

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	Venne van den Boomen
Student number	5645654

Studio		
Name / Theme	Resilient Coastal Landscapes (RCL)	
Main mentor	Steffen Nijhuis	Landscape Architecture & Urbanism
Second mentor	Robbert Jan van der Veen	Urbanism
Argumentation of choice of the studio	We live in a decisive decade, where in the coming years around 70% of the population will live in coastal areas and where the sea levels are rising due to climate change, putting pressure on our existing systems. Understanding these complex systems and finding a way to design with nature, socio-ecological processes and water dynamics will be key for this foreseen future in my lifetime as a landscape designer; this is why I wish to participate in the resilient coastal landscapes lab, to gain knowledge, and how to understand and design with these complex systems.	

Graduation project	
Title of the graduation project	Grow With the Flow <i>Developing a dynamic coastal interface for the Wadden Sea Region</i>
Goal	
Location:	Wadden Sea Region, West-Europe

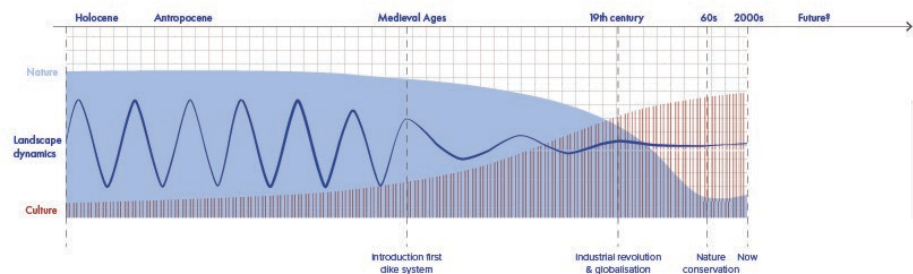
The posed problem,

Looking back into the past, people used to live with the dynamic water of the Wadden Sea, until the need for (economic) stability and sea-ward land claim in relation to population growth resulted in a battle of land between man and sea (Wiersma & Nieuwhof, 2018). The introduction of dikes and hard infrastructures during the Medieval ages and the impressive growth of technological innovation in flood defense and drainage systems during the 20th century has resulted in the reduction and eventual loss of most of the dynamic interaction people have with the Wadden Sea (Betten, 2018). The process of the cultural occupation of the land of the Wadden Sea Region has influenced the natural processes in its landscape greatly.

Outside of the dikes the sea level keeps rising, while there is uncertainty regarding how much this rise will be in the far future, there is certainty in the fact that it will rise (Oppenheimer, et al., 2019). The existing traditional dike structures are fixed in place, while the pressure of the water keeps building up eventually leading to possible large areas of inundated land (Rowley, et al., 2007). The most common response to sea level rise is raising the existing dike and dunes along the coast, a costly procedure that won't provide long-term solutions and put more strains on the natural landscape. Nature of the Wadden Sea gets squeezed out between infrastructural development and the rising sea level, resulting in unstable habitat, loss of biodiversity and, due to a lack of sediment supply, the drowning of the Wadden Sea itself (Betten, 2018).

On the secured inner side of the dikes, the landscape has become fragmented and fixed due to privatized land claims, drainage systems and infrastructural interventions. Landscape fragmentation because of infrastructure, land privatization and sectoral silos impacts biodiversity by reducing habitat size and decreasing species interaction. At the same time the fragmented natural land has been transformed in monotonous crop production and pasture fields, which has to be drained in order to be dry and productive. The resulting subsidence of the land together with the threat of saline intrusion from the rising sea level impacts the monofunctional crop production yield and with it the economic dependence of the inhabitant living in the area (Oppenheimer, et al., 2019). Lack of trilateral governing results in a lack of cohesion which impacts biodiversity, flood risk, ecological and coastal resilience.

The land that used to be of a highly dynamic nature and connected to the sea interface now has strong boundaries and contrasts between land man and sea, creating a landscape that lacks resilience when facing pressing contemporary issues, that strongly relate to climate change.



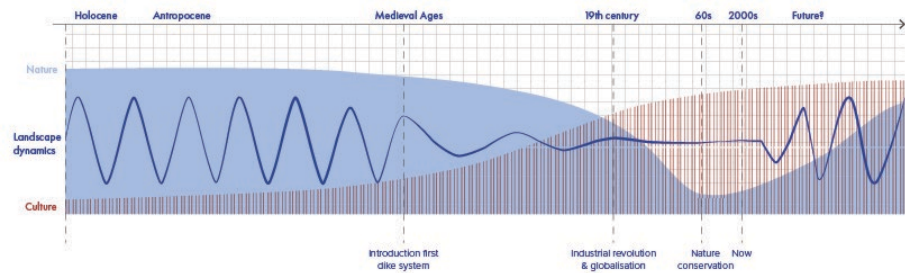


Figure 1: the relation between cultural, natural and landscape dynamics over time until now and the timeline if dynamics were reintroduced in the landscape.

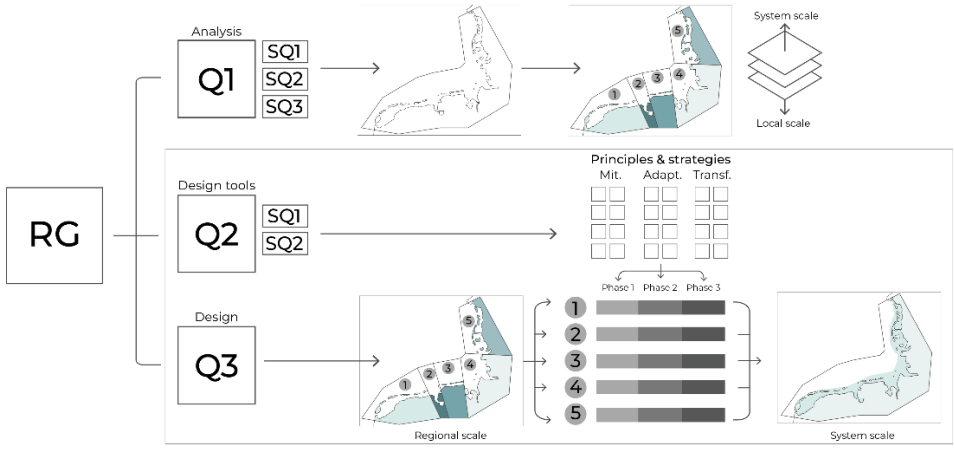
Approaching the spatial regional design of the Wadden Sea Region from a landscape approach and as a whole system could provide solutions to the existing problems within the landscape and create regional cohesion. A landscape-based approach entails future-oriented strategy that aims to enhance spatial development by applying bioregional planning and design principles that view the (urban) landscape as a social-ecological inclusive, dynamic, and complex system (Nijhuis 2019). Designing through the scales, through time and from a landscape perspective, by reintroducing regenerative ecosystem principles, can create more ecological and coastal resilience. Natural processes and dynamics are reintroduced throughout different scales, creating new syntheses in the landscape. At the same time these changes of a more adaptable nature and can change over time. Meaning, that when a certain intervention needs to be up- or down-scaled there is flexibility to do so, also creating more variation in the landscape for natural or cultural development and producing new possibilities of mixed functions. Design is used as a way to (re)connect landscape functions and disciplines by looking at new ways of border design. Landscape gradients transform hard edges to more soft and adaptive transition areas that are flexible in space and time. Instead of the traditional way of boundary design, the adaptive nature of gradient landscapes gives opportunity to adapt to the challenges in the future and to grow with them.

research questions and

The main research goal to support the problem statement:

To explore the potential of an adaptive landscape strategy for designing a resilient dynamic coastal interface for the Wadden Sea Region

Four questions have been developed providing structure and in depth knowledge to reach the main research goal. Each questions focuses on a different research aspect that interrelate to one another, this being: understanding, providing design tools, designing and reflecting. These four research questions contain their own sub questions to make answering them more manageable.

	<p>1. How did the Wadden Sea Region transform over time to its current state and what landscape forming processes were involved in this? (understanding)</p> <ul style="list-style-type: none"> a) What are the spatial impacts that happened so far in the landscape? b) What are the spatial challenges and potentials connected to it? c) What different landscape typologies can be distinguished within the region? <p>2. What (adaptive) design strategies and principles are suitable for flood mitigation and socio-ecological development? (providing design tools)</p> <ul style="list-style-type: none"> a) What design strategies and principles can be applied to the coastal interface of the Wadden Sea Region? b) What are the different strategies for the different areas of the Wadden Sea Region? <p>3. How can we apply the design principles and strategies in the coastal interface of the Wadden Sea Region to increase flood resiliency and socio-ecological resilience? (Design)</p> <p>4. What can we learn from this research? (Reflection)</p>
<p>Design assignment in which these result.</p>	<p>The design outcome answering research question three will be extracted from the design implementation of research question two throughout different scales and phases, while using the background information extracted from research question one. Analysis of the overall region and local scale areas will distinguish different landscape typologies, which divide the larger region into regional scale design areas. By further scaling down more detail oriented design interventions can be explored.</p>  <p>Figure 2: relationship between the different research questions and design outcomes.</p>

The overall research will result in the following design outcomes:

A set of (location specific) strategies and principles extracted from precedent study for adaptive coastal protection and socio-ecological development. (Q2)

Typology and scale specific strategies that, depending on the location and scale, re-introduce the natural processes in the landscape and combine landscape functions to increase resilience.

System scale strategy of the Wadden Sea Region (Q3)

Overall structure strategy for the Wadden Sea Region that increases coastal resilience and socio-ecological resilience

Regional design strategy (Q3)

More elaborated design strategy

Sub-region design applications of the design strategies and principles in the region (Q3)

Applying the extracted strategies and principles on site-specific areas on a smaller scale to test and possibly revise. The small scale design elaborates further on the impact of the principles and can be used for the larger scale regional and system scale strategy.

Crucial detail elaboration to complement sub-region design (Q3)

Design detailing as additional design research on the implementation of the principles and strategies (e.g. sections, detail design plan, vegetation plan).

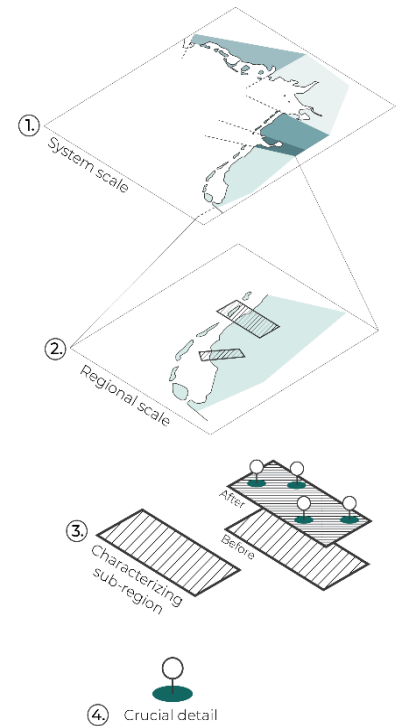


Figure 3: the different design scales.

Process

Method description

The four different research questions discussed prior in the graduation plan require different methods to answer them.

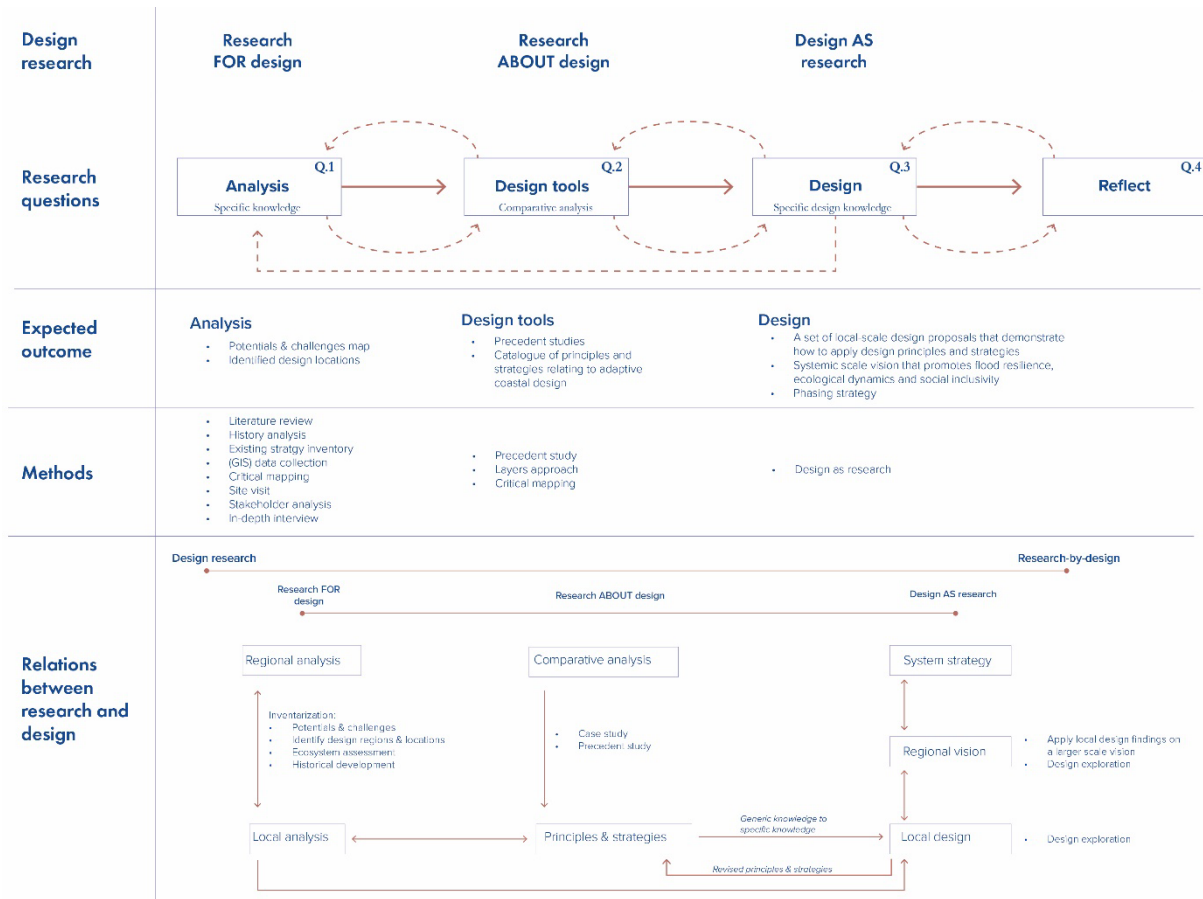


Figure 4: Methodical structure.

Q1. 1. How did the Wadden Sea Region transform over time to its current state and what landscape forming processes were involved in this? (understanding)

In order to understand the way the landscape has been changing, the impact of the change on the existing landscape and the developing future changes an extensive **literature review** should be conducted. **Historic data** and **existing plans** should be reviewed to understand the cultural development relating to the landscape so far and in the foreseeing future. The cultural impact on the natural systems can be inventoried using an **ecosystem assessment**, using **(GIS) data collection** provides the supportive tools to do this and also provides in depth knowledge on the relating processes in the landscape throughout the scales. The result is **critical mapping** of the challenges and opportunities in the area. When researching the cultural developments and gathering specific knowledge, a **stakeholder analysis** and **interviews** with local inhabitants of the area can provide additional information.

2. What (adaptive) design strategies and principles are suitable for flood mitigation and socio-ecological development? (providing design tools)

In order to develop the tools necessary for designing site and time specific measurements different methods are used to develop a set of principles and strategies regarding dynamic (flood) risk management, design with nature and interface development. A **precedent study** on the examples of elements or designs that have been established in literature over time and how they are applied through a **case study** review produces a set of appropriate principles. The applicability of the principles will be based on scale and time frame (phasing)

3. How can we apply the design principles and strategies in the coastal interface of the Wadden Sea Region to increase flood resiliency and socio-ecological resilience? (Design)

To test the design principles several landscape typology regions are identified using landscape and morphology characteristics extracted from analysis on a regional and local scale. The different principles and strategies each have a scale they are applicable on and each have certain time frames they can be applied in. By analyzing and designing throughout the scale using **research-by-design** the different design assignments can be produced together with a phasing plan.

4. What can we learn from this research? (reflection)

At the end of the graduation lab a **critical review** will revise on the work that has been done, what could have been done differently throughout the design process and lacking research on the topics.

Literature and general practical preference

Literature that can be consulted for this research is data concerning the existing landscape structures in the Wadden Sea Region, which can be collected from desktop research and GIS data analysis. Theories regarding resilience theory, risk management and interface development theories are consulted in order to understand and develop the strategies and principles to design the region's ecosystem, develop social resilience and increase coastal resilience. General knowledge sources on the topics discussed in the problem statement are also shown below:

Baptist, M. J., van der Wal, J. T., Gräwe, U., Folmer, E. O., & Elschot, K. (2019, June). Data for: An ecotope map of the trilateral Wadden Sea. Wageningen, The Netherlands.

Betten, E. (2018). Terpen- en Wierdenland . Uitgeverij Noordboek.

Collinge, S. K. (1996, January). Ecological consequences of habitat fragmentation: implications for landscape architecture and planning. *Landscape and Urban Planning* , pp. 59-77.

Dijkema, K. S. (sd). Data: salt marsh data from the 1970s. Common Wadden Sea Secretariat .

Kombiadou, K., Costas, S., Carrasco, A. R., Plomaritis, T. A., Ferreira, Ó., & Matisa, A. (2019). Bridging the Gap between Resilience and Geomorphology of Complex Coastal Systems. *Earth-Science Reviews* , p. Volume 198.

Nijhuis S, De Vries J (2019) Design as research in landscape architecture. *Landsc J* 38(1–2):87–103.

<https://doi.org/10.3368/lj.38.1-2.87>

Oppenheimer, M., Glavovic, B., Hinkel, J., Wal, R. v., Magnan, A., Abd-Elgawad, A., Z. Sebesvari. (2019). *Sea level Rise and Implications for Low-lying Islands, Coasts and Communities*. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Cambridge, UK and New York, NY: Cambridge University Press

Panagos, P., Liedekerke, M., Jones, A., & Montanarella, L. (2012). *Land Use Policy*. European Soil Data Centre: Response to European policy support and public data requirements, pp. 329-338.

Parsons, M., Thoms, M.C., Flotemersch, J.E., 2017. Eight river principles for navigating the science-policy interface. *Mar. Freshw. Res.* 68, 401–410.

Rowley, R. J., Kostelnick, J. C., Braaten, D., Li, X., & Meisel, J. (2007). Risk of rising sea level to population and land area.

Wiersma, J., & Nieuwhof, A. (2018). Het ontstaan van het terpen- en wierdenlandschap. In J. Wiersma, J. Nicolay, & J. Wiersma, *De geschiedenis van terpen- en wierdenland: Een verhaal in ontwikkeling* (pp. 11-26). Vereniging voor Terpenonderzoek.

Precedent research on the different principles regarding adaptable landscape-based solutions for transforming boundaries into gradients and how these can support biodiversity and sponge capacity are explored. Case studies will be used in order to learn how the different principles can be applied are also shown below:

Charlier, R. H., Chaineux, M. P., & Morcos, S. (2005, January). *Panorama of the History of Coastal Protection*. *Journal of Coastal Research*, pp. 79-111.

de Groot, A., & van Duin, W. (2013). Best practices for creating new salt marshes in a saline estuarine setting, a literature study.

Dramstad, W. E., Olson, J. D., & Forman, R. T. (1996). *Ecology Principles in Landscape Architecture and Land-use Planning*. United States of America (USA): Harvard University Graduate School of Design; Island Press; Society of Landscape Architects.

Martin J. Baptist, T. G. (2019). Beneficial use of dredged sediment to enhance salt marsh development by applying a 'Mud Mover'. *Ecological Engineering*, p. Volume 127.

Newman, G. D., & Qiao, Z. (2022). *Landscape Architecture for Sea Level Rise: Innovative Global Solution*. Routledge.

Reflection

What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

My graduation topic revolves around changing and developing the dynamic coastal interface of the Wadden Sea from a landscape-based regional design assignment in order to create more resilience within the (coastal) area by researching the existing boundaries and how they spatially can be changed. Relationships between natural and cultural processes are explored throughout the scales and throughout time, while taking the landscape as a base to understand the processes that have happened, are happening and what could happen in the future. This is something essential within the master track of Landscape Architecture as well, as we learned this from the four different themes taught by the faculty: palimpsest, scale continuum, process and perception of space. This graduation topic relates to the master track, because it will explore new landscape forms by trying to reintroduce the natural processes in a landscape that, for the past decades, has been ruled by cultural occupation. Combining the existing cultural qualities of the landscape with the natural processes can provide new views on the possible future of the Wadden Sea Region and raise awareness to the existing issues in the landscape. Because the site might require also a technical approach, a multi-disciplinary approach to create integrated solutions using knowledge from the other master tracks is required throughout the design process.

What is the relevance of your graduation work in the larger social, professional and scientific framework.

Because of the existing trends of climate change and sea level rise, a new way of looking at the landscape that has protected and nourished its inhabitants so far is needed. Because of globalization and urban expansion, the strain on the landscape is increasing and contemporary issues regarding climate change and its consequences for man are getting more attention. The realization that the way we are interacting with our landscape has to change is slowly sinking in on larger societal basis, but the change of mind of adapting towards a more sustainable approach on handling the landscape is still needed to further develop this realization. Through this research new views on coastal protection and its multifunctional benefits might be adopted, through the visualization of new possibilities regarding agriculture, living and industry. Instead of holding on to something, because 'that is the way it always has been done' and showing new combination of function and what they could look like will grow the social acceptance towards alternative perspective thinking.

The professional relevance of the research lies in the system-based approach of the Wadden Sea Region and its large-scale analysis and design. To view the Wadden Sea as a whole system, made out of landscape typologies that all relate to one another, instead of three countries that each manage their own property. This large-scale approach and working through the scales are an addition to the work that has been done so far on the Wadden Sea Region, which systemic approach has only been acknowledged relatively recently by The Netherlands, Germany and Denmark.

From a scientific relevance, more knowledge can be gained on the physical implementation of the different principles that already exist and how local characteristics can shape them. There are many different theories and literature written on flood risk management, coastal development, adaptive agriculture and sediment catchment, but implementing them from a landscape perspective on existing areas is something that can be developed more. Bridging the gap between theory and design is the benefit of this graduation project on a scientific level, testing the different principles that have been developed on a real situation and issues. The

design outcome can contribute to sharpening the principles and theories according to the specific climate, conditions and cultural characteristics of the Wadden Sea Region, resulting in a more contextualized set of strategies.