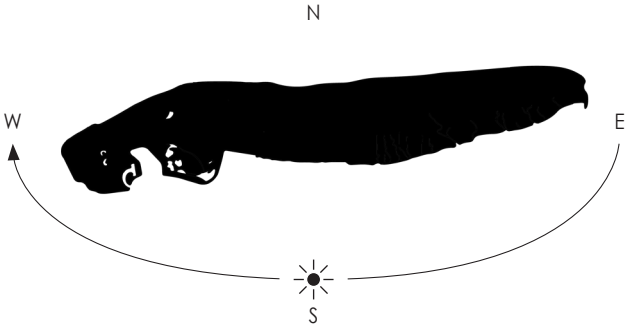


Figure 32 Sun orientation

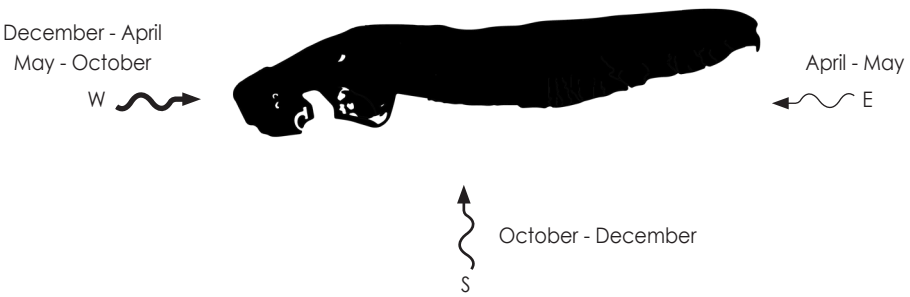


Figure 33 Most common wind direction

Rain, wind and cloud cover

Legend

- Average monthly rainfall (x10 mm)
- Average wind speed (m/s)

Cloud cover (x10 %):

- Overcast
- Mostly cloudy
- Partly cloudy
- Mostly clear
- Clear

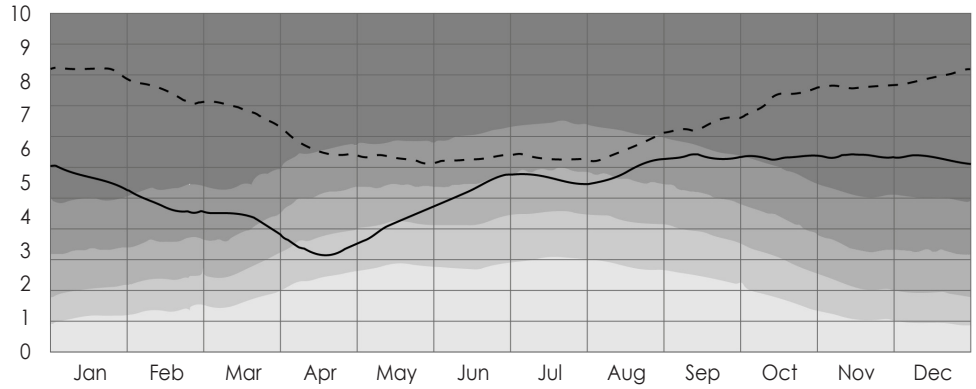


Figure 34 Rain, wind and cloud cover
Derived from Weather Spark.

Daylight and solar energy

Legend

- Hours of daylight (hr)
- Average daily incident shortwave solar energy (kWh)

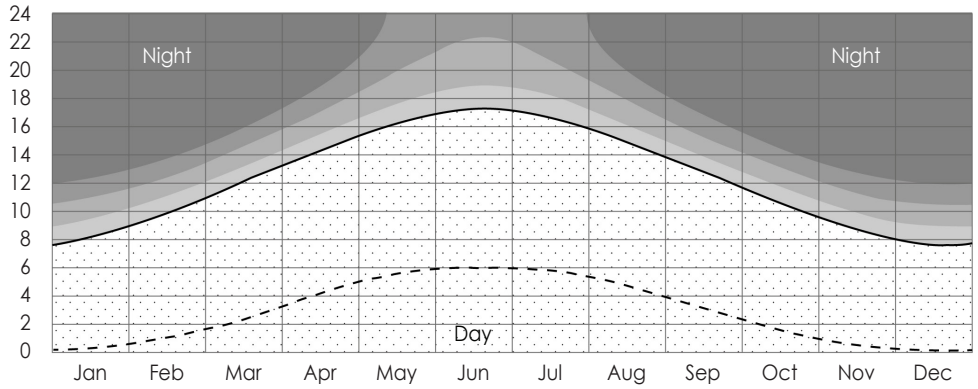


Figure 35 Daylight and solar energy
Derived from Weather Spark.

Land- and water temperature

Legend

- Average high temperature
- Average low temperature
- Percentile band temperature
- Average water temperature

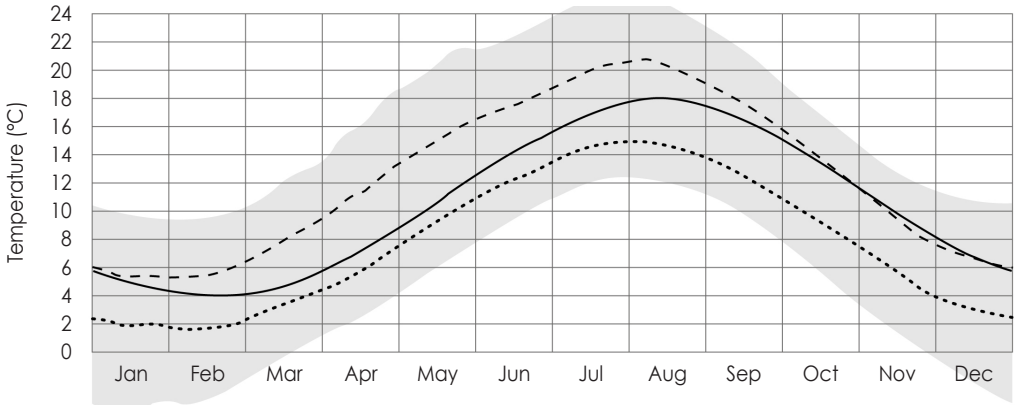


Figure 36 Land- and water temperature
Derived from Weather Spark.

A balance between sea level rise and sedimenttransport

With the rising sea level, the average speed of the currents will decrease, causing a disproportionate reduction of sediment transport. Normally nearly the same amount of sediment will be tranported in, and out of the tidal basins. With an increased water depth, the system will be disturbed. Ebb currents will be slower than flood currents, causing more sediment to be transported in the basins than out. This extra sediment will decrease the water depth again, which brings it back to its previous balance. This way, the sedimenttransport will let the bottom of the Wadden Sea follow the rising sea level.[1]
Nevertheless, it is still uncertain how the Wadden Sea will look like in the future. The balance between sea level rise and sedimenttransport, is namely completely dependant on the availability of sediment.[2] Without enough sediment, the tidal flats will not rise, and the Wadden Sea will continuously be submerged. The characteristics and availability of sediment change the morphologic response and response times.[3]

Norderney has a tidal range of 2,4 m.

The Norderneyer Seegat has maximum tidal current velocities of 1,5 m/s.

1 Müller, J. (2004). *Long-term Morphological Evolution of the Norderneyer Seegat.* Technical University Delft. Retrieved from http://resolver.tudelft.nl/uuid:18e68bbe-3719-4809-9c4a-8417b14ce155 Page 27.

2 Van Goor, M. A., Zitman, T., Wang, Z. B. and Stive, M. J. F. (2003). *Impact of sea-level rise on the morphological equilibrium state of tidal inlets.* Marine Geology, 202, 3-4. https://doi.org/10.1016/S0025-3227(03)00262-7 Page 211–227.

3 Benninghoff, M. and Winter, C. (2019). *Recent morphologic evolution of the German Wadden Sea.* Scientific Reports, 9:9293. https://doi.org/10.1038/s41598-019-45683-1 Page 6.

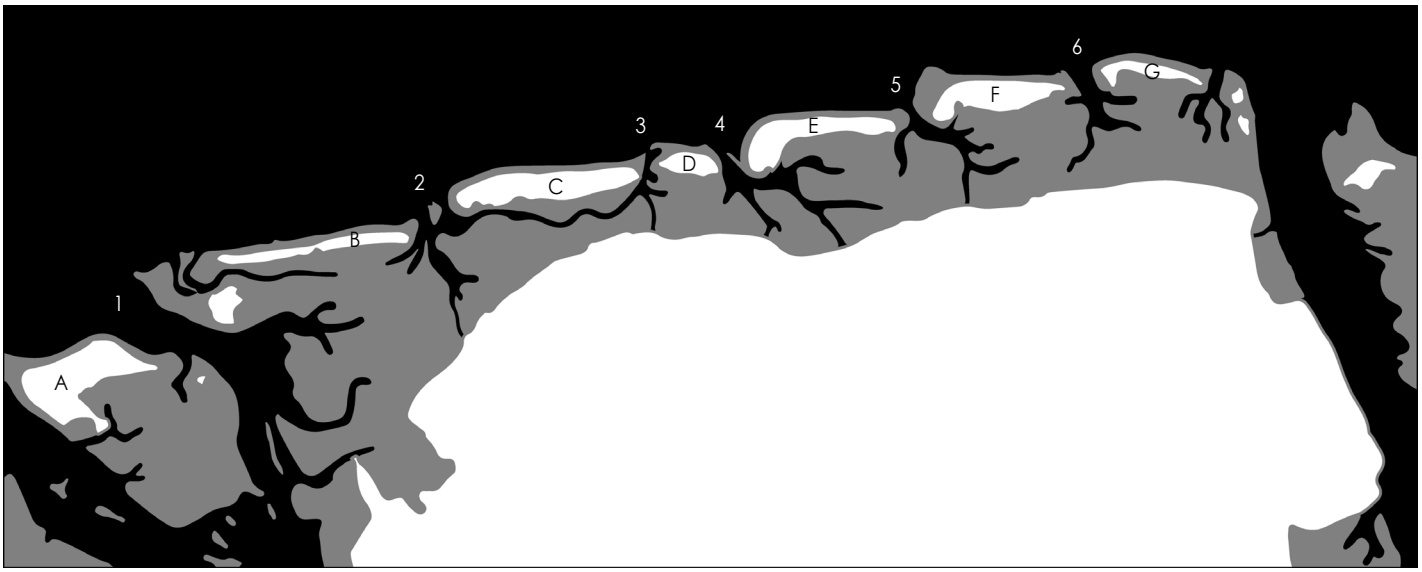


Figure 37 Wadden Sea area of Lower Saxony
Derived from Müller, J. (2004, page 13).

- Intertidal flats
- North Sea and tidal channels
- 1 Osterems
- 2 Norderneyer Seegat
- 3 Wichter Ee
- 4 Accumer Ee
- 5 Otzumer Balje
- 6 Harle
- Barrier islands and main land
- A Borkum
- B Juist
- C Norderney
- D Baltrum
- E Langeoog
- F Spiekeroog
- G Wangerooge

DIKES

The Hauptdeich

The Hauptdeich (translated as main dike) of the island is approximately ten kilometres long and consists of the Sübstrandpolderdeich (translated as the Southern beach polder dike) built in 1940/1941, and the Grohdepolderdeich built from 1926 to 1928. This Hauptdeich protects the southern side of the island.

Sübstrandpolderdeich

The dyke of the Sübstrandpolder was increased and modernized between 1999 and 2004. The main revetment was replaced with rubble stones and a paved path was laid on top of it. The height of the dyke increased from 5.2 m. to approximately 6.6 m. above sea level (see fig. 41 for the exact heights of the dyke). A lock to connect the Wadden Sea side with the saltwater lake on the inside of the dyke, was completed in 2004.

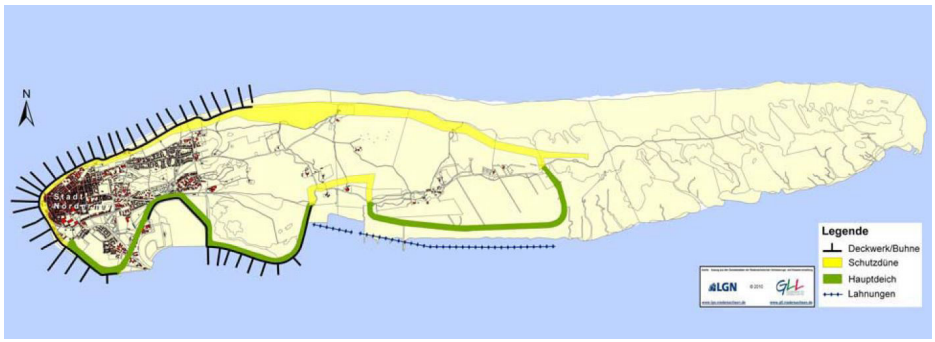


Figure 38 Ring aus Küstenschutzanlagen am Beispiel von Norderney (NLWKN, 2010)

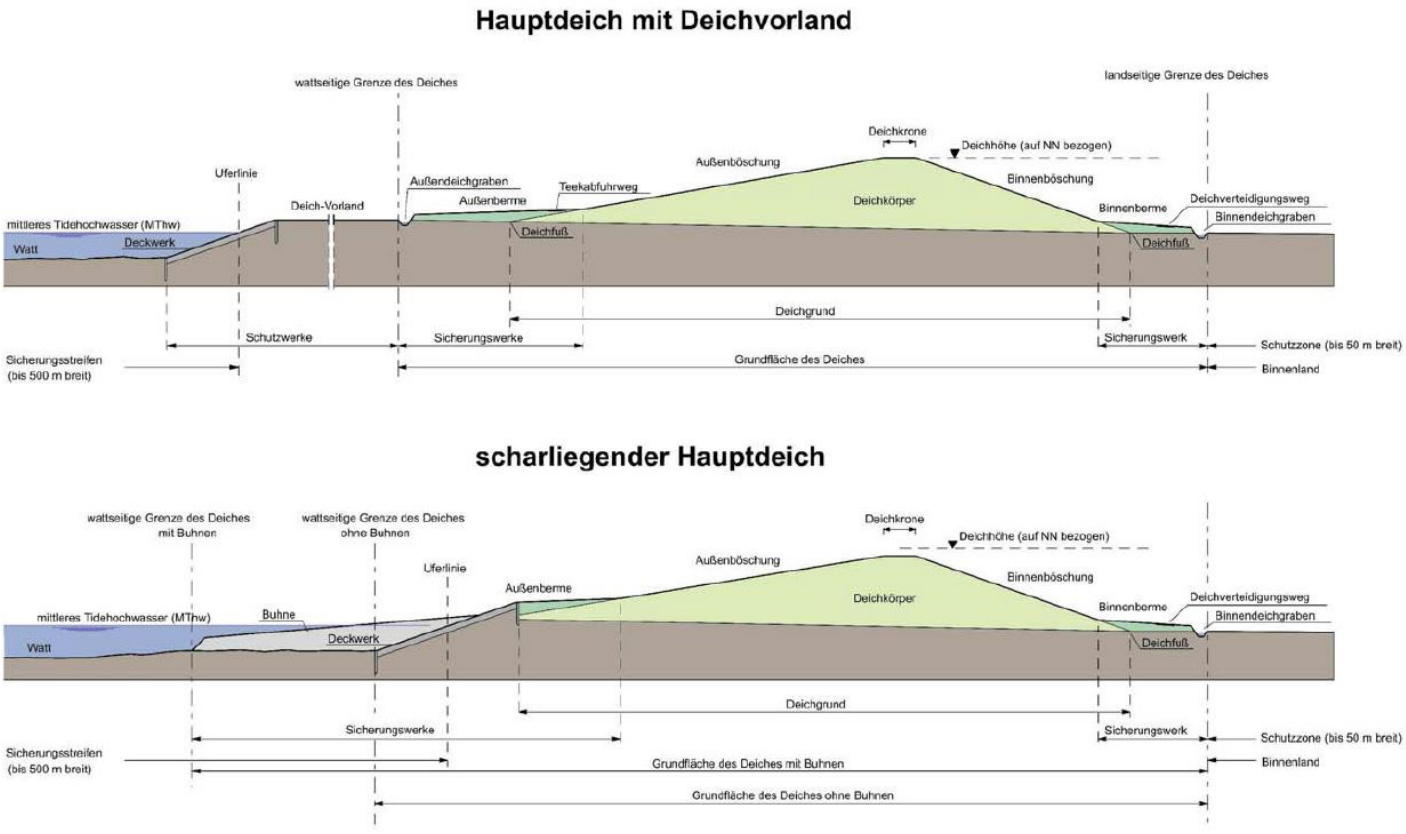


Figure 39 Profile of the Hauptdeich (NLWKN, 2010)

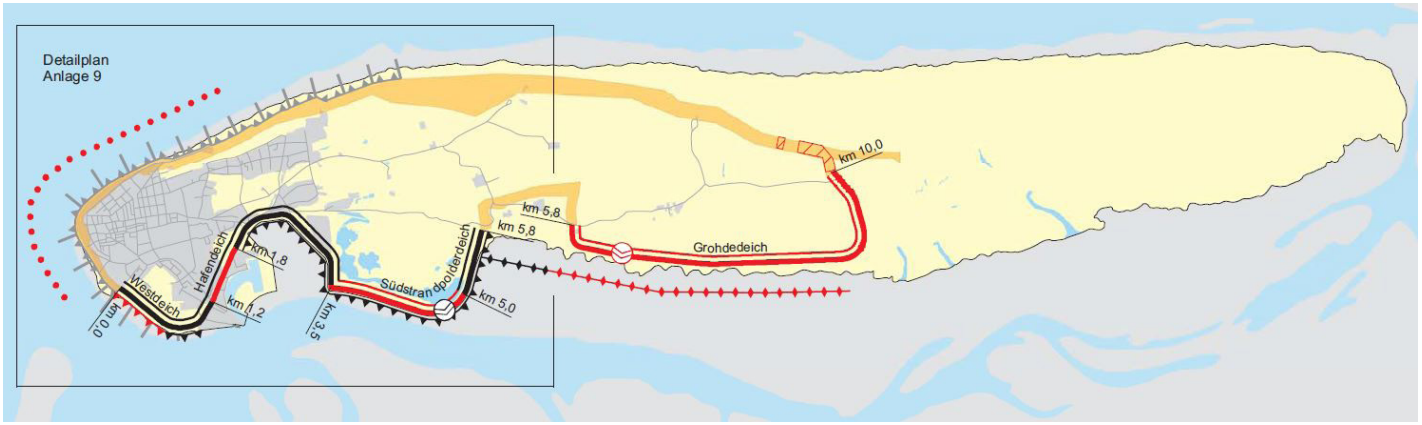


Figure 40 Dikes Norderney
(NLWKN, 2010)

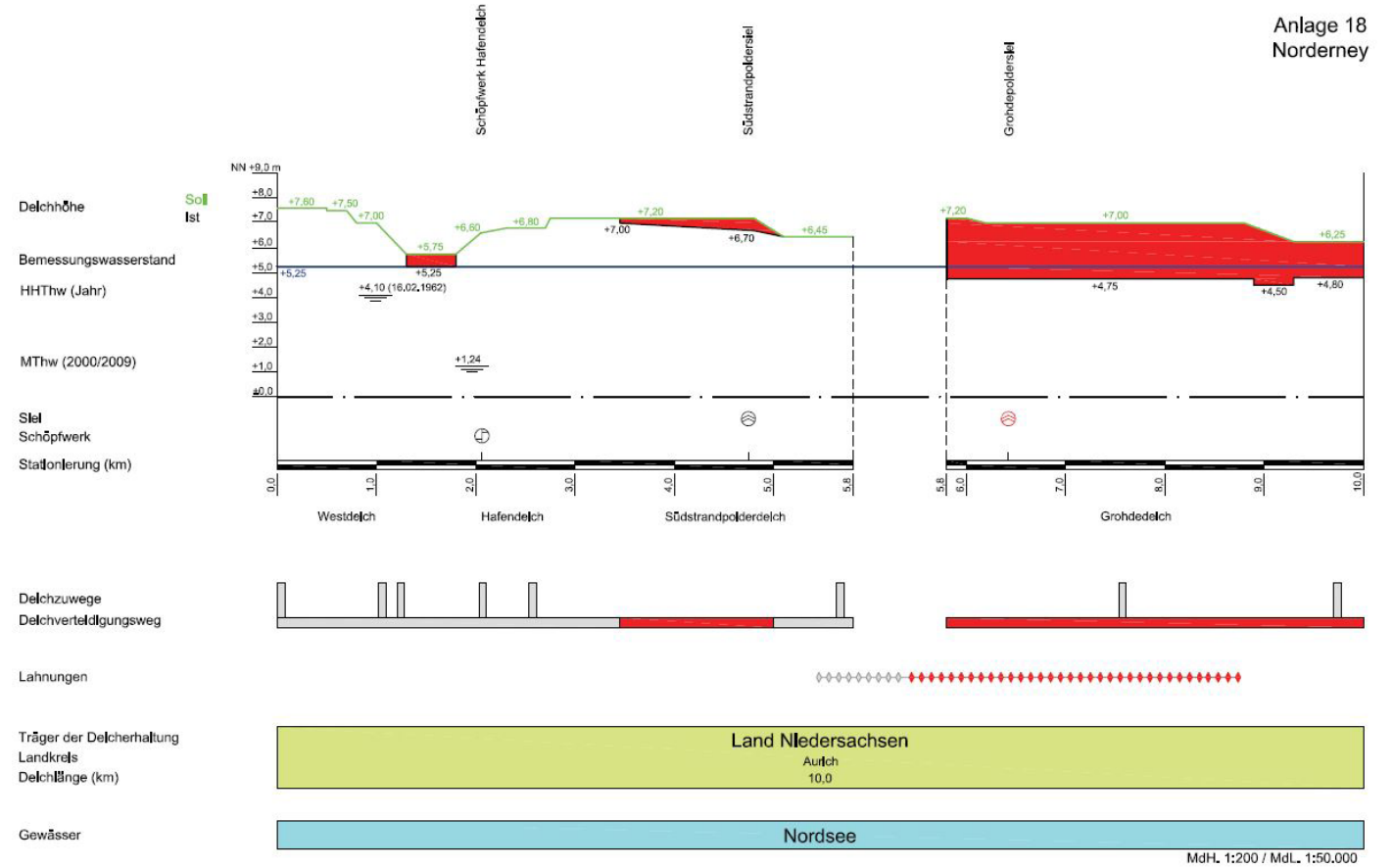


Figure 41 Dikes heights Norderney
(NLWKN, 2010)

Man-Made environments

Harbour

Luftbild Norderney (Havenmeester, n.k.)

Urban

Infrastructure

Airport

Flughafen norderney (Nordseewolf, n.k.)

Campsites

Beach *(sand nourished)*

Embankments: *Dykes*

Sea walls

Groins

Man-Made Nature environments

Polders

Parks

Napoleonschanze
(Norderney Nordsee-Magazin, n.k.)

Pasture land

Norderney-Pferde (Sabine Groel-Koch, 2018)

Natural environments

Beaches

Tidal creeks

Dunes: *Fore dunes*

Dune slacks

White dunes

mudflat

Grey dunes

Salt marshes

Brown dunes

Forest

Apartments

Detached houses

Row houses

Public buildings

Bird watching hut

Weisse Düne Restaurant

Beach pavilion

Lighthouse

Visitor centre

Mill

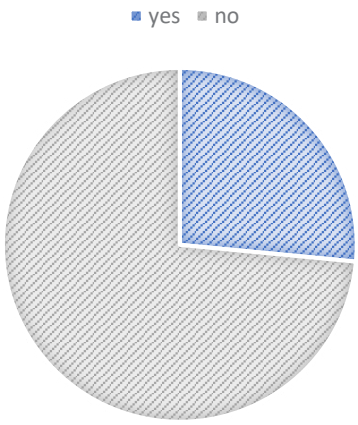
Primary school

Post office

INTERVIEW

I wanted to know more about what peoplle think about certain topics. Their opinion could help me make decision in the coming designing process.
In the attachments is the original interviewform I used to question people.

ARE YOU A RESIDENT OF NORDERNEY?

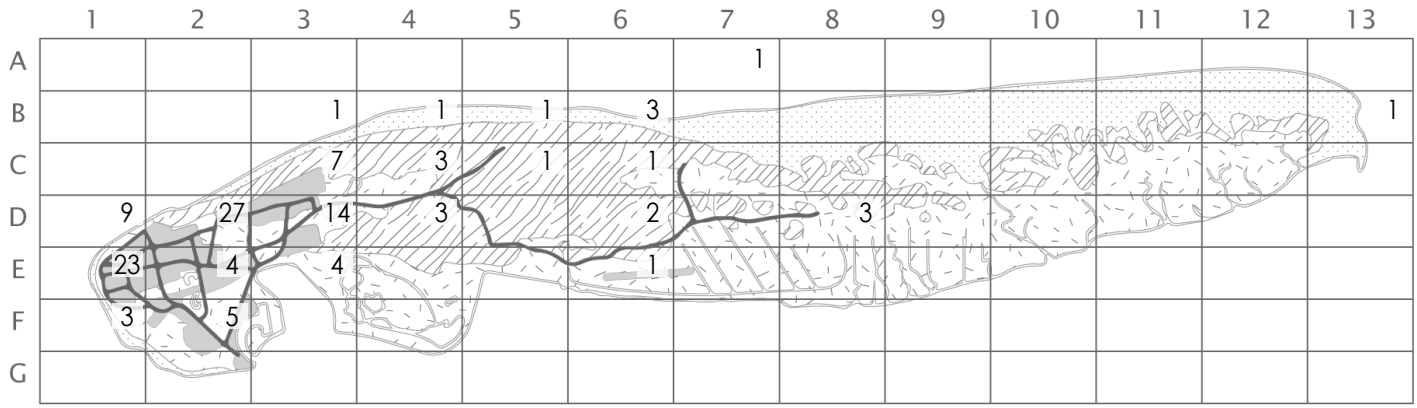


RESPONSES

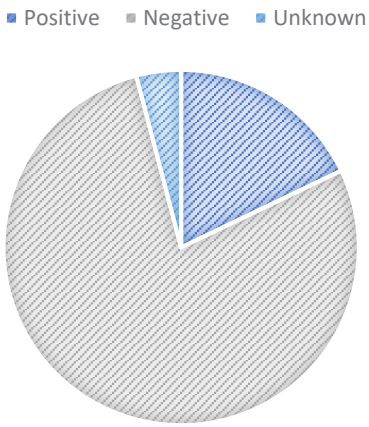
“Es ist toll auf Norderney... Zumindest in den Zeiten, wo nicht so viele Touristen unterwegs sind, die alles und jeden Moment Fotografien müssen, einen mit ihrem E- Bike (welches sie nicht beherrschen) umfahren oder einen anmotzen, weil man zu langsam durch die Straße laufe. Mensch, ihr macht Urlaub!”

It’s great on Norderney... At least in times when there are not so many tourists who have to take photos of everything and every moment, drive around with their e-bike (which they do not master) or puk one because you walk too slowly through the street. Man, you are on vacation!

IF YOU COULD LIVE ANYWHERE ON THE ISLAND, WHERE WOULD YOU LIKE TO LIVE?



WHAT DO YOU THINK ABOUT LIVING IN SCHUTZZONE 1 (PROTECTION ZONE 1) OF NORDERNEY?



SOME NEGATIVE RESPONSES

Tourismusprobleme:

"Bin strikt dagegen. Es bringt niemanden etwas, denn es ist jetzt sowieso schon schwer genug die aktuelle Anzahl an Touristen zu versorgen..also das notwendige Personal für Gastronomie, Hotellerie etc zu bekommen. Es schadet einzig und allein der Umwelt und den Norderneyern selbst. Selbst wenn der Wohnraum nur für Norderneyer sein soll..ist es zwar gut gemeint, wird aber niemals so bleiben (das Geld und die Gier regiert am Ende)."

"Leider ist dort zu wenig Wohnraum für Insulaner da erstens zu teuer und zweitens fast alles Ferienwohnungen."

Gehäuseprobleme:

"Trotz der schwierigen Wohnungslage auf der Insel, würde ich eine Bebauung der Schutzzone nicht befürworten."

"Die Schutzzone (Ruhezonen) sollte als dieses bestehen bleiben. Wohnraum hätte gebaut worden können (ehemals Kletterpark, ehemals Therapiezentrum (hinter Conversationshaus)."

"Dort sollte kein Wohnraum entstehen! Es gibt genug Wohnraum, der besser aufgeteilt werden müsste und das dringend!"

"Unbedingt eine Schutzzone,-der Tourismus ist ja extrem geworden .Insulaner können ja kaum noch auf der Insel leben und wenn dies Wohnraum wäre...wären die Preise auch wieder extrem hoch."

Tourism problems:

I'm strictly against it. It does not help anyone, because it is already difficult enough to "supply" the current number of tourists anyway.. So to get the necessary staff for gastronomy, hotels, etc. It only harms the environment and the Norderneyers themselves. Even if the living space is only for Norderneyers.. It is meant well, but will never stay that way (money and greed rule in the end).

Unfortunately, there is too little living space for islanders because firstly it is too expensive and secondly almost everything is holiday apartments.

Housing problems:

Despite the difficult housing situation on the island, I would not advocate building in the protection zone.

The protection zone (quiet zones) should remain as it is. Living space could have been built (formerly climbing park, formerly therapy center (behind the conversation house))

No living space should be created there! There is enough living space that should be divided better and urgently!

Definitely a protection zone - tourism has become extreme and because of this, islanders can hardly live on the island. If this were living space ... the prices would be extremely high again.

Ökosystemprobleme:

"Der Name sagt alles: RUHEzone sollte auch wirklich Ruhezone sein. Ohne funktionierende Flora und Fauna wäre die Insel nichts..."

"Sie ist sowohl für die Tier als auch für die Pflanzenwelt absolut notwendig! Meiner Meinung nach sollte auch für Wanderer das betreten eingeschränkt werden, vor allem im Inselosten."

"Das ist nicht in Ordnung. Der Wohnraum sollte nicht durch Gefährdung von Natur erweitert werden. Die Natürlichkeit der Insel muss in den Schutzzonen erhalten bleiben."

"Der jetzige bewohnte Bereich muss ausreichen."

"Schlimm, sollte nicht gemacht werden..... Schutzzone 1 als Wohnraum bedeutet die Natur zahlt für die Geldgier der Verwaltung und der Insulaner."

"Dies sollte nicht gemacht werden. Die Tiere sollten nicht noch weiter von uns Menschen verdrängt werden!"

"Es wird sowieso schon zu viel gebaut auf Norderney. Man sollte wenigstens ein bisschen Natur noch erhalten lassen. Es geht nicht immer nur ums Geld im Leben!"

SOME POSITIVE RESPONSES

"Sehr gut, damit nicht die komplette Insel vom Tourismus vereinnahmt wird!"

"Wohnraum für Insulaner muss dringend her."

"Ist ganz gut, so gibt es Ruhe in der Stadt."

"Wenn Wohnraum, dann nur noch für norderneyer. Es kann nicht sein das man als Jugendlicher gezwungen ist wegzuziehen da es keinen Wohnraum mehr gibt."

Ecosystem problems:

The name says it all: RUHEzone should really be a quiet zone. Without functioning flora and fauna, the island would be nothing...

This area is absolutely necessary for both animals and plants! In my opinion, this should also be restricted for hikers, especially the east part of the island.

It's not OK. The urban space should not be expanded by endangering nature. The naturalness of the island must be preserved in the protected areas.

The current inhabited area must be sufficient.

Bad, shouldn't be done ..... Protection zone 1 as living space means nature pays for the greed of the administration and the islanders.

This shouldn't be done. The animals should not be pushed out even further by us!

Too much is being built on Norderney anyway. At least a little bit of nature should be preserved. It's not always about money in life!

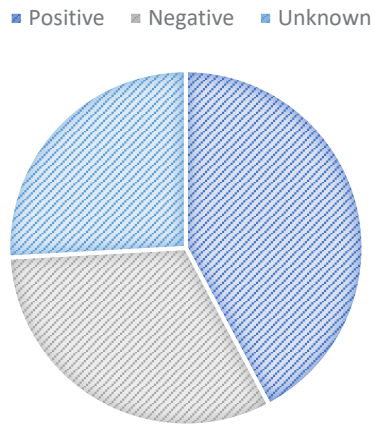
Very good, so that the entire island is not taken over by tourism!

Housing for islanders is urgently needed.

It's quite good, there will be more tranquility in the city.

If it becomes living space, then only for norderneyers. It cannot be that teenagers are forced to move away, because there is no more living space.

WHAT DO YOU THINK ABOUT LIVING ON THE WATER?



only temporary: 25

SOME NEGATIVE RESPONSES

“Auch hier sollte kein Wohnraum errichtet werden. Das sind unnatürliche Eingriffe in die Natur.”	Also here should not be built. Building there are unnatural interventions in nature.
“Die Meere leiden schon genug unter der Verschmutzung der Menschen, da muß man sie nicht auch noch zum Lebensraum machen und noch mehr belasten.”	The seas already suffer enough from the pollution of the people, you don’t have to make them a habitat and burden them even more.
“Wassersport in den ausgewiesenen Strandabschnitten ist gut. Wildtiere wie Seehunde werden dadurch nicht gestört.”	Water sports in the designated sections of the beach are alright. Wild animals, such as seals, are not disturbed by this.
“Nicht notwendig auf Norderney. Lieber das Gästewohnen besser regulieren.”	Not necessary on Norderney. Rather regulate the guest houses better.
“Der Mensch muss sich nicht überall breit machen.”	Humans don’t have to spread out everywhere.
“Wenn sie Pfahlbauten meinen, auch das nicht, da bewohnte Zonen immer die Natur negativ beeinflussen.”	If you mean stilt houses, no, since inhabited zones always have a negative impact on nature.
“Damit kenne ich mich nicht aus und kann somit keine Aussage treffen. Ich weiß nicht wie die Möglichkeiten heutzutage sind und ob man, ohne das Ökosystem Meer zu schädigen, auf dem Wasser bauen kann. Generell denke ich, sollte der Mensch sich etwas zurück nehmen, statt sich mehr und mehr überall auszubreiten.”	I am not familiar with this and therefore I cannot make a statement. I don’t know what the options are today and whether you can build on water without harming the ocean ecosystem. In general, I think people should take something back instead of spreading more and more everywhere.
“Auch hier wird ins Ökosystem eingegriffen. Zuleitungen von Wasser/ Abwasser/Strom und evtl. Gas...”	The ecosystem is also here affected. Supply of water / waste water / electricity and possibly gas...
Leben auf dem Wasser?? Lasst den Lebewesen im Wasser Ihren Lebensraum.Wir Menschen haben hier nichts zu suchen. Es reicht schon, dass die Windkrafträder ,die Fähren und Frachtschiffe die Ruhe stören. Das Leben auf dem Wasser wird doch sicherlich wieder nur für Touristen angedacht.Die ganze Kultur wird schon durch diesen Massentourismus kaputt gemacht. Zudem sind in einigen Monaten nur Leerstände...die die Wirtschaft in dieser Region auch nicht braucht.	Living on the water?? Let it be the living space of the creatures in the water, we humans have no business there. It is enough that the wind turbines, the ferries and cargo ships disturb the calm. Life on the water will surely only be considered for tourists again, the whole culture will be ruined by this mass tourism. In addition, there are a few vacancies in a few months... which the economy in this region does not need either.

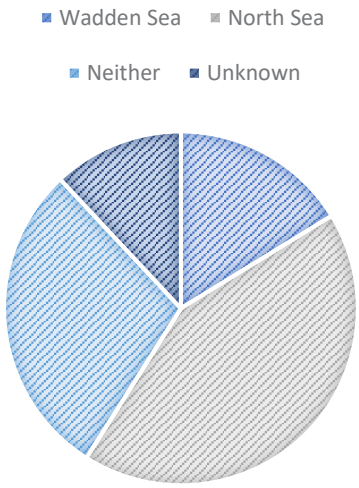
SOME POSITIVE RESPONSES

“Finde ich eine tolle Idee, so könnte man auch auf Inseln den Lebensraum erweitern.”	I think it is a great idea, this way you can expand the habitat on islands.
“Jeglicher Schiffs- und Bootsverkehr sollte in Grenzen gehalten werden.”	All ship and boat traffic should be kept within limits.
“Auf Binnengwaessern kann ich mir das gut vorstellen, auf dem Meer nicht.”	I can imagine that on inland waters, not at sea
“Das Leben auf schwimmenden Potons sollte in Küstenregionen ausgebaut werden. Der Meeresspiegel wird unaufhörlich steigen und so sichert man Raum in küstennähe.”	Life on floating potons should be expanded in coastal regions. The sea level will rise incessantly and this can secure space near the coast.
“Ja, da wo die bestehende Natur nicht beeinträchtigt oder zerstört wird”	Yes, where the existing nature is not impaired or destroyed.
“Würde ich spannend finden mit direktem Zugang zum Festland”	I would find it exciting with direct access to the mainland.
“In Form von Hausbooten im Hafen find ich das großartig, aber nicht erbauen von Anlagen auf dem Wasser!!”	In the form of houseboats in the harbor, I think that’s great, but not building systems on the water!!
“Kann durch im Einklang mit der Natur stattfinden.”	Can take place in harmony with nature.
“In Kanälen und Flüssen ja, im Wattenmeer an Stränden nein.”	In canals and rivers yes, in the Wadden Sea on beaches no.
“Das wäre ein Traum.”	That would be a dream.

SOME UNKNOWN RESPONSES

“Ein Leben auf dem Wasser ist für mich nicht vorstellbar.”	Life on the water is inconceivable for me.
“Kann ich nichts zu sagen hab noch nie auf dem Wasser gewohnt oder Urlaub gemacht.”	I can’t say anything about that. I’ve never lived or had an vacation on the water.
“Kann ich mir nicht vorstellen.”	I can’t imagine it.
“Es hat alles seine Vor- und Nachteile. Es kann eine Bereicherung für Tiere und Natur sein aber auch eine Gefahr.”	Everything has its advantages and disadvantages. It can be an enrichment for animals and nature but also a danger.

WOULD YOU PREFER TO LIVE ON THE NORTH SEA OR ON THE WADDEN SEA?



WADDEN SEA

“Wattenmeer da sieht man die Natur live.”	Wadden Sea, there you can see nature live.
“Lieber am Wattenmeer, da es dort verhältnismäßig ruhig sein sollte.”	Preferably on the Wadden Sea, because it should be relatively quiet there.
“Wenn dann überhaupt im Wattenmeer, da es dort nicht so wellenbehaftet ist.”	If at all, then in the Wadden Sea, since it is not so subject to waves there.
“Wattenmeer da dort die Anbindung zum Festland besser.”	Wadden Sea, because the connection to the mainland is better.
“Wenn dann Wattenmeer. Nur immer Wasser drum herum, könnte ich mir nicht vorstellen.”	If at all, then Wadden Sea. I can’t imagine living somewhere surrounded by only water.

NEITHER

“In beiden Zonen nicht. Das Wattenmeer ist geschützt, die Nordsee ist zu unruhig.”	Neither. The Wadden Sea is protected, the North Sea is too restless.
“Im Wattenmeer oder in der Nordsee möchte ich nicht leben. Es ist der Lebebsraum von Pflanten und Tieren.”	I don’t want to live in the Wadden Sea or in the North Sea. It is the living space of plants and animals.
“Das wäre mir egal. Man muss schon eine gute Selbstdisziplin haben, damit durch den eigenen Lebensstil die Natur dort nicht gestört oder verhüllt wird.”	I wouldn’t care. You need to have good self-discipline, so your lifestyle doesn’t distrub or hide the nature there.
“Weder noch. Aufgrund des Klimawandel und ansteigender Meeresspiegel.”	Neither. Due to climate change and rising sea levels.
“Ich möchte weiterhin gern auf Norderney wohnen.”	I would like to continue living on Norderney.
“Ich bin sehr gerne an der Nordsee und liebe das Wattenmeer, möchte, daß soviel Natur wie möglich erhalten bleibt und geschützt wird.”	I love being on the North Sea and I love the Wadden Sea. I want as much nature as possible to be preserved and protected.
“Nein, keins von beiden. Auf dem Festland im Hinterland ist genug platz. Dann lieber begrünte Hochhäuser wie in Singapur.”	No, neither of them. There is enough space on the mainland in the hinterland. Then prefer green skyscrapers like in Singapore.

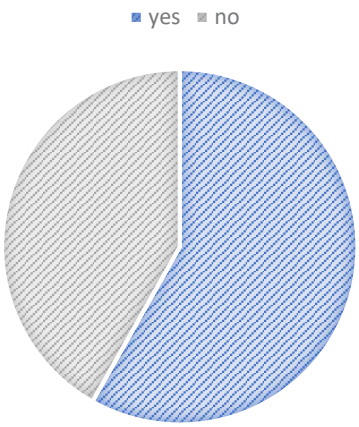
NORTH SEA

“Nordsee , schön unruhig.”	North Sea, nice and restless.
“Nordsee, immer Wasser.”	Noth Sea, always water.
“Auf jeden Fall an der Nordsee mit ihrer Brandung, ihren Wellen und dem weiten Horizont!”	Definitely on the North Sea with its surf, its waves and the wide horizon!
“in der Nordsee, denn das Wattenmeer ist ja eine Lebenszone für kleinere Lebewesen..”	In the North Sea, because the Wadden Sea is a living zone for smaller creatures..
“Nordsee ist durch das rauhe Klima interessanter aber wohlgleich auch das Leben schwieriger.”	Due to the harsh climate, the North Sea is more interesting, but life is also more difficult.
“In der Nordsee, wegen der guten Bedingungen für die Atmung.”	In the North Sea, because of the good breathing conditions.
“In der Nordsee...weitläufiger Blick und das fühlen der Naturgewalten.”	In the North Sea ... wide view and the feeling of the forces of nature.
“Wattenmeer ist nicht als Wohnraum für Menschen gedacht... an der Nordsee wohnen ist schön, wenn man umweltbewusst denkt.”	Wadden Sea is not intended as a living space for people ... living on the North Sea is nice if you think environmentally conscious.
“Lieber Nordsee, um zu spüren kleiner als die Natur zu sein.”	Preferably North Sea, to feel smaller than nature.
“Lieber in der Nordsee. Das Wattenmeer ist wichtig zur Reinigung des Wassers und zum überleben vieler nützlicher Tierarten.”	Better in the North Sea. The Wadden Sea is important for cleaning the water and for the survival of many useful animal species.
“Nordsee ist sauberer.”	North Sea is cleaner.

UNKNOWN

“Kann ich nicht beurteilen, müsste ich mich vorher richtig informieren lassen und vorstellbar nur wenn das ökologische Gleichgewicht nicht zerstört wird.”	I cannot judge, I should be well informed in advance and it is only imaginable if the ecological balance is not destroyed
“Ich finde beides schön und reizvoll.”	I find both beautiful and attractive.

WOULD YOU LIKE TO LIVE IN A SMALL SUSTAINABLE COMMUNITY/ ECOLOGICAL VILLAGE ON NORDERNEY?



ARGUMENTS FOR "YES"

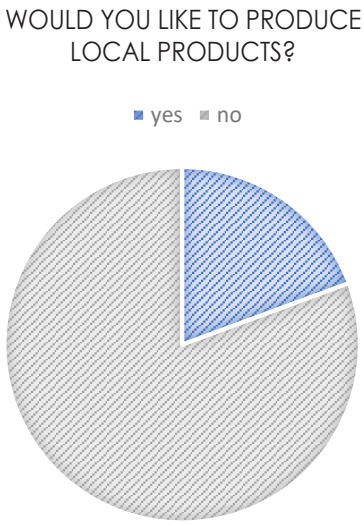
"Wegen der nähe zur Natur."	Because of the proximity to nature.
"Ja, weil nur möglichst nachhaltiges/ ökologisches Leben mit Blick auf künftige Generationen vernünftig/ sinnvoll ist."	Yes, because only sustainable/ ecological life is sensible with a view to future generations.
"Ja, sehr gern! Weil ich versuche möglichst viel für unsere Erde zu tun und diese Insel liebe."	Yes, very much! Because I try to do as much as possible for our earth and I love this island.
"Wir müssen unser Bewusstsein im Umgang mit der Natur verändern."	We have to change our awareness of how we deal with nature.
"Traumhafter Ort um in Einklang mit der Natur zu leben. Also ja aber nicht mit kleineren Kindern, da in einer solchen Gesellschaft keine mehreren Generationen überleben können.... die Welt ist nicht reif dafür."	Fantastic place to live in harmony with nature. So yes, but not with smaller children, because in such a society no generations can survive ... the world is not ready for that.
"Ja. Mit der Natur leben und nicht nur ausnutzen."	Yes. Living with nature and not just exploiting it.
"Sehr gerne, denn auf Norderney wurden in den letzten Jahren extrem viele Flächen versiegelt."	Very much welcome, because in recent years, an extremely large number of areas on Norderney have been sealed.
"Soviel wie möglich selber produzieren und somit die Umwelt schonen."	Produce as much as possible yourself and thus protect the environment.
"Um das Kulturerbe Wattenmeer zu schützen."	To protect the Wadden Sea cultural heritage.

ARGUMENTS FOR "NO"

"Ich möchte nicht auf Norderney Leben, weil die Insel begrenzte Ressurcen hat und sie nicht über Gebühr ausgebeutet werden sollte."	I don't want to live on Norderney because the island has limited resources and it shouldn't be over exploited.
"Es soll so bleiben wie es ist"	It should stay as it is.
"Nein, ich bin völlig dagegen, weil Norderney genau so bleiben soll, wie bisher."	No, I am completely against it, because Norderney should remain exactly as before.
"Wo denn? In der Ruhezone? Es ist doch kein Platz mehr und auch kein bezahlbarer Wohnraum hier mehr möglich. Abgesehen davon, dass der Anstieg des Meeresspiegels nicht mehr aufzuhalten ist."	Where then? In the Ruhezone? There is no longer any space or affordable living space here. Apart from the fact that the sea level rise is unstoppable.

"Natürlich möchte ich gerne so wenig Müll wie möglich, der Natur so wenig wie möglich belasten und nicht in sie eingreifen. Aber natürlich möchte ich es mir im Urlaub auch gut gehen lassen. Essen gehen, gemütlich mit Freunden etwas trinken, ein Eis am Strand essen."

Of course I would like to produce as little garbage as possible, burden nature as little as possible and not interfere with it. But of course, I also want to enjoy myself on vacation. Eating out, having a drink with friends, having an ice cream on the beach.



6. OTHER RESEARCH

ECO-CENTRIC ARCHITECTURE

Zero impact

- Self sustaining
  - *food*
  - *water*
  - *energy*

- Energy neutral
  - *solar energy*
  - *wind energy*
  - *wave energy*
  - *tidal energy*

- Water neutral
  - *blackwater treatment system*
  - *greywater treatment system*
  - *rainwater collection*

- CO_2 neutral or negative
  - *CO_2 negative materials*
  - *materials from the environment*
  - *passive systems*

- Circular construction
  - *No waste*

Physical space for green

- Bird/green roof

- Greenhouse/urban farming
- Green facade
- Gardens/terraces

Materials

- Wood
- Straw Bales
- Rammed Earth
- HempCrete
- Bamboo
- Recycled Plastic
- Mycelium
- Eco-centric road: Grasscrete

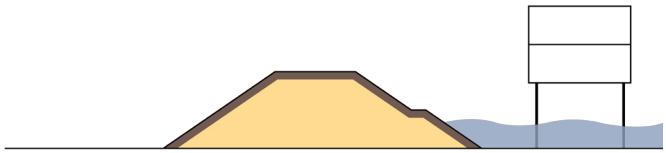
Local materials

- Seaweed and algeas
- Sand and mud
- Salt (from seawater)
- Marram- and lyme grass
- Seafood shell waste

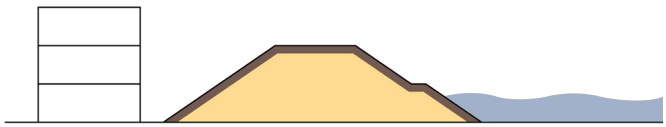
BUILDING POSITIONS IN RELATION TO THE DIKE

Besides

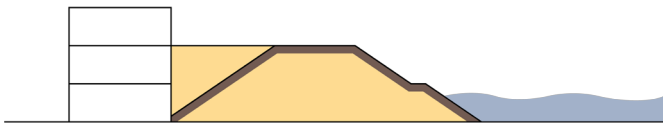
Outside the dike



In front of the dike

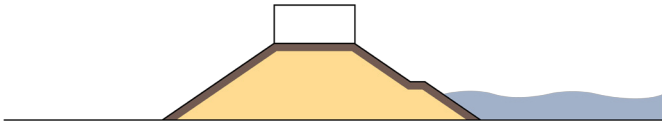


Against the dike

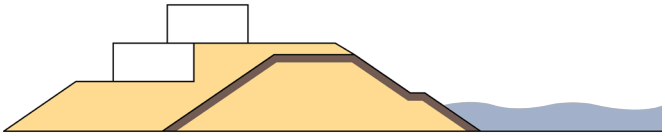


On

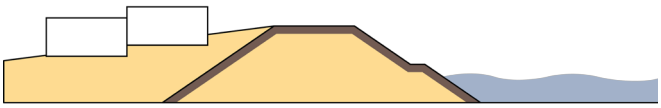
On the dike



On the overdimensioned dike

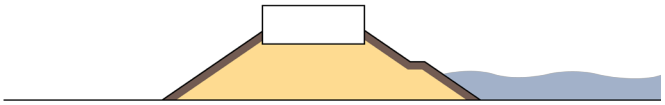


As an extention of the dike

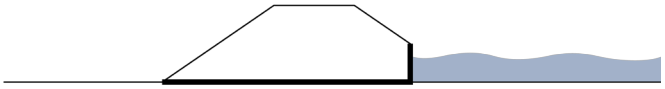


In

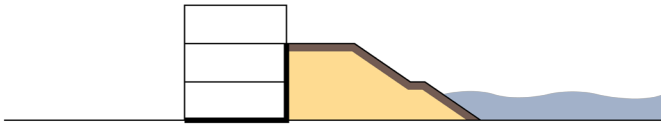
In the dike



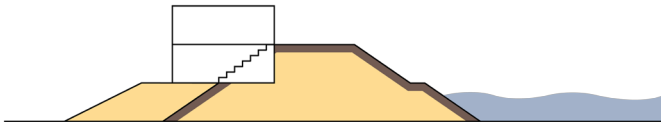
The building as the dike



Integrated with the dike



Blended with the dike



OYSTERS

Some data I collected while designing:

Picking season: from September till April
(Oysters reproduce from May till August, they will taste milky because of that)

Oysters are sold or shipped in the shell, for the months may till august oysters are shucked, on ice.

How many oysters can be harvested in one day?
1-3 pond oesters per persoon per uur. = 0,454 – 1,361 kg oesters p.p. per uur.
10 kilo oester ≈ 100 oesters

6 uur werken per dag = 6 x 1,3 kg = **7,8 kg oesters per dag p.p.**

How many oyster can grow in the area?

Totaal m2 oyster reef:	oyster per m2:	Totaal oesters:
Oysters on the dyke - 3.738 m2.	15	56.070
	200 (in reserves)	747.600

https://www.frontiersin.org/articles/10.3389/fmars.2017.00326/full

	100	373.800

with an average and standard deviation of 44.58 ± 208.49 oysters m−2.
https://www.frontiersin.org/articles/10.3389/fmars.2017.00326/full

Intensive farming - 2.063 m2. (wooden frames, 2000 per tray)	3000	6.189.000

How many oysters can be harvested per year?
It takes 2-3 years for an oyster to reach maturity
6.189.000 / 2,5 = **2.475.600 oysters per year**
2.475.600 oysters ≈ 247.560 kg.

How many working days are there per year?
52 weeks per is 52 x 5 = 260 working days
Minus the oyster reproduction season, May till August 87 working days.
260 – 87 = 173 working days.

Per year a person can harvest:
Per person 7,8 kg oyster per day x 173 working days = 1.349,4 kg

247.560 kg per year / 1.349,4 kg per person ≈ 184 people needed.

How many wild oysters can be farmed and how many people are needed for that?
56.070 wild oysters / 2,5 = 22.428 oysters per year ≈ 2.242,8 kg
2.242,8 kg per year / 1.349,4 kg per person ≈ 2 people needed
373.800 wild oysters / 2,5 = 149.520 oysters per year ≈ 14.952 kg
14.952 kg per year / 1.349,4 kg per person ≈ 11 people needed

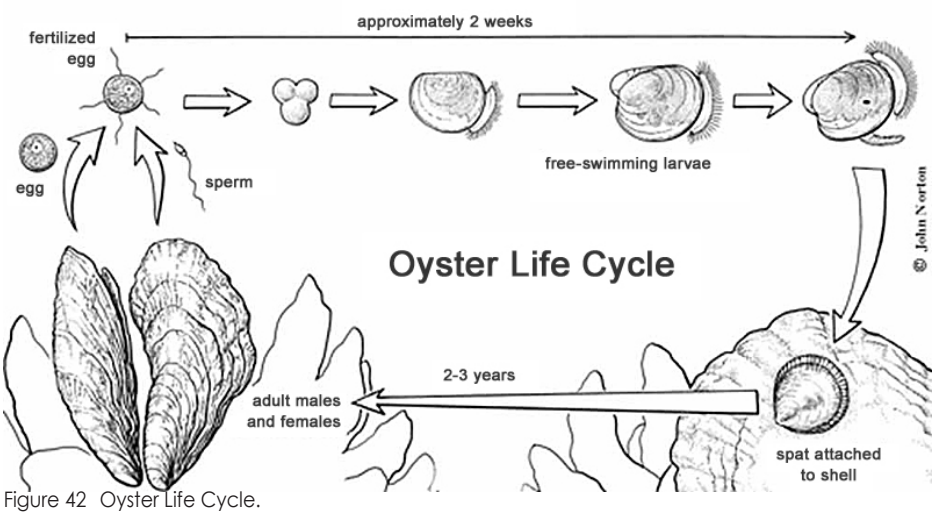


Figure 42 Oyster Life Cycle. (Lu, C., 2014)

Interesting information:

Exemption to shellfish industry:
https://books.google.nl/books?id=c4lhjbKBCkgC&pg=PA27&lpg=PA27&dq=oysters+production+per+hour&source=bl&ots=tvfYFcVl5F&sig=ACfU3U2Y9w5ef_yvq-dVZnsR4650LiVkvQ&hl=nl&sa=X&ved=2ahUKEwj467uL-abpAhWC66QKHfaXDCkQ6AEwAHoECAgQAQ#v=onepage&q=oysters%20production%20per%20hour&f=false

3000 per m2:
https://books.google.nl/books?id=VEpw_6Ce9ZkC&pg=PA49&lpg=PA49&dq=oysters+per+m2&source=bl&ots=2Z7XNAbezh&sig=ACfU3U1G1Fkdbn0fZt8PtBW4akmDVZrbCQ&hl=nl&sa=X&ved=2ahUKEwiXpo-O96bpAhUD-qQKHfzHCUEQ6AEwAnoECAUQAQ#v=onepage&q=oysters%20per%20m2&f=false

Aquaculture production systems:
https://books.google.nl/books?id=p7ocOAjnR5sC&pg=PT115&lpg=PT115&dq=how+many+oysters+can+I+harvest+per+m2&source=bl&ots=-leewde2sd&sig=ACfU3U3E-EH4P3zq8Zcikq-zaT9jgglK2g&hl=nl&sa=X&ved=2ahUKEwjXl8z26qbpAhXEMewKHUa2BlkQ6AEwAHoECAoQAQ#v=onepage&q=how%20many%20oysters%20can%20I%20harvest%20per%20m2&f=false

Ultraviolet light purification systems:
https://books.google.nl/books?id=ooVvna2w9l0C&pg=PA250&lpg=PA250&dq=oyster+farming+per+m2+per+person&source=bl&ots=B_CAVGy9Xm&sig=ACfU3U28Z8aF5J18iPMBG37fysP6zk8bbQ&hl=nl&sa=X&ved=2ahUKEwiM7PXh86bpAhXPsaQKHQ9sDMcQ6AEwAHoECAoQAQ#v=onepage&q=by%20one%20person&f=false

Site 10 kilo = 100 schelpen:
https://www.buitenlevengevoel.nl/oesters-plukken/

SEAWEED

The downside:

- Not water resistance at first Using a membrane may be necessary.

Seaweed as building material:

- Renewable and circular
- Mold resistant
- Unattractive to pests
- Invites plant growth
- Fire retardant (class B2)
- Moisture regulating (can be placed in damp areas)
- CO2-negative
- Acoustically dampening
- High heat buffer capacity
- Lambda (λ) value: 0,039 W/mK
- Vapor diffusion: 1-2`μ
- Lifespan 200-300 years (depending on how it is used)

APPLICATION METHODS

Figure .... Læsø Andrine's House.
(Schnack, A., n.k.)

Figure .... Byggeskik.
(Studio Seagrass, n.k.)

<u>Seaweed thatching</u>
Dried seaweed twisted into ropes placed on rafters (figure ...).
This method takes a long time to construct and there is a large amount of seaweed (eelgrass) needed.

Figure .... VÆVE
(Studio Seagrass, n.k.)

Figure .... VÆVE Teknik
(Studio Seagrass, n.k.)

<u>Seaweed weaving</u>
A flexible mounting technique where seaweed (eel grass) is weaved around a steel skeleton. These steel, seaweed modules can attached to a wooden frame (figure ...).

Figure .... Plade-installation.
(Studio Seagrass, n.k.)

Figure .... Plade proces.
(Studio Seagrass, n.k.)

<u>Seaweed plates</u>
A 100% bio-based replacement for wooden plates, like OSB or MDF plates. The seaweed with biological binder can be used as an airy insulating mat, or it can be compressed with a heat press into a dimensionally stable plate (1200x2400 mm). (Figure ...).

Figure .... The Modern Seaweed House. (Vandkunsten Architects, n.k.)

Figure .... Seaweed House Vandkunsten Realdania Byg. (Grozdanic, L., 2013)

Seaweed stuffing

After drying seaweed for 14 days, it can be used as stuffing. Wool nettings filled with seaweed are used for the facade of the Modern Seaweed House (figure ... and ...). This alone is not watertight enough for a building.

Figure .... Prefabricated seaweed thatched panels. (Lorentzen, A., 2019)

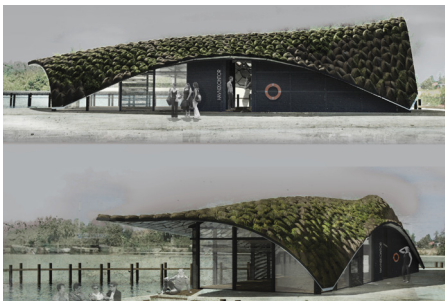


Figure .... Bio-concretion. (Øhrstrøm, T. G. L., 2015)

Seaweed panels

The Danish designer Kathryn Larsen developed prefabricated seaweed thatched panels (figure ...). She found that the natural binders that were used, made the seaweed more stiff and sometimes brittle, but it improved the waterproofness.
Another example of seaweed panels, is the design from Tobias Øhrstrøm. He created panels by mixing (natural) binders with seaweed (figure ...).

Figure .... Making Houses Out of Seaweed (DaSilva, 2019)

Figure .... Vide Expo Studio Zeewier. (Architectuur centrum Amsterdam, 2019)

Seaweed bricks

In figure ..., the bricks are constructed out of 60% sargassum (seaweed) and 40% organic materials, like adobe and clay. Another example, is the wool-and-seaweed bricks: a combination of wool, seaweed polymer and clay. Those bricks don't need to be fired and they are 37% stronger than traditional bricks.

Figure .... Terroir Chair (Edvard, J., n.k.)

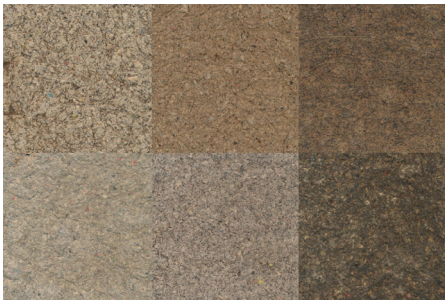


Figure .... Terroir material, texture and colour (Edvard, J., n.k.)

Seaweed and recycled paper waste

Jonas Edvard and Nikolaj Steenfatt created a tough and durable material from seaweed combined with recycled paper waste. It is light and has the softness from cork. It is made by cooking seaweed powder into glue. This is possible with the viscous and adhesive effect of alginate (the natural polymer of brown algae).

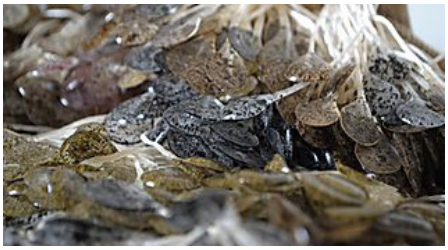


Figure .... The Seaweed Girl Collection (Linington, J., n.k.)

Figure .... The Seaweed Girl Collection (Linington, J., n.k.)

Seaweed decoration

Beside being functional, seaweed can also have a decorative function. Jasmine Linington used seaweed in the fashion and textiles industry.

LAYERS

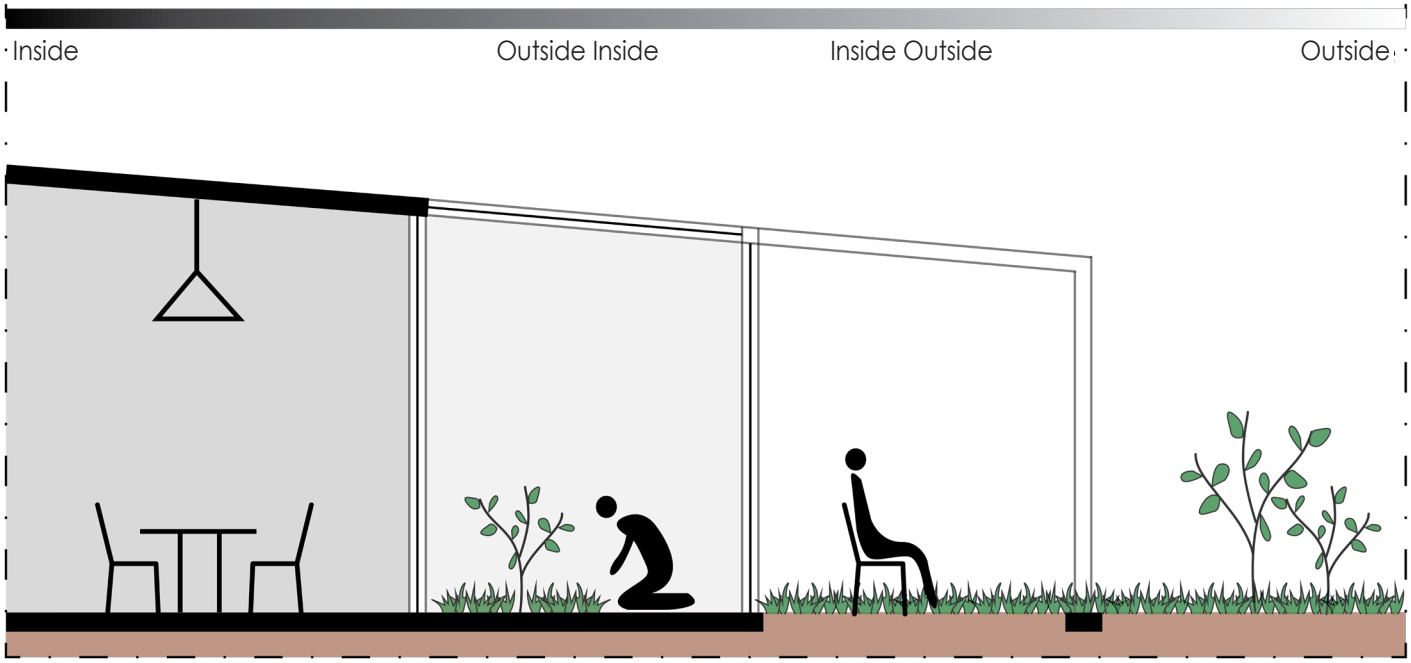
Layers can be helpful to create a smooth transition between two different sides, in this case between the inside and the outside. Besides creating a smooth transition, layers can have different functions.

Five references I analysed, are examples of how layers can improve the living situation:

- S3 House - attachment 1
  With different layers there is made a gradient between public and private, and between the inside and the outside.
- Membrane House - attachment 2
  The layers around the Membrane House are regulating light and temperature, creating a comfortable indoor climate.
- House N - attachment 3
  House N is located in a busy neighbourhood. Layers around the house provide different levels of privacy with different ambiences.
- ReGen villages - attachment 4
  Each house in the ReGen village has its own extra greenhouse layer. This extra layer makes it possible to grow your own herbs next to kitchen and to enjoy an outside environment, without being bothered by a cold wind or rain.

For eco-centric architecture, a gradient between the inside and the outside can be a helpful element to bring nature closer. It can strengthen the connection between the inhabitants and the outside. Layers can create spaces with different ambiences, each having their own qualities and different levels of experiencing the outside.

The inside-outside gradient



7. THE PROJECT

Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Anneloes van Slooten
Student number	4655230
Telephone number	06 30812712
Private e-mail address	a.r.vanslooten@hotmail.com

Studio		
Name / Theme	Transitional Territories	
Main mentor	Jacques Vink	Architecture
Second mentor	Sjap Holst	Building Technology
Argumentation of choice of the studio	The North Sea waterscape, is a constantly changing environment, and with the acceleration of climate change, sea level rise is becoming more and more a thread to the surrounding habitats. I choose the Transitional Territories studio, because waterscapes are the most important habitats of the planet. It is an important challenge to adapt to the quick changing environments.	

Graduation project	
Title of the graduation project	Eco-centric Architecture
Goal	
Location:	Norderney (a german wadden island)
The posed problem,	Human activities are speeding up normal climate fluctuations on the planet, while this is taking away the time to adapt to new living conditions, for the whole biosphere. The sea level keeps rising, threatening to drown the by humans occupied land. As a reaction, coastal protections are built, and many people are searching for new solutions to protect the man-made world. The Wadden Sea islands form a natural shield for the mainland against the high waves of the North Sea. Unfortunately, also those islands are threatened to drown. Flood protections on the islands and the mainland, stop the coastline from moving. This is causing, together with a lack of sand transport from the North Sea, a sediment shortage. Sand nourishment – which is a short-term

	solution – strengthen the defense by several islands, but not without consequences for the ecosystems: It disturbs breeding birds and it buries benthic communities (De Groot, A.V., et al. 2017). Beside the negative ecological effects, there are also doubts if there will be enough sand to protect every land that is vulnerable to sea level rise. Climate influences human activities, which influences again the climate. It is a loop that will never stop if humans do not change their way of living. There is so much time, money and energy spend on fighting against natural phenomena, while it is now proven that, with the taken actions against nature, humans are depleting and disturbing important ecosystems. Instead of spending so much to fight against nature, we should use this to adapt to the changing environment. Adapting, without depleting or disturbing the ecosystems of which all the living depends on. To slow down climate change, mankind has to change the way they think and behave: they need an ecocentric mindset. With ecocentricity, it is possible to conserve, protect and benefit ecosystems and habitats (Yeang, K. 2020). Humans need to live in symbiosis with ecosystems to let the biosphere grow, instead of depleting it.
research questions and	**Territorial scale:** *What kind of sustainability principles can be applied to the North Sea Waterscape?* Sub questions: 1. *How can the general sustainability principles be summarized?* 2. *Which human activities are unbalancing the ecosystems of the North Sea waterscapes?* **Architectural scale:** *How to create a symbiosis between architecture and its surrounding ecosystems?* Sub questions: 1. *What methodologies are used towards the start of a symbiosis between architecture and its surrounding ecosystems?* 2. *Which projects are a successful start towards a symbiosis between architecture and its surrounding ecosystems?*
design assignment in which these result.	The design assignment is to create an ecological design, a living environment that is responding and working with its surrounding ecosystems: both humans and nature must be able to thrive. Norderney is one of the Wadden Sea islands where sand nourishment has been done a several times. With the largest town

	of all islands and its usage of renewable energy, it is time for the next step towards a self-sustaining, ecocentric island.

Process

Method description

To create a symbiosis between architecture and the surrounding ecosystems, research on the exact movements of energy and material is necessary. Because of the constant changing environment, the research will have to answer questions about place, time and process. Findings about climate, ecosystems, architecture and future predictions, will be described in my thesis (in text, maps, pictures, diagrams, etc.) to get an overview of the broad topic.

I planned to visit Norderney after the P2 presentation, to experience some of my findings by myself.

Literature and general practical preference

Literature from Ken Yeang, like:
Yeang, K. (2019). *Saving the planet by design.* London: Routledge.

Beatley, T. (2014). *Blue urbanism: Exploring connections between cities & oceans.* Washington: Island Press.

IPCC: for data about climate change and future predictions.

Kuismanen, K. (2008). *Climate-conscious architecture – design and wind testing method for climates in change.* Oulu: Oulu University Press.

Reflection

My graduation topic is about adaptation to climatic changes in an ecocentric way. These changes are especially noticeable in and around oceans and seas, like the North Sea waterscape. Therefore, it is a perfect topic to combine with the graduation studio Transitional Territories.
Many designers are searching for sustainable solutions, and together we must search for an ecocentric lifestyle. Architecture plays a major role towards new environments in which natural ecosystems – of which all life depends – can flourish again.

Reflection

Info

Name	Anneloes van Slooten
Studentnumber	4655230
Phone	+31 630812712
Email	a.r.vanslooten@hotmail.com

Studio

Name	Transitional Territories *North Sea: Landscapes of Coexistence*
Main mentor	Jacques Vink
Second mentor	Sjap Holst
Third mentor	Taneha K. Bacchin

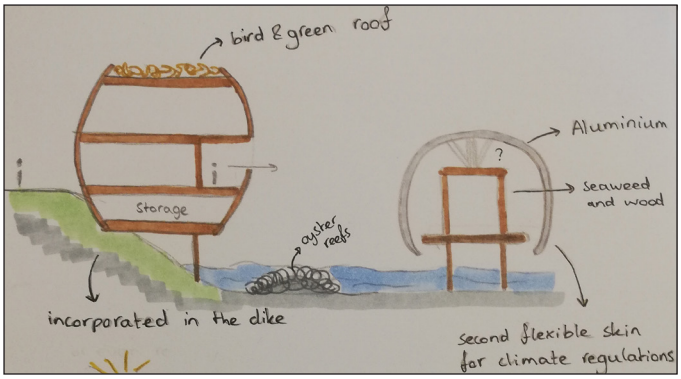
Graduation Project

Name	Eco-centric Architecture
Location	Norderney, Germany

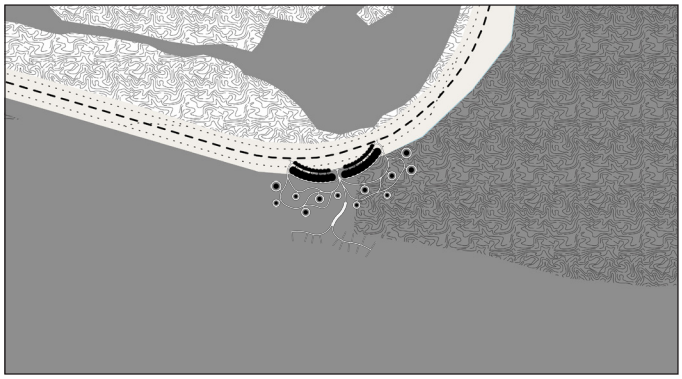
From my research it became clear to me that I am looking for a way to inhabit this world without destroying, displacing and fragmenting natural habitats. We should start designing with an ecocentric mindset instead of an anthropocentric mindset. Coastal protection for example, is fragmenting natural habitats and separates us from the ecosystems around us. We need to defend ourselves against threatening natural fluctuations, but it is not needed to completely exclude those natural phenomena. We should find eco-friendly ways to deal and work with the fluctuations, instead of fighting against them. We could use those fluctuations for the good of all life. Mankind should learn how to live with all the elements of the ecosystem.

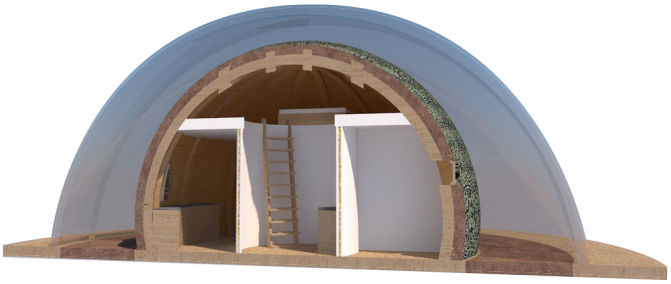
The first outcomes

While designing, I kept trying to answer the main question: How to create a symbiosis between architecture and its surrounding ecosystems? Unfortunately, the goal not to destroy the world got me stuck, by trying not to affect the current surroundings and its ecosystem. To build an eco-friendly, but durable building, the foundation is the most critical part of the structure. With this in mind, I began with the wrong choices to start designing. When looking at how a building changes its environment, buildings on poles have the smallest footprint on the natural environment. Underneath the building, the abiotic and biotic parts of the ecosystem can still move around. While going for a structure on poles, high enough to be safe for the sea, I completely lost the connection with the surroundings. The first design, shown during the p3, could be placed anywhere along a coast. A low impacting structure led to an inefficient way of living, without connecting people to the environment they should take care off. I tried so hard not to affect the surroundings, while actually the design assignment was to create a new environment where both can thrive.



7,2 m lifted above the sea, losing its connection with the surrounding.


Organic forms, where functionality was completely lost.


Relation with Norderney and its specific location is completely lost

The inevitable changes

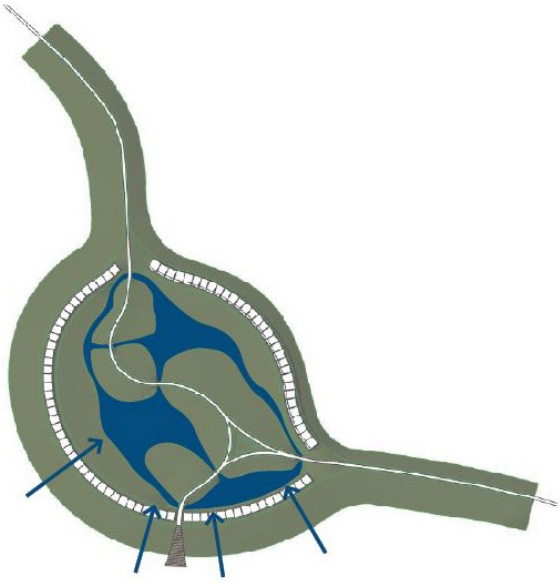
Thanks to the feedback I received before and during the P3, I realised the many flaws of the project. The three biggest flaws that made me no longer enthusiastic about my own project:

- The inhabitants could only experience the environment at the harbour, but from their own home, that is on top of a mudflat, they could only experience this special habitat by looking at it.
- There was almost no relation between the specific location and the design ideas.
- I was pushing round shapes too far, creating inefficient homes. The idea was to connect the building with its surrounding by mimicking the round shapes of the sediments on the island. In combination with protecting the dwelling against the sea, the whole idea of mimicking disappeared.

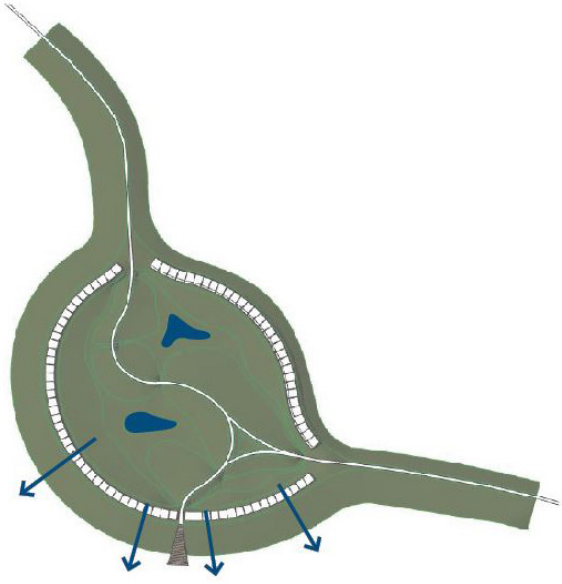
By taking a big step back and looking at the characteristics of the island, helped me to focus on my main goal and brought me into a whole new direction. While completely abandoning my design and starting with other methods, I tried to search for a way to work with nature instead of fighting against it or rising above it, like the P3 design. This is what I initially wanted, but what I lost out of sight due to the focus on the least impacting foundation. With everything people do, they will influence the natural environment. This is how everything works; an action causes a reaction as everything is interrelated. So, keeping in mind that you want to let the current ecosystem grow while inhabiting it: trying not to change it, is far from the most important task while designing habitat. When inhabiting an area, changes are inevitable, important is to make those changes worth it. Let new designs be a boost for the balance of the ecosystem. We should only disturb the planet when we are sure that the whole natural environment can thrive. The new main question became: how can I create a habitat for people, with a positive influence on the future environment (and the future planet)?

The new design

To let people take care of their environment, it is important to connect them with this environment. The most characteristic elements of the Wadden Sea, in which my design is situated, are the constant changes of the surrounding. When emphasizing this in the plan, people will have a constant reminder or experience of the surrounding ecosystem. There will be awareness of where they are and what they are inhabiting. This is how I arrived at a new design with a landscape approach. A semi-enclosed dyke area, let water of the sea flow in and out with the movement of the tides. This inside area, which will alternately be wet and dry, is a new habitat for humans and the ecosystem of the Wadden Sea. Together they function as one whole, creating favourable circumstances for each other.



High Tide



Low Tide

Focussing on what really matters
The search to find the right direction for my project, took lots of time. It was a search for a balance between human habitats and the ecosystem, without a possible perfect solution. The methods I used to reach the end design could have been way more efficient. Apparently, I needed lots of time to search for different methods and to test them. Methodologies of designing I looked at during my research have faded away, lost on the background. Only now, during the end of my graduation, I realise how I could have done it better. Instead of focussing, I went in lots of different directions. To soon I jumped from all these different aspects to conclusions, excluding other options. Going into many different directions always enriches your work and knowledge, but I got distracted by lots of interesting subjects which gave me a hard time focussing on what really mattered. Exactly this, is also happening worldwide. While focussing on money and interesting developments, we lose the planet we depend on out of sight.

Improving habitats
With this final design -in which humans and ecosystem live in symbiosis with another- the question remains, to what extent this new environment is worth changing the old environment. This never depends solely on the new design, but also on the current state on which the design is situated. The Wadden Sea is a constant changing area, in which humans decided to build dykes and stop certain changes, which I think is a real shame. My final design, is on an already man-made location: a polder surrounded by dykes to protect it against the Wadden Sea. Although this polder was meant for a military airport, it is transformed into a perfect bird sanctuary, enriching the existing ecosystem. This new design can be a perfect addition to this area, by being a food production place for birds and humans. Therefore, I believe this design is worth it, adding something to the current ecosystem and expanding the human habitat to deal with the population growth.

Drawing experiences
This final part of the graduation period I will focus on finishing all drawings in an ecological style. I want to show clearly that both humans and the ecosystem can thrive in this final design. Drawings showing how the plan can be experienced from different heights and different perspectives, will clarify the intentions and the goal of the design. These drawings will also explain the many activities that will take place in this new environment. These drawn experiences and perspectives, will show how people in the ecosystem are embedded.

8. LITERATURE

FIGURES

Figure ...:
Roonguthai, W. (Photographer). (2007, March 31). *Inside a wild-type banana*. Retrieved from https://en.wikipedia.org/wiki/File:Inside_a_wild-type_banana.jpg

Figure .... From an anthropocentric to an ecocentric mindset
Used Images:

1. Planet Earth - A Global Perspective

Briney A. (2019, July 27th). *An Overview of the Last Global Glaciation.* Retrieved 02-10-2019, from https://www.thoughtco.com/the-last-glaciation-1434433

Graham, S., Parkinson, C. and Chahine, M. (2010, October 1). *The Water Cycle*. Earth observatory, NASA. Retrieved 01-01-2020 from https://earthobservatory.nasa.gov/features/Water/page1.php

Hsia, M. (n.k.). *An Intersection Between Architecture and Nature.* (Unpublished master dissertation). Texas Tech University, Lubbock, Texas, USA.

IPCC (2014). *Climate change 2014: Synthesis Report.* Retrieved 23-10-2019, from https://ar5-syr.ipcc.ch/ipcc/ipcc/resources/pdf/IPCC_SynthesisReport.pdf

Lovelock, J. (2009). *The Vanishing Face of Gaia: a final warning.* New York: Basic Books.

Mensvoort, K. and Grievink, H. (2012). *Next nature: Nature changes along with us.* Barcelona/New York: Actar.

National Oceanic and Atmospheric Administration (2017). *Global and regional sea level rise scenarios for the United States.* Retrieved 23-10-2019, from https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

Roser, M. (2019). *Future Population Growth.* Retrieved 23-10-2019, from https://ourworldindata.org/future-population-growth

Roser, M., Ritchie, H. and Ortiz-Ospina, E. (2019). *World Population Growth.* Retrieved 23-10-2019, from https://ourworldindata.org/world-population-growth

Storms J. (2019). *Towards a +3 m rise in sea level: planned strategies or Russian Roulette?* Powerpoint presentation. SLIKC – Sea level Impact Knowledge Collective, TU Delft, delivered 27 September 2019.

Sylvan, R. and Bennett, D. (1994). *The Greening of Ethics*. Cambridge: White Horse Press and Tucson: The University of Arizona Press.

The Sea First Foundation (n.k.). *Importance of the sea.* Retrieved 01-01-2020 from https://www.seafirst.org/themas/importance-of-the-sea/?lang=en

Vernadsky, W. I. (1945). The Biosphere and the Noösphere. *American Scientist, 33 (1), 8.* Retrieved from https://monoskop.org/images/5/59/Vernadsky_WI_1945_The_Biosphere_and_the_Noosphere.pdf

Venkataramana, R. K., Sampangi-Ramaiah, M. H., Ajitha, R., Khadke, G. N., & Chellam, V. (2015). Insights into Musa Balbisiana and Musa acuminata species divergence and development of genic microsatellites by transcriptomics approach. *Plant Gene, 4, 78–82.* https://doi.org/10.1016/j.plgene.2015.09.007

Yeang, K. (2020). *Saving the planet by design: reinventing our world through ecomimesis.* New York: Routledge.

2. Territory - North Sea

Encyclopaedia Britannica (2019). *Battle of Jutland.* Retrieved 02-10-2019, from https://www.britannica.com/event/Battle-of-Jutland

Encyclopaedia Britannica (2019). *The war at sea, 1914-15*. Retrieved 02-10-2019, from https://www.britannica.com/event/World-War-I/The-war-at-sea-1914-15
Gov.UK (2014). *The Thames Barrier.* Retrieved 02-10-2019, from https://www.gov.uk/guidance/the-thames-barrier

Griffiths, D. (2019). Rethinking the early Viking Age in the West. *Antiquity Publications Ltd, 93, 368, pp. 468-477.* https://doi.org/10.15184/aqy.2018.199

KNMI (n.k.). *Watersnoodramp 1953.* Retrieved 02-10-2019, from https://www.knmi.nl/kennis-en-datacentrum/achtergrond/watersnoodramp-1953

Macleod, F. and Richardson, S. (2018). *Piper Alpha: The Disaster in Detail.* Retrieved 02-10-2019, from https://www.thechemicalengineer.com/features/piper-alpha-the-disaster-in-detail/

Maione, U., Majone-Lehto, B., & Monti, R. (Eds.). (2000). *New trends in water and environmental engineering for safety and life.* Rotterdam: CRC Press.

Mauch, F. (2012). The great flood of 1962 in Hamburg. *Environment & Society Portal, Arcadia, no. 6.*

FIGURES

Figure ...:
Bayliss-Brown, G. and Lynam, C. (n.k.). *Significant interactions in the North Sea ecosystem, modelled using statistical tGAMs.* Edited by author. Retrieved from http://www.ices.dk/community/Documents/Expert%20Groups/Lynam_tGAMmodel_key_mov.pdf

Retrieved from http://www.environmentandsociety.org/arcadia/great-flood-1962-hamburg

NIOZ Royal Netherlands Institute for Sea Research (n.k.). *Key area North Sea: balancing human use and healthy ecosystems in one of the busiest seas.* Retrieved from https://www.nioz.nl/en/research/north-sea

NorthSee (n.k.). *The history of shipping of the North Sea.* Retrieved 02-10-2019, from https://northsearegion.eu/northsee/s-hipping/the-history-of-shipping-of-the-north-sea/

Officer of the watch (2013). *Alexander L. Kielland Platform capsize accident - investigation report.* Retrieved 02-10-2019, from https://officerofthewatch.com/2013/04/29/alexander-l-kielland-platform-capsize-accident/

Papenmeier, S., et al. (2020). Winnowed gravel lag deposits between sandbanks in the German North Sea. In Harris, P. T. and Bakker, E. (Eds.), *Seafloor Geomorphology as benthic habitat: GeoHab Atlas of Seafloor Geomorphic Features and Benthic Habitats* (pp. 451-460). Amsterdam: Elsevier.

Rijkswaterstaat (n.k.). *De Deltawerken.* Retrieved 02-10-2019, from https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/waterkeringen/deltawerken/index.aspx

Tucker, S.C. (2016). *World War II: The Definitive Encyclopedia and Document Collection.* California: ABC-CLIO

3.1. Ecosystems

Khan Acadamy (n.k.). *Biogeochemical cycles.* Retrieved December 21, 2019, from https://www.khanacademy.org/science/biology/ecology/intro-to-ecosystems/v/ecosystems-and-biomes

Khan Acadamy (n.k.). *Ecosystems.* Retrieved December 21, 2019, from https://www.khanacademy.org/science/biology/ecology/intro-to-ecosystems/v/ecosystems-and-biomes

Udvardy, M. D. F. (1975). A Classification of the Biogeographical Provinces of the World. *IUCN Occasional Paper, No. 18. Morges, Switzerland, 1975.* Retrieved from: https://www.fnad.org/Documentos/A%20Classification%20of%20the%20Biogeographical%20Provinces%20of%20the%20World%20Miklos%20D.F.%20Udvardy.pdf

Goodall, D. W. (1974). Ecosystems of the World. *Elsevier, Amsterdam, 36 (11)*. Archived 2016-09-18 at the Wayback Machine.

3.2. HUMAN INFLUENCES

Figure ...:
Icons used from the Noun Project, dates not known: Aquaculture. Troiano, A.; World. Furtado, G.; Energy production. Panasovska, O.; Syringe. Icon Lauk.; Ship. Artdabana@Design.; Levees. Coloripop.; Jump Into The River. Prado, L.; Fishing Vessel. Prado, L.

3.2. Human influences

International Energy Agency and the United Nations Environment Programme (2018). *2018 Global Status Report: Towards a zero-emission, efficient and resilient buildings and construction sector.* Retrieved from https://www.worldgbc.org/sites/default/files/2018%20GlobalABC%20Global%20Status%20Report.pdf

Lawrence, D. M. et al. (2016). The Land Use Model Intercomparison Project (LUMIP) contribution to CMIP6: rationale and experimental design. *Geoscientific Model Development, 9(9), 2973-2998.* http://doi.org/10.5194/gmd-9-2973-2016

Schneider, A., Friedl, M. A., and Potere, D. (2009). A new map of global urban extent from MODIS satellite data. *Environmental Research Letters, 4, 044003.* http://doi.org/10.1088/1748-9326/4/4/044003

Song, X. et al. (2018). Global land change from 1982 to 2016. *Nature 560, 639-643.* http://doi.org/10.1038/s41586-018-0411-9

3.3. North Sea Waterscape

Carrell, S. (2019, April 27). *Scotland's salmon crisis: 'Anglers only want one. But it's just not happening'*. The Guardian. Retrieved from https://www.theguardian.com/environment/2019/apr/27/scotlands-salmon-crisis-anglers-only-want-one-but-its-just-not-happening

Defeo, O., et al. (2009). Threats to sandy beach ecosystems: A review. *Estuarine, Coastal and Shelf Science, 81 (1), 1-12.*

Explore Beaches (2020). *Beach Nourishment.* The Regents of the University of California. Retrieved from http://explorebeaches.msi.ucsb.edu/beach-health/beach-nourishment

De Groot, A. V. et al. (2017). *Wadden Sea Quality Status Report: Beaches and dunes.* Edited by: Kloepper, S. et al., Common Wadden Sea Secretariat, Wilhelmshaven, Germany. Last updated 21-12-2017. Retrieved 06-01-2020 from http://qsr.waddensea-worldheritage.org/reports/beaches-

FIGURES

Figure ...:
Carmen_Seaby (2007, September 1). *At the Eden Project.* Retrieved from https://www.flickr.com/photos/carmen_seaby/1296950244/

Figure ...:
Damonte, B. (2019, April 8). *The Amazon Spheres by NBBJ.* Retrieved from https://www.interiordesign.net/articles/16194-nbbj-puts-nature-into-the-workplace-for-the-amazon-spheres-in-seattle/

Figure ...:
Bandyopadhyay, S. (2016, June 25). *Top view from Living Root Bridge in Mawlynnong.* Retrieved from https://nl.wikipedia.org/wiki/Bestand:Top_view_from_Living_Root_Bridge_in_Mawlynnong.jpg

and-dunes

Leewis, L., et al. (2012). Does beach nourishment have long-term effects on intertidal macroinvertebrate species abundance? *Estuarine, Coastal and Shelf Science, 113, 172-181.*

Luijendijk, A. and van Oudenhoven, A. (2019). *The Sand Motor: A Nature-Based Response to Climate Change: Findings and Reflections of the Interdisciplinary Research Program NatureCoast.* Delft: Delft University Publishers - TU Delft Library.

NIOZ Royal Netherlands Institute for Sea Research (n.k.). *Key area North Sea: balancing human use and healthy ecosystems in one of the busiest seas.* Retrieved from https://www.nioz.nl/en/research/north-sea

Nordstrom, K. F., et al. (2012). Effects of beach raking and sand fences on dune dimensions and morphology. *Geomorphology, 179 (0), 106-115.*

4.2 Methodologies

Bernett, A. (2015, January 17). *Biomimicry, Bioutilization, Biomorphism: The Opportunities of Bioinspired Innovation.* Terrapin Bright Green. Retrieved from https://www.terrapinbrightgreen.com/blog/2015/01/biomimicry-bioutilization-biomorphism/

Dali, S. (1996). *Dali on Modern Art: The Cuckolds of Antiquated Modern Art.* New York: Dover Publications. This is a reprinted edition from the english translation from the bilingual edition published by the Dial Press in 1957.

Lucia, V. (2014). *The Ecosystem Approach between Ecocentrism and Anthropocentrism*. UiT Arctic University of Norway.

McWhirter, G. (2019). NBBJ Puts Nature Into the Workplace for the Amazon Spheres in Seattle. *Interior Design.* Retrieved from https://www.interiordesign.net/articles/16194-nbbj-puts-nature-into-the-workplace-for-the-amazon-spheres-in-seattle/

Myers, W. (2018). *Bio Design: nature science creativity.* Revised and expanded edition. London: Thames & Hudson.

Pawlyn, M. (2010, November). *Using nature's genius in architecture* [Video]. TEDSalon London. Retrieved from https://www.ted.com/talks/michael_pawlyn_using_nature_s_genius_in_architecture#t-163624

Silvernail, D. (2019). *Cradle-to-Cradle Design in Architecture*. Santa Cruz Architect at WordPress.com. Retrieved from https://santacruzarchitect.wordpress.com/2016/11/13/cradle-to-cradle-design-in-architecture/

Wall, A. (n.k.) *Programming the Urban Surface. In Recovering Landscape: Essays in Contemporary Landscape Architecture.* Edited by Corner, J. New York: Princeton Architectural Press.

Worster, D. (1977). *Nature's Economy: A History of Ecological Ideas.* Cambridge: Cambridge University Press.

Wright, F.L. (1945). *When Democracy Builds.* Chicago: University of Chicago Press.

Yeang, K. (2020). *Saving the planet by design: reinventing our world through ecomimesis.* London and New York: Routledge.

5.1. Identity - Historical Precedents

Het Tij Geleerd (2008). *Eilanden natuurlijk: Natuurlijke ontwikkeling en veerkracht op de Waddeneilanden.* Groningen: Het Grafisch Huis.

Kunz, H. (n.k.). *Shoreline Protection of the East Frisian Islands of Norderney and Langeoog.* American Society of Civil Engineers. Retrieved from https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0051792

De Vereniging voor Vreemdelingenverkeer (VVV) (n.k.). *Werelderfgoed.* Retrieved from https://www.wadden.nl/wadden/unesco-werelderfgoed

Ecomare (n.k.) *Nederlandse wadden.* Stichting Texels Museum. Retrieved from https://www.ecomare.nl/verdiep/leesvoer/waddengebied/nederlandse-wadden/

Meaden, G. J. and Do Chi, T. (1996). *Geographical information systems Applications to marine*

fisheries. Rome: Food and Agriculture Organization of the United Nations.

Waddenzee Werelderfgoed (n.k.). *Contouren ontstaan.* Retrieved from https://www.waddensea-worldheritage.org/nl/contouren-ontstaan

5.2. Site analysis

AdminStat Germania (2020). *Municipality of Norderney.* UrbiStat S.r.l.. Retrieved 06-01-2020, from https://ugeo.urbistat.com/AdminStat/en/de/demografia/stranieri/norderney/20156138/4

Eilanden info (n.k.). *Norderney.* Retrieved from http://www.eilandeninfo.nl/eilanden.php?eiland=norderney

German National Tourism Board (2019). *De Duurzaamste Bestemming Ter Wereld: Norderney.* Travel 360°. Retrieved from https://travel360benelux.com/nl/german-national-tourism-board/norderney-duurzame-bestemming-itb/

Kunz, H. (n.k.). *Shoreline Protection of the East Frisian Islands of Norderney and Langeoog.* American Society of Civil Engineers. Retrieved from https://cedb.asce.org/CEDBsearch/record.jsp?dockey=0051792

Müller, J. (2004). *Long-term Morphological Evolution of the Norderneyer Seegat.* Technical University Delft. Retrieved from http://resolver.tudelft.nl/uuid:18e68bbe-3719-4809-9c4a-8417b14ce155

NLWKN (2010). Generalplan Küstenschutz Niedersachsen – Ostfriesische Inseln. Norden: Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz.

Stadt Norderney (n.k.). *Der Nationalpark Niedersächsisches Wattenmeer.* Retrieved 08-01-2020, from https://www.stadt-norderney.de/natur-umwelt/nationalpark/mn_42927

Stadt Norderney (n.k.). *Kläranlage.* Retrieved from https://www.stadt-norderney.de/publish/172cb2ec_7e90_43c1_7d040636d0f71038.cfm?m_id=42874

Stadt Norderney (n.k.). *Klärschlammvererdung durch das EKO-Plant - st- Verfahren.* Retrieved from https://www.stadt-norderney.de/publish/05ff1bba_7e90_43c1_7a9ac460e0fc3cf4.cfm?m_id=42930

Stadt Norderney (n.k.). *Natur und Umwelt auf Norderney.* Retrieved from https://www.stadt-norderney.de/publish/c515e8ea_7e90_43c1_7e0c7a3ca135a1fd.cfm?m_id=42871

Stadt Norderney (n.k.). *Weltnaturerbe Wattenmeer.* Retrieved from https://www.stadt-norderney.de/publish/172cb26f_7e90_43c1_766ed4cbda0e4326.cfm?m_id=42872

Sustainable Destinations Top 100 (n.k.). *Norderney.* Retrieved from http://sustainabletop100.org/dest/norderney-juist/

Wikipedia (n.d.). Norderney. Retrieved from https://de.wikipedia.org/wiki/Norderney

Wikiwand (n.k.). *Norderney.* Retrieved 06-01-2020, from https://www.wikiwand.com/de/Norderney

Beach Inspector (n.k.). *Strandkaart Nordernery*. Retrieved 10-01-2020, from https://www.beach-inspector.com/nl/ba/norderney-2

ENVIRONMENT CATALOGUE

Groel-Koch, S. (2018, May 30). *Norderney-Pferde.* Retrieved from https://www.flickr.com/photos/139830726@N06/44215478240

Havenmeester (n.k.). *Luftbild Norderney.* Retrieved from https://www.portmaps.com/eng/ports/norderney-sportboothafen-19/photos

Norderney Nordsee-Magazin (n.k.). *Napoleonschanze.* Retrieved from https://magazin.norderney-zs.de/adressen/napoleonschanze/105/

Nordseewolf (n.k.). *Flughafen norderney.* Retrieved from https://www.pinterest.cl/pin/716564990687342921/

FIGURES CLIMATE

Figure ...:
Carstens, H. (1962, Februari 17). *Überfluteter Deich.* Retrieved from http://www.hvonstorch.de/klima/Media/PMs/sturmflut%201962-3.jpg

Figure ...:
Nomo Norderney (2017, Januari 12). *Kleine Sturmflut.* Retrieved from https://www.nomo-norderney.de/12-januar-2017-kleine-sturmflut

Figure ...:
Wetterkanal (2015, October 28). *Heute vor 2 Jahren (28.10.13) - Orkan Christian.* Retrieved from https://wetterkanal.kachelmannwetter.com/heute-vor-2-jahren-28-10-13-orkan-christian/

CLIMATE

Deutscher Wetterdienst (2013). *Orkantief Christian am 28. Oktober 2013*. Retrieved from https://www.dwd.de/DE/leistungen/besondereereignisse/stuerme/20131028_orkantief_christian.pdf?__blob=publicationFile&v=4

Weather Spark (n.k.). *Average Weather in Norderney.* Retrieved 26-02-2020, from https://weatherspark.com/y/58403/Average-Weather-in-Norderney-Germany-Year-Round

OYSTERS

Fig. 42
Lu, C. (2014 June 27). *Oyster Life Cycle*. Retrieved from https://www.pangeashellfish.com/blog/oyster-life-cycle-on-farm

SEAWEED

Architectuur centrum Amsterdam (2019). *Vide Expo Studio Zeewier.* Retrieved from https://www.arcam.nl/vide-expo-studio-zeewier/

DaSilva (2019, February 20). *Making Houses Out of Seaweed.* Retrieved from https://magazine.mayaluxe.com/articles/making-houses-out-of-seaweed

Edvard, J. (n.k.). *Terroir Chair.* Retrieved from https://jonasedvard.dk/work/terroir/

Edvard, J. (n.k.). *Terroir material, texture and colour.* Retrieved from https://jonasedvard.dk/work/terroir/

Grozdanic, L. (2013, December 7). *Seaweed House Vandkunsten Realdania Byg.* Retrieved from *https://inhabitat.com/seaweed-clad-house-in-denmark-combines-traditional-materials-with-21st-century-building-techniques/seaweed-house-vandkunsten-realdania-byg-8/*

Linington, J. (n.k.). *The Seaweed Girl Collection.* Retrieved from https://www.jasminelinington.com/seaweed-girl-collection

Lorentzen, A. (2019, August 2). *Prefabricated seaweed thatched panels.* Retrieved from https://materialdistrict.com/article/prefabricated-seaweed-thatched-panels/

Øhrstrøm, T. G. L. (2015). *Bio-concretion.* Retrieved from http://www.iaacblog.com/programs/bio-concretion/

Schnack, A. (n.k.). *Læsø Andrine's House*. Retrieved from https://www.designboom.com/architecture/seaweed-roof-laeso-denmark-07-25-18/

Studio Seagrass (n.k.). *Byggeskik.* Retrieved from https://studioseagrass.cargo.site/Taenge-02

Studio Seagrass (n.k.). *Plade-installation.* Retrieved from https://studioseagrass.cargo.site/Presse-02

Studio Seagrass (n.k.). *Plade proces.* Retrieved from https://studioseagrass.cargo.site/Presse-04

Studio Seagrass (n.k.). *VÆVE.* Retrieved from https://studioseagrass.cargo.site/Vaeve-01

Studio Seagrass (n.k.). *VÆVE Teknik.* Retrieved from https://studioseagrass.cargo.site/Vaeve-02

Vandkunsten Architects (n.k.). *The Modern Seaweed House.* Retrieved from https://vandkunsten.com/en/projects/seaweedhouse

6. Other research

SEAWEED

Buckley, S. (2020). *Seaweed as insulation?* Architecture & Design. Retrieved from https://www.architectureanddesign.com.au/news/seaweed-as-insulation#

DaSilva (2019). *Making Houses Out of Seaweed.* In Magazine Maya Luxe. Retrieved from https://magazine.mayaluxe.com/articles/making-houses-out-of-seaweed

Ecobouwers (2019). *Zeegrasisolatie als bio-ecologisch bouwmateriaal.* Retrieved from https://www.ecobouwers.be/artikels/zeegras-isolatie-bio-ecologisch-bouwmateriaal

Edvard, J. (n.k.). *Terroir.* Retrieved from https://jonasedvard.dk/work/terroir/

Larsen, K. (2018). *Seaweed Architecture: Eelgrass as a Construction Material.* Retrieved from https://issuu.com/kathrynlarsen/docs/seaweedarchitecture

Material District (2019). *Prefabricated seaweed thatched panels.* Retrieved from https://materialdistrict.com/article/prefabricated-seaweed-thatched-panels/

Material District (2014). *Strength of Seaweed.* Retrieved from https://materialdistrict.com/article/strength-seaweed/

Studio Seagrass (n.k.). *Plade-installation.* Retrieved from https://studioseagrass.cargo.site/Presse-02

9. ATTACHMENTS

TU Delft
Delft University of Technology

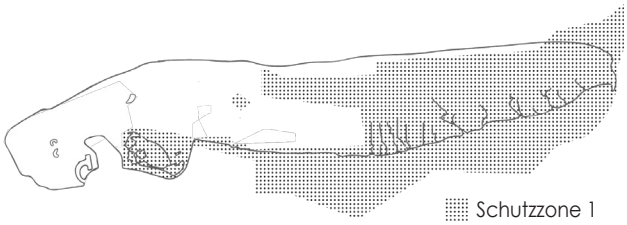
Einwohner Norderney Interviewformular

1.

Wie stehen Sie zur Verwendung der Schutzzone 1 (ruhezone) von Norderney als Wohnraum?

What do you think about living in Schutzzone 1 (protection zone 1) of Norderney?

Wat zou u ervan vinden om in Schutzzone 1 (beschermingsgebied 1) van Norderney te wonen?

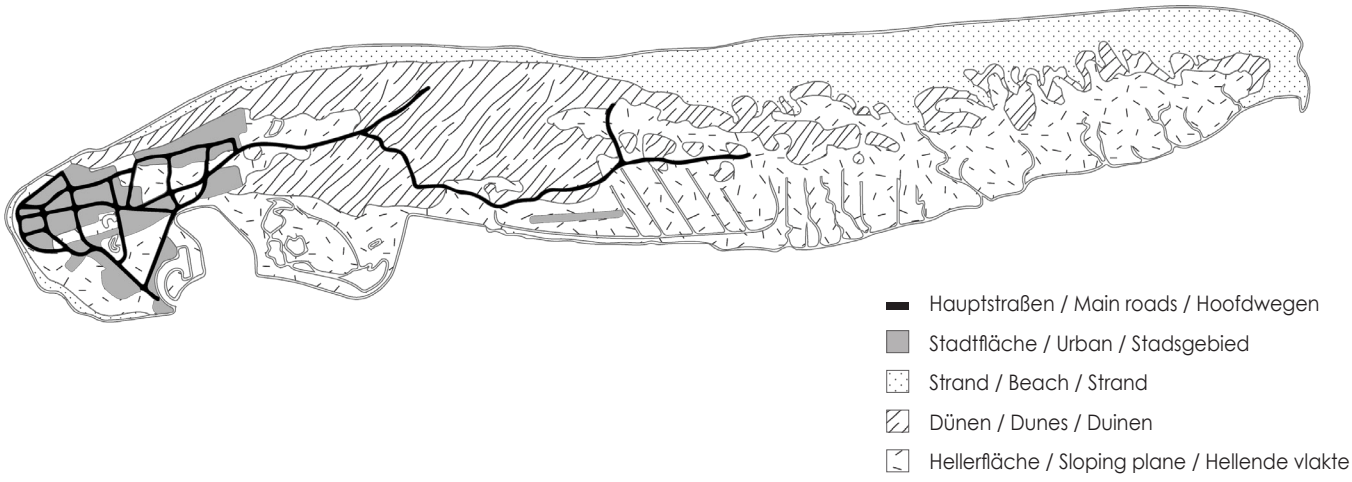


2. a.

Wenn Sie irgendwo auf der Insel leben könnten, wo würden Sie gerne leben? Setzen Sie unten ein Kreuz auf die Karte.

If you could live anywhere on the island, where would you like to live? Put a cross on the map below.

Als het overal mag, waar zou u dan willen wonen op het eiland? Kruis de locatie aan op onderstaande kaart.



b.

Warum bevorzugen Sie diesen Ort?

Why do you prefer this location?

Waarom heeft deze locatie uw voorkeur?

3. a. Wie stehen Sie zum Leben auf dem Wasser?

What do you think about living on the water?

Wat zou u ervan vinden om op het water te wonen?

b. Möchten Sie lieber in der Nordsee oder im Wattenmeer wohnen und warum?

Would you prefer to live on the North Sea or on the Wadden Sea and why?

Zou u liever op de Noordzee of op de Waddenzee willen wonen en waarom?

Setzen Sie einen Kreis auf die Karte, wenn sich Ihr bevorzugter Wohnort geändert hat.

Put a circle on the map, if your preferred living location changed.

Zet een cirkel op de kaart, als uw favoriete woonlocatie is gewijzigd.

4. Möchten Sie in einer kleinen nachhaltigen Gemeinde oder einem ökologischen Dorf auf Norderney leben und warum?

Would you like to live in a small sustainable community or ecological village on Norderney and why?

Zou u in een kleine duurzame gemeenschap of ecologisch dorp op Norderney willen wonen en waarom?

5. Welchen Beruf üben Sie aus?

What is your profession?

Wat is uw beroep?

6. a. Arbeiten Sie oft von zu Hause aus und ungefähr wie oft?

Do you work often from home and approximately how often?

Werkt u vaak vanuit huis en ongeveer hoe vaak?

b. Was brauchst du, um zu Hause zu arbeiten?
(Zum Beispiel: einen Schreibtisch, Platz für einen Drucker, Platz zum Empfangen von Kunden)

What do you need to work from home?
(for example: a desk, a place for a printer, space to receive customers, etc.)

Wat heb je nodig om thuis te werken?
(Bijvoorbeeld: een bureau, plaats voor een printer, plaats om klanten te ontvangen, etc.)

7. Möchten Sie regionale Produkte herstellen?
(Zum Beispiel Algen oder Austern)

Would you like to produce local products?
(for example seaweed or oysters)

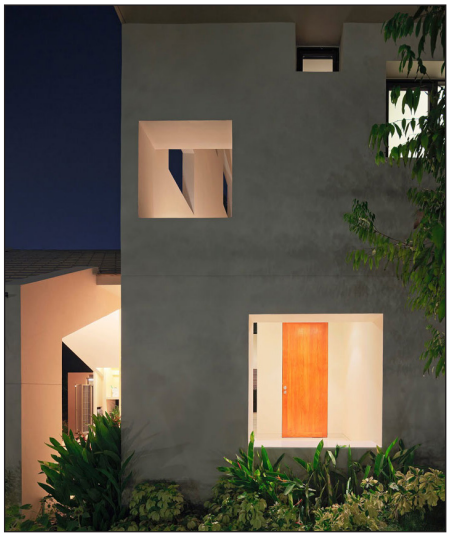
Zou u het leuk vinden om locale producten te produceren?
(Bijvoorbeeld zeewier of oesters)

Vielen Dank für Deine Teilnahme an dieser Studie!

Thank you very much for participating in this study!

Heel erg bedankt voor het meedoen aan dit onderzoek!

Project information
Architect: All(zone)
Location: Ramkamheng 118 road, Bangkok, Thailand



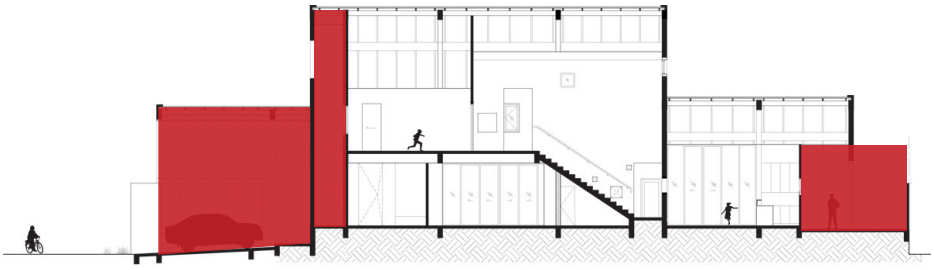
Photographs:
S3H House
(piyawut srisakul, 2013)

Drawings:
S3 House Floor plans and sections
(All(zone), n.k., edited by author)

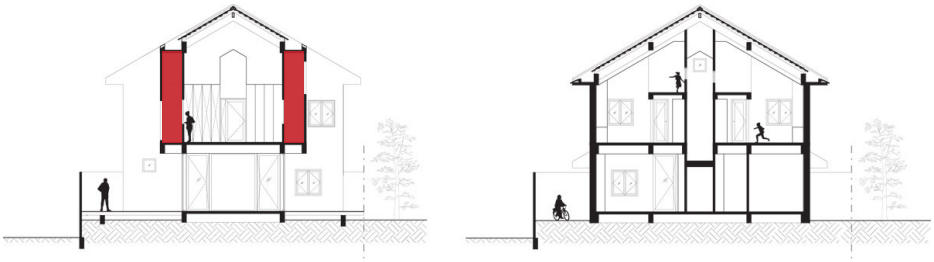
S3 HOUSE

The several layers, slicing the dwelling into different spaces, leads you gradually from the outside to the interior rooms. This transition from the public street to the building's interior is a journey from public to private. Beside defining and separating spaces, this layering system of geometric volumes filters the light coming through.

The layers before the inside:

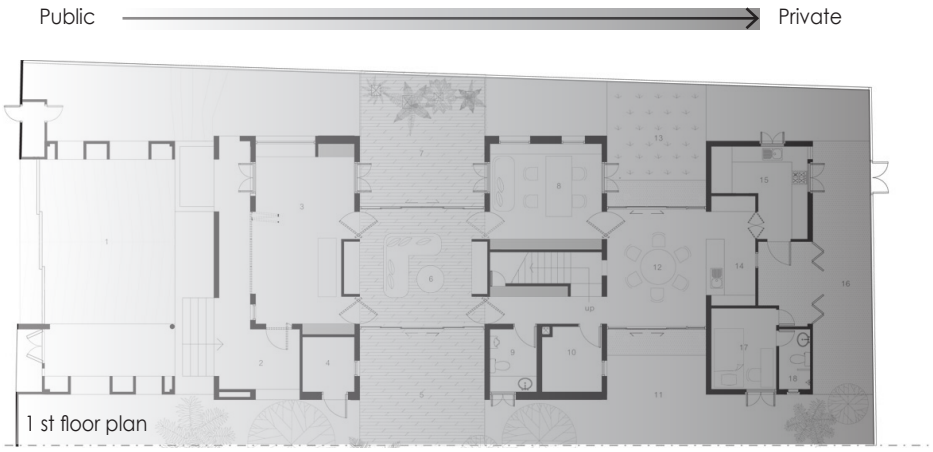


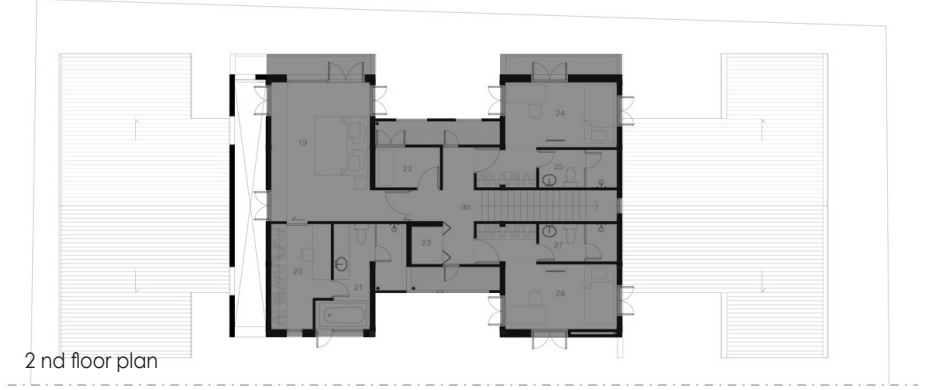
Longitudinal section

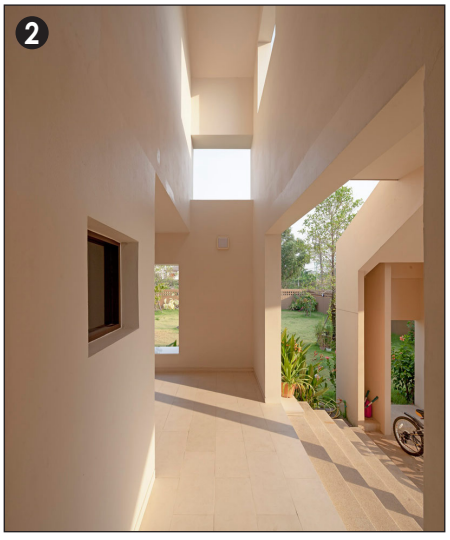


Cross-sections

The journy from public to private:

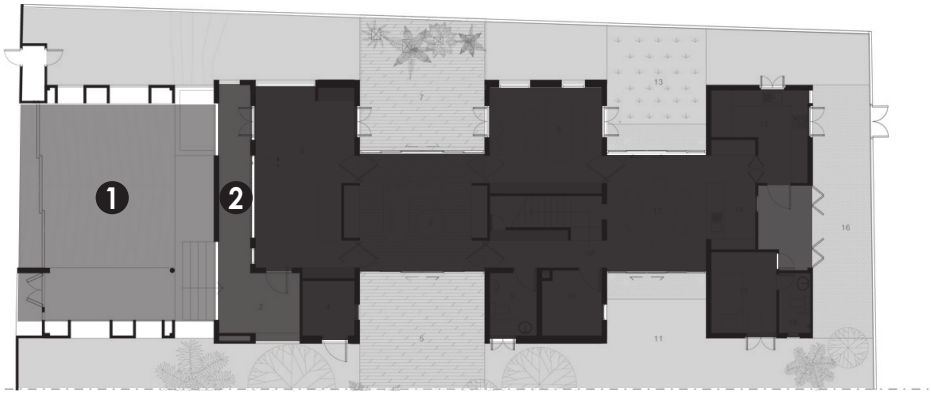




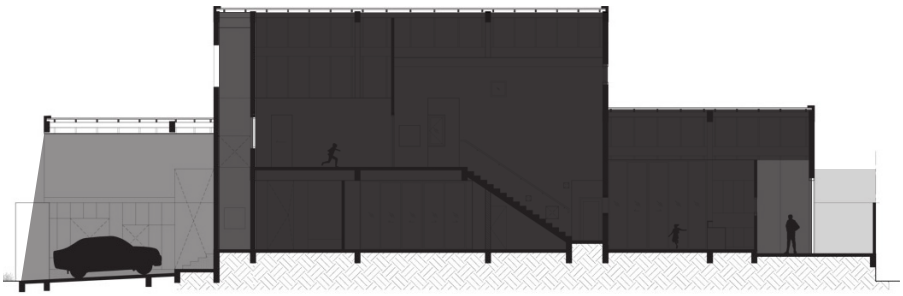


Private-outside (garden)
Semi-outside
Semi-inside
Inside

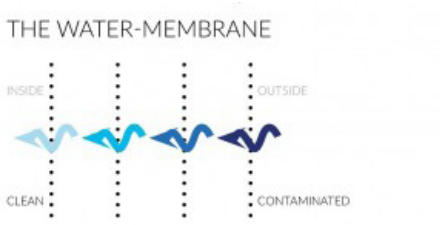
1 st floor plan

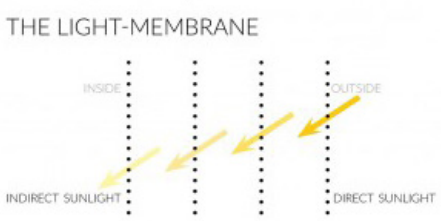


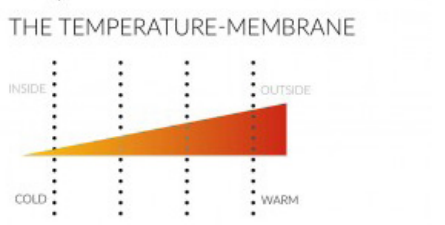
Longitudinal section



Project information
Architect: Architectuurstudio IR
Location: Novelda, Spain







Illustrations:
Membrane house
(Architectuurstudio IR, n.k.)

MEMBRANE HOUSE

The membrane house is designed to convert an uninhabitable desert, into a lively oasis. The name Membrane House can be found in three different ways in the design:

1. Water from the river Vinalopo is filtered with the reverse osmosis principle. This process is based on a membrane technology that convert the water into drinking water.
2. Besides the normal facade, there are three extra concrete, perforated layers. The perforation is decided by using a calculation of the different sun positions, to keep out as much sunlight as possible without losing certain views on the environment.
3. In between the three layers, is water from the river Vinalopo with greenery. This cools down the hot air from outside before it enters the dwelling, and the air is humidified and purified by the plants.

The terraces on the ground floor and the first floor offer in turn an outdoor space in the shade or sun

Plattegrond, Laag 0
(Architectuurstudio IR, n.k.)

Plattegrond, Laag 1
(Architectuurstudio IR, n.k.)

HOUSE N

Project information
Architect: Sou Fujimoto
Location: Oita, Japan

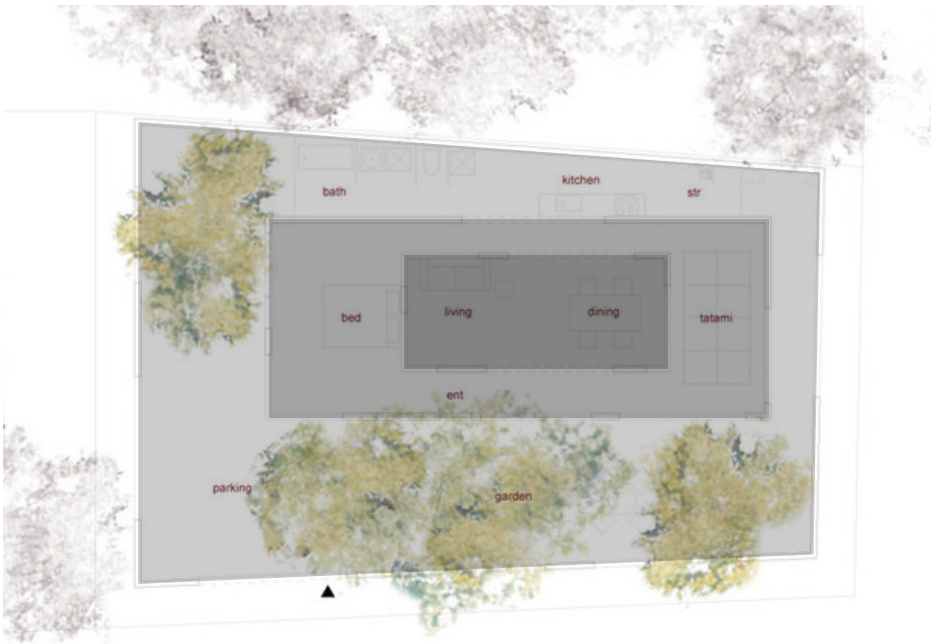
House N consists of three shells.
- The outer shell covers a semi-indoor garden.
- The second shell is the barrier between inside and outside, creating a limited inside space.
- The last shell holds a smaller interior space.

Those shells create a gradient from outside to inside. Each space has a different distance from the public street, with a different ambience and level of privacy. The architect wanted to expres the riches of what can be between houses and streets.

House N
(Iwan Baan, 2011)

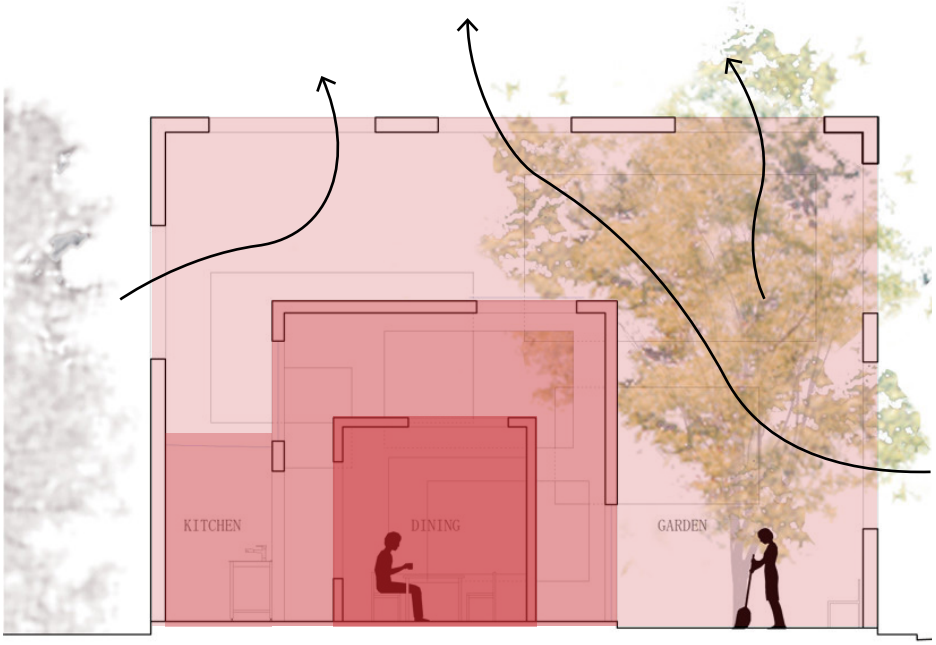
House N
(Iwan Baan, 2011)

Casa N en Oita
(Juan Carlos Julcahuanca Vera, 2018)



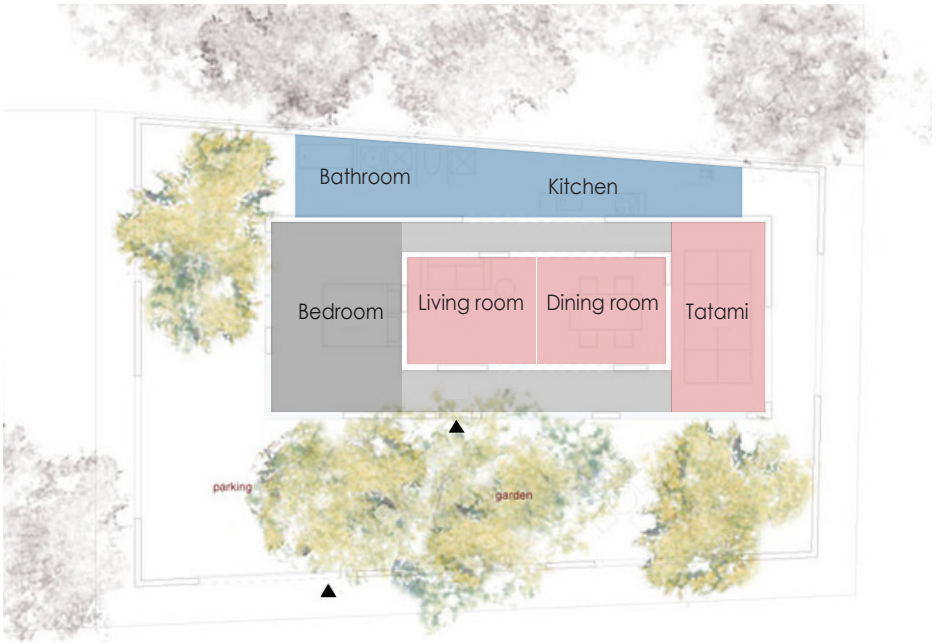
Drawings:
House N Floor plan and section
(Sou Fujimoto Architects, n.k., edited by author)

Each space also has a different distance from the outside weather:



- Semi-enclosed, still outside
- Enclosed
- Core, with a distance of two airlayers from the outside

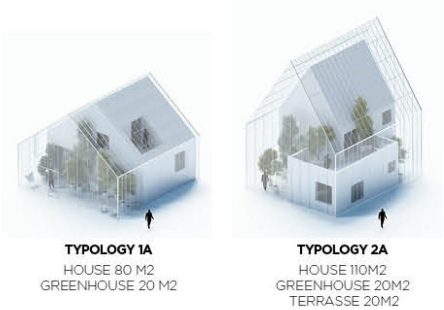
The inside spaces:



- Circulation space
- Living areas
- Wet spaces
- Private space

Project information
Architect: Effekt
Location: Almere, Netherlands

Housing typologies:



Illustrations:
Regen villages
(Effekt, n.k.)

REGEN VILLAGES

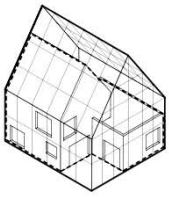
ReGen is abbreviated for regenerative, it means that outputs of a system, are the inputs of another. It is a holistic approach, including:

- Energy positive homes
- Renewable energy
- Energy storage
- Door-step high-yield organic food production
- Vertical farming aquaponics/aeroponics
- Water management
- Waste-to-resource systems

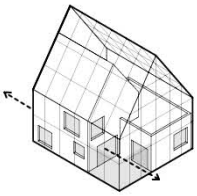
"ReGen Villages adds not only environmental and financial value, but also social value, by creating a framework for empowering families and developing a sense of community, where people become part of a shared local eco-system: reconnecting people with nature and consumption with production." (Effekt, n.k.)

25 Housing units + Food production

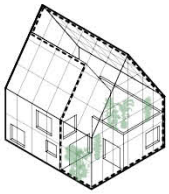
Housing features:



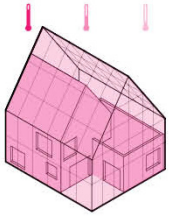
Prefabricated and demountable living box



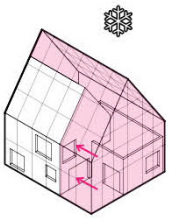
Openable



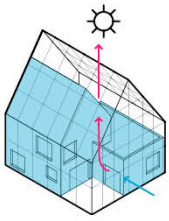
Extended living zone



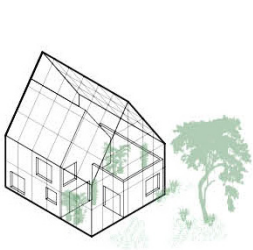
Passive heat + heated space



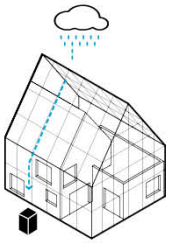
Preheated air in winter



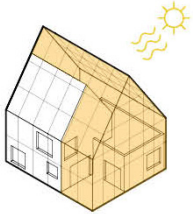
Natural ventilation



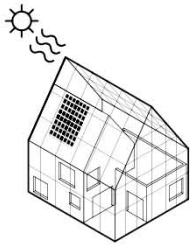
Inside & outside blends



Natural ventilation



Extending summer season



Built-in solar energy

Program:

HOME
AREA:
120M2

GREENHOUSE
AREA:
40M2

AQUAPONIC
AREA:
300M2

SEASONAL GARDEN
AREA:
100M2

LIVESTOCK
AREA:
25M2

SOLAR CELLS
AREA:
34M2

WATER STORAGE
AREA:
20M2

Program

What are the basic needs for a family of 3 / year?

TOTAL AREA: 639 M²

HOME
AREA:
3000M2

GREENHOUSE
AREA:
1000M2

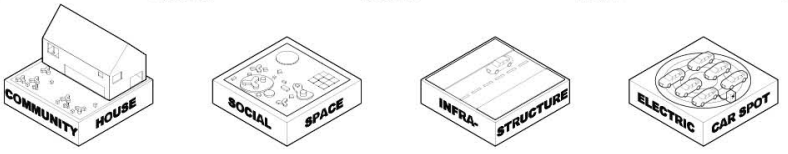
AQUAPONIC
AREA:
2500M2

SEASONAL GARDEN
AREA:
1500M2

LIVESTOCK
AREA:
450M2

SOLAR CELLS
AREA:
850M2

WATER STORAGE
AREA:
500M2



COMMUNITY HOUSE
AREA:
350M2

SOCIAL SPACES
AREA:
3500M2

INFRASTRUCTURE
AREA:
1500M2

EL-CAR PARKING SPOT
AREA:
300M2

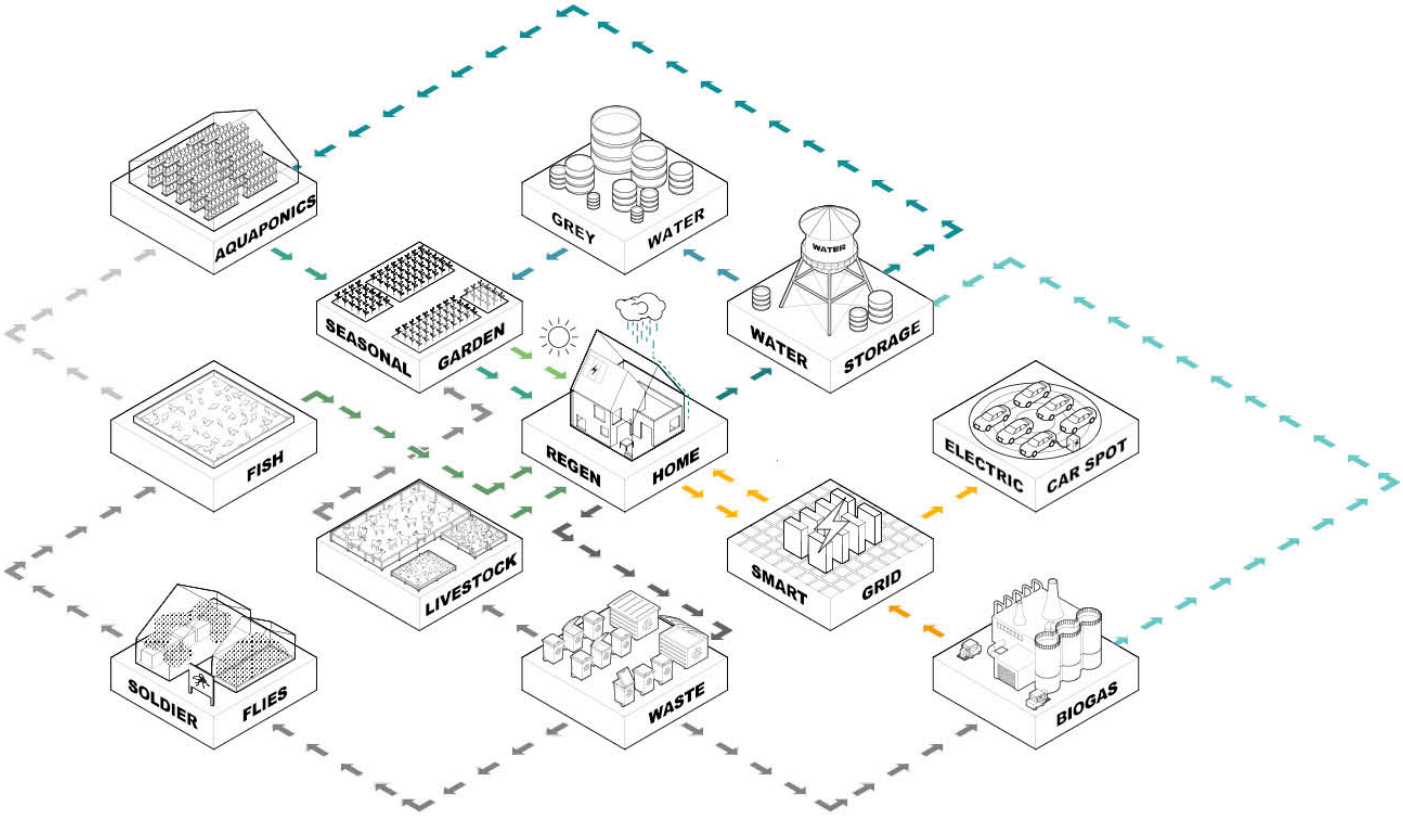
Program

What are the basic needs for ReGen Villages?

TOTAL AREA: 15450 M²

Illustrations:
Regen villages
(Effekt, n.k.)

Regen System:



WASTE

01 HOUSEHOLD WASTE
IS SORTED, INTO DIFFERENT CATEGORIES, SO IT CAN BE RE-USED FOR MULTIPLE PURPOSES

02 BIO-WASTE
THAT IS NON COMPOSTABLE IS USED IN THE BIOGAS FACILITY

03 COMPOST
BECOMES FOOD FOR SOLIDER FLIES AND LIVESTOCK

04 SOLDER FLIES AND LIVESTOCK MANURE
SOLDIER FLIES ARE FED TO THE FISH AND MANURE FROM LIVESTOCK IS USED TO FERTILIZE THE SEASONAL GARDENS.

05 FISH FECES
BECOMES FERTILIZER FOR THE PLANT IN THE AQUAPONIC SYSTEM

FOOD

06 AQUAPONICS
THE AQUAPONICS SYSTEM PRODUCE VEGETABLES AND FRUIT FOR THE REGEN HOME

07 SEASONAL GARDENS
PRODUCE A WIDE VARIETY OF PRODUCES FOR HOME COMSUMPTION.

08 LIVESTOCK AND FISH
AS THE PRIMARY PROETIN FOOD SOURCE.

WATER

09 RAINWATER COLLECTION AND STORAGE
THE SETTLEMENT IS DESIGNED TO COLLECT AND RE-USE RAINWATER.

10 BIOGAS FACILITY
BURNING THE BURNING OF BIOWASTE, THE BIO GAS FACILITY EXTRACT WATER, THAT IS THEN STORED

11 GREY WATER
IS SEPARATED TO BE RE-USED

12 GREY WATER
IS USED TO IRRIGATE THE SEASONAL GARDENS.

13 AQUAPONICS
CLEAN WATER FROM THE WATER STORAGE IS DISTRIBUTED TO THE AQUAPONICS SYSTEM WHEN NEEDED

ENERGY

14 SOLAR CELLS AND SMART GRID
ON THE SETTELMENT PROVIDES ENERGY FOR THE HOME AND DISTRIBUTES THE SURPLUS OF ENERGY TO THE SMART GRID.

15 BIOGAS FACILITY
THE ENERGY PRODUCES IN THE BIOGAS IS ADDED TO THE SMART GRID

16 EL-CAR CHARGING STATION
THE SURPLUS ENERGY IN THE SMART GRID, WILL BE USED FOR THE EL-CAR CHARGING STATIONS

10. LITERATURE ATTACHMENTS

SOURCES S3 HOUSE:

Mahon, C. (2013). *all(zone): S3H multi-layered house features exterior cut-outs.* Retrieved from https://www.designboom.com/architecture/allzone-s3h-multi-layered-house-features-exterior-cut-outs-09-27-2013/

Photographs:
Srisakul, P. (2013, September 29). Retrieved from https://www.designboom.com/architecture/allzone-s3h-multi-layered-house-features-exterior-cut-outs-09-27-2013/
S3H02s
S3H Nighttime view
S3H Detail of the exterior skin
S3H04s
S3H05s
S3H06s
S3H Layering of geometric volumes

Drawings:
All(zone). (n.k.). *S3 House 1st floor plan.* Retrieved from https://www.designboom.com/architecture/allzone-s3h-multi-layered-house-features-exterior-cut-outs-09-27-2013/
Edited by author.

All(zone). (n.k.). *S3 House 2nd floor plan.* Retrieved from https://www.designboom.com/architecture/allzone-s3h-multi-layered-house-features-exterior-cut-outs-09-27-2013/
Edited by author.

All(zone). (n.k.). *S3 House Section A.* Retrieved from https://www.designboom.com/architecture/allzone-s3h-multi-layered-house-features-exterior-cut-outs-09-27-2013/
Edited by author.

All(zone). (n.k.). *S3 House Section B+C.* Retrieved from https://www.designboom.com/architecture/allzone-s3h-multi-layered-house-features-exterior-cut-outs-09-27-2013/
Edited by author.

SOURCES MEMBRANE HOUSE:

Architectuurstudio IR (n.k.). *Membrane house.* Retrieved from https://www.studioir.nl/portfolio/membrane-house/

SOURCES HOUSE N:

Archdaily (2011). *House N/Sou Fujimoto Architects.* Retrieved from https://www.archdaily.com/7484/house-n-sou-fujimoto

Photographs:
Baan, I. (2011, September 14). *House N.* Retrieved from https://archide.wordpress.com/2008/12/23/house-n-by-sou-fujimoto-architects-oita-japan/

Vera, J.C.J. (2018, Augustus 23). *Casa N en Oita.* Retrieved from https://issuu.com/juancarlosjulcahuancavera/docs/el_croquis_-_151_-_sou_fujimoto/77

Drawings:
Sou Fujimoto Architects (n.k.). *House N Floor plan and section.* Retrieved from https://www.archdaily.com/7484/house-n-sou-fujimoto
Edited by author.

SOURCES REGEN VILLAGE:

Effekt (n.k.). *Regen Villages.* Retrieved from https://www.effekt.dk/regenvillages