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From Nature-Based to Nature-Driven: Landscape First for the Design of Moeder Zernike in Groningen

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Abstract: Global climate change impacts the future of urbanism. The future is increasingly uncertain, and current responses in urban planning practice are often human-centered. In general, this is a way to respond to change that is oriented towards improving the life of people in the short term, often extracting resources from the environment at dangerous levels. This impacts the entire ecological system, and turns out to be negative for biodiversity, resilience, and, ultimately, human life as well. Adaptation to climatic impacts requires a long-term perspective based in the understanding of nature. The objective of the presented research is to find explorative ways to respond to the unknown unknowns through designing and planning holistically for the Zernike campus in Groningen, the Netherlands. The methods used in this study comprise co-creative design-led approaches which are capable of integrating sectoral problems into a visionary future plan. The research findings show how embracing a nature-driven perspective to urban design increases the adaptive capacity, the ecological diversity, and the range of healthy food grown on a university campus. This study responds to questions of food safety, and growing conditions, of which the water availability is the most pressing. Considering the spatial concept, this has led to the necessity to establish a novel water connection between the site and the sea.

Keywords: nature-based solutions; landscape and urban design; urban agriculture and food systems; coastal dynamics; Groningen

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1. Introduction

Climate change is one of humanity's biggest problems [1], and this is largely part related to the ways in which humans live, even causing a new geological era, the anthropocene [2]. The climate's impact on land use, productivity, and food security [3], ecology [4], livability [5–7], and safety, which is under pressure of accelerated sea level rise [8,9], is moving beyond planetary boundaries [10]. The question of whether policy responses can deal with these uncertainties is investigated in this article. It is clear that adaptation is inescapable [11,12].

Current spatial planning focuses on the past, reiterating former policies for novel problems [13,14]. New problems, however, cannot be solved with solutions derived from the actions that caused them. Contemporary policies in the Groningen political arena tend to 'muddle through' [15], and are focused on the near future and on well-understood problems [16,17].

Current achievable policy outcomes are rooted in an existing context of political negotiations and compromises in governance. Wicked problems cannot be dealt with using linear answers—a common mistake. A 'negotiated average' provides solutions for an already changed problem the moment the solution is brought forward, contradicting the long-term larger scale [18], forming an adaptation gap [19,20]. Planning that responds to emergencies is continuously 'muddling through' [15], while uncertainty and wicked problems [21] require 'unsafe planning' [22], bridging this gap (Figure 1).

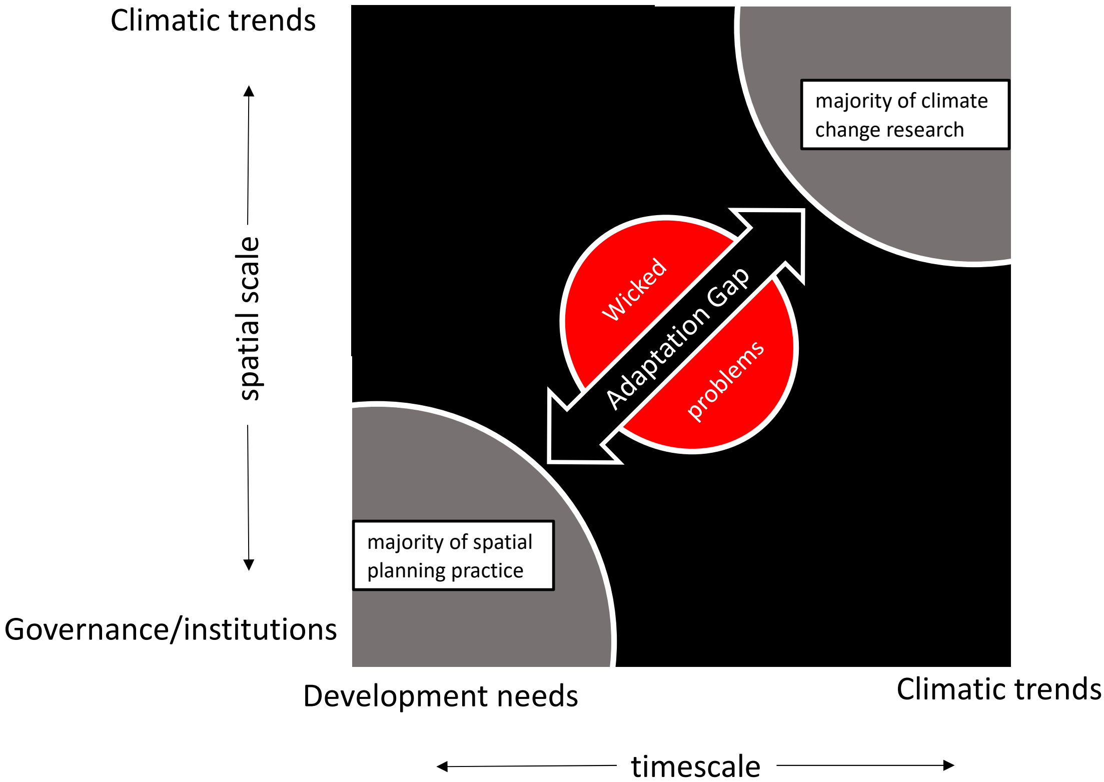

Figure 1. The adaptation gap and wicked problems [19].

Instead, climate adaptation requires innovation in spatial planning that bypasses short-term path-dependency. Therefore, coping with uncertainty [23] is essential, and short-term spatial policymaking needs to be replaced by applying the art of the long view [24] and unsafe planning [22], allowing us to leapfrog current policies.

Climate adaptation is viewed as a spatial challenge [25], positioning 'design' to discover holistic solutions [26–28]. This way, adaptation is designed for the Zernike campus, located on the northern fringe of the city of Groningen in the Netherlands (Figure 2). This university campus is home to two universities, several research institutes, and many enterprises and start-ups. It hosts approximately 30,000 people, including students and staff. The Moeder Zernike project is part of the design-manifestation of the Climate Adaptation Week Groningen, in which the task is to propose solutions for a 100-year future.

This article takes nature-based solutions (NBS) as the point of departure and investigates the potentialities of how to anticipate climate impacts.

Figure 2. Zernike campus in the northern fringe of the City of Groningen.

2. Research Problem

2.1. Problem Definition

Climate adaptation is often practiced with a human-centred objective. In many cases, this leads to increased deterioration of ecosystems and biodiversity loss, puts pressure on agricultural systems, and leads to economic problems and foodborne diseases. Moreover, the lack of green space decreases the quality of life of humans, both physically as mentally.

2.1.1. Ecology

The worldwide decrease in biodiversity, up to 68% [29,30], has a negative impact on soil and water quality. This impacts the functioning of all kinds of natural processes. In 2007, populations of the black-tailed godwit, redshank, oystercatcher, and lapwing were 10–60% lower than in 1990 [31], and this decline in open farmland birds has not stopped (Figure 3). The numbers of the black-tailed godwit decreased by 40%, which is internationally important since the major breeding area in Europe is in the Netherlands [32]. As a result of intensified farmland and cattle farming, this trend has continued to decline since 1960 [31]. Biodiversity loss since the second half of last century is very high. This umbilical cord cannot be severed, as human life depends on nature.

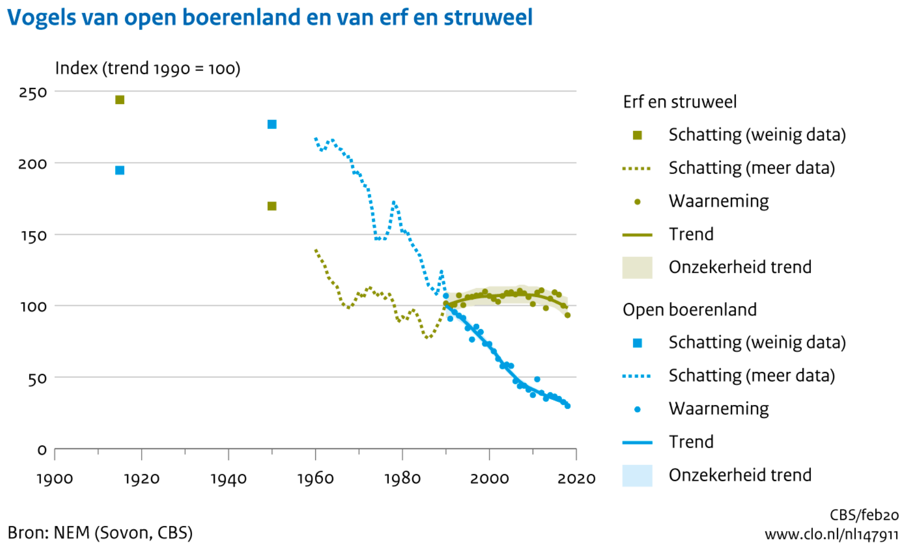

Figure 3. Trends in bird populations open farmland in the Netherlands (in blue) [31].

2.1.2. Agriculture

A few crops, including potatoes, wheat, and sugar beet, and grassland dominate the current agriculture in Groningen [33], and these land uses lead to the dewatering of peatlands, causing carbon emissions constituting approximately 40% of the total Groningen emissions from agriculture [34]. The EU subsidizes agricultural production, and due to future reduction in these subsidies [35], farmer's incomes are increasingly under pressure. Globally, food security concerns rise [36]. Groningen's agriculture is not capable of feeding its own population, and it must therefore import food from around the globe. Food safety poses another serious risk [37], as it may cause illnesses, epidemics, or pandemics. Dewatering in combination with relative sea level rise causes soil subsidence and increasing salinity [38]. This problem has increased through recent droughts [39], creating additional risks for the fresh water-dependent crops. In Groningen, agriculture has undergone a transformation. As part of general developments in the Netherlands [40], land consolidation in the 20th century led to larger parcels (Figure 4), increasing the vulnerability to illnesses and economic change.

Figure 4. Landscape change in the Marne area as a result of land consolidation, from 1925 to 1975.

Agriculture finds itself at an intersection: will it follow existing pathways of increasing efficiency of production methods, using up all the natural resources and emaciating the landscape, or growing crops that enrich the soil, keeping nature healthy?

2.1.3. The Soil-Salinity Complex

The soil in the landscape of the Groningen area is subjected to a toxic mix of increasing salinity [41–43], soil subsidence resulting from dewatering the agricultural lands in conjunction with peat oxidation [44–47] and gas extractions [48–50], and the desiccation of the land [51,52], mutually exaggerating each other's impacts. Dewatering of the land causes soil subsidence, increasing the influence of seepage from the sea, which is even more detrimental due to the land drying out as result of climatic droughts. Increasing differences between the level of the land and the rising sea strengthens salinification, which causes further dewatering, which, in turn, causes additional soil subsidence, subsequently exaggerating salinity. This vicious circle of land degradation leads to ever more compromised conditions for growing food, induces a strictly controlled and managed water system, causes further loss of biodiversity, and instigates an (assumed) need to raise dikes to prevent the land from flooding. The impact of this process on traditional forms of agriculture in the northern Netherlands makes it difficult for these farming types to stay economically viable. Salinity alone is leading to an economic loss of EUR 1166/ha for potato fields [53].

2.1.4. Health-Problems

Resulting from the human-centred way in which we grow food and have organised our settlements, human and ecological health has come under increasing pressure. Urbanization is considered to be one of the most important health challenges of the 21st century [54], being associated with an increase in chronic and non-communicable conditions such as obesity, stress, poor mental health, and a decline in physical activity [55]. When a population becomes more urbanized, green space has a positive influence on mental health, social cohesion, and physical behavior [56,57]. In urban environments with a lack of reasonable amounts of accessible green spaces, health problems tend to increase, as the opportunities to exercise are limited, leading to higher chances of obesity [58–61]. More children living in these precincts suffer from attention disorder at school [62–65] or encounter ADHD and similar illnesses [66–69]. The influence of green space on children's spatial working memory and their cognitive functioning is positive and strongly related to academic achievement in children's performance [62,63]. Psychological problems amongst adults [70–72] cause higher levels of stress and domestic violence [73]. People living in areas without access to nature were 1.27 times more likely to experience symptoms of depression [74], and these areas were found to have higher crime levels compared to other areas [75]. Meanwhile, the health-related outcomes of living close to natural areas [76–83] and being able to undertake physical activity in nature [84–88] include reduced levels of morbidity [89] by reducing cardiovascular disease [90]. Patients with views of trees and greenery out their windows heal faster and need less medication [57], indicating the restorative influence of gardens in many different urban contexts [91–99]. Furthermore, green space provides cleaner air and mitigates heat, hence creating a healthier atmosphere in the city [100–103].

2.2. Research Objective and Question

The objective of this research is to explore whether taking a nature-driven approach to planning and design for climate adaptation brings benefits for liveability, productivity and ecology on the Zernike campus. The research question is: how can a nature-driven campus be designed that offers positive impacts in the face of the threat of future changes caused by climate change?

3. Methodology

The applied methodology is design-led [27–29]. The design results are continuously valued in a research-through-design process [104–110]. By applying 'designerly' explorations [111,112], out-of-the-box thinking and creativity are enhanced. This overarching methodological view is elaborated in detail in specific methods in every stage of the research process (Figure 5). In practice, these methods are intertwined:

1. The analysis of current impacts and threats resulting from climate change is undertaken through a literature review of the most recent academic results in the Netherlands, such as the climate scenario [113], the national delta-program [114], recent insights into accelerated sea level rise [9], and the novel risk of droughts [115].
2. During the second stage of the research, a comparative analysis [116,117] is undertaken into three specific viewpoints, defining the way to guide climate adaptation.
3. After the preferred viewpoint is chosen, the core question of how to design a campus that could be self-reliant is investigated. Through literature review of the concepts of self-reliant areas [118–121] and self-sufficiency [122–124], the programmatic contours for the design are formulated.
4. The program of demand for the growth of food, its spatial implications, and the required amounts and spaces for water are quantitatively analysed [125–127].
5. Once the quantitative consequences of a self-reliant campus become clear, the quest for a holistic design intervention, responding to this long-term view [25], is explored via futuring [128,129] and spatial visioning [130,131]. A design that responds to uncertainties regarding the future and leapfrogs current policy constraint backtracking [132], oriented towards creating a (spatial) tipping point [133], is applied to change path-dependency. Understanding the theory of complexity [19,134] and its processes of self-organisation and emergence [135] in an urban design context is essential. In order to include these concepts, a co-creative working method is chosen, through which collaborative design work can take place in a design charrette [136–139] approach.
6. The final stage of the research takes the integrated spatial view as the starting point for thematic spatial explorations of food-, eco- and waterscapes. The creative process is here mingled with analytical interactions, typical for a research by design method. The spatial propositions are permanently assessed, and new design questions are raised, which in turn lead to adjusted design explorations. In a cyclic process, the designs are tested and modified until satisfied. In the Moeder Zernike project, the thematic aspects are separated from each other using a layered mapping method [140], making it possible to quantitatively and qualitatively investigate the consequences of spatial choices.

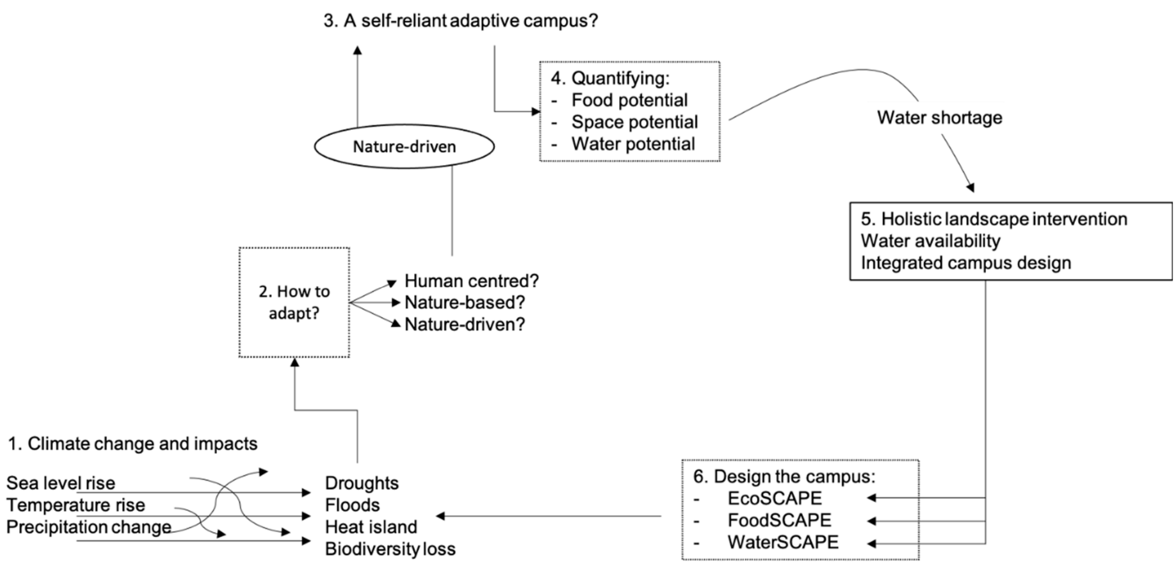

Figure 5. Methodology.

4. Results

4.1. Ways to Respond

The main objective is to take nature as the basis for the urban transformation. In this sense, the city is seen as being part of nature. This could be a bold statement; however, the city of Rotterdam recently presented itself as a wilderness park because its urban wildlife is so abundant [141]. Being part of nature enhances the health not only of the urban wilderness, but also of its human inhabitants when living close to green areas [142]. Developing urban areas need to achieve balance in the exchange of materials, resources, and the potential to allow co-existential living systems, urban and natural, to emerge and evolve by creating regenerative cities [143–146]. However, cities, having extracted natural resources at a large scale ever since the industrial revolution, should become reciprocal [147]. Three gradations of responsiveness are distinguished (Figure 6): searching for human-centred contrast, establishing nature-driven contact, and striving for nature-driven contract [148].

	CONTRAST	CONTACT	CONTRACT
IMAGE OF NATURE	wilderness	accessible nature	ecosystem services
Formal Interaction	city and nature have sharp boundaries, protected areas	city and nature intertwine	city and nature take each others form
commentary	*bring the city to nature 'satellites' and 'garden cities'*	*insert nature into the city 'green wedges' and 'parks'*	*go for a complete mix, 'reweaving the urban tapestry' and 'broadacre city'*
Functional Interaction	city and nature are each others jungle	city and nature come to each others rescue	city and nature take on each others form
commentary	*'places to get lost'*	*regulated leisure in nature*	*produce food on your own gardenlot*
Physical Interaction	city and nature keep their distance	city and nature exchange information	city and nature take on each others construction
commentary	*natural expression of the city 'non human' outside*	*natural expression of the city 'well tempered' environment outside*	*expression of city and agriculture 'new hybrids' in- and outside the city*
VISION OF THE CITY	from 'Cabanes' to 'Metropolis'	'Green-Blue infrastructure' to 'Lobe city'	from 'Subtopia' to 'Metabolic City'

Figure 6. Relationships of nature and the city [148].

When a perspective of the city is taken where urban life is seen in contrast with nature, the wilderness is the opposite of human life. This human-centered view aims to enhance human ability, overcome human limitations, and human preferences and concerns are explicitly considered in the design [149,150]. In such a human-centered view, nature has instrumental value [151], and according to Aristotle, "nature has made all things specifically for the sake of man" (cited in [152]). The human-centered approach considers basic human needs, motivations, and meaningful experiences in relation to green areas [153].

Nature-based solutions bring nature and the city into contact to improve urban sustainability [154]. 'Nature-based solutions aim to help societies address a variety of environmental, social and economic challenges in sustainable ways. Nature-based solutions use the features and complex system processes of nature in order to achieve desired outcomes that ideally are resilient to change' [155]. They are 'solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions' [155]. Hence, nature-based solutions are seen as deliberate interventions seeking to use the properties of nature to address societal challenges.

In contrast with the human-centered view on nature, a biocentric perspective considers humans as members of an interconnected 'web of life' [156,157]; nature and the city have a moral 'contract', with people seen as an integral part of nature, rather than its master or steward [151]. Current practice often starts with an economically driven program, after which green spaces are fitted in. A nature-driven approach [142,158,159] takes the ecological system as the foundation for the design within which other (urban) functions are embedded. The resilience and self-organising power of ecosystems safeguard their own existence, in which humans but also non-human organisms survive in the context of uncertain climatic conditions.

Choosing for a nature-driven future places humans within the wider natural system and allows the system to be guided by its own resilience and synergies. It opens the pathway towards an autonomously operating symbiosis of nature and man, but it also implies that all resources should and need to be supplied, used, and treated within those same boundaries.

4.2. Self-Reliance

A self-reliant area, in this case the Zernike campus, should therefore be able to function without substantial support from outside the system, e.g., the city, neighbourhood, or broader area. This means that all that is generated and wasted should stay and be used within the system boundaries. On top of this, the area, as part of its natural environment, needs to stay within its own 'planetary boundaries' [10], downscaled from the global level to the area of observation. The goal to design a nature-driven campus implies that natural systems determine the productivity on campus. In addition to preventing decreasing biodiversity [29], a nature-driven campus grows its own food, provides a cooling environment, generates sufficient renewable energy, and the water system, with its in- and outgoing flows, is bound to the area's boundaries. The key question is whether a nature-driven, self-reliant campus, in the context of climate change, can grow sufficient healthy food for its consumers (students, staff, visitors and residents) and if enough space and water is available. Moeder Zernike transforms from a parasite, fetching its resource lifelines from outside, to an amoeba (Figure 7), self-sufficiently generating resources from within.

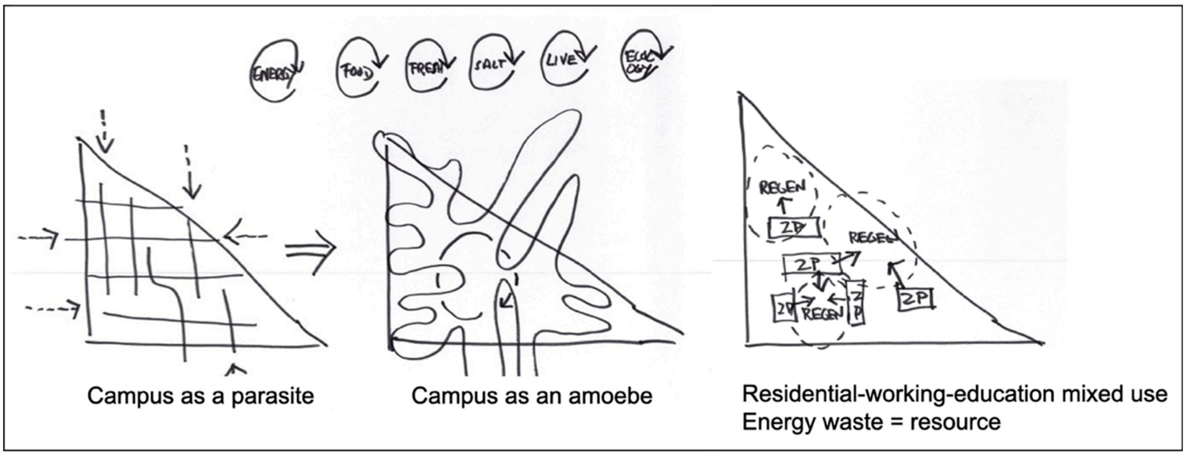

Figure 7. The Zernike amoeba, regenerating its material flows.

4.3. Quantifying Potentials

4.3.1. Food

Firstly, the amount of food required to provide the new diet [160], based on a per person estimation of food categories (Figure 8) applied to all consumers on campus (30,000 students and staff and an additional 10,000 of new residents), is calculated. These amounts are combined with the number of meals the different groups, students, staff, and residents, consume on campus, taking into account holiday periods. The total amount of food needed is almost 5.5 million kg per year.

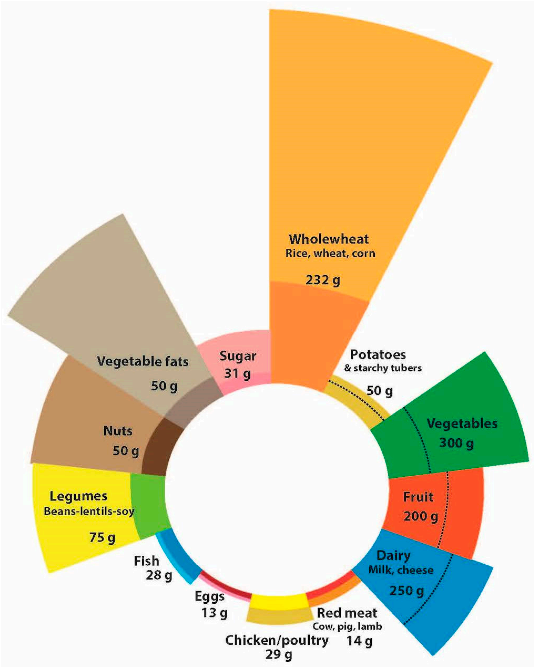

Figure 8. Amounts of food for a healthy diet, recalculated for the Dutch context. Based on [160].

4.3.2. Space

The area needed for growing all crops (Figure 9) adds up to an area of approximately 0.1 km^2 (or 100,000 m^2). Assuming the largest portion of these crops will grow inside, on rooftops, or clinging to the facades of campus buildings, using novel multiple harvest technologies, such as aqua- and aeroponics, the useable spaces of current buildings is calculated (Figure 10). Potentially 140,000 m^2 of rooftop area and 90,000 m^2 indoors is available. Additionally, inside existing buildings, almost 10,000 homes can be realised. The total area for growing food on Zernike is 230,000 m^2, more than twice the required space.

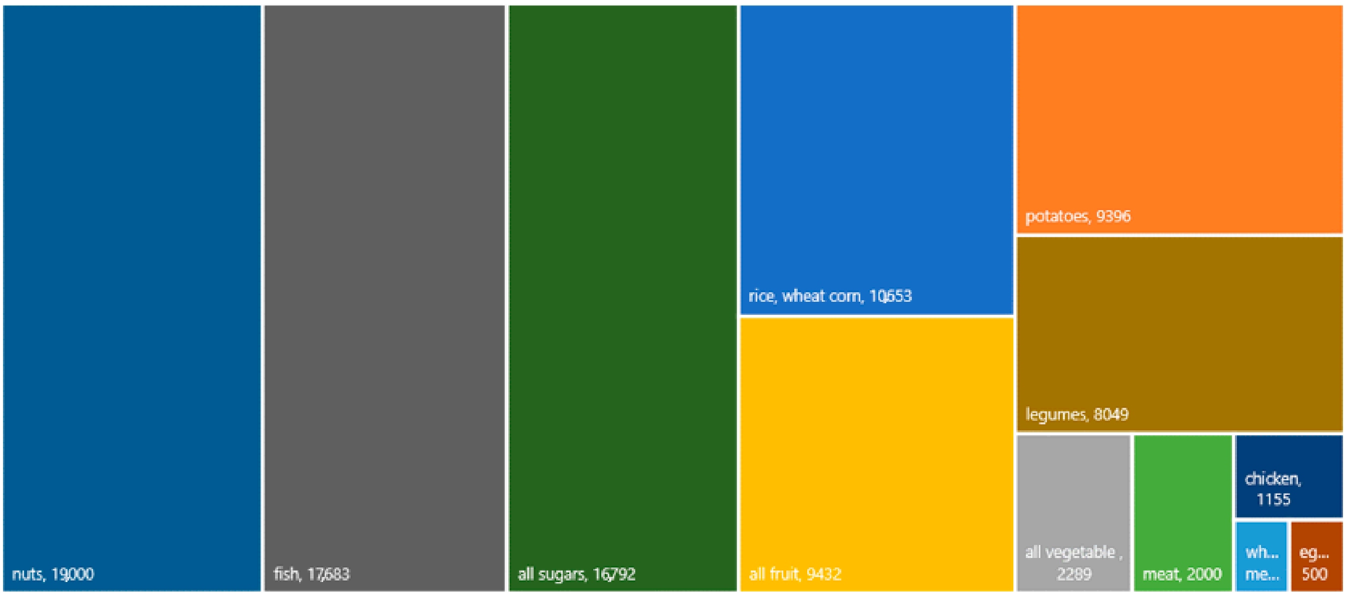

Figure 9. Area needed to produce food in m^2.

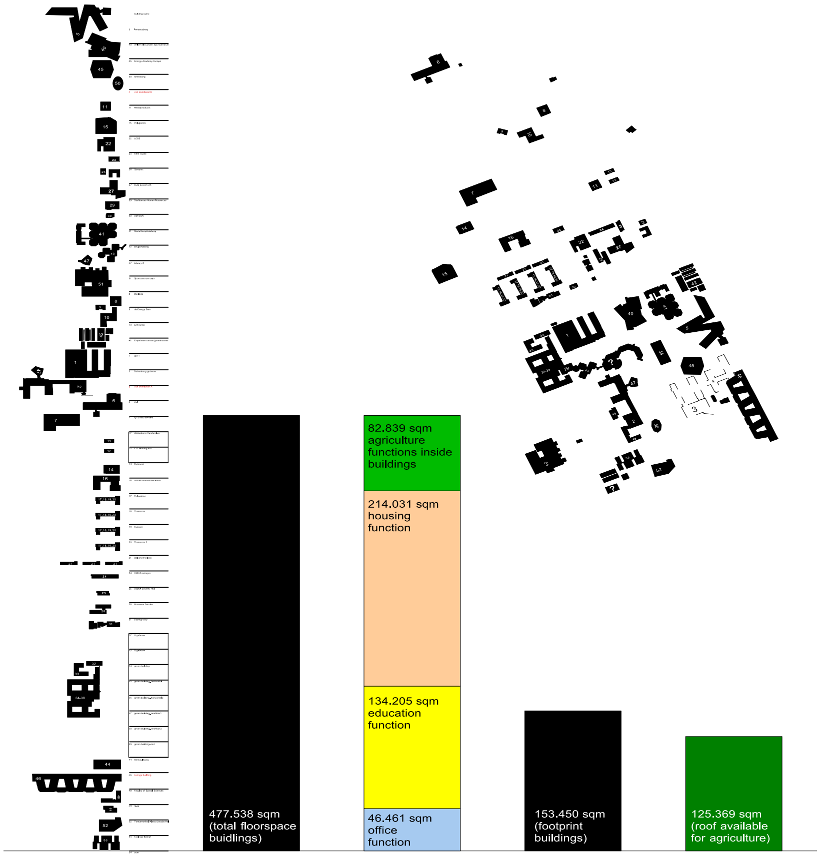

Figure 10. Area available for food production in and on buildings.

4.3.3. Water

The total amount of water needed to grow all crops is almost 3.5 billion litres/year, equalling nearly 1400 Olympic swimming pools. On top of this, nearly 400 Olympic swimming pools (approx. 1 billion litres) of drinking water are required for daily use, totalling 1800 pools/year. Analysis of the expected amounts of precipitation on Zernike (Table 1) shows that, according the driest climate scenario, a little more than 2500 Olympic pools are available. Around 50% of this water evaporates [161], hence only 1250 will remain for usage. This implies that on a yearly basis, there is a shortage of 550 pools (1.4 billion litres) of water. Especially in the context of increasing droughts in the Netherlands [115], current rainfall will not suffice to grow all the crops on Zernike, and water from outside the campus is needed. In order to avoid extracting water from other users in neighbourhoods across the city, only one option remains: retrieve water from the sea.

Table 1. Calculation of rainwater amounts for the Zernike campus.

	Current Climate (1981–2010)		2085 Wl Scenario Based on 2019 Weather (+3.5 Degrees/No Changes in Currents)		2085 Wl Scenario Based on 2019 Weather (+3.5 Degrees/No Changes in Currents)		2085 Wh Scenario Based on Climate Data (+3.5 Degrees, +Changes in Currents)		2085 Wh Scenario Based on 2019 Weather (+3.5 Degrees, +Changes in Currents)	
Month	Rain (In Olympic Pools)	Cumulative								
Jan	710	710	580	807.2	660.3	660,3	937	937	768	768
Feb	400	1110	210	1269.7	247.8	908.1	550	1487	303	1071
Mar	390	1500	880	1732.8	1016.8	1924.9	571	2058	1208	2279
Apr	−130	1370	−280	1635.5	−269.8	1655.1	−134	1924	−302	1977
May	−240	1130	−560	1436	−567.5	1087.6	−251.8	1672.2	−610.2	13,668
Jun	−110	1020	−200	1389.6	−149.9	937.7	−105.4	1566.8	−206.2	1160.6
Jul	−140	880	−750	1123.6	−845.5	92.2	−468.8	1098	−938.5	222.1
Aug	10	890	−140	1022.5	−243.6	−151.4	−292.5	805.5	−408	−185.9
Sep	340	1230	1020	1275.5	899	747.6	71.8	877.3	595.4	409.5
Oct	550	1780	820	1862.6	874.65	1622.25	621.4	1498.7	923.8	1333.3
Nov	740	2520	550	2651.25	586.3	2208.55	831	2329.7	618.2	1951.5
Dec	760	3280	520	3460.9	554.05	2762.6	852.2	3181.9	583.4	2534.9
		3280		3460.9		2762.6		3181.9		2534.9

4.4. Holistic Intervention

The crucial factor in the design for Moeder Zernike therefore is the supply of enough water to feed agriculture on campus. Out of the co-creative design process and analyses, one impactful proposition emerged, to establish a lifeline between campus and the infinite water source of the Wadden Sea. This is a large-scale long-term intervention benefitting a multitude of aspects: ecology, safety, food, and water. By establishing this tipping point, Moeder Zernike is suddenly placed in a new ecological context, where fresh water and saline influences collide. The saline influence also induces a spatial novelty in the form of an inversed wierde (a cultural relic found everywhere in the northern landscape), creating a freshwater reservoir (Figure 11).

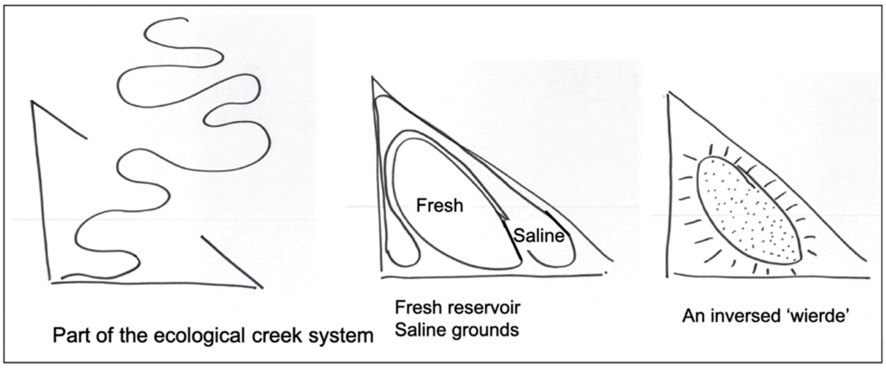

Figure 11. Moeder Zernike embraces fresh and saltwater, creating an inversed wierde for freshwater storage.

As saltwater flows around the freshwater reservoir (Figure 12), it brings nutrients and sediment, leaving behind fertile soils, enriching agricultural potential and providing the dynamic environment for a steep increase in biodiversity.

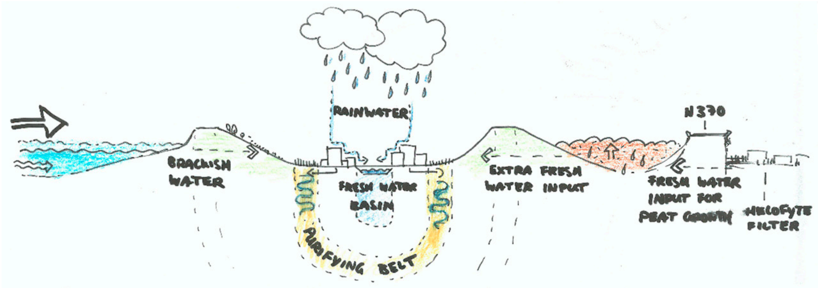

Figure 12. Cross-section, showing the different environments and water features.

The inversed wierde protects Moeder Zernike against outside influences, while a sandy membrane simultaneously filters saline water for use on campus. This provides the urgently needed water for growing food. Spatially, a coherent inner world emerges, in which the experimental life within Moeder Zernike takes place, while outwardly, the campus presents itself as a spatial entity within the surrounding landscape (Figure 13).

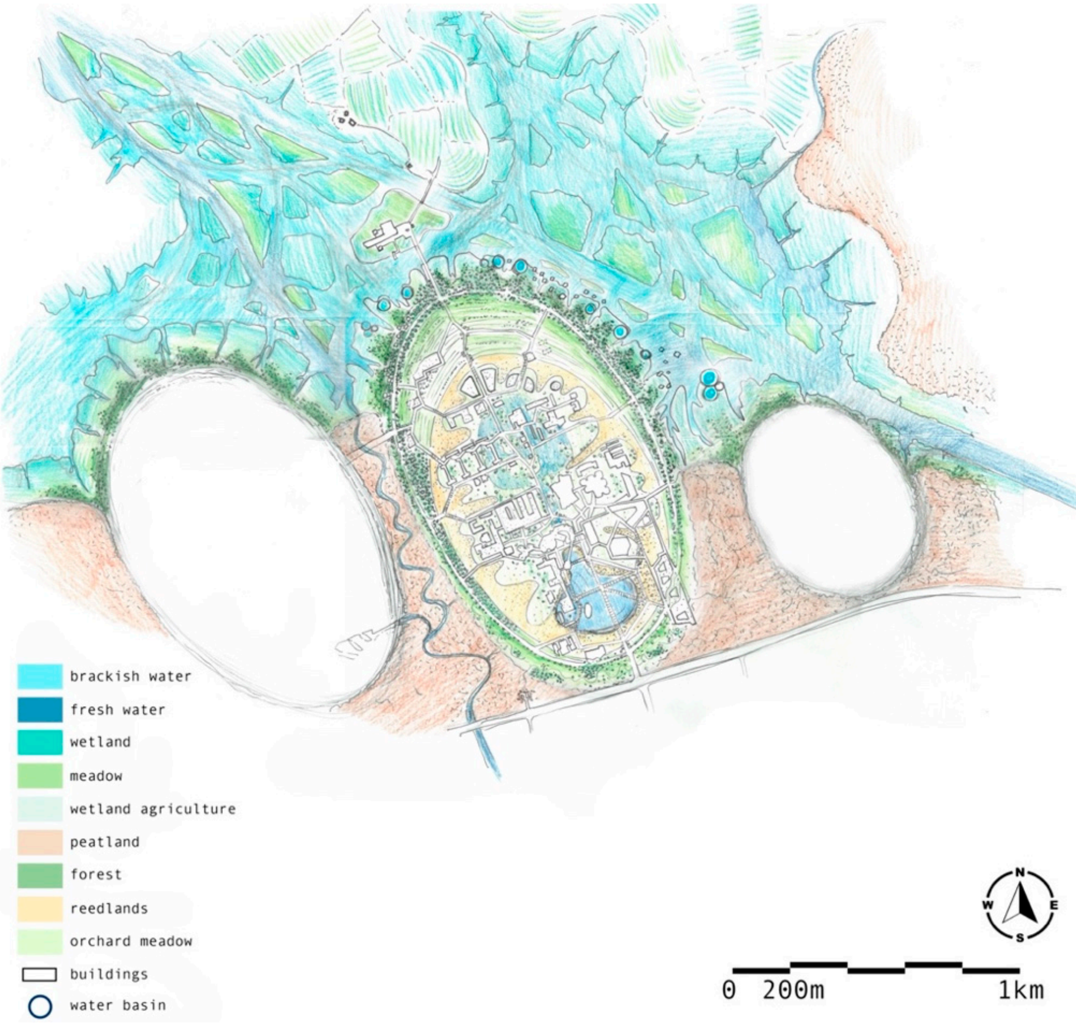

Figure 13. Moeder Zernike as a freshwater reservoir in a saline landscape.

4.5. Design of Scapes

The fundamental choice of bringing water from the sea inland to provide the conditions to become self-reliant impacts ecology, food-, and waterscapes.

4.5.1. Foodscape

A rich diversity of growing conditions emerges (Figure 14), producing everything for the consumption of the new diet. Apart from the food production in existing buildings, the campus will contain fishing grounds in open water with salmon, eel, and sturgeon, have saline aquafarms at the campus edges for prawns and lobster, free-ranging cattle wandering the slopes of the wierde, while inside orchards nuts will be grown. In the terraced landscape, water is used multiple times, trickling down through fruit and berry plantations and rice paddies. Freshwater fish, carp and tilapia, live in the water reservoir, whilst the southern mound is home to caves for chicory and fungi, mushrooms and insects. On top of these, a publicly accessible picking garden is foreseen so urban residents can freely gather their lunch and dinner ingredients.

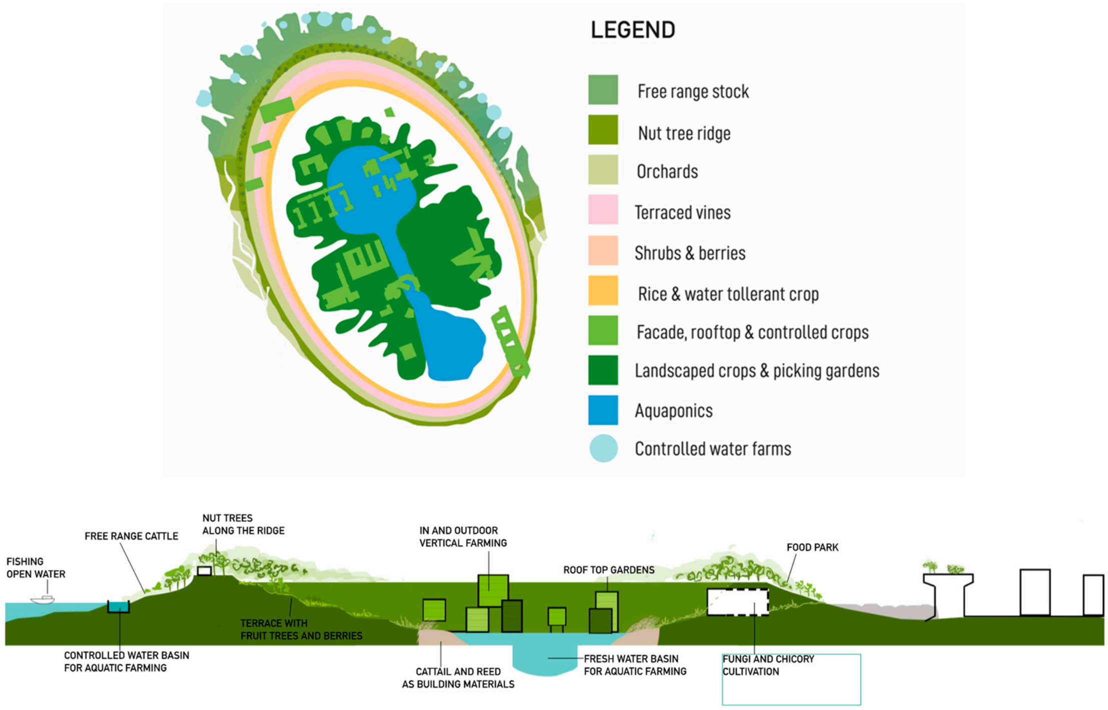

Figure 14. Foodscape of Zernike.

4.5.2. Waterscape

By connecting the campus with the sea, saline, brackish, and fresh water are all part of the waterscape (Figure 15). The protective sand edge purifies the saline water before it enters campus, at the same time protecting Moeder Zernike against the spring tide. All wastewater from buildings is filtered and cleaned in a helophyte system, making it usable for growing crops. During periods of heavy rainfall, the central lake fills up, is home to fish, provides the water for indoor crop growth, and cools the environment on hot days. The pond also functions as a heat exchanger, generating energy. Slowly growing peat is supplied with pre-purified household water from urban neighborhoods.

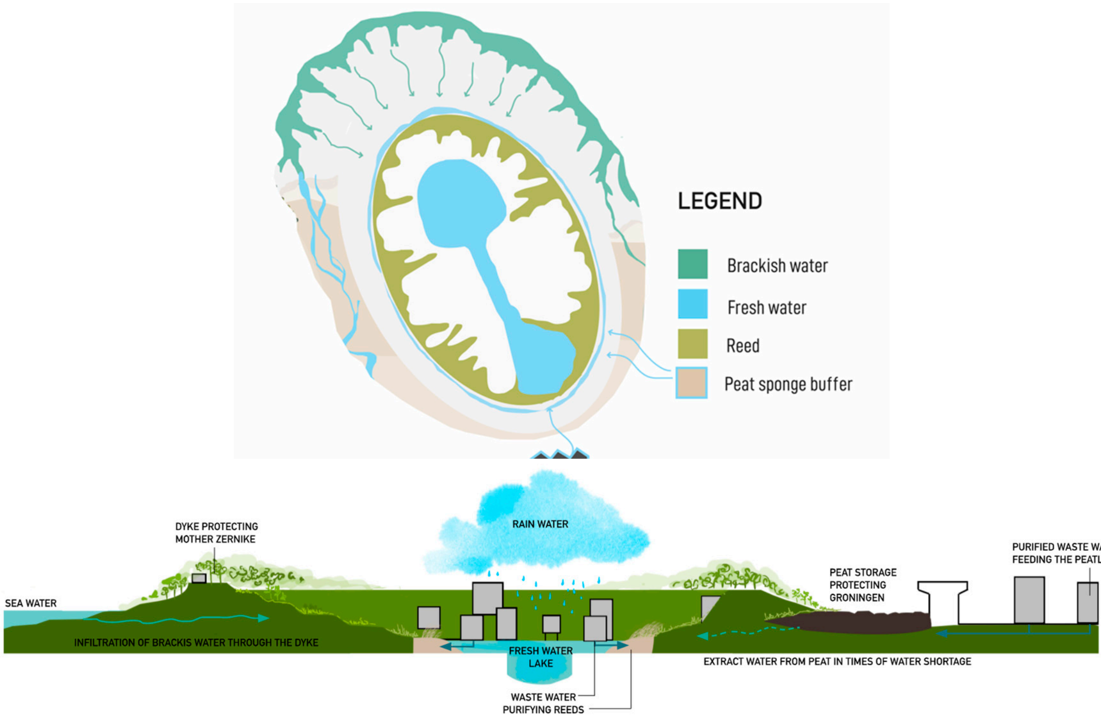

Figure 15. Waterscape of Zernike.

4.5.3. Ecoscape

Ecological qualities are enhanced, bringing brackish and saline waters together with freshwater conditions, kindling new gradients. A diverse range of ecotypes emerge (Figure 16), such as new islands and wetlands, occasionally flooding, while other parts permanently rise above the water level. The reed-lands of the helophytes are home to insects, small fish, and reptiles, in turn attracting all kinds of birds. An abundant range of species inhabit the inner side of the ridge. Built structures will offer a unique rock-biotope for specific plants, butterflies, bees, and nesting places for birds and bats. Finally, peatlands offer a habitat to water birds, insects, and a range of reed plants.

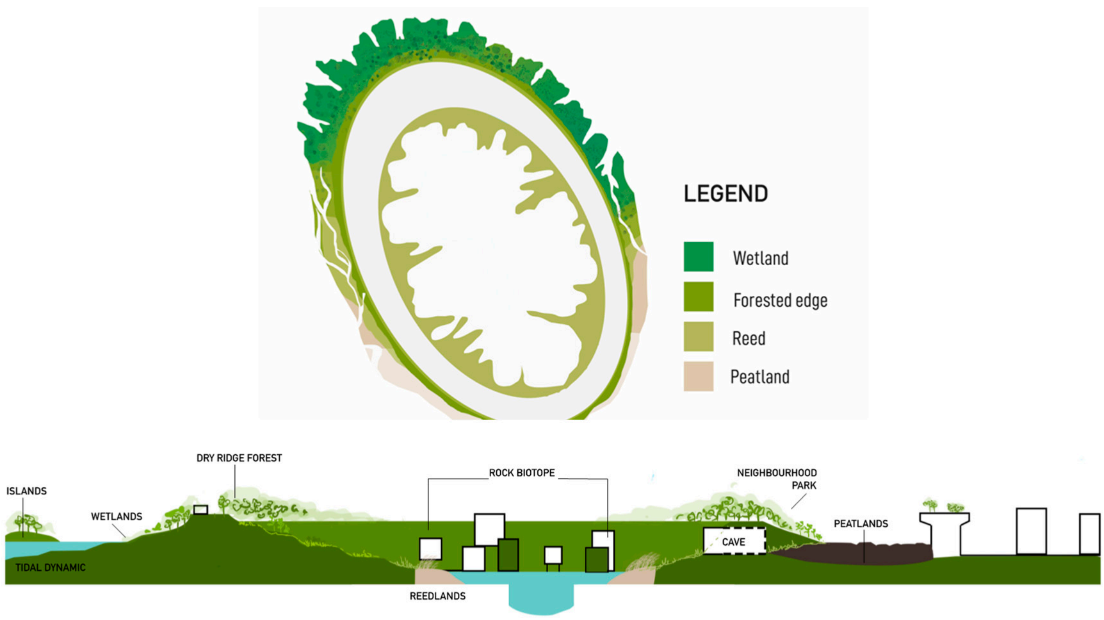

Figure 16. Ecoscape of Moeder Zernike.

5. Discussion

The research presented in this article illuminates tensions between three forms of future planning. First, current short-term practices often plan for the known knowns, and decide on that basis, even if there is a chance of making bad decisions. The second way of acting, dubbed adaptive management, delays decisions until more knowledge or data are available. The third way proposes developing a long-term view then working towards that view with the understanding that the future is full of unknown unknowns. In this case, it is well-understood that the unknown unknowns are difficult to comprehend, especially regarding long-term or deep uncertainties, and imagining a far future could then guide the way forward.

In this article, a pledge is made for using imagination to plan for a desired future, as opposed to potentially making the wrong decision or postponing decisions until we know more. Therefore, the Zernike plan takes on the largest quests of our time—biodiversity, food supply and climate impacts—and unites them around an imagined long-term future, on the basis of which implications for current decisions can be derived. This not only gives direction—it also brings coherence and inspiration, and offers comprehensive spatial thinking for the campus grounds.

The question, however, is how policy making and political decision making may be diverted from the current practice of responsiveness, short-term orientation or the ever-apparent quest for more knowledge, data, and research. Indeed, more information is not always needed; instead, larger insights must emerge so that decision making can be based on wisdom rather than rationality.

Moreover, the process of creating an inspirational design is, in a way, magical, and can be used more profoundly. The magic happens when out of a set of problems and questions, at a certain moment, a vision comes forward, resulting from irreducible co-creative ways of drawing, building, talking, and exchanging ideas. This approach, in which interaction delivers tangible results, is often underestimated in planning processes. In practice, seemingly estimated policy boundaries limit approaches that explore the unexplored. Often, these are seen to undermine the current culture, put the intangible hidden agreements out in the open, or overhaul just adopted plans and policies. The fear of discovering something new, which is essential for an unknown future, is paralyzing the involved bureaucrats, planners, and policymakers. This rusty cultural constraint prohibits free and novel ideas from emerging. This could be dangerous, as continuing on a familiar pathway will hardly ever offer solutions for the unknowns. Three typical options remain:

1. Breaking the barriers in a way that is acceptable, by means of inspiration, future thinking, and offering a pleasant and plausible future that differs from the known world.
2. Experimenting on and developing small novelties in a controlled context that guide the way to what could be possible in the future.
3. Waiting for something to go terribly wrong, causing a tipping point for changing course. A disaster could overcome the fear of change, as it becomes clear to everyone existing approaches have caused the devastation.

Naturally, it is preferable to anticipate such disastrous events before they happen and be quick enough to change course before the worst occurs.

6. Conclusions

The Moeder Zernike research has illustrated how a nature-driven approach can be applied for designing a future oriented plan. By doing so, the plan is able to incorporate nature as the driving force and allows the emergence of a self-reliant and biodiverse urban precinct.

The distinction between human-centred, nature-based, and nature-driven may sound artificial, but it brings crucial questions to the debate. Do we, as humans, design for our own sake, to get better lives for ourselves, as the human species? Or do we offer nature-based solutions, that adjust urban environments so there is also place and space for natural processes? Does this, looking through human spectacles at nature, suffice for our survival in increasing constraining futures? Or do we need to start with nature and let nature drive the human behaviour of urban dwellers? This poses the question as to where humans fit in the natural environment surrounding them.

The plan for Moeder Zernike has shown that a plan that is driven by nature starts with understanding the landscape and its ecological, systemic features and characteristics. Starting the design process by firstly looking at the landscape guarantees a development of cities and urban contexts that are embedded in and embraced by nature. This offers humans the best proposition for sustainably surviving on the planet.

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