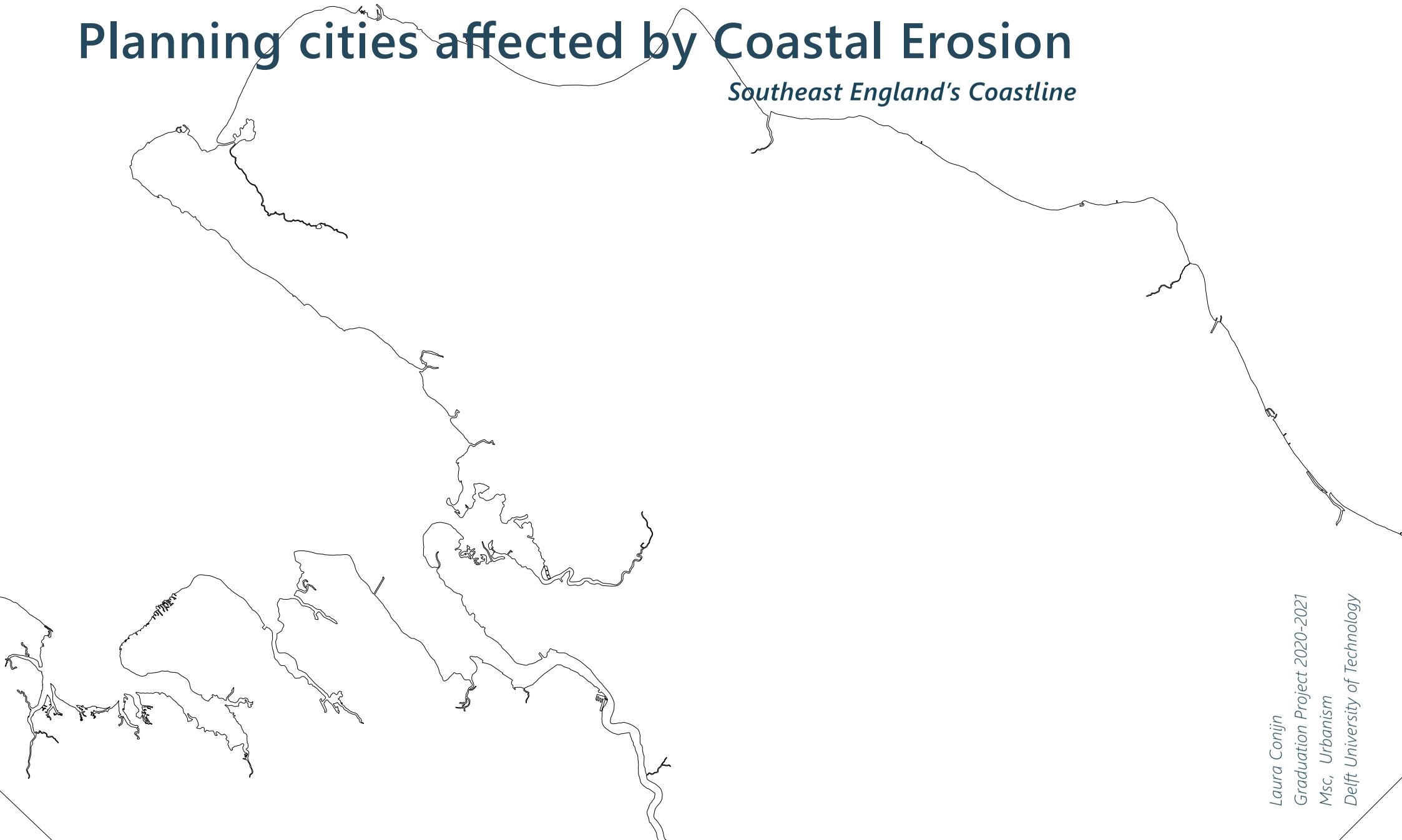
DEVELOPING STRATEGIES

Planning cities affected by Coastal Erosion

Southeast England's Coastline



Laura Conijn
Graduation Project 2020-2021
Msc, Urbanism
Delft University of Technology

COLOFON

Developing Strategies:
planning cities affected by coastal erosion
The case of the southeast England's coastline

Master thesis
Msc Architecture, Urbanism & Building Sciences

Department of Urbanism
Faculty of Architecture and Built Environment, TU Delft

Author: Laura Conijn (4568605)
Research Studio: Transitional Territories

First Mentor: Dr. Fransje Hooimeijer
Environmental Technology & Design
Department of Urbanism

Second Mentor: Dr. Marcin Dabrowski
Spatial Planning and Strategy
Department of Urbanism

Courses: AR3U040 Graduation Orientation
AR3U023 Theories of Urbanism
AR3U013 Methods of Urbanism
AR3U100 Graduation Lab

2/07/2021
Delft, Netherlands

FIGURE 1: PERMAFROST COLLAPSE (USGS, N.D)

PREFACE

This thesis presents my work including research and design towards the development of urban planning strategies for coastal cities affected by environmental risks such as coastal erosion with a focus on the southeast English coast. It has been written as for my graduation project at the Delft University of Technology for the MSc Urbanism in the Transitional Territories studio during the academic year 2020/2021.

My project started as a personal fascination of the English Transitional Territories between land and sea, where in the English coastal regions white cliffs cover a great part of the coastline. The beautiful white cliffs that form a great part of the English nationhood are, beyond beautiful and great, also the cause of urban risks and the baseline for societal problems. The exploration towards opportunities and challenges of these cliffs and their urban environments has, in my project, led to the development of a regional strategy with the strategic objective of social justice and the goal to achieve regional resilience and sustainable urban environments.

During my thesis I recieved great guidance and support. For this I would like to thank my first mentor Dr. Fransje Hooimeijer for the weekly support, motivation and enhusiasm that has helped me during the research, writing and design phases of the thesis.

I would also like to thank my second mentor Dr. Marcin Dabrowski for the support and interest in my project, the encouragement to interview stakeholders and especially the knowledge I gained from our meetings.

Besides my mentors, my sincere thanks goes out to the mentors of the Transitional Territories Studio: Dr. Ir. Taneha Kuzniecow Bacchin, Dr. Diego Sepulveda and Dr. Luisa Calabrese for their enthusiasm, motivation and guidance during the studio meetings.

Lastly, I would like to thank Andrew Coleman from the University of Brighton for showing interest and enthusiasm in my project and for inviting me to lectures by important stakeholders to help me further in my project.

I hope you enjoy my thesis.

Laura Conijn

Delft, July 2, 2021

TABLE OF CONTENTS

FIGURE 2: OCEAN WAVES (UNKNOWN, N.D)

1 METHODOLOGY

In this chapter an introduction of the research of the thesis is given, with an explanation of the used methods and theories. Also the project is explained through the research framework as a project guide.

1.0.1 INTRODUCTION

In the United Kingdom spatial challenges are formed due to a significant erosion rate, especially on the southeast coastline, where the soil has a weak resistance to erosion (Masselink & Russell, 2013; Hurst et al, 2016). As shown on FIGURE 2, the hydraulic action of the ocean waves generates erosion. This erosion causes the soil to be washed away until no soil remains (Dornbush et al, 2006). An extreme example of coastal erosion is shown in FIGURE 1 & 3.

Ecology, society and urban environments are at risk in coastal cities due to environmental risks. Protection measures, such as sea walls and embankments, are the primary solutions to current erosion risks. These protection measures are often expensive, short-term and can have negative influences on other sections of the coastline. The measures influence the processes along the coastline by interruption of longshore sediment transport (Cooper and McKenna, 2007). Currently, cities and their residents are unable to adapt to this increasing erosion and are often exposed to unforeseen and abrupt events that impact their habitat and, therefore, have an influence on the human livability. In the English context, a regional strategy is needed to find a balance between coastal social justice and the continuing risks of coastal erosion (Apine, 2011; Alexander et al, 2012; Cooper and McKenna, 2007), which are further investigated and explained in the thesis.

This project investigates possible strategies for urban environments to adapt to the increasing erosion rates which is the result of climate change and sea level rise. With the use of mixed methods research, a regional strategy is formulated and implemented in local urban designs.

The research method used to achieve the formulation of a strategy is the Data, Opportunities, Challenges & Anecdote (DOCA) method developed by FABRIC (Vafa, 2018). This method uses opportunities and challenges that can be found on a regional scale, but also on the local scale for different coastal cities in the project area. In the thesis this method is used to find local innovation opportunities that can be integrated within a regional urban strategy. This approach considers interdisciplinary and layered approaches with the use of domains that involve defence-resilience, networks, tourism and economy. Within the DOCA method, the six-step approach by Hooimeijer et al (2020) is applied to create a multi-scalar and adaptive planning system.

With the use of both these methods, thesis aims to create an urban design as a response to ecological, societal and urban environmental challenges relating to coastal erosion effects and spatial planning strategies. The project's developed regional strategy aims for regional resilience in southeast England with the design of local Sustainable Urban Environments in Bexhill-on-Sea and Hastings.

FIGURE 3: THE NEEDLES OF ISLE OF WRIGHT (GEOPHOTO, 2019)

1.0.2 PROJECT GUIDE

Transitional Territories between water and land are unique areas where these two elements come together and influence each other. For the UK, the border exists mostly of these unique areas that transition between water and land, which is why this is an interesting location to research. With the white cliffs of Dover, the coastline makes up for an interesting and diverse landscape. Many Brits desire to live near or even on top of these cliffs because the cliffs' significant value to the English nationality (Readman, 2014). However, sea cliffs, especially in southeast England, have characteristic disadvantages. Coastal erosion is the number one threat in these areas and has a great impact on the livability on and near coastal cliffs (Hurst et al, 2016; Cooper and McKenna, 2007). So how can we adapt the current coastal urban environments that are at risk to prevent dangerous consequences with respect to the livability, considering socio-environmental justice (Cooper and McKenna, 2007)?

The research framework forms the roadmap for the structure of the thesis' research. The research of the thesis involves the development of strategies of spatial planning within cities that are affected by environmental risks, with a focus on coastal erosion. For this project the southeast English coastal cities, in the counties of Kent and East-Sussex are the main focus. In this region, many coastal urban environments are affected by the consequences of coastal erosion.

The main research question that is formed for this thesis is: 'What aspects should an Urban Planning Strategy for England's vulnerable coastal cities include to create a sustainable urban environment that adapts to (accelerated) coastal erosion?' With the use of subquestions that involve several subtopics, the main question is answered with the formulation of a multi-scalar and interdisciplinary adaptive planning strategy. The regional scale, the urban scale and the local scale are used for interventions and spatial planning adaptations to include a qualitative design. Important for the formulation of a regional strategy are the stakeholders and the use of the spatial planning in the spatio-temporal scale.

The adaptive planning strategy is formed through research with the use of different theories and methods. During this research, the theoretical themes of the thesis: urban planning strategies, sustainable urban environment and coastal erosion will play a critical role. This leads to the conceptual phase where a relationship is established between coastal management, including hydrodynamic risks, and livability including vulnerability within the societal, ecological and the urban environment. The concepts and theories form the starting point for the analysis and design phase. During this phase spatial analysis will be performed together with the analysis of trends and projections in coastal zones. This analysis is used in a research by design method and with the use scenario's an adaptive planning strategy will be formed. Methods used during the research of this thesis are: literature review, data collection, spatio-temporal analyis, stakeholder analysis, critical mapping and strategy making through research and design.

The different methods complement each other and are linked to the research approaches that are the DOCA method and the six-step approach by FABRIC in Vafa (2018) and Hooijmeijer et al (2020). The use of these methods creates a circle of analysis, design, feedback and redesign and is used to create a design that creates an adaptive and, therefore, a sustainable urban, societal and ecological environment. An evaluation, including a discussion and reflection ends the research with the formulation of limitations, ethical considerations, societal relevance and scientific relevance of the project.

MOTIVATION + RELEVANCE

Development of cities invulnerable to environmental risks

PROBLEM FIELD

problem

Risk by water, climate change, sea level rise, adapting to coastal erosion hazards, risk protection and management, environmental risks

location

North Sea, southeast English coastline, East Sussex, Bexhill-on-sea and Hastings.

statement

The acceleration of the eroding coastline due to climate change and sea level rise causes ecological, societal and urban problems. Protection measures are not sufficient for the long term and can negatively influence erosion in other sections of the coastline. Cities and their residents are unable to adapt to this increased erosion and are often exposed to unforeseen and abrupt events that impact their habitat and have an influence on their livability. In the English context, a regional strategy is required to find a balance between livability and the risks of coastal erosion.

RESEARCH QUESTION

What aspects should an Urban Planning Strategy for vulnerable English cliff cities include to create a Sustainable Urban Environment that adapts to the (accelerated) Coastal Erosion?

RESEARCH AIM + OUTPUT

The research aim of the thesis is to understand gaps in current urban practices related to coastal erosion.
A regional strategy for English coastal cities will be formulated for the southeast English coast and applied in a design for two cities. This regional strategy in combination with the designs will aim to create regional resiliency and a sustainable urban environment.

regional scale

regional strategy (2100), qualitative strategy (2100)

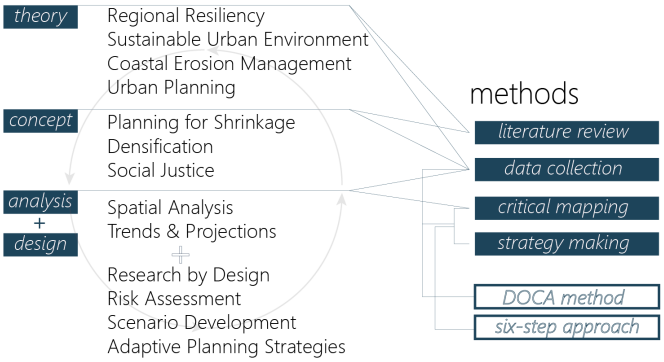
urban scale

local strategy (2100)

local scale

redesign of two coastal cities based on the regional strategy, phasing

METHODOLOGY



EVALUATION + REFLECTION

limitations, ethical consideration, relevance

FIGURE 4: FAIRLIGHT COVE DUSK (PURDIE, N.D)

1.1 PROBLEM FIELD

This paragraph will describe the problem field of the ongoing consequences of environmental risks relating to the urban environment and the current methods of risk management. The problem statement is formulated and the main research question and subquestions are specified and divided in categories. The research aim for the thesis project and its expected output are also defined.

1.1.1 PROBLEM STATEMENT

ENGLISH LACK OF ADAPTIVE PLANNING

In the United Kingdom's coastal regions many houses are located on the coastline and the cliffs with over 5 million residents in coastal towns (ONS, 2020). Residents are unsure if and when their house will experience environmental risks and are, therefore, living in uncertainty (Cooper and McKenna, 2007) . Currently, in these coastal urban environments there are no solutions for people that are almost losing their homes due to coastal erosion. These environments have no other strategy to adapt than: 'move away before it is too late' (Coleman, personal communication, 2021). There can be concluded that within the English spatial planning system, there is a lack of ability to adapt to the increased erosion rate and the long-term consequences of coastal erosion (Ministry of Housing, Communities & Local Government, 2019; Environment Agency, 2020). Other than the lack of ability to adapt, erosion management in coastal England also causes conflicts relating to social justice and spatial planning (Masselink and Russel, 2013; Cooper and McKenna, 2007; Marchand 2010). When adding the rising sea level and the increase of extreme climate weather events to these management issues, a conflict arises that can and should be solved through the use of spatial planning (Boateng, 2010).

COASTAL EROSION

Around 80% of the Earth's ocean is assisted by sea cliffs and, therefore, vulnerable to coastal erosion (Hurst et al, 2016). Coastal erosion is a process where material from a coastal profile is misbalanced and in many cases causes a loss of land (Mangor, 2004). For sea cliffs this erosion can be accelerated due to climate change effects such as sea level rise, storm surges and droughts (Hurst et al, 2016).

HUMAN VULNERABILITIES

Environmental risks, such as coastal erosion become a problem when the anthropogenic landscape is at risk and the use of infrastructure along with the livability of an urban environment is endangered. In Europe, the effects of coastal erosion have a significant effect on the vulnerability of the anthropogenic landscape and, therefore, can cause economic loss, ecological damage and societal problems (Marchand, 2010).

Coastal erosion is the main cause for retreat and landslides (FIGURE 5) causing risk in coastal urban environments (Masselink and Russel, 2013). Prediction methods that identify cliff sensitivity while taking sea level rise into account, should be applied for certain coastal regions where residential developments and infrastructure are located in high risk urban environments. In many of these high risk environments, erosion management methods are applied in the form of erosion prevention. This erosion management often results in adapted occupation patterns in urban environments that are highly dependent on this erosion management (Bray and Hooke, 1997).

COASTAL EROSION MANAGEMENT

Coastal management is linked to the prediction of future erosion rates for specific locations (Bray and Hooke, 1997). This is the reason that erosion prevention as coastal management in urban areas has only been successful to a certain end. Erosion defence systems have, in several cases, locally resulted in exhaustion of coastal sediments and changed the coastal hydraulics. This affected the areas nearby to a negative extent. These areas experienced accelerated erosion as a result of the taken measures for the defence systems (Masselink and Russel, 2013). This means that a local prevention measure can influence coastal characteristics such as sediment transport in the regional scale.

ACCELERATED EROSION

Prediction of future erosion rates and the erosion management are complex multi-scalar challenges and rely on many factors. Factors with

FIGURE 5: FAIRLIGHT COVE (LYCETT, 2005)

coastal influences include the sea-level history, relative sea-level change, geology, sediments (and their longshore transport), human impacts, linkages between different coastal systems, waves, tides, storm surges and geomorphology (Masselink and Russel, 2013).

In England 29,8% of the coastline is experiencing erosion and 45,6% of the coastline is protected with coastal defence works (EUROSION, 2004). This percentage of protection corresponds with the English landscape. The southeast English landscape is in most areas rather flat and low than high and steep. Protection measures are needed due to the geology of the English coastline that is continuously experiencing effects of coastal erosion due to weaker types of sediments that are exposed to wave action. These cliffs consisting of weak sediments are 'soft rock' cliffs and have a tendency to be instable and changing (FIGURE 4). Hard rock cliffs, in western England, are often relatively unaffected. (Bray and Hooke, 1997). Along with the geology, height differences in the English landscape also cause varieties in flood risk and measures for coastal protection in the coastal regions. The protection of some coasts from erosion has reduced the nearshore sediment supply, creating an increased influence on coastal spits and low-lying areas (Nicholls et al, 2013).

MANAGED REALIGNMENT

As response to anticipate to the increase of coastal erosion an additional type of coastal management is introduced in England's coastal environments. This coastal management: 'Managed Realignment', is defined by the Environment Agency (2011) by the removal of coastal defences along the English coastline and the allowance of natural processes. Managed Realignment often goes hand in hand with the term 'Managed Retreat', where urban environments are expected to move landward to make room for nature and decrease anthropogenic and natural risks (Neal et al, 2017).

With the Managed Realignment policy, residents of environments at risk are expected to move land inwards, away from the vulnerable coasts.

This means that these residents will lose their current living environment and every part of land they own (Esteves, 2013; Cooper, 2003).

The cliffs are not cliffs

The reason for not retreating from the coastline, next to the loss of land ownership and economic reasons, is according to Morris (1962), that the cliffs are not just cliffs for the English population. The coastal regions are a representation of England's nationalism. The appreciation for the coastal regions has been growing stronger since the 19th century, when coastal tourism became popular. Before this, the coast was seen as a dangerous landscape that brought more horror than pleasure. The 19th century popularization of the white cliffs, caused a strengtening of association of nationhood and a greater sense of seperation from the European continent by the British (Readman, 2014). The cliffs are now a symbol for a return home from a land of strangers. The cliffs represent the continuity of national homeland and, simultaneously, are symbols of defence, defiance and difference (Readman, 2014). This creates great value to the coastal landscape by the English population. For the white cliffs of Dover, for example, the physical appearance of the cliffs is less important than the associations of nationhood in the British minds (Tuan, 1990) (figure 6).

From this can be concluded, that living in coastal cliff cities is part of the British nationalism. This would explain why they would find their homes often along this, often marked as striking, coastline. This also explains why there is a strong sense of commitment to this coastline, and prevents the Brits from moving away in advance to possible dangers related to coastal erosion in affected or soon to be affected urban areas (Alexander, 2012).

Lack of knowledge

Aditionally to the resistance from British nationhood and the loss of current living environments, the Brits have another reason not to retreat. This reason is according to Cooper (2008), established through the lack of knowledge by residents about the effects of coastal erosion on the coastal urban environment, but also the lack of knowledge about strategies of managed retreat. This lack of knowledge is caused by the lack of collaboration between the different local planning systems that involve coastal environments and urban environments, but also the involvement of the National Government, Local Planning Authorities and Environment Agency that pretend the current, often Hold the Line, Shoreline Management Plans (SMPs) where today's coastline is maintained, are sustainable for the long-term future of the British coastline.

Summary

Even with the strong resistance against managed retreat, in the long-term, moving away cannot be avoided. Other prevention measures of coastal erosion effects can only be limited in a short-term manner. These measures can effect the natural environment to a negative extent with the acceleration of coastal erosion due to climate change (Marchand, 2010; Bray and Hooke, 1997; Masselink and Russel, 2013).

A living environment in a safe environment is the basis of the strategy that is needed in the case of coastal southeast England. This strategy should provide a safe solution for current coastal residents and governments, and should be able balance livability, the socio-environmental justice and urban risks that are the result of the effects of coastal erosion (Neal et al, 2017; Cooper and McKenna, 2007).

This strategy should be a regional strategy that involves coastal urban environments in the southeast of England and can provide a collaboration between several coastal counties in England, but also creates possibilities for the United Kingdom. With this regional strategy, a local scale design should provide local scale opportunities for innovation to adapt to the issues that are caused by environmental risks, such as coastal erosion, in these coastal environments.

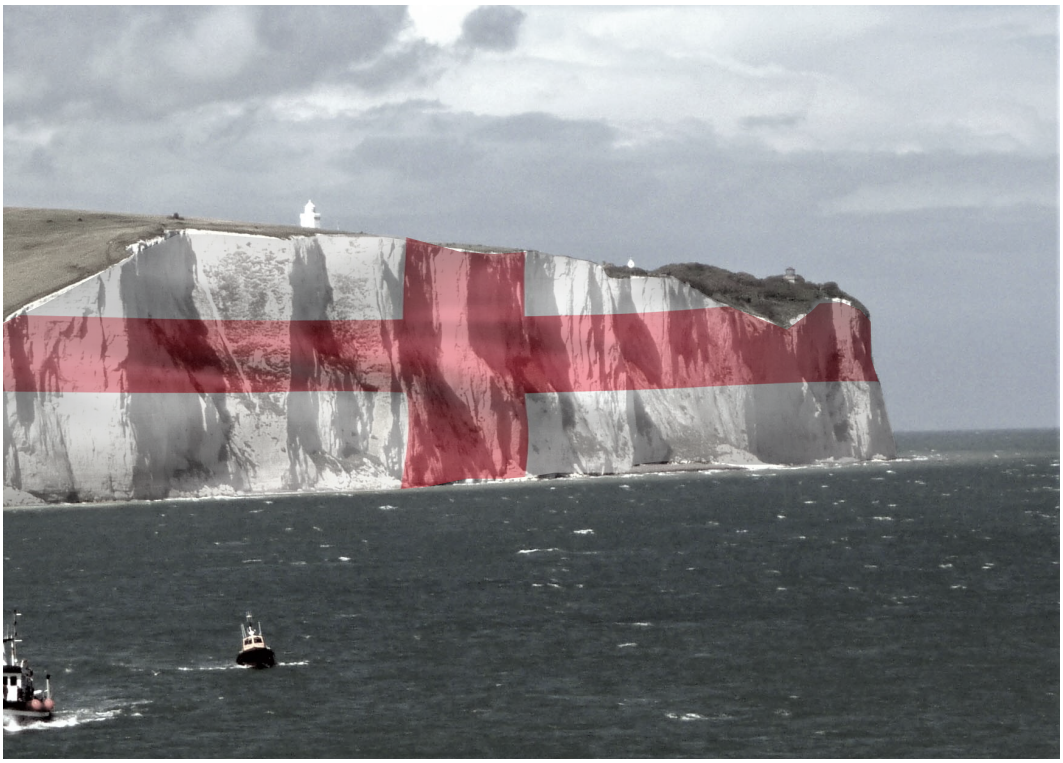


FIGURE 6: ADAPTED BY CONIJN (2021) FROM WHITE CLIFFS OF DOVER (GIEL, 2012)

1.1.2 KNOWLEDGE GAPS

Within the subject of coastal erosion and its effects, the most important knowledge gaps include the uncertainties of erosion rate processes followed up by the inability to find the best solution to environmental risks according to Masselink and Russel (2013). Usually, measures are taken without a clear strategic objective, preventing the realisation of an effective and sustainable solution to coastal erosion (EUROSION, 2004). The term 'managed retreat' in combination with the SMP 'Managed Realignment' is known but unused as the implementation of such planning strategies is prevented due to the lack of exploration in different time scales (Esteves, 2013). According to Cooper (2008), short-term options are preferred to long-term planning options due to the lack of knowledge about these different time scales. Cooper (2008) also describes that, to implement managed retreat into the planning system, the UK is in need of:

- Long-term changes to integrate coastal engineering and land-use planning to free up space for the implementation of managed retreat;
- Compensatory mechanisms for loss of land and property;
- Knowledge about the benefits of the implementation of managed retreat;
- Identification of 'strategic packages' of managed retreat to enhance the function of natural systems; and
- The distribution of knowledge about feasible strategies of managed retreat.

To reach the integration of Managed Realignment and other SMPs into the spatial planning system, greater collaboration between scientists and policy-makers is needed (Bray et al, 1997). This collaboration should also facilitate the compromises between various interest groups, making the integration of SMPs into the planning system an even greater challenge (Nicholls, 2013).

RESEARCH QUESTION

What aspects should an Urban Planning Strategy for England's vulnerable coastal cities include to create a Sustainable Urban Environment that adapts to (accelerated) Coastal Erosion?

1.1.3 RESEARCH QUESTIONS

The problem statement leads to a research question involving different domains by which the project aims to find aspects in urban planning strategies Strategies to create regional resilience with the creation of sustainable urban environments that adapt to coastal erosion.

The first domain in the research question is the urban planning strategy and focuses on spatial planning that is used in the English context. The second domain is the sustainable urban environment where a sustainable urban environment is achieved through the balance of social justice. A sustainable urban environment should be the outcome of the strategy and should, therefore, be researched through subquestions. The last domain is (accelerated) coastal erosion, which is used to find its consequences on the natural and anthropogenic landscapes and its management.

With the definition of these domains, four subquestions are formulated to answer the main research question.

A: Urban Planning Strategy
B: Sustainable Urban Environment
C: (accelerated) Coastal Erosion

A+B

What are Climate Change effects and how do they impact Spatial Planning and Erosion Management in cities aiming for Sustainability?

A+C

What are current Urban Planning Strategies and how do they influence Coastal Erosion Management?

B+C

How can an Urban Environment adapt to the effects of Coastal Erosion and the impact on the Socio-Environmental System?

B

Can a Sustainable Urban Environment be explained through the theoretical framework?

1.1.4 RESEARCH AIM

A+B

This question is used to find the implications for coastal cities that occur in the English spatial planning due to the adaptation of coastal management as a result of climate change effects.

A+C

This question is needed for the research of current urban planning processes and their relation to today's coastal erosion management.

B+C

This question includes the exploration of possible changes in the urban environment when adapting to the effects of coastal erosion. This adaptation should fit in the socio-environmental system.

B

This question is used to understand the definition of a sustainable urban environment in relation to the strategic objective of the project: social justice.

Research aim

This thesis project's research aim is to understand and bridge the gaps in English urban spatial planning practices related to or affected by environmental risks with a focus on coastal erosion.

The societal, ecological and urban environmental risks that have effects or are effected by coastal erosion are researched, but also the risk management that is used and needed to deal with the effects of coastal erosion is implemented in the research and the formulation of a regional strategy for regional resilience.

The overall coastal erosion effects that threaten livability, and therefore, social justice, such as cliff retreat and landslides, but also long-term effects of erosion management measures and the response to these effects, are assessed in the formulation of a regional strategy for an sustainable urban environment. When researching these risks, propositions are developed based on research by design to create a regional strategy.

Research output

With this research aim, the research output is formulated and designed. As mentioned, a regional strategy for southeast English coastal cities, that are affected by coastal erosion, is defined based on spatial, stakeholder and risk analysis.

The regional strategy aims to create regional resilience and Sustainable coastal Urban Environments with the use of response strategies that adapt to environmental risks. With this regional strategy, a qualitative strategy is created to ensure quality in the region. Resulting from the regional and qualitative strategy, two urban designs are proposed in cities with reciprocal functions.

FIGURE 7: WAVES NEAR CLIFFS (UNKNOWN, N.D)

1.2 RESEARCH

In this paragraph different frameworks that are used in the research framework are explained. The project's theoretical, conceptual and analysis and design framework are explained.

1.2.1 THEORETICAL FRAMEWORK

The theoretical framework defines the theory of the domains spatial justice and environmental justice. In this framework their relation to social justice and the triple bottom line (people, planet, prosperity) is established to explain the outline and identify the position of the project, which can be considered an addition to the triple bottom line in urban design.

THE TRIPLE BOTTOM LINE

The urban sustainability framework that includes the triple bottom line is designed to create awareness in urban design to achieve sustainability by considering the domains of people, planet and prosperity in the project, where society, environment and economy are explored. In this framework, urban sustainability should be achieved with the original intensions of minimizing negative impacts and maximizing positive impacts on the three domains (Kraaijenbrink, 2019).

SPATIAL JUSTICE AND SOCIAL JUSTICE

Spatial justice includes the interest in distributive justice and procedural justice, which can respectively be explained by the justice in creation, location and access to public goods, resources and services and the justice in procedures and decision-making (Rawls, 1971; Ostrom, 2015). Spatial justice focuses on the spatiality of an urban system, where Soja (2009) argues that all social justice has a spatial element, shapen by the physical environment. This spatial element is currently known as a fixed element rather than a shaping factor of society, resulting in a potentially unjust space. For this can be argued that social and spatial justice should be linked to define a just project where society is shaped by spaces and spaces are shaped by society (Manuel, 2012). Spatial justice within social justice results in an interdepence within the urban sustainability framework, where the domains of people and project of the triple bottom line can be linked in a definition of spatial justice, within social justice, where spatial justice is an essential element of sustainability, but also of democracy that is needed to achieve this just spatial environment (Soja, 2009).

In this project spatial justice can be found in procedural justice, where the processes of decision-making are guided by safety and livability of society with respect to the environmental risks, where a just process leads to a just space and, eventually, social justice.

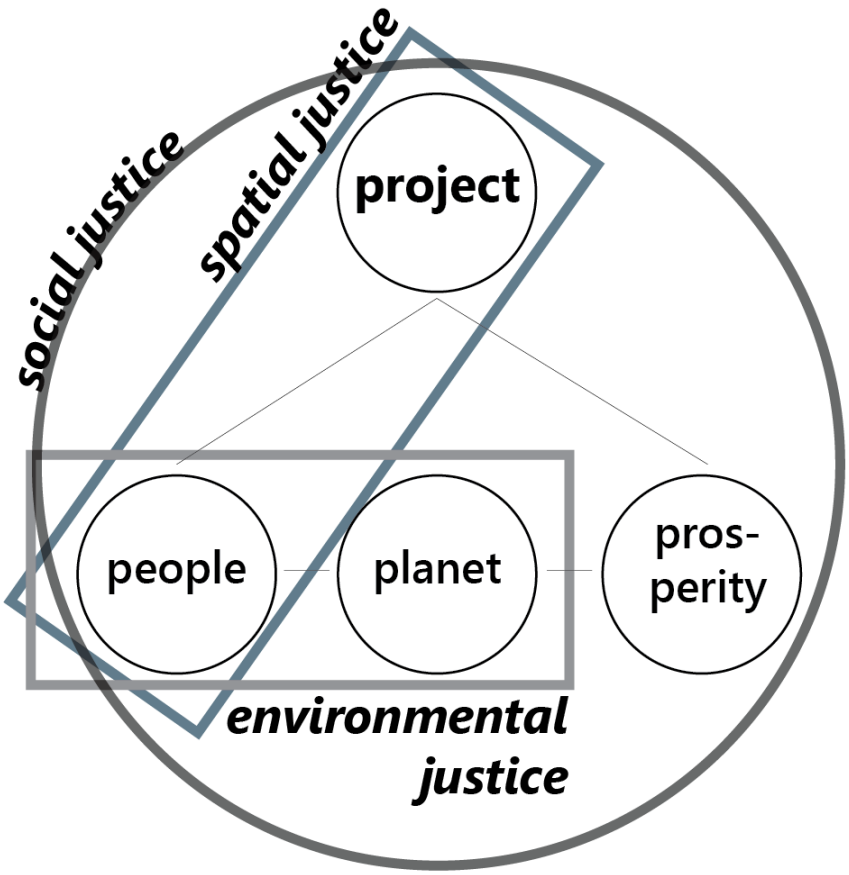
ENVIRONMENTAL JUSTICE AND SOCIAL JUSTICE

Environmental justice can be recognized as a fair distribution of the, urban or natural, environment between people as an element of social justice, but can, in this project, also be defined as the interrelation between people and planet, where the natural environment is ensured for future generations (Bolte et al, 2011). Environmental justice, can be defined with the aspects of distributive justice, equitable access and procedural justice, which are respectively the just distribution of environmental burdens, equal access to environmental resources and justice in decision-making for those affected by environmental interventions with a focus on both the physical and the social environment (Böhme et al, 2015).

In this project, environmental justice can be found in the people negatively affected by environmental risks with their inability to adapt to these risks resulting in vulnerable environments linking the domains of people and planet of the triple bottom line.

SOCIAL JUSTICE

Spatial and environmental justice can be understood as forms of social justice related to the triple bottom line that includes society, environment and economy. These concepts can and should be brought into relation with each other in a process of urban development to achieve sustainability in the project and in all three domains of people, planet and prosperity.



based on Kraaijenbrink (2019), Rawls (1971), Ostrom (2015), Soja (2009), Manuel (2012), Bolte et al (2011), Bohme et al (2015)

1.2.2 CONCEPTUAL FRAMEWORK

The conceptual framework shows the network of concepts. Key concepts and their relation with other concepts that are researched for the thesis are visualised. This abstract visualisation of the research forms the basis of the thesis. Coastal erosion, social justice, regional resilience and sustainable urban environments are the main concepts of this thesis. These concepts should be researched and prioritised in every step of the thesis and should be linked to their affective target audiences.

ENVIRONMENTAL RISK

The first part of the conceptual framework shows the initial issues that are related to environmental risks. The combination of hydrodynamics (FIGURE 7), and cliff geometries are the primary reasons to apply coastal erosion management to specific locations as explained in the problem statement. Coastal erosion management is a method to prevent, embrace or advance these effects of coastal erosion on anthropogenic landscapes. Coastal managment methods can interfere with the current spatial planning practices and choices need to be made. The value of spatial planning and coastal management are compared. In this project spatial planning and coastal management will be aligned and integrated to prevent future issues concerning contrasting values.

Revision of the SMPs leads to a new response strategy: retreat, formulated by Dronkers et al (1990). This strategy selection includes stakeholders engagement and should be in agreement with the indicators that assess the vulnerability for the profiles of coastal English cities with the use of common characteriscitc of culture, population, defence-resilience, economy and tourism inspired by Vafa (2018).

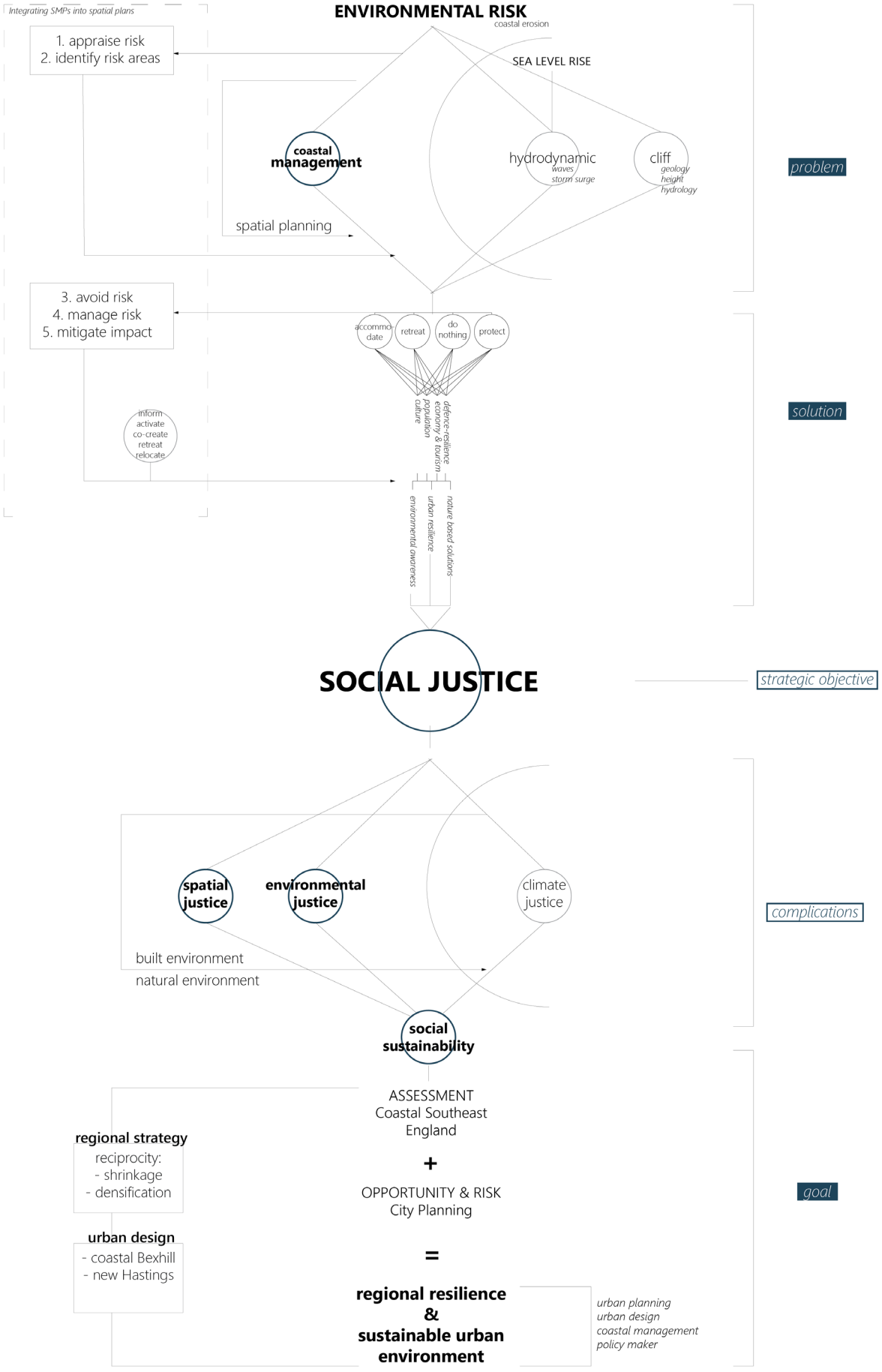
SOCIAL JUSTICE

Response strategies are based on the impact on the social justice system. The relationship between spatial justice and environmental justice within the natural and built environment is the focus of this project and used as a guideline to find a strategy of regional resilience. This social system brings complications into the planning strategies in relation to stakeholder engagement. Important is to consider the relationship between the case for intervention and the spatial/temporal scale. Where according to Cooper and McKenna (2007), the case for intervention or non-intervention depends heavily on the local and short-term or national and long-term scales.

STRATEGY

Decreased social justice due to environmental risks in coastal environments is a result in a need for a regional strategy that includes the achievement of regional resilience and prevents social and environmental risks. The regional strategy aims to find a long-term balance between the natural and built environments while decreasing risks and vulnerabilities that result from Environmental Risks. The aim is to create regional and local environments that include urban resilience, where economy, society and environment are balanced and able to respond in a recovering sense to abrupt change. Environmental awareness and a possibility to use nature based solutions are included as a way to address the challenges of society relating to environmental risks, but also in relation to urban resilience where nature-based solutions and environmental awareness act as tools to achieve urban resiliency (Bush & Doyon, 2019).

Regional resilience has a direct effect on society's social sustainability with a system of urban green spaces, facilitating recreation, social interaction and building community cohesion an introduction of spatial, environmental and climate justice (Jennings and Bamkole, 2019). This means a regional strategy that, in this case, includes a reciprociy of cities planning for shrinkage or densification, is the first step of the creation of regional resilience and Sustainable Urban Environments.



based on Cooper & McKenna (2007), Department for Communities and Local Government (2010), Dronkers et al (1990) and Eurosion (2004),

1.2.3 ANALYTICAL AND DESIGN FRAMEWORK

The analytical and design framework is a framework that describes the tools and methods that are used for the thesis.

METHODS

During the project, different methods were used to understand the social, environmental and climatic challenges and opportunities . These methods were used to find conclusions on different topics and provided the foundation of the regional strategy and local design.

The methods that are used in this project are:
Literature review, data collection, critical mapping, scenario development, stakeholder analysis and spatio-temporal analysis to fit into the used research design approaches:
- Six-step approach (Hooimeijer et al, 2020)
- DOCA opproach (Vafa, 2018)

1. Literature review

The literature review is used to understand the relationship between Shoreline Management Plans (SMPs) and spatial planning strategies and relate this to socio-environmental justice. With keywords that include these concepts, the literature review will add a conceptual, theoretical and scientific perspective to the thesis research with the use of Google Scholar, Research Gate, Science Direct and Jstorr.

keywords

COASTAL EROSION MANAGEMENT
[shoreline management, coastal protection measures, Managed Realignment]

SPATIAL PLANNING STRATEGIES
[urban adaptation strategy, managed retreat]

SOCIO-ENVIRONMENTAL JUSTICE
[social risks, environmental risks, coastal communities]

2. Data Collection

Gathering data is need to create knowledge about the topic of the thesis. This data collection can result in qualitative and quantitative information about locations, conflicts, relations, challenges and opportunities.

database

NORTH SEA
[data.gov.uk, IGIS map, FAO, latestdata, OpenDEM, Eurostat, EMODnet, Environment Agency, DEFRA North SEE, data.overheid.nl]

SOUTHEAST ENGLAND
[data.gov.uk, Environment Agency, DEFRA, Ordnance Survey, GCN, Historic England, WFD, UK Data Service, MaritimeMaps, CEFAS]

3. Critical Mapping

Critical mapping is used to extract critical information from the data collection. Vulnerable systems and risks will be identified with the processes and flows related to matter, topos, habitat and geopolitics in different (time)scales.

4. Scenario Development

Scenario Development is used to explore the effects of the SMPs and goals that are related to coastal adaptation and management. The scenarios will be exagerrated to understand the short and long term effects of different types of coastal management.

5. Stakeholder Analysis

The stakeholder analysis in the form of interviews and power-interest analysis is used to assess the involvement of actors including position and motivation in relation to spatial planning strategies. This analysis is used to test feasibility of the interventions and/or strategies.

6. Spatio-Temporal Analysis

A spatio-temporal analysis is a tool that is used to understand the development of the local design and/or regional strategy in time. Phasing of the project is a critical part of this analysis.

DESIGN APPROACHES

- Six-step approach (Hooimeijer et al, 2020)

The six-step approach is focused on the formulation of a design and is in the thesis used for the formulation of a regional strategy. Step 1 and 2 are described by Hooimeijer et al (2020) as the analysis of the original situation of the case area. The DOCA approach is the basis of the first two steps involving the analysis.

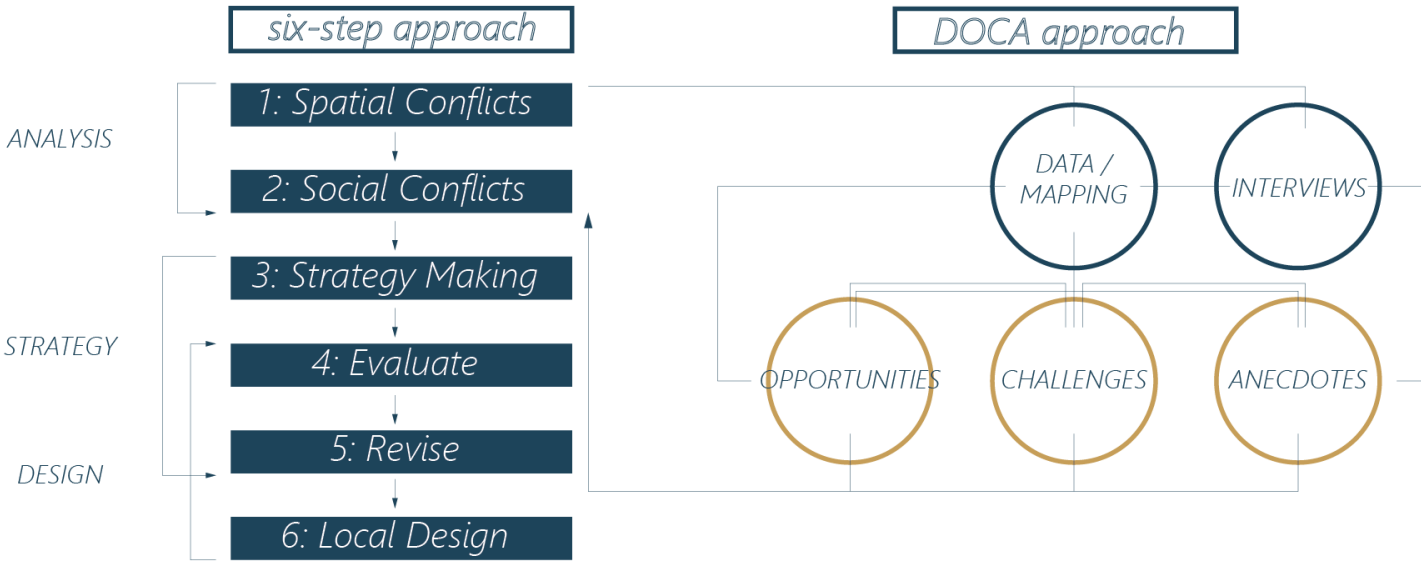
During step 1 and 2 of the six-step approach the goal is to find data on qualitative matters such as socio-spatial conflicts, environmental conflicts, spatial context and policies and map these. Land-use, surfaces and functions will be explored in a quantitative analysis. This step is critical for defining the problems in the project location, Southeast England. Step 2 involves the search for opportunities, challenges and anecdotes. The DOCA approach elaborates further on step 1 and 2.
After the analysis, step 3 involves the redesign of the project area. This redesign is based on the outcomes of step 2 and should include resolving urban issues as well as societal and environmental issues.
In step 4, the strategy and design is evaluated and the effect of the implemented opportunities and challenges can be analysed. This step lead to the use of new ideas in step 5, which is the phase of adapting the strategy and design to new standards.
Step 6 is the last step and focused on a redesign of the public space for the design and a phasing for the developed strategy.

• DOCA approach (Vafa, 2018)
DOCA is an abbrevation for Data, Opportunities, Challenges and Anecdotes. In this approach, developed by urban design office FABRIC and integrated in a Japan project by Vafa (2018), the foundation relies on literature review, data collection and critical mapping. Critical mapping is in this project used as a form of study to explore the spatial drivers and their relations. After this process, opportunities are extracted from critical mappings. In this project, opportunities are found in designs that involve the regional scale and its connections with the local scales of coastal southeast England. The challenges in this approach are found in the reverse engineering of spatial planning conflicts that are currently present in the cities affected by coastal erosion. During this process the flaws in spatial planning systems were explored and possible scenarios were developed to be integrated in a spatio-temporal analysis. The last part of the approach focuses on anecdotes by stakeholders and is covered by the relation between social and environmental justice for coastal cities through the use of interviews with locals.

These approaches are used to create an integrated perspective on the development of spatial planning of Sustainable Urban Environments related to coastal erosion.

Analytical and Design Framework

based on Hooimeijer et al (2020), Vafa (2018)



ANALYSIS, STRATEGY AND DESIGN

The Developing Strategies project knows three phases, which are analysis, strategy and design. The analysis includes the literature review, data collection, critical mapping and interviews. Literature review and data collection support critical mapping. During critical mapping, spatial, social, stakeholder, spatio-termporal and policy analysis are done to find challenges and opportunities, and their risks, as conclusions for the development of a strategy.
Interviews are carried out with the purpose of finding anecdotes on personal opinions, but also on matters of spatial planning and coastal management.

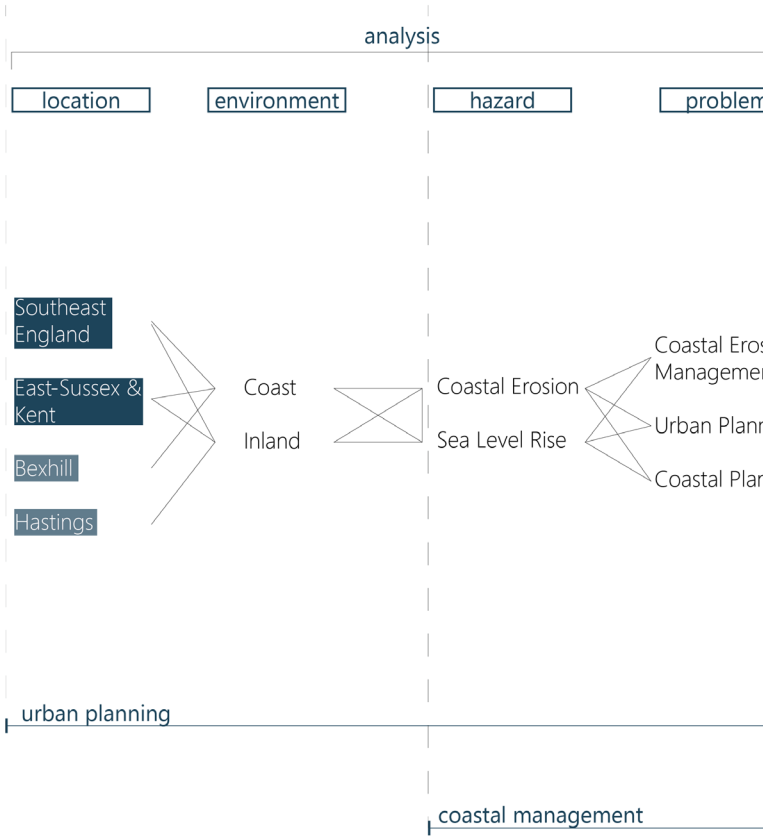
Within the strategy phase, scenarios are developed to explore urban vulnerabilities and find fitting and realistic adaptation strategies with the use of the SMPs. Conclusions of this phase are used in the strategy making through the conclusions of cities at risk and, in the design phase, their risk management that are implementated in the regional strategy including the phasing of the project. In this design phase, also the local urban design is developed.
The analysis, strategy and design phases lead to the end products that included a regional strategy and an urban local design.

TAXONOMY OF DOMAINS

These phases can also be identified in a taxonomy (*FIGURE 9*) that defines domains that are of importance and their scales of operation in the project. The phases of analysis, strategy and design are divided over several professions that are expected to collaborate to achieve the project goals of regional resilience and a sustainable urban environment.

Urban planners are expected to analyse the coastal urban environment on a regional and local scale, in collaboration with coastal managers, to understand hazards and their challenges and opportunities and bring those in relation to the urban environment. These professions are expected to find agreements in goals and concepts within the phase of strategy development. After this, principles are decided upon by urban planners in collaboration with urban designers and policy makers resulting in the implementation of these principles in a local urban design and the search for solution spaces in this local scale.

The collaboration of urban planners, urban designers, policy makers and coastal managers should lead to the formulation of concepts and principles that, in this project, lead to the achievement of regional resilience and a sustainable urban environment.



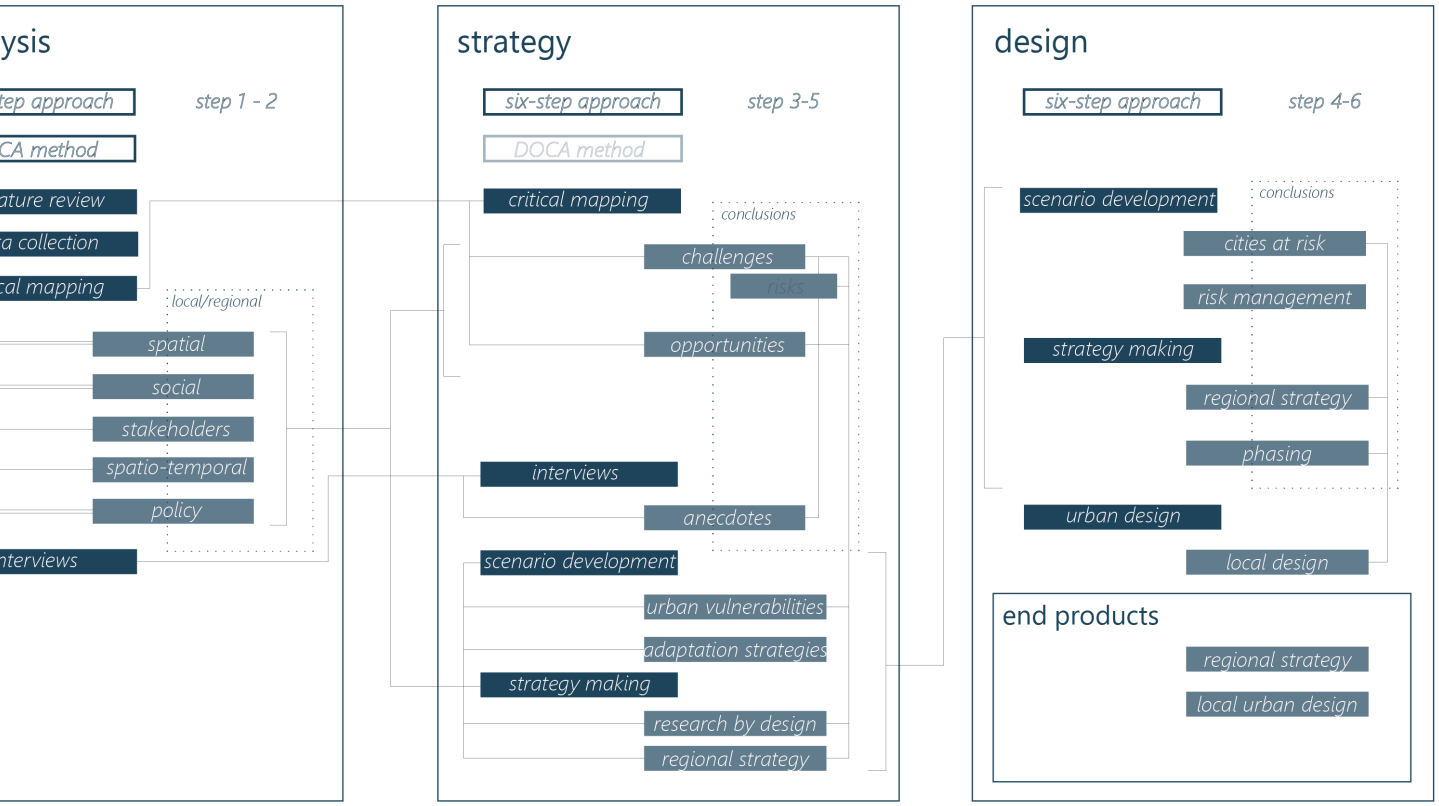


FIGURE 8: VISUAL SUMMARY OF THE USE OF METHODS AND CONCLUSIONS BASED ON HOOIMEIJER (2020) AND VAFA (2018)

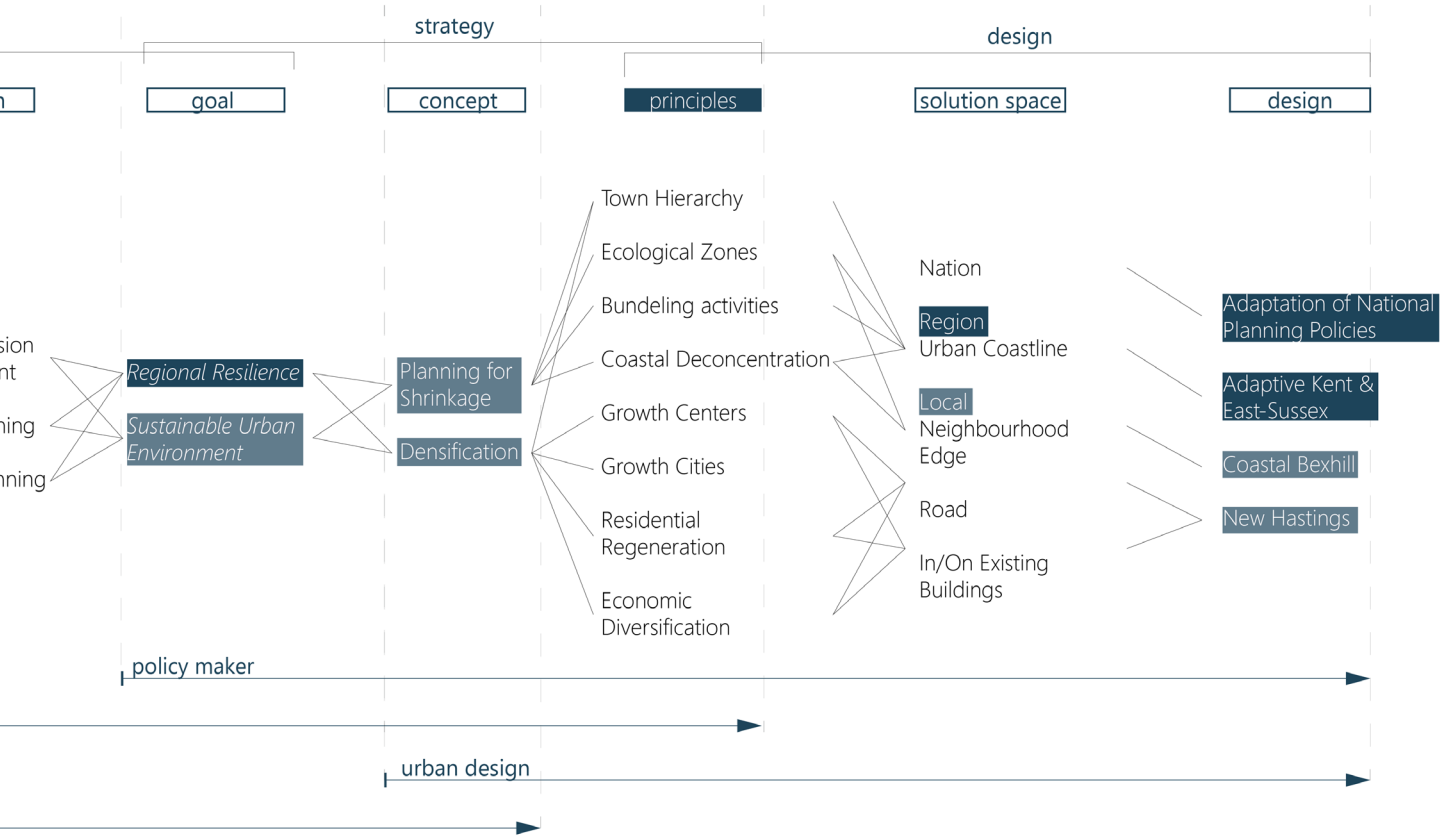


FIGURE 9: TAXONOMY OF DOMAINS IN PHASES OF ANALYSIS, STRATEGY AND DESIGN BASED ON MINISTRY OF HOUSING, COMMUNITIES & LOCAL GOVERNMENT (2019) -NPPF AND MVRO (1977) - VERSTEDELIJKINGSNOTA

FIGURE 10: WHITE CLIFFS OF DOVER, ENGLAND (PINTEREST, N.D)

2 ANALYSIS

The English planning system is explored and the synthesis of the four lines of inquiry, of the Transitional Territories studio: matter, topos, habitat and geopolitics are analysed through the use of composition, alteration and limits. For every line of inquiry, coastal erosion is, as shown on FIGURE 10, the main theme.

2.0.1 ENGLISH SPATIAL PLANNING SYSTEM

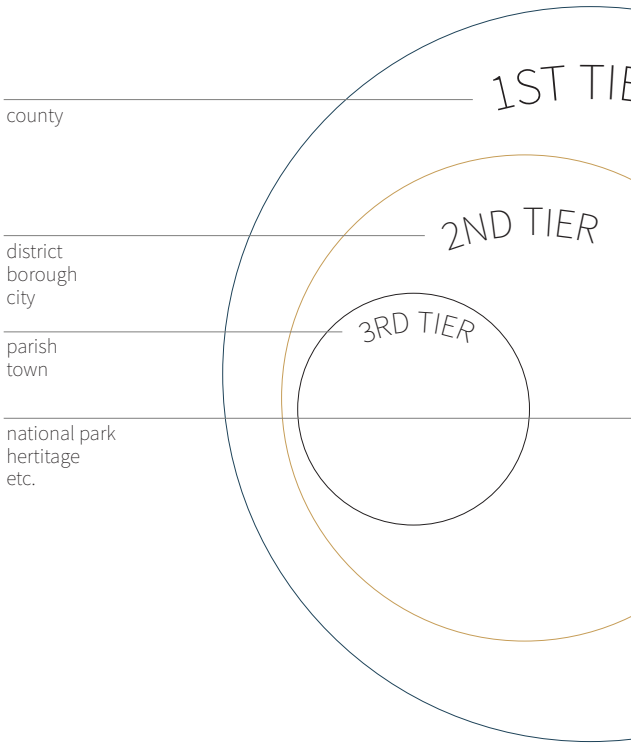
SPATIAL PLANNING IN ENGLAND

The principles of spatial planning in England have been unchanged since 1947, which are that planning is about protecting and promoting the public good (Planning Officers' Society, 2001). The spatial planning, however, has changed significant since 1947. More than once the planning system has undergone several changes with new regulations and planning acts (The National Archives, n.d).

In 2005, a system with regional spatial strategies and local development documents was introduced to deliver a sustainable development. In this system the spatial planning should integrate policies for the use and development of land with other policies and programmes that include the nature of places and their function (ODPM, 2005). This system agreed with the existence of the Regional Development Agencies Act that was accepted in 1998, where regional planning authorities could refuse planning applications that are not in the region's best interest. Within 10 years, most of these regional planning authorities have been abolished and new planning acts are introduced (Queen's Printer of Acts of Parliament, 1998).

The Localism Act in 2011 included fewer regional strategies and more local initiatives that allowed self-organized groups of residents to formulate plans about their own neighbourhood (Department for Communities and Local Government, 2010; HMSO, 2011).
In 2004, 2008 and 2011 different acts have been accepted that dismantle old urban and environmental planning principles, causing England's planning system to lose grip over clear regulations concerning this system. The alterations of principles within different acts have been causing a ping-pong effect between regional and local planning systems. This repeated change of territories in the planning system can be recognized as crisis management trying to solve the unjust economic model (Lord & Tewdwr-Jones, 2012).
In the modern planning system of England, the National Planning Authority is formed by the Ministry of Housing, Communities and Local Governments. This ministry formulates regulations and acts to increase the housing supply, support local government and create strong communities. The key decision-takers in this planning system are Local Planning Authorities (LPAs) which can be defined by three tiers: (1) county councils, (2) district, borough or city councils and (3) parish or town councils. These authorities are accompanied by local councillors, who have the key leadership and officers, who assist with the procedures of the planning system (Department for Communities and Local Government, 2015).

The second tier, defined by district, borough or city councils is the most important tier in the current planning system and is responsible for most planning decisions other than transport, mineral and waste planning. Single tier authorities such as National Park authorities and Heritage authorities have responsibility for both

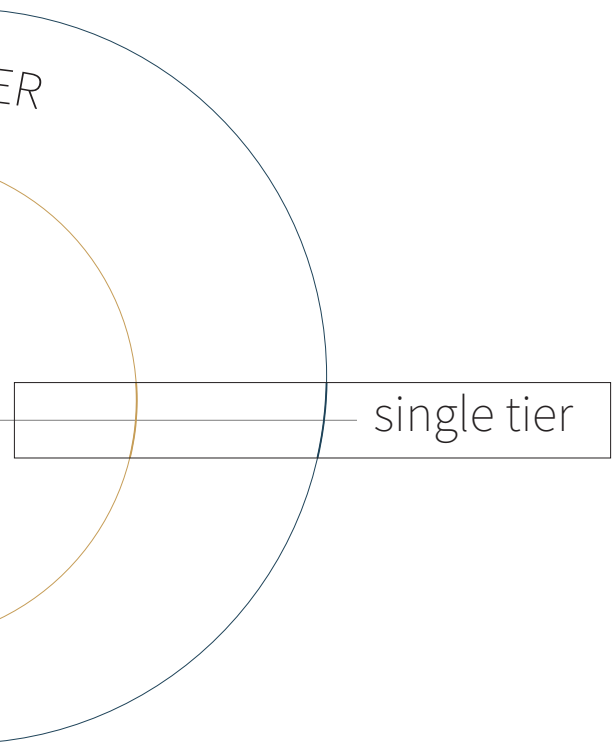


first and second tier planning matters visualised in FIGURE 11. The third tier is responsible for passing of planning applications to produce neighbourhood plans.

The Department for Communities and Local Government (2015) states, that planning is more effective when the people that are affected are an integral part of the process. This statement results in the National Planning Policy Framework, with the exception of London, to focus on local and neighbourhood plans to be the main strategies of planning and provide plans for a minimum of 15 years.
The focus on local and neighbourhood plans does not rule out the need for cooperation between different Local Planning Authorities. Within the Localism Act 2011 a 'Duty to cooperate' is integrated to ensure the collaboration between Local Planning Authorities and public bodies (Department for Communities and Local Government, 2015).

This 'Duty to cooperate' is needed to integrate the Shoreline Management Plans (SMPs) or coastal management plans into spatial plans. For this process a policy hierarchy is created by the Department for Communities and Local Government. This hierarchy reaches from appraising risk with the involvement of SMPs to mitigation and their impact with the use of an adaptation strategy (Department for Communities and Local Government, 2010)

FIGURE 11: ADAPTED BY CONIJN (2021) FROM ENGLISH PLANNING SYSTEM DISTRIBUTION BY DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (2015).



In the planning process the Environment Agency fills a strategic overview role who manages flood risks and SMPs on behalf of DEFRA and works with collaborates authorities to ensure maintenance and prioritisation of coastal protection measures (Environment Agency, 2021). Other examples of agencies and bodies that are interested in spatial planning cooperation within southeast coastal England include Natural England, the National Trust, English Heritage, the Marine Management Organisation, Primary Care Trusts and Coastal Groups (Department for Communities and Local Government, 2015).

THE SYSTEM IN PRACTICE

According to experts that are involved in this planning process, the many changes to the system in the past ten years have caused many planning issues. In particular the change from regional planning to local planning has caused miscommunication between the two scales and introduced a sense of individuality into the English Planning System (Crates, personal communication, 2021). This individuality is encouraged by the short-term minimum of Local Plans. Also, the 'Duty to cooperate' can currently only be relied upon during the search for new construction sites, this policy is not controlled in terms of the desired topic of sustainability in relation to social justice, according to experts in the field of Urban Planning and Coastal Management (Crates, personal communication, 2021; Coleman, personal communication, 2021).

The lack of policies and local plans regarding sustainability can be considered a problem in today's society as many coastal urban areas that experience issues with coastal erosion have been

informed by experts in the past, but ignored this research due to the lack of legislation. According to the Maritime Archaeology Trust, this is a reason for LPA's to be held responsible for the current issues with Coastal Change (Momber, personal communication, 2021).
Another point of criticism by experts on the current planning system includes the function of SMPs in the system, as they are non-statutory, unfunded and unsustainable as they are not adaptive to the future climate change and the resulting coastal erosion and can, therefore, not be relied upon (Coleman, personal communication, 2021; Momber personal communication, 2021). Due to the non-statutory function of SMPs, the government has no duty to provide protection (Environment Agency, 2021).

ADAPTING THE SYSTEM

With knowledge about the current system, expectations and experts' opinions it can be concluded that England is in need of a policy change that includes the aim for a sustainable urban environment. This need was introduced in 2005 by ODPM, but has however, since 2011 been discarded (ODPM, 2005; Lord & Tewdwr-Jones, 2012)

Future changes in the system can be explained through the re-introduction of the regional scale to the planning system that provides room for policies that can be applied on both the National scale and the regional scale to improve collaboration between the scales and tiers (FIGURE 13). Old policies that are related to coastal erosion should be revised, and new policies can be integrated into the system to provide a foundation for the desired sustainability in Coastal Urban Environments. Where in the current system the National scale and the local scales are seperated, will in the new adapted system be a linkage between these scales through the regional scale.

Shoreline Management Plans should be revised and considered on both the regional and the local scale to provide a strong realistic foundation for sustainable regional development as the current Shoreline Management Plans are unsustainable (Momber, personal commnication, 2021). The revision of SMPs should, in the new planning system, lead to the formulation of an adaptive urban environment. Integration of the revised SMPs can be achieved through regional collaboration and possible funding. These revised SMPs will pressure the coastal urban environments to include not only Climate Change Adaptation, but also include Coastal Change into the Local Plans. In FIGURE 12, the current integration of Coastal Change into Local Plans is shown, where, in southeast England, most Local Authorities do not mention Coastal Change in their plans, leading to the establishment of unsustainable plans. When the regional scale is implemented in this planning system, Local Plans will not be able to exclude Coastal Change.
With the integration of the regional scale, the timeframe of plans should also be adjusted to make regional and local plans feasible within the different scales. In the new planning system, a longer term of plans should be integrated in Development Plans, leading to possibilities to an increased sustainability. New plans are aimed to last for at least 50 years, nearly eliminating the Hold the Line- strategy for many Coastal Urban Environments and causing an essential argumentation to search for opportunities in other, more sustainable SMPs.

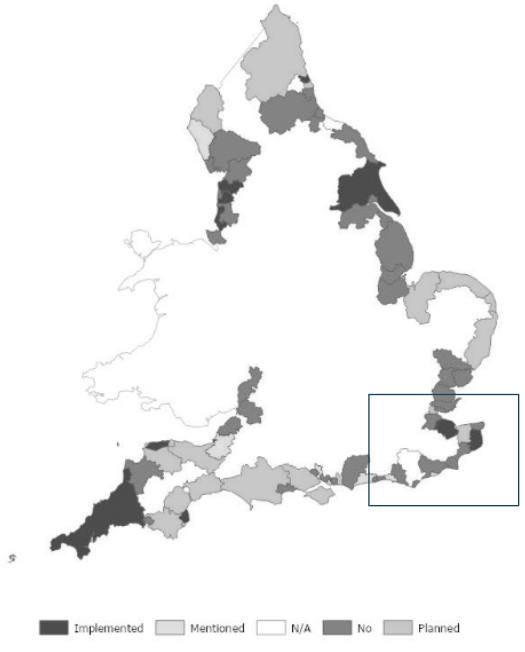
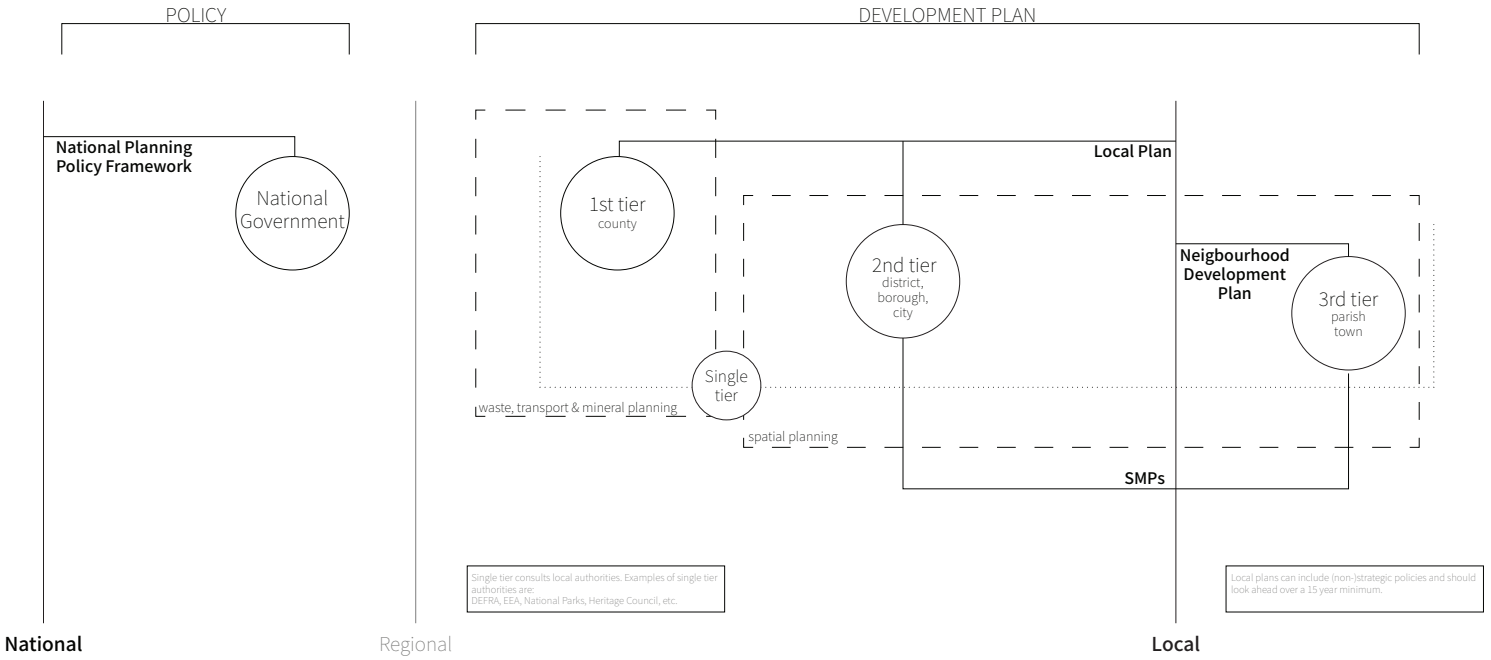


FIGURE 12: COASTAL LPAS WITH CCMA STATUS (KIRBY ET AL, 2020)



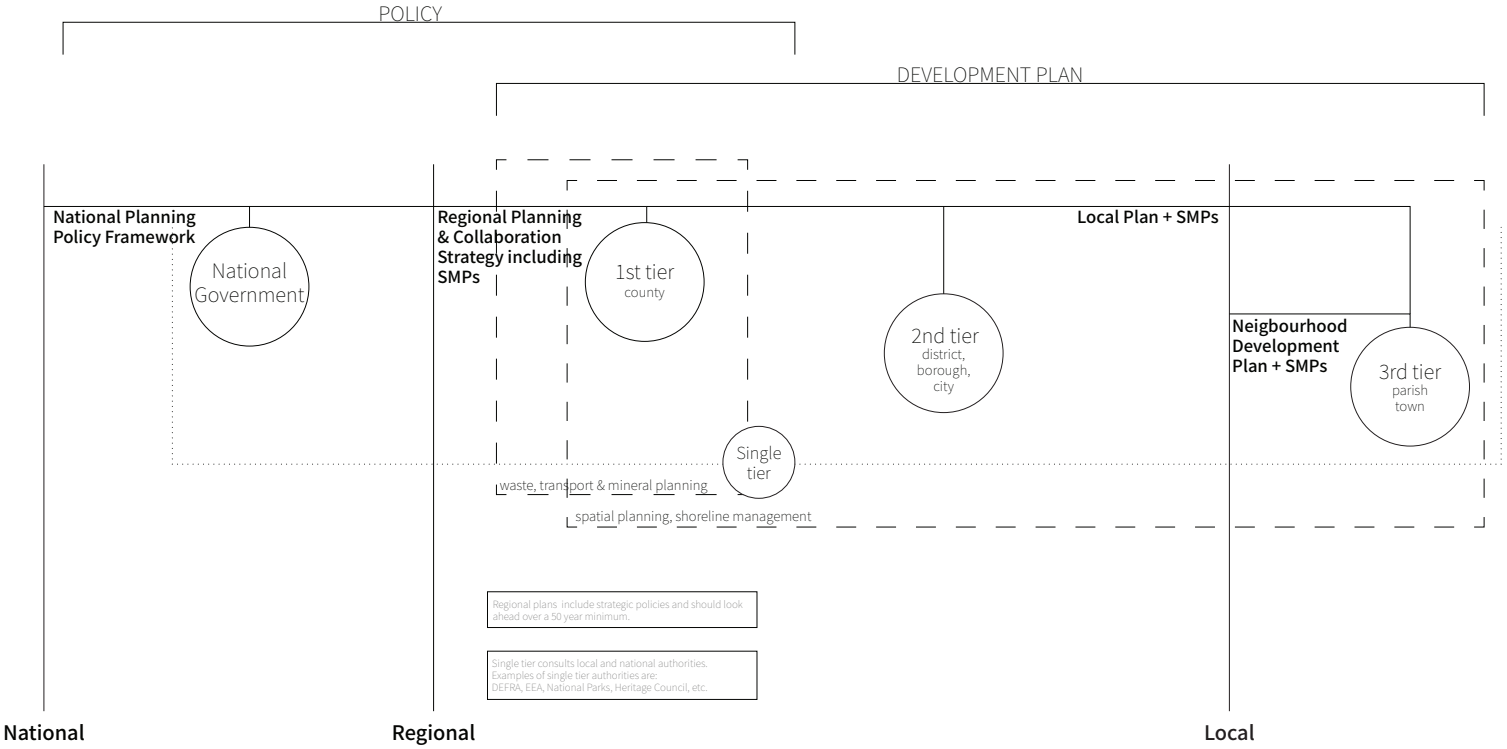


FIGURE 13: CURRENT AND ADAPTED ENGLISH SPATIAL PLANNING SYSTEM BASED ON DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (2015), MINISTRY OF HOUSING, COMMUNITIES & LOCAL GOVERNMENT (2019), POLICY PLANNING OFFICE (2015), MOMBER (2021), COLEMAN (2021), CRATES (2021), ENVIRONMENT AGENCY (2020)

FIGURE 14: WHITE CHALK CLIFFS OF DOVER (PINTEREST, N.D)

2.1 MONOGRAPHS

Important conclusions of the four lines of inquiry are explained through the use of analysis that includes mapping the horizontal, vertical and spatio-temporal planes of the coastal areas as shown in FIGURE 14. This analysis is used to find limitations, but also to find opportunities and challenges within the different scales that are introduced in this project.

2.1.1 SPATIAL ANALYSIS

COMPOSITION OF MATTER

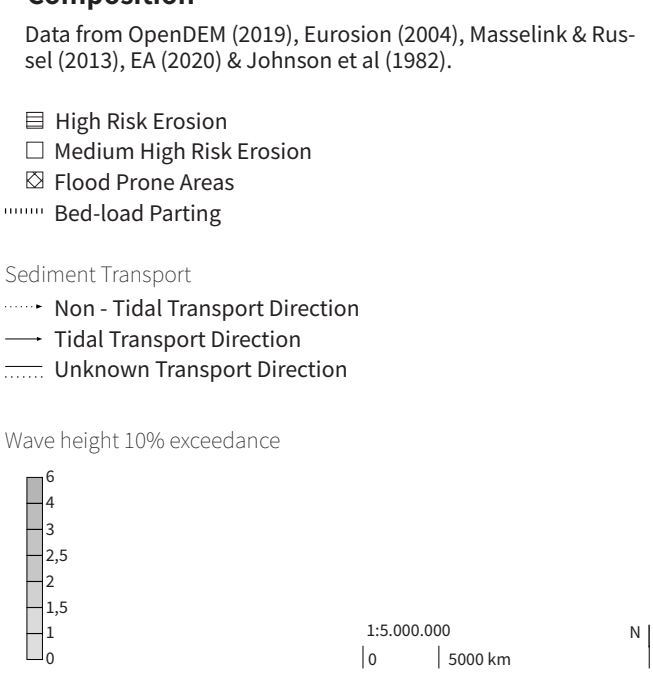
70,9% percent of earth's surface consists of water (USGS, n.d) where the North Sea covers a small percentage of this surface as an inland sea that is a small part of the Atlantic Ocean. This inland sea can be found on the European continental shelf and is adjacent to the countries: Great Britain, Denmark, Norway, Germany, the Netherlands, Belgium and France. Coastal areas in these European countries coastlines create room for recreation and tourism, but can also be defined as territories for disaster. The Transitional Territories that can be found adjacent to the North Sea often experience problems between water and lands surfaces. Sea level rise and coastal erosion have been reoccuring issues in the North Sea and the adjacent coasts in West-Europe.

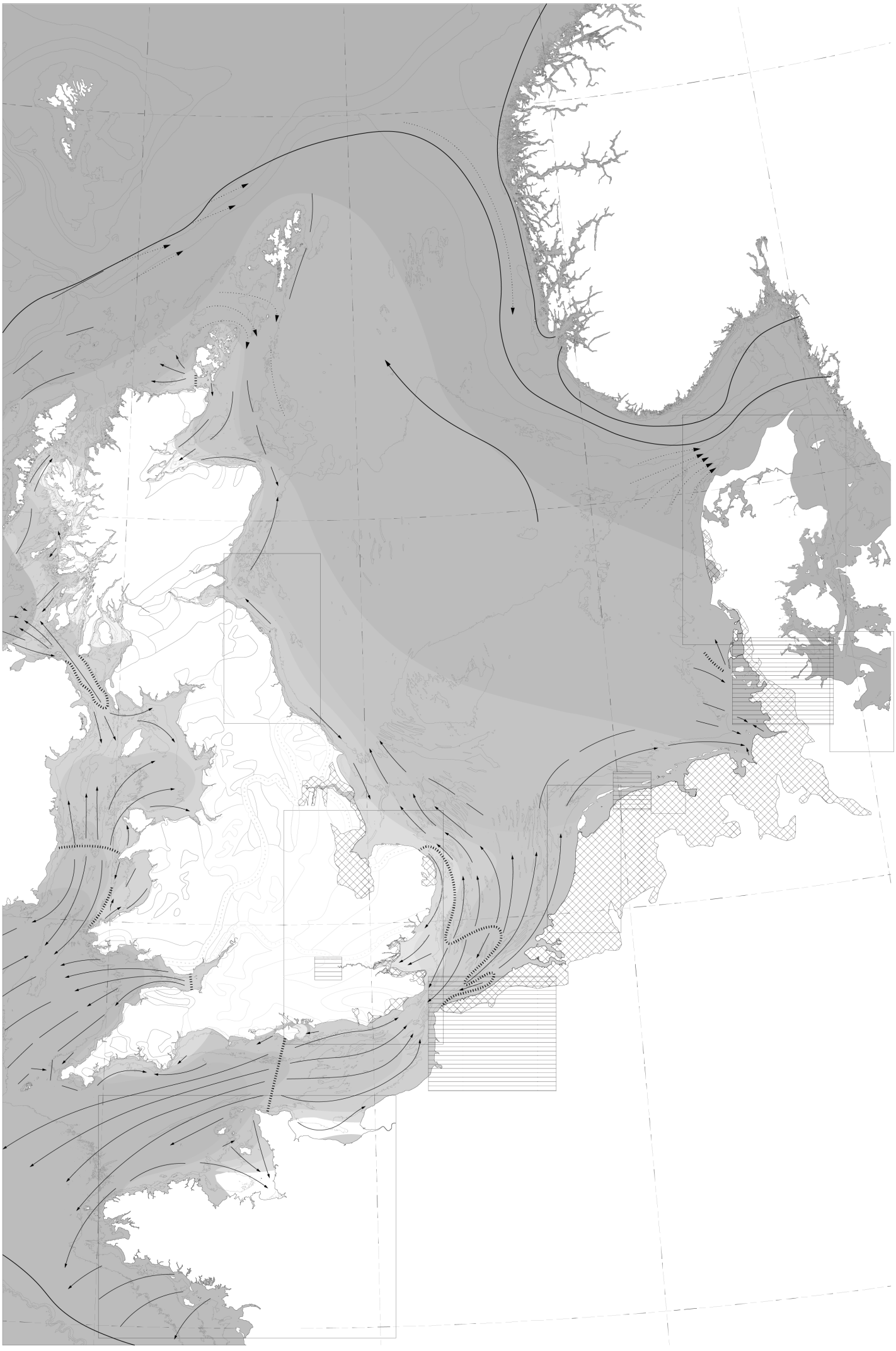
Water is the primary source of coastal erosion effects on land surfaces. The impact of this water can be defined through the composition in comparison to the soils that are exposed to erosion due to direct physical contact with surfaces of water. Through coastal erosion the sea slowly takes ownership of the land and replaces this land with water, increasing the water surface in certain locations.

Vulnerable areas for this erosion process can be found in southeast England where big parts of the coast are defined as high risk and medium risk areas to erosion (Eurosion, 2004). These vulnerabilities are caused by sea level reise, the soil types that consist mainly of soft soils like chalk, but also the water flows, the sediment transport, sea bathymetry and the wave height are factors that have impact on the risks and vulnerabilities of coastal zones (de la Vega-Leinert & Nicholls, 2008; Masselink & Russel, 2013; Hazelden & Boorman, 2001). Water flows in combination with sea bathymetry and wind flows can cause the coast to be attacked by energetic waves, resulting in medium risk coastal erosion zones if frequently repeated. With the expectated increased frequencies of storms and the rise of sea levels, an increase in imbalance in sediment transport will be established resulting in transformations from medium to high risk coastal zones (Hurst et al, 2016). In southeast England, the coast experiences a significant impact from the water flows and sediment transport due to the influences of the British channel, the nearby coastal zones and the bed-load partings in the sea bathymetry (OpenDEM, 2019; Johnson et al, 1982).

In other countries adjacent to the North Sea, coastal erosion is not the main issue as stronger soil types can be found, but also due to the more important issue of sea level rise that forms bigger threat to these coastal areas, due to the low land surfaces (Environment Agency, 2020).

FIGURE 15





THE COMPOSITION OF TOPOS

The English coastline is known for its cliffs that surround the islands of the United Kingdom. In particular the southeast coastline, where the white chalk cliffs are located. Apart from these high cliffs, the coast also consists of lower areas that are at risk of flooding. These different terrain types cause a need for coastal management in the form of Shoreline Management Plans (SMPs) to prevent urban environments to be at risk from the negative effects of water.

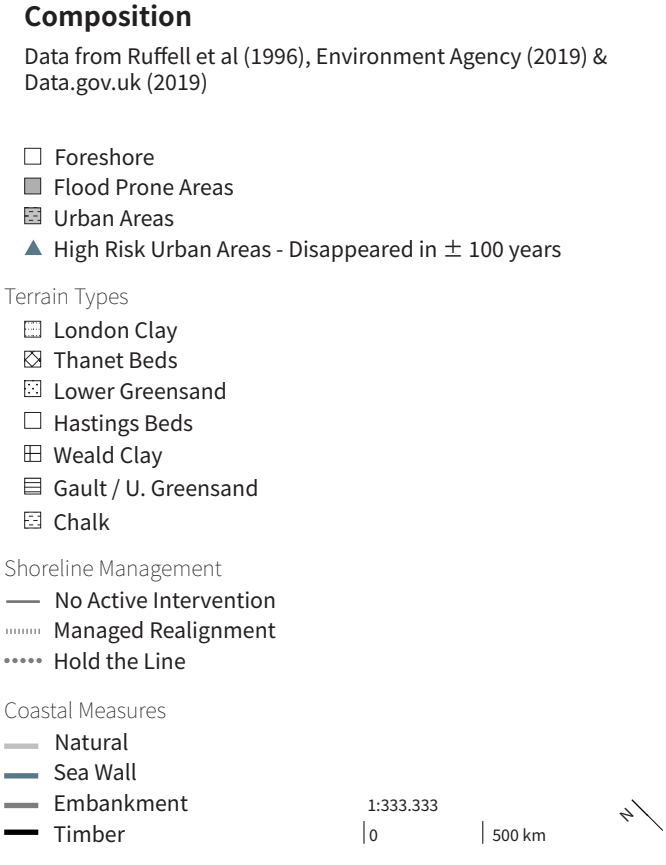
Four types of SMPs are implemented in coastal England by DEFRA in collaboration with the Environment Agency (DEFRA, 2001; Environment Agency, 2011). For the coast of southeast England, that is defined as coastal cell 4 and includes the coastlines of East-Sussux and Kent, only three types of SMPs are used. Currently, the most used type of management is Hold the Line management, where the current coastline is maintained in its current state with the use of coastal protection measures. Natural protection through height differences, but also sea walls, embankments and timber constructions are used to prevent coastal erosion and floods. Other active SMPs in coastal cell 4 are: No Active Intervention, where the current natural resources are sufficient or the land is not worth protecting, and Managed Realignment, where the coastline is moved backwards to give space to the natural coastline resulting in conflicts of boundaries between urban environments and natural environments (Environment Agency, 2011).

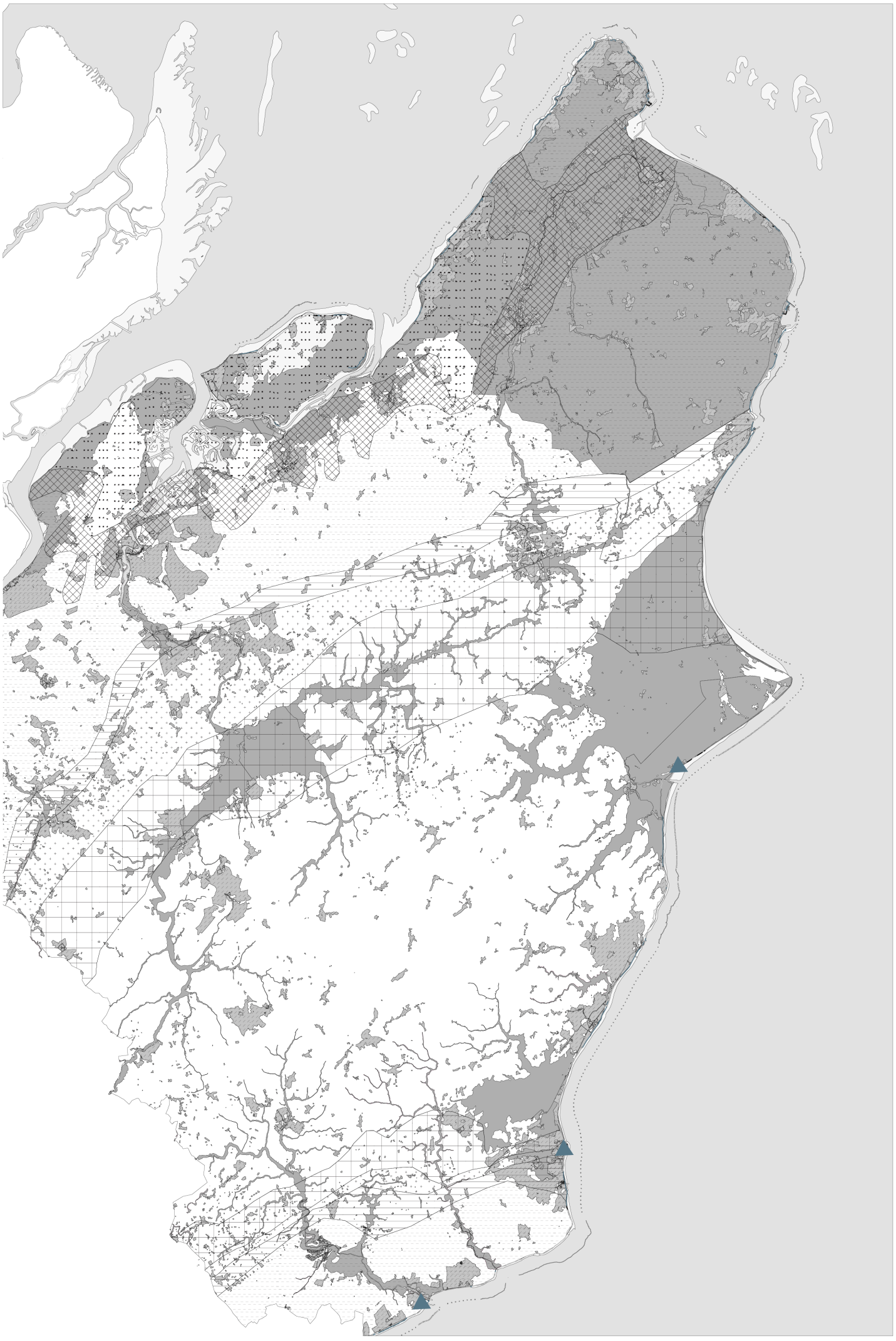
Shoreline Management Plans are, for the English coast, used as a tool to manage terrain types while preventing vulnerabilities in coastal urban environments. These terrain types all erode in a different pace and are, therefore, in need of different measures and management plans (Boardman, 1990; Neal et al, 2019).

While the SMPs consist of plans and policies to manage the coastal areas, decisions have to be made between benefits and costs of these plans. For many coastal areas with a Hold the Line strategy, this might not be beneficial on the long-term and will only cost the Local Authorities money while postponing the actual issues due to the limited amount of financial support and the unlimited temporal scale for a defence to last.

Although the SMPs are policies, these policies are non-statutory, resulting in no funding from and no right to be protected by the National Government causing protection measures to be developed in the local scale instead of the National scale, leading to knock-on effects and additional costs (Nicholls et al, 2013; Marchand, 2010)

FIGURE 16





The goal of the SMPs is primarily to maintain the urban environment, however, it is also important to maintain the natural cliff environments as these coastal cliffs are a home to a great biodiversity unaffected by the athropocene landscape in the coastal zones of England (Larson et al, 2005). The coastal management types, also called shoreline management plans (SMP) in the UK, each focus on maintaining either the urban environment or the natural environment, with the exeption of Managed Realignment, which focuses on maintaining both environments (DEFRA, 2001). For many locations, maintaining both environments would be a desired outcome of shoreline management.

The management plans can be distinguished by their function. No Active Intervention and Managed Realignment have the function of limited intervention with natural processes, while management strategies such as Hold the Line and Advance the Line are prevention strategies that intervene with the current natural processes. The prevention methods are then distinguished by the location of these measures. Where Hold the Line strategies focus on prevention measures along the current coastline, the Advance the Line strategy moves the coastline further in sea and uses coastal measures that should be located in at sea to create this distance from the current coastline.

These prevention measures have positive effects towards the erosion as they are able to limit the hydraulic action to a certain amount. However, most prevention measures interfere with the natural processes in such a way that the sediment quantity and transport is negatively impacted, causing erosion issues including sediment quality and quantity in other, nearby, locations along the coastline (Brown et al, 2011; Nicholls et al, 2013; Masselink & Russel, 2013; Moore & Davis, 2014).

The erosion in the southeast of England is currently limited through the use of coastal protection measures within the Hold the Line strategy. If these protection measures are removed in a Managed Realignment strategy, the land will erode naturally in locations where the soil resistance is weak. The limits of this erosion will be defined by the transition in land to strong resistance soils that are naturally resistant to the effects that cause erosion (Masselink & Russel, 2013).

Eros

FIGURE 17

Alteration

Data from Shnizai (2012), Brown et al (2011), EUROSION (2004) & Masselink & Russel (2013).

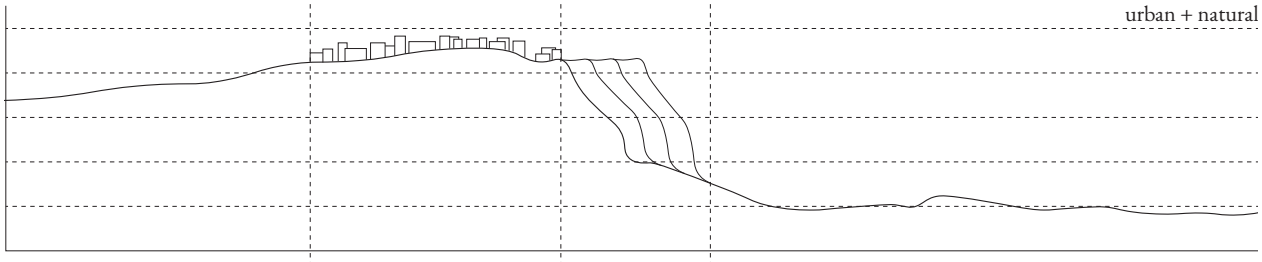
- Strong Resistance Soils
- Weak Resistance Soils
- Water
- Sediment Transport
- Sediment Limits

Terrain Types

- London Clay
- Thanet Beds
- Lower Greensand
- Hastings Beds
- Weald Clay
- Gault / U. Greensand
- Chalk

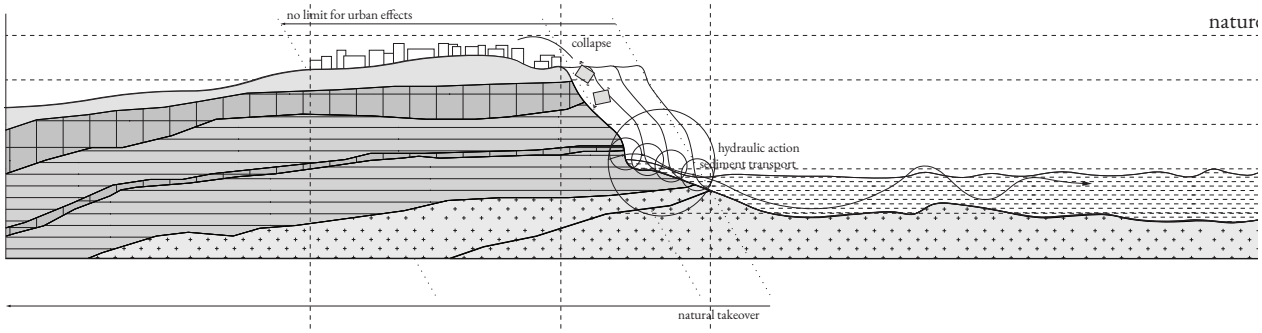
Goal

MAINTAIN NATURAL
MAINTAIN URBAN



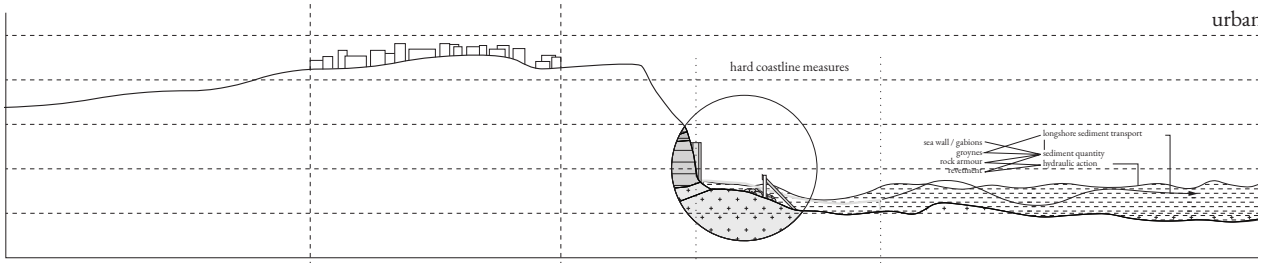
Erosion
No Limits

NO ACTIVE INTERVENTION

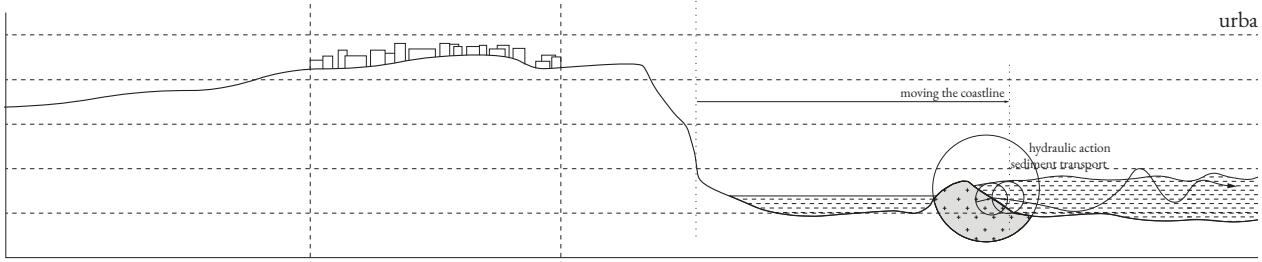


sion Prevention

HOLD THE LINE

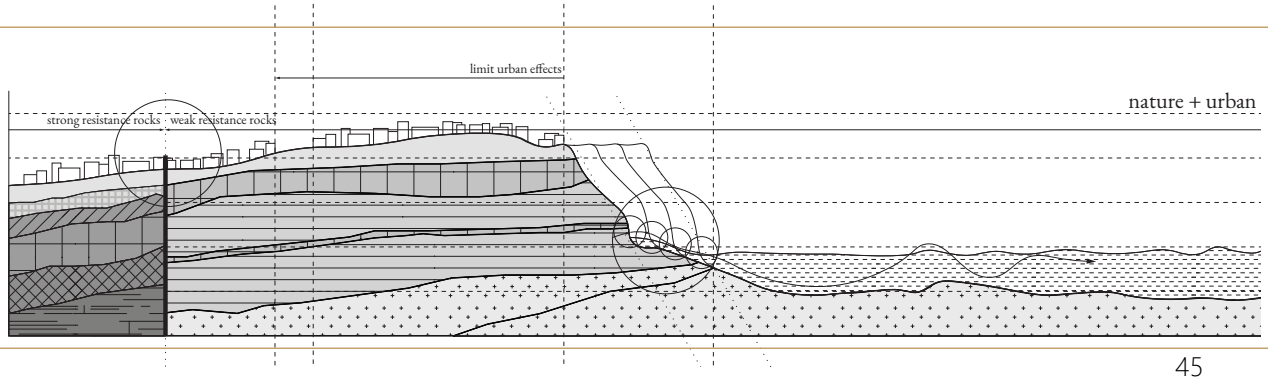


ADVANCE THE LINE



Erosion
Limits

MANAGED REALIGNMENT



The shoreline management plans (SMPs): Hold the Line, Managed Realignment, Advance the Line and No Active Intervention, all have a different impact on the spatio-temporal scales. Plans such as Advance the Line and Hold the Line are active on the spatial scale as these are plans to maintain the current coastal environments as they are and do not have adaptive characteristics in the temporal scale. The distance of these plans is defined by the erosion distance the measures are able to prevent, the temporal scale is defined by the time the coastal measure is in operation. This time of use is for most coastal measures around 30 to 50 years (DEFRA, 2001; Environment Agency, 2011).

The No Active Intervention Management Plan works for a certain erosion distance where the urban environment is still unaffected. After a certain period of time this distance has overlapped with the urban environment and creates an environment with a negative livability.

The Managed Realignment Management Plan is an adaptive plan as it follows the path of erosion and creates an urban environment that keeps changing position to avoid risks and vulnerabilities. This relocation happens parallel to the erosion rate of the soils that exist in a location. This means that for each location this pattern will differentiate.

In locations for sandy soils, the need for adaptive management plans are most needed as the erosion rate is significantly higher than other soils. However, the erosion rates of both chalk and clay still require management plans. This is the case for all of southeast England as hard rock soils can only be found in the northern part of the United Kingdom.

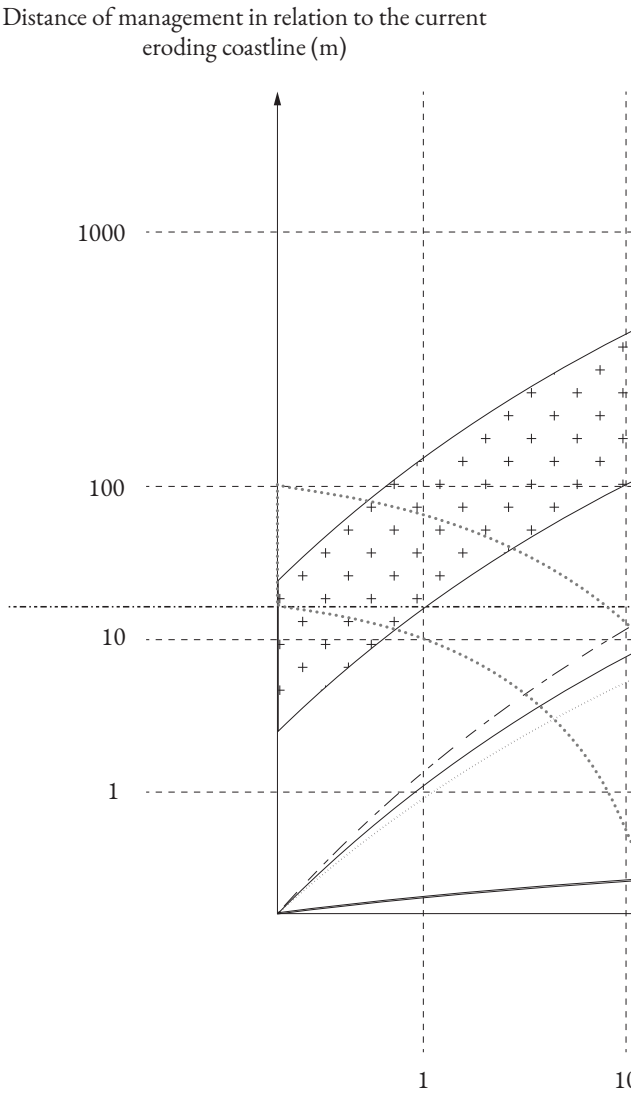
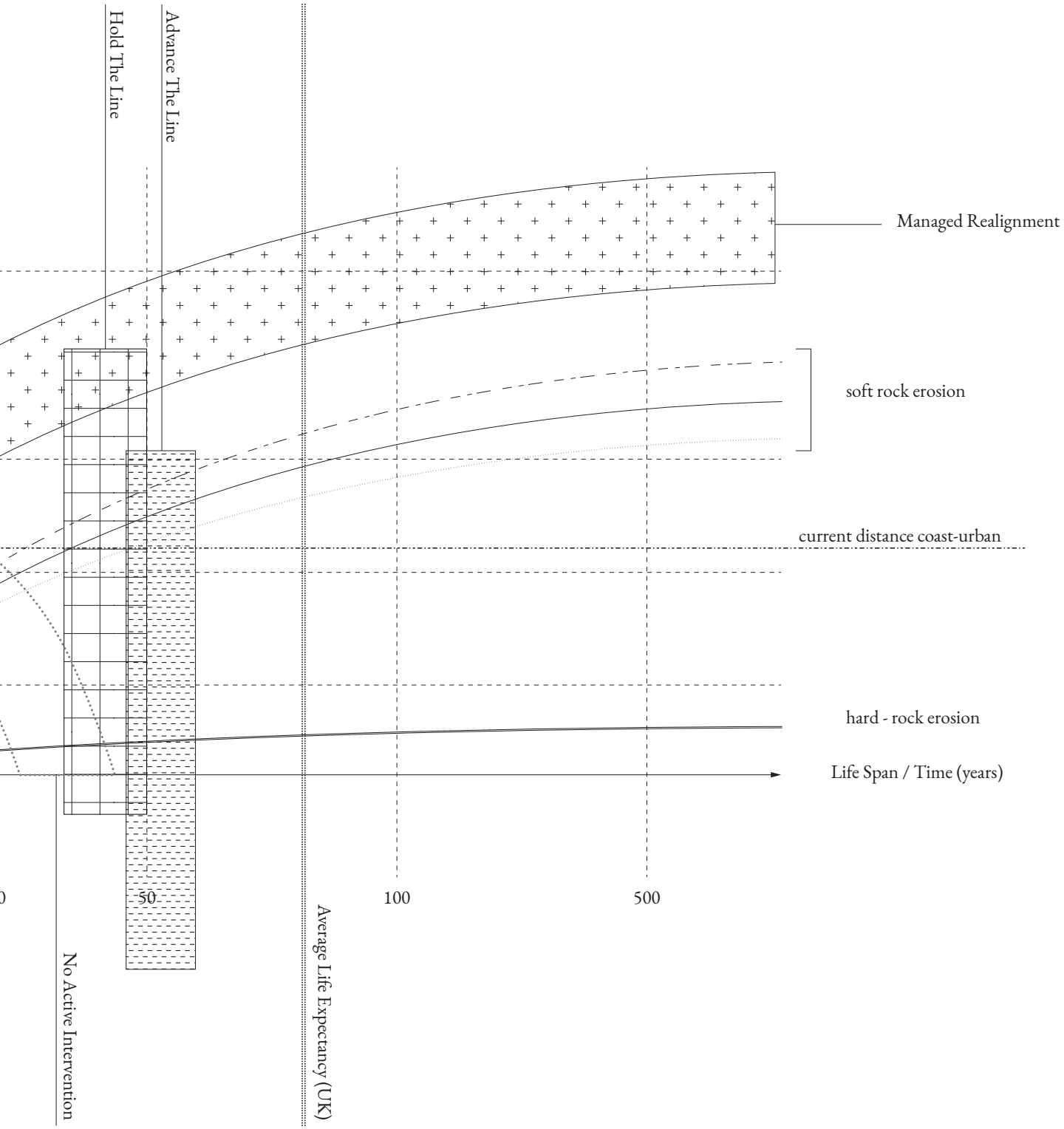


FIGURE 18


Hold The Line
Advance The Line
Managed Realignment
soft rock erosion
current distance coast-urban
hard - rock erosion
Life Span / Time (years)
0
50
100
500
No Active Intervention
Average Life Expectancy (UK)

THE ALTERATION OF HABITAT

In southeast England's coastal zones, urban developments can be found along the coastline. Between the urban environment and the sea environment an area of protection measures, wetlands or cliffs can be found. In southeast England the percentage of these coastal environments is around 6%. Of this 6% nearly 47% includes coastal protection measures (UK Centre for Ecology & Hydrology, 2015). These protection measures can include the different types of Shoreline Management Plans in TOPOS. Seawards, the areas adjacent to the coasts are used for temporary and permanent uses, where temporary uses include fishing and shipping, while permanent use is defined by uses that are long-term such as windfarms, oil production, drill platforms and waste disposals.

In southeast England, many urban environments can be found in the coastal zones of the British land. However, this coastal zone is often defined by coastal cliffs, causing a vulnerable urban environment due to the effects that can be caused by coastal erosion (Brown et al, 2011). Land inwards these urban environments can be neighbouring other anthropogenic landscapes such as horticultural landscapes, orchards and hops.

Another great part of the southeast English landscape is occupied by grasslands. These grasslands are part of the natural landscape of England and are often protected due to biodiversity, the origin and location of the landscape (Natura 2000, 2020).

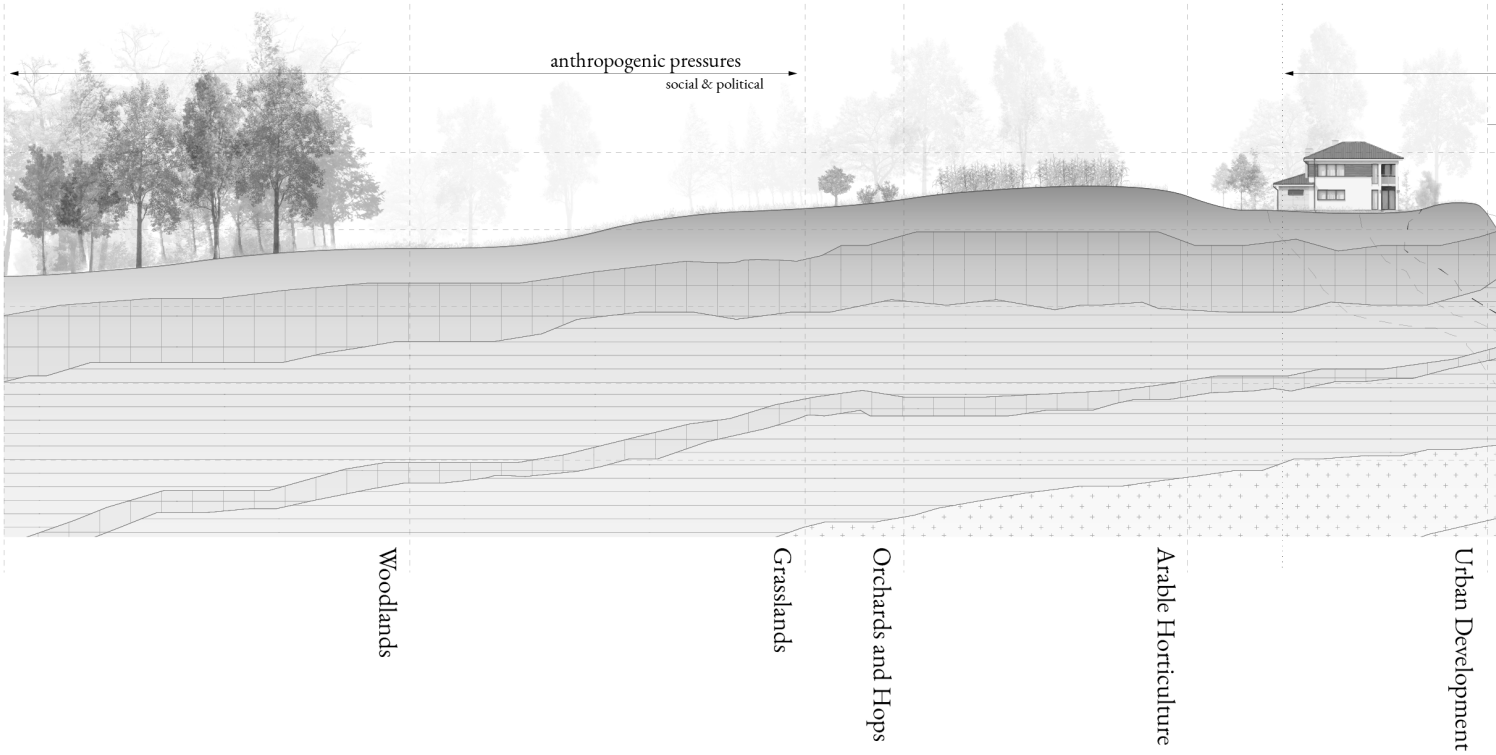
These different forms of landuse are the result of anthropogenic influences on the landscape and do, on their turn, influence the existing landscape in the conflict between natural pressures, by land, sea and biodiversity and anthropogenic pressures, by society, politics, environments and space.

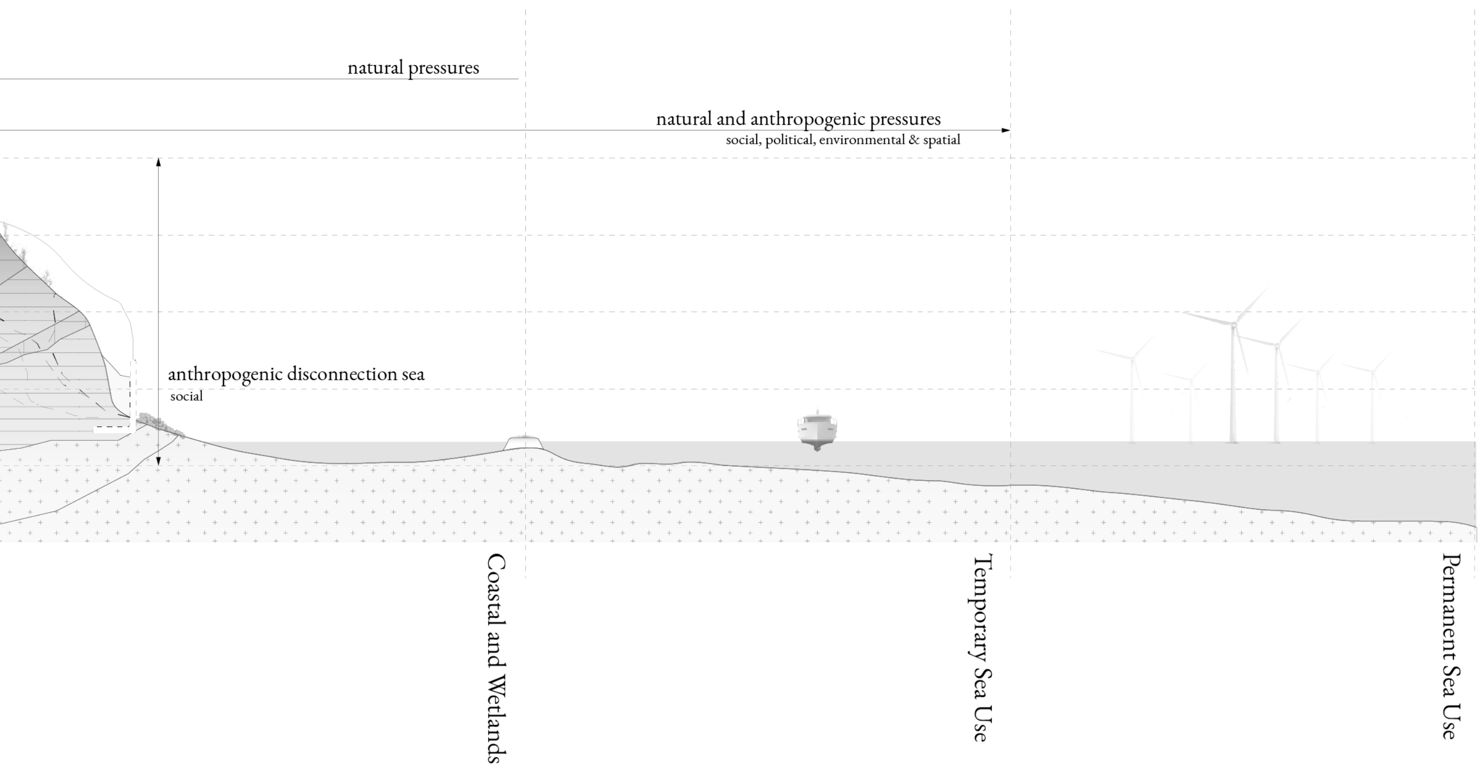
The conflicts of these pressures are often overruled by the anthropogenic landscape to provide for humans, however, this is not indefinite as the natural landscape is changing and will, eventually, take over their property. Nature has more time and energy than the government has time and money (Dornbusch, 2021).

FIGURE 19

Alteration

UK Centre for Ecology & Hydrology (2015), Natura 2000 (2020 & Maritime Archaeology Trust (2020)




natural pressures
natural and anthropogenic pressures
social, political, environmental & spatial
anthropogenic disconnection sea
social
Coastal and Wetlands
Temporary Sea Use
Permanent Sea Use

COMPOSITION OF GEOPOLITICS

In relation to geopolitics in the southeast of England, different conflicts arise. Between the anthropogenic landscape that includes urban environment and infrastructural objects, great areas of protected natural landscapes can be found. Areas of Outstanding Beauty, but also Environmentally Sensitive Areas and Heritage Coasts enclose the anthropogenic landscape and natural landscape and create geopolitical boundaries, conflicts and limits for the possibility of anthropogenic changes in the English landscape.

In the sea, protected areas also create boundaries. The Natura 2000 areas and the special protected areas both have purposes in remaining the biodiversity of the natural environment. The special protected areas have a special function in bird protection, whereas Natura 2000 focuses on more species.

In the coastal zone of the UK, and in particular southeast England, many shipwrecks can be found. Most of these shipwrecks origin from the worldwars in the early 20th century. Some of these shipwrecks are marked as protected due to their archeological, historic or artistic value (Martime Archaeology Trust (2020).

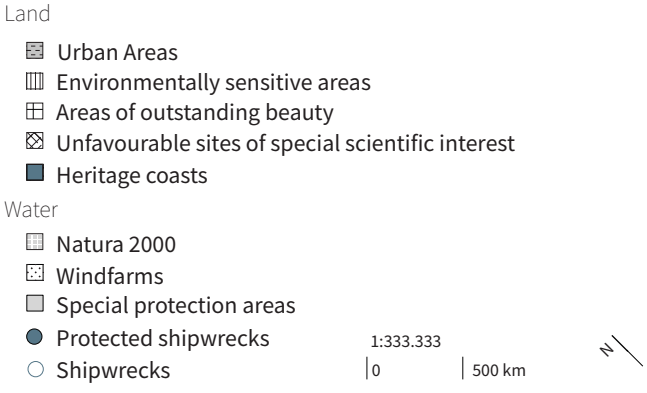
Other areas that cause geopolitical boundaries, conflicts and limtations at sea are areas identified as waste disposal areas, windfarms, oil fields, pipelines and cables of which some can be found in close distance to the shoreline of the southeast English coast along the North Sea (The Crown Estate, 2020). These boundaries are found water surface, but also in the seabed and can interfere with the natural environment, making a case for the protection of certain areas.

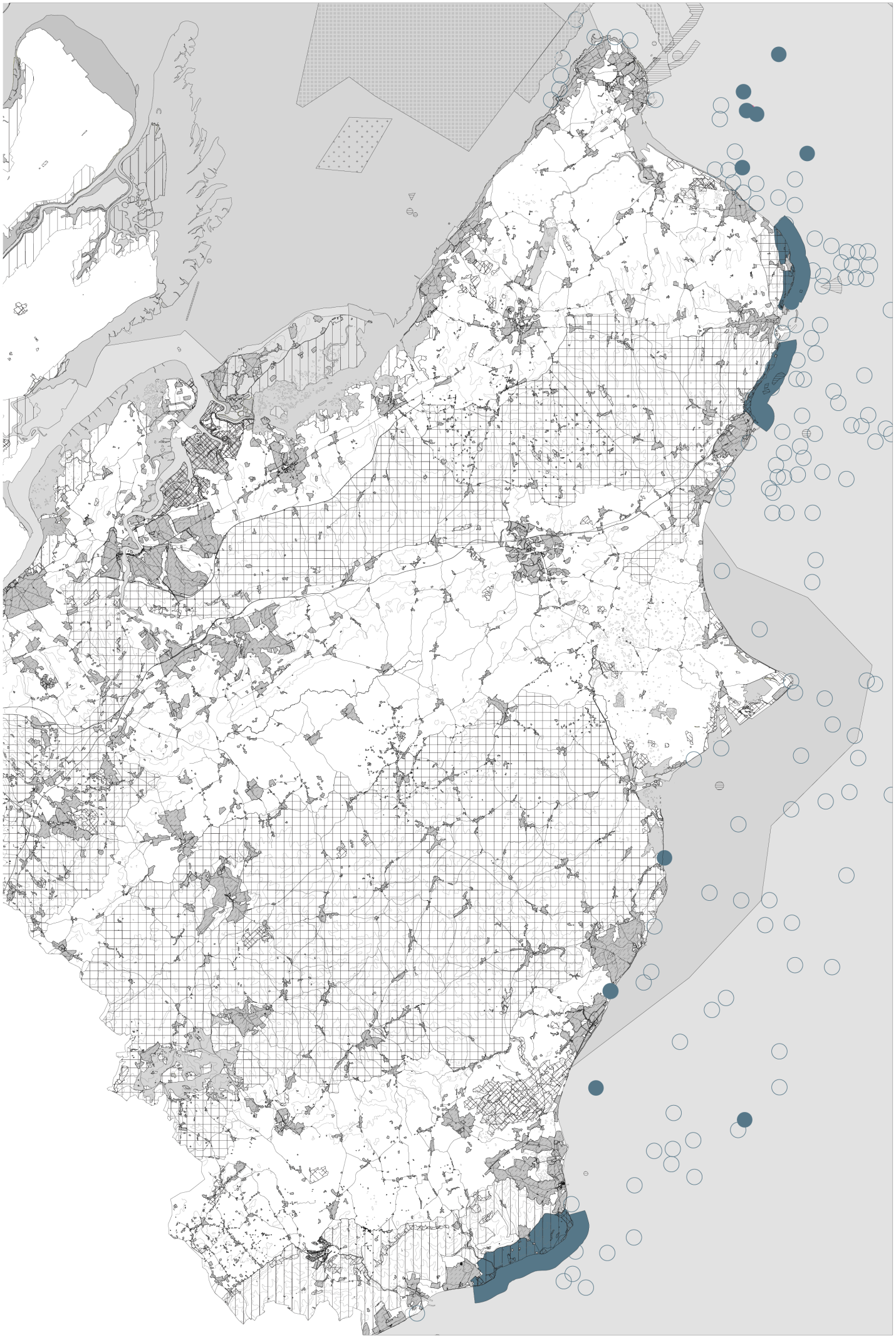
While these protected areas are defined by several organisation specialising in the preservance of natural environments, not all areas and advices are included in the governmental policies but have an advising role in the planning process, resulting in an extensive ignorance of natural and cultural values but also landscape values in relation to coastal erosion. The lack of legislation within certain areas of the geopolitical field allows for partial ignorance of this landscape and can provide opportunities for Local Planning Authorities to further ignore possible future risk environments. This lack of legislation has been an issue for decades and is the cause of the current unsustainability of coastal urban environments due to the ignorance of coastal change by Local Planning Authorities (Momber, personal communication, 2021).

FIGURE 20

Composition

Data from Data.gov.uk (2019) and Maritime Archaeology Trust (2020), Natura 2000 (2020) & The Crown Estate (2020).





2.1.2 SYNTHESIS

From the monographs can be concluded that the lines of inquiry of TOPOS and GEOPOLITICS are for the southeast of England regarding spatial planning strategies the most significant. Within TOPOS different coastal management strategies are explored together with their explicit coastal measures. Hold the Line, Advance the Line, Managed Realignment and do nothing management strategies are distributed along the coastline to deal with the impact of coastal erosion near urban environments.

Some of these management strategies correspond with their respective situation on land, for example, small urban environments in flood prone areas that adopt the Managed Realignment strategy. These urban environments will, with this strategy, eventually be relocated to a less vulnerable area further inland.

However, most of the coastline is represented by Hold the Line strategies, allowing coastal cities to grow and creating a vicious circle regarding coastal protection measures, their expenses and population growth. This vicious circle can cause coastal cities to fall into economic decline due to the lack of economic growth, which is described by The Select Committee on Regenerating Seaside Towns and Communities (2019).

Another significant line of inquiry is the GEOPOLITICAL line of inquiry, which includes protected areas such as Areas of Outstanding Beauty, Heritage Coasts and Environmentally Sensitive Areas. These areas limit the possibilities of strategies for specific coastal urban environments. An example of an urban settlement that can experience issues regarding protected areas is the city of Hastings, which is one of the bigger cities of southeast England, but is enclosed by flood prone areas and Environmentally Sensitive Areas.

Due to the lack of ability to grow, nearby settlements in, possibly, more vulnerable areas are expected to grow and create new location for urban environments that are, in the eyes of the residents, favourable to protect, distributing the issues regarding coastal erosion further along the coastline and increasing the favour to Hold the Line indefinitely.

FIGURE 21

Conclusion

Data from Data.gov.uk (2019) and Maritime Archeology Trust (2020), Natura 2000 (2020) Ruffell et al (1996), Environment Agency (2019) & The Crown Estate (2020).

- Urban Areas
- Environmentally sensitive areas
- Areas of outstanding beauty
- Heritage coasts
- Special protection areas
- Flood Prone Areas

Shoreline Management

- No Active Intervention
- Managed Realignment
- Hold the Line

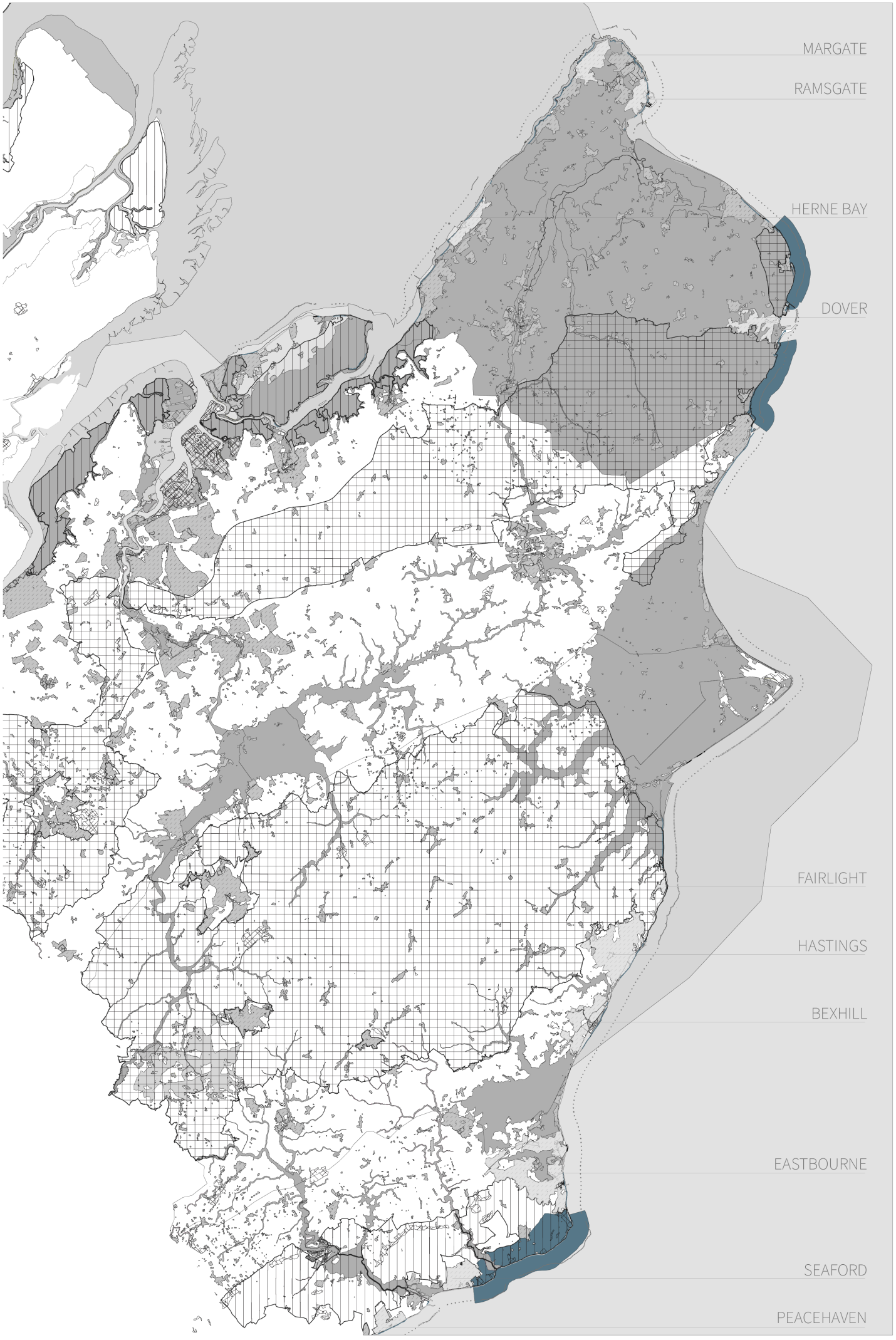
Coastal Measures

- Natural
- Sea Wall
- Embankment
- Timber

1:333.333

0 | 500 km

N


MARGATE
RAMSGATE
HERNE BAY
DOVER
FAIRLIGHT
HASTINGS
BEXHILL
EASTBOURNE
SEAFORD
PEACEHAVEN

2.1.3 MANIFESTO

From the spatial analysis can be concluded that coastal England is in need of a regional and local strategy that is in favour of its residents with the consideration of social justice rather than the current use of unsustainable SMPs.

The first step for this process is to revise the SMPs and reestablish these while taking the aim to reach long-term sustainability into account. The revised SMPs will be the foundation of the formation of regional resilience and a strategy that creates an adaptive urban system as alternative to today's reactive system. The southeast English region will adopt a system where Managed Realignment is the norm, with the exception of selected areas where a Hold the Line management will be active. This new spatial planning system will provide relocation areas beforehand to prevent climate change risks from affecting the urban environment.

Regional resilience is established through the embrace of climate change effects that include coastal erosion rather than preventing these effects and, with the implementation of social justice through spatial and environmental justice, create a sustainable urban environment. Through this embrace, adaptation of the urban environment is established.

Figure 22 is a visual representation of the concept of preventing disaster with the use of adaptation measures, rather than creating a response after it is too late.

FIGURE 22: YOUNG GIRL PULLED FROM EDGE OF UK CLIFFS (GETTY IMAGES, 2020)

FIGURE 23: CLIFFHANGER COLLAPSES, ISLE OF SHEPPEY (SWNS, 2020)

2.2 BASELINE FOR STRATEGIES

This paragraph analyses the cities along the coastline and their risks relating to the effects of climate change, with a focus on sea level rise and coastal erosion as a strategy is needed to prevent houses collapsing on the coast as in FIGURE 23.

2.2.1 CITIES AT RISK

In the southeast of England, 35 coastal cliff locations can be found (Brown et al, 2011). For this project a selection is made for coastal cliff cities located in the counties of Kent and East-Sussex that have direct boundaries along the coastline.
For this project the coastal cliff cities include:

Herne Bay, Margate, Ramsgate, Dover, Fairlight, Hastings, Bexhill-on-Sea, Eastbourne, Seaford and Peacehaven.

For the creation of a strategy the risks of these cities will be accessed through the use of the formula '*risk = <probability of adverse event> x <consequences>*' by Fraunhofer (IVAVIA, 2020). This formula considers the influences hazards, adaptivity and stress & sensitivity on the risk and vulnerabilities.

HAZARD

The hazard is defined by the effects of Climate Change that lead to coastal erosion (IPCC, 2014), which are: increase of precipitation and sea level rise and are similar for the several selected coastal cities in Kent and East-Sussex

STRESS & SENSITIVITY

The stresses and sensitivities are created by the social aspects of the residents in the city (IPCC, 2014). In this diagram these vulnerabilities are divided in the categories: population size, population growth, economic decline, cultural value and tourism dependency influenced by Vafa (2018). Additional categories are the economy sector, programme of the urban environment, economic classes and percentage of retired population.

ADAPTIVITY

The last part of the impact calculation is based on the influence of drivers that create available opportunities or challenges in adaptivity (IVAVIA, 2020).

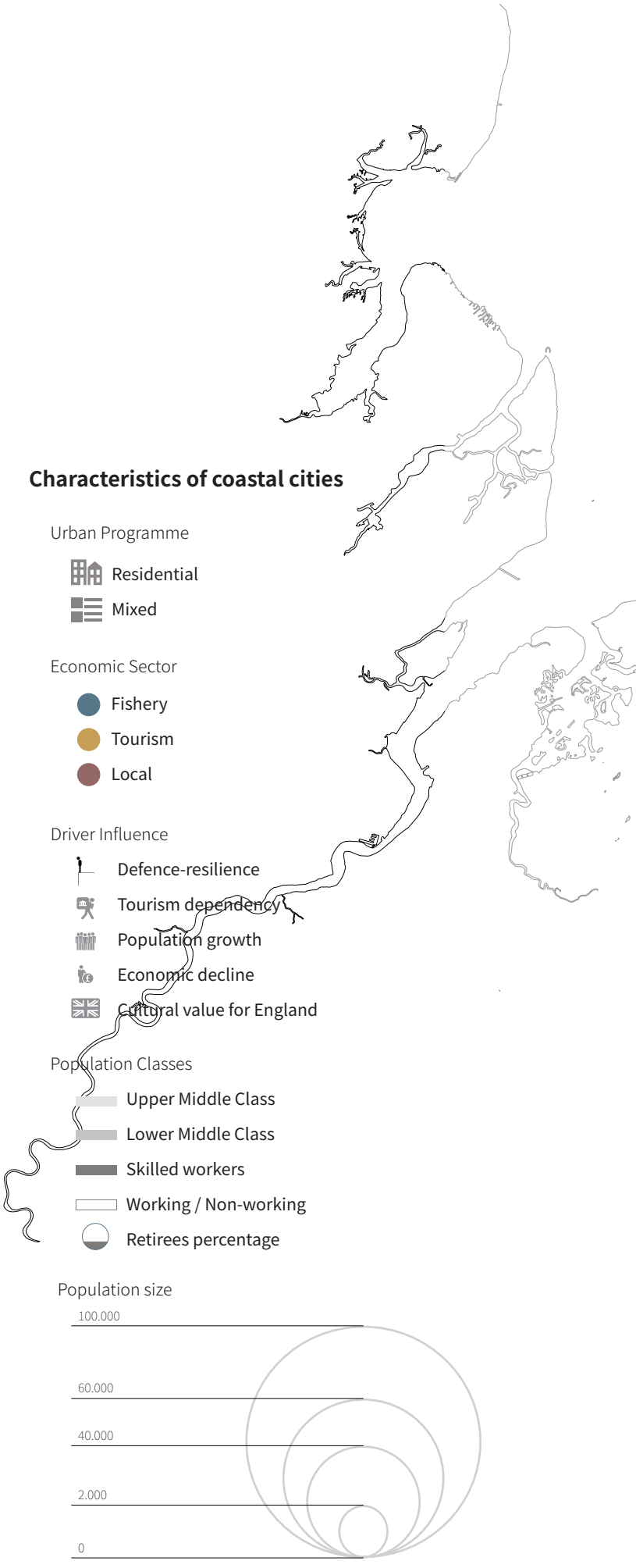
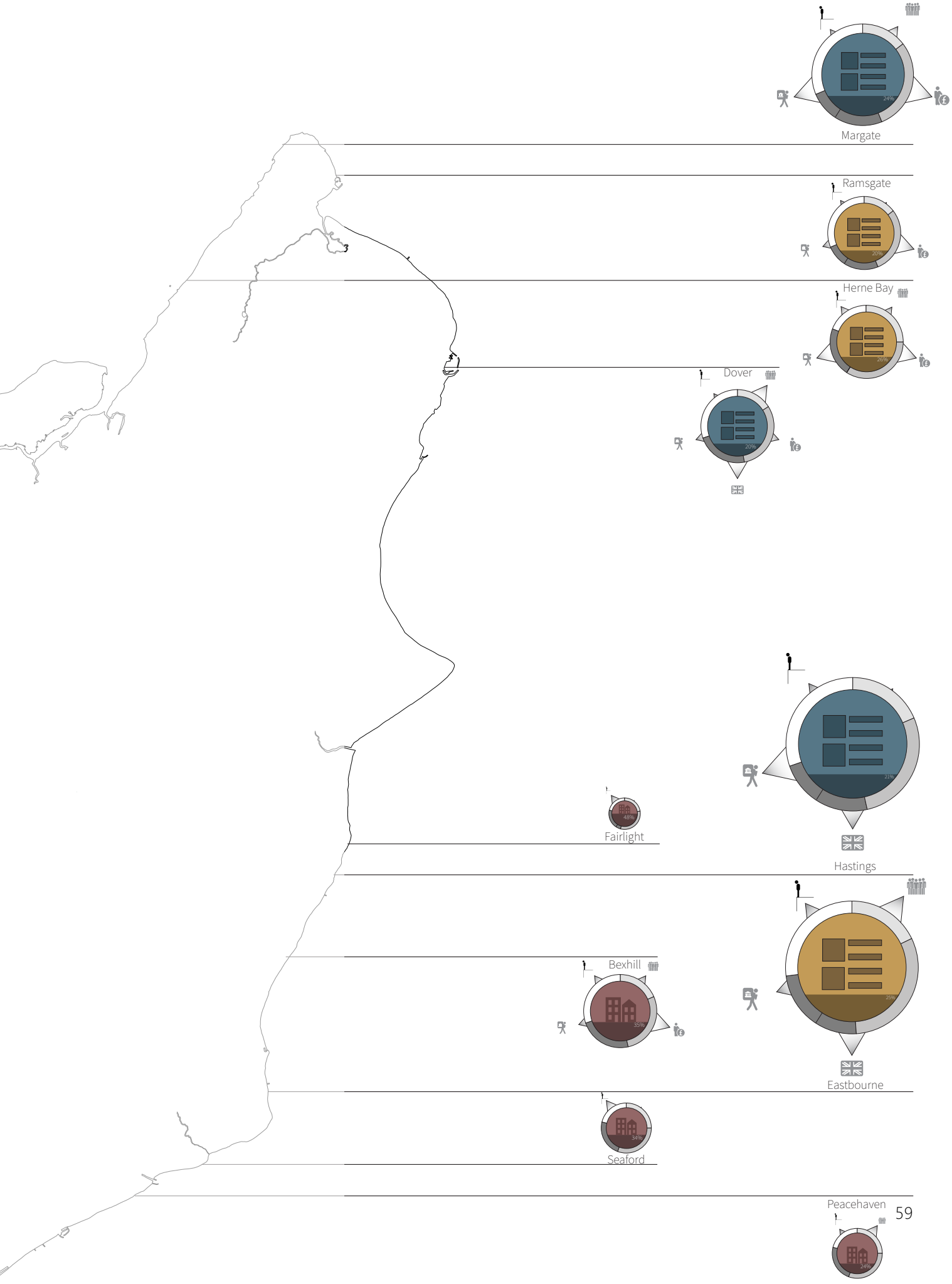


FIGURE 24

Charachteristics of coastal cities

Data from ONS.gov.uk (2017), ILiveHere UK (2017), City Population (n.d), Select Committee on Regenerating Seaside Towns and Communities (2019) & Rother District Council (2011).


Margate
Ramsgate
Herne Bay
Dover
Fairlight
Hastings
Bexhill
Eastbourne
Seaford
Peacehaven

IMPACT CHAIN

The impacts of the risk in a city are defined by the probability of the event times the consequences, where the probability is defined by the hazard and the consequences can be found in coping capacity and stress & sensitivity (Fraunhofer, n.d; IVAVIA, 2020; IPCC, 2014) .

From IVAVIA (2020), guidelines for impact and vulnerability analysis of vital infrastructures and built-up areas can be derived for the consequences of Climate Change. These guidelines are used as an example in methodology of risk assessment.

After selecting and categorizing the hazards, drivers and stressors, the impact chain can be defined and used to identify indicators of hazards, stresses, senstivities and adaptivity.

Drivers within the category of hazard, are defined in the IVAVIA guidelines (2020) as events and trends that are climate-related and have an important effect on the system causing an increased vulnerability to climate-related risk. In this project, the hazard is caused by coastal erosion, which defines the drivers as Climate Change events that increase the vulnerabilities of this hazard such as increase of precipitation and sea level rise.

IDENTIFYING INDICATORS

Indicators of adaptivity are in the IVAVIA (2020) guidelines defined as the ability of stakeholders to adress, manage and overcome adverse conditions in the shorter terms (IVAVIA, 2020; IPCC, 2014; Fraunhofer, n.d). In this project, these indicators can be defined by defence-resilience that includes the SMPs and their sustainability, but also spatial planning system that should be designed to adapt to coastal erosion.

The indicators of sensitivity and stress can be defined through direct and indirect non-climatic drivers that are an important part to the vulnerability and can increase this risk in to climate-related risk (IVAVIA, 2020; Fraunhofer 2016).

In this project these drivers and indicators lead to the exposure that includes the presence of people in areas that can are negatively affected. This exposure results in the impact that can also be referred to as consequences and outcomes that create risks, for this project the risk is defined by the current prevention of exposure that can result in a lack of social justice in the future as it is an unsustainable solution to hazards, adaptivity and stress & sensitivities.

For the risk assessment ONS (2017), ILiveHere UK (2017), CityPopulation (n.d), Select Committee on Regeneration of Seaside Towns (2019) and Communities and Rother District Council (2011) are used to provide data for the categories of defence-resilience, population, culture and economy are divided in indicators that are defined as exposure, stress & sensitivity and adaptivity.

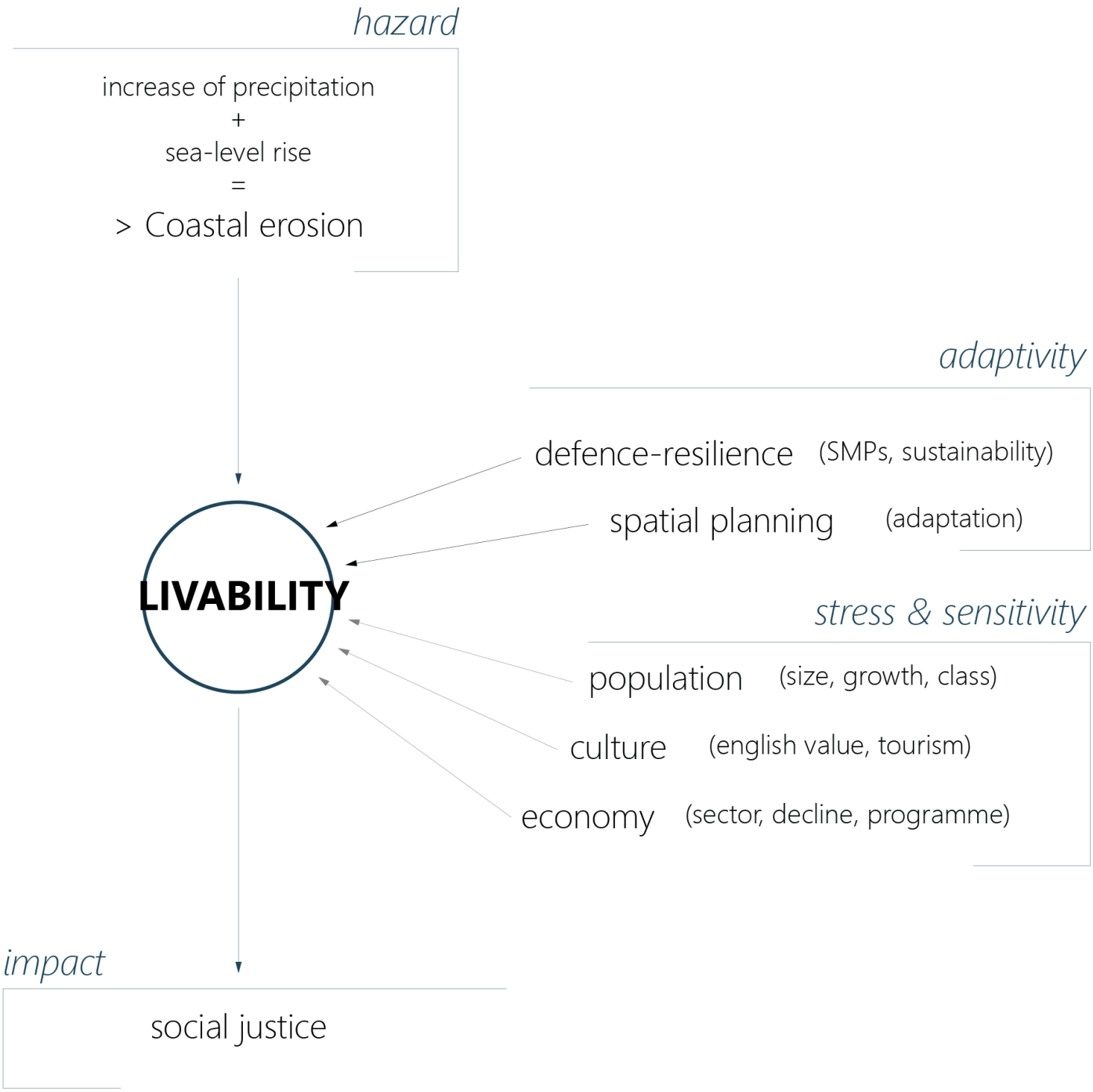


FIGURE 25: IMPACT CHAIN OF HAZARDS, COPING CAPACITY, STRESS & SENSITIVITY BASED ON IVAVIA (2020) AND IPCC (2014)

WEIGHTING INDICATORS

The identifyed indicators are each weighted from 1 to 5, where each weighting is defined from best to worst relatively in their own category.

For exposure this means that a bigger population size will create a higher exposure to the hazard of coastal erosion.

In the category of sensitivity, a big lower class population can mean that there will be a limited amount of funding for and understanding of coastal erosion resulting in higher sensitivity.
The economic sector is weighted based on the sensitivity created by their coastal location.
The urban program, only has two can only be defined in two categories which are: mixed and residential.

For adaptivity, the national cultural value, tourism dependency, coastal management, population growht and economic decline are all weighted in relation to the existing circumstances.

MEASURING RISK

As the weighting factors have been decided, the exposure, sensitivity and adaptivity can be measured in numbers. Each category forms a mean value that can be used in the conclusion of the risk assessment that calculates the total risk of the cities. In this calculation the cities with the highest exposure are: Hastings and Eastbourne, resulting from their population size.
Bexhill-on-Sea has the highest score in the category of sensitivity due to the mainly residential urban program en lower population classes.
For the adaptivity, Dover and Hastings are the least adaptive of the ten assessed coastal cities due to their dependency on tourism, cultural value, coastal management.

For this assessment can be concluded that the city that is most vulnerable within the chosen indicators to the long-term effects of coastal erosion are the cities of Bexhill-on-Sea and Hastings and are in most need of a regional strategy that can create Regional resilience with the creation of Sustainable Urban Environments.

City	Exposure	Sensitivity				
	Population	Population class	Economic Sector	Urban Program	*Mean*	Culture
Herne Bay	3	2	3	1	2	
Margate	4	4	5	1	3,3	
Ramsgate	3	4	3	1	2,6	
Dover	3	4	5	1	3,3	
Fairlight	1	2	1	5	2,6	
Hastings	5	4	5	1	3,3	
Bexhill	3	4	1	5	**3,6**	
Eastbourne	5	3	3	1	2,3	
Seaford	2	2	1	5	2,6	
Peacehaven	2	2	1	5	2,6	

Adaptivity

National Cultural Value

1 Insignificant
5 Significant

Weighting of Indicators

Exposure

Population size

1 below 5.000
2 between 5.000 and 25.000
3 between 25.000 and 50.000
4 between 50.000 and 75.000
5 between 75.000 and 100.000

Tourism Dependency

1 Small
2 Lower than average
3 Average
4 More than average
5 Large

Sensitivity

Population class

1 < 25% lower class
2 25-40% lower cl
3 40-55% lower class
4 55-65% lower class
5 > 75% lower class

Coastal Management

1 Managed Realignment
3 Do Nothing
5 Hold The Line

Growth

1 0-5%
2 5-10%
3 10-15%
4 15-20%
5 >20%

Economic Sector

1 Local
3 Tourism
5 Fishery

Urban Program

1 Mixed
5 Residential

Economic Decline

1 Small
3 Medium
5 Large

	Adaptivity					Total
	Tourism	Coast	Growth	Economic Decline	*Mean*	
1	4	3	2	5	3	*15*
1	5	5	3	5	*3,8*	*27,74*
1	2	5	1	5	*2,8*	*15,68*
5	2	5	5	3	*4*	*25,2*
1	1	1	1	1	*1*	*3,6*
5	5	5	1	3	*3,8*	*31,54*
1	2	3	2	5	*2,6*	*17,16*
5	3	3	5	1	*3,4*	*24,82*
1	1	1	1	1	*1*	*4,6*
1	1	3	4	1	*2*	*9,2*

TABLE 1: INDICATOR WEIGHTS , MEANS AND TOTAL

PRESENTING RISK

In FIGURE 26 table 1 is visualised to understand the impact of the categories on the vulnerability.

For this graph, the adaptivity category is mirrored from the calculations in table to fit this into the context of the other categories and creates an easier understanding of the relation between categories. The closer to the centre, the lower the vulnerability (-), exposure (-), sensitivity (-) or adaptivity (-).

This means that Eastbourne and Hastings experience the largest exposure while Seaford and Fairlight have the highest adaptivity mainly due to their coastal management: Managed Realignment (Environment Agency, 2020). Seaford and Fairlight can be used as an example for this project in terms of coastal management that allows them to find opportunities in adaptivity, and can, therefore, decrease the vulnerability of the coastal environments. While many cities in the southeast England region have a similar sensitivity, Bexhill-on-Sea can still be recognised as the most sensitive city in this coastal region.

The cities that need to be further assessed are the cities that include the most significant vulnerabilities and are, therefore, at most risk or a city that includes all the common characteristics of seaside towns in England. The current selection of cities is based on the presence of coastal cliffs that experience coastal retreat near urban environments (Brown et al, 2011).

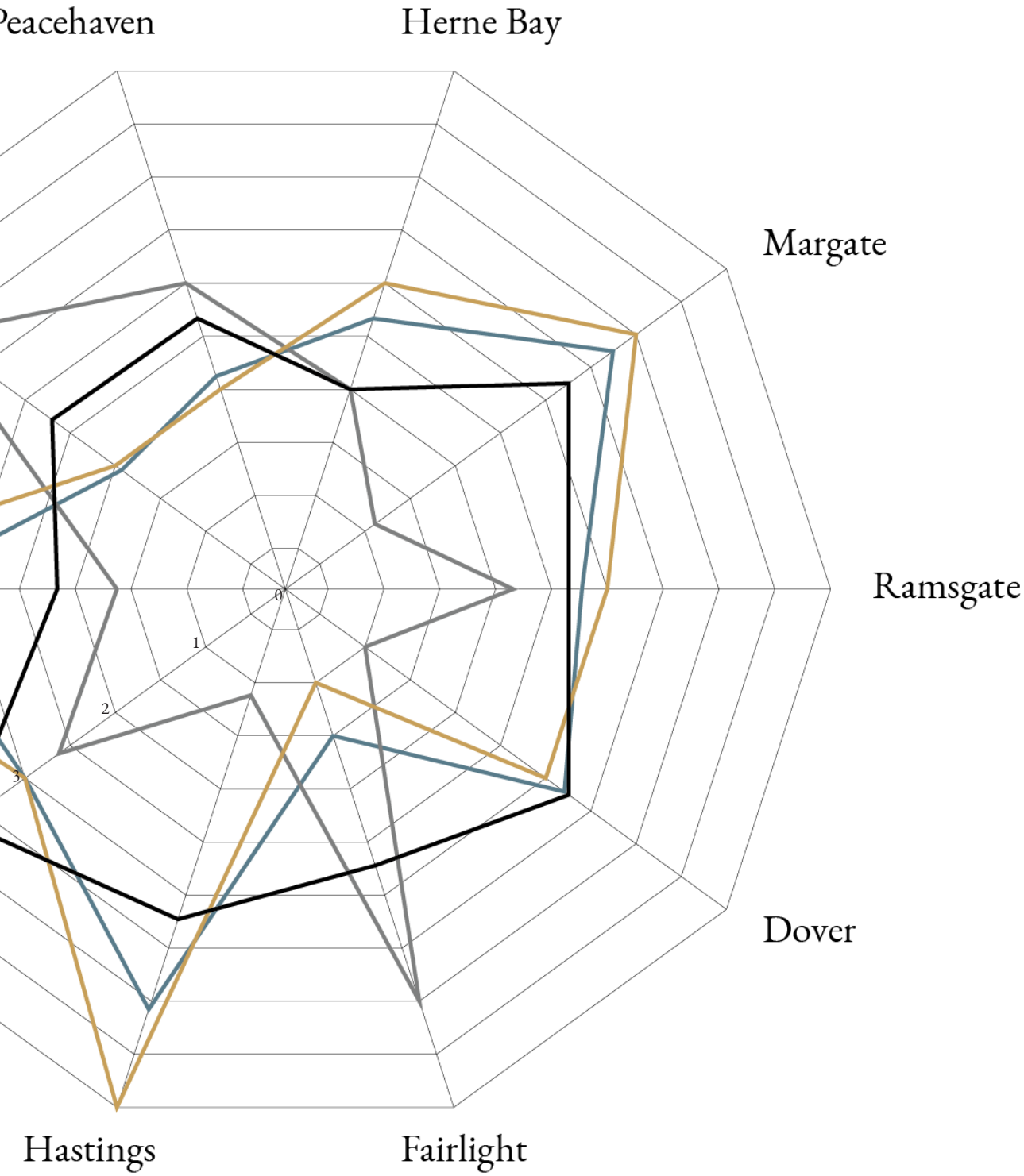
For this strategy the city of Hastings and the city of Bexhill-on-Sea has been selected as a focus for the regional strategy and urban design. For now, the most important drivers to take into account during the development of a spatial planning strategy regarding the adaption to coastal erosion are population size and defence-resilience as these heavenly impact vulnerability and cause challenges, but also opportunities for future scenarios and strategies.

FIGURE 26

Presenting Risk for Coastal Cities

Based on Fraunhofer (n.d), IVAVIA (2020), IPCC (2014)

- Adaptivity
- Sensitivity
- Exposure
- Vulnerability


Peacehaven
Herne Bay
Margate
Ramsgate
Dover
Fairlight
Hastings
0
1
2
3

2.2.2 EXPLORATION OF SCENARIOS

With the use of the risk assessment in FIGURE 26, the cities that are most at risk can be selected and used for an adaption strategy and small-scale design. The city of Bexhill-on-Sea is defined as a city that is at high risk due to their economic and social status (ONS, 2017; Rother District Council, 2011). The population is growing, but the partly tourism dependent economy is in decline and the cultural value of the city to England is insignificant. Today's Bexhill-on-Sea can be defined as residential city that depends on local services for its economy (Rother District Council, 2011). Around 35% of the residents finds themselves in an age group above 65 years (ILiveHere UK, 2017). Compared to the other coastal cities this is relatively high (ONS, 2017; ILiveHere UK, 2017).

Bexhill-on-Sea can be an example for the implementation of a response strategy. The strategies defined by the Environment Agency are to prevent, adapt or embrace the effects of coastal erosion (DEFRA, 2001; Environment Agency, 2021; Dronkers et al, 1990). Prevention and adaptation include measures to maintain the urban environment on the current location with the use of coastal measures or erosion-proof housing. Embracing the effects of coastal erosion is based on the acceptation of these effects. Urban retreat and do nothing can both facilitate this embrace. However, urban retreat is focused on both the urban environment and the natural environment whereas do nothing is essentially focused on the natural environment (DEFRA, 2001; Dronkers et al, 1990).

For the city of Bexhill-on-Sea the possible spatial effects of the strategies retreat, do nothing, protect and accommodate are explored in a scenario, defined by IPPC (1994) through the method of research by design to understand complications and opportunities within the use of these scenarios and the development of a regional and national strategy for the coastal zone of Southeast England.

URBAN RETREAT

In FIGURE 27 the city of Bexhill-on-Sea is designed as a fully retreating city. This extreme way of retreating can cause complications outside the city boundaries. The buildings that are now outside the city boundaries have to be integrated into new plans of relocation with a place in the city or compromised with possibilities to move inland.

Another option for retreat is to find locations that are empty open spaces along the city boundaries. These new locations should have a significant distance from the current coastline to create a long-term solution.

During expansion or densification of a city due to the desired population and economic growth these areas should be left clear of new development until the time has come to retreat. Coastal zones will each have their respective areas to relocate to when the coastal erosion is reaching their part of urbanisation.

DO NOTHING

A Do Nothing strategy is a strategy without any anthropogenic interaction. This means that the city is left down to its own devices. It could also mean that the residents decide to leave the town at their own initiative before their properties are wiped away due to the effects of coastal erosion.

The coastline of the city will slowly be abandoned and the natural environment will rehabit the coastal zone.

FIGURE 27: TWO TYPES OF SCENARIO'S FOR BEXHILL-ON-SEA WITH IMPLEMENTATION OF THE STRATEGY OF URBAN RETREAT

FIGURE 28: SCENARIO FOR BEXHILL-ON-SEA WITH IMPLEMENTATION OF THE STRATEGY OF DO NOTHING

PROTECT

Another strategy is the protect strategy where the city of Bexhill-on-Sea would be protected from coastal erosion by coastal prevention measures with the SMP Hold the line.

Protection of the coastline in Bexhill-on-Sea will result to a growth in population in this city, resulting in urbanisation and an increasing need for protection measures (Neumann et al, 2015). Meanwhile coastal areas near the protection measures will experience accelerated erosion rates dus to the change of longshore sediment transport (Bray and Hooke, 1997). In an extreme situation this could lead to island-forming in Bexhill-on-Sea. From this strategy can be concluded that there is a need for limiting coastal protection measures and coastal city growth.

ACCOMMODATE

The last strategy accommodates the buildings to coastal erosion effects, where an option would be to built erosion-proof housing as shown in FIGURE 31.

This solution can be a very expensive solution and creates complications in terms of accessibility, but also in the desired safety standards for residents (Elam and Björdal, 2020).

SELECTION OF SCENARIOS

In the design examples for the city of Bexhill-on-Sea, the different scenario's are exaggerated to create a sense of understanding for the different strategies. Due to exaggeration of these four strategies, the consequences and feasibility for future interventions is assessed.

Where Managed Retreat can cause issues with relocation due to the many geopolitical boundaries, preventing coastal erosion effects with the use of protection measures can cause complications related to future island-forming and ongoing financial issues. Accommodating to coastal erosion effects with erosion-proof housing can expand the living environment. This option will, however, decrease accessibility significantly, increase vulnerability at sea and increase financial pressures. Embracing the issues with a do nothing strategy is the easiest and cheapest solution for governments, leading to a socially unjust system.

The importance of finding a balance between the urban and natural environment is considered with its challenges and opportunities during strategy making that include social justice in terms of spatial and environmental justice, and therefore, lead to the choice for an embracing strategy of retreat is explored in this project.

FIGURE 29: SCENARIO FOR BEXHILL-ON-SEA WITH IMPLEMENTATION OF THE STRATEGY OF PROTECT

FIGURE 30: SCENARIO FOR BEXHILL-ON-SEA WITH IMPLEMENTATION OF THE STRATEGY OF ACCOMMODATE

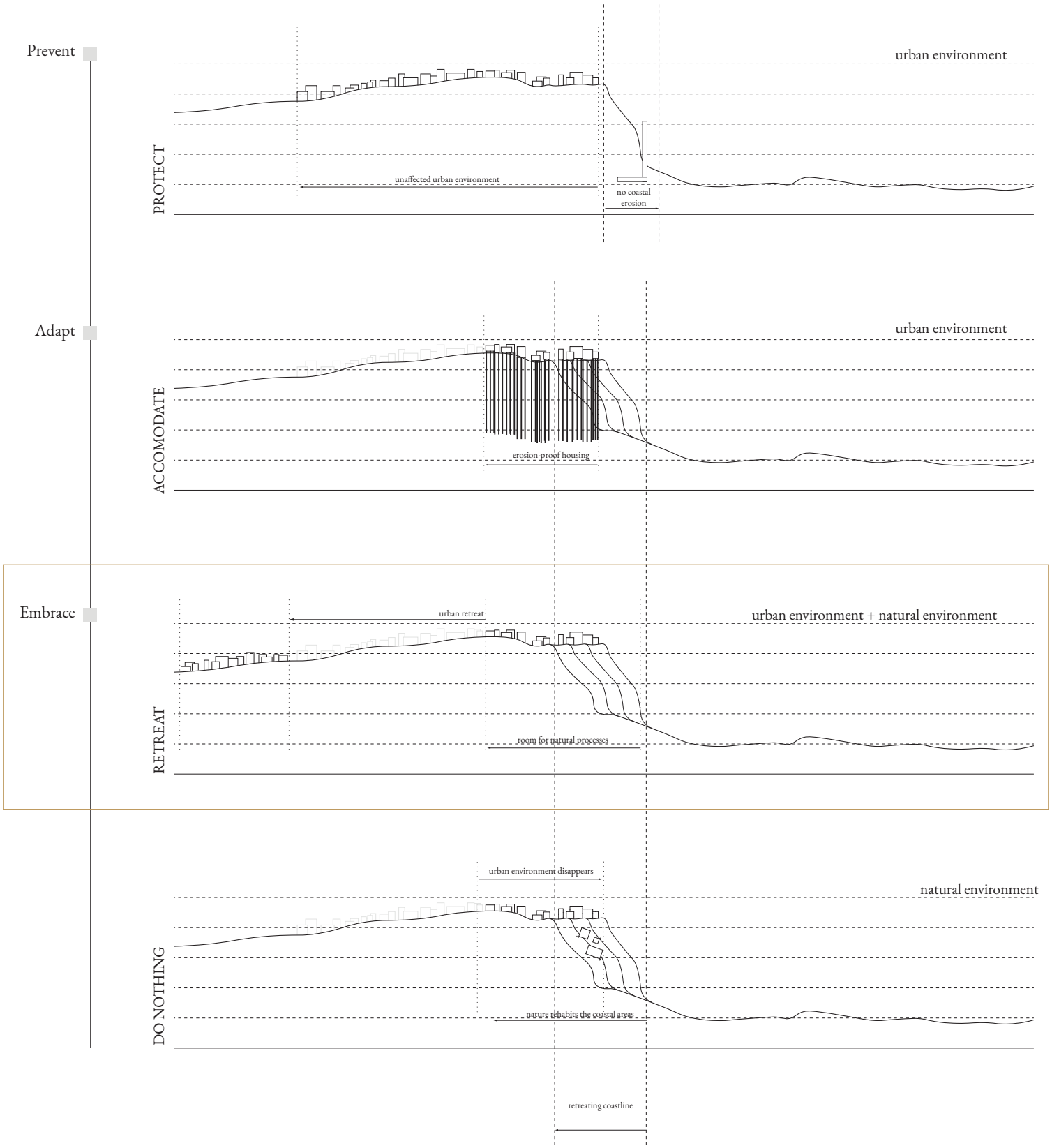


FIGURE 31: SECTIONS OF THE SCENARIO'S FOR BEXHILL-ON-SEA WITH IMPLEMENTATION OF THE FOUR STRATEGIES BASED ON DRONKERS ET AL (1990)

2.2.3 STAKEHOLDERS

ACTIONS

As this project aims to increase collaborations between national, regional and local scales, part of the focus lies on the issues within the lack of communication between stakeholders. Stakeholders have a significant role on the outcomes of this project, which is why their actions, engagement and attitude are assessed in the path to the selection of a strategy.

In TABLE 2 (APPENDIX), the stakeholders are categorised in organisational stakeholders •, local stakeholders • and wider stakeholders •, where organisational stakeholders are defined as stakeholders groups that are related to planning with coastal erosion. These organisational stakeholders can also be defined as most desired stakeholders as they can provide a collaboration between planning authorities and authorities of coastal erosion management.
The Local Stakeholder Group includes stakeholders that have influences on planning decisions in the local scales of the urban environment. In this Local Stakeholder Group, the Local Planning Authorities are the authorities with most power in terms of urban planning. As discussed in 2.0.1 THE ENGLISH PLANNING SYSTEM, this planning system focuses on local planning rather than regional planning causing issues in topics related to sustainability.

The third category of stakeholders can be defined as wider stakeholders. These wider stakeholders work on national and regional scales and are often less interested in small scale interventions. For this project, these stakeholders are needed to include the regional scale in the planning system.

In TABLE 2 (APPENDIX) the actions of the stakeholder groups are defined that are for many unrelated to coastal erosion. The lack for attention for coastal erosion and other climate change effects is caused by the lack of duty to provide protection or right to be protected (Dornbusch, personal communication, 2021), resulting in residents making their own decisions in terms of adaptation to coastal erosion.

POWER INTEREST AND COLLABORATION

Changing attitudes of stakeholders can shift power and interests in the expected diagram in FIGURE 32. In the model Local Planning Authorities have high power and interests in the planning system, however they lack collaboration with larger scales on matters relating to climate change and climate change effects that include coastal erosion.

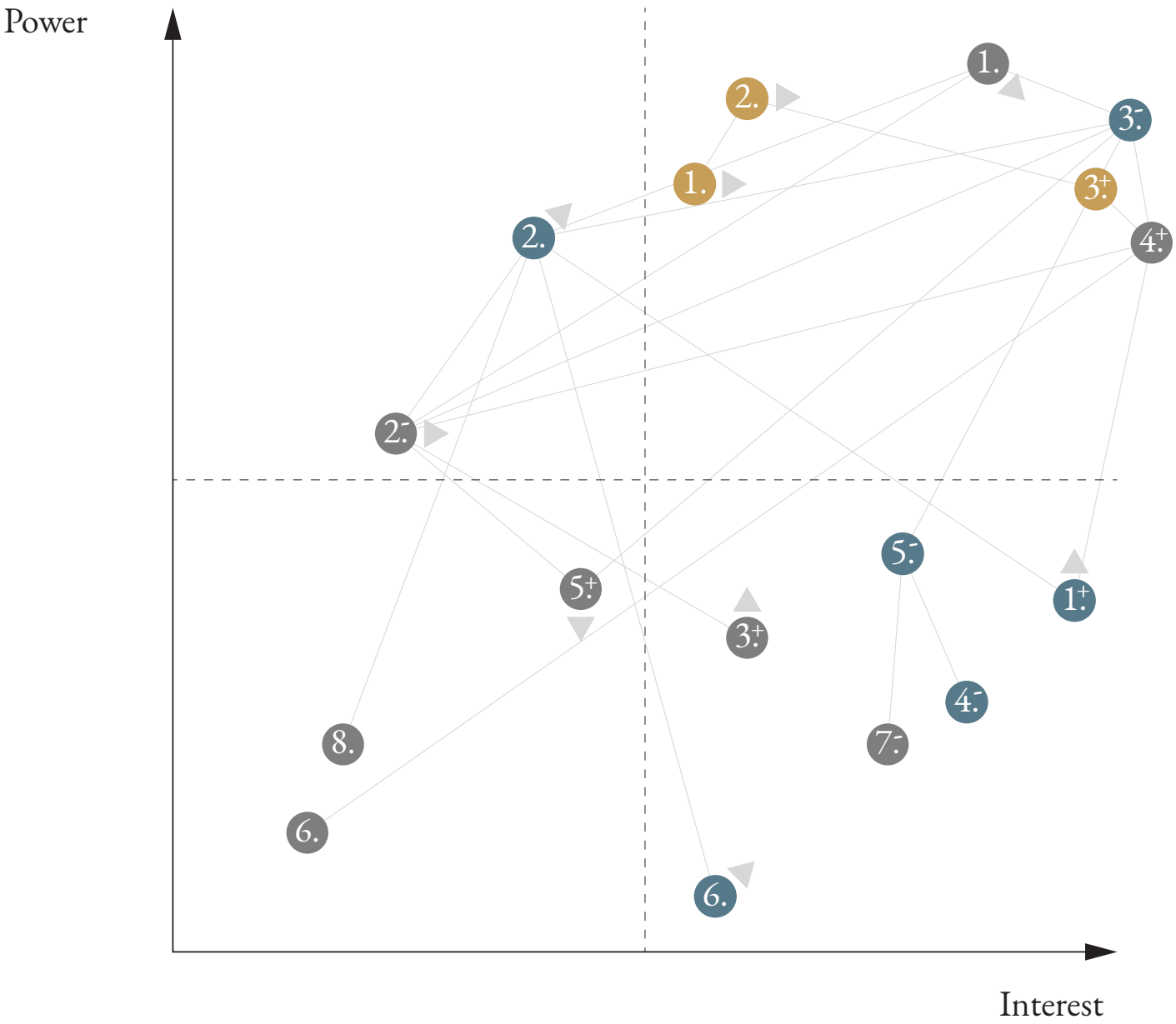
Local authorities only collaborate within the 'Duty to Coorperate'-policy as explained in 2.0.1 THE ENGLISH SPATIAL PLANNING SYSTEM, where in practice the main focus lies on locations for the construction of housing. Which is a reason to aim for change of policies to provide a foundation for a desired shift in power and interests and collaboration that aims to increase sustainability in the urban environment through strategizing collaborations and attitudes on a regional scale or even a national scale.

FIGURE 32

Stakeholders' Powers and Interests, Attitude Desired Shifts and Collaboration

1. Managing Authorities of Coastal Erosion
2. Planning Commitee Spatial Planning
3. Public Authorities Coastal Planning
1. Knowledge Providers - Scientists
2. County Council Planning Authority
3. Local Planning Authorities
4. Business Sector
5. Landowners & Developers
6. Service Providers
1. Ministry of Housing, Communities and Local Government
2. National & EU Policy Makers
3. Directorate General Environment European Commission
4. DEFRA & EA
5. English Heritage Trust
6. Marine Management Organisation
7. British Property Federation
8. Infrastructure and Projects Authority

\+ Postive attitude
\- Negative attitude


Power
1.
2.
3-
1.
3+
2.
4+
2-
5+
3+
5-
1+
4-
8.
7-
6.
6.
Interest

ATTITUDE AND CHANGE

The main profiles explain how stakeholders can have negative attitudes towards spatial plans impacting their living and work environment with actions to engage. Negative attitude stakeholders should, before the project starts, undergo a change of attitude to create positive participation.

The change from negative to positive attitudes is explained in TABLE 4 (APPENDIX) and is expected to be heavily influenced through information distribution and the creation of knowledge within stakeholder groups about coastal erosion effects, but also about choices that can be made by different stakeholders regarding environmental risks.

With the engagement of stakeholders within the planning process decisions can be made in the stakeholder group and create understanding for planning processes that consider coastal erosion effects. The project aims to respect and include stakeholder opinions to create compromises and find solutions to satisfy the different stakeholders.

ENGAGEMENT

The actions of the stakeholder groups influence their actions to engage, resulting in an engagement model whereafter the stakeholders their main profile can be defined.

From FIGURE 33, can be derived that the main profiles of the wider scale planning authorities are currently defined as influential sleeping giants, these stakeholders are relied on for co-creation and partnerships.

For this project, there are stakeholders with possible negative impacts, however their actions are still needed for partnerships or co-creation. The most important stakeholders are the National and EU policy-makers, the Local Planning Authorities, DEFRA & Environment Agency and the landowners and developers that should find partnerships and collaborations to create positive attitudes about the establishment of a sustainable urban environment that satifies most to all stakeholders.

To acquire these collaborations and partnerships, a change in attitude is needed through the use of compromises, the creation of opportunities and distribution of knowledge.
These tools help to interrupt the current negative chains of impact by negative influential stakeholders to other stakeholders and alter these attitudes to positive attitudes.

For this project a shift in stakeholder dynamics is needed with the introduction of the regional scale. Stakeholders are engaged to co-create and involved in partnerships with the formation of positive attitudes about social sustainability to achieve social and environmental justice and increase the livability in the coastal environment.

FIGURE 33

Stakeholders' Actions to Engage, Main Profiles and Influences

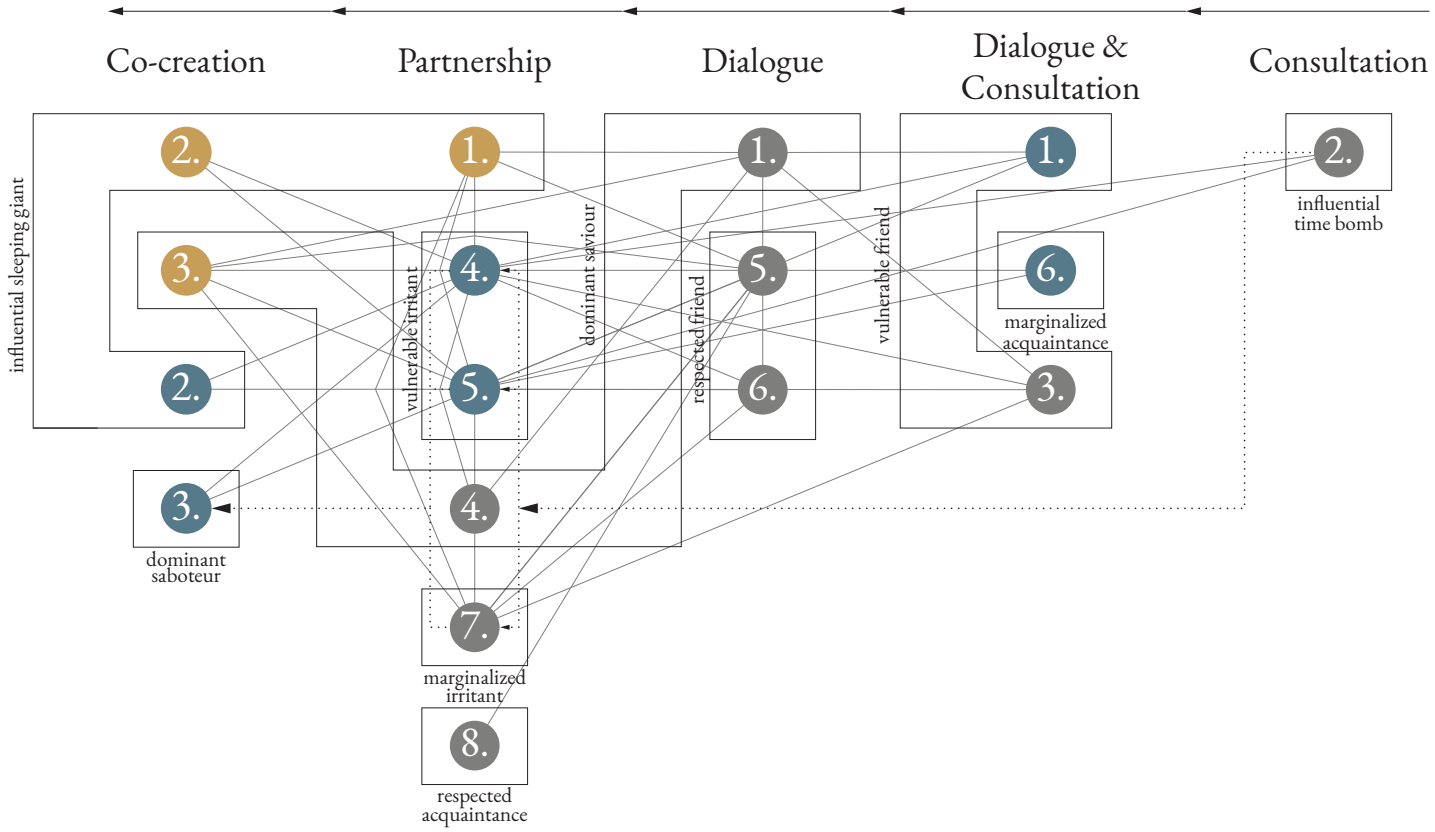

Co-creation
Partnership
Dialogue
Dialogue & Consultation
Consultation
influential sleeping giant
2.
3.
2.
3.
dominant saboteur
1.
4.
5.
4.
7.
marginalized irritant
8.
respected acquaintance
vulnerable irritant
dominant saviour
1.
5.
6.
respected friend
vulnerable friend
1.
6.
marginalized acquaintance
3.
2.
influential time bomb

FIGURE 34: CHALK CLIFFS SEVEN SISTERS, HAMLET (PLATT KENDALL, N.D)

3 STRATEGY & DESIGN

Chapter 3 describes a long-term regional strategy for the southeast English coastal cities to adapt to the effects of climate change that include coastal erosion and sea level rise causing risk for urban environments (FIGURE 34). This chapter zooms in on two locations to show the small scale effects of this strategy in a design.

3.1.1 REGIONAL STRATEGY

SYSTEM

The regional strategy informs the English spatial planning system and aims to create a sustainable region to climate change effects, in particular coastal erosion.

The spatial planning strategy for coastal Southeast England is derived from the Dutch 'Verstedelijkingsnota' (Ministerie van Volkshuisvesting en Ruimtelijke Ordening (MVRO), 1977), where 'groeikernen' en 'groeisteden' are appointed to control urban growth in the region with the use of an hierarchy, deconcentration, densification and phasing.

DEFINE HIERARCHY

The use of the Verstedelijkingsnota as a guideline with the introduction of a Regional Coastal Planning Group pressures the need to define hierarchy in the region. In this region, the cities with most cultural national value, financial resources and need for regeneration resulting from the risk assessment, Hastings and Dover, are selected as growth cities (groeisteden). Inland cities are selected as growth centres (groeikernen) based on their respective locations from coastal cities, but also from the coastline.

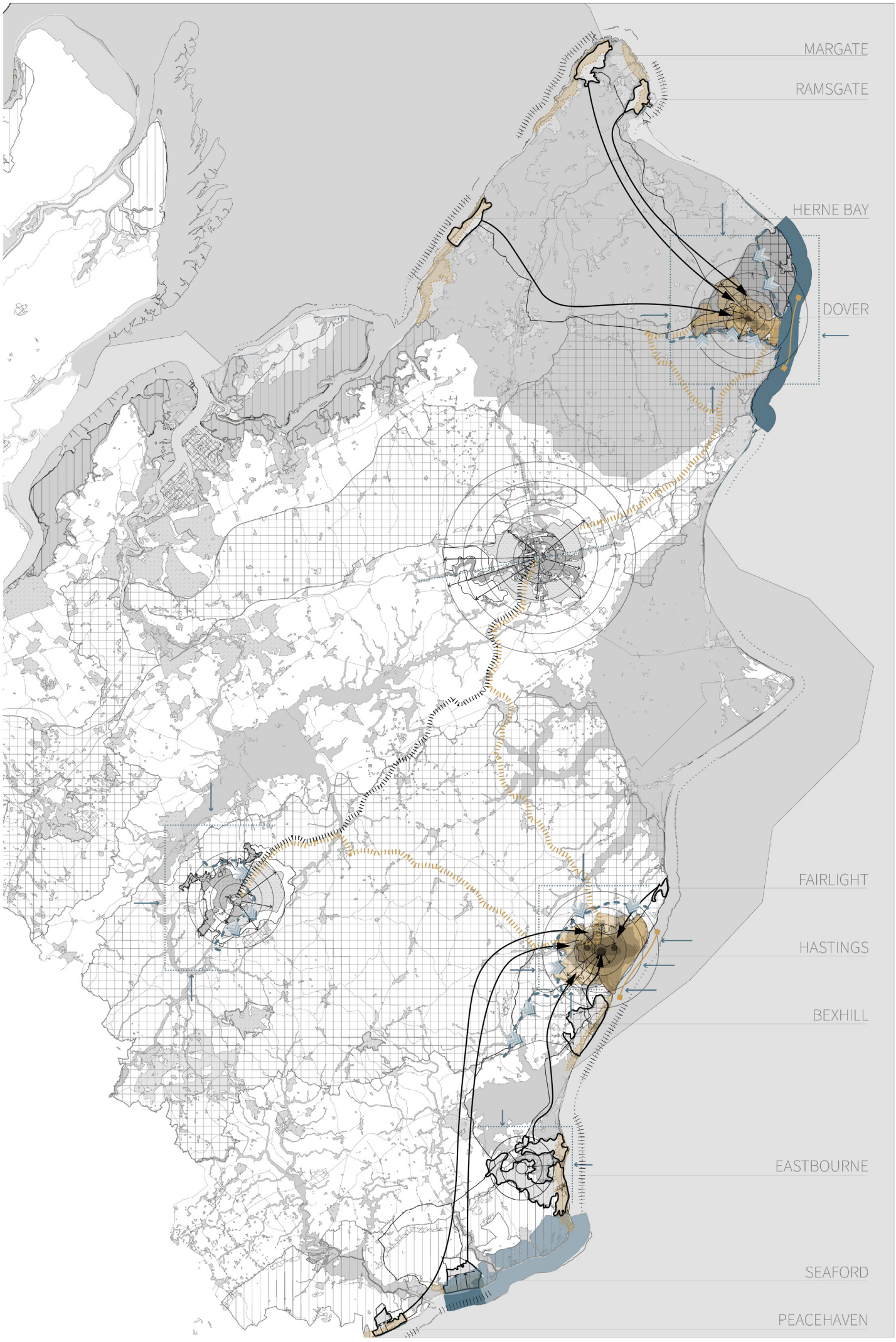
For this region Ashford and Turnbridge Wells have been selected as growth centres due to their locations, growth patterns, and accessibility from coastal regions. While Ashford and Turnbridge Wells both have natural and geopolitical boundaries that can limit urban development, these locations and low vulnerabilities of these cities provide for a strong foundation in this long-term strategy as growth centres. Inland growth centres aim to densify in the long-term to provide for deconcentration or shrinkage in other coastal locations in the region to limit urban climate change effects. The need for these cities to be defined during an early phase of strategizing can influence certain decision-making in other phases.

FIGURE 35

Regional Adaptive Spatial Planning Strategy for Southeast England

- Migration flows
- Managed Realignment strategy
- Hold the Line strategy
- Geopolitical boundaries
- Pressure by geopolitical boundaries
- Pressure by natural processes
- Limits of natural pressure
- Secondary migration flows
- Tertiary migration flows
- Direction of shrinkage / growth
- Urban environment
- Densification locations
- Coastal Change Management Areas
- Heritage coasts
- Cities planning for shrinkage

1:333.333
0 | 10 km
N


MARGATE
RAMSGATE
HERNE BAY
DOVER
FAIRLIGHT
HASTINGS
BEXHILL
EASTBOURNE
SEAFORD
PEACEHAVEN

In this new hierarchy, a third type of city is introduced, which is the city planning for shrinkage. Cities planning for shrinkage, are coastal urban environments that are cities that are sensitive to coastal erosion and are in need of strategic urban planning solutions to provide a livable environment for their residents. Currently, the English spatial planning system is focused on Local Planning causing small cities councils and their planning authorities in collaboration with residents to design their living environments without considering the larger scale effects and inevitable knock-on effects that influence the coastal ecological systems (NPPF, 2019). Not only their planning individuality can be considered a problem, but also the rising populations in these coastal cities that originate from the assumptions that these cities will be protected against urban climate change effects (Alexander et al, 2012). The aim for the introduction of the definition of an hierarchy is to limit issues regarding the urban environment and prevent the formation of a vicious process of urban growth resulting in increased risk as a result of poor local planning decisions.

DECONCENTRATION

The deconcentration model is inspired by a statement by Dornbusch (2021) from the Environment Agency that there is, in coastal England, no duty to provide protection and there is no right to be protected from climate change effects that include coastal erosion. This means that individual residents are expected to protect themselves from these effects by either moving away or implementing unprofessional protection measures, where the latter has little probability in the outcome of a sustainable solution considering the small scale and the individuality of the protection infrastructures (Tyler & Moench 2012). This is why current coastal management with a Hold the Line strategy can be considered unsustainable. This can be solved with decreasing the range of areas in need of coastal protection through change of coastal policies that limit urban development and encourage urban shrinkage along the southeast English coast.

DENSIFICATION

To provide for shrinkage in coastal cities, locations for urban development need to be appointed (MVRO, 1977). Both growth centres and growth cities are selected to densify to inhabit former residents of cities planning for shrinkage. This densification should lead to the regeneration of current deprived areas and limit city expansion outside current city boundaries.

PHASES OF THE STRATEGY

The regional strategy is a long-term strategy that is in need of a phasing. The phasing creates an order in the deconcentration and densification process and engages stakeholders and local residents for participation in the process to find a suitable location for relocation. Ongoing phases of stakeholder engagement, policy change, regeneration and relocation are needed to achieve completion of the strategy.

THE STRATEGY

In this strategy introduction the Regional Coastal Planning Group, defining a hierarchy and defining locations of deconcentration and densification while considering natural and geopolitical limits are proposals to create a long-term and sustainable urban environment. The aim for implementing these proposals is expected to be achieved through the principles of bundling of activities, introduction of ecological zones to shrinking cities, residential regeneration and economic diversification (MVRO, 1977; NPPF (2019). Locations of densification, Hastings and Dover, should be strenghtened by increasing accessibility and urban development, which is also desired for inland cores of growth, which are, in for this region, Ashford and Royal Tunbridge Wells.

POLICY CHANGES

THE REGIONAL STRATEGY PROVIDES PROPOSALS FOR POLICY CHANGES THAT ARE ALL IN FAVOR OF THE CREATION OF A SUSTAINABLE URBAN ENVIRONMENT IN THE REGION OF COASTAL SOUTHEAST ENGLAND.

1. REINTRODUCE REGIONAL SCALE WITH THE REGIONAL COASTAL PLANNING GROUP AS PLANNING AUTHORITY TO THE ENGLISH PLANNING SYSTEM TO ACHIEVE REGIONAL RESILIENCY IN A STRATEGY AND TO FORCE COLLABORATIONS BETWEEN LOCAL PLANNING AUTHORITIES ON TOPICS REGARDING SUSTAINABILITY

2. REVISE SHORELINE MANAGEMENT PLANS (SMPS) TO REALISTIC PLANS, INCLUDING COASTAL CHANGE MANAGEMENT AREAS, WITH KNOWLEDGE OF PROFESSIONALS

3. INTRODUCE A BUY-TO-RENT SCHEME TO THE CITIES PLANNING FOR SHRINKAGE AS COMPENSATION AND FUNDING OF A MANAGED REALIGNMENT STRATEGY IN COASTAL CHANGE MANAGEMENT AREAS

4. DEFINE AN HIERARCHY BETWEEN CITIES WITH GROWTH CITIES, GROWTH CENTRES AND CITIES PLANNING FOR SHRINKAGE TO PRESSURE THE ESTABLISHMENT REGIONAL RESILIENCY

5. EXTEND LONG-TERM PLANNING FROM A MINIMUM OF 15 YEARS TO A MINIMUM OF 50 YEARS, WHERE (SHORT-TERM) LOCAL PLANS SHOULD FIT INTO THE VISION OF THE LONG-TERM REGIONAL PLANS

6. ENFORCE NO-BUILT ZONES IN CITIES PLANNING FOR SHRINKAGE WITH THE AIM TO CREATE ECOLOGICAL COASTAL ZONES THAT SUPPORT A NATURAL COAST

7. PRIORITIZE RESIDENTS OF CITIES PLANNING FOR SHRINKAGE OVER INLAND RESIDENTS FOR THE PURCHASE OF RESIDENCES IN DENSIFICATION CENTRES, FACILITATED BY THE CITY COUNCIL

8. RESTRICTIONS ON BUILDING, RENOVATIONS AND BUILDING MATERIALS ENFORCING CIRCULAR URBAN DEVELOPMENT IN RELATION TO FUTURE FLEXIBILITY IN ADAPTING TO THE EFFECTS OF COASTAL EROSION IN FUTURE RISK ZONES SELECTED FOR RELOCATION

QUALITY

For the regional strategy to work as a well-functioning system a qualitative dimension is established that is created as a vision of additional qualities to the existing area with the implementation of the regional strategy with the aim to avoid social risks and abandonment. This qualitative design is implemented on an intermediate scale along coastal urban environments and shows the interaction between these environments in terms of quality. In a relocation strategy, the focus should lie on both the area of relocation and the area that relocates to, in this project, these areas can be defined as the densification areas and the areas planning for shrinkage where limits are defined through natural and geopolitical boundaries. Boundaries include protected areas, flood alert areas and the retreating coastline. These boundaries can influence the qualities of the coastal natural and urban environment through forms of coastal squeeze where possibilities to add quality decrease.

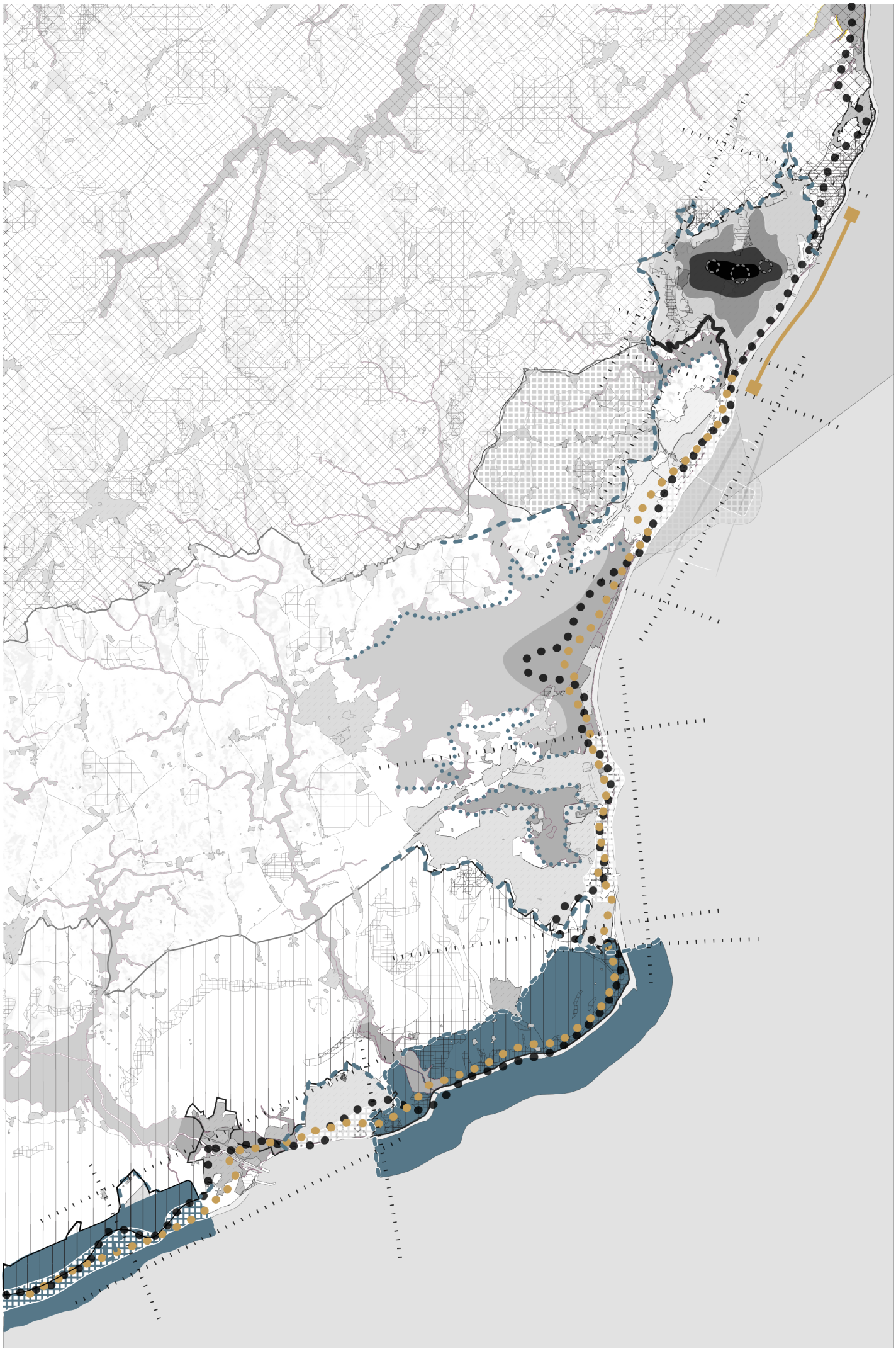
The qualitative dimension focuses on restoring nature while promoting small scale tourism that allows the seascape identity to remain with minimal disturbance (MMO, 2020). This dimension can also have a role in creating awareness of climate change effects by creating accessible coastal environments (MMO, 2020) by implementing the Coastal Path (Natural England, 2021) and landmarks that show coastal change. Restored nature can provide a nexus between resilient, adaptive environment and ecosystem services with the use of natural erosion delayers and ecological zones (Haase et al, 2014). Additional, the small scale tourism in combination with both coastal deconcentration and densification can increase economic value of both the cities planning for shrinkage as well as the growth cities due to their collaboration and reduced need for coastal protection measures (Tyler & Moench, 2012) .
The qualitative design aims to create a vision about the additional qualities of the regional strategy to achieve regional resilience and a sustainable urban environment.

FIGURE 36

Regional Adaptive Spatial Planning Strategy for Southeast England

- Seascape identity
- Ecological zones
- Heritage coasts
- Flood prone coast
- Densification
- Retreating coastline
- Coastal path
- Pressure geopolitical boundaries
- Limits of pressure
- Pressure natural boundaries
- Pressure urban boundaries
- Hold the Line strategy
- Densification centres

1:200.000
0
5 km
N



3.1.2 LOCAL STRATEGY

SPACE

In a local scale that includes the cities of Bexhill-on-Sea and Hastings, Bexhill-on-Sea can be identified as a city planning for shrinkage due to the urban risks regarding climate change and the lack of economic value and funding to protect this city into the far future (Roter District Council, 2011). Hastings is defined as a city planning for densification as explained in the regional strategy. The local strategy for Bexhill-on-Sea is to relocate the first zones, where a no building policy is established to encourage urban shrinkage near the shoreline and increase the collaboration between ecosystem services to improve the human quality of life (Haase et al, 2014). Housing in these first zones is expected to be vacated to be relocated or demolished due to migration by residents to cities planning for densification. The aim is to relocate these urban environments to a comparable environment close to the current location.

In this strategy, Bexhill-on-Sea and Hastings can be indentified as cities with mutual reciprocity of shrinkage and densification. Where in this area, growing cities can only be defined as cities that increase in population densities due to the outside pressures and establishment of 'coastal squeeze' from protected areas and pressure from decrease in land surface through erosion (Doody, 2012). Planning for densification is a two purpose strategy and will not only increase population density, but can simultaneously provide a regeneration model for deprived urban living environments and provide room for and influence the changing demography of Hastings (Cacciaguerra, 2015; Ferrante, 2020; East Sussex County Council, 2019).

BEXHILL-ON-SEA

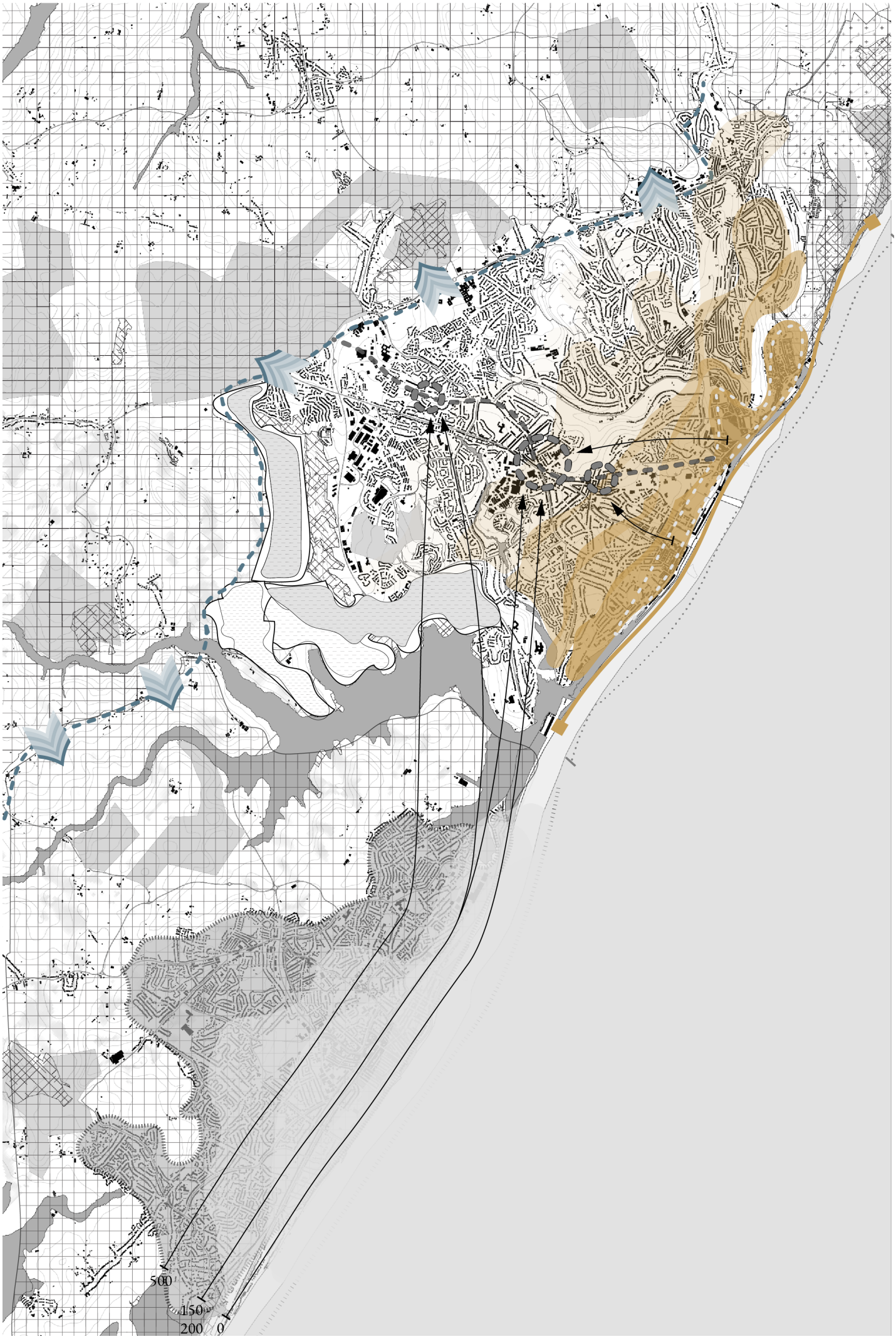
The local strategy proposes Bexhill-on-Sea as a city of shrinkage and defines coastal zones based on the respective coastal location and characteristics of the coast. The first zones of the city are, in 2100, proposed as Coastal Change

FIGURE 37

Local Adaptive Spatial Planning Strategy for Bexhill-on-Sea and Hastings

- Migration flows
- Managed Realignment strategy
- Hold the Line strategy
- Geopolitical boundaries
- Pressure by geopolitical boundaries
- Areas of potential growth
- Potential future retreat
- Densification centres

1:20.000
0
1 km
N


500
150
200
0

Management Areas that provide room for the natural environment with the use of coastal ecological zones and urban deconcentration and residents are expected to relocate in Hastings. This relocation process is partly funded through the use of temporary urbanism and a buy-to-rent model where the Local Planning Authority buys houses from residents in the first zones and rents them out in a cost recovery model, introduced by DEFRA (2015) with an example derived from the Happisburgh Settlement Package (Frew, 2012). Another part of the funding can be recovered from the profits of the regeneration model in Hastings. This financial model is needed as the Local Planning Authorities (LPAs) can only apply for funding from the National Government of £6.000 per demolished house, where only £60.000 is available for England (Hodgson, 2020; Crates, personal communication, 2021). For this project, the main responsibility lies with the LPA's who are responsible for the urban development in high risk areas due to their ignorance regarding Coastal Change in the past (Momber, personal communication, 2021).

The coastline of Bexhill-on-Sea will transform into a natural coastline, where ecological zones and room for small scale toursism are established with the use of temporary urbanism. Accessibility of the coastal natural environment is encouraged to create awareness of coastal change and activate the anthropogenic landscape to encourage interaction with the natural landscape without interference of the natural processes (MMO, 2019).

HASTINGS

The past few years, Hastings has experienced an increase in migration by people from ages 15-24 (East Sussex County Council, 2019). This migration flow results in an aging population and smaller households, decreasing the popularity of detached houses and a rising need for housing with less floor space (FIGURE 39; FIGURE 41)(CDRC Maps, 2019; East-Sussex County Council, 2019). There is a need for economic diversification to re-attract young people to live in Hastings. This need for economic diversification in combination with residential regeneration is caused by the deprivation of the current city of Hastings, causing the city to be known as one of the most deprived cities of England (FIGURE 38) (ILiveHere UK, 2017; Sussex Live, 2020). To change this image of the city, provide a space for Bexhill-on-Sea relocatees and create benefits for Hastings residents, the city is in need of a regeneration model with a focus on densification instead of expansion.

The regeneration for Hastings is proposed along the main road of Hastings, which is the A21, due to high accessibility and inland location opposed to the location of the current city centre along the coastline and expected to be hit by erosion within 100 years if coastal protection is not maintained (Environment Agency 2019). This regeneration is proposed in a mixed use location that is in need of maintenance and regeneration, while maintaining the city's identity with an increased economic value.

SOCIAL BENEFITS

The regional strategy for Hastings and Bexhill-On-Sea's provides policies and strategies that prevents future residents from living in risk environments. The reciprocity between Hastings and Bexhill-On-Sea increases the economic value of the region by responding to societal risks that include societal neglection and deprivation resulting from environmental risks. A local strategy including cities planning for shrinkage and densification creates room for urban regeneration and opportunities for society to create well connected, inclusive, differentiating and accessible new places with the integration of mixed-use elements that result in an enhanced productivity and, therefore, economy.

With the integration of sustainability in a regional strategy, where several disciplines collaborate, society is informed and livability is increased with the result of reduced environmental risks affecting the urban environment.

”Hastings, the place everyone wants to live...i mean avoid!”

East Sussex, nine out of the 10 most deprived neighbour-hoods are located in the the town

“Now where do I start. If you’re a teenage mother in this town, you’ll fit in just fine! If you own a Corsa and pointlessly drive it around the town, you’ll fit in just fine!”

Researchers name Hastings as worst place to earn a living in Britain'

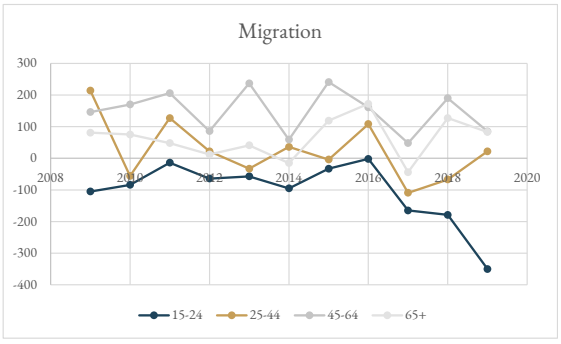
Baird in Hastings: The heartbreaking reality of life in the most deprived area of Sussex

Areas of Hastings make up the majority of Sussex’s most deprived areas

It maybe the birth place of motor racing, but it seems everyone under the age of 65 has used their motor vehicle to leave the place. Eastbourne just along the coast, has been described as ‘God’s waiting room’, well Bexhill is the place for those who can’t afford a seat in the grim reaper’s departure lounge and are loitering outside.

How the resident described it: “If Eastbourne is god’s waiting room, Bexhill is for those who can’t afford a seat and are peering in through the window of the grim reaper’s departure lounge.

FIGURE 38: RESIDENTS OPINIONS OF BEXHILL-ON-SEA AND HASTINGS (SUSSEX LIVE, 2020; ILIVEHERE, 2017)



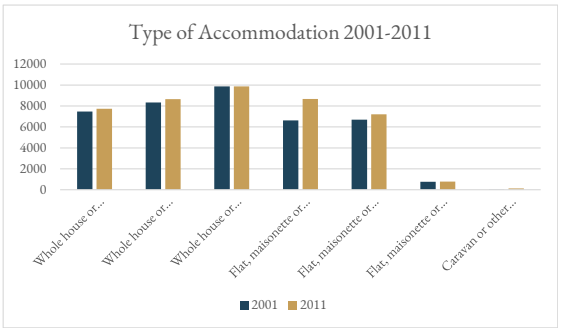


FIGURE 39: MIGRATION FROM HASTINGS BY DIFFERENT AGE GROUPS
FIGURE 40: CHANGE IN ACCOMMODATION TYPES BETWEEN 2001-2011 IN HASTINGS
DATA FROM EAST SUSSEX COUNCIL (2019)

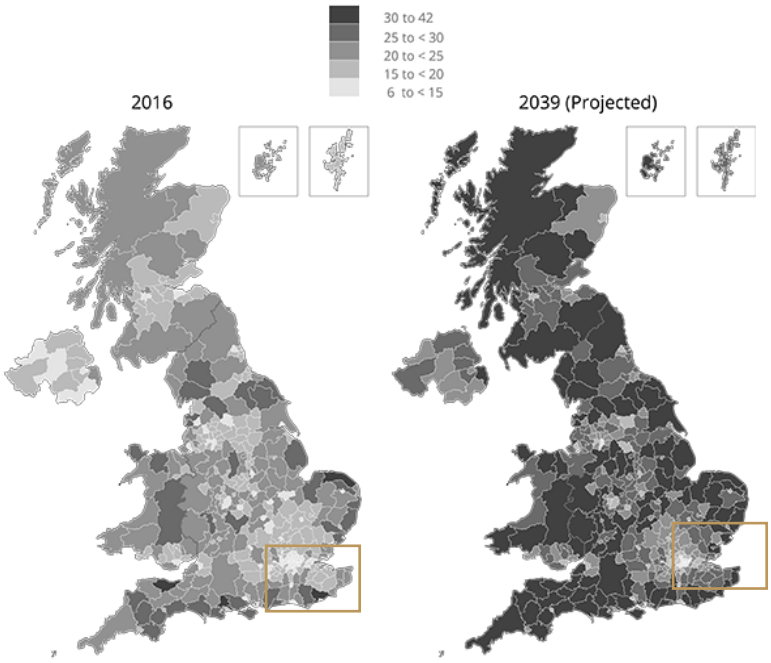


FIGURE 41: PROPORTION OF THE POPULATION AGED 65+ 2016 AND 2039 (2016 MID-YEAR POPULATION ESTIMATES FOR UK, OFFICE FOR NATIONAL STATISTICS, 2014-BASED SUBNATIONAL POPULATION PROJECTIONS FOR UK, OFFICE FOR NATIONAL STATISTICS, WELSH GOVERNMENT, NATIONAL RECORDS SCOTLAND AND NORTHERN IRELAND STATISTICS AND RESEARCH AUTHORITY, CONTAINS OS DATA (THE CROWN, 2018)

3.1.3 PHASING

The local and regional strategy can be established through a series of phases. These phases together are the foundation of a long-term strategy that creates regional resilience. The phasing of this strategy is created with the start of the process in 2021.

PHASE 0

This phase is used as a preparation for the implementation of the long-term regional strategy (FIGURE 42). In this phase stakeholder engagement is essential to collect knowledge of all fields involved in spatial planning and coastal erosion. This knowledge is used to both inform, engage and motivate residents, but also to create interaction between different fields of stakeholders. Activation and engagement of stakeholders is expected to result in collaboration, which is needed for the implementation of the regional strategy to regional resilience. The creation and distribution of knowledge in combination with regional and local collaborations between sectors is the source for opportunities in forms of co-creation and are expected to steer the strategy and the local urban designs.

This phase is also defined by the policy changes that are needed to achieve the strategy of regional resilience. Policy changes that are implemented in this first part of the phasing include:

1. A revision of the SMPs, where the SMPs are used as a tool to create sustainability rather than the preservance of urban environments.

2. A long-term planning policy where regional and local plans should have a minimum of 50 years and should fit into the regional strategy.

3. No built zones in urban environments along the coastlines where a Hold the Line strategy is not beneficial. These cities will be considered as cities planning for shrinkage, where the first zones are expected to relocate within a maximum of 50 years.

4. A Buy-to-rent model policy funded by Local Authorities to compensate for their ignorance of future expected risks within the field of coastal erosion.

PHASE 1

After the introduction of the project to stakeholders, a new phase has arrived that includes consecutively both the a regeneration process and the relocation process, where first a relocation destination is approved for regeneration, and later the residents are able to relocate to this destination.

In this phase the policies from phase 0 are applied and executed as a first step towards regional resilience.

The first zone of Bexhill-on-Sea is preparing for retreat and retreating, while the first regeneration of Hastings takes place. When the first zone of Bexhill-on-Sea is relocated, this zone can be transformed into a natural coast and a coastal change management area, where vacated buildings are disassembled or demolished, materials are recycled and sites are cleaned to create coastal ecological zones. The restored nature provides room for temporary urbanism that is implemented for small scale tourism and is in line with the policies of the Marine Management Organisation (2019).

Simultaneously, in Hastings, the first regeneration starts and a plan is made for the funding and maintenance of the regeneration, relocation and the Hold the Line strategy that should be established before taking action. This phase introduces a policy regarding the regenation of Hastings:

1. Bexhill-on-Sea residents from the first zones selected as no-built zones should be given priority to relocate to the regenerated areas of Hastings. This policy should be facilitated by the city council.

PHASE 2

The second phase of the project introduces a

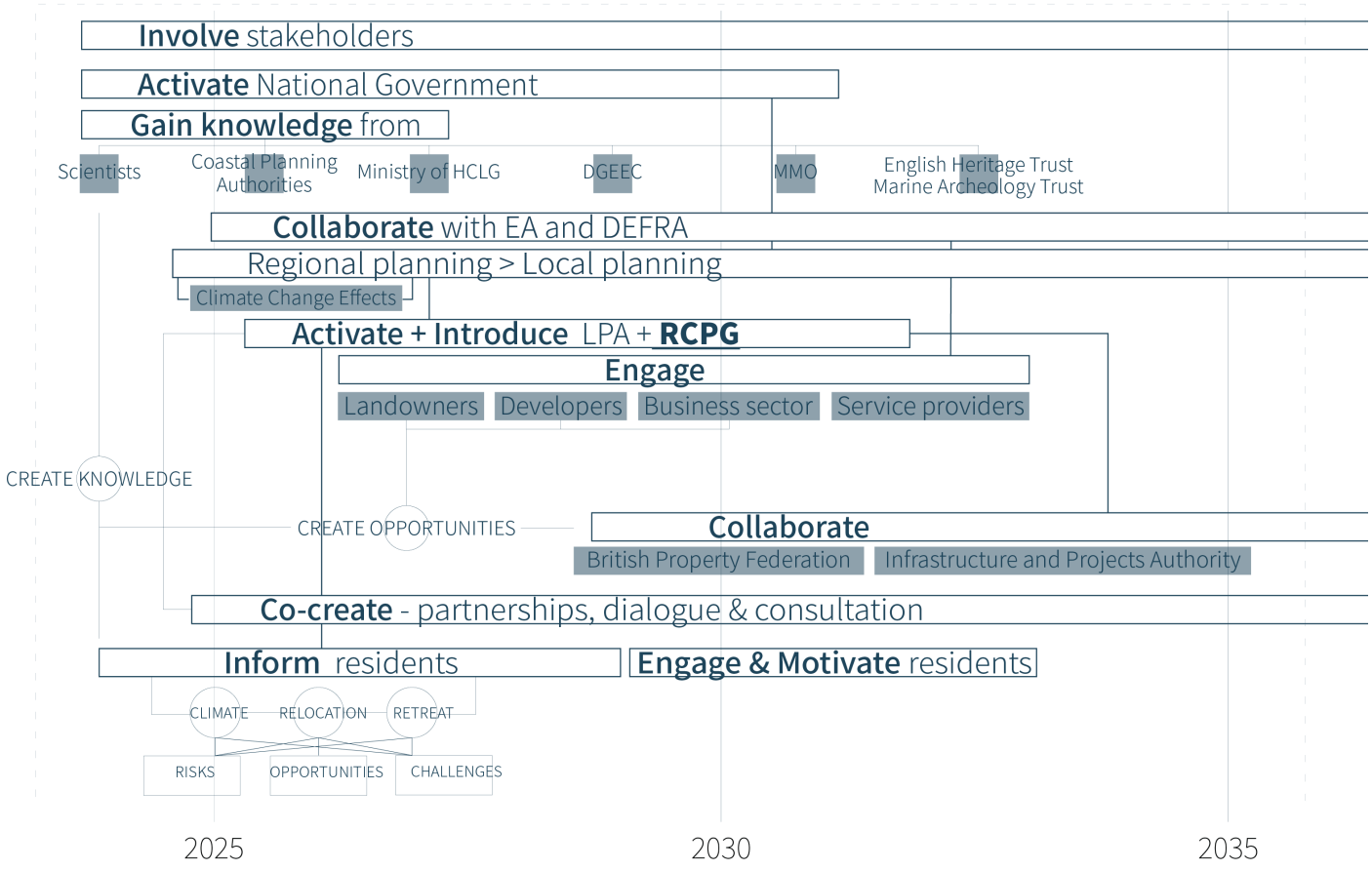


FIGURE 42: PHASE 0 OF THE DEVELOPED STRATEGY FOR SOUTHEAST ENGLAND: STAKEHOLDER ENGAGEMENT

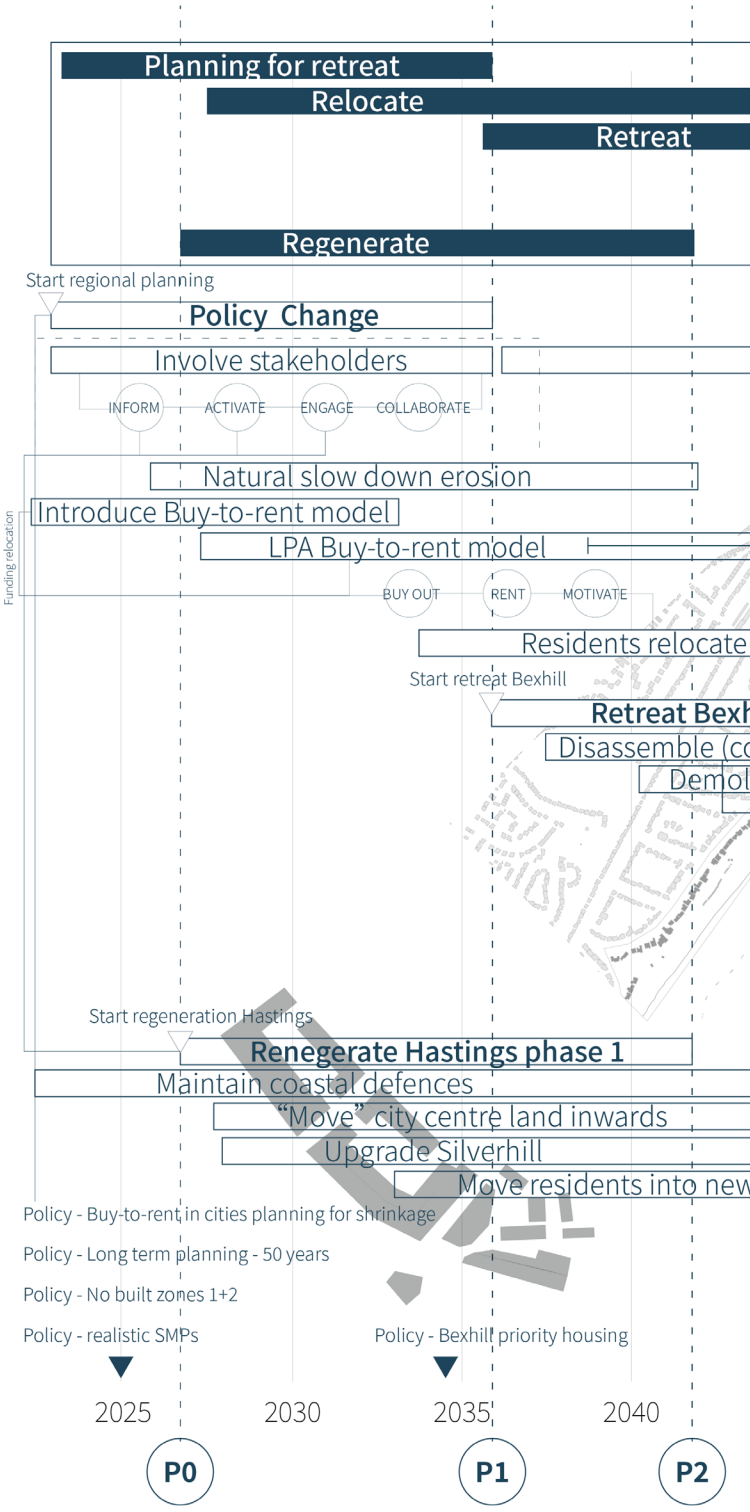
Hastings policy that includes the transition to circular housing:
1. New housing that is built in (future) risk zones in Bexhill-on-Sea need to meet the standards of circular housing.

This policy is implemented to encourage residents to gain knowledge about sustainable environments and creating awareness about coastal change.

With the implementation of this policy the phase of reproducing the process starts, where stakeholders in new locations are selected and engaged for the completion of another part of Hastings that can be regenerated and densified. In this project, proposed future regeneration locations in Bexhill-on-Sea are the district of Baldslow, which is located inland from Silverhill, while the other relocation area is smaller and located in south Silverhill.

Where the official phases of regeneration return every few years to accommodate the retreating areas, the relocation of residents, involvement of stakeholders and the buy-to-rent model are ongoing processes where the end is still undecided, but should, in many years, be based on the characteristics of future coastal change.

Where in the first phase of retreating, a significant amount of housing needs to be relocated, later phases are expected include less housing in need of retreat due to the raised awareness, the no-built zones and the structure of the developed strategy that follows an ongoing retreat of the coastal urban environments selected for shrinkage, but also the redistribution of important areas of the city to inland locations, such as the Hastings city centre that will be relocated to the district of Silverhill, as a substitute of the current coastal city centre.



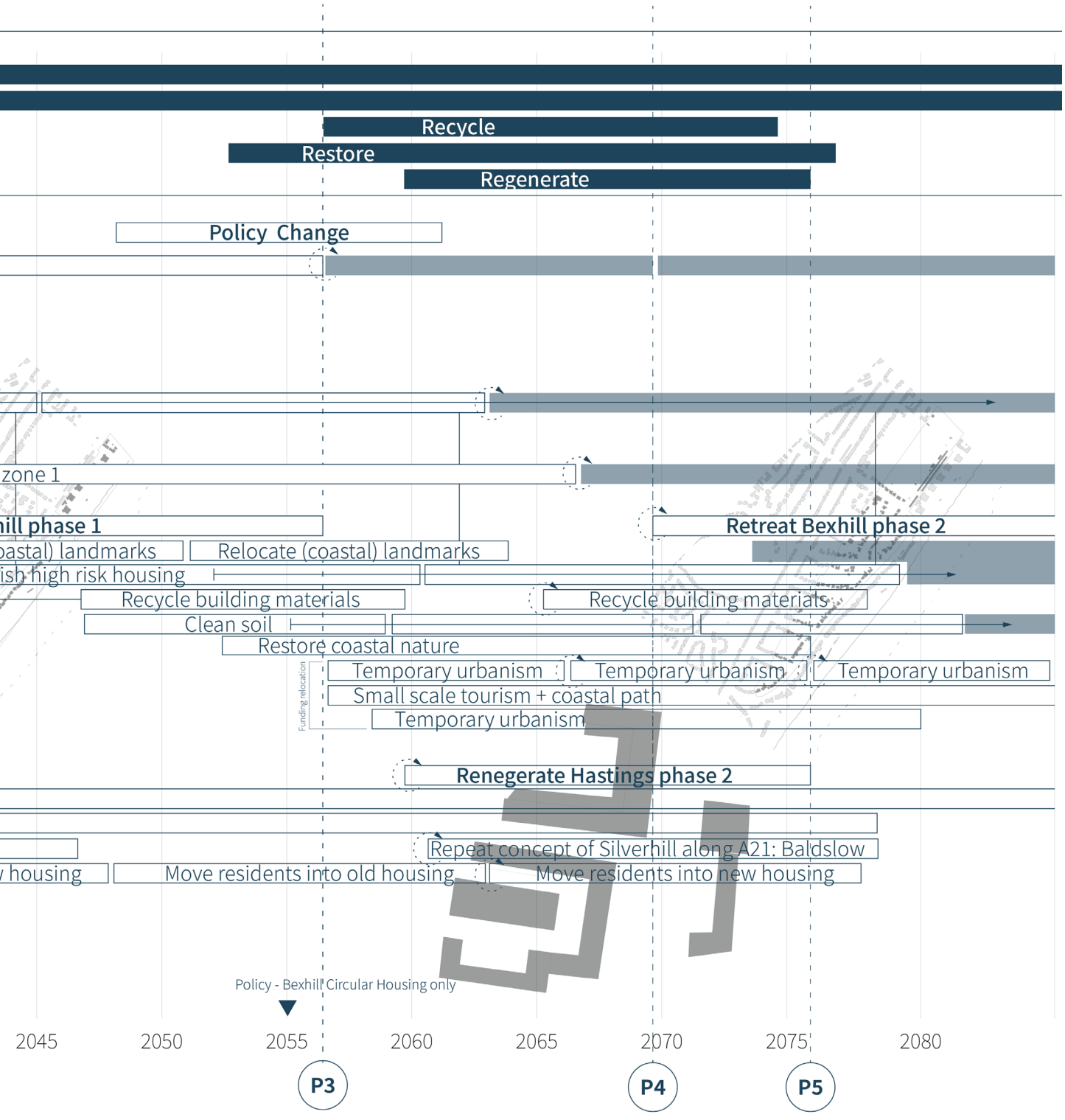


FIGURE 43: PROPOSED PLANNING OF THE PROJECT INCLUDING RETREAT, REGENERATION AND RELOCATION

FIGURE 44: THE COASTAL PATH (WINGCLIPPED, 2013)

3.2 BEXHILL-ON-SEA

This paragraph shows the erosion rate in Bexhill-on-Sea and its complications due to coastal squeeze, as shown in FIGURE 44, and a proposed design that can be implemented when following the developed regional strategy.

3.2.1 DESIGNING FOR SHRINKAGE

NATURE HAS MORE TIME AND ENERGY THAN THE GOVERNMENT HAS TIME AND MONEY

The city of Bexhill-on-Sea is, according to the Rother district council (2011), an attractive seaside town in East Sussex between Hastings and Eastbourne with a dominant age group of 45-64 year olds, mainly attracting retirees. The council recognises aging as one of the main issues leading to deprivation in the city. Another main issue, that is not mentioned by the district council, is the city's reaction to coastal erosion, which is not implemented in the current regeneration plans of the city (Kirby et al, 2020).

While the Environments Agency (2011) Shoreline Management Plans for the city are to Hold the Line and protect the coastal region of Bexhill-on-Sea, the city's economic deprivation limits the available funding to implement this strategy resulting in the desire by the Local Planning Authorities for resident's responsibility to maintain and finance protection measures that protect their own lot and residence, possibly interfering with the natural environment (FIGURE 45), resulting in knock-on effects for neighbours and excluding residences that can not afford to maintain these measures (Hodgson, 2020). These residents have no choice but to wait until disaster happens, leaving them without a home.

PLANNING FOR SHRINKAGE

With the knowledge that risks will increase when sea level rises, this project proposes to extremely revise the SMPs for these smaller, depriving, coastal cities with similar characteristics as Bexhill-on-Sea and embrace the coastal change effects resulting from climate change with the implementation of a strategy for the future of coastal cities that includes urban shrinkage but ecological growth.

Embracing the effects of coastal erosion can create additional qualities to the city that attract tourism and can decrease deprivation while increasing economic collaborations with the city of Hastings creating possibilities for the formation of a sustainable urban environment and regional resilience.

FIGURE 45: BEXHILL-ON-SEA COASTAL DEFENCES (GOOGLE, 2020)

URBAN RETREAT AND RELOCATION

The city of Bexhill-On-Sea is proposed to retreat in a plan for shrinkage with the implementation of Coastal Change Management Areas. In this plan residents of the coast are expected and motivated to relocate to the city of Hastings. This leaves the coastal environment without permanent residents and creating space for ecological regeneration and the opportunity to create an environment where nature is dominant to the urban environment, resulting in a natural coastline.

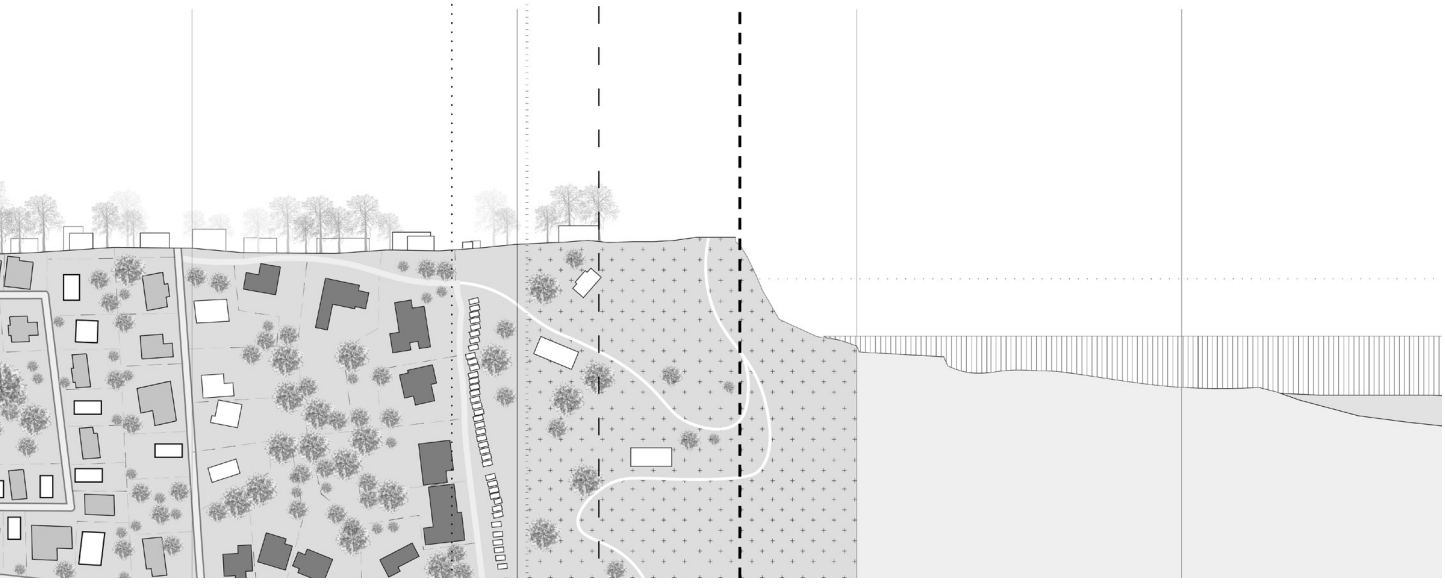
For this strategy, the aim is to revise the existing Hold the Line strategy, which focuses on maintaining the current position of the coast and, therefore, allowing private and public protection measures, to a Managed Realignment strategy where the coastline retreats with the (expected) accelerating natural rate of the ongoing coastal erosion. With this strategy, the private and public coastal protection measures that are currently in use will be removed, allowing the natural environment to regulate the coast, allowing a natural coast line. This revision of the SMP is facilitated and substantiated by the policy changes that aim to achieve regional resilience with the incorporation of the regional scale in the english planning system.

For Bexhill-on-Sea, the occuring average erosion rate is 0,75 m/year, with a minimum of 0,53 m/year and a maximum of 0,97 m/year (Environment Agency, 2019). This means that within the next 50 years, the coastline can retreat up to 48,5 meters, resulting in a need for a strategy to deal with this retreating coastline, which is, in this project, relocation. This relocation is divided over risk zones, where zone 1 is at high risk while zone 5 can, for now, be considered as a risk-free zone. With the definition of risk zones, the order and temporal scale of relocation are defined. The land surface is divided in several zones, for now zones one until five, which are zones that need to be included in a regional strategy due to their temporal scales. In this zoning system, the first zone starts at the current coastline and zone five can be found more inland, around 400 meters from the existing coastline. Zones 1 and 2 have urgent needs for relocation within the next 50 years, while the inland zones can be considered less urgent and are expected to retreat after at least 50 years.

With the relocation of Bexhill-on-Sea's coastal urban environments at high risk, a lot of space, especially in the first zones, is cleared that allows the natural environment to be restored and can result in the natural delay of the cosatal change effects of coastal erosion through the growth of vegetation (Coppin and Richards, 1990). This natural coastal erosion delay is encouraged through the implementation of ecological zones in the coastal zones at risk.

FIGURE 46

3	2	1	zone
50-100	0-50 years	yesterday	when to relocate (years)



: RELOCATION ZONES RESPECTIVELY TO THE COASTLINE DUE TO COASTAL EROSION AND OTHER CLIMATE CHANGE EFFECTS AND EXPECTED TIME FRAME TO RELOCATE
Data from Environment Agency (2020)

These ecological zones, Coastal Change Management Areas, and the retreat plan are the foundation of the temporal scale in the Bexhill design, where temporality is defined through the use of temporary urbanism in the form of relocatable, re-usable and recyclable, tiny houses with a vacation purpose to attract small scale tourism and create low-risk coastal accessibility and awareness of the ever changing coastal region that fits the existing policies of the Marine Management Organisation. The aim for this temporary urbanism is, that when risk is rising, these accommodations are able to be relocated to the next zone. In this process, the full accomodation can be relocated, or materials can be used to create other accommodations and tiny houses.

LANDMARKS AND CHARACTERISTIC BUILDINGS

This strategy creates room to relocate, recycle and reuse Bexhill-On-Sea's properties and introduce these to Hastings as a foundation for regeneration and attraction and engagement of Bexhill-on-Sea's residents to the densification model of Hastings. Landmarks and characteristic buildings are proposed to be used as a source of inspiration for Hastings' regeneration. The use of Bexhill's buildings in the regeneration model of Hastings can be used as a tool of engagement and motivation for local residents of both cities to participate in the regeneration and relocation process and aims to satisfy both Bexhill-on-Sea's and Hastings' residents.

Not only does the developed regional and local strategy aim to provide room for relocation to densified areas of Hastings, but also proposes low-density relocation areas within the city boundaries of Hastings for residents that prefer to and have funding to fully relocate their current coastal accommodation or built a new accommodation.

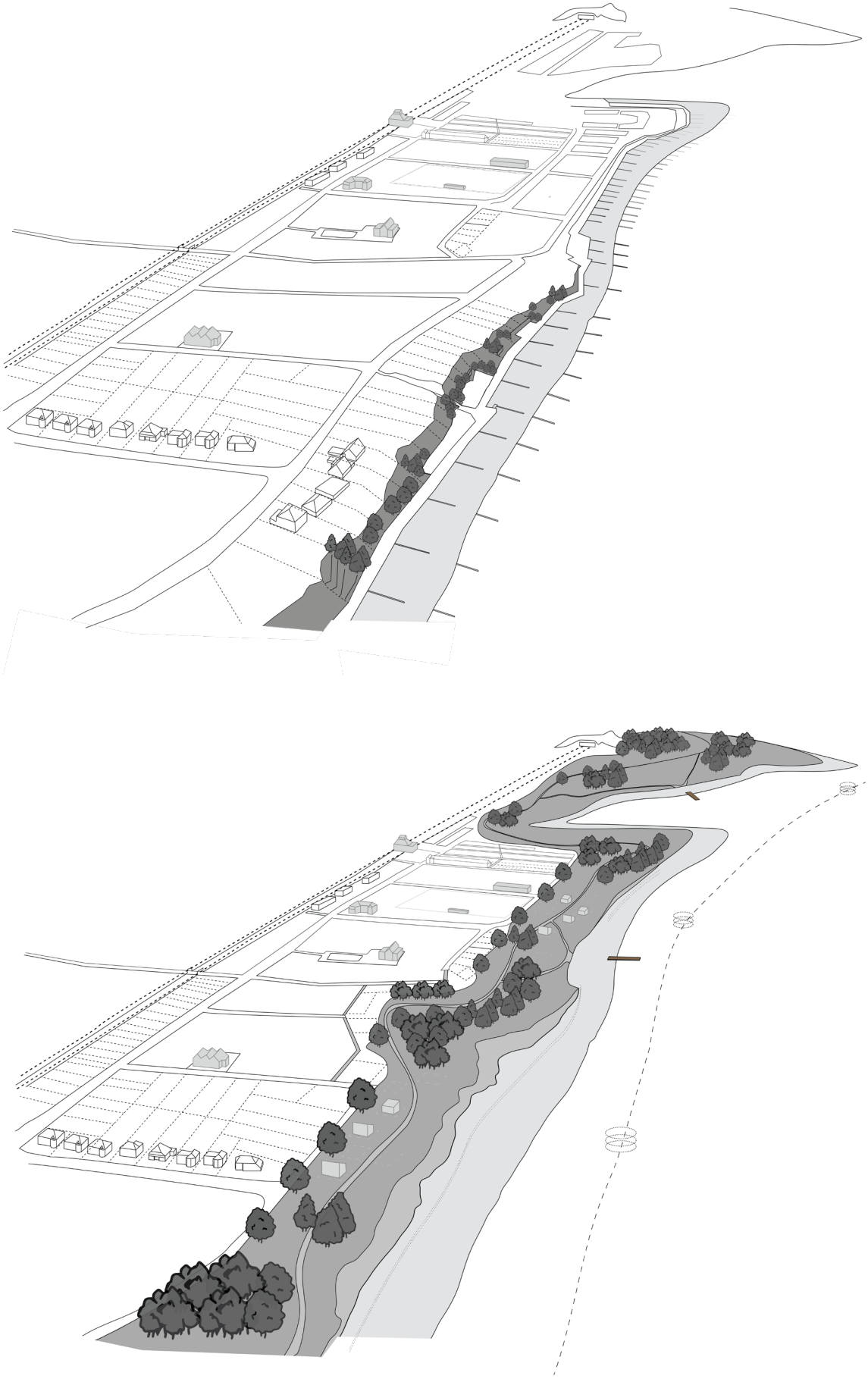


FIGURE 47: PALMBOUT DRAWING OF THE CITY PLANNING FOR SHRINKAGE: BEXHILL-ON-SEA INCLUDING TEMPORALITY AND VEGETATION AS NATURAL EROSION CONTROL

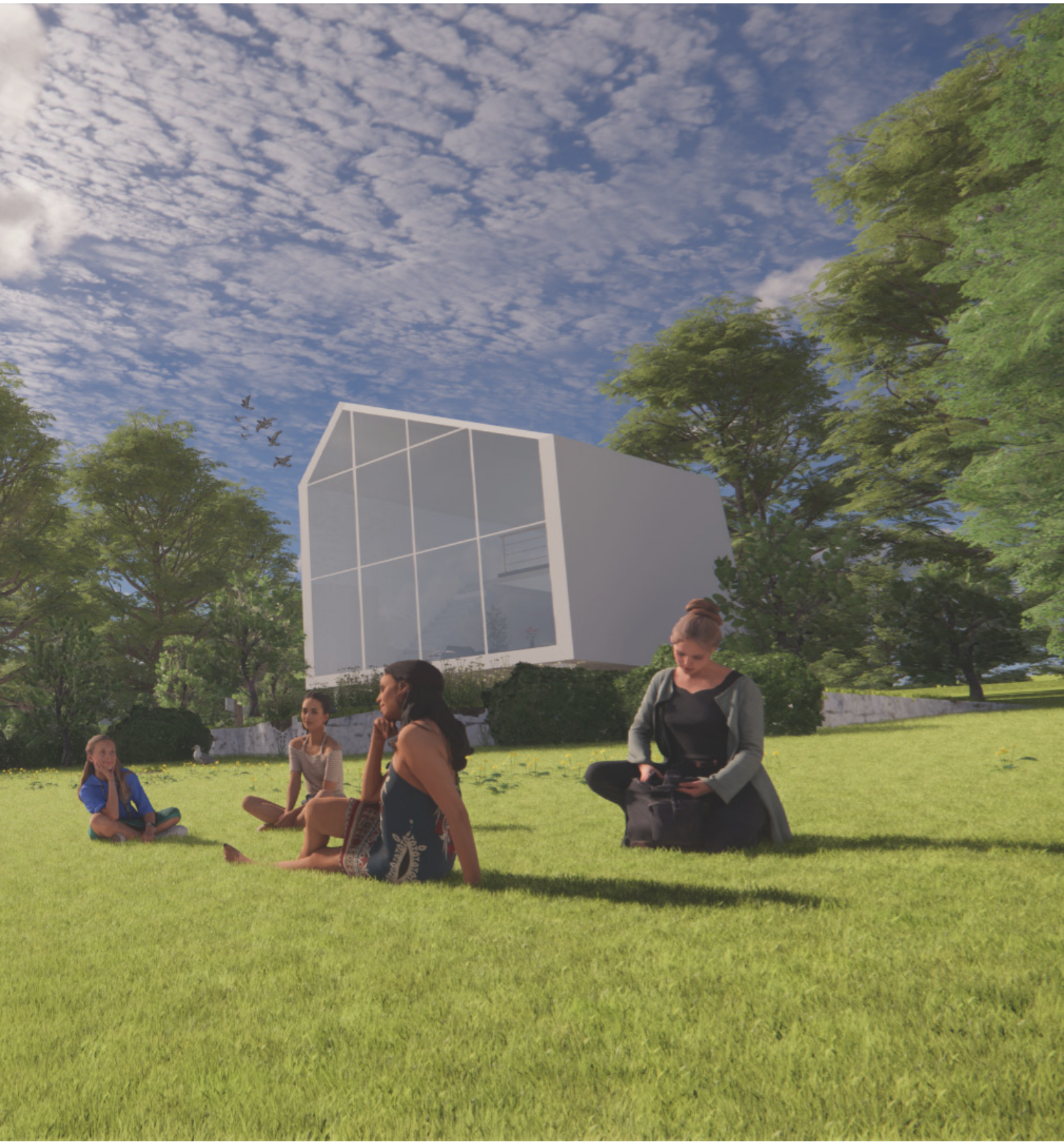


FIGURE 48: IMPRESSION OF NEW COASTAL ENVIRONMENT IN BEXHILL-ON-SEA WHERE THE COAST CAN NATURALLY RETREAT

DESIGN

The design for coastal Bexhill-on-Sea within their plan for shrinkage aims to provide for an environment that improves the ecological habitat while providing space for small scale recreation and tourism.

The design aims to improve the natural environment of the coast by introducing vegetation to the area, providing room for coastal biodiversity with the reduction of the anthropogenic pressures on the area but also increasing the natural resistance to erosion.

Small-scale recreation and tourism are tools to create awareness on the eroding coasts and coastal changes that are implemented with the use of temporary urbanism in the form of vacation cottages in different sizes, from tiny houses to full sized bungalows that can facilitate families. These accommodations have natural characteristics due to the use of nature based materials. The use of natural materials contributes to the low weights of the cottages, making them suitable for relocation when the coastline retreats and zones, 3, 4 and 5 of Bexhill-on-Sea have relocated.

In the design, the implementation of the Coastal Path is explored as a tourist attraction and a tool to provide a walking route and cycling route within the coastal region without creating risk environments. The Coastal Path is an initiative of the National Trail, provided by the National Government through Natural England, Natural Resources Wales and Local Authorities and aims to offer a safe way to experience the coastline (National Trail, 2021).

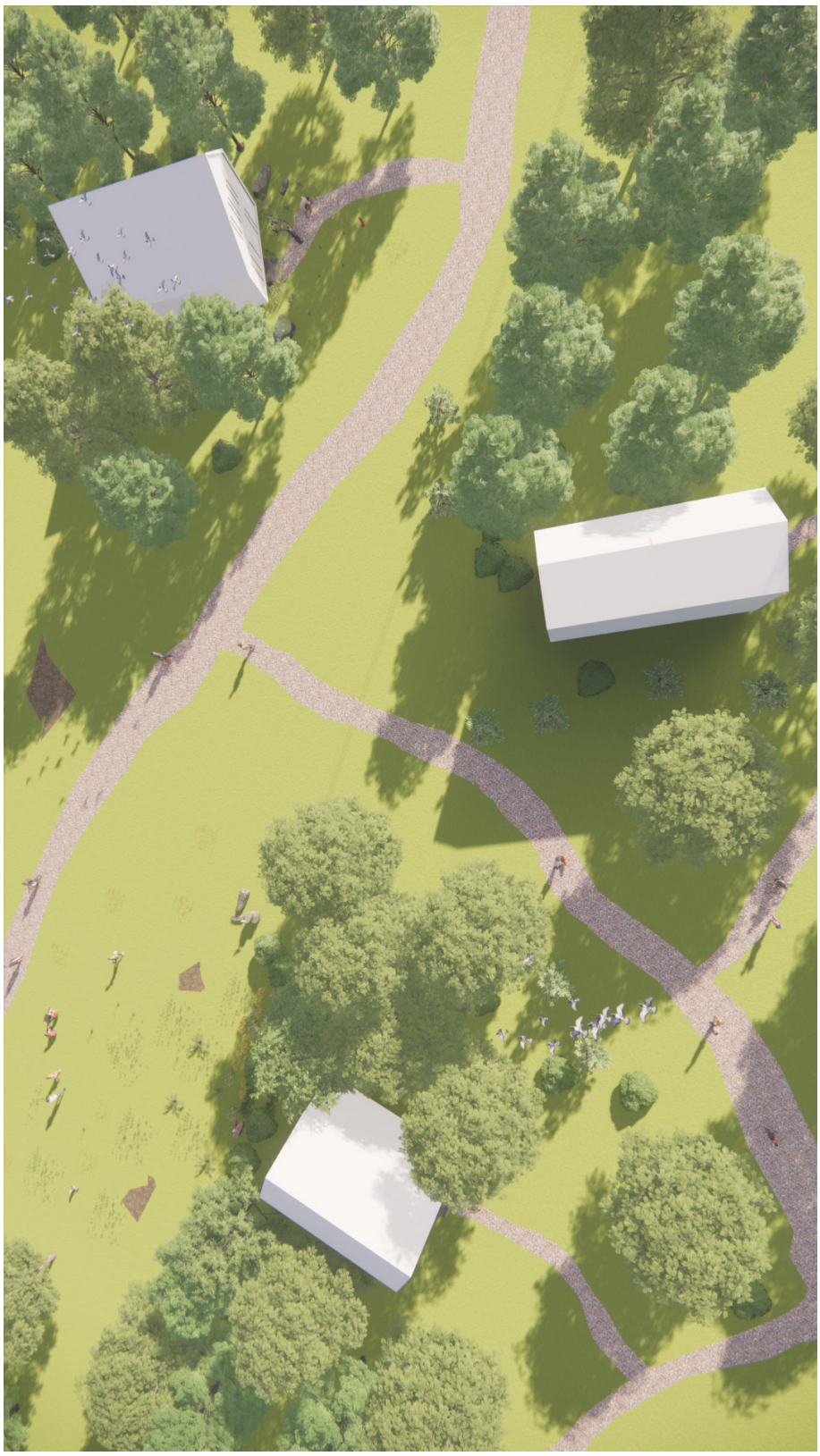


FIGURE 49: IMPRESSIONS OF COASTAL BEXHILL-ON-SEA AFTER RELOCATION OF ZONE 1


HILL LIFT

FIGURE 50: CLIFF RAILWAY HASTINGS (HISGETT, 2010)

3.3 HASTINGS

This paragraph shows a design for a regeneration strategy ifor the city of Hastings, where the old city centre is currently located at the coast (FIGURE 50) and the regenerational area inland to easily adapt to coastal erosion that locates spaces for Bexhill-on-Sea residents to move to.

FIGURE 51: HOUSING TYPOLOGIES AND AREAS SUITABLE FOR REGENERATION
Data from CDRC Maps (2019)

3.3.1 PLANNING FOR DENSIFICATION

REGENERATION MODEL

The city of Hastings facilitates for the living environment of a diverse population, where the majority occupies a lower social grade (ILiveHere, 2017; City Population (n.d). This diverse population is a stakeholder that is facilitated in the process of designing a regeneration model where both former residents of Bexhill-on-Sea and residents of Hastings can be identified as individual stakeholders.

In this regeneration model, densification and sustainability are both considered as key aspects that are applied in a redesign of an existing urban area.

DENSIFICATION

The city of Hastings can be considered a city with low urban densities caused by the existing housing types with an average of two storeys (CDRC Maps, 2019). These low urban densities can not provide for the regional and local strategy that includes the relocation of Bexhill-on-Sea residents to Hastings in combination with the present housing shortage, resulting in a need for densification in the city of Hastings (Nazir et al, 2019). This densification is ideally created by a repetition of the recognisable terraced housing that provides not only the connection between the public and private space, but also is societies' preferred type of housing in English cities due to their aesthetics and the culture of masonry craft (Self Build Guide, 2019). In the technical field, the traditional building method is also preferred due to their life-time of hundreds of years (Lovell & Smith, 2010). However, for this project, the latter might not be an argument due to the cities' intentional urban retreat.

The preference for traditional building methods and the masonry aesthetics in combination with the popularity of terraced housing and the need for densification results in a demand for a new typology that can provide this urban desired environment in a city suitable for densification.

SUSTAINABILITY: TRADITIONAL VS MODULAR

According to the English Housing Survey HOMES, the average English house consists of two storeys, where a large percentage of houses are built with traditional building methods that include masonry (Department for Communities and Local Government, 2012). While there is a visible dominance of the traditional building methods, according to Lovell and Smith (2010) this method is costly, inflexible and inefficient and does not meet the demands of the National Government in their desires for sustainability (Rhodes, 2018). However, a shift to an innovative building method is a complex process where society as stakeholder can have a significant influence and should, therefore, be included in this process.

For this project, a shift is desired to a modular building typology using the financial and temporal advantages of prefabricated building technologies that can partially solve the housing shortage on short-term, fastly increase density and add to a sustainable urban environment due to their high recyclability, low weight, low energy use and high wastage savings as shown in FIGURE 54 (Nazir et al, 2020; Oliveira et al, 2019; Wrap, 2007; Actavo, 2019).

While the preferred masonry is typically not used in modular and prefabricated building methods, the preference is, for residents, essentially based on aesthetics, which can be replicated in modular housing and would satisfy these residents. The complications of the shift to this building method can be found in the number of skilled workers in the modular building sector resulting in a need for training and another argument for transition rather sooner than later (Nazir et al, 2020).

NEW TYPOLOGY

A new typology aims to find collaboration between the need for both densification and sustainability by implementing key features of existing popular typologies (FIGURE 52) in combination with sustainable features to attract relocatees to certain appointed areas for densification models.

FIGURE 52: CHARACTERISTIC ELEMENTS OF TERRACED HOUSING BY GOOGLE (2021) ADAPTED BY CONIJN

FIGURE 53: DEPRIVATION AND NEGLECTION IN SILVERHILL (GOOGLE, 2009; GOOGLE 2020)

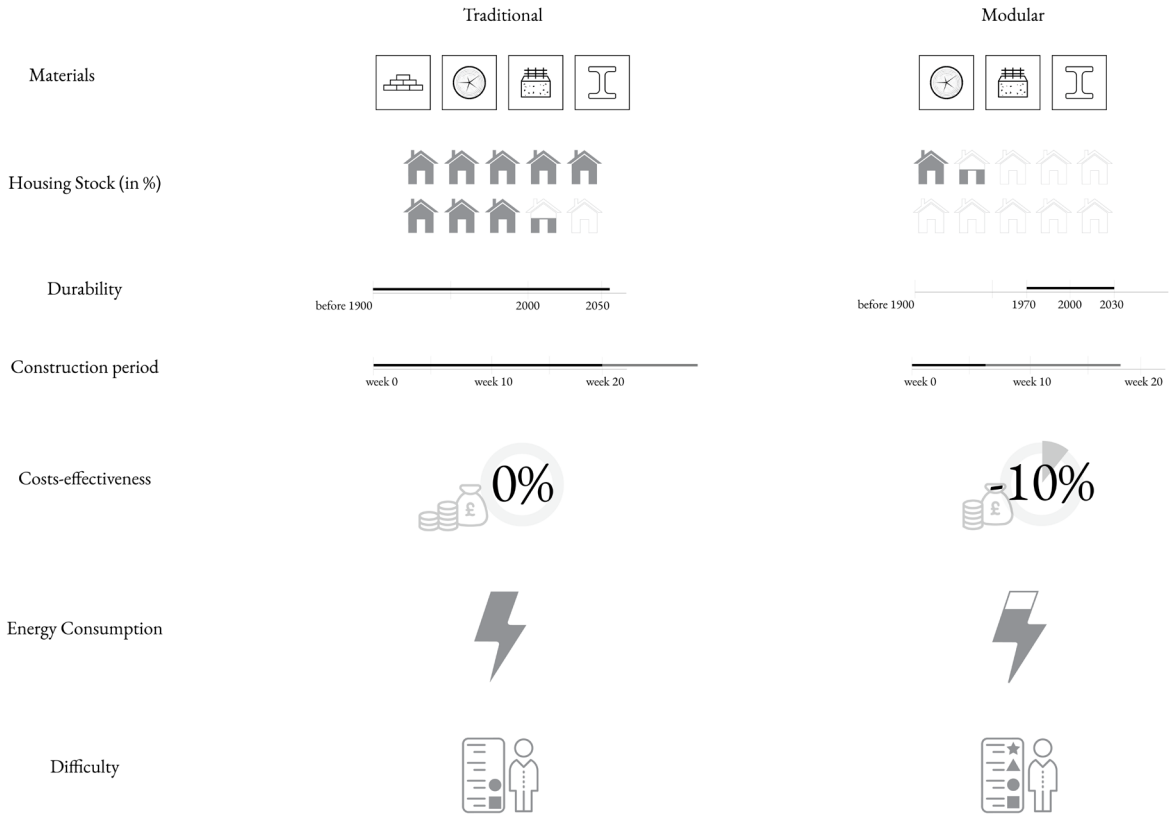


FIGURE 54: MODULAR VS TRADITIONAL BUILDING
DATA FROM: LOVELL & SMITH (2010); GIESEKAM ET AL (2014); NAZIR ET AL (2020); BRIGDEN (2013); CRL (2018); GOLAWSKI (2018) & MTX (2017)

3.3.2 SILVERHILL

Hastings' city centre is located in a coastal position within the city's geopolitical and natural limits. This coastal location makes the city centre without its coastal protection, in relation to coastal erosion, an unsustainable and high risk urban environment, pressuring a need for a regeneration model that focuses on locations land inwards. This project proposes a new city centre in an urban environment that possesses key features that improve accessibility, productivity and economic growth (Tyler & Moench, 2012). A location for a regeneration model for Hastings can be found along the primary road through Hastings, the A21, where key aspects of potential for urban, climate resilient, regeneration can be found in the district of Silverhill originating from a mixed-use program of both commercial and residential elements. This potential city centre in Silverhill has been depriving for at least ten years (FIGURE 53) and is in desperate need of a regeneration model (Google 2009; Google 2020).

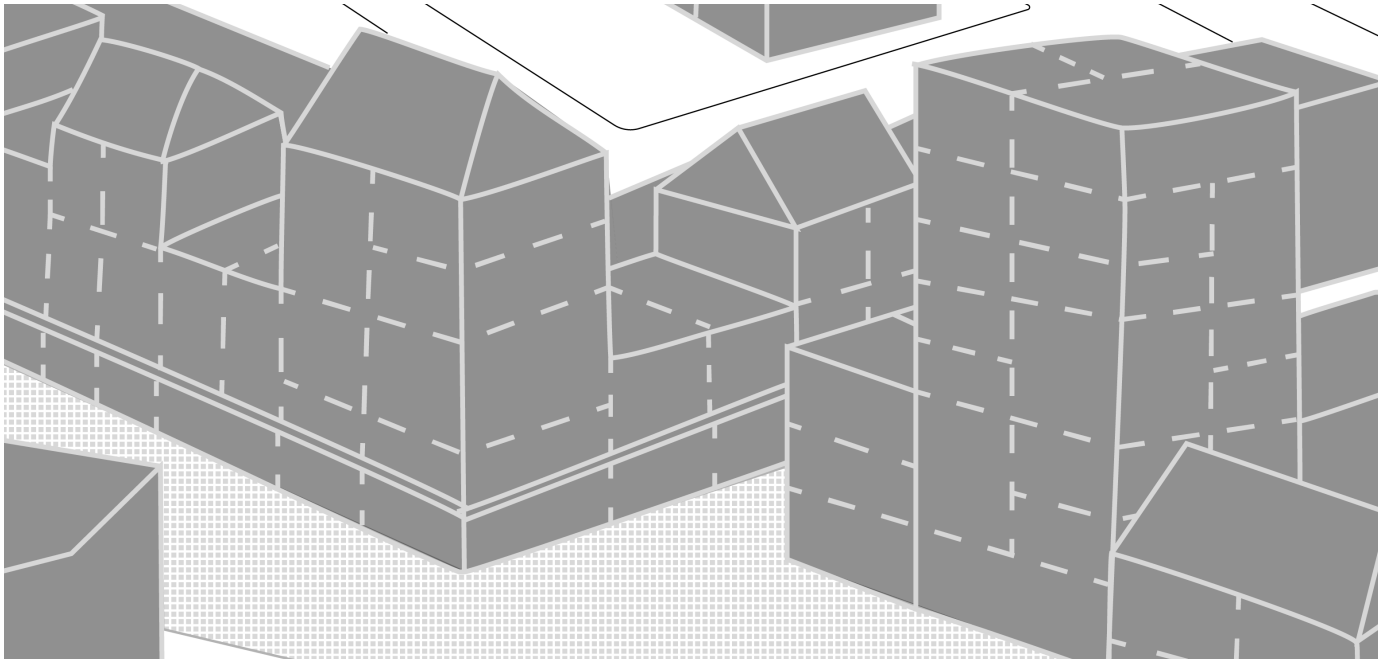
The regeneration model of Hastings includes spatial and environmental justice with a fair distribution of space, people and nature to achieve social justice with the improvement of society's wellbeing and social connectedness, encouraging productivity in a densifying city. The urban design aims to be a response to the demand for housing in coastal regions while increasing livability.

DESIGN

The design for the densification and regeneration model proposes to increase density with a new typology that stacks the terraced housing typology and allows terraced roofs to provide housing that includes outside space. This new typology includes housing of different sizes, from apartment to maisonette, to provide for a diverse population and community. This new typology includes a reference to the victorian period that is recognisable in the average English building stock (BRE Trust, 2017).

The regeneration of Hastings introduces building blocks with a mixed-use program with the aim to create valuable, inland, properties to attract relocatees of Bexhill-On-Sea. This creation of valuable properties goes hand-in-hand with the re-use of existing properties and respect to the city's identity. The size of the new terraced roof typology is, derived from the current housing stock in the design location to include transformation and possibilities to top up or re-use existing building structures.

In the urban design location in Silverhill, the streetlevel is occupied by commercial uses. In the regeneration model, the commercial program is the foundation for the resident program that includes housing and terraces. This mixed use program can, in this design, provide for interaction and collaboration between infrastructural and social system of the different floors.



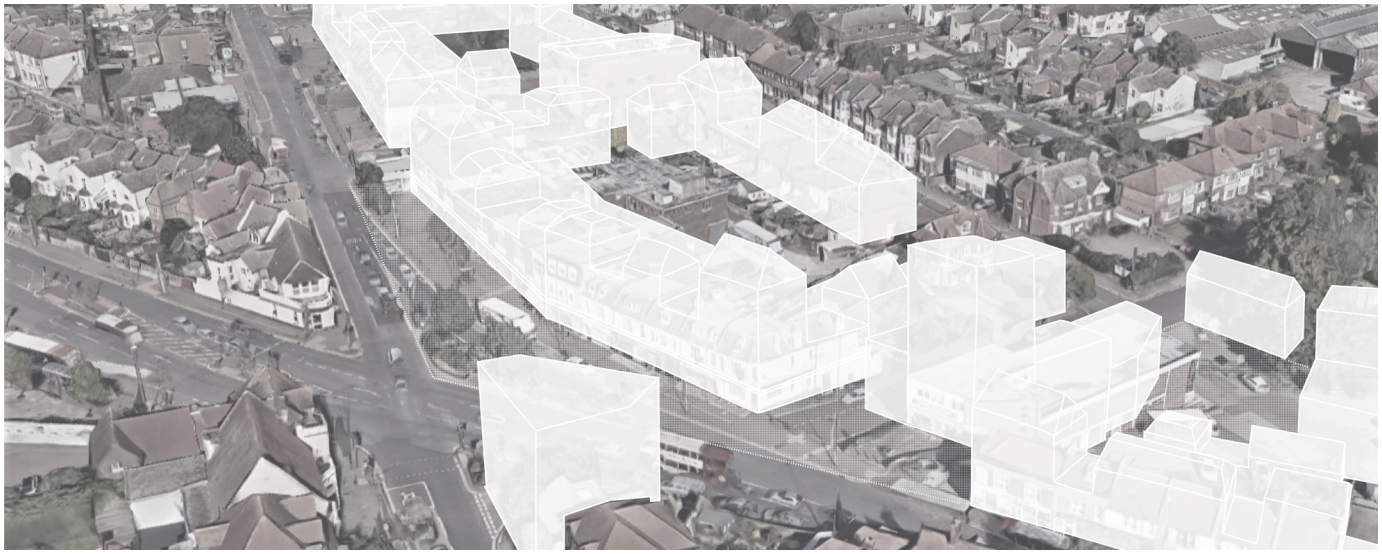


FIGURE 55: CONCATENATION OF 28 OUT OF 150 HOUSES IN THE NEW TYPOLOGY
FIGURE 56 + 57: 3D VIEW AND MAP OF IMPLEMENTATION OF AROUND 150 RESIDENCES IN THE NEW TYPOLOGY IN SILVERHILL

1:1.000
0
25 m
N

FIGURE 58: TOP VIEW IMPRESSION OF SILVERHILL'S TERRACED ROOFSCAPE AND THE RELATION TO THE PUBLIC SPACE AT STREET-LEVEL

The roofscape is defined by terraces with low fencing to encourage social connectedness and interaction between floors with the intention to strengthen the terraced roof community. While the design aims to achieve higher densities, the desired new terraced roof typology aims to facilitate the residents and contributes to an urban environment that supports the mixed-use elements with the goal to increase economic value in with the creation of Hastings' new city centre in Silverhill.

The public space is designed to boost society's pride and image with the development of high quality, modern outside spaces where slow traffic is encouraged with the expansion and introduction of a shopping boulevard and urban greenery.

Public and private areas are divided through the positioning of the design's building blocks along the A21, where the A21 provides public space and entrances to the commercial program while the back side consists of diverse private spaces composed by height differences and division between commrecial and residential program.

This urban design aims to introduce a higher scale of density to an area that has potential for regeneration and use this in combination with a need for a new typology to regenerate a neglected mixed use environment. The design uses the bundling of activities, residential regeneration and economic diversification as tools to increase density and establish a sustainable urban environment.

FIGURE 59: IMPRESSIONS OF THE IMPLEMENTATION OF THE REGENERATION OF SILVERHILL

3.3.3 DESIGN TRANSFERABILITY

While the elaborative design focuses on the Silverhill location, other locations for a comparable regeneration model can be found both seawards and landwards, where the seawards location south to Silverhill includes a transformation proposal for a neighbourhood centre and the inland location in the district of Baldslow includes a terraced roofscape in combination with large scale commercial buildings. These designs are proposals for future regeneration locations in the same regeneration model that is applied to achieve the proposed regional strategy for southeast England.

These designs are examples of diverse approaches to replicate the main design proposal with the proposed typology of stacked terraced houses that include roof terraces in different locations within the city of Hastings and along the A21.

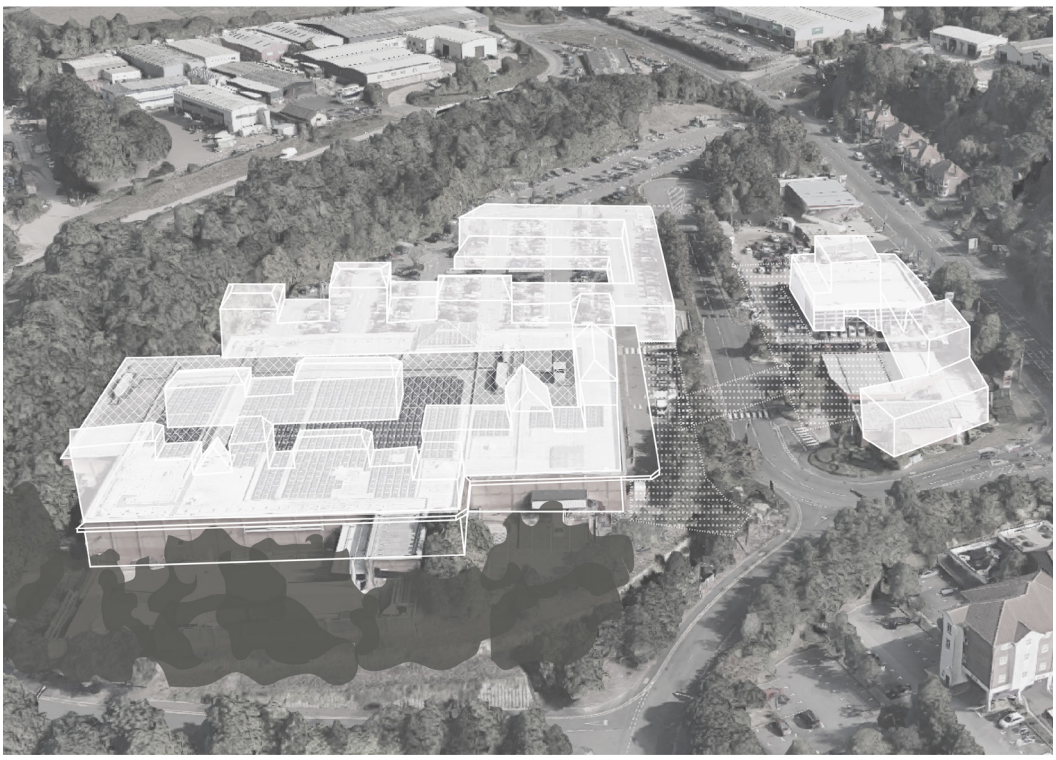
These transferability designs show that the new typology can be used in different scales and will, therefore, be able to designed to accommodate the migration flows from the cities that are planning for shrinkage to cities planning for densification in the regional strategy.

FIGURE 60: MAP AND 3D VIEW OF THE BALDSLOW REGENERATION PROPOS

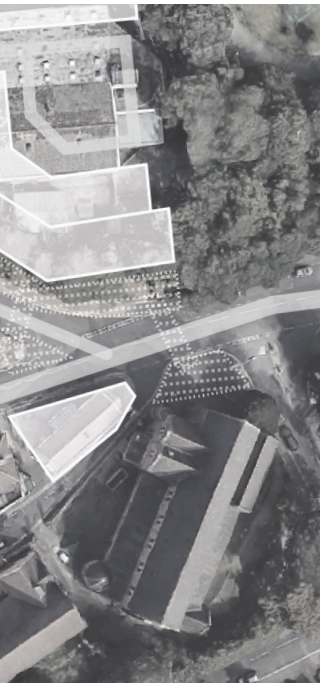
1:20.000
0 25 m
N

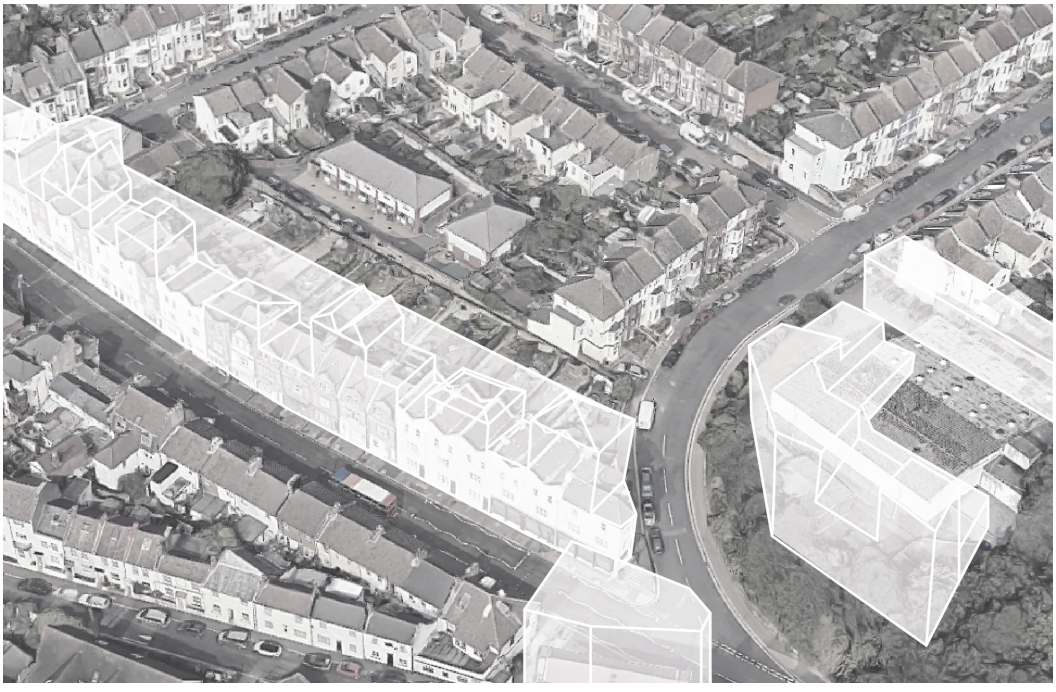
FIGURE 61: MAP AND 3D VIEW OF THE SOUTH SILVERHILL REGENERATION P

1:20.000
0 25 m
N



SAL





PROPOSAL

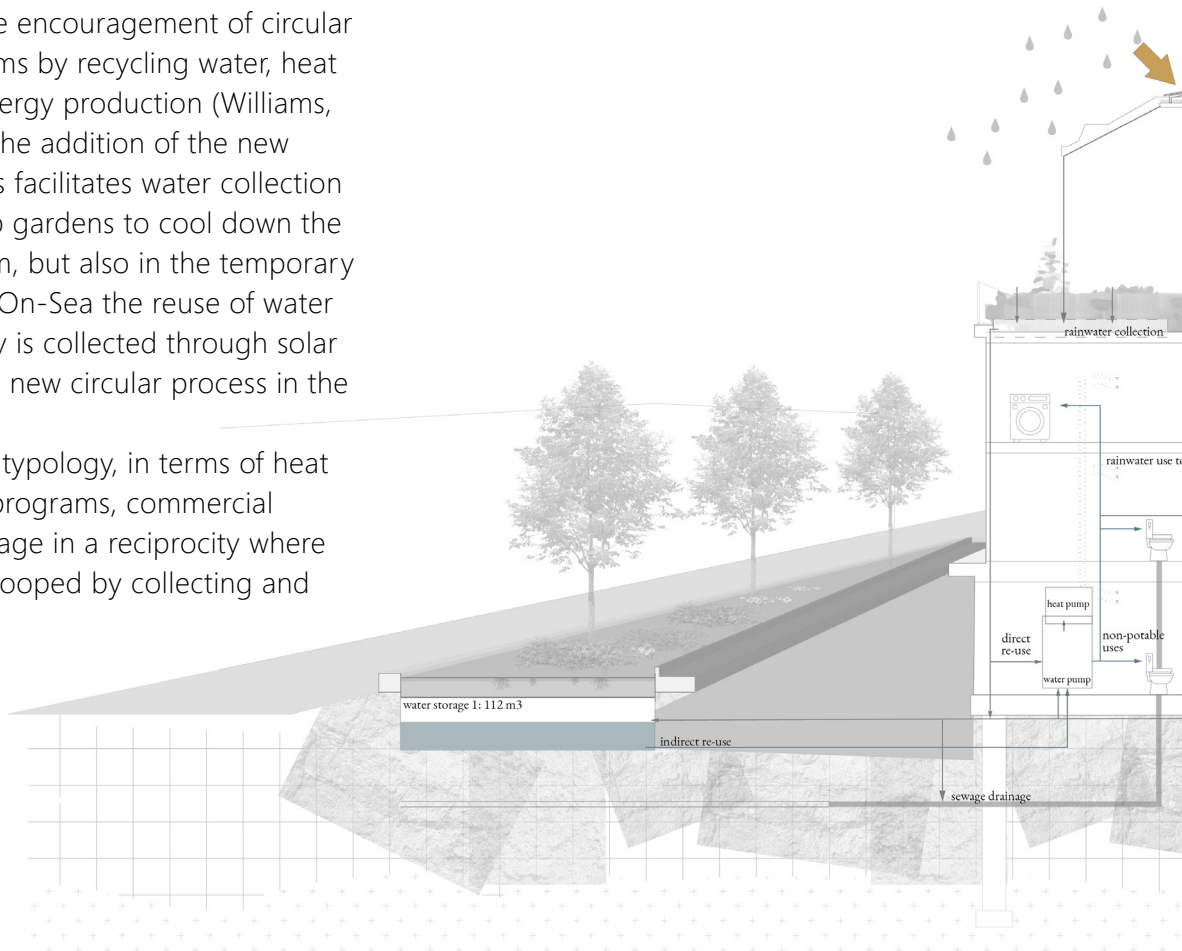
3.3.4 SUSTAINABILITY OF THE URBAN DESIGNS

SILVERHILL

The new typology introduces a partly vegetated roofscape with strong resemblance to the existing and popular English terraced housing. This typology can add to the creation of a circular economy with the addition of regenerative and adaptive urban ecosystems resulting in a sustainable urban environment. Between the street-level commercial program and the residential program that inhabits the roofscape, resource efficiency of supply chains and production processes can be improved in the city of Hastings. This circularity is needed in the strategy with the aim for future adaptation to shocks and long-term changes in the regional landscape, minimizing ecological impacts by resource looping, adaptation and ecological regeneration (Williams, 2021).

In Bexhill-On-Sea and Hastings, these three actions are implemented in the developed urban designs. Resource looping aims to recycle, reuse and recover with the encouragement of circular infrastructural systems by recycling water, heat and by including energy production (Williams, 2021; Czop, 2019). The addition of the new typology in Hastings facilitates water collection beneath the rooftop gardens to cool down the commerical program, but also in the temporary urbanism in Bexhill-On-Sea the reuse of water is integrated. Energy is collected through solar panels on roofs as a new circular process in the urban environment.
In the terraced roof typology, in terms of heat exchange, the two programs, commercial and residential, engage in a reciprocity where commercial heat is looped by collecting and transporting heat for residential use. The adaptation of buildings to accommodate new forms of circularity can be defined as the action of adaptation in the process to a circular city (Williams, 2021). Ecological regeneration is, in Hastings, encouraged with the introduction of green roofscapes, vegetated terraced roofs and water management.

In Bexhill-On-Sea, next to water and energy collection, temporary tiny houses are implemented in the design as addition to a regenerative system of circular economy. Eco-friendly, relocatable and deconstructable tiny houses are, as a resource loop that ecologically regenerates with the addition to green structures and adapts to coastal erosion, placed in retreated areas that have converted into natural environments along the coast.



roofgardens

total area	124	m2
total water	3,72	m3 per hour
directly to sewer	2,55	m3
delayed to sewer	0,44	m3
to natural system	0	m3

surplus in 2 hours	2,99	m3

sloped roofs

total area	174,2	m2
total water	5,226	m3 per hour
directly to sewer	3,8343	m3
delayed to sewer	0,67	m3
to natural system	0	m3

surplus in 2 hours	4,5043	m3

TABLE 5: WATER FLOW CALCULATION SUMMARY FOR SLOPED ROOFS WITH SOLAR PANELS AND ROOFGARDEN BASED ON EXCEL SHEETS FROM TU DELFT (2019)

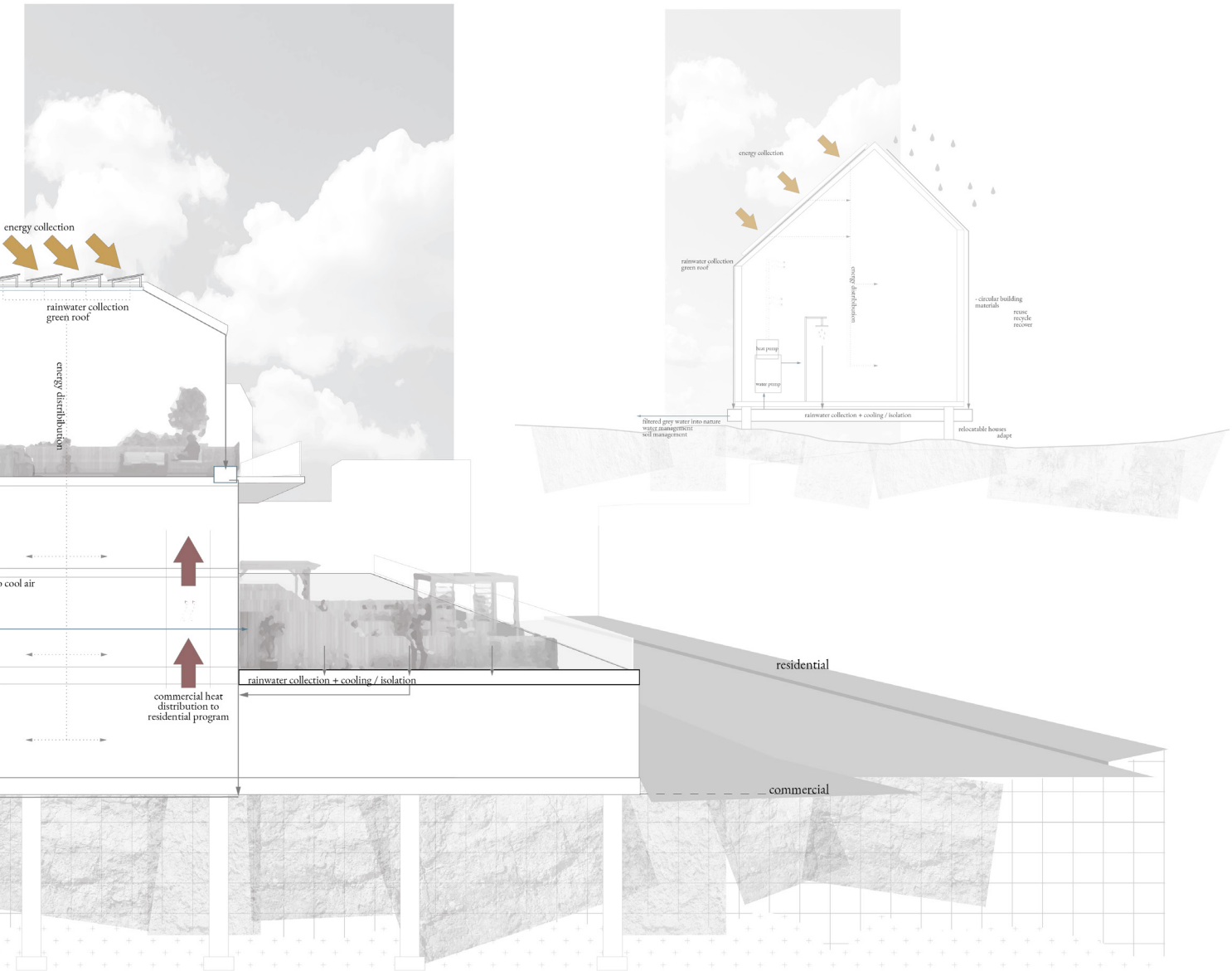


FIGURE 62: SECTIONS OF BEXHILL-ON-SEA AND REGENERATED SILVERHILL HOUSING INCLUDING RESOURCE LOOPIN, ADAPTATION AND ECOLOGICAL REGENERATION THROUGH WATER, ENERGY, HEAT AND BUILDING MATERIALS

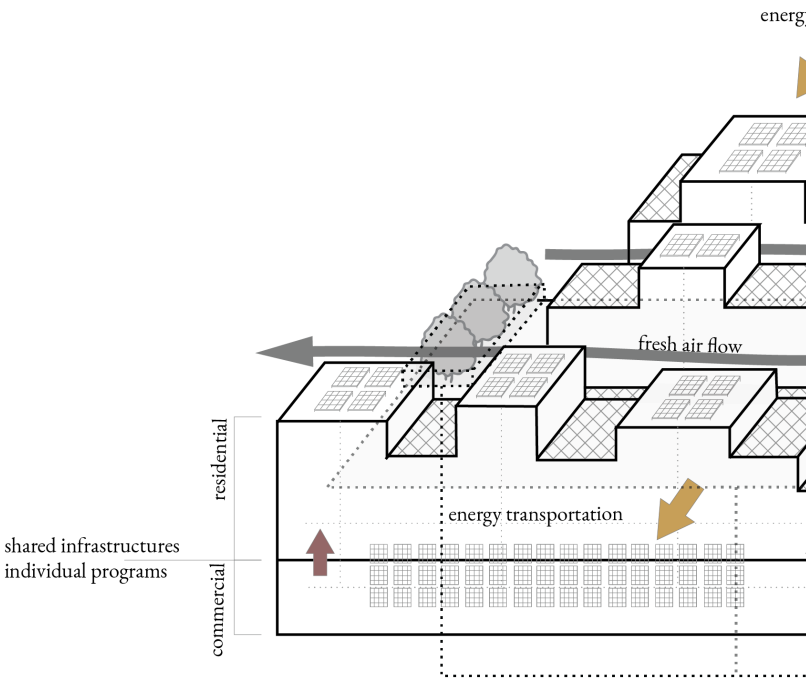
TRANSFERIBILITY TO BALDSLOW

The concept of Silverhill's densification and its sustainable design can be reused in the design for a larger location in the district of Baldslow that was used for the transferability design.

The transferability design of Baldslow introduces three types of roofscape: a roofscape for energy collection, a terraced roofscape and a semi-public roofscape that both partly function as water storage while facilitating a fresh air flow.

Energy and water is collected for use in the commercial and residential program. Vegetated roofgardens introduce water collection and the ability to cool down the roofscape and the commercial program at street level through the usage of water as isolation. Water collection tanks are integrated in this roofscape to release pressure from the sewers from the rain water for the excessive roofscape of the commercial and residential program.

To match energy collection surfaces from before topping up the roofscape, the use of vertical solar panels is needed on the southern facades. With the use of new solar panels performing on higher efficiency, this total surface aims to provide the whole block of energy.



total area	2600	m2
roof area	1840	m2
wall area	700	m2
output roof	3245	kWh per year per m2
output wall	2526	kWh per year per m2

total output	7739000	kWh per year
	100	TJ per year

total area	7521	m2
total water	225,63	m3 per hour
directly to sewer	120,535	m3
delayed to sewer	56,68	m3
to natural system	0	m3

surplus in 2 hours	177,215	m3

TABLE 6: ENERGY PRODUCTION OF BUILDING BLOCK BASED ON DATA BY NREL (N.D) AND WATER FLOW CALCULATION SUMMARY FROM EXCEL SHEET FROM TU DELFT (2019)

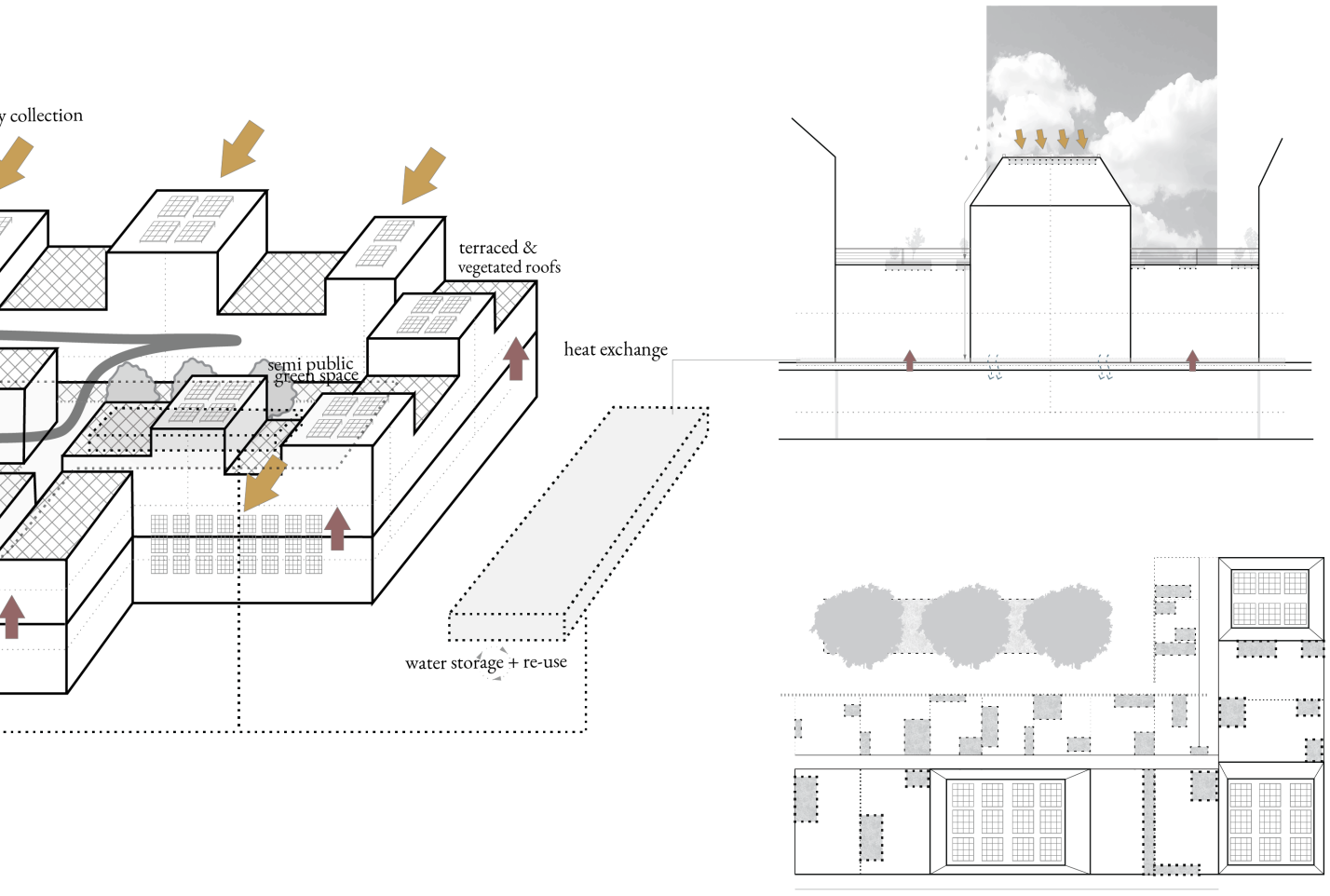


FIGURE 63: TRANSFERABILITY OF SUSTAINABILITY DESIGN IN BALDSLOW

FIGURE 64: CLIFFS OF ENGLAND (PXFUEL, N.D)

4 CONCLUSION

This chapter concludes the thesis by answering the research questions, explanation of ethical dilemmas and the thesis place in today's literature. This chapter also includes a reflection that reflecs on the research and design, the societal and scientific relevance, ethical considerations and transferability.

4.1.1 RESEARCH QUESTIONS

The thesis of Developing Strategies: Planning cities affected by coastal erosion on Southeast England's Coastline, the main question: "What aspects should an urban planning strategy for England's vulnerable coastal cities include to create a sustainable urban environment that adapts to (accelerated) Coastal Erosion?" is answered with a focus on the topics Urban Planning Strategies, Sustainable Urban Environments and (accelerated) Coastal Erosion.

CLIMATE CHANGE EFFECTS AND SUSTAINABLE URBAN ENVIRONMENTS

What are Climate Change effects and how do they impact Spatial Planning and Erosion Management in cities aiming for Sustainability?

For the understanding of spatial planning strategies in coastal England, the impact of the climate change effects on coastal urban environments (as in FIGURE 64) and their management need to be understood.
Sea level rise and the increased climate extremes are the cause of accelerated coastal change in locations with vulnerable soils. Changing water flows in combination with extreme weather conditions can result in energetic waves attacking the shoreline, and thus adapting the average sediment flow. This results in an imbalance of coastal sediments creating coastal transformations in already vulnerable coastal areas leading to environmental risks such as coastal erosion and flooding. In coastal southeast England, these effects are reduced by the use of coastal management in the form of three types Shoreline Management Plans (SMPs): No Active Intervention, Managed Realignment and Hold the Line, where, in southeast England, the latter is used as a basis within the urban territory (Environment Agency, 2020). In the case of southeast England, the SMPs are the non-statutory guidelines for Local Planning Authorities to protect from, embrace or adapt to the urban effects of coastal erosion, resulting in urban growth and need for expansion in protected areas or areas at risk (DEFRA, 2001). This need for urban growth increases the exposure of the city with the need for protection measures and, therefore, the overall vulnerability of the coastal city. This process of urban growth and need for protection measures results in a vicious circle of sensitive spatial planning and environmental risk management resulting in an unsustainable urban environment that is constantly at risk of coastal erosion and flooding.

URBAN PLANNING STRATEGIES AND COASTAL EROSION

What are current Urban Planning Strategies and how do they influence Coastal Erosion Management?

The English planning strategy is divided in three tiers, where the first tier includes the regional scale and the second and third tier are based on local scales. In this system, the local scales are responsible for most planning decisions, with the exception of transport, mineral and waste planning, with the reasoning by the Department for Communities and Local Government (2015) that planning is more effective when the affected people are an integral part of the process. This system has been introduced in 2011 with the Localism Act, after ten years of alterations of principles alternating between the local and regional scale. This repeated change of territories in the planning system can be recognized as crisis management trying to solve the unjust economic model (Lord & Tewdwr-Jones, 2012). With the Localism Act (2011), the 'Duty to cooperate' was introduced to ensure the collaboration between Local Planning Authorities and public bodies, however, due to the lack of policies and control these collaborations mainly include new construction rather than a shift towards sustainability.

The lack of policies regarding sustainability results in ignorance by Local Planning Authorities to introduce urban planning as a solution for the effects of coastal erosion instead of relying on the current unsustainable and unrealistic use of the SMPs, where a Hold the Line-strategy is applied to nearly every urban

environment regardless of the local environment its characteristics.

SOCIAL JUSTICE AND COASTAL EROSION

How can an Urban Environment adapt to the effects of Coastal Erosion and the impact on the Socio-Environmental System?

A sustainable urban environment requires a long-term nexus of the anthropogenic and ecological environment in the form of mutualism. In the case of southeast England, this can be achieved with urban retreat by coastal urban environments. In the current situation, these two environments interfere resulting in negative effects for both environments. While the natural environment causes risks in the urban environment, the urban environment pollutes the natural environment, resulting in an increasing the need for sustainability.

In the English spatial planning system, the risks of coastal erosion are carried by the residents of the cities at risk, who often lack money and awareness due to the lack of knowledge about environmental risks that derives from the Local Planning Authorities' ignorance of coastal erosion. These Local Planning Authorities should be held responsible for their past actions in ignorance towards the effects of coastal erosion and their solution to maintain an unsustainable SMP: the Hold the Line strategy. A regional strategy is needed to facilitate and compensate residents in coastal environments at risk to be included in a socially just process to sustainability. This sustainability is proposed with an urban retreat scheme that introduces hierarchy in the English regions considering the coastal erosion risk environments and providing these environments with relocation proposals and the introduction of a natural coast.

SUSTAINABLE URBAN ENVIRONMENT AND THE THEORETICAL FRAMEWORK

Can a Sustainable Urban Environment be explained through the theoretical framework?

The thesis' theoretical framework connects the sustainability framework which includes the triple bottom line of project, people, planet and prosperity with two types of social justice: spatial justice, which is defined as a fair distribution of benefits and burdens across space and environmental justice, defined as a fair distribution of environments between people, where also future generations should be considered. The thesis aims to develop a fair distribution of these benefits, burdens and environments through fairness of processes and decision making guided by safety and livability of society with respect to environmental risks, ensuring not only todays fairness, but also fairness to future generations.

Connecting the triple bottom line with social justice results in a democratic effort by society to adapt to climate change and avoid climate change effects in urban environments. The relation between the triple bottom line and social justice explains the development of a sustianable urban environment.

TOWARDS A STRATEGY OF REGIONAL RESILIENCE

The regional strategy informs the English spatial planning system and aims to create a sustainable region to environmental risks, with a focus on coastal erosion. With the introduction of a regional strategy for regional resilience and the Regional Coastal Planning Group, a platform for the integration of regional resilience is created to introduce a collaboration between scales and disciplines that include urban planning, urban design, coastal management and policy making.

To reach regional resilience, the regional strategy introduces a regional hierarchy in the form of growth centres, growth cities and cities planning for shrinkage derived from the Dutch 'Verstedelijkingsnota' (Ministerie van Volkshuisvesting en Ruimtelijke Ordening (MVRO), 1977), where cities planning for shrinkage are defined by smaller, high risk cities that are in need of a strategy against coastal erosion. Growth centres are defined as inland, low risk cities with high accessibility from coastal zones. Growth cities defined by relatively low risk cities with high national cultural value in

the region with high potential for regeneration. These growth cities and centres are destinations for relocation and, therefore, regeneration for relocatees of the cities planning for shrinkage. With this hierarchy, Local Planning Authorities are forced to include urban planning within their adaptation strategy rather than considering it as two independent fields.

The developed strategy is a long-term strategy that creates an order in deconcentration and densification with the intensive engagement of stakeholders. The strategy proposes to introduce hierarchy while considering natural and geopolitical limits. Regional resilience is expected to be achieved through the bundling of activities, introduction of ecological zones, residential regeneration and economic diversification while strengthening the growth cities through increasing accessibility and urban development (MVRO, 1977; NPPF, 2019). The strategy includes qualitative and spatial dimensions, where the qualitative dimension focuses on the addition of qualities related to tourism, identity, nature, local adaptivity and economic value to the adapted environment to ensure social sustainability rather than social risks and abandonment due to the retreat scheme. The spatial dimension introduces phases of relocation and regeneration while respecting the natural and geopolitical limits to avoid chaos and sudden depopulation of coastal environments.

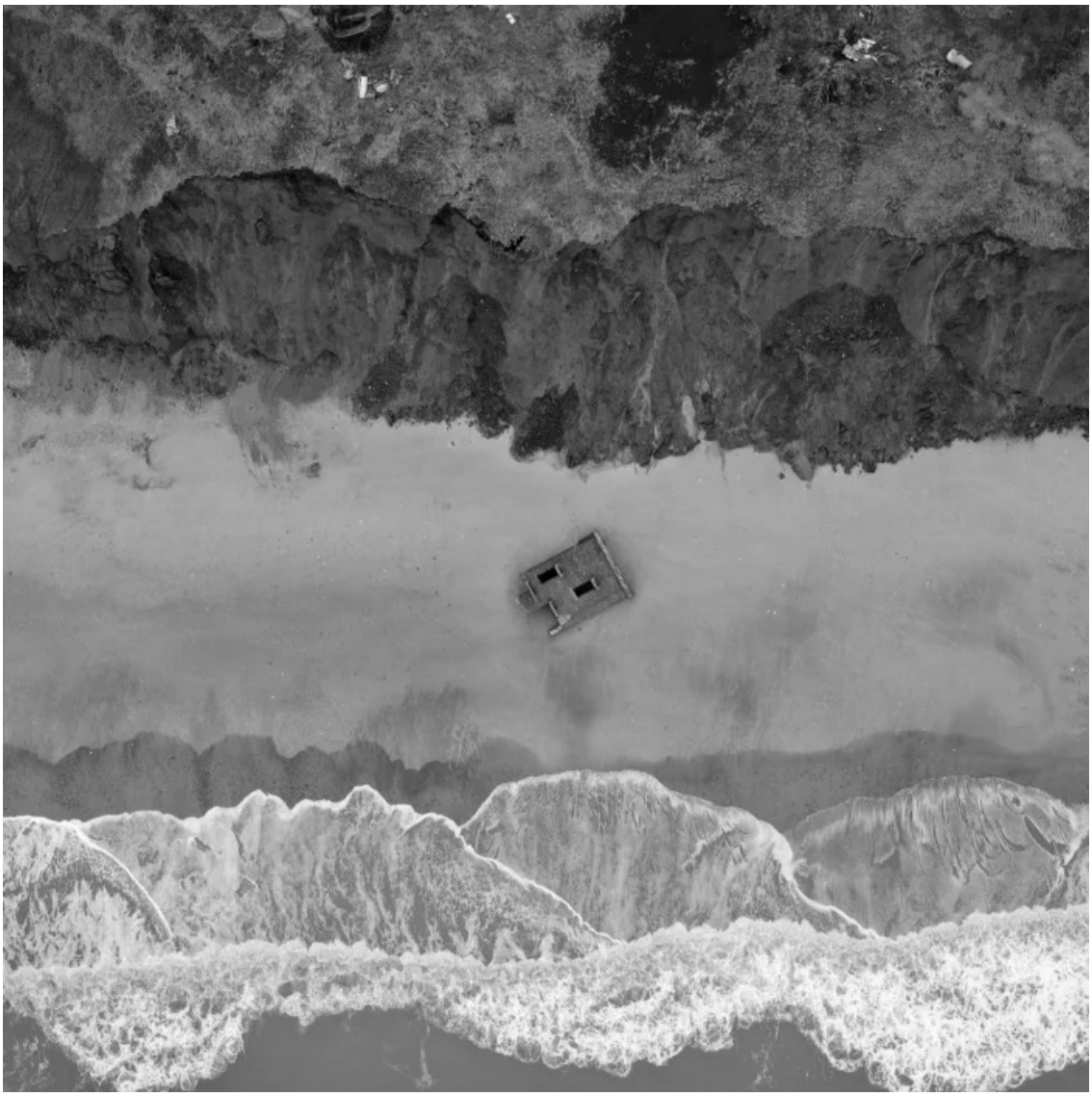


FIGURE 65: COASTAL EROSION OF THE URBAN ENVIRONMENT (FURLONG, N.D)

4.1.2 DISCUSSION

CONTRIBUTION TO THE LITERATURE

This thesis forms a critique on the current English spatial planning system and their lack of policies and legislation regarding the topic of sustainability. The planning system is socially unjust to residents in the coastal urban environment at risk of cliff fall due coastal erosion as illustrated in FIGURE 65. The integration of the current SMPs in the coastal cities can be considered unsustainable and unrealistic with the lack of collaboration and the exclusion of the regional scale. With the introduction of aspects such as the regional scale, the relation between social justice and sustainable urban environments and the collaboration across spatial planning and coastal management disciplines , the thesis aims to be an example for urban designers, urban planners, coastal managers and policy makers. The thesis suggests, with the implementation of Managed Realignment in the form of a reciprocity between cities planning for shrinkage and desnification, where English spatial planning strategies and policies should be revised and adapted to embrace the effects of coastal erosion and reach regional resilience.

The thesis provides extreme scenarios and analysis that can be used as guidelines for a strategy and can introduce a plan for regional resilience. The integration of coastal response strategies by Dronkers et al (1990) and their restrictions by geopolitical and natural boundaries results in a limited capacity to adapt to environmental risks, creating a need for spatial strategies and the introduction of social justice including spatial and environmental justice. Current policies are the baseline for the ignorance of the natural landscape and the inability of the urban environment to adapt. A change in policies, integration of the regional scale and collaboration across disciplines should be a solution to a sustainable urban environment. The thesis provides a much needed design-driven exploration of the effects of environmental risks such as coastal erosion and introduces an example of the described regional-scale design that explains the operationalisation.

The intentional use of extreme scenarios and the development of an extreme strategy aims to emotionally activate by creating an emotion of shock by stakeholders in the coastal planning discipline that includes urban designers, urban planners and coastal managers to raise awareness of the measures and solutions that are needed and to use this thesis' solutions as an example to possibly prevent future catastrophic events in the urban environment regarding coastal erosion. vv

ETHICAL DILEMMAS

In this thesis ethical dilemmas in relation to the current spatial planning system regarding coastal erosion are discussed and considered, due to the thesis' focus on sustainability in relation to social justice. The thesis balances social justice by including environmental justice and spatial justice. Tradeoffs between choices in favor of natural or urban environment are made with the relocation of coastal urban environments and disassemblance of coastal protection measures, in a process of considering different opinions and statements by stakeholders. In this thesis, decisions are made for the long-term in favor of the natural environment, which can have negative effects on the urban environment in the short-term, such as deprivation and abandonment. This enhancement of nature and decision making for the future can be difficult to understand or seem unethical by current residents of the affected coastal urban environments. To reduce the feeling of social injustice a balance between short-term and long-term decisions needs to be found with the engagement of society. This engagement aims to create a sense of ownership within decision making, giving affected residents power in the process to ensure spatial and environmental justice.

The plan for relocation to other cities can be considered as another ethical dilemma as

residents of coastal urban environments do possibly not want to relocate to a regenerated city centre. While in the thesis, coastal residents are expected to relocate to these appointed areas, residents can not be forced to move but only encouraged with the use of compensations, priority policies, a buy-to-rent scheme and knowledge distribution of coastal erosion effects. And even then, how ethical is it to make abandonment plans for someone's home? While in the long-term this strategy seems an utopia, the strategy is expected to be achieved in a gradual process, aiming to minimize spatial and environmental injustice by informing and engaging stakeholders in the planning process and limiting natural and urban short-term negative effects.

The strategy can cause financial problems for residents and Local Planning Authorities on the short-term, but what is more important, money or peoples current and future lives? The thesis chooses to invest in peoples lives, but this can cause problems to current residents because how understanding are residents and would they want to move to possibly favor future residents? The strategy is a long-term process that future residents will benefit from, however, current residents might not be able or willing to invest in the future by retreating as there is a chance that they will not experience the benefits themselves.

4.2 REFLECTION

RESEARCH AND DESIGN

The Transitional Territories studio focuses on the urban project that is increasingly mediated by the frequency and distribution of extremes and their spatio-morphological, socio-ecological and political changes. These extremes vary per location, and this created an opportunity to do a project for a location that I have always been interested in, but never understood the actual impact of. During this project I expected many problems and solutions to be found in natural processes and changes, but further in the project I realised that the natural processes are not the cause of environmental risks, society is. Designing with this point of view allowed me to experiment with scenarios that fitted the project location and also increased my motivation to find a feasible approach.

In the studio of Transitional Territories, the maritime dynamics, as well as the coastal ecosystems and the need for revision of coastal spatial planning systems due to climate change and economic development are to be analysed and translated into an urban design that provides a sustainable solution of adaptation that reacts to the extreme environment of coastal erosion. As the Transitional Territories studio started it became evident that this studio focuses on the exploration and encouragement of an approach combining ecological and infrastructural systems, which can be an effective and resilient way to adapt to climate change risks when integrated in an urban design.

My thesis aims for a collaboration between land, that includes society, and sea, that includes climate change effects, to find a spatial planning solution that adapts to the effects of coastal erosion and is enhanced by coastal ecosystems to provide a safe and livable environment for not only residents of coastal urban environments, but also ecosystems within and near these environments. With this project I aim to be an example of spatial planning collaboration in

the regional scale to create regional resilience in a long-term spatial planning strategy by adapting the current spatial planning system in the region of south-east England in the counties of Kent and East-Sussex. These regional spatial planning systems and strategies should adapt to climate change effects that puts coastal urban environments and their residents at high environmental risk. The regional planning strategy is derived from the Dutch 'Verstedelijkingsnota (1976)' and introduces a planning hierarchy in the existing coastal cities, including cities to suitable for densification and cities planning for shrinkage. This translates into a smaller scale that can enhance the area in a qualitative matter, leading to a spatial distribution of existing and new programs and eventually a small-scale design that shows the implications of this regional strategy.

The biggest and still remaining question during this project is about possible negative reactions of current society to this regional planning strategy. However, these residents' knowledge about present and future risks is often limited to their own experiences. I believe that solving this knowledge gap by informing and engaging residents, and other stakeholders, is a crucial element of the designed strategy. This project demonstrates the close relation between urban design and the involvement of spatio-morphological, socio-ecological and political systems, wherein the Anthropocene society has altered the surfaces and systems to serve society over other functions. The task of an urbanist is to balance the natural and human systems to provide a sustainable urban environment that limits damages to the natural environment.

METHODS AND APPROACH

The thesis follows the DOCA approach by FABRIC, integrated into the Six-step approach by Hooijmeijer et al (2020). Where the DOCA approach (Data, Opportunities, Challenges & Anecdotes) forms the foundation of the project by analysing the existing environment with data and mapping to find opportunities, challenges and anecdotes through literature review, critical mapping, scenario development, stakeholder analysis and spatio-temporal analysis. The Six-step approach forms the methodology of the overall project process including analysis, design and evaluation.

The first research method is initiated by the Transitional Territories studio and includes the collection of data and mapping on the respective locations, to get to know the territorial context of the chosen project location. Cartography of aspects of Matter, Topos, Habitat and Geopolitics helped me to identify locations vulnerable to aspects that are related to coastal erosion and understanding the present and future risks that should be integrated into the project.

From this first critical mapping and stakeholder analysis, scenarios could be developed through the scales that resulted in the formulation of a strategy and eventually a design that reaches a qualitative, spatial and design scale. The limits of this scenario development were found in the involvement of residents in this process. Due to the current travelling restrictions, it was difficult to include small scale stakeholders and their opinions in the decision-making of selecting a scenario to include in the strategy. However, an attempt was made to include different groups of stakeholders by discussions with larger stakeholders involved in both spatial planning and coastal erosion management and including not only their business point of view but also their personal opinions on the project with possible outcomes and expectations. Discussions with these stakeholders have led to interesting new points of view that have helped me forward with my project when it was needed.

Another way to include residents as a stakeholder in the project was through literature including social justice and the use of representative case-studies in and outside of England. These limits weigh in on the end result of the selected strategy and the expected role of stakeholders in the process. It is, to me, unknown what residents' opinions and feelings about the current system of coastal spatial planning

and future planning systems, resulting in a possibly underdeveloped model of small-scale stakeholder engagement and attitudes.

From using these methods and approaches in this project, I developed an understanding that the lack of reaction of spatial planning to coastal erosion and adapting this to a sustainable planning system is an essential, long-term, process to create sustainable coastal region in southeast England.

SCIENTIFIC AND SOCIETAL RELEVANCE

This project contributes to the worldwide efforts to find sustainable urban environments in coastal regions that are able to adapt to climate change effects. The thesis addresses 'urban retreat' by Dronkers et al (1990) as a response strategy to avoid urban vulnerability, but also to restore natural coastlines and avoid interference of coastal ecosystems while respecting geopolitical and natural boundaries. Retreat goes hand-in-hand with the concept of 'planning for shrinkage' and works as a reciprocity with areas suitable for densification in a strategy derived from the Dutch 'Verstedelijkingsnota' (Ministerie van Volkshuisvesting en Ruimtelijke Ordening (MVRO), 1977). The thesis introduces a collaboration between coastal planning disciplines on the regional scale that are currently not implemented in the English planning system. This collaboration aims to find co-dependency between coastal cities that are planning for shrinkage or are suitable for densification by assessing their individual risks with a focus on drivers, derived from Vafa (2018).

The thesis attempts to be innovative by contradicting the current trend of defending the present coastline and its coastal urban environments by the Environment Agency (2020) and redirecting the favor to the natural environment. The trend of nature adapting to the urban environment should be overturned to the urban environment adapting to nature. Therefore, a shift in mindset is needed within the political environment in both spatial and temporal scales (Torabi and Dedekorkut-Howes, 2020).

For the human scale these interventions introduce a system in the form of a regional strategy to fall back on where coastal erosion effects reach urban environments. Leaving the residents of coastal urban environments with a chance to adapt to future climate change effects rather than react after climate change effects with limited prospects. Where England's current spatial planning strategies abandon the coastal society, this regional strategy aims to include residents in the planning process increasing the opportunities to achieve regional resilience, but also provide an opportunity to be able to re-imagine future cities while considering climate change and resource loops that are still to be explored (Siders et al, 2019; Black et al 2011).

In this project, I propose a change in mindset to adapt to the ever-changing natural environment rather than dominating the natural environment as society. This project defines social justice as a strategic objective and as a fundamental concept within spatial planning as a reaction to coastal erosion, where sustainable urban environments can be explained as component of social justice. Spatial justice and environmental justice are domains in social justice that are considered within the natural environment and the built environment to reach both social sustainability as environmental and spatial sustainability.
This project contributes to several Sustainable Development Goals described by the United Nations that include safety, health, economy, partnerships and are needed to build sustainable cities and communities.

RESEARCHER BIAS

The thesis for Developing Strategies for coastal southeast England critically reflects on the English spatial planning system, while proposing new strategies and policies to improve the existing system with a focus on social sustainability. Therefore, ethical considerations need to be acknowledged.

First of all, my background in the Dutch

spatial planning system as a Dutch student at the TU Delft Faculty of Architecture and Built Environment, influences my view on the English planning system. While I critically reflect on this system in my thesis, the proposed changes do not aim to change the entire planning system, but add to the current system with a regional scale, the strategic objective of social justice and new policies in a search for regional resilience and Sustainable Urban Environments. The thesis uses Dutch planning knowledge as a guideline to respectfully propose suggestions for the English planning system with the introduction of regional scale. These suggestions implement proposals of the literature and case-studies in a bigger scale to facilitate alternatives for coastal societies and Local Planning Authorities.

As a Dutch student, that has lived in the low-risk, Dutch, planning system my whole life, it can be difficult to understand why residents of coastal urban environments would want to live in high-risk environments of both coastal erosion and flooding. However, in my thesis I aim to respect, understand and engage these stakeholders and consider them as valuable assets to the planning process to achieve social sustainability as a form of social justice. With the reciprocity between cities of densification and cities planning for shrinkage, a safe living environment is proposed for coastal residents with the implementation of a strategy and several policies that introduces opportunities, qualities and safety for these residents. The aim is to create more benefits than disadvantages to create a socially just environment for both the urban environment and the natural environment.

In the thesis I try to understand the complex English planning system, however I do not claim to completely understand the details in this system but have, with the help of experts, selected the most important issues of this system regarding my project.

TRANSFERABILITY

The knowledge gained in this thesis can be used for future research in the field of development of urban strategies to adapt to environmental risks in a collaboration between urban designers, urban planners, coastal managers and policy makers. The developed strategy can be adopted in other regions that experience environmental risks such as coastal erosion. These regions can be found in other coastal parts of England, but also in other countries experiencing relating issues. If this thesis is used as an example with the intention to adopt similar strategies in countries with contrasting planning systems, this strategy should be adapted to their respective planning strategies as a guideline rather than a situation where the strategy is applied as an exact copy to respect local characteristics and be able to achieve sustainability in a new region (Stone, 2017).

The design proposal are examples of the Hastings and Bexhill-On-Sea case. The use of the regional strategy in other locations will usually have a different outcome in other coastal cities experiencing coastal erosion. In FIGURE 66 European regions similar to the southeast English region with high coastal erosion are marked as locations of regions possibly in need of a strategy that adapts to environmental risks such as coastal erosion. Further research for these locations and their respective planning systems and coastal management is needed for the right implementation of a regional strategy.

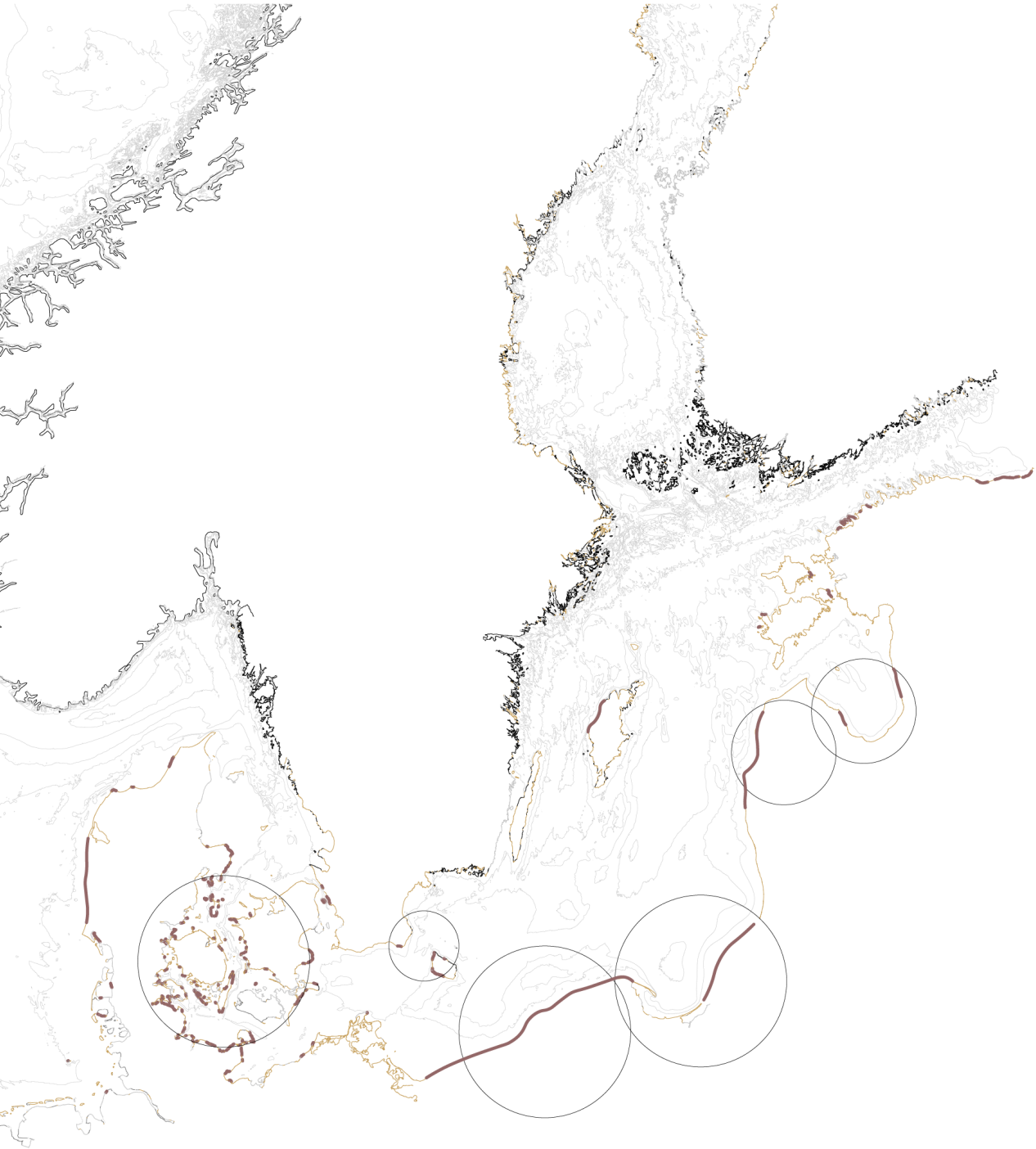


FIGURE 66: EUROPEAN REGIONS WITH COASTAL CONDITIONS VULNERABLE TO COASTAL EROSION AND POSSIBLY SUITABLE FOR A TRANSFERABILITY DESIGN OF THE DEVELOPED REGIONAL STRATEGY.
Data from OpenDEM (2019) and EUROSION (2004)

REFERENCES

5

LITERATURE

2B.3B *Rock Strata and Complex Cliff Profiles*. (n.d.). A-LEVEL GEOGRAPHY REVISION: EDEXCEL. Accessed on 25 oktober 2020, from https://geographyrevisionalevel.weebly.com/2b3b-rock-strata-and-complex-cliff-profiles.html

Actavo. (2019). 4 reasons why modular is more sustainable than traditional construction. Accessed on 2 February 2021, from https://actavo.com/latest-news/4-reasons-why-modular-is-more-sustainable-than-traditional-construction/

Alexander, K. S., Ryan, A. & Measham, T. G. (2012). Managed retreat of coastal communities: understanding responses to projected sea level rise. *Journal of Environmental Planning and Management*. 55(4). 409-433. https://doi.org/10.1080/09640568.2011.604193

Arnell, N. W. & Reynard, N. S. (1996). The effects of climate change due to global warming on river flows in Great Britain. *Journal of Hydrology*. https://doi.org/10.1016/0022-1694(95)02950-8

Apine, L. (2011). Residents' attitude towards possible adaptation measures to the sea coast erosion in Latvia. *International Journal of Climate Change Strategies and Management*. 3(3). 238-249. https://doi.org/10.1108/17568691111153393

BGS. (2020). *UK Soil Observatory.* UKSO. Accessed on 1 November 2020, from http://mapapps2.bgs.ac.uk/ukso/home.html

Black, R., Bennett, S. R. G., Thomas, S. M., & Beddington, J. R. (2011). Migration as adaptation. Nature, 478(7370), 447–449. https://doi.org/10.1038/478477a

Boardman, J., Evans, R., Favis-Mortlock, D., & Harris, T. (1990). Climate change and soil erosion on agricultural land in England and Wales. *Land Degradation & Development*. 2. 95-106. https://doi.org/10.1002/ldr.3400020204 .

Boateng, I. (2010). *Spatial Planning in Coastal Regions* (Commission 8). International Federation of Surveyors. https://www.researchgate.net/publication/262493763_Spatial_Planning_in_Coastal_Regions_Facing_the_Impact_of_Climate_Change

Böhme, C., Preuß, T., Bunzel, A., Reimann, B., Seidel-Schulze, A., & Landua, D. (2015). *Environmental justice in urban areas – Development of practically oriented strategies and measures to reduce socially unequal distribution of environmental burdens.* Deutsches Institut für Urbanistik gGmbH. Accessed on 16 June 2021, from https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/umwelt_und_gesundheit_01_2015_summary.pdf

Bolte, G., Pauli, A., & Hornberg, C. (2011). Environmental Justice: Social Disparities in Environmental Exposures and Health: Overview. Encyclopedia of Environmental Health, 459–470. https://doi.org/10.1016/B978-0-444-52272-6.00685-1

Bray, M.J. & Hooke, J.M. (1997). Prediction of soft-cliff retreat with accelerating sea-level rise. *Research*. 13(2). 453-467. Fort Lauderdale (Florida).

Brick Hunter. (2019). *Brick or render?*. Accessed on 22 March 2021, from https://brickhunter.com/blog/brick-or-render

Brigden, M. (2013). *The Pros and Cons of Brick and Block Construction – The Green Home.* The Green Home. Accessed on 22 March 2021, from http://thegreenhome.co.uk/builing-products/brick-and-block-construction/

Brown, S., Barton, M., & Nicholls, R. (2011). Coastal retreat and/or advance adjacent to defences in England and Wales. *Journal of Coastal Conservation*. 15(4). 659–670. https://doi.org/10.1007/s11852-011-0159-y

Burden, A., Smeaton, C., Angus, S., Garbutt, A., Jones, L., Lewis H.D. & Rees. S.M. (2020) Impacts of climate change on coastal habitats relevant to the coastal and marine environment around the UK. *MCCIP Science Review 2020*. 228–255. https://doi.org/10.14465/2020.arc11.chb

Bush, J., & Doyon, A. (2019). Building urban resilience with nature-based solutions: How can urban planning contribute? Cities, 95, 1–8. https://doi.org/10.1016/j.cities.2019.102483

Cacciaguerra, G. (2015). Urban re-densification and regeneration: 21st century city strategies. *Sustainable Development and Planning VII*. 193. 217–226. https://doi.org/10.2495/sdp150181

Cambridge University Press. (2020). Habitat. *In Cambridge Dictionary*. Accessed on 25 October 2020, fromhttps://dictionary.cambridge.org/dictionary

CDRC Maps. (2019). *CDRC Maps: Maps of UK open data*. Accessed on 2 February 2021, from https://maps.cdrc.ac.uk

City Population (n.d) South East England (United Kingdom): Counties and Unitary Districts & Settlements - Population Statistics, Charts and Map. City Population. Accessed on 2 January 2021, from https://www.citypopulation.de/en/uk/southeastengland/

Confused.com. (2019). *Living on the edge*. Accessed on 2 November 2020, from https://www.confused.com/home-insurance/living-on-the-edge

Cooper, J. A. G., & McKenna, J. (2008). Social justice in coastal erosion management: The temporal and spatial dimensions. *Geoforum.* 39(1). 294–306. https://doi.org/10.1016/j.geoforum.2007.06.007

Cooper, N. J. (2003). The use of managed retreat in coastal engineering. *Engineering Sustainability.* 156(2). 101–110. https://doi.org/10.1680/ensu.156.2.101.37009

Coppin, N.J. & Richards, I.G. (1990). Use of Vegetation in Civil Engineering. Butterworth. London. 272.

Clayton, K. & Shamoon, N. (1998). New approach to the relief of Great Britain II. A classification of rocks based on relative resistance to denudation. *Geomorphology*. 25. 155-171.

CRL. (2018). Advantages and disadvantages of modular construction. Accessed on 22 March 2021, from https://c-r-l.com/content-hub/article/modular-construction/

Czop, K. (2019). Infographic 2- Resource Loop. CircularPP. Accessed on 24 June 2021, from http://circularpp.eu/infographic-2-resource-loop/

data.gov.uk. (2019). *Find open data - data.gov.uk* [Dataset]. data.gov.uk. https://data.gov.uk/

Dahm, C. (2002). Beach user values and perceptions of coastal erosion. Environment Waikato
Technical Report. *Environment Waikato*. Hamilton.

DEFRA. (2001). Shoreline Management Plans—A Guide for Coastal Defence Authorities. Defra Publications. London

DEFRA. (2006). Procuring the Future—The Sustainable Procurement Task Force National Action Plan. DEFRA. London.

Department for Communities and Local Government. (2010). *Planning Policy Statement 25 Supplement:Development and Coastal Change Practice Guide*. Crown. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/247455/0971.pdf

Department for Communities and Local Government. (2012). *Annual report on England's housing stock.* The Crown. https://

assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6748/2173483.pdf

Department for Communities and Local Government. (2015). *Plain English guide to the Planning System*. Crown. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/391694/Plain_English_guide_to_the_planning_system.pdf

Doody, J.P. (2004). Coastal squeeze - an historical perspective. *Journal of Coastal Conservation*. 10. 129-138. https://doi.org/10.1652/1400-0350

Doody, J. P. (2013). Coastal squeeze and managed realignment in southeast England, does it tell us anything about the future?. *Ocean & Coastal Management*. 79. 34–41. https://doi.org/10.1016/j.ocecoaman.2012.05.008

Dornbusch, U., Robinson, D. A., Moses, C., Williams, R., & Costa, S. (2006). Retreat of Chalk cliffs in the eastern English Channel during the last century. Journal of Maps. 2(1). 71–78. https://doi.org/10.4113/jom.2006.46

Dronkers, J., Gilbert, J. T. E., Butler, L. W., Cary, J. J., Campbell, J., James, E., McKenzie, C., Misdorp, R., Quin, N., Ries, K. L., Schroder, P. C., Spradley, J. R., Titus, J. G., Vallianos, L, & von Dadelszen, J. (1990). Strategies for Adaptation to Sea Level Rise. Report of the IPCC Coastal Zone Management Subgroup: Intergovernmental Panel on Climate Change. Geneva: Intergovernmental Panel on Climate Change

Duany Plater-Zyberk & Co. (2001). Transect Code (Miami, Duany Plater-Zyberk & Co.

Ducrotoy, J., & Elliott, M. (2008). The science and management of the North Sea and the Baltic Sea: Natural history, present threats and future challenges. Marine Pollution Bulletin. 57(1–5). 8–21. https://doi.org/10.1016/j.marpolbul.2008.04.030

ebird. (n.d.). eBird - *Discover a new world of birding*... Accessed on 19 October 2020, from https://ebird.org/ebird/home

EEA. (2019). *Data and maps* [Dataset]. EEA. https://www.eea.europa.eu/data-and-maps

Elam, J., & Björdal, C. (2020). A review and case studies of factors affecting the stability of wooden foundation piles in urban environments exposed to construction work. I*nternational Biodeterioration & Biodegradation*. 148. 1–9. https://doi.org/10.1016/j.ibiod.2020.104913

England Explore. (2020). British Coastal Wildlife: The Birds, Fish & Other Animals Of The British Coastline | englandexplore. englaadmin. https://englandexplore.com/british-coastland-wildlife/

Environment Agency. (2020). *SMPS Environment Agency ArcGIS*. National Coastal Erosion Risk Mapping. Accessed on 5 February 2021, from https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=9cef4a084bbb4954b970cd35b099d94c

Environment Agency. (2021). *Shoreline management plans (SMPs).* GOV.UK. Accessed on 5 February 2021, from https://www.gov.uk/government/publications/shoreline-management-plans-smps/shoreline-management-plans-smps

Esteves, L. S. (2013). Is managed realignment a sustainable long-term coastal management approach? *Journal of Coastal Research*. 65. 933–938. https://doi.org/10.2112/si65-158.1

EUROSION. (2004). Living with Coastal Erosion in Europe: Sediment and Space for Sustainability. http://www.eurosion.org/reports-online/part1.pdf

Ferrante, A., Fotopoulou, A., & Mazzoli, C. (2020). Sustainable Urban Regeneration through Densification Strategies: The Kallithea District in Athens as a Pilot Case Study. *Sustainability*. 12(22). 1–21. https://doi.org/10.3390/su12229462

Fleming, C.A. (1992). The development of coastal engineering. *Coastal Zone Planning and Management*. Thomas Telford. London. 5–20.

Frew, P. (2012). Adapting to coastal change in north Norfolk, UK. *Proceedings of the Institution of Civil Engineers - Maritime Engineering*. 165(3). 131–138. https://doi.org/10.1680/maen.2011.23

GEBCO. (2020). *Nearly a fifth of world's ocean floor now mapped.* Accessed on 22 November 2020, from https://seabed2030.gebco.net/news/gebco_2020_release.html

Gibbard, P. (2017). The real story behind Britain's geological exit. *Physics Today*, 1–4. https://doi.org/10.1063/pt.6.1.20170607a

Gilbert, O. L. (2003). The lichen flora of unprotected soft sea cliffs and slopes. *The Lichenologist*. 35(3). 245–254. https://doi.org/10.1016/s0024-2829(03)00026-4

Google. (2021; 2020; 2009). Google Maps [Streetview]. https://www.google.nl/maps

Golawski, P. (2018). Advantages and disadvantages of modular homes. Accessed on 22 March 2021, from https://medium.com/@piotrgoawski/advantages-and-disadvantages-of-modular-homes-3592799ea

Haase, D., Haase, A., & Rink, D. (2014). Conceptualizing the nexus between urban shrinkage and ecosystem services. *Landscape and Urban Planning*. 132. 159–169. https://doi.org/10.1016/j.landurbplan.2014.09.003

Hazelden, J., & Boorman, L. A. (2001). Soils and managed retreat in South East England. *Soil Use and Management*. 17(3). 150–154. https://doi.org/10.1079/sum200166

HMSO (Her Majesty's Stationary Office). (2011). Localism Act 2011. Crown

Hodgson, C. (2020). Britain's disappearing coastline: 'Right now we abandon people'. Financial Times. Accessed on 2 March 2021, from https://www.ft.com/content/2f93cc1b-08ea-49d0-8c5a-dfd2ad3c2177

Hooimeijer, F., Rizzetto, F., Acheilas, I., ter Heijden, W., de Vette, K., von der Tann, L., & Durand Lopez, L. (2020). Subsurface Equilibrium: Transformation towards synergy in construction of urban systems. Delft University of Technology.

Hurst, M. D., Rood, D. H., Ellis, M. A., Anderson, R. S., & Dornbusch, U. (2016). Recent acceleration in coastal cliff retreat rates on the south coast of Great Britain. *Proceedings of the National Academy of Sciences*. 113(47). 13336–13341. https://doi.org/10.1073/pnas.1613044113

Hyams, A. & McCann, E. (2018) Construction Methods Modular. *Building Magazine*. https://www.buildoffsite.com/content/uploads/2018/07/Unlocking-the-Potential-of-Modular-Construction_Building-FINAL-by-Anilea.pdf

ILiveHere UK. (2017). *Socio-economic statistics for [city in Southeast England]*. iLiveHere - Britain's worst places to live. https://www.ilivehere.co.uk/statistics-[city-in-england].html

Jeddi Farzaneh, O., Daryani, S., & Mokhberkia, M. M. (2019). Explanation of Urban Development Patterns in Order to Sustainable Development. *Urban Manage Energy Sustainability.* 1(2). 55–63. https://doi.org/10.22034/ijumes.2017.18.12.019

Jennings, V. & Bamkole, O. (2019). The relationship between social cohesion and urban green space: An avenue for health promotion.

International Journal of Environmental Research and Public Health. 16(3). https://doi.org/10.3390/ijerph16030452

JNCC. (2020). *UKBI Protected Areas*. Accessed on 15 December 2020, from https://jncc.gov.uk/our-work/ukbi-c1-protected-areas/

Johnson, M. A., Kenyon, N. H., Belderston, R. H., & Stride, A. H. (1982). Sand Transport. *Offshore Tidal Sands: An Introduction*. 58-94.

Kent County Council & KISS. (2008). *Land Cover Change Kent 1961-2008*. Kent County Council. https://www.kent.ac.uk/sac/50farmers/images/maps/pdf/Kent%20County%20Land%20Cover%20Change%20Table.pdf

Kirby, J., Masselink, G., Poate, T., Scott, T., Essex, S., & Ridgewell, J. (2020). *Coastal Change Management Areas A National Overview* [Presentation slides]. Sweep. https://sweep.ac.uk/wp-content/uploads/3.1.2-Kirby.pdf

Larson, D. W., Matthes, U., & Kelly, P. E. (2000). *Cliff Ecology: Pattern and Process in Cliff Ecosystems* (Cambridge Studies in Ecology). 1st edition. Cambridge University Press.

Lord, A., & Tewdwr-Jones, M. (2012). Is Planning "Under Attack"? Chronicling the Deregulation of Urban and Environmental Planning in England. *European Planning Studies*. 22(2). 345–361. https://doi.org/10.1080/09654313.2012.741574

Lovell, H., & Smith, S. (2010). Agencement in housing markets: The case of the UK construction industry'. *Geoforum*. 41(3). 457-468. https://doi.org/10.1016/j.geoforum.2009.11.015

Mangor, K. (2004). Shoreline Management Guidelines. *DHI Water and Environment*. 294.

Manuel, J. (2012). Social and Spatial Justice: Grassroots Community Action. Open Lab. 1–4. Accessed on 13 June 2021, from http://depts.washington.edu/tatlab/socialjustice/wp-content/uploads/2016/02/Manuel-Social-and-Spatial-Justice-Supporting-Grassroots-Community-Action.pdf

Maritime Archeology Trust. (2019). *Forgotten Wrecks of the First World War - Interactive Chart. Forgotten Shipwrecks*. https://map.forgottenwrecks.org/

Marine Management Organisation. (2020). *Our MMO story- the next ten years*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/901328/mmo_the_next_10_years_web.pdf

Marine Management Organisation. (2019). *Marine licensing - Definitions*. GOV.UK. Accessed on 10 December 2020, from https://www.gov.uk/guidance/marine-licensing-definitions

Marchand, M. (2010). Concepts and Science for Coastal Erosion Management. Concise report for policy makers. Deltares. Delft. 2010. Accessed on 16 November 2020, from http://www.conscience-eu.net/documents/concise-report-final.pdf

Masselink, G., & Russell, P. (2013). Impacts of Climate Change on Coastal Erosion. *Marine Climate Change Impacts Partnership: Science Review*. 71–86. https://doi.org/10.14465/2013.arc09.071-086

Ministerie van Infrastructuur en Milieu. (2013). *Ontwerp Structuurvisie Infrastructuur en Ruimte*. Rijkswaterstaat. https://www.commissiemer.nl/docs/mer/p25/p2524/2524-062ontwerpstructuurvisie.pdf

Ministry of Housing, Communities & Local Government. (2019). *National Planning Policy Framework*. National Planning Policy Framework. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

Ministerie van Volkshuisvesting en Ruimtelijke Ordening (1977). Derde Nota over de Ruimtelijke Ordening – Deel 2. Verstedelijkingsnota. Ministerie van VRO. Den Haag.

Moore, R., Clark, A. R. & Lee, E. M. (1998). Coastal Cliff behaviour and management: Blackgang, Isle of Wight. In: Maund, J. G. & Eddleston, M. (eds) *Geohazards in Engineering Geology*. Geological Society, London, Engineering Geology Special Publications. 15.49-59.

Moore, R., & Davis, G. (2014). Cliff instability and erosion management in England and Wales. *Journal of Coastal Conservation*. 19(6). 771–784. https://doi.org/10.1007/s11852-014-0359-3

Morris, M. (1962). 'A West Indian student in England'. *Caribbean Quarterly*. 17–29.

MTX (2017). Modular Vs. Traditional Construction. Accessed on 22 March 2021, from www.mtxcontracts.co.uk/modular-vs-traditional-construction/

National Trail. (2021). *The Trails*. Accessed on 4 May 2021, from https://www.nationaltrail.co.uk/en_GB/trails/

National Trust. (2015). *Cliff top wildlife*. Accessed on 19 October 2020, from https://www.nationaltrust.org.uk/the-white-cliffs-of-dover/features/cliff-top-wildlife-

Natural England. (2021). *England Coast Path* - Stretch Progress. The Crown. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984383/coastal-access-england-map.pdf

Natura 2000 End 2019 - Shapefile. (2019). [Dataset]. EEA. Accessed on 4 November 2020, from https://www.eea.europa.eu/data-and-maps/data/natura-11/natura-2000-spatial-data/natura-2000-shapefile-1

Nazir, F.A., Edwards, D.J., Shelbourn, M., Martek, I., Thwala, W.D.D. & El-Gohary, H. (2020). Comparison of modular and traditional UK housing construction: a bibliometric analysis. *Journal of Engineering, Design and Technology*. 19. 164–186. https://doi.org/10.1108/jedt-05-2020-0193

NDFF. (n.d.- a) *NDFF Verspreidingsatlas*. Verspreidingsatlas. Accessed on 19 October 2020, from https://www.verspreidingsatlas.nl/

NDFF. (n.d.-b). *[Plants coastal cliffs]. Verspreidingsatlas*. Accessed on 19 October 2020, from https://www.verspreidingsatlas.nl/

Neal, W. J., Bush, D. M., & Pilkey, O. H. (2017). Managed Retreat. *Encyclopedia of Earth Sciences Series*. 1–7. https://doi.org/10.1007/978-3-319-48657-4_201-2

Nearing, M. A., Xie, Y., Liu, B., & Ye, Y. (2017). Natural and anthropogenic rates of soil erosion. *International Soil and Water Conservation Research*. 5(2). 77–84. https://doi.org/10.1016/j.iswcr.2017.04.001

Neumann, B., Vafeidis, A. T., Zimmermann, J., & Nicholls, R. J. (2015). Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment. PLOS ONE, 10(3), 1–34. https://doi.org/10.1371/journal.pone.0118571

Nicholls, R. J., Townend, I. H., Bradbury, A. P., Ramsbottom, D., & Day, S. A. (2013). Planning for long-term coastal change: Experiences from England and Wales. *Ocean Engineering*. 71. 3–16. https://doi.org/10.1016/j.oceaneng.2013.01.025

NoiseCat, J. B. (2019). No, climate action can't be separated from social justice. The Guardian. Accessed on 13 June 2021, from https://www.theguardian.com/commentisfree/2019/jun/10/no-climate-action-cant-be-separated-from-social-justice

Nong, D. H., Lepczyk, C. A., Miura, T., & Fox, J. M. (2018). Quantifying urban growth patterns in Hanoi using landscape expansion modes and time series spatial metrics. *PLOS ONE*. 13(5). https://doi.org/10.1371/journal.pone.0196940

Noy, I. (2020). Paying a Price of Climate Change: Who Pays for Managed Retreats? *Current Climate Change Reports*, 6(1), 17–23. https://doi.org/10.1007/s40641-020-00155-x

NREL. (n.d.). PVWatts Calculator. PVWatts Calculator. Accessed on 23 June 2021, from https://pvwatts.nrel.gov/pvwatts.php

ODMP. (2004). *Planning Policy Statement 12: Local Development Frameworks*. Crown. https://files.cambridge.gov.uk/public/ldf/coredocs/RD-GOV-140.pdf

ODPM (2005). *Planning Policy Statement 1: Delivering Sustainable Development*. Crown

Oliveira, S., Burch, J., Hutchison, K., Adekola, O., Jaradat, S. & Jones, M. (2019). Making Modular Stack Up: Modern Methods Of Construction In Social Housing. 19-22. https://www.flagship-group.co.uk/media/1921/full-report-final.pdf

ONS. (2017). *Socioeconomic statistics England*. Office for National Statistics. Accessed on 2 January 2021, from https://www.ons.gov.uk/

ONS. (2020). Coastal towns in England and Wales - Office for National Statistics. ONS. Accessed on 16 June 2021, from https://www.ons.gov.uk/businessindustryandtrade/tourismindustry/articles/coastaltownsinenglandandwales/2020-10-06

OpenDEM. (2019). OpenDEM. Accessed on 2 November 2020, from https://www.opendem.info/download_bathymetry.html

Ostrom, E. (2015). Governing the commons: The evolution of institutions for collective action. Governing the Commons: The Evolution of Institutions for Collective Action. https://doi.org/10.1017/CBO9781316423936

Planning Officers' Society (2001). *Planning for Change*. Planning Officers' Society.

Policy Planning Office. (2015). *An Overview of Spatial Policy in the United Kingdom*. An Overview of Spatial Planning Policy in Asian and European Countries. https://www.mlit.go.jp/kokudokeikaku/international/spw/general/uk/index_e.html

Prémaillon, M., Regard, V., Dewez, T. J. B., & Auda, Y. (2018). GlobR2C2 (Global Recession Rates of Coastal Cliffs): a global relational database to investigate coastal rocky cliff erosion rate variations. *Earth Surface Dynamics*. 6(3). 651–668. https://doi.org/10.5194/esurf-6-651-2018

Preston, I., Banks, N., Hargreaves, K., Kazmierczak, A., Lucas, K., Mayne, R., Downing, C., & Street, R. (2014). Climate Change And Social Justice: An Evidence Review. JRF. Accessed on 13 June 2021, from https://www.jrf.org.uk/report/climate-change-and-social-justice-evidence-review

Prime Minister's Office. (2020). *New plans to make UK world leader in green energy*. GOV.UK. Accessed on 15 December, 2020 from https://www.gov.uk/government/news/new-plans-to-make-uk-world-leader-in-green-energy

Queen's Printer of Acts of Parliament. (1998). *The Regional Development Agencies Act 1998 (Commencement No. 1) Order 1998*. legislation.gov.uk. https://www.legislation.gov.uk/uksi/1998/2952/article/2/made

Rahman, M. (2014). Barriers of Implementing Modern Methods of Construction. *Journal of Management in Engineering*. 30(1). https://doi.org/10.1061/(ASCE)ME.1943-5479.0000173

Rawls, J. (1971). A theory of Justice. Cambridge, Mass.: Harvard University Press.

Readman, P. (2014). The Cliffs are not Cliffs: The Cliffs of Dover and National Identities in Britain, c.1750-c.1950. *History*. 99(335). 241–269. https://doi.org/10.1111/1468-229x.12054

Rhodes, C. (2018). *Construction industry: statistics and policy*. House of Commons Library. 3-5. Available from: www.researchbriefings.files.parliment.uk

Robinson, D. A., University of Sussex, & Williams, R. B. G. (1984). The High Weald Coast From Hastings To Pett Level. *Classic Landforms of The Weald*. 4. 39–43. Accessed on 3 October 2020, from http://www.sussex.ac.uk/geography/researchprojects/coastview/Fairlight/Classic_landforms_of_the_weald

Rother District Council. (2011). *Bexhill Town Profile*. https://www.rother.gov.uk/wp-content/uploads/2020/01/Bexhill_Town_Profile.pdf

RSPB. (n.d.). *Spectacular UK Seabirds*. The RSPB. Accessed on 19 October 2020, from https://www.rspb.org.uk/birds-and-wildlife/natures-home-magazine/birds-and-wildlife-articles/features/enjoy-a-seabird-spectacular/

Ruffell, A., Ross, A. & Taylor, K. (1996). Early Cretaceous Environments of the Weald. *Geologists' Association Guide*. 55. 81.

Select Committee on Regenerating Seaside Towns and Communities. (2019). *The future of seaside towns*. House of Lords. https://publications.parliament.uk/pa/ld201719/ldselect/ldseaside/320/320.pdf

Shnizai, Z. (2012). Landslip Remediation of Fairlight Cove, Brighton Cliff. *MSc Environmental Geology*. https://www.researchgate.net/publication/331114066_Landslip_Remediation_of_Fairlight_Cove_Brighton_Cliff_MSc_Environmental_Geology

Siders, A., Hino, M., & Mach, K. J. (2019). The case for strategic and managed climate retreat. Science. 365(6455). 761–763. https://doi.org/10.1126/science.aax8346

Soja, E. (2009). The city and spatial justice. Spatial Justice, 1–5. Accessed on 13 June 2021, from https://www.jssj.org/wp-content/uploads/2012/12/JSSJ1-1en4.pdf

Stan, A. (2013). Morphological patterns of urban sprawl territories. *Urbanism. Architecture. Constructions*. 4(4). 11–24.

Statista. (2020). *Regional United Kingdom (UK) population forecast: South East of England 2016-2041*. Accessed on 10 December 2020, from https://www.statista.com/statistics/379028/south-east-of-england-population-forecast/

STBA (Sustainable Traditional Building Alliance). (2012). *Responsible retrofit of traditional buildings*. www.ihbc.org.uk/recent_papers/docs/STBAresponsible_retrofit2012.pdf

Stone, D., 2017. Understanding the transfer of policy failure: bricolage, experimentalism and translation. *Policy & Politics*. 45. 55–70. https://doi.org/10.1332/030557316x14748914098041

Sündermann, J., & Pohlmann, T. (2011). A brief analysis of North Sea physics. *Oceanologia*. 53(3). 663–689. https://doi.org/10.5697/oc.53-3.663

Talen, E. (2002). Help for Urban Planning: The Transect Strategy. *Journal of Urban Design*. 7(3). 293-312. https://doi.org/10.1080/1357480022000039349

The Cornell Lab. (n.d.). *Online bird guide, bird ID help, life history, bird sounds from Cornell*. All About Birds. Accessed on 19 October, from https://www.allaboutbirds.org/news/

The Crown Estate. (2020b). *Maps and GIS Data | The Crown Estate*

[Dataset]. The Crown Estate. https://www.thecrownestate.co.uk/en-gb/resources/maps-and-gis-data/

The Crown Estate. (2020). *Downloads | The Crown Estate*. Accessed on 15 December, from https://www.thecrownestate.co.uk/en-gb/resources/downloads/

The National Archives. (n.d.). The Cabinet Papers: Post-War Policy. https://www.nationalarchives.gov.uk/cabinetpapers/themes/post-war-policy.htm

The Self Build Guide. (2019). "Why choose masonry construction?". *The Self Build Guide*. Accessed on 22 March 2021, from www.the-self-build-guide.co.uk/masonry-construction/

Torabi, E., & Dedekorkut-Howes, A. (2020). When It's Time to Let Go: Re-Imagining Coastal Urban Living in the Face of Rising Seas. SeaCities. 39–58. https://doi.org/10.1007/978-981-15-8748-1_3

Tuan, Y. (1990). Topophilia: A Study of Environmental Perception, Attitudes, and Values (Reprint editie). Columbia University Press.

TU Delft. (2019). Water flow calculation [Excelsheet]. Brightspace. Accessed on 22 june 2021, from https://brightspace.tudelft.nl/d2l/le/content/192657/viewContent/1574554/View

Tyler, S., & Moench, M. (2012). A framework for urban climate resilience. *Climate and Development*. 4(4). 311–326. https://doi.org/10.1080/17565529.2012.745389

UK Centre for Ecology & Hydrology. (2015). *CORINE Land Cover Map datasets for the UK, Jersey and Guernsey - EIDC [Dataset]*. UK Centre for Ecology and Hydrology. Accessed on 4 November 2020, from https://catalogue.ceh.ac.uk/documents/2fad7f16-6585-438a-9fe3-a7d68ff642f9

UK Data Service. (2019). *Historic ports and coastal sailing routes in England and Wales, 1540-1914 - ReShare [Dataset]*. UK Data Service. Accessed on 4 November 2020, from https://reshare.ukdataservice.ac.uk/853711/

USGS. (n.d.). *How Much Water is There on Earth?* USGS Science for a changing world. Accessed on 17 december 2020, from https://www.usgs.gov/special-topic/water-science-school/science/how-much-water-there-earth?qt-science_center_objects=0#qt-science_center_objects

Vafa, N. (2018). *Activate Resilience on the Myagi Coast (Thesis)*. Accessed on 17 November, 2020 from http://resolver.tudelft.nl/uuid:9200c56a-e0c8-4e9e-b5b3-38e69511c49f

de la Vega-Leinert, A. C., & Nicholls, R. J. (2008). Potential Implications of Sea-Level Rise for Great Britain. *Journal of Coastal Research*. 2008(242). 342–357. https://doi.org/10.2112/07a-0008.1

Williams, J. (2021). Circular Cities: What Are the Benefits of Circular Development? *Sustainability*. 13(5725). 1–27. https://doi.org/10.3390/su13105725

Woodland Trust. (n.d.). *Ancient Woodland - British Habitats*. Accessed on 15 December 2020, from https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/habitats/ancient-woodland/

Wrap. (2007). Current Practices and Future Potential in Modern Methods of Construction. 7. http://www.wrap.org.uk/sites/files/wrap/Modern%20Methods%20of%20Construction%20-%20Summmary.pdf

Xu, J., & Kang, J. (2017). Comparison of Ecological Risk among Different Urban Patterns Based on System Dynamics Modeling of Urban Development. *Journal of Urban Planning and Development*. 143(2). https://doi.org/10.1061/(asce)up.1943-5444.0000365

FIGURES

Crown (2018). Proportion of the population aged 65+ 2016 and 2039 (2016 mid-year population estimates for UK, Office for National Statistics, 2014-based subnational population projections for UK, Office for National Statistics, Welsh Government, National Records Scotland and Northern Ireland Statistics and Research Authority, contains OS data. Office for National Statistics. Accessed on 2 January 2021, from https://www.ons.gov.uk/

Furlong, C. (n.d.). Coastal Erosion of the Urban Environment [Photo]. Accessed on 3 May 2021, from https://www.gettyimages.co.uk/detail/news-photo/lookout-post-which-used-to-be-situated-on-top-of-the-cliffs-news-photo/1198501770

Geophoto. (2019). The Needles of Isle of Wright [Photo]. Geographical. Accessed on 7 November 2020, from https://geographical.co.uk/nature/geophoto/item/3181-photographing-the-white-cliffs

Getty Images. (2020). Young Girl pulled from edge of UK cliffs [Photo]. Accessed on 7 November 2020, from https://www.google.com/url?sa=i&url=https%3A%2F%2Fau.news.yahoo.com%2Fyoung-girl-pulled-from-edge-of-uk-cliffs-notorious-for-falls-101255937.html&psig=AOvVaw1cmhZU4B2YXOQt4fGV6RQr&ust=1617709610104000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCMjUjIuE5-8CFQAAAAAdAAAAABAD

Giel, I. (2012). White Cliffs of Dover [Photo]. Wikimedia. Accessed on 14 October, from https://commons.wikimedia.org/wiki/File:White_Cliffs_of_Dover_02.JPG

Hisgett, T. (2010). Cliff Railway Hastings [Photo]. Wikimedia. Accessed on 5 Januari 2021, from https://upload.wikimedia.org/wikipedia/commons/0/01/Cliff_Railway_Hastings_%284906029502%29_%28cropped%29.jpg

Kirby, J., Masselink, G., Poate, T., Scott, T., Essex, S., & Ridgewell, J. (2020). *Coastal Change Management Areas A National Overview* [Presentation slides]. Accessed on 3 March 2021, from Sweep. https://sweep.ac.uk/wp-content/uploads/3.1.2-Kirby.pdf

Lycett, J. (2005). Fairlight Cove [Photo]. Rye and Battle Observer. Accessed on 14 October 2020, from https://www.ryeandbattleobserver.co.uk/news/aps18-million-fairlight-cove-erosion-project-set-start-1211901

Ocean Waves. (n.d.). [Photo]. Accessed on 2 November 2020, from https://i.pinimg.com/originals/96/e3/9e/96e39e8d067116fcdce9be490de832c1.jpg

Pinterest. (n.d.). White Cliffs of Dover, England [Photo]. Pinterest. Accessed on 3 December 2020, from https://i.pinimg.com/originals/e1/28/ee/e128ee711fea884c3644ce546947956e.jpg

Platt Kendall, A. (z.d.). Chalk Cliffs Seven Sisters, Hamlet [Photo]. Accessed on 3 December 2020, from https://cdn.britannica.com/s:690x388,c:crop/34/194334-050-26FD1E0E/chalk-cliffs-Seven-Sisters-hamlet-coast-East.jpg

Purdie, D. (n.d.). Fairlight Cove Dusk [Photo]. Purdie Gallery. Accessed on 2 November 2020, from https://purdiegallery.co.uk/collections/canvas-editions/products/failright-cove-dusk

SWNS. (2020). Cliffhanger collapses, Isle of Sheppey. [Photo]. The Times. Accessed on 2 February 2021, from https://www.thetimes.co.uk/imageserver/image/%2Fmethode%2Ftimes%2Fprod%2Fweb%2Fbin%2F44d27554-a50b-11ea-a585-dcb14d2bcd47.jpg?crop=2600%2C1462%2C0%2C135&resize=1180

Waves near Cliffs. (n.d.). [Photo]. pxfuel. Accessed on 2 November 2020, from https://www.pxfuel.com/en/free-photo-jygnh

6 APPENDIX

This chapter gives additional, substantive information on the project including the literature review, monographs and details of the stakeholder and spatial analysis

Coastal Erosion

The Socio-Environmental Impacts of Spatial Planning resulting from Shoreline Management in England

AR3U023 Theories of Urbanism
MSc Urbanism | Delft University of Technology | Transitional Territories Graduation Studio

Laura Conijn
25/11/2020

Abstract

The United Kingdom has a coastline that has been and will be continuously struggling with coastal change due to erosion and ways to respond to this coastal change. In particular the coastal cliffs located in southeast England. In the upcoming years this coastal cliff erosion will affect the English coast even more due to the effects of climate change, as well as sea level rise. This only becomes a problem when people that are unable to adapt to these changes are involved. In the English context, a spatial planning strategy is required to find a balance between livability and the impact of erosion risks.

This literature review will research spatial planning of urban areas affected by coastal cliff erosion, specifically cliff retreat. Strategies for the spatial planning and management of urban areas affected by coastal erosion and their long- and short-term results are reviewed to be considered during the strategy-making process. Hard engineering solutions are compared to soft engineering solutions and the consequences in terms of spatial planning that result from the implementation of these structures are discussed and will be reviewed upon. Eventually, the strategy should be a balance between urban- and ecological environment and Social Justice, but also a balance between temporal and spatial scales needs to be reached.

Keywords: Coastal Erosion Management, spatial planning strategies, socio-Environmental Justice, southeast England

1 Introduction

The transitional territory between sea and land that can be found in the United Kingdom is characterised by a varied and dynamic coastline that has been exposed to coastal erosion and, therefore, retreated for over thousands of years. While coastal systems are naturally dynamic and resilient to change, the alteration of natural coastal environments due to the development on the coast causes conflicts for the natural process of inland movement by coastal systems (Burden et al, 2020). This lack of ability to retreat by the coastline is the cause of issues regarding the urban context and creates a need for either protection measures or adaptation by the use of spatial planning. Since the 19th century protection measures have been repeatedly used around the coastlines. For the UK often hard engineering measures were taken to decrease the impact of coastal erosion on the coastal urban areas. However, the need of maintaining these hard engineering measures is questioned with today's knowledge. This shows that there is a need for a less constrained shoreline that is able to adapt to the rising sea level and the effects of climate change (Nicholls et al, 2013). Without these engineering measures the urban environment in shoreline cities will be at risk and a need arises for a change in current spatial planning strategies.

In the 1920s the English planned for an extensive sea wall building programme. In the years after, innovation of these coastal structures was planned together with repairs and sea wall extension. 40 years later, in the 1960s, the first soft engineering measures were implemented (Fleming, 1992). Since the 1990s, the management of the coast has expanded by

combining strategic planning and risk-based management techniques to encourage the embrace of risk management concepts. These concepts also include stakeholder engagement with the goal to develop plans that result in increased resilience and long-term sustainability (Nicholls et al, 2013). The mechanisms used to reach a compromise between these concepts and groups of interest are the Shoreline Management Plans (SMP): (1) advance the existing defence line, (2) hold the existing defence line, (3) Managed Realignment and (4) No Active Intervention (EUROSION, 2004). The realisation of the SMPs can be challenged due to increased coastal change due to erosion (Nicholls et al, 2013). The implementation of these SMPs has significant impact on urban environments and, therefore, creates a need for an urban adaptation strategy in the form of a spatial planning strategy that includes defence, adjustment or retreat (Apine, 2010) or in other words protection, accommodation or retreat (Alexander et al, 2011).

The main question of this literature review: "How is the socio-Environmental Justice impacted by the use of SMPs in spatial planning of urban environments?". In this literature review, spatial planning in combination with the SMPs will be discussed for the UK. Also, the socio-environmental effects of these planning strategies will be discussed with the use of different literature sources.

2 Methods

A systematic literature review has been done. The literature is assessed by a method that will be following several dimensions: 1) year conducted, 2) location, 3) sample size, 4) data collection methods and 5) main findings. All items are assessed on reliability, relevance, replication and validity (Bryman, 2012). Literature is only included if:

- It is a peer-reviewed article, quality conference paper or research report of a trusted organisation;
- The findings originate from the results, discussion or conclusion section;
- The topic is related to shoreline management plans and urban effects, such as spatial planning, Social Justice and Environmental Justice;
- The study took place in a developed country.

Three types of documents are used for this literature review: peer-reviewed scientific articles, conference papers, books and reports. Three main topics are included: shoreline management plans, socio-Environmental Justice, spatial planning methods and the location.

English Coastal Erosion Management and its impact on urban environments

Concept Groups	**Keywords**
Socio-Environmental Justice	Social Risks, Environmental Risks, Coastal Communities
Shoreline Management Plans (SMP)	Managed Realignment, Coastline Management
Spatial Planning Methods	Urban Adaptation Strategy, Managed Retreat
Location	England, United Kingdom, west Europe, Coastal Urban Environment

The starting point for each search is the following advanced search on Google Scholar:

Truncation	Socio-Environmental Justice AND (Shoreline Management Plans (SMP) OR Spatial Planning) AND Location
Search Strategy	TS = ("social risks" OR "environmental risks" OR "coastal communities") AND SU= ("Managed Realignment" OR "coastline management" OR "urban adaptation strategy" OR "managed retreat"). AND SU= ("England" OR "United Kingdom" OR "west Europe" OR "coastal urban environment"). Refined by: Document types: ARTICLE

Synonyms and concepts related to coastal erosion and shoreline management plans are included in this search, including the risks of these concepts. The search integrated results from all fields that engage in extreme climates. This can result in over 300.000 results and should be compromised by including terms including the impact on socio-environmental systems and the topic of coastal erosion. Keywords to these concept groups were used as synonyms in the search for articles for these topics.

To select possible articles, abstracts and conclusions are assessed. This helps finding relevant articles on the topics that are mentioned in the search strategy.

3 Results

3.1 The use of SMPs in the UK

Human activity in coastal zones increases the coastal erosion as well as the effects on vulnerable ecosystems along the coastline such as the change of sediment transport due to the use of sea territory for anthropogenic functions. These functions have a significant role in non-climate change factors that impact coastal erosion (Apine, 2010). The eastern coastline of the United Kingdom is continually exposed to these functions and their effects due to the location adjacent to the North Sea. However, these functions also cause a considerable variety in coastal erosion rate and process. This diversity in coastal erosion rates influenced by different anthropogenic activities, in combination with climate change, is the reason for unpredictable changes in the coastal landscape. The unpredictability of the landscape is an argument for a need for protection measures or an adaptation strategy in the form of spatial planning.

Protection measures that have been included in the UK's coastline can be distinguished in hard protection measures and soft protection measures. Both types of measures can be used to protect the coastline and prevent erosion from occurring. These measures do not only protect the coastline, but are also able to prevent the existing urban environment to be affected, which is the main reason for the use of protection measures. Whereas the hard-coastal structures, are built to reduce coastal erosion and maintain inhabited space by using artificial structures, a soft coastal structure is based on a sustainable and natural approach for coastal engineering that preserves the natural and recreational value (Marchand, 2010). The length of these two types of artificial coastal structures in the UK are shown in figure 1 for each county.

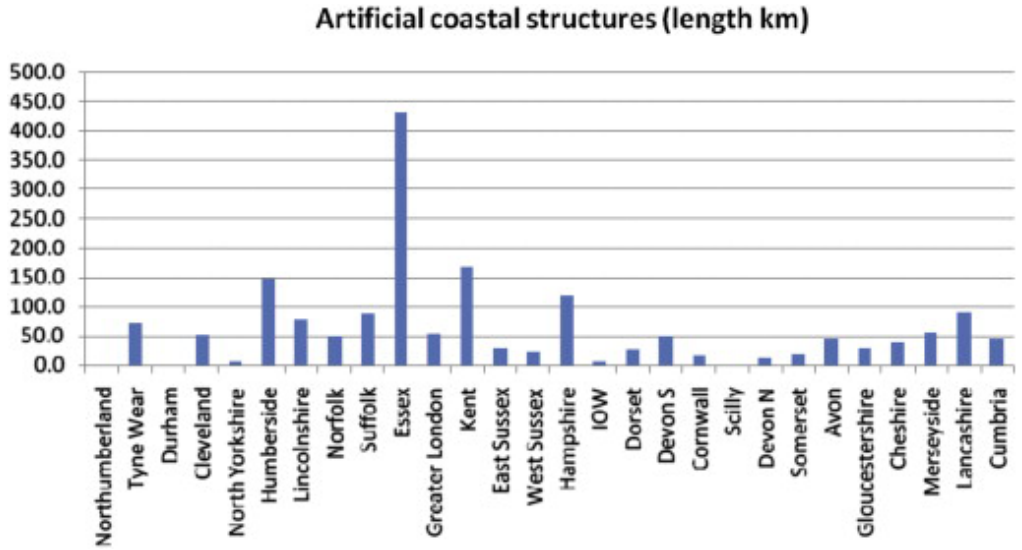


Figure 1: Artificial coastal defence structures in context (Doody, 2013).

Another option, other than protection measures, are the use of spatial planning strategies. Three of these strategies are: defence, adjustment and retreat (Apine, 2010). Alexander et al (2011) identifies identical strategies with the synonyms: protection, accommodation and retreat. Alexander et al (2011) expects highly valued coastal locations to have a protection or accommodation strategy. The smaller urban areas are more likely to have a retreat policy. This expected differentiation in spatial planning strategies is made due to the variation in values and scales and the costs of the planning strategies relatively to the scale of the benefits.

This cost-benefit analysis is a reason for each section of the coastline to have a different SMP assigned. In the UK, currently, the most frequently used SMP is Managed Realignment. As mentioned by Fleming (1992), this used to be different. Over the past years, SMPs were introduced and implemented. The management for coastal protection has shifted from a method similar to (2) hold the existing defence line to (3) Managed Realignment. The former method (2) was aiming to Hold the Line in its existing location with the use of soft and hard protection measures, such as beach nourishment and seawalls. This strategy includes protection and accommodation strategies that, according to Abel et al (2011), are much more expensive than a managed retreat strategy, and are, according to Alexander et al (2010), only feasible if connected to highly valued coastal locations. The new method (3) aims to minimalize the costs and recover the natural environment. Neal et al (2017) describes the Managed Realignment strategy as a restrictive policy where hard and soft coastal structures are removed from the shorelines to create a natural maintained environment and allow the coastline to naturally erode. This erosion is positive for sediment transport and maintenance of the sediment budget. With this type of coastal management, flooding of low-lying areas and the promotion of natural defences are encouraged (Cooper & McKenna, 2008). Neal et al (2017), also links the spatial planning strategy of managed retreat to Managed Realignment as these two concepts are often used as synonyms. Cooper (2003), adds to this that the spatial planning strategy of managed retreat can be used in a wider range than Managed Realignment, as the latter is limited to the specifics of the coastal area.

3.2 Methods of spatial planning: Managed Retreat

According to Neal et al (2017) primary spatial planning methods of managed retreat include avoidance, abandonment and relocation. These methods are approached with the use of spatial planning tools such as building restrictions and setbacks and are often combined with management methods related to coastal erosion, such as Managed Realignment. Distinctions in management for these spatial planning methods are made in active planned management and passive unplanned management. Examples of management, methods and tools for the spatial planning strategy of managed retreat are shown in figure 2.

Management		Methods
		Avoidance
Active	Planned	Ban development/redevelopment in hazard zones (no-build areas: setbacks, rolling easements, zoning)
		Abandonment
Passive	Unplanned	Loss of development/redevelopment by ongoing attrition (erosion, flooding)
Active	Planned	Post-event condemnation/removal/ reconstruction limits
Active	Planned	Emergency pre-event removal
		Relocation
Passive	Unplanned	Post-event relocation of salvageable buildings
Active	Planned	Pre-event relocation (short to intermediate term)
Active	Planned	Systematic relocation of community out of hazard zone (long-term) including acquisitions: planned pre- and post-event property buy-outs in hazard zones (no future construction), and rolling setbacks and easements: planned regulatory construction setback based on defined hazards and periodically revised, based on changing hazard zones (e.g., sea-level rise, storm surge levels, erosion rates, evacuation requirements)

Figure 2: Spatial planning management and tools for the use of managed retreat (Neal et al, 2017).

Neal et al (2017) concludes that, even though the spatial strategy of avoidance can in cases of undeveloped and lightly developed areas be a fine solution, for urbanised shores only planned relocation is realistic and ideal. Added is, that spatial planning using the strategy of managed

relocation can only be feasible when land use planning and zoning efforts are integrated to gain a larger scale. Other forms of spatial planning that Neal et al (2017) describes, such as abandonment and avoidance are described as short-term buffers rather than solutions to the actual long-term problems that are related to the urban effects of coastal erosion.

While Neal et al (2017) discusses methods on the implementation of managed retreat in a planning system, he fails to take consideration in Social Justice aspects of this planning strategy and mainly focuses on the governmental and economic aspects that include convenience and costs. Cooper (2003) states the responses to managed retreat as a spatial planning strategy for several circumstances including the urban and ecological environment of the affected area.

3.3. Socio-Environmental Justice of spatial planning strategies

3.3.1 Social Justice

The perspective of Neal et al (2017) is mainly an economic perspective that leaves gaps in the understanding of the consequences in the field of Social Justice. This can be a mistake, as according to Cooper and McKenna (2008), Social Justice is one of the three elements needed to create sustainable development and has, therefore, a significant influence on the development of the coastal landscape. For the UK coastline, matching the world's coastlines, the anthropogenic landscape is the main reason for the need of adaptation to coastal erosion, which is also why involving society and including Social Justice is required in the strategy-making for coastal urban environments.

In terms of coastal defence, the UK government currently takes little responsibility in the field of Social Justice with their latest SMP shift to Managed Realignment, where spatial planning methods such as managed retreat are promoted rather than the implementation of coastal defences. The coastal defences are, for many locations, now an optional activity that can be introduced by local public authorities. The choice for a coastal management plan such as Managed Realignment, can be identified as a surprising choice as 47% of the UK population has settled in coastal urban environments. With the use of a spatial planning strategy including managed retreat this number is expected to decrease. The high percentage of inhabitant of coastal zones indicates that the coastal urban environment is not only significant for living, but also for a great part of the economy (de la Vega-Leinert & Nicholls, 2008). A spatial planning strategy such as managed retreat will, therefore, be of great impact on the society in these coastal urban environments.

Due to the governmental policy change to Managed Realignment many inhabitants of coastal UK expect a governmental subsidy or compensation to either build their own coastal defence or to relocate. This is, according to Cooper and McKenna (2008), where many people mistake Social Justice for equality. With today's knowledge, former urban and coastal strategies cannot be justified. This means, that coastal residents might feel disadvantaged due to the change of policies, however, this is not related to Social Justice, but to equality with former policies. Next to this, however, is stated by Cooper and McKenna (2008) that in case of interference with property rights an impartial balance between public interests and private rights should be established. For the natural processes of the eroding coastline the government might not feel responsible, but would the UK government be responsible for the interference with property rights when discontinuing management of coastal interventions? This question raises conflicts in terms of payment for the possible measures and policies as shown in figure 3.

Cooper (2003), argues that managed retreat largely impacts public safety in a positive manner as risks due to erosion are reduced and the defence line can be shifted lands inward. This means that a managed retreat strategy is supposed to create public interest and would point to responsibility of payment by public instances, such as the UK government. However, the current shift to Managed Realignment plans in the UK, is used by the UK government to shift the responsibility of payment towards the

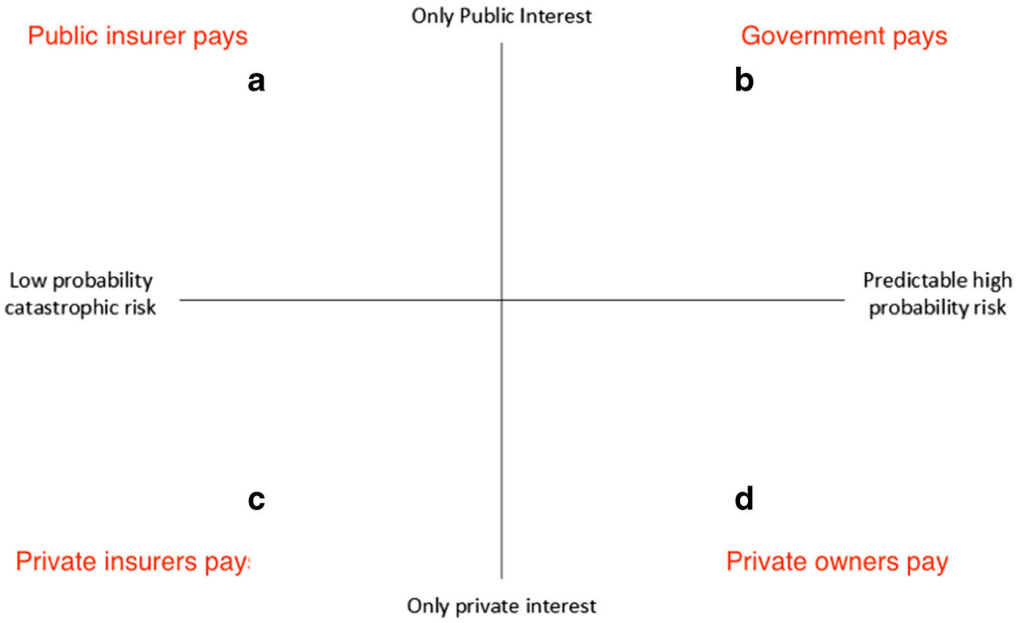


Figure 3: Who pays for the decision of retreat? (Noy, 2020).

residents of the coastal villages and not the UK government. But without encouragement by the UK government with the use of financial compensation, managed retreat is for most residents unaffordable.

Even though spatial planning in the form of managed retreat is recommended by Neal et al (2017) and Cooper (2003), this is highly expensive for private home owners. Managed retreat as a spatial planning strategy will cause the increase of market uncertainty and the decrease of land values, resulting in higher costs for individual property owners that are exposed to eroding coastlines (Alexander et al, 2011). This is why, currently, nearly all coastal residents prefer coastal protection to managed retreat (Readman, 2014). On the other hand, Cooper and McKenna (2008) argues, that implementation of protection measures only leads to the postponement and increase of social issues as more coastal development will take place and, therefore, coastal urban areas will have an increasing population. The risk management will only become more difficult with this increased development along the temporal scale.

Apine (2010) argues that, not only costs are the reason of the society its resistance against managed retreat, but also the unawareness of erosion risks, the threats to human identity and the sense of ownership that relates to a specific location, play a significant role in the fight against a spatial planning strategy in the form of managed retreat. These statements are supported by Dahm and Economos (2002) who, in accordance with the results of their survey, conclude that property owners have a general preference for decreasing or preventing erosion to relocating. This conclusion is in agreement with Readman (2014), who argues that the residents of coastal cliff cities along the coastline of the United Kingdom have a strong mental attachment to the British coastline. The coastal landscape including the cliffs creates an association with the British nationhood and increases their sense of nationalism providing more arguments against intervention in terms of Managed Realignment and, therefore, managed retreat.

Even with the current resistance against managed retreat, Apine (2010) states that in the future, housing relocation might be a considerable option. Planning developments such as managed retreat need a gradual transition to inform and convince society about vulnerabilities and risk management including the consequences should be more frequently addressed. Including the public in the planning process of adaptation measures can raise awareness for individuals at risk. Currently, individuals at risk may not be aware of the

possible strategies that are involved when dealing with hazards, with more knowledge and participation they will be able to make more informed and possibly better choices and not limiting the options to only one strategy.

3.3.2 Ecological Environmental Justice

In terms of coastal management, social justice is not the only aspect that should be included in a spatial planning strategy. The problem of coastal erosion only occurs and needs to be managed when there is a threat of destruction of human infrastructure. This means that the available management methods for society are to make an intervention to prevent the effects of coastal erosion or to accept the changes and adapt with the use of a spatial planning strategy (Cooper and McKenna, 2008).

As mentioned, society is currently adapting to the urban effects of coastal erosion but preventing these effects. Currently, the most used management strategy is the prevention of coastal erosion effects by using hard or soft protection measures as a third of the English coastline is protected by these structures (EUROSION, 2004). While these protection measures are needed to maintain the urban environment and are preferred by society, coastal erosion is needed to maintain the ecological environment. Coastal protection measures often interfere with natural processes along the coastline. Cooper and McKenna (2008) mention loss of scenic quality, access difficulty, loss of resilience and reduction of sediment supply as immediate effects caused by protection measures. According to Cooper and McKenna (2008) protection measures will also encourage development in areas of high risk creating a recurring need for more coastal engineering interventions and, therefore, establish an increasing lack of appreciation for the natural system and environment.

While in Neal et al (2017) several methods of managed retreat such as avoidance, abandonment and relocation are discussed, the article lacks environmental perspective of these methods. Cooper (2003), however, states several responses to spatial planning in the form of managed retreat in his article including the environmental effects of this managed retreat. Of the responses to managed retreat as a planning strategy, Cooper (2003) discussed for five circumstances, three are strongly related to Environmental Justice. The first one emphasizes an improved flood defence and coastal protection as the natural habitat including its natural protection can be of optimal use when anthropogenic effects do not longer impact this environment. This circumstance focuses on enhancing the function of the natural system. In the second circumstance mentioned by Cooper (2003) without human intervention, the accommodation space for natural change creates an option to avoid problems that are caused by the loss of coastal features due to coastal squeeze. In which coastal squeeze is the loose of intertidal land as Doody (2004) describes. The last circumstance that is related to Environmental Justice in Cooper's article is about environmental enhancement by removing coastal defences to reactivate ecological processes and, therefore, includes a contribution to biodiversity. These responses to managed retreat as a spatial planning strategy can also be implemented in the SMP that is embraced by the UK: Managed Realignment.

According to Cooper and McKenna (2008) the best solution is to allow the coast to fluctuate freely without the impact of long-term effects on the natural landscape and its ecosystems, however, this development is only possible without anthropogenic influences. However, Cooper and McKenna (2008) also argue that a balance between spatial and temporal planning scales should be made in terms of Social Justice and Environmental Justice.

This balance between temporal and spatial planning scales is shown in figure 4 and describes that the case for intervention is stronger for local or short interventions as the erosion costs for the individual may be greater than the costs for protection measures. Longer interventions and national interventions are more likely to affect the environment negatively and, also in terms of costs, can have implications. If the government would decide to financially compensate homeowners for managed retreat, this would be considered

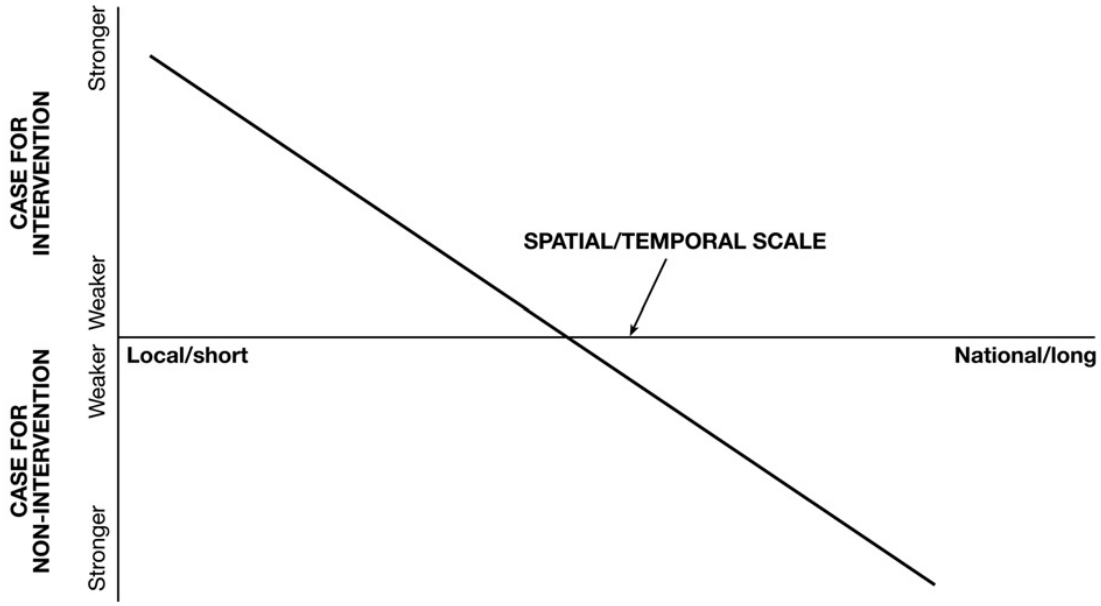


Figure 4: Case for intervention for the spatial/temporal scale (Cooper and McKenna, 2008).

a one-of payment and would be preferable to the risk of paying for a long-term protection and its continuing need for maintenance and upgrading. This statement may conflict with the statement made by Alexander et al (2011), which states that only highly valued coastal locations should be protected as these are more economically beneficial. In this statement, however, the exact definition of highly valued remains unknown and it can only be speculated that this value is given to a coastal location due to the economic benefits of this location.

4 Discussion

This literature review mentions several topics that are important to take into account when researching the impact that can be caused by certain types of management of the coastline. The urban consequences of these management plans in topics of socio-Environmental Justice are also explored.

This literature review acknowledges the research of Nicholls (2013), who raises questions that include the need for shoreline protection and management but also about the environmental consequences that these measures appear with. Apine (2010) pleads, therefore, for the need of an adaptation strategy that includes either defence, adjustment of retreat. This need for adaptation is acknowledged by Cooper (2003), Cooper and McKenna (2008) and Neal et al (2017). However, the exact adaptation measures are still to be researched and are different for every location along the coastline in terms of socio-Environmental Justice and should be related to the spatial-temporal scale that is introduced by Cooper and McKenna (2008).

From this can be concluded that the impact of SMPs on spatial strategies by Apine (2010) are interesting to research further in the future. Furthermore, the difference between the measures that can be taken for social systems and environmental systems is already slightly discussed in the results and should be researched more to know the exact impact of the events on both these systems.

5 Conclusion

The question from which this literature originated: “How is the socio-Environmental Justice impacted by the use of SMPs in spatial planning of urban environments?” resulted in a search for, in particular, British SMPs and their impacts on different aspects of socio-Environmental Justice in relation to spatial planning strategies.

The results of this literature review show that there is adequate knowledge about current SMPs in the United Kingdom and the socio-Environmental Justice that is related to the effects of accelerated coastal erosion due to climate change and sea level rise. For the United Kingdom the aim is to implement a Managed Realignment strategy in coastal urban areas which is frequently linked to the spatial planning strategy of managed retreat. The use of a managed retreat strategy is explored in terms of social and Environmental Justice and there can be concluded that this strategy creates issues regarding these topics. Social impacts due to Managed Realignment that often includes managed retreat are repeatedly negative and raise questions in terms of finances, while the ecological impacts of managed retreat seem to have multiple positive effects.

This conclusion was constructed by the use of many small parts in several sources that include the impact of English coastal erosion management on its urban environment. The topic of coastal erosion is relevant as this is increasing parallel to climate change effects and the rising sea level.

6 References

Alexander, K. S., Ryan, A. & Measham, T. G. (2012).
Managed retreat of coastal communities: understanding responses to projected sea level rise. *Journal of Environmental Planning and Management*. 55(4). 409-433. https://doi.org/10.1080/09640568.2011.604193

Apine, L. (2011).
Residents' attitude towards possible adaptation measures to the sea coast erosion in Latvia. *International Journal of Climate Change Strategies and Management*. 3(3). 238 – 249. https://doi.org/10.1108/17568691111153393

Bryman, A. (2012).
Social research methods. 4th edition. Oxford university press.

Burden, A., Smeaton, C., Angus, S., Garbutt, A., Jones, L., Lewis, H.D., & Rees. S.M. (2020).
Impacts of climate change on coastal habitats relevant to the coastal and marine environment around the UK. *MCCIP Science Review 2020*. 228–255. https://doi.org/10.14465/2020.arc11.chb

Cooper, J. A. G., & McKenna, J. (2008).
Social Justice in Coastal Erosion Management: The temporal and spatial dimensions. *Geoforum*. 39(1). 294–306. https://doi.org/10.1016/j.geoforum.2007.06.007

Cooper, N. J. (2003).
The use of managed retreat in coastal engineering. *Engineering Sustainability*. 156(2). 101–110. https://doi.org/10.1680/ensu.156.2.101.37009

Dahm, C. & Economos. (2002).
Beach user values and perceptions of Coastal Erosion. *Environment Waikato Technical Report*. Environment Waikato. Hamilton. Accessed on 16 November 2020, from https://waikatoregion.govt.nz/assets/WRC/WRC-2019/TR03-03.pdf

Doody, J. P. (2004).
Coastal squeeze - an historical perspective. *Journal of Coastal Conservation*. 10. 129-138. https://doi.org/10.1652/1400-0350

Doody, J. P. (2013).
Coastal squeeze and Managed Realignment in southeast England, does it tell us anything about the future?. *Ocean & Coastal Management. 79. 34–41. https://doi.org/10.1016/j.ocecoaman.2012.05.008*

EUROSION. (2004)
Living with Coastal Erosion in Europe: Sediment and Space for Sustainability. Accessed on 16 November 2020, from http://www.eurosion.org/reports-online/part1.pdf

Fleming, C. A. (1992).
The development of coastal engineering in Barret, M. G. *Coastal Zone Planning and Management*. Thomas Telford. London. 5–20.

Marchand, M. (2010).
Concepts and Science for Coastal Erosion Management. Concise report for policy makers. Deltares. Delft. 2010. Accessed on 16 November 2020, from http://www.conscience-eu.net/documents/concise-report-final.pdf

Neal, W. J., Bush, D. M., & Pilkey, O. H. (2017).
Managed Retreat. *Encyclopedia of Earth Sciences Series*. 1–7. https://doi.org/10.1007/978-3-319-48657-4_201-2

Nicholls, R. J., Townend, I. H., Bradbury, A. P., Ramsbottom, D., & Day, S. A. (2013).
Planning for long-term coastal change: Experiences from England and Wales. *Ocean Engineering*. 71. 3–16. https://doi.org/10.1016/j.oceaneng.2013.01.025

Noy, I. (2020).
Paying a Price of Climate Change: Who Pays for Managed Retreats?. *Current Climate Change Reports*. 6(1). 17–23. https://doi.org/10.1007/s40641-020-00155-x

Readman, P. (2014).
The Cliffs are not Cliffs: The Cliffs of Dover and National Identities in Britain, c.1750-c.1950. *History*. 99(335). 241–269. https://doi.org/10.1111/1468-229x.12054

de la Vega-Leinert, A.C., & Nicholls, R. J. (2008).
Potential Implications of Sea-Level Rise for Great Britain. *Journal of Coastal Research*. 2008(242). 342–357. https://doi.org/10.2112/07a-0008.1

2.1.1 MATTER

01. Currents & Tides
Flow of water effecting the transitional territories of different landsurfaces

02. Sea Level Rise
Raise of the water level in the sea that can leads to an increase of complications on landsurfaces.

03. Storm Surges
Climate change effect that involves the change of hydraulic action of wind and water.

04. Longshore Sediment Flow
The flow of sediments along the coastline caused by erosion.

05. Wave height
A raising wave height is a side effect of sea level rise and storm surges and can lead to several complications.

06. Coastal Erosion
The removal of sediments along the coastline causing urban areas to experience problems in the transitional territories.

07. Hydraulic Action
The force of the flow of water that is caused by the wind and wave conditions.

The matter of an area can be described in water, land and air. The characteristics of the types of matter can cause a need for different analysis. For this paragraph of analysis the matter water is chosen to be analysed as it has significant influence on the affected type of matter which is, in this case, the land.

In the case of coastal erosion, the water affects the land by hydraulic action and wave action. This hydraulic actions causes the sediment transport of the soil that is adjacent to the sea or in the sea and is able to damage coastal areas, and thus, coastal cliffs. This process can be accelerated through the change of climate paired with the sea level rise and the increase in the frequency in which storms occur, resulting in an increasing wave height and, therefore, increased hydraulic action resulting in (accelerated) coastal erosion.

In England, a significant area of the land consists of soft soils, such as the white chalk cliffs of Dover, causing a vulnerable environment to coastal erosion. Next to the vulnerability to coastal erosion, the land is also partly vulnerable to the results of sea level rise caused by the height of the low lands that are adjacent to the sea.

The results of sea level rise and coastal erosion cause urban environments, that are currently located in vulnerable coastal zones, to be at risk and in need for adaptation measures or strategies.

In the analysis of matter, the vulnerabilities and risk zones that are created by the characteristics of water are mapped with their effects and impacts that occur on a different type of matter: the land.

Before the North Sea existed like it does today, continental Europe included Great Britain. 400.000 years ago a transformation happened and Britain geologically parted from continental Europe due to overspilling of water into lower areas, which are today's location of the North sea. This phenomenon was shortly reproduced 12.500 years ago (Gibbard, 2017) .

During the Weichselian Glaciation, the most recent glacial period, Britain was shortly reconnected to continental Europe. The North Sea was filled with ice sheets, a limited amount of rivers and mostly dry land. Only a small lake was filled with water during this period (1).

After this glacial period, due to the rise of temperature, the North Sea returned to today's state with its original borders adjacent to several European countries. The sea is also connected to the Norwegian sea and the British Channel (2).

As the North Sea was reformed, the conflicts between water and land arose. One of these conflicts is flooding. Over the next years, the sea level will rise significantly due to climate change. This will cause parts of low-lying continental and non-continental Europe to flood (3) (EA, 2

Next to sea level rise, erosion will be acce due to sea level rise and, therefore, cha hydraulic action as a result of temperatu in the modern warm period. A great p England, if not all, is highly sensitive to e due to the weak resistance created by so such as chalk (4) (Masselink & Russel, 201 level rise and coastal erosion are even cause water to 'replace' the land surfa therefore, decrease possible room for settl and population. With the increase of temp and the increase of these water related this might form complications for the Warm periods have been happening rep for thousands, however, this time there anthropogenic impact on this temperatu and vice versa.

FIGURE 1

Limits

Data from Clayton & Shamoon (1998), Ducrotoy & Elliot (2008), EA (2020) & Masselink & Russel (2013),

- Land
- Sea
- Weak Resistance Soils
- Flood Prone Areas
- Limit of the Weichselian Glaciation
- Limit of Wolstonian Glaciation and Devensian Glaciation
- Limit of North Sea Drainage Basin


12500 years before now
1
0 °C
2
2 - Forming the North Sea
3 - Sea Level Rise
1 - North Sea in Weichselian glaciation
4 - Erosion
4
3
0 °C
millennia
Now

2.1.2 TOPOS

01. Flood Risk
Flood prone areas that are expected to flood with sea level rise

02. Terrain
Different types of soil that exist at the land surface

03. Coastal Erosion
The removal of sediments along the coastline

04. Elevation
Height differences in the surface create different characteristics for each part of the land

05. Geology
The origin and types of the layers of soil underneath the land surface

06. Coastal protection measures
Protection by anthropogenic features to protect urban settlements from coastal erosion and floods

07. Shoreline Management Plans
Soil and urban environmental related strategy to protect the coastal urban environments

For this chapter the topics of flux and erasure are explored by analysis of different geological areas that can be found in the southeast coastal England, but also in the national scale of the United Kingdom. The properties of the different terrain types and soils shown are the cause of diversity in erosion rates and needed management. Also, differences between the anthropogenic and natural landscapes will be analysed and the coastal management strategies that are needed regarding these landscapes.

Management strategies for vulnerable and areas at risk are created to protect coastal zones and urban environments within these zones. Strategies of coastal management are:

- No Active Intervention
- Managed Realignment
- Hold the Line
- Advance the Line

Strategies such as hold the line and advance the line are created to preserve coastal urban environments, to great satisfaction of the coastal population. These strategies, however, can include limited consideration for the natural landscape and can even be the cause of negative impacts of the surrounding environment. For strategies such as no active intervention and managed realignment these impacts are limited. Strategies and their impacts should, therefore, be considered in different time frames and spatial scales.

The use of coastal management can be a tool to steer spatial planning in the direction that is preferable according to national and local governments and the involved Environment Agency.

More than 400 000 years ago, Great Britain used to be part of continental Europe. This changes when a glacial lake in the North Sea basin spills over and causes a flood filling the former dry surfaces between the current island of Great Britain and continental Europe with water (Gibbard, 2017). The ridge of sedimentary rocks consisting of white chalk that was formed in the Cretaceous period transitioned to the function of coastline.

This change in proportions between land and sea is what is today's cause of erosion on the coastline of the North Sea and coastal England. The ridges form conflicts with the damaging characteristics of water. Water transport due to the current and the impact of wind is the cause of changes in soil composition and sediment transport ultimately resulting in erosion.

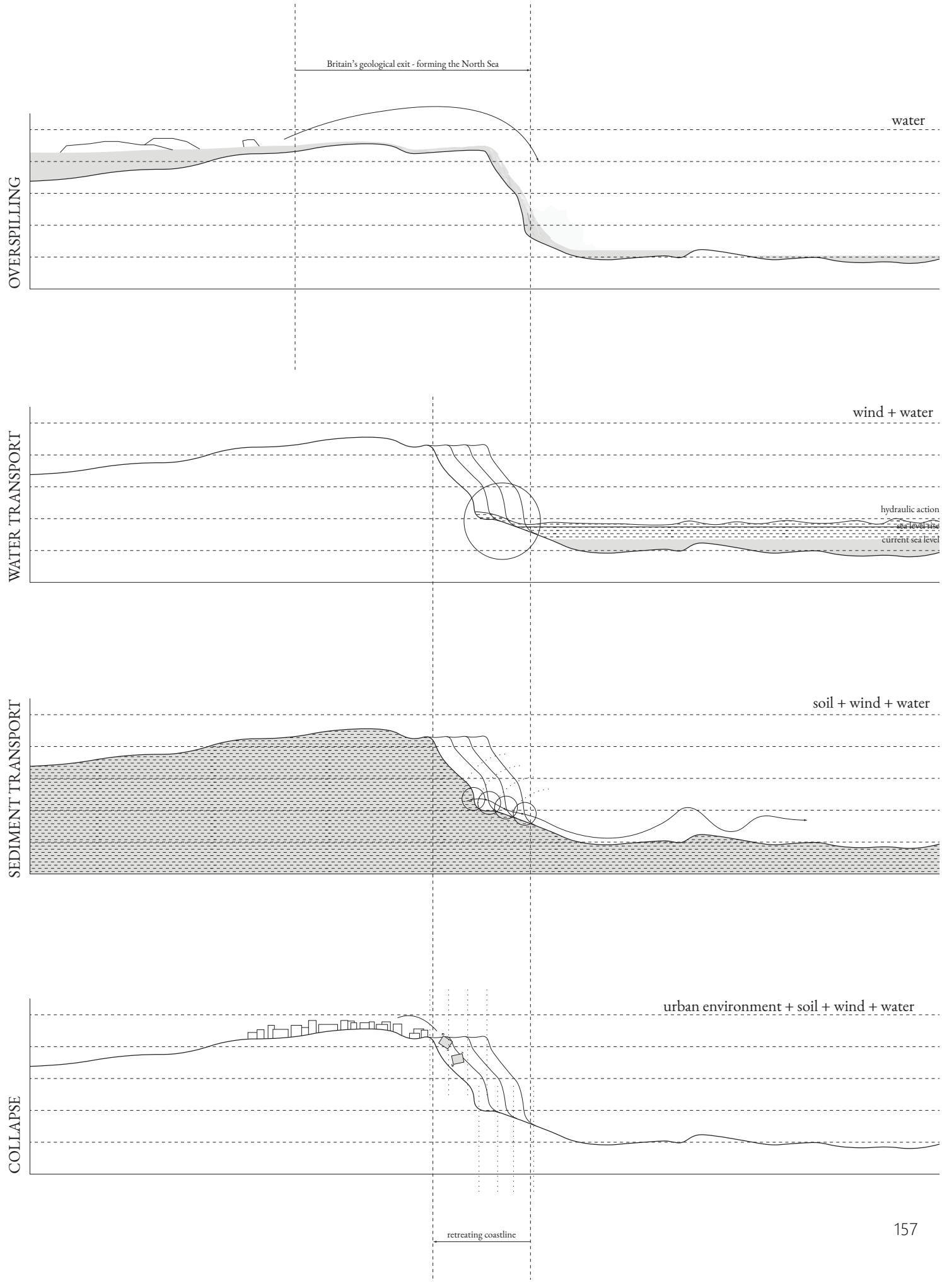
Today's coastline is highly inhabited by human populations due to the benefits of living near water and sea in terms of shipping, recreation and tourism. This coastline is, however, also highly altered due to the eroding conditions of water. Erosion causes significant conflicts in urban areas resulting in collapse of housing due to the retreat of the coastline.

FIGURE 2

Alteration

Data from Eurosion (2004), Hurst et al (2016) & Masselink & Russel (2013).

- Water
- Sea Level Rise
- Land
- Sediment Transport
- Sediment Limits


Britain's geological exit - forming the North Sea
OVERSPILLING
water
WATER TRANSPORT
wind + water
hydraulic action
sea level rise
current sea level
SEDIMENT TRANSPORT
soil + wind + water
COLLAPSE
urban environment + soil + wind + water
retreating coastline

2.1.3 HABITAT

01. Anthropogenic use of land habitat
Part of the north sea that humans use as a temporary habitat.

02. Anthropogenic use of sea habitat
Part of the sea that is permanently used by humans as a habitat.

03. Cliff habitat
Rare species that create their own independent and non-competitive habitat.

04. Power vs. Fragility: Sea vs. Land
The natural competition between sea and land that creates conflicts for the independent cliff habitat and human habitat.

05. Public vs. Private
The conflicts in human ownership of habitats that are caused by the power and fragility of land and sea.

For this theme of habitat the terms competition and mutualism are explored by analysing the different types of use for the habitats at land and sea.

The British land cover is divided in woodland, arable horticulture, grasslands and urban developments. Where woodland and grassland are primarily natural, the horticulture and urban developments are strong anthropogenic landscapes. This division in landscapes creates a competition. The anthropogenic landscape is always in competition with the natural landscape in terms of use. As soon as the anthropogenic landscape needs more space, the natural landscape will have to adjust to these anthropogenic demands.

The competition between natural and anthropogenic landscapes causes conflicts in urban growth and coastal management. With the use of coastal management this competition is delayed as coastal protection form a buffer to the decrease of land and, therefore, the change of habitats.

Without coastal management and coastal protection, the urban developments will soon be affected, which results in a need for relocation. This relocation due to coastal is again a form of competition between the natural environment and the anthropogenic environment. Coastal erosion causes the natural landscape to be replace the anthropogenic landscape, resulting in a need for anthropogenic landscape in current natural landscapes.

On land this diversification is more clear than at sea. Anthropogenic sea habitat is used for temporary use and permanent use. Shipping routes and fishing can exist next to the natural sea landscape. Drill platforms, windfarms and the use of pipes in the sea habitat limit the natural use of the sea in these locations and provide permanent anthropogenic landscapes at sea.

In southeast England, the land and sea are part of the anthropogenic landscape. Only a small percentage (17%) of the land is, however, part of urban developments (UK Centre for Ecology & Hydrology, 2015). These developments are often found in the coastal regions and have functions that are in relation to the sea and are accesbile through the use of water and ports. The coastal locations of these developments can, however, be negatively affected due to coastal erosion that is caused by the hydraulic action of the water, that is explained during the analysis on matter.

Most of the land around the urban developments is used for arable horticulture, where plants are used for food and non-food products used for personal or social needs. For England this can only be applied in certain regions where the land, and the soil, is arable and thus can be used to grow plants.

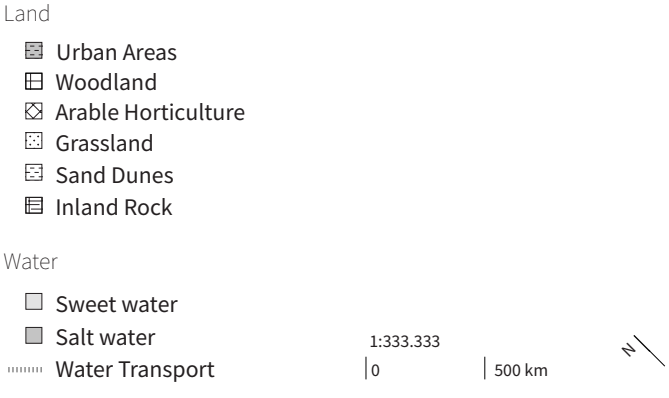
Land that is not arable to grow horticulture, or is unaccesible, is filled with grassland or woodland. Some of these woodlands are the remains of the ancient woods from the 1600s and are unique and complex communties of plants, fungi, insects and microorganisms.

Today, only 2,5% of the UK is covered by ancient woodlands and can be classified into different categories: Ancient semi-natural woods, that have developed naturally, and plantations on ancient woodland sites, that have replanted with non-native species (Woodland Trust, n.d).

FIGURE 3

Composition

Data from UK Centre for Ecology & Hydrology (2015), UKSO (2020) & UK Data Service (2020).



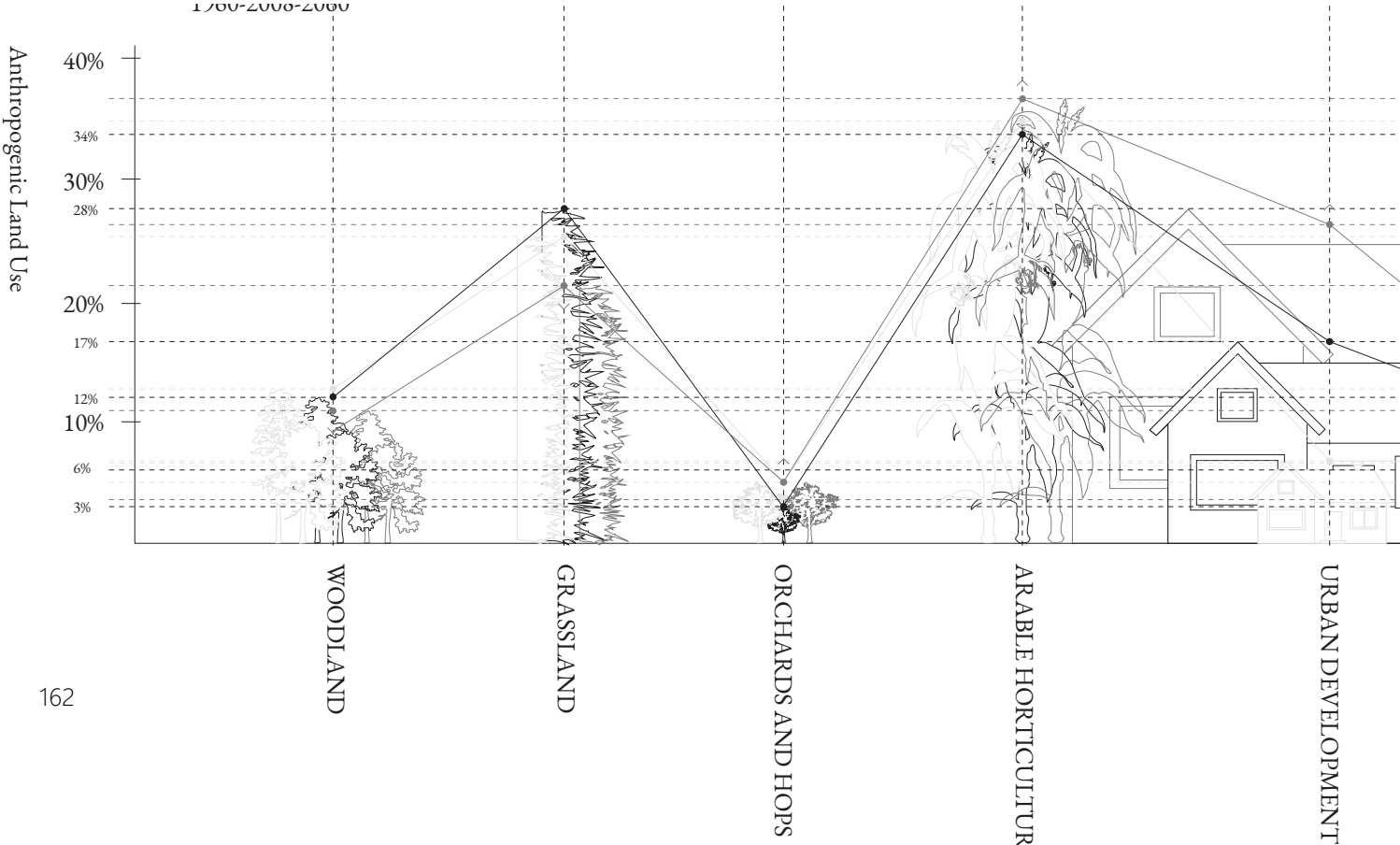
Due to the effects of erosion, the land is affected. Some habitats and uses will increase in coastal zones and others will decrease. Due to coastal erosion environments that are identified as coastal zones and wetland in the alteration will be the first zones that are affected. Expected can be that this environment at the coastline will be caused to retreat due to coastal erosion. This retreat will have effect on other environments, but also other issues will affect this change. Examples of changes that affect the English environments can be the economy, the population growth, tourism and culture.

From the 1960s till 2010 the urban environments in the southeast of England have grown 60% bigger (Kent County Council & KISS, 2008). Without the growth of landsurface, this means that other habitats are forced to decrease in size. In the 50 years between 1960 and 2010 these decreases can be found in habitats such as arable horticulture, woodlands, orchards and hops. If the urban environment increases more in size, also the grasslands are expected to shrink. Shrinkage in the arable horticulture habitat is not expected in the next 50 years as, in combination with Brexit, import and export of this sector can influence this sector positively, therefore, a greater part of the British land will be use for this purpose.

The sea landscape has also known changes in the past. Until some years after the 1960s the sea habitat has only been used for shipping purposes. Energy and oil production facilities with a more permanent sea use have taken their place between the late 20th century. Between 2010 and 2050 the use of the sea is expected to change with an increase in energy production (Prime Ministers Office, 2020). A decrease of shipping and oil production is expected caused by brexit and the transition to green energy.

FIGURE 4 (ENLARGED)

Limits



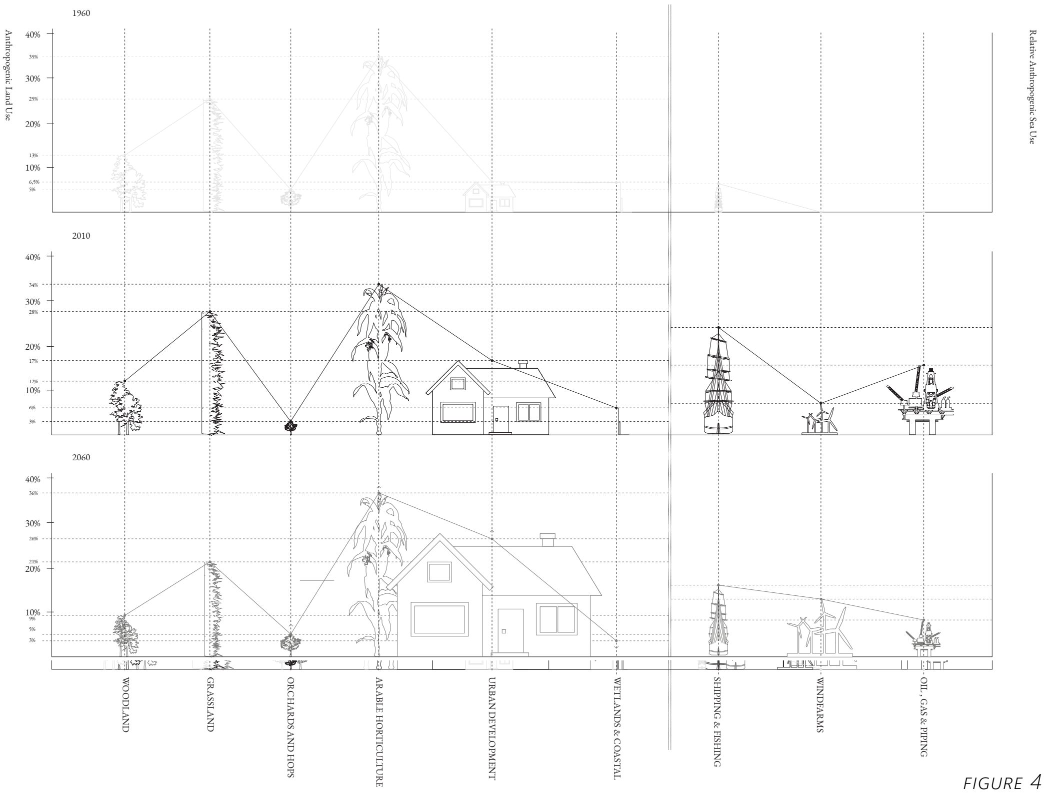
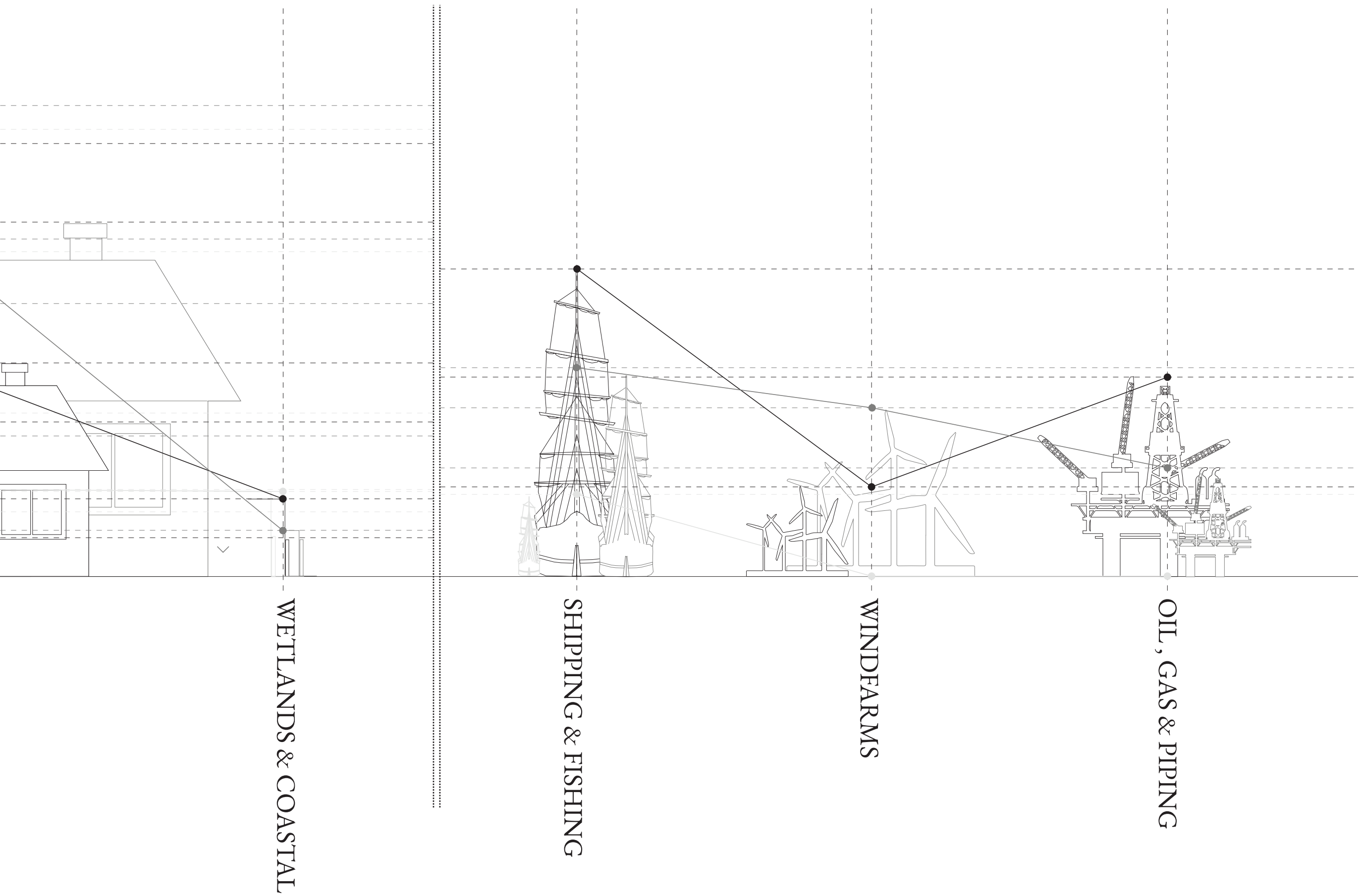


FIGURE 4

Data from data.gov.uk (2020), UK Centre for Kent County Council, data.gov.uk (2020) & Prime ministers Office (2020).



2.1.4 GEOPOLITICS

01. Borders in the Sea
Part of the north sea that humans use as a temporary habitat.

02. Fishing Competition
Part of the sea that is permanently used by humans as a habitat.

03. Competition for Space
Rare species that create their own independent and non-competitive habitat.

04. Brexit
Rare species that create their own independent and non-competitive habitat.

05. Protected areas: Land or Sea
The natural competition between sea and land that creates conflicts for the independent cliff habitat and human habitat.

06. Economy
The natural competition between sea and land that creates conflicts for the independent cliff habitat and human habitat.

When in 2020 Brexit occurs, many geopolitical conflicts arise due to the existance of geopolitical boundaries. Leaving the European Union, creates hard borders between the adjacent countries and, therefore, geopolitical issues. For the United Kingdom, these borders can primarily be found at sea with the exception of the border between Northern Ireland and Ireland. These country borders at sea, with Brexit, create great conflicts in current shipping routes, fishing habitats and energy production areas as the windfarm.

However, for this geopolitical paragraph, the focus lies on the geopolitical borders in southeast England that primarily includes protected areas. These protected areas are important for this project as they form the boundaries and limitations for spatial planning in the coastal zones in terms of relocation and other management strategies.

In geopolitical boundaries another form of competition occurs, which can be found between protected areas and urban development in combination with the population growth.

The combination of the linkage of different protected areas or boundaries are the basis for management strategies or opportunities.

The geopolitical boundaries, in combination with topos and habitats that have been analysed in former paragraphs, are the base of the spatial analysis.

The combination of different types of protected areas in relation to the built environment can cause conflicts within different adaptive strategies.

The coastline is in many cases the boundary between different habitats and topos in the case of the coastal cliffs. The different combinations of use of water and land and protected areas that can be found in the areas near the coastline can be the cause of the choice between different strategies. When an urban environment is included in the section and near the coastline, a different strategy should and could be used than for a section where an urban environment is not present.

In case of protected areas on one or either sides of the urban environment the available options for adaptive strategies can be limited due to the limited space for strategies such as retreat or advance. For these cases, a strategy such as embrace would be a more efficient strategy.

Another boundary that should be taken into account when thinking of urban developments in combination with erosion management, is the territorial zone of England within the North Sea with the limits of 12 nautical miles, which can be translated to 22 kilometers from the coastline of the British land (Marine Management Organisation, 2019). This territorial sea is regarded as a sovereign territory where ships from other countries are only allowed to pass through. For air and the seabed, this sovereignity should also be taken into account as a geopolitical boundary.

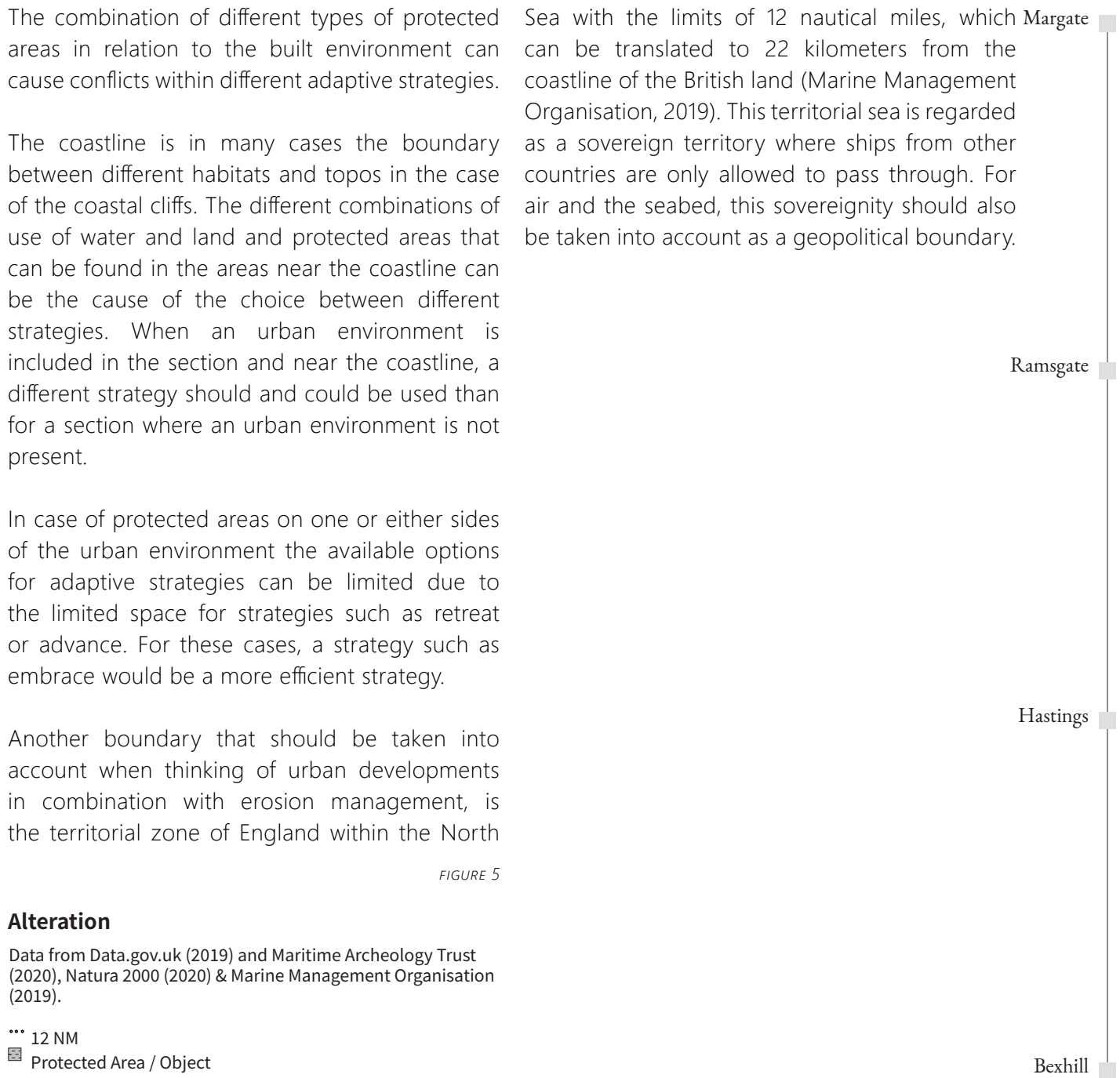
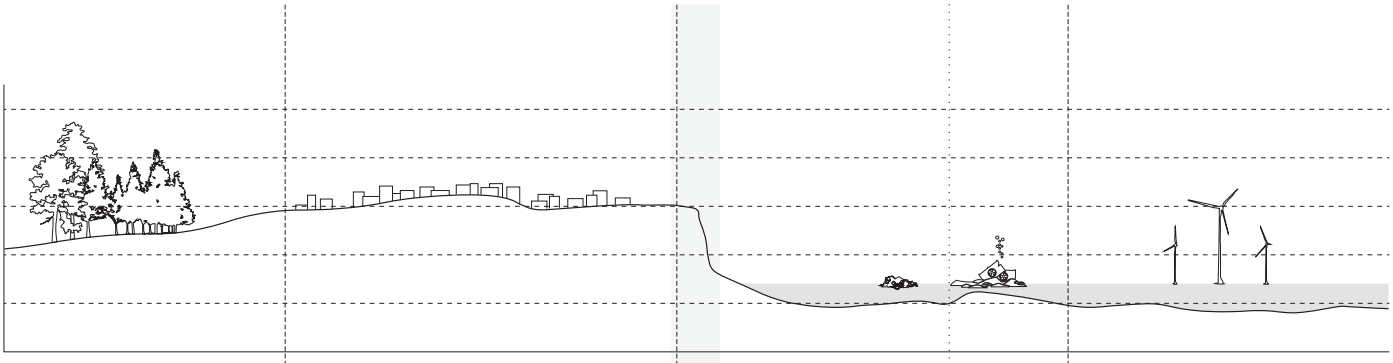


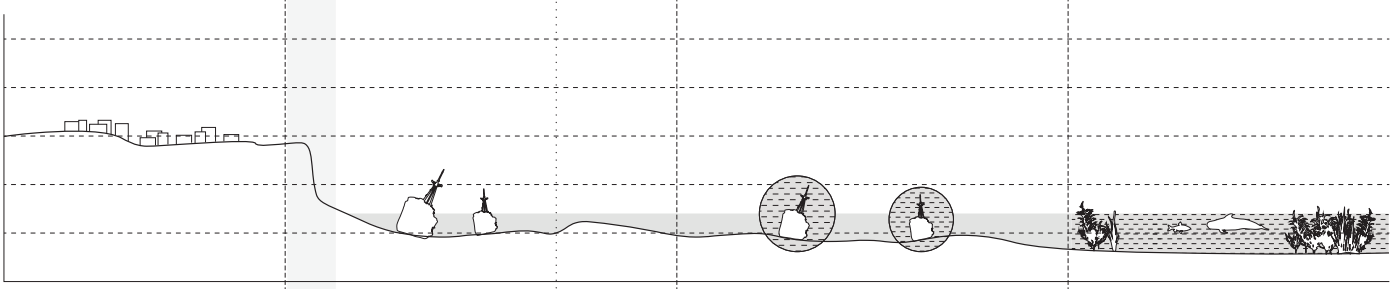
FIGURE 5

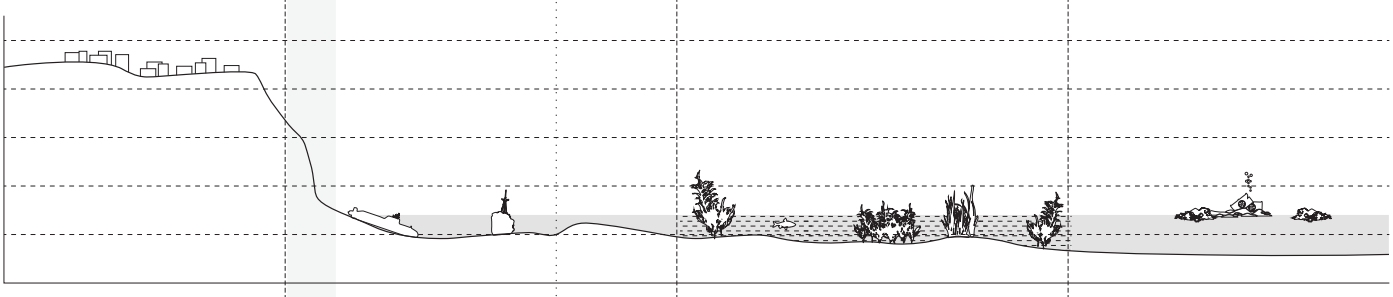
Alteration

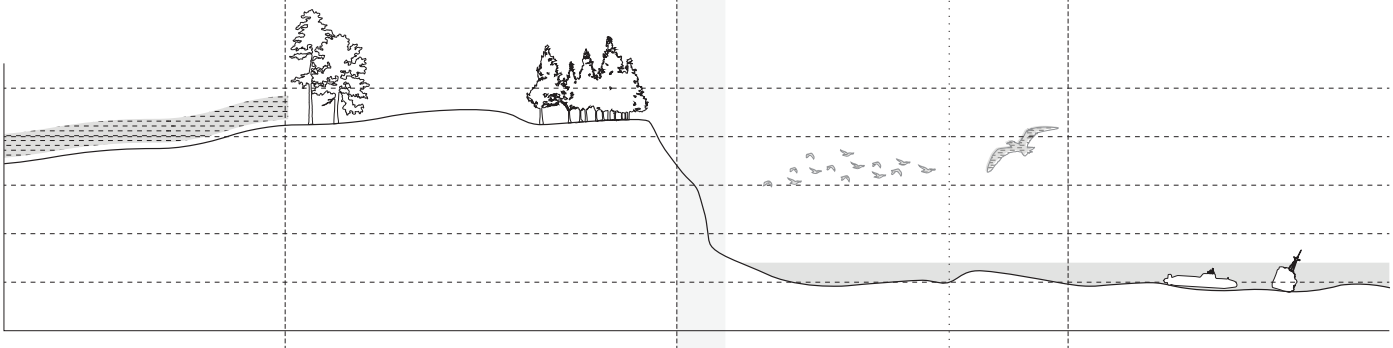
Data from Data.gov.uk (2019) and Maritime Archeology Trust (2020), Natura 2000 (2020) & Marine Management Organisation (2019).

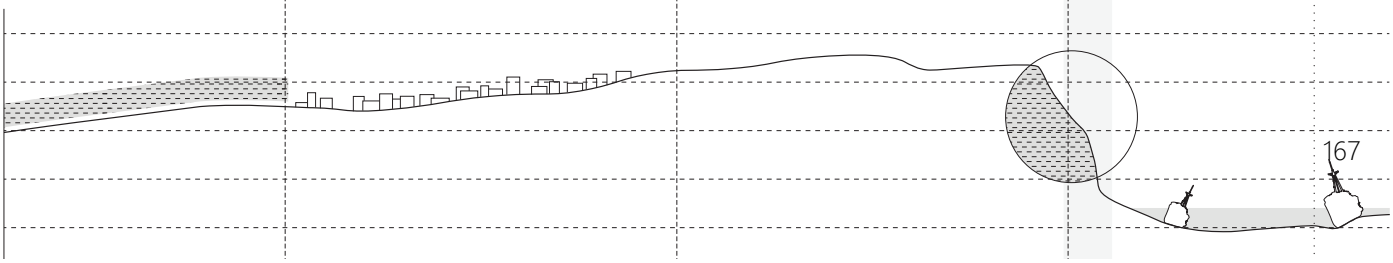
12 NM
Protected Area / Object







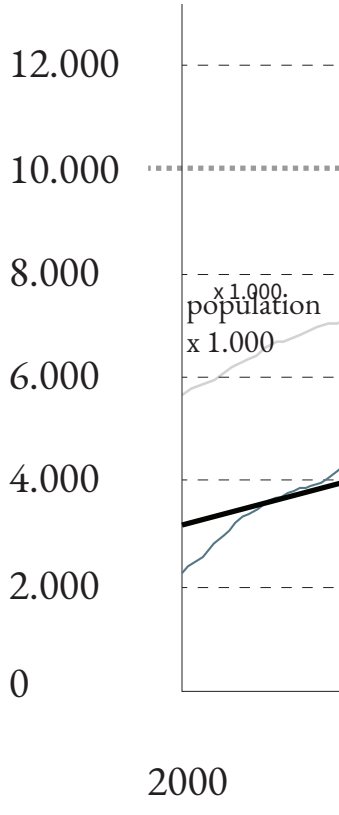




In the next 10 years, the protected areas are expected to grow by 4%. Since the 1950s, these protected areas have increased from 0% to 26% of the total surface of England, and southeast England (JNCC, 2020) . This means that this trend of increasing the protected areas every 10 years with nearly 4% has been going on for over 60 years. If this trend of growth continues, this percentage will raise above 50% in about 50 years.

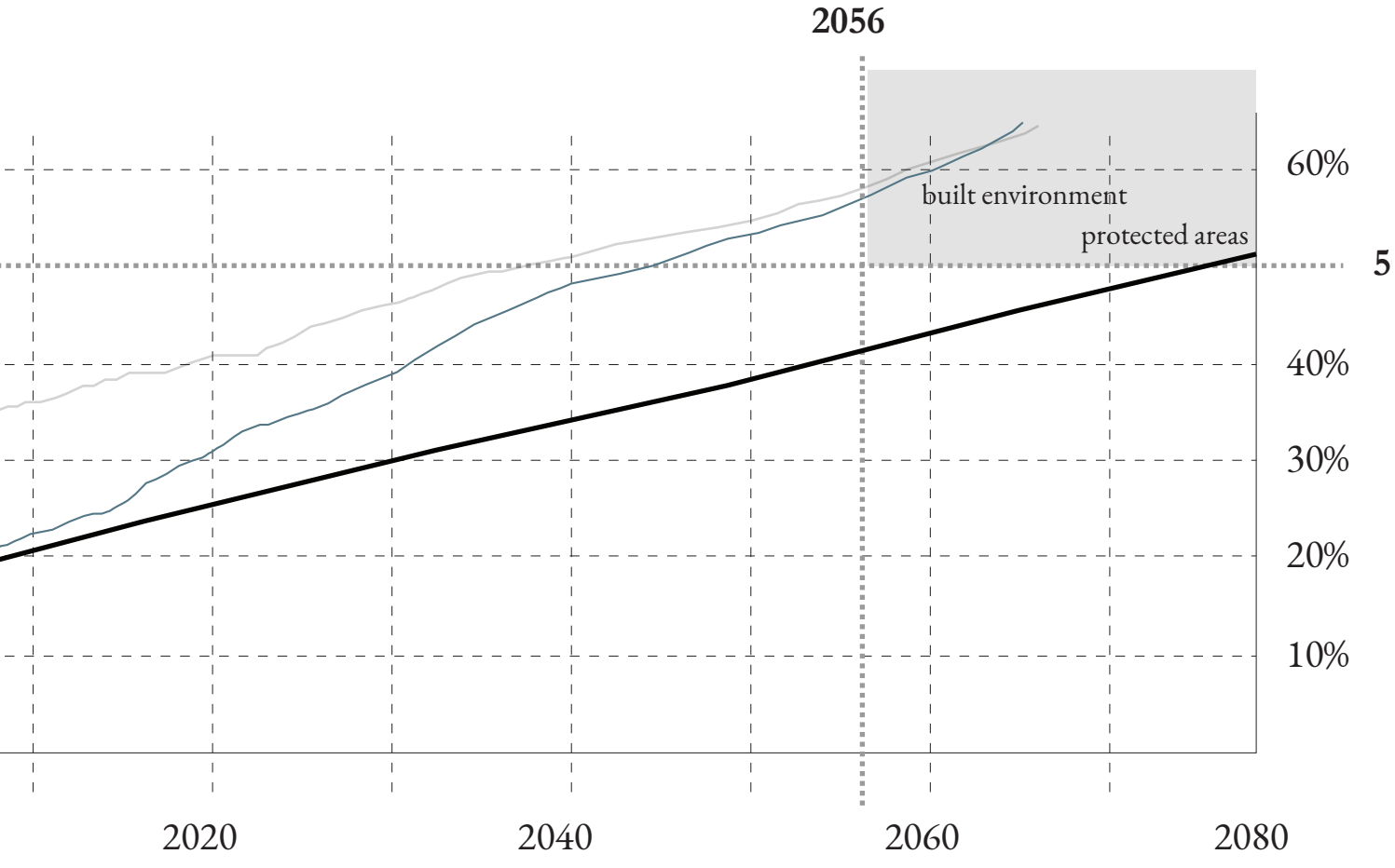
In the mean time, the built environment is increasing as the population is rising in southeast England. In one point in time, around 2056, the built environment and the protected areas will be competing with one another and will be able to limit development in both areas. The expanding protected area in combination with the increasing population and, therefore, the built environment, conflicts will arise between these geopolitical boundaries. This also arises the issue of social justice that includes environmental justice. The importance of either the built environment or the protected areas should be prioritised to create a just environment. This prioritisation should be included in plans and strategies that are formulated for coastal zones including these conflicting areas.

FIGURE 6



Limits

Data from Data.gov.uk (2019), JNCC (2020) & Statista (2020).


2056
60%
built environment
protected areas
5
40%
30%
20%
10%
2020
2040
2060
2080

2.1.6 PROJECTION

In the projection is shown how the SMP of Managed Realignment can be used to protect the residents of the coastal urban environments by preventing the coastal erosion to reach their living environment. The effects of sea level rise and Climate Change that are able to affect the rate of coastal erosion are anticipated on by the use of an Urban Managed Retreat strategy. This Urban Managed Retreat in the form of a process of relocation is a process of many phases where stakeholder involvement is needed to provide opportunities for residents to be able to move away before coastal erosion Effects reach their house. The Local Governments will collaborate on a regional scale to provide locations for relocation generating a choice for residents to relocate to a safe, regenerated location near their current living environment or an environment that is similar or to the environment they inhabit at the moment. However, this relocation should always be an improvement of their current living environment. The relocation process should be defined in a strategy that considers social justice in terms of spatial justice, environmental justice but also climate justice.

The relocation of coastal urban environments will free up space for the natural processes that include restoring nature, but can also naturally slow down erosion processes along the coastline and can improve the habitat for the rare cliff ecology that can be found on the English cliffs. The transformation of urban environments to natural environments will create a new type of ecology that can quickly adapt to the effects of coastal cliff erosion. Not only will the current and future ecology benefit from the transition from coastal inhabitation to a natural coast, but also residents and tourists can access this natural coast which will create in addition to a space for recreation, an awareness for Coastal Change. The natural coast is a tourism concept for small scale tourism, and should be limited to prevent disturbance to the natural processes.

This projection shows only one side of the project which is the natural coast, however for a relocation strategy, a second location is needed to provide room for residents to relocate to. These locations can be found within city limits of nearby cities, that are either coastal or inland considering the limits, challenges and opportunities that can be concluded from the analysis.

FIGURE 7: PROJECTION

TABLE 1: STAKEHOLDERS AND ACTIONS

	Stakeholders	A
1. Organisational	1.1 Managing Authorities of Coastal Erosion	M
	1.2 Planning Committee Spatial Planning	R
	1.3 Public Authorities responsible for Coastal Planning	R
2. Local Stakeholder Group	2.1 Knowledge Provider - Scientists	R
	2.2 County Council (Kent & East-Sussex) Planning Authority	P
	2.3 Local Planning Authorities (per city)	P
	2.4 Business Sector; tourism/fishery/local	P
	2.5 Landowners and developers	In
	2.6 Service Providers (health, education, transport, emergency)	P
3. Wider	3.1 Ministry of Housing, Communities and Local Government	C p
	3.2 National & EU Policy Makers	C
	3.3 Directorate General Environment European Commission	C
	3.4 Defra & EA	M
	3.5 English Heritage Trust/ Natural England	M
	3.6 Marine Management Organisation	P
	3.7 British Property Federation	S
	3.8 Infrastructure and Projects Authority	S

Actions
Manage coastal erosion by implementation of protection measures
Responsible for spatial planning decisions
Responsible for involvement of the coastal environment in spatial planning
Raise awareness for urban hazards that include coastal erosion
Provide a livable environment for their coastal and inland residents
Provide a (short term) livable environment for their residents
Produce, manufacture and provide services for the urban environment and economy
Invest and develop in land to make it usable in the urban environment
Provide services to the residents in the most efficient way
Create policies to engage local people in decision making for spatial planning to create great places to live and work
Create national policies to create both a livable living environment - no specific location
Create EU policies to protect the natural environment and secure high quality living qualities
Manage the natural and urban environment by introducing implementations to this environment
Manage and protect the English heritage to bring the Story of England to life
Protect and enhance the marine environment and support economic growth
Support a diverse, successful and sustainable real estate industry
Support major infrastructure projects

TABLE 2: STAKEHOLDERS, ACTIONS TO ENGAGE, ENGAGEMENT MODEL AND MAIN PROFILE

	Stakeholders	Actions to Engage
1. Organisational	1.1 Managing Authorities of Coastal Erosion	Advise Coastal Planning Auth
	1.2 Planning Committee Spatial Planning	Production of Spatial Plans
	1.3 Public Authorities responsible for Coastal Planning	Production of Coastal Plans
2. Local Stakeholder Group	2.1 Knowledge Provider - Scientists	Exchange information with an about climate change effects ar
	2.2 County Council (Kent & East-Sussex) Planning Authority	Production of regional spatial
	2.3 Local Planning Authorities (per city)	Production of local spatial plar
	2.4 Business Sector; tourism/fishery/local	Advise the Local Planning Aut important spatial planning issu
	2.5 Landowners and developers	Advise the Local Planning Aut important spatial planning issu
	2.6 Service Providers (health, education, transport, emergency)	Exchange information and con include specific knowledge of s
3. Wider	3.1 Ministry of Housing, Communities and Local Government	Vision and policy making that
	3.2 National & EU Policy Makers	Policy making that include the opportunities and risks
	3.3 Directorate General Environment European Commission	Policy making that include the for environmental opportuniti
	3.4 Defra & EA	Advise Coastal Planning Auth
	3.5 English Heritage Trust/ Natural England	Exchange information with an on spatial plans that interfere v
	3.6 Marine Management Organisation	Exchange information with an on spatial plans that include th
	3.7 British Property Federation	Advise Local Planning Author
	3.8 Infrastructure and Projects Authority	Advise Local Planning Author

	Engagement Model	Main Profile
orities & give consent for specific coastal planning decisions	Partnership	Influential Sleeping Giant
	Co-Creation	Influential Sleeping Giant
	Co-Creation	Dominant Saviour
d consult Organisational stakeholders and Local Planning Authorities nd the impact on spatial planning	Consultation & Dialogue	Vulnerable Friend
plans	Co-Creation	Influential Sleeping Giant
ns	Co-Creation	Dominant Saboteur
thorities, County Council and Organisational stakeholders about ues that involve the business sector	Partnership	Vulnerable Irritant
thorities, County Council and Organisational stakeholders about ues that involve the landowners and developers	Partnership	Vulnerable Irritant
nsult about Local Authorities about spatial planning decisions that service providers (emergency routes, etc.)	Consultation & Dialogue	Marginalized Acquaintance
include the urban effects of coastal erosion on the local scale	Dialogue	Dominant Saviour
national effects of coastal erosion and consult the local scale for	Consultation	Influential Time Bomb
EU environmental effects of coastal erosion and consult the national scale ies and risks	Consultation & Dialogue	Vulnerable Friend
orities & give consent for specific coastal planning decisions	Partnership	Dominant Saviour
d consult Local Stakeholder Groups and Organisational Stakeholders with English Heritage	Consultation & Dialogue	Respected Friend
d consult Local Stakeholder Groups and Organisational Stakeholders e marine environment	Dialogue	Respected Friend
ities on opportunities for development	Partnership	Marginalized Irritant
ities on accessibility for new development	Partnership	Respected Acquaintance

TABLE 3: STAKEHOLDERS, ATTITUDE AND CHANGE OF ATTITUDE

Stakeholders	att	Change of attitud
1.1 Managing Authorities of Coastal Erosion	/	Create knowledge a
1.2 Planning Committee Spatial Planning	/	Create knowledge a
1.3 Public Authorities responsible for Coastal Planning	+	
2.1 Knowledge Provider - Scientists	+	
2.2 County Council (Kent & East-Sussex) Planning Authority	/	Create knowledge a
2.3 Local Planning Authorities (per city)	-	Create knowledge a
2.4 Business Sector; tourism/fishery/local	-	Create opportuniti
2.5 Landowners and developers	-	Create opportuniti developers on selec
2.6 Service Providers (health, education, transport, emergency)	/	With a regional spa providers.
3.1 Ministry of Housing, Communities and Local Government	+	
3.2 National & EU Policy Makers	-	Create knowledge a rise and coastal eros
3.3 Directorate General Environment European Commission	+	
3.4 Defra & EA	+	
3.5 English Heritage Trust/ Natural England	+	
3.6 Marine Management Organisation	+	
3.7 British Property Federation	-	Create opportuniti
3.8 Infrastructure and Projects Authority	+	

e
about new (spatial planning) possibilities to deal with the effects of coastal erosion
about implementation of coastal erosion measures into spatial planning
about benefits of regional planning based on climate change effects including sea level rise and coastal erosion
about dangers of the current local spatial planning system for the long term
es for business in areas fitted for relocation based on the strenghts of a new location
es for landowners and developers in areas fitted for relocation (compensation for relocation, discounts for ted areas) - challenge to come up with sustainable solutions
tial plan, higher densities wil be reached per city, minimizing travel time between cities for service
about benefits of regional planning instead of local planning based on climate change effects including sea level sion
es for landowners and developers in areas fitted for relocation

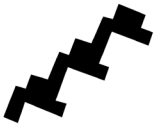
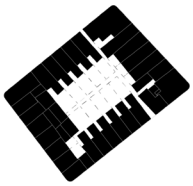
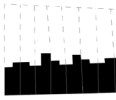
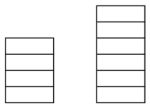
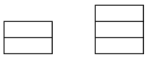
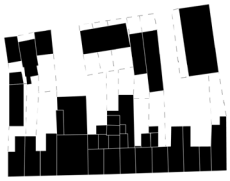
typology	apartments	closed building block	old row housin
floor plan			
typical number of floors			
building age	1950-1970	pre 1900	pre 1900
program	residential	residential	residential
urban morphology	central business district	victorian terraces	victorian terraces
cost indication	£	£	£
population change	1-5%	1-5%	1-5%
location	seaside		
deprivation	most deprived		
life expectancy (in years)	75 or less		

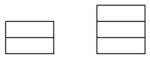
FIGURE 7: ANALYSIS OF HOUSING TYPOLOGIES AND ZONETYPOLOGIES ALONG THE A21 THROUGH HASTINGS

FIGURE 8: PHOTOS OF HOUSING TYPOLOGIES ALONG THE A21 THROUGH HASTINGS (GOOGLE, 2021, 2020, 2009)

g

teringzooi





pre 1900

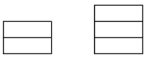
residential/ commercial

high street and promenades

££

1-5%

semidetached housing



1920-1950

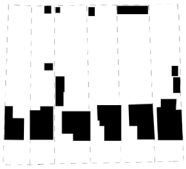
residential

suburban landscapes

££

<1%

single housing



1920-1950

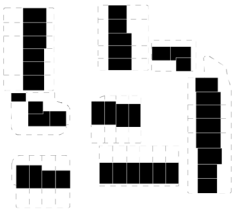
residential

countryside sceneries

£££

1-5%

stamp housing



1950-1970

residential

victorian terraces

££

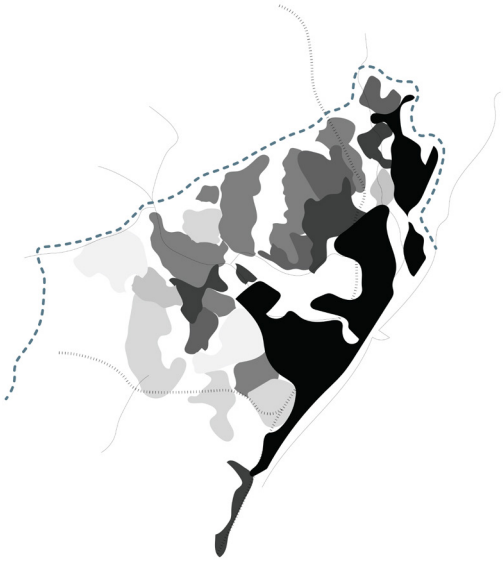
1-5%

inland

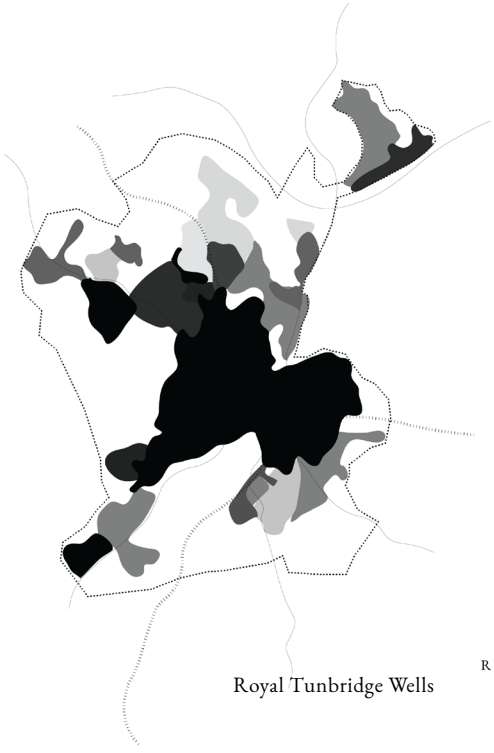
least deprived

83

Ashford



Hastings



Royal Tunbridge Wells

Bexhill

figure 9: development schemes of 2 growth centres, 1 growth city and 1 city planning for shrinkage including limits and accessibility

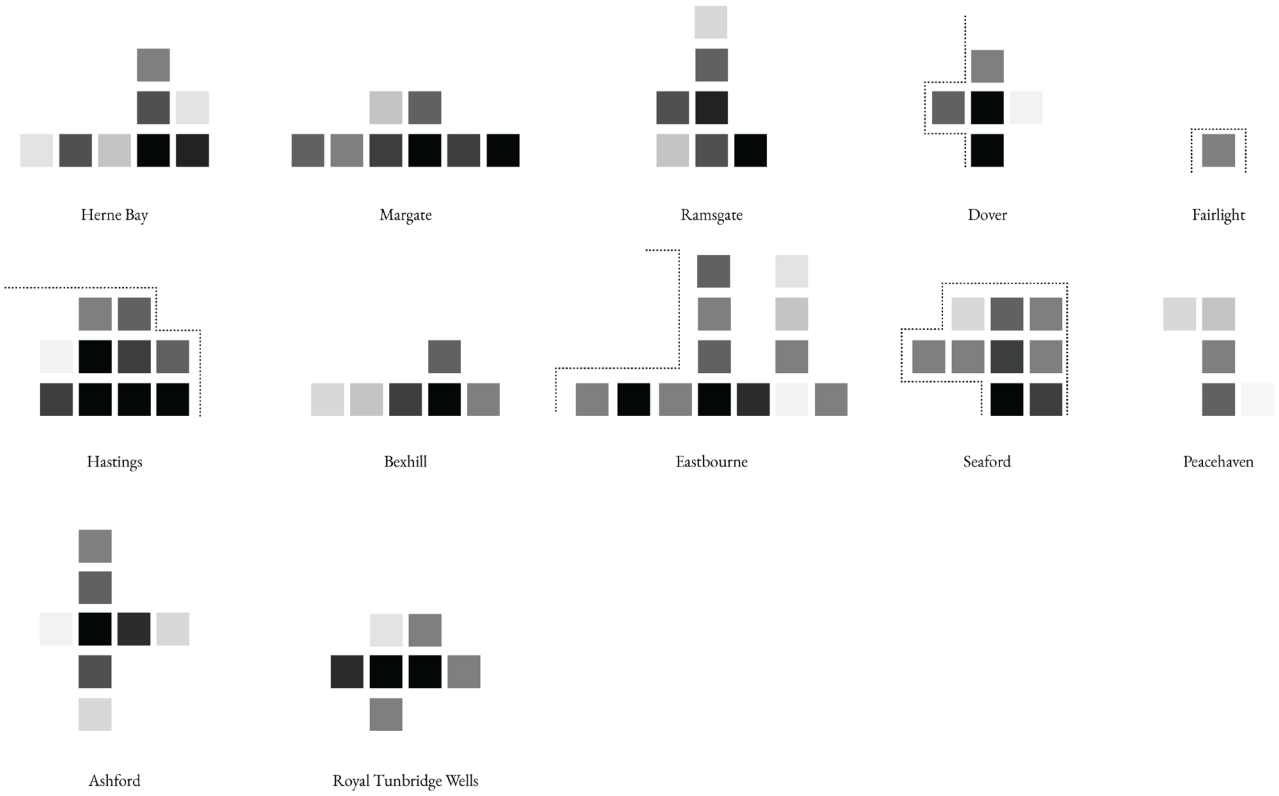


FIGURE 10: ABSTRACT DEVELOPMENT SCHEMES OF 2 GROWTH CENTRES, 1 GROWTH CITY AND 1 CITY PLANNING FOR SHRINKAGE INCLUDING LIMITS

Land cover type:	Your area surface in m^2	x 30 mm water in 1 hour = m^3 water	Depression storage [mm]	Infiltration loss [mm/h]	Specific storage capacity	Delay [min]	Your area water coming in	Your area without 'negatives' *
private								
Roofs – sloping	79,2	2,376	1	0	0	0	2,2968	2,2968
Roofs – flat, tar	61,5	1,845	5	0	0.05 m3/m2	10	1,5375	1,5375
Green roofs – extensive	33,75	1,0125	10	0	0.1 m3/m2	15	0,675	0,675
Green roofs – intensive	0	0	25	0	0.2 m3/m2	15	0	0
Garden tiled	0	0	3	8	0.05 m3/m2	5	0	0
total private area in m^2	174,2	5,226	total of water in 1 hour					
total public area in m^2	0	0	total of water in 1 hour					
Total area in m^2 and total m3 water	**174,2**	**225,63**						

sewer capacity: 20 mm per day

1,7 mm in 2 hours

mm of water going to the sewer in 2 hours: **27,2516**

3,8343	m^3 directly to sewer (roof and street)
0,67	m^3 delayed to the sewer (green roof)
-0,935	m^3 to natural system
4,5043	= total amount of water m3 that enters your area in 2 hours
4,5043	= **total of surplus in m^3 water (of 2 hours)**

Land cover type:	Your area surface in m^2	x 30 mm water in 1 hour = m^3 water	Depression storage [mm]	Infiltration loss [mm/h]	Specific storage capacity	Delay [min]	Your area water coming in	Your area without 'negatives' *
private								
Roofs – sloping	0	0	1	0	0	0	0	0
Roofs – flat, tar	102	3,06	5	0	0.05 m3/m2	10	2,55	2,55
Green roofs – extensive	22	0,66	10	0	0.1 m3/m2	15	0,44	0,44
Green roofs – intensive	0	0	25	0	0.2 m3/m2	15	0	0
Garden tiled	0	0	3	8	0.05 m3/m2	5	0	0
total private area in m^2	124	3,72	total of water in 1 hour					
total public area in m^2	0	0	total of water in 1 hour					
Total area in m^2 and total m3 water	**124**	**3,72**						

sewer capacity: 20 mm per day

1,7 mm in 2 hours

mm of water going to the sewer in 2 hours: **25**

2,55	m^3 directly to sewer (roof and street)
0,44	m^3 delayed to the sewer (green roof)
0	m^3 to natural system
2,99	= total amount of water m3 that enters your area in 2 hours
2,99	= **total of surplus in m^3 water (of 2 hours)**

Land cover type:	Your area surface in m^2	x 30 mm water in 1 hour = m^3 water	Depression storage [mm]	Infiltration loss [mm/h]	Specific storage capacity	Delay [min]	Your area water coming in	Your area without 'negatives' *
private								
Roofs – sloping	840	25,2	1	0	0	0	24,36	24,36
Roofs – flat, tar	3847	115,41	5	0	0.05 m3/m2	10	96,175	96,175
Green roofs – extensive	2834	85,02	10	0	0.1 m3/m2	15	56,68	56,68
Green roofs – intensive	0	0	25	0	0.2 m3/m2	15	0	0
Garden tiled	0	0	3	8	0.05 m3/m2	5	0	0
total private area in m^2	0	225,63	total of water in 1 hour					
total public area in m^2	7521	0	total of water in 1 hour					
Total area in m^2 and total m3 water	7521	225,63						

sewer capacity:	20 mm per day		
	1,7 mm in 2 hours	120,535	m^3 directly to sewer (roof and stree)
mm of water going to the sewer in 2 hours:	31,33220691	56,68	m^3 delayed to the sewer (green roof)
		0	m^3 to natural system
		177,215	= total amount of water m3 that enters your area in 2 hours
		177,215	= total of surplus in m^3 water (of 2 hours)

FIGURE 10: WATER FLOW CALCULATIONS EXCEL SHEET FROM TU DELFT (2019)

SYSTEM INFO

Modify the inputs below to run the simulation.

DC System Size (kW):	4
Module Type:	Standard
Array Type:	Fixed (open rack)
System Losses (%):	14.08
Tilt (deg):	90 0
Azimuth (deg):	180

SOLAR RESOURCE DATA

The latitude and longitude of the solar resource data site is shown below, along with the distance between your location and the center of the site grid cell. Use this data unless you have a reason to change it.

Solar resource data site: (INTL) LONDON/GATWICK, UNITED KINGDOM 39 mi

RESULTS

2,526 kWh/Year*

Print Results

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	1.43	149	N/A
February	1.69	159	N/A
March	1.96	204	N/A
April	2.69	263	N/A
May	2.68	261	N/A
June	2.47	230	N/A
July	2.67	254	N/A
August	2.90	278	N/A
September	2.66	254	N/A
October	2.27	229	N/A
November	1.49	149	N/A
December	0.93	96	N/A
Annual	2.15	2,526	0

RESULTS

3,245 kWh/Year*

Print Results

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	0.71	69	N/A
February	1.20	110	N/A
March	2.12	221	N/A
April	3.64	361	N/A
May	4.92	493	N/A
June	4.91	471	N/A
July	5.01	489	N/A
August	4.35	426	N/A
September	2.97	286	N/A
October	1.74	173	N/A
November	0.97	93	N/A
December	0.55	53	N/A
Annual	2.76	3,245	0

FIGURE 11: ENERGY COLLECTION IN HASTINGS PER M2