



WORKING WATERFRONT NEWTOWN CREEK

Adaptive multi-layer flood protection
on brownfield opportunity areas

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Colophon

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Final report

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Preface and Acknowledgment

For 400 years New York has a turbulent interaction with its surrounding waters. It embraced, tamed, neglected and rediscovered the waterfront which made its greatness possible. Hurricane Sandy brought in a new complexity for New York and its relationship with the waterfront. The storm reminded the city where it is located and paid a high price for ignoring the forces of the water. Yet, New York has a too long and tangled relationship with the waterfront to retreat upland or cower behind seawalls. The city has to find new strategies how to **live with the water**.

The master's project addresses the active working waterfront at Newtown Creek and a mixed-use waterfront development at Greenpoint which aims to create an accessible, adaptive and vibrant riverfront which is capable of restoring the ecology of the creek and resilient against natural hazards and sea level rise.

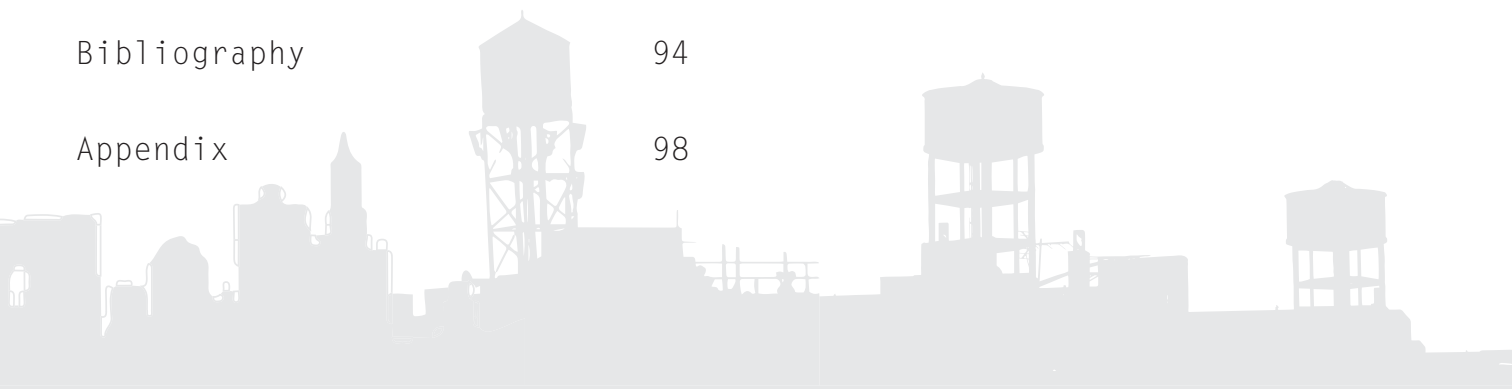
I would especially like to thank my mentors Frits Palmboom who sat so often with me on the drawing table and retraced the 'Larissa line' and Diego Sepulveda who always encouraged me and provided me with bright comments. Also, I would like to thank the various interview partner in New York and The Netherlands who gave me a lot of inspiration. Furthermore, my family who were always supporting me, the 'Deltas' with whom I became a strong team and which made the graduation year so much fun and Milo, Erifyli, Beryl, Marco, Tomas and Nien-Ping for making my two years in Delft unforgettable.

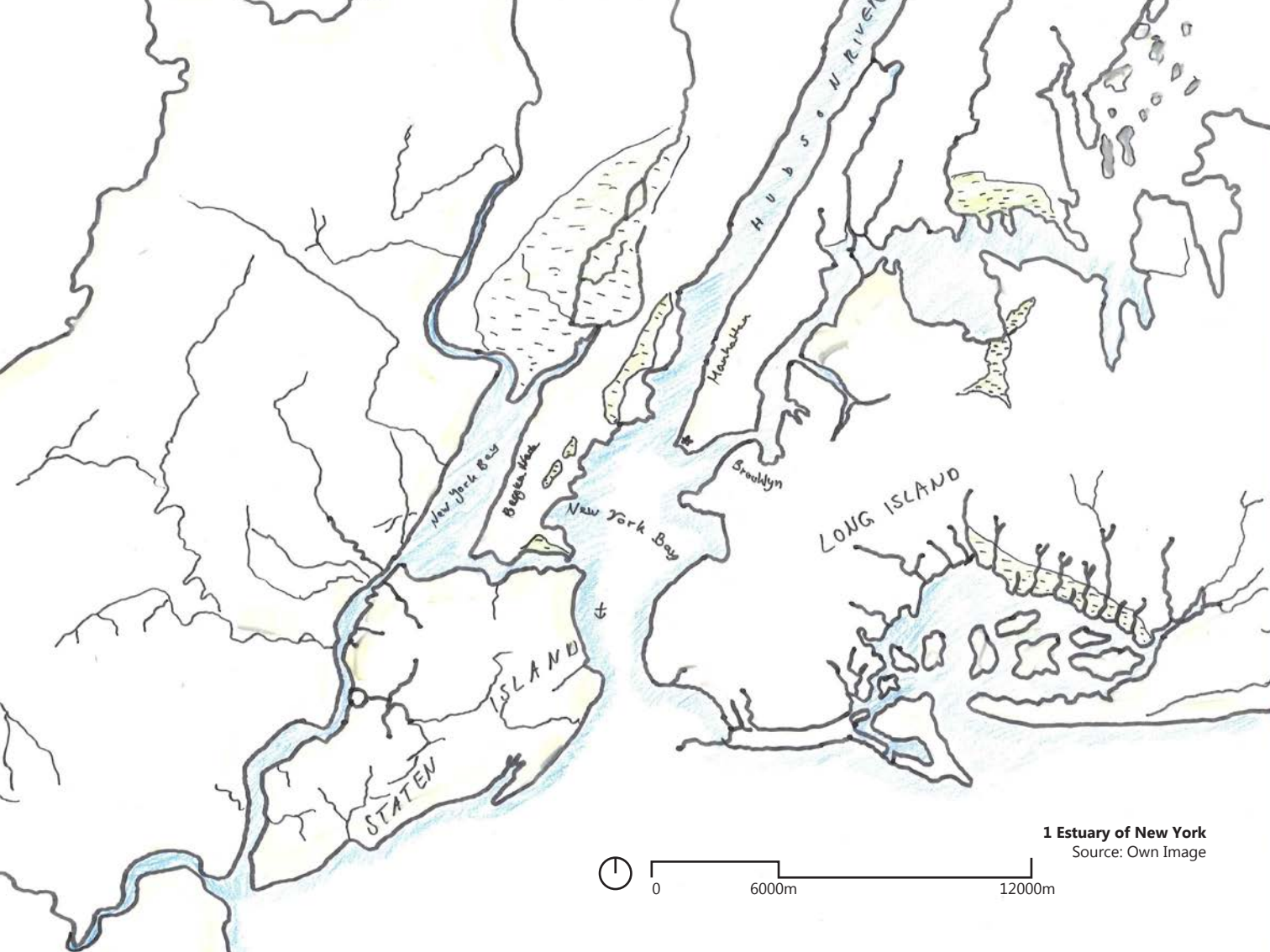


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1 Estuary of New York

Source: Own Image



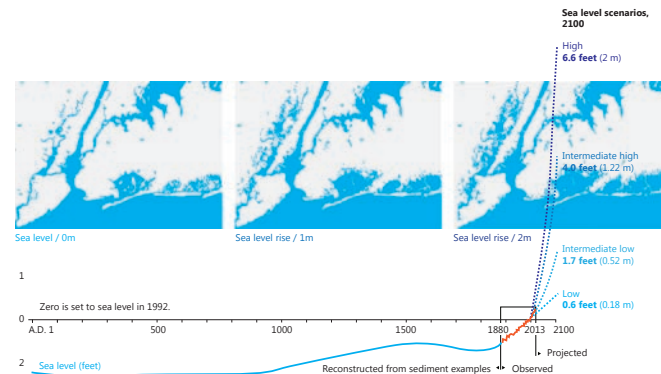
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I. Motivation

The history of human settlement is greatly influenced by the presence of rivers or protected bays – despite the natural hazard of flooding the economic advantage through trading, safe harbours, food and fresh water supply were more alluring (Hooimeijer, Meyer, Nienhuis 2005). But while motorways become more vital for the economic prosperity cities turned their back towards the water.

The story of the importance and the negligence of the waterways is also reflected in the history of New York City. The city's waterfront which was once teeming with commerce and vitality had nearly fallen into total ruin – a forbidding no man's land which one did not even want to have access to (Balsley 2012). Robert Moses the powerful planner of New York City in the 1930s transformed the abandoned marginal river zones into vast infrastructure – an inseparably knot of highways (Caro 1975). Today the situation has turned - heavy polluted, channelized, abandoned waterfronts are turned into vibrant urban space. But now New York City faces new problems – natural hazards and climate change as sea level rise (see

image 2), increasingly intense rainfalls, greater differences in the volumes of water produced by the rivers, as well as severe hurricanes (comp. Meyer, Morris, Waggoner 2009).



2 Floods maps depicting sea level rise
Data: Flood.firetree.net / NOAA / NASA / JPL
Source: Own image

Climate change can be seen as a threat to coastal cities, but it can as well be regarded as an opportunity to implement new innovative design approaches and help to evaluate the understanding of how we want to life now and in the future. With my graduation project in the field

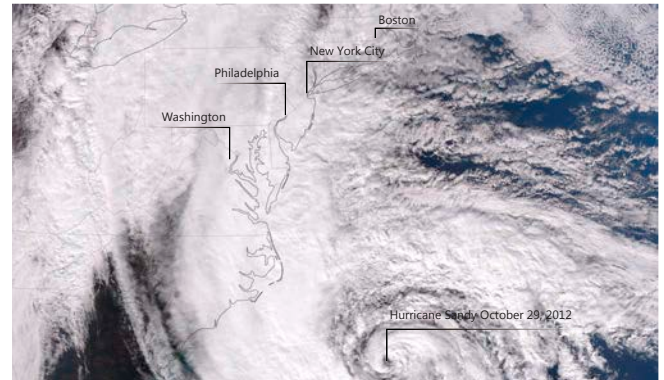
of Urbanism at Technical University of Delft I would like to raise awareness for the forthcoming problems of climate change and enhance comprehensive solutions which integrate urbanism, the ecosystem, natural morphology, design and socio-economic processes into flood protection measurements.

II. Context

On October 29, 2012, Sandy, a vast destructive hurricane hit the East Coast unexpectedly hard (see image 3). New York City paid a high price for its vulnerability – the hurricane left 43 dead in the city and the economic loss is estimated to be \$19 billion (Folger 2013). The hurricane demonstrated that the New York region is not prepared to weather future storms and flood events, especially with regard to sea level rise.

Hence, in December president Obama signed an executive order creating the Hurricane Sandy Rebuilding Task Force to empower the affected communities to improve the region's resilience (Rebuild by Design brief 2013). Hereafter, the Hurricane Sandy Rebuilding

Task Force launched the multi-stage regional design competition Rebuild by Design which encompasses regional to local scale solutions. The interdisciplinary teams comprises (landscape) architecture offices, academic institutions, engineering companies, experts of finance, as well as, community engagement experts. The Delta Interventions Studio is established within the wider framework of the competition.



3 Aerial Photograph of Hurricane Sandy
Source: NASA Earth Observatory 2012

III. Problem definition

Within New York City the master's thesis is located on the industrial waterfront of Newtown Creek, North Brooklyn (see image 4). Newtown Creek used to be one of the vital industrial centres of the region. Oil distilleries, shipyards, foundries, industrial food processors, fabric and paper mills settled along the river's edge. However, a lot of those factories are now abandoned and leaving behind one of the nation's most polluted canal which is suffering from raw sewage and oil spill (see image 5). Newtown Creek experiences almost no water movement next to given tidal action. Low flow and 150 years of heavy industrial use has resulted in a contaminated layer of sediments up to 4.6 meter thick lying on the Creek's bed. CSOs and other contamination combined with stagnant waters create large areas of the Creek with low to no dissolved oxygen (Newtown Creek BOA 2012).

During Sandy the low-lying neighbourhoods adjacent to Newtown Creek were very vulnerable towards the storm surge and its ecological consequences. Inundation resulted from astronomically high tides and transient

increases in sea levels due to Hurricane Sandy. Much of these waters was typified as 'black water' and exhibited high salt contents, as well as pollutants such as fuel oils and sewage. The damage comprised an oil film on adjacent streets, the aggradation of industrial garbage and pollutants in the surrounding neighbourhoods and the combined sewage system reached its capacity.

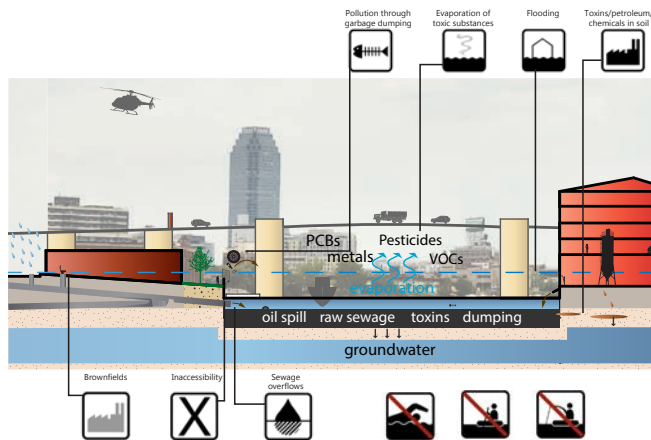


4 Location Newtown Creek, Brooklyn

Source: Own image

Furthermore, the Newtown Creek Water Control Plant was endangered to shut down, basements and first floors were flooded, the electrical systems collapsed and buildings were damaged. In addition, the heavily used metro line G was inundated which means that power cables, exposed to salt water, are corroding from the

inside while exterior corrosion of rails and fasteners has increased the likelihood of short circuits. The damage is insidious and continuing and reparation works will cost billions of dollars over several years and make the line over vast amounts of time inoperative for its users (Flegenheimer 2013).



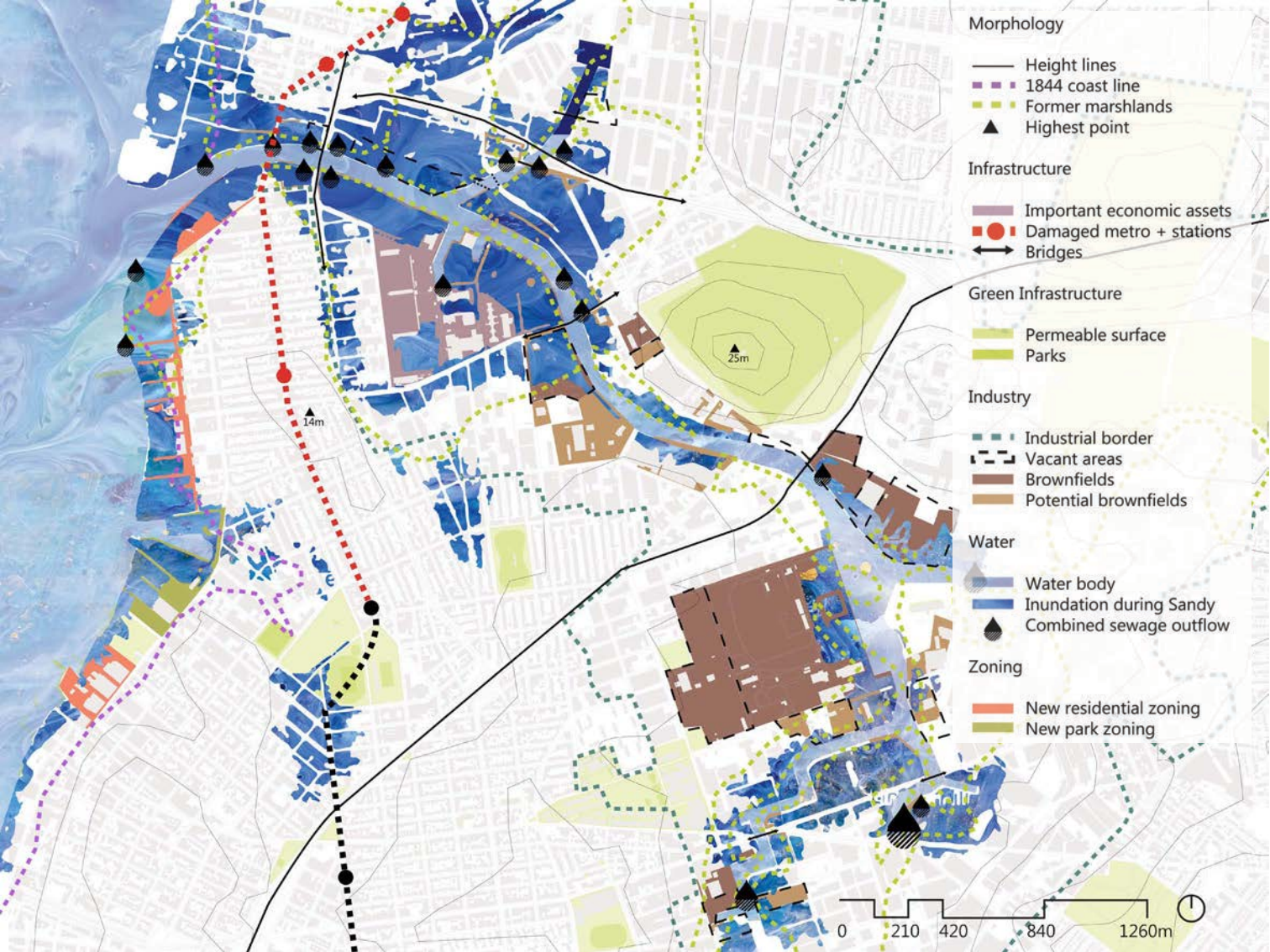
5 Section of Newtown Creek indicating problems

Source: Own image

The analysis in the aftermath of Hurricane Sandy (see image 6) depicts the inundation but also the ecological stress a natural hazard causes for the surrounding densely populated area and the vulnerable infrastructure along the creek. The analysis also illustrates clearly that the inundation is corresponding to the topography. In the shallow former marshlands and the coastline which were filled with land during the industrialisation, flooding was especially severe and the storm surge was pressed until the end of the creek.

6 Analysis Newtown Creek in the aftermath of Sandy

Source: Own image



IV. Review

The master's project addresses how to re-activate the **working waterfront** at Newtown Creek and simultaneously create an accessible, adaptive and resilient riverfront which is capable of restoring the ecology of the river and resilient against natural hazards and sea level rise. Meanwhile the project has to reconsider the social dynamics and changes and address a new framework which considers the diversification of jobs and new demands of the inhabitants.

a. Flood protection

In order to improve the resilience of the waterway vulnerabilities concerning storm surge, sewer backups into streets, lack of sewer connection and storm water drainage has to be reduced. Within the project the multi-layer safety approach of prevention, spatial planning and evacuation is tested. Further questions are whether to rely on 'soft' or 'hard' shoreline mitigation measures as well as the integration of socio-economic and ecological issues.

b. Ecological reconstruction

In order to improve the long term living quality and economic viability of business in the project area, the environmental health of the waterway has to be addressed. Especially the water quality, natural inflow, rain water management and the reconstruction of marshland as a habitat for flora and fauna, where applicable, has to be thematised.

c. Economic vitality

Furthermore, the industrial business area is characterized by a shift away from manufacturing and wholesale trades. The shift represents a larger city-wide and regional trend. Nevertheless, the combination of relatively cheap land, reliable vehicular access to the regional highway system, and proximity to dense residential and commercial markets in Manhattan and high-growth areas of Brooklyn and Queens continues to support Newtown Creek as an industrial area. There is a need to influence urban policy to keep urban industry in the centre of the city. While industry will become cleaner and greener in the future, it will be important to maintain as much of the Business

Context for industrial use to allow the Newtown Creek to evolve into a model of a 21st Century Maritime Industrial Area (Newtown Creek BOA 2012).

d. Public accessibility

The Creek performs primarily as a working waterfront. There is however, some interest in securing more public access to the creek edge and the water itself. Balancing the provision of open space and recreational Creek access for nearby neighbourhoods with the needs of expanding industry and commercial operations will be a key concern when planning the area's future (Newtown Creek BOA 2012).

e. Living quality

A further challenge is the contamination of adjacent plots due to the industrial heritage of Newtown Creek. However, it depicts also an opportunity since brownfield redevelopment was targeted as an important component to accommodate growth (Pearsall 2013). The PlaNYC 2030 progress report projected the population to grow from 8.36 million to 9.1 million in 2030:

'As our need for space grows while our supply of land remains fixed, we must use our existing stock of land more efficiently. Brownfields represent one of our greatest opportunities.' (NYC 2007, p. 41)

Especially the mouth of the river is especially interesting for new residential development on brownfield opportunity areas. But has at the same time the industrial heritage, the involvement of the adjacent neighbourhoods, a comprehensive flood protection and the public domain along the waterfront has to be considered.

V. Research and design questions

Out of the problem statement and the review a catalogue of research questions derived.

a. Main research question

How can brownfield opportunity areas at the waterfront be adapted and transformed in response to climate change with regard to spatial and environmental quality? (→ answer page 52)

b. Sub-questions

What are the definitions of terms shaping the current climate adaption literature, such as uncertainty, resilience, adaptability and transformation? (→ answer page 29)

What are the multi-layer safety approach and the American equivalent of multiple lines of defence? (→ answer page 33)

What are the advantages and disadvantages of flood protection measurements in both Netherlands and the United States and what can the opposing approaches of resilience and preventative flood protection learn from each other? (→ answer page 36)

c. Research applied on design

How to integrate multi-layer flood protection measurements in mixed-use waterfront development on former industrial brownfields in Brooklyn, New York City, in order to sustain an adaptive and resilient eco-

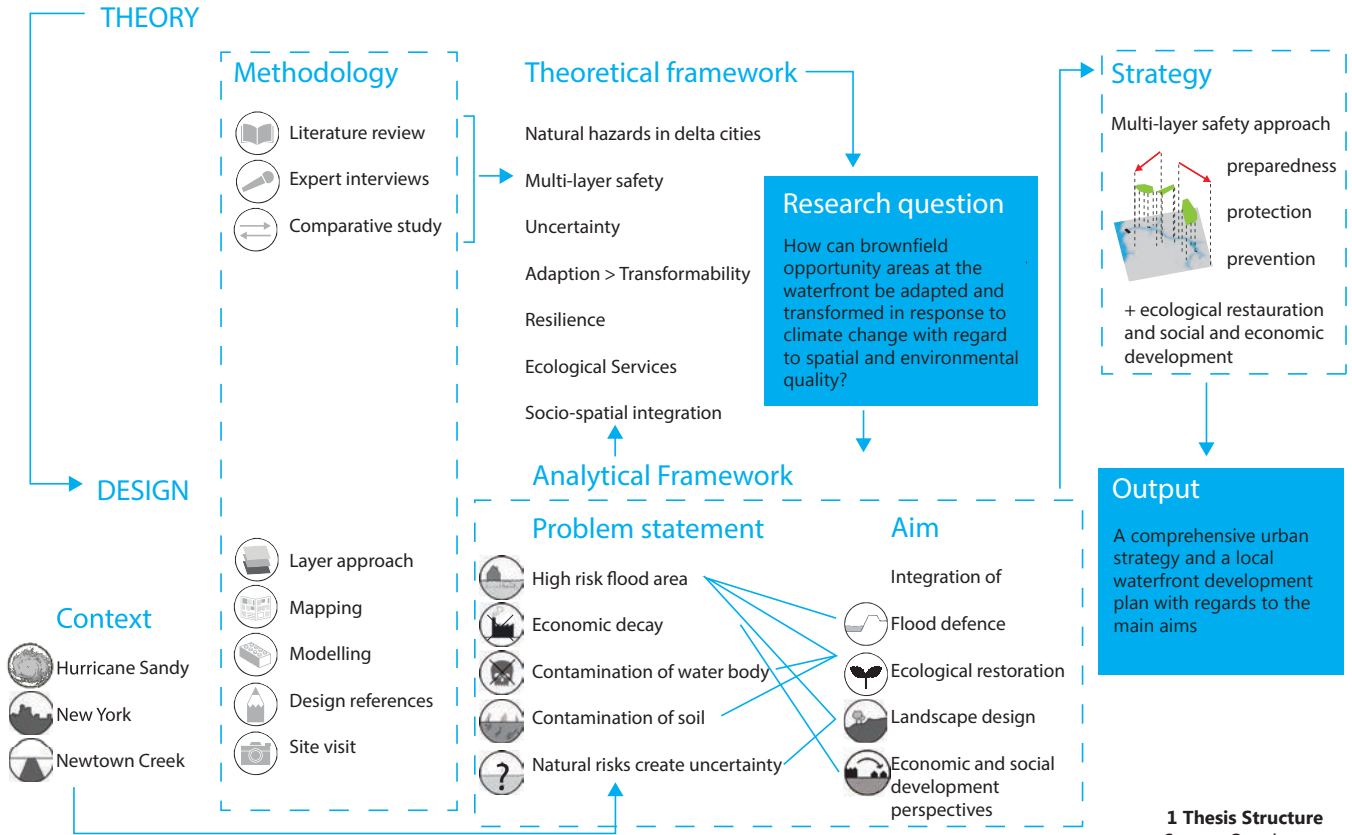
system to oppose climate change and natural hazards? (→ answer page 52)

d. Design sub-questions

How can the natural topography and morphology of the surrounding area of Newtown Creek used to embrace flood protection, e.g. through the identification of elevations or marshlands? (→ answer page 52 ff.)

How can the theory of multi-layer safety approach be applied in Brooklyn, New York City? (→ answer page 52 ff.)

What are appropriate flood protection measures to enhance the idea of the multi-layer safety approach and to rehabilitate the ecology and integrate socio-economic issues? (→ answer page 52 ff.)



1 Thesis Structure
Source: Own image

Theoretical framework

In order to get a deeper understanding of Delta urbanism and its challenges through natural hazards and climate change the design part is backed up by a research part which focuses on the integration of flood protection measurements with ecology and socio-economic concerns. Reflecting on flood protection from the Dutch perspective the American approach towards flood management is very divergent. While The Netherlands aim at long-time solutions to diminish flood-prone areas to an almost imperceptible event the US approach is that the 'coastal region must enhance its resilience to be able to effectively respond and thrive given these future risks and vulnerabilities' (Rebuild by Design brief 2013, p.12).

Consequently, the master's thesis reflects on the opposing approaches of resilience and preventative flood protection. An informative overview about different options how different societal contexts cope with climate change, is given by Dessai in 'Uncertainty and Climate Change Adaptation - a Scoping Study' (2007). Furthermore, Adger et al. (2005) discusses how cities facing uncertainties can adapt to changing circumstances

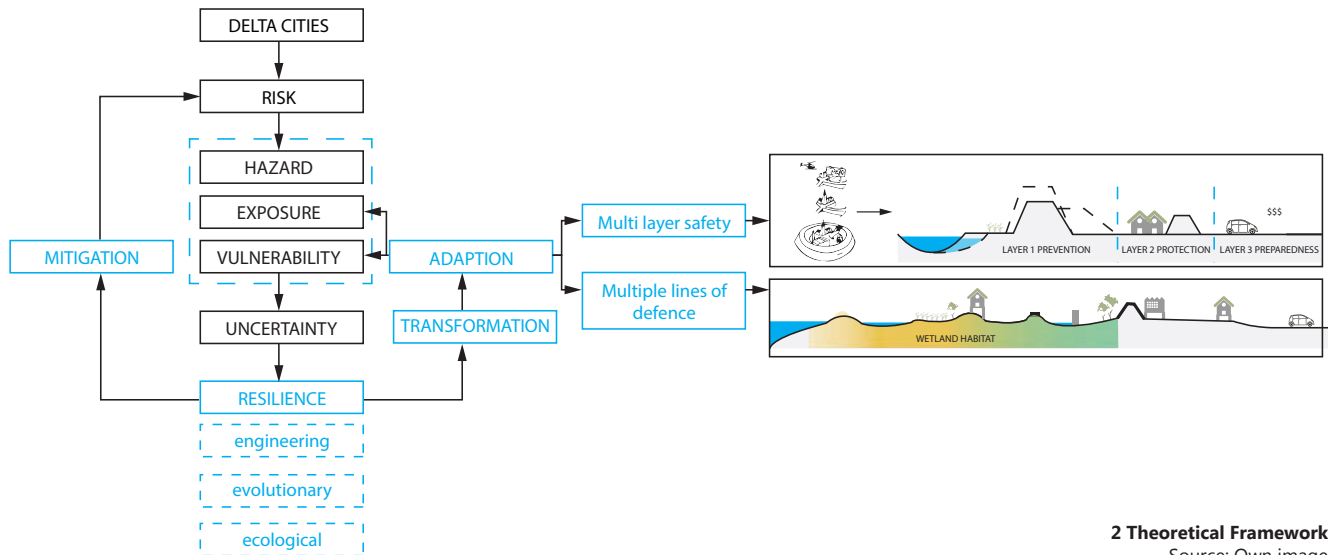
and the impact of climate change (Adger 2005). Other main authors consulted are Davoudi (2012) which is describing in the paper 'Resilience: A Bridging Concept or a Dead End?' the differences between engineering, ecological and evolutionary resilience. She describes critically that a return to 'normal' is not always desirable and introduces the concept of evolutionary resilience which challenges complex socio-ecological systems not to return to normality but to change, adapt and transform in response to disturbance (Davoudi 2012).

Therefore, the multi-layer safety approach as a concept to integrate the ecosystem, natural morphology, design and socio-economic processes into flood protection measurements can have valuable input to develop evolutionary resilient coastal cities (see image 2). The multi-layer safety approach which was developed in The Netherlands and is a rather new approach how to tackle flood defence, is not tested yet. Hence, the graduation project introduces the multi-layer safety approach and tests how it could be applied on a highly urbanized and vulnerable area in terms of flood risk.

A similar strategy is the multiple lines of defence which illustrates the importance of different landscape types into flood protection in order to not rely solely on man-made structures. The concept of multiple lines of defence was developed by coastal scientist Lopez (2009) in the

aftermath of the failure of engineered storm protection in New Orleans 2005.

Moreover, the main approaches and terms used in current climate adaption literature, such as uncertainty,



2 Theoretical Framework

Source: Own image

resilience and transformability are explained. The paper 'Resilience, Adaptability and Transformability in Social-ecological Systems' (Walker et al. 2004) is thus studied. More theoretical depth can be found on page 27 and following.

I. Methodology

The methodology used for the master's thesis consists of a set of mostly qualitative methods such as a literature review, comparative studies, expert interviews and mapping. The set of methods is carefully chosen to support the research. For example literature was reviewed in order to develop a scientific understanding of flood risk and climate change, experts consulted to obtain site or flood specific knowledge. Many design references were studied to receive a wide range of options for the actual design challenges. Mapping helped to understand the site specific problems and set it in context to the research. In the following paragraph the applied methodology will be introduced.

a. Literature review

The literature review contains the reading of various papers about flood protection which have been reviewed in order to build up the theoretical framework. A wide range of urbanism books and magazine articles about New York City helped to contextualize the problem definition and the consultation of design books gave a lot of inspiration. The books consulted encompassed, from 'Delirious New York' by Rem Koolhaas (1994), to articles related to waterfront development in the Topos landscape magazine till almost classic books about ecological design as 'Design with Nature' by McHarg (1969), but also newer literature as 'River.Space.Design' by Prominski et al. (2012).

b. Comparative study

Since The Netherlands are very advanced in flood protection measurements and gained knowledge how to protect the country of the threats of the water since centuries, I use the example of flood protection and urban planning in The Netherlands, especially in Rotterdam, in order to do a comparative study with the American

delta cities of New York and New Orleans. Therefore, I studied the books of Meyer (1999) 'City and Port: Urban Planning as a Cultural Venure in London, Barcelona, New York and Rotterdam', as well as, 'Dutch Dialogues. New Orleans - Netherlands' by Meyer, Morris and Waggoner (2009) and 'Atlas of Dutch water cities' by Hooimeijer, Meyer and Nienhuis (2005).

Although, the cultural and political mind-sets are divergent, both systems can learn from each other. There is a shift of paradigm in the Netherlands as well, from conventional, top-down, costly, hard-engineering structures to more integrated, flexible, multi layered safety approaches.

c. Stakeholder review

To understand the complexity and the scope of the graduation project a vast stakeholder review was inevitable. From a European perspective it is a rather new that the civic society is engaging so much into planning processes and political decisions. In order to understand the different interests and demands of alliances I created

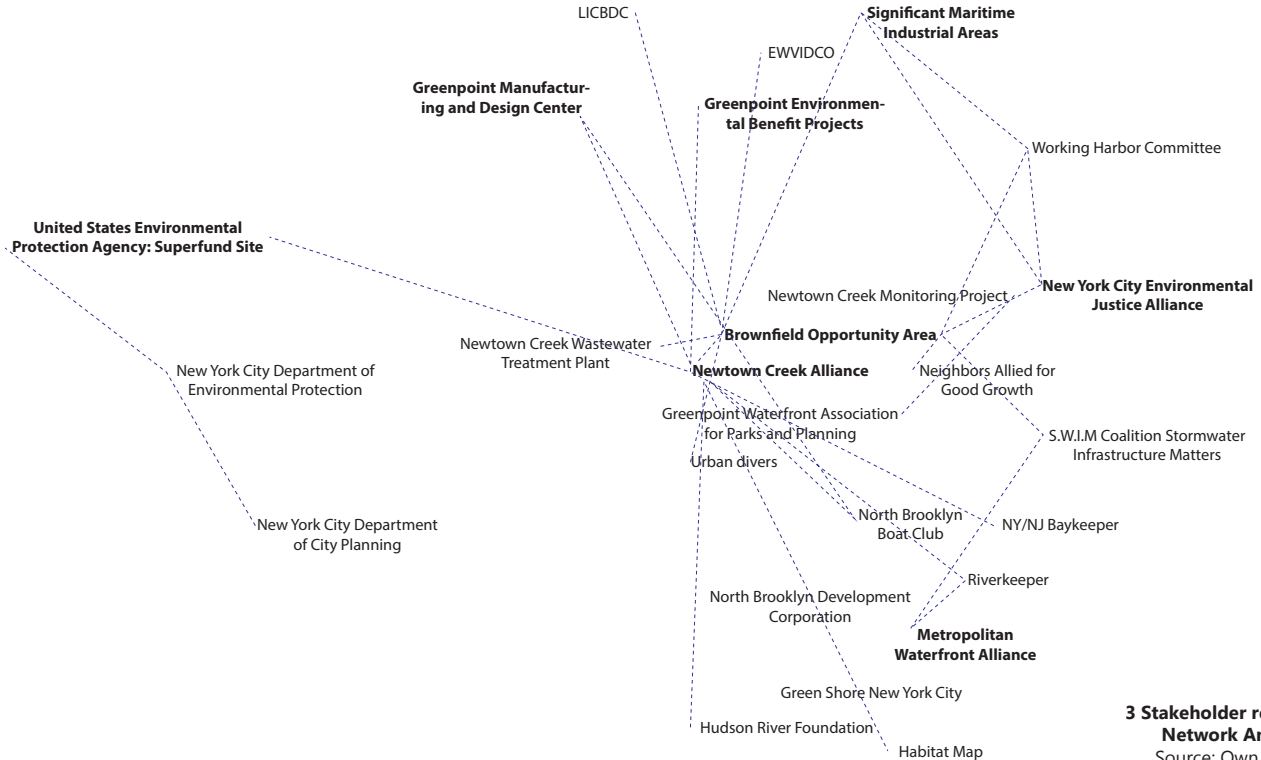
a network analysis how different stakeholders cooperate and made interviews with the key interest groups.

d. Expert interviews

In addition, while going on excursion to New York, the opportunity was given to speak with different stakeholders, experts and local community organisations. The interview partners were carefully chosen and presented a wide variety of persons engaged with flood protection measurements from design, financial, ecological, social and engineering perspectives. The interview partners are also contact person which help to make the project more feasible and closely connected to the needs of the area. The experts met in New York hopefully will also stimulate a fruitful and closely connected cooperation in the on-going realisation of the graduation project.

After returning from New York, I used the possibility to make phone interviews with stakeholders involved at Newtown Creek. The interview partners comprised environmental activists, but as well employees of the US Environmental Protection Agency and the New York

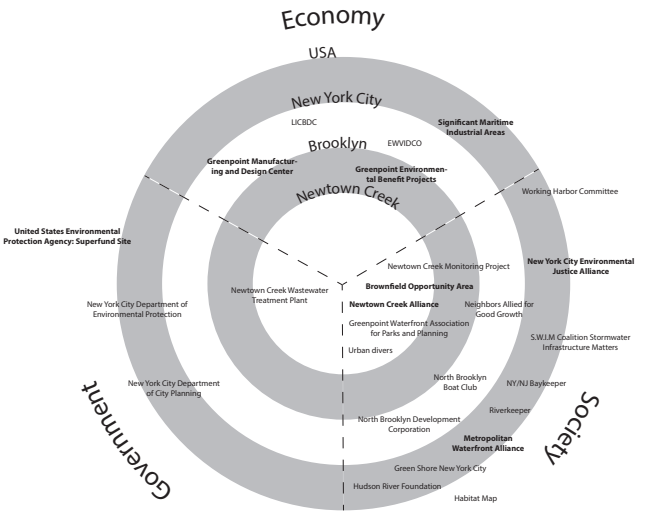
Theoretical framework



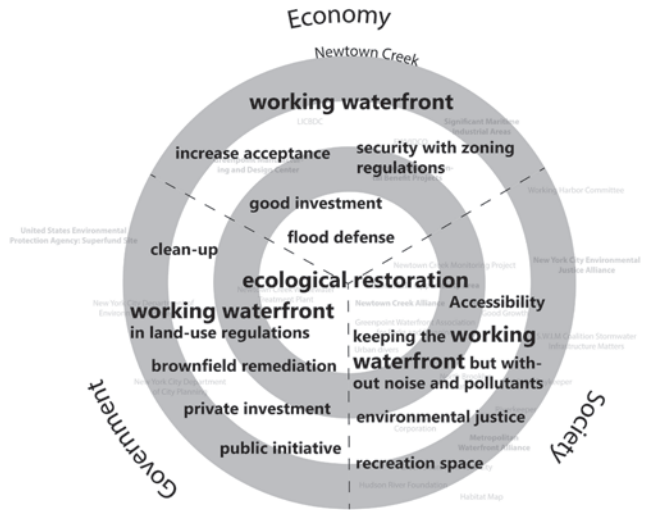
**3 Stakeholder review:
Network Analysis**
Source: Own image

State Attorney. In the appendix (page 98) the reader can find the full interviews with the consulted stakeholders. Furthermore, I consulted hydraulic experts from the Faculty of Civil Engineering of TU Delft. Professor Bas Jonkman, Mark Voreendt and Ties Rijcken gave me

valuable insights how to apply the multi-layer approach on Newtown Creek. Frank de Graaf, an urban planner and expert of waterfront planning and coastal development at Royal HaskoningDHV explained me how he works in practice from a water to land perspective.



4 Stakeholder Analysis
Source: Own image



5 Changing Demands
Source: Own image

	Expert interview
	Bas Jonkman, Professor of Hydraulic Engineering, TU Delft
	Frank de Graaf, Expert of waterfront planning and coastal development, RHDHV
	Michael Heimbinder, Activist, Newtown Creek Alliance
	Peter Washburn, Policy Advisor, Environmental Protection Bureau, GCEF
	Ties Rijcken, Researcher Hydraulic Engineering, TU Delft
	Wanda Ayala, Community Involvement Coordinator, U.S. Environmental Protection Agency
	Mark Vorendt, Researcher of integral and sustainable design of multifunctional flood defences, TU Delft

d. On-site interviews

During the New York excursion various sites in different contexts as marshlands, high-urban densities and barrier islands were visited. If it was possible, locals and experts were supporting the field trip to show locations with either implemented smart solutions or areas which problematic flood issues in order to get a real understanding and a sense for the scale and dimensions of the different project areas. Furthermore, conversations with locals helped to understand what happened during

Sandy and what are their ideas and wishes for the future.

f. Mapping

Additionally, conventional mapping was used in order to understand the complex, coupled human-natural systems of communities, cities, waterways and ecosystems in New York. Delta Interventions Studio also enhances the process of retroperspective mapping such as hand drawing and tracing back the evolution of New York to get surprising insights (see images 6+7).

g. Identifying different typologies / flood protection measurements

Moreover, the different typologies of the built-up structure and the natural zones are categorised and exploited. The different typologies bear different flood protection measurements which are also categorised.

h. Design references

Besides, successful implementations of flood-proof buildings and public space, also civil engineering structures were visited and studied to get additional

inspiration. In New York City we visited Hunters Point South by Thomas Balsley Associates and the heavy polluted Gowanus Canal which should be transformed into a 'Sponge Park' by dlandstudio. Furthermore, the book River.Space.Design and the entries of the Rebuild by Design competition provided the graduation project with fruitful inspiration.

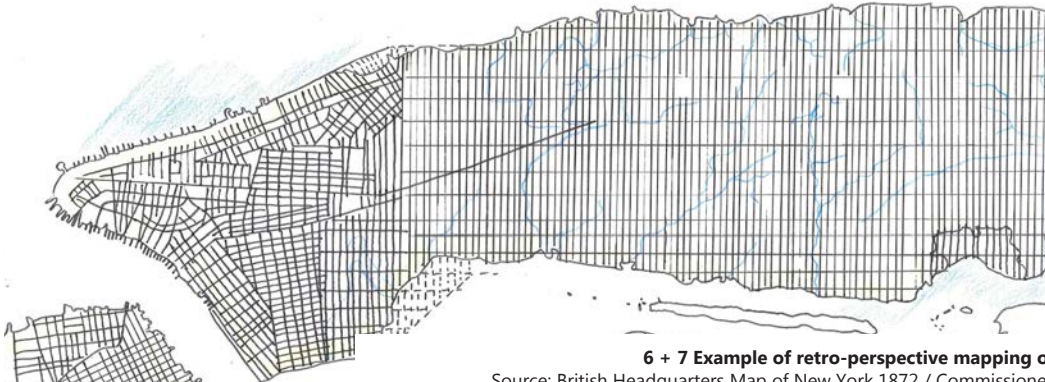
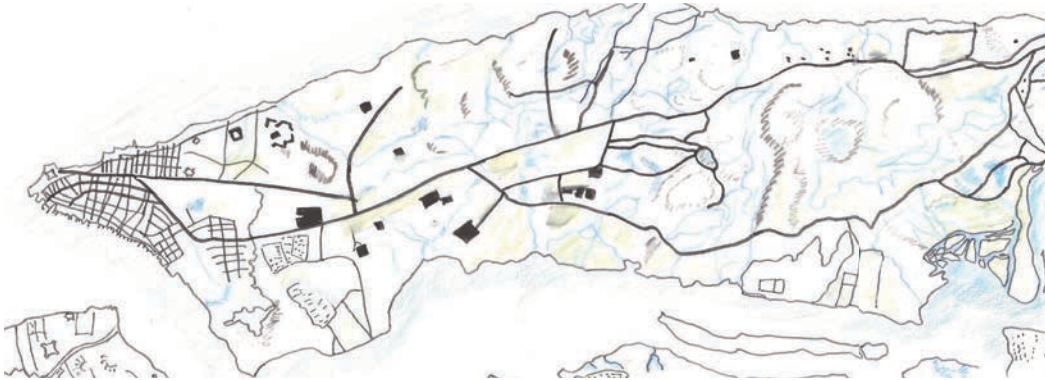
II. Social and scientific relevance

The actuality of climate change and its effects in delta regions is very high. Natural hazards and vast floods cost every year human life and destroy the economic vitality, living quality and ecological habitat of affected regions. Today already a quarter of the world's population live within 100 kilometre of the coast (Small, Nicholls 2003) and each year an estimated 10 million people experience coastal flooding due to storm surges (Nicholls 2004). In delta cities exposure towards flooding is especially high due to their scale and spread and increasingly complex owing to their heterogeneities and differences. Additionally, the damage disasters causes are ever increasing since economic assets and population is rising.

Consequently, building resilience in coastal regions represents urgency (Adger et al. 2005). Therefore, understanding the effects of sea level rise and increasing storms in New York City and finding integrated solutions can also help understanding deltas in other parts of the world. The sooner new strategies of adaption, mitigation and resilience are exploited and tested the faster effects can be evaluated and potentially be implemented in other deltas as well.

III. Outcome + design goal

The final results of the graduation project include a theoretical framework about the future challenges of delta urbanism which are translated into the design of an adaptive and resilient waterfront at Newtown Creek, New York City. The design goals are to provide an resilient urban environment resisting climate change and storm surge, supporting the existing and future maritime industries, improving the ecological functioning of Newtown Creek through habitat reconstruction and green infrastructure and a safe and attractive open space network along the waterfront for the local community.



6 + 7 Example of retro-perspective mapping of Manhattan

Source: British Headquarters Map of New York 1872 / Commissioner's Plan 1811



1 Kosciuszko Bridge spanning the Newtown Creek
Source: Mitch Waxman

Resilience, uncertainty and climate change

Multi-layer safety as an approach to develop adaptive and resilient urban environments in complex delta ecosystems

Abstract – In the face of climate change many coastal cities are at risk of natural hazards. This paper is aiming at defining the main approaches and terms used in current climate adaption literature, such as uncertainty, resilience and transformability. Moreover, it discusses how cities facing uncertainties and vulnerability towards climate change can progressively adapt to changing circumstances. The concept of **evolutionary resilience** is introduced which challenges complex socio-ecological systems to change, adapt and transform in response to disturbance. Therefore, the multi-layer safety approach as a concept to integrate the ecosystem, natural morphology, design and socio-economic processes into flood protection measurements can have valuable input to develop resilient coastal cities. A similar strategy is the multiple lines of defence which illustrates the importance of different landscape types into flood protection in order to not rely solely on man-made structures. Finally, the case

studies of The Netherlands and The USA are introduced which depict different possibilities of coping with coastal hazards and uncertainties.

Key words – Delta urbanism; natural hazards; flood protection; climate change; resilience; multi-layer safety

I. Introduction

Tracing back history people always settled next to rivers or protected bays – despite the natural hazard of flooding the economic advantage through trading, agricultural fertility and fresh water supply were more alluring (Hooimeijer, Meyer, Nienhuis 2005). Hence, ‘societies, organisations and individuals have been adapting to changing conditions for centuries’ (Dessai 2007, p.5). However, since the last decade of the twentieth century delta cities face new urgencies – natural hazards and climate change in form of sea level rise, increasingly intense rainfalls, heat waves, greater differences in the volumes of water produced by the rivers, as well as severe hurricanes create unforeseen vulnerabilities to the delta cities (Meyer, Morris, Waggoner 2009).

In delta cities exposure towards flooding is especially high due to their scale and spread and increasingly complex owing to their heterogeneities and differences. Each coastal city has its own peculiarities and varies ‘in their exposure to risk, their expertise in mitigation, the vulnerability of their populations and infrastructures, and the resources they have at hand to deal with adversity’ (Amin 2012, p.4). Additionally, the damage disasters causes are ever increasing since economic assets and population is rising.

Consequently, building resilience in coastal regions represents urgency (Adger et al. 2005). However, there is much research done about the vulnerabilities of deltas and forthcoming problems caused by climate change. But there are not many strategies how to tackle climate change and use it as an opportunity to implement new innovative design approaches and rethink existing urban structures. Climate change is not only a threat but helps to evaluate our understanding of how we want to life now and in the future.

This paper introduces the multi-layer safety approach which can have valuable input to redesign delta cities in a way that the natural morphology and ecosystem are taken into account, as well as to support the balance of soft and hard mitigation measures in order to create robust water-related environments.

The methodology of the paper contains a literature review of the most beneficial and recent papers about the multi-layer safety approach, resilience and coastal hazard mitigation. The main research question discusses ‘How the multi-layer safety approach can be better integrated in complex delta ecosystems to achieve adaptive and resilient urban environments?’. The structure of the paper contains first an overview of the used vocabulary, such as resilience, adaption and transformability, then the two similar approaches of multi-layer safety and multiple lines of defence are introduced and case studies of The Netherlands and The USA are presented to amplify different strategies how to deal with water-related hazards.

II. Definitions

In current literature and design many buzz words as resilience or adaption appear. Yet, many of these concepts are used inconsistently and are often left unexplained (Fünfgeld, McEvoy 2012). Resilience e.g. is used as a versatile and fashionable umbrella term and not defined in an exact way. In order to receive some clarity, the following paragraph acquaints the reader with definitions of terms which shape the different approaches towards flood protection.

a. Flood risk

‘Flood risk is defined as the probability of flooding multiplied by the impact of the flood’ (Hoss 2010, p.28).

b. Vulnerability

Vulnerability to environmental hazards means the potential for loss (Cutter, Boruff, Shirley 2003). By understanding the linkages between ecosystems and socio-economic processes the vulnerability in coastal areas towards natural hazards can be reduced and the resilience enhanced (Adger 2005).

c. Flood proofing

Flood proofing is an approach to realise dry feet: to control flood prevention and to be prepared for crisis (Rijkswaterstaat 2008).

c. Uncertainty

Uncertainty is dealing with unpredictable future events. The phenomenon can be simply defined as ‘missing knowledge; i.e., the absence of information’. (Walker, Marchau, Swanson 2010, p. 917) ‘There are two kinds of uncertainties, the so-called known unknowns ‘are familiar but unpredictable as to when and where they will happen’(Termeer, Brink 2013, p. 44). Second, ‘the unknown unknowns are completely unforeseen until they happen, and will always be experienced as surprises’ (Ibid. p. 44). Uncertainties will become more likely in the future due to the increasingly connectivity and complexity of our world (Ibid.).

Unprecedented low-probability events, causing major social-economic disruption, can happen even in the most well monitored regions. Climate change is expected to

change local weather patterns, water supplies and sea levels. However, there are many uncertainties about when and where changes will happen, which magnitude and potential impacts these changes have and which strategies are the most effective and feasible to adapt to climate change. Failing to prepare for them may imply taking a risk that is not socially acceptable and is furthermore rising the questions how much disasters preparation a modern society can afford (Tsimopoulou et al. 2014). Governmental organizations hence ‘face the paradox that they must plan, but also plan for not having a plan’ (Termeer, Brink 2013, p. 44).

There are two ways of dealing with uncertainty: the first is to characterise, reduce, manage and communicate uncertainty and tempts to foresee the future (Dessai 2007). The second is oriented towards resilience and hence, learning from past events. In this approach some uncertainties associated with climate change are irreducible and therefore accepted. It emphasises to abandon the notion of stability, expecting the unexpected, and increasing the capability to learn from crisis (Berkes

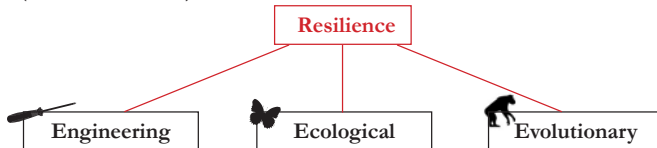
2007).

d. Resilience

Resilience as well as adaptability have to do with the dynamics within a system (Walker et al. 2004). ‘Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks’ (Walker et al. 2004, p.2) For instance, a resilient water system can restore its normal equilibrium after extreme runoff events. Resilience in social systems includes the adaptability of humans to inevitable unanticipated conditions. Resilience consists of three main characteristics: the amount of change the system can undergo while retaining the same functions, the degree of the system of self-organisation and the capacity for learning and adaption (Dessai 2007). Part of the resilience concept lies in the regenerative ability of ecosystems to change to continue to deliver resources and ecosystem services while undergoing change. The concept of resilience is shifting from the traditional perspective of ‘controlling changes in systems that are assumed to be

stable', towards 'sustaining and enhancing the capacity of social-ecological systems to adapt to uncertainty and surprise' (Adger 2005).

There are three definitions of resilience: engineering resilience, ecological resilience and evolutionary resilience (Davoudi 2012).



Engineering resilience assumes the time needed for a system to bounce back to its original state after a disturbance, such as flooding. The faster the system restores, the more resilient it is. Engineering resilience is designed to protect existing assets, people and places from the impacts of climate variability, such as sea walls and flood levees (Fünfgeld, McEvroy 2012).

Ecological resilience is a more dynamic approach, where 'the magnitude of the disturbance that can be absorbed

before the system changes its structure' is emphasized (Holling 1996, p. 33). Here, resilience is defined not just according to how long it takes for the system to bounce back after a shock, but also how much disturbance it can take and remain within critical thresholds.

There are also critical voices that the concept of resilience shows that modern society is incapable of choosing between resignation and the belief to control risks (Amin 2012). With economic recession and uncertainty because of climate change governments tend to step back (Shaw 2012). However, the reason that there are some communities with higher level of social capital and 'natural resilience' cannot be an excuse for communities to fend for themselves. Local authorities are responsible to support, manage problems and provide the resources for the communities (Ibid.). Furthermore, critical is the emphasis on the return to 'normal' without questioning what normality entails (Davoudi 2012). A striking example of the potential undesirability of the 'normal' is Hurricane Katrina in 2005. Besides destroying the physical fabric of New Orleans, the storm also

exposed social processes which many people did not find acceptable to return to pre-disaster normal (Ibid.).

However, it is assumed that ‘if uncertainties regarding climate impacts are so big that science is unable to provide any reliably estimates, one might still have enough knowledge to strengthen the general resilience of the impacted system’ (Dessai 2005, p. 39). Therefore evolutionary resilience or socio-ecological resilience is introduced which ‘challenges the whole idea of equilibrium and advocates that the very nature of systems may change over time with or without an external disturbance’ (Davoudi 2012, p. 302). Here resilience is not conceived as a return to normality, but as the ability of complex socio-ecological systems to change, adapt and transform in response to disturbance (Ibid.).

e. Adaption

‘Adaptability is the capacity of actors in a system to influence resilience’ (Walker et al. 2004, p. 3). Developed by ecologists Holling (1978) and Walters (1986) adaptive management contains feedback loops and learning

based strategies ‘to cope with risk in decision making in a context of uncertainty’ (Dessai 2007, p.40). The experimental approach emphasises on a process of continuous learning which seeks to maximize flexibility, keep options open and avoid lock-in effects (Ibid., p.40). Hence, adaptation is often reactive, triggered by observed extreme weather events and their impacts (Ibid., p.5). An adaptive policy is aware of the multiplicity of plausible futures that lie ahead, is designed to be changed over time as new information becomes available, and leverages autonomous response to surprise (Walker, Marchau, Swanson 2010). Decisions can be reviewed, and further decisions implemented as improved information of the present day and future climate risk becomes available (Dessai 2007).

f. Transformability

Transformability is ‘the capacity to create a fundamentally new system when ecological, economic, or social (including political) conditions make the existing system untenable’ (Walker et al. 2004, p.3).

III. Multi-layer Safety

When hurricane Katrina made landfall in New Orleans in 2005, the flood defence structure - mostly supported by dikes - failed catastrophically and reminded people, particularly in the Netherlands, that despite the achievements in flood defence in the past 60 years there still remains a risk of living in a delta (Meyer, Morris, Waggoner 2009). New Orleans represents a man-made landscape which relied on levees, bulwarks, and other rigid, flood defences which showed no flexibility to respond to hydrological dynamism (Manaugh, Twilley 2005). While the man-made structures failed, they created an inversion – the walls and levees, helped keep the flood waters in (Ibid.). But it was not only the failure of the water defence system but as well the environmental degradation and inefficient evacuation programs that resulted in large economic damage and the loss of many human lives.

In reaction to the Hurricane Katrina disaster, in 2006, the Dutch parliament explicitly defined the goal of improving its organizational and administrative preparation for

floods (Termeer, Brink 2013) and introduced the concept of multi-layer safety in the National Water Plan in 2010 (Heuvel, Roovers, Eijer 2010).

The flood control measures are classified into three safety layers. The first layer comprises measures for the prevention of flooding, such as dikes, dunes and storm-surge barriers. The second layer embraces land use planning for the mitigation of losses, such as flood proofing or relocation of buildings to safer places. The third layer comprises evacuation which depicts temporary solutions in case an emergency is unavoidable and limits the damage from possible flooding (Tsimopoulou et al. 2014). While the first layer is minimizing the probability the second and third layer is reducing the ecological and socio-economic vulnerability towards a flood.

IV. The integration of ecosystems

Coping with natural hazards depicts a critical element of how resource use and human settlement have evolved and is an ongoing part of human history (Adger 2005). Structural features such as levees and floodgates, as well

as non-structural features such as elevating houses and evacuation routes have long traditions. However, they are often not attuned to each other or the integration of different measures comprises a less clear engineering and science input.

While the multi-layer safety approach is emphasising to reduce the risk in time of disaster, a similar approach was introduced by Lopez in 2009, but which is aiming at the integration of landscape elements in order to not rely solely on man-made structures (see illustration 2). This represents a very new approach since natural ecosystems and the ecosystem services they provide to human societies have been ignored in risk reduction programs before. In spite that natural ecosystems such as coastal reefs and marshlands have been identified as a priority for hazard mitigation and risk reduction (Pérez-Maqueoa, Intralawana, Martínez 2007).

‘The multiple lines of defence strategy’ contains two elements: ‘(1) using natural and man-made features (lines of defence) that directly impede storm surge or reduce

storm damage and (2) establishing and sustaining habitat goals’ (Lopez 2009, p.186). The strategy integrates structural and non-structural flood protection with coastal restoration (Ibid.). The multiple lines of defence acknowledge the fragility of the urban infrastructure and the changing dynamics of the hydrological landscape since coupled socio-ecological systems are always in flux and transformation is essential. The application of the strategy is more consistent with traditional land use where settling on protected land was essential to survive than modern land use is today (Ibid.).

The integration of landscape features and coastal restoration is undoubtedly driven by the conclusion ‘that structural protection cannot be relied on solely as a result of many factors such as costs, high subsidence, sea-level rise, risk of failure, etc.’ (Lopez 2009). Therefore, Lopez (2009) claims that coastal restoration should be coordinated and prioritised where it can provide flood protection benefits. The result of the introduced habitat goals which are to maintain and improve the intactness of the wetland hydrology, should be a functional estuary that

is as self-sustaining as possible.

The 'lines of defence' include 'barrier islands, the sounds, marsh land bridges, natural ridges, man-made ridges, flood gates, flood levees, pump stations, home and building elevations, and evacuation routes' (Ibid., p. 189f.). The flood protection measurements are not structured as hierarchical as the multi-layer approach but can be broadly divided into structural, non-structural and coastal restoration features.

However, designing with nature is not a new approach. The ecological planner McHarg propagated in 1969 to reconsider man's relation with the environment and take the natural layer into account while shaping our living habitat. Although it is evident that wetlands have enormous capacities of mitigating flood risk, coastal restoration and flood protection were long time regarded as separate entities (Lopez 2009). Through the establishment of man-made flood protection, human kind developed the hubris that man can control nature and knowledge of the capacities of landscape mitigating

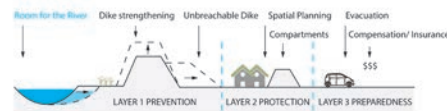
flood risk were long-time neglected. Recent events, such as hurricane Katrina made clear, that coastal restoration and flood protection have to be integrated.

Liu et al. (2007) challenges as well in the paper 'Complexity of Coupled Human and Natural Systems' the lack of integration of ecological and social sciences. The authors reveal in their integrated research the complex

MULTIPLE LINES OF DEFENCES



MULTI LAYER SAFETY



2 Comparison of Multiple Lines of Defence (USA) and Multi-layer safety (NL)

Source: Own Image

interactions and feedback between human and natural systems. The research measures not only ecological variables (landscape patterns, wildlife habitat, biodiversity) and human variables (socioeconomic processes, social networks, land-use, governance) but also variables that link natural and human components (low-lying wetlands in consideration to economic assets).

V. US vs. Dutch approach

As case studies, The Netherlands and The USA were chosen since they are both facing increasing risks from extreme weather events, sea level rise, and flooding due to climate change, but due to the varying attitudes towards risk and uncertainty both countries are using a very different approach (comp. Dessai 2007). Nonetheless, in both cultures the urgency to adapt to climate change has become unavoidable’ (Ibid.).

The decision frameworks and analysis tools are grouped into two schools of thought: ‘the predictive top-down approach and the resilience bottom-up approach’. The Dutch approach generally starts from top down ‘by

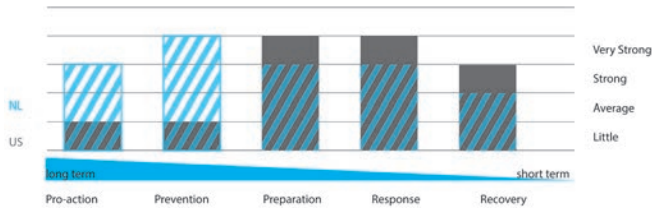
exploring which effects climate change will have and which measures have to be taken to remain flood-proof’. The traditional US approach starts at the bottom and ‘explores how resilient or robust this system is to changes and variations in climate variables and how adaptation can make the system less prone to uncertain and largely unpredictable variations and trends in the climate’ (Ibid., p.6).

While the USA have drawn on the diagnosis of the future as increasingly jeopardous and uncertain the principle of risk avoidance and universal protection are replaced by ‘restricted guarantees, aggressive response,

	NL	US
Philosophy	Prevention	Recovery and adaption
Scale	Delta / dike rings	Building / structure
Responsibility	Public	Private
Management tools	National Delta Program	NFIP insurance and building regulations
Financing	Public	Developers / private owners (little public funding)
Approach	Integral	Sectoral

3 Comparison of flood protection in the USA and NL
Source: Ten Brinke (2008) Own image

and responsibility devolved to communities and citizens', the Dutch response has been to find solutions to strengthen its established all protections approach (see image 3 and 4).



4 Comparison of flood protection in the USA and NL

Source: Veelen, v. P. (2013) Own image

a. The Dutch approach

The Dutch 'flood risk management policy is dominated by aiming to reduce the probability of flooding rather than the loss of a flood' (Hoss 2010, p.43). The prevention-based standard indicates the probability of flooding. The damage that a flood would cause is only considered in the cost-effectiveness-analysis when determining which flood standard is the most economic (Ibid.). Changing the hydraulic conditions or building flood defences are

the primary pillars of the Dutch flood defence (Ibid.).

By implication, as the population feel safe behind dikes and have trust in the government, they will not develop the capability to improvise at times of crisis and even extend establishing living environments in unreasonable areas from a hydrological and environmental point of view. 'As a result, it is likely that the 'control paradox' will continue to exist and will even increase' (Termeer, Brink 2013).

However, since the 1970s, the Dutch society and politics have put the position of Rijkswaterstaat, responsible for the practical execution of water management, and the technocratic way in which it realised infrastructure projects, under pressure. With democratisation and environmental awareness citizens tend to be more critical with big infrastructural projects (Termeer, Brink 2013). The implementation of huge engineering structures from the 1960s on to keep the country flood proof and the lack of knowledge and consideration of the coastal habitats have resulted in the loss of 90 percent of coastal wetlands

and significant water quality problems (Lopez 2009).

In the mid-nineties the paradigm shift from reactive and curative adaptation in response to disasters towards planned adaptation in response to anticipated climate change. The safety standards have to be recalculated every five year to prevent surprises caused by climate change and dikes have to be adapted to the new situations regularly. It emerges that the Precautionary Principle is not based on 'zero risks' but aims to achieve lower or more acceptable risks or hazards. We see this reflected in a shift in parlance from "flood defence" to "flood risk management" (Dessai 2007, p.31).

Today The Netherlands are facing issues of retrofitting the regional flood protection system to improve the coastal ecology (Lopez 2009). The Oosterschelde storm surge barrier which integrated partly permeable flood gates to sustain salt water marine life and the Room for the River project have shown Rijkswaterstaat's capacity to integrate water safety, ecology and spatial planning in an innovative way (Termeer, Brink 2013).

The basic idea of the 'Room for the River' concept is to enlarge the discharge capacity of the main Dutch rivers by increasing the amount of space for the rivers, and to simultaneously improve the spatial quality of the riverine areas. The emphasis is on spatial rather than technical measures to reduce the flood probability (Ibid.). With the Room for the River project, the whole safety chain, from proaction and prevention to preparation, response and aftercare was addressed (Ibid.). For instance, the buildings and infrastructure had to be adjusted, houses were relocated, dams built, evacuation routes planned and early warning systems were developed. Although Rijkswaterstaat is until now primarily responsible for prevention, such as taking measures beforehand that aim to prevent flood accidents and disasters, by introducing the flood risk approach, 'Rijkswaterstaat thus is preparing not only for physical measures but also for organizing its social networks with other partners in the safety chain, such as municipalities, provinces, water boards, private companies and citizens' (Ibid., p.52).

b. The US approach

While the Netherlands aim at long-time solutions to diminish flood-prone areas to an almost imperceptible event the US approach is that the 'coastal region must enhance its resilience to be able to effectively respond and thrive given these future risks and vulnerabilities' (Rebuild by Design brief 2013, p.12). The emphasis on self-reliance in resilience thinking is in essence an American idea, focusing on the ability of people to recover and reinvent themselves in the face of external challenges (Davoudi 2012).

Therefore, the most relevant institution in times of natural hazards, is the 1979 established Federal Emergency Management Agency (FEMA) which was created to closely link preparedness, response and mitigation within one organization. The aim was to integrate preparedness with response and recovery in order to create continuous improvement and effective response operations (Termeer, Brink 2013).

The term flood proof is consciously not used in the repertoire of politicians and ministries in the US rather than resilience since the uncertainties due to climate change make it impossible to predict a 100 percent flood proof situation at all time.

VI. Conclusions

Finally, it can be said that due to climate change, uncertainty and the growing vulnerability through the expansion of economic assets and population, flexibility in flood protection has to be maintained. Natural hazards will remain a risk, but the risks can be reduced. However, risk reduction requires a deeper understanding of cultural, political, social, economic, psychological, technological, physical and natural conditions (Pérez-Maqueoa, Intralawana, Martínez 2007). Coastal cities have to adapt to changed circumstances and keep the ability to change and transform themselves because the socio-ecological system itself remains in a continuous flux. In this perspective coastal cities are not understood as fixed, but as cities in continually changing process. During this process it has to be constantly reflected what

is worth to preserve and where transformation is more appropriate. To turn the forecast of natural hazards into an opportunity requires a great deal of preparedness and the capacity to imagine alternative futures. Coastal cities should be prepared for innovative transformation at times of change and uncertainties. Furthermore, in the possibility of transformation lies the chance to realise potentially better coastal cities which integrate ecology, socio-economic processes and flood protection. Each coastal city has to find its own tailor-made solution how to tackle climate change and natural hazards. Whether multiple layers of safety are reasonable in a flood management system and which layers should be prioritised depends significantly on the characteristics of the hydraulic landscape, flood risk, scale, economic assets, urbanisation degree and the path dependency of already implemented flood defences. Furthermore, significant factors are the degree of public awareness of flood risk, the occurrence and severity of flood events in the recent past and the degree of flexibility in policy-making that allows economic resources to be available for financing flood risk management projects (Tsimopoulou et al.

2014). However, the theoretical framework to enhance a unifying strategy is essential in order to create additional benefits from flood protection.

In both case studies, the USA and the Netherlands, the integration of ecology and design in the flood protection system is desirable. A combination of natural and modified ecosystems, adequate built flood protection and social awareness may be able to yield the best results to live rather than to cope with natural disasters and climate change. The proposed strategy is potentially a unifying vision for the coast: embracing environmental habitat restoration, spatial planning and quality as well as engineered flood protection. Spatial planning allows for smart growth and building with less vulnerability.

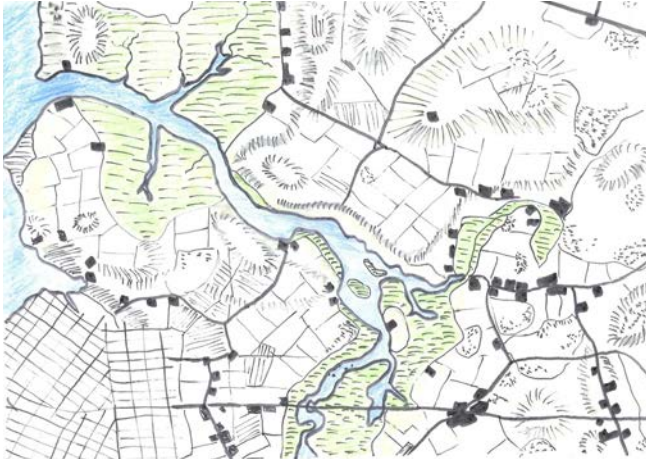
1 Newtown Creek with view to Manhattan

Source: Own image

Urban Strategy



Morphology



2 Retrace of map from 1844: Agricultural Development

Source: Own image

Around 1600 Newtown Creek represented a long tidal creek system with surrounding wetlands and freshwater inflow from undeveloped upland.

From 1613 high grounds were settled by Dutch farmers. As the settlements grew, demands on the water bodies increased. During 1700 and 1800 the creek and canal

were modified through drainage and land fill to support fishing, farming, and general commercial and industrial activities.



3 Retrace of map from 1891: Industrial Development

Source: Own image

Around 1850 the physical and ecological characteristics were permanently altered by dredging, straightening, bulk-heading and landfills. Wetlands and open space in the area were replaced with urban developments.

Widespread paving, building development and city-wide sewers came to replace the freshwater stream (New York City Department of Environmental Protection 2011).

As industry expanded in the nineteenth and twentieth century, the area became heavily urbanized, the Creek was straightened, and its natural depth of around 3.7 meters was dredged deeper and far upstream. In 1870 a rail line along the north side of Newtown Creek was established.

By the end of the 19th century over 100 oil distilleries established on both sides of Newtown Creek. Other noxious industries established themselves along the Creek, including sugar refineries, leather tanning plants, canneries, and copper wiring plants. Before World War II, Newtown Creek was one of the busiest commercial waterways in the country (Newtown Creek BOA 2012).

By the new millennium, industry along Newtown Creek had dwindled to a shadow of its former activity, though the area remains active. The map from 2013 shows how restricted the creek is into the urban fabric which does

not leave any room for the river. The creek has completely lost its capacity of a functioning water system and there is no natural inflow provided due to the impermeability of the surrounding surface. Today the creek is almost invisible since the urban grid structure has not found a way yet how to respond to the natural dynamics of the waterfront.

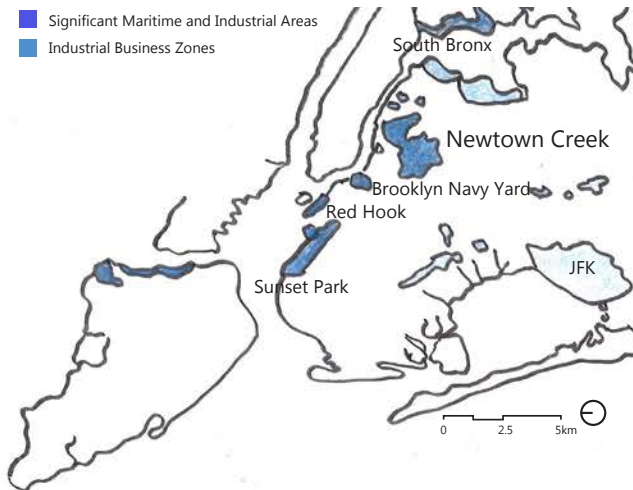


4 Retrace of map from 2013: Post-Industrial Development

Source: Own image

Significant Maritime and Industrial Areas

The map depicts the Significant Maritime and Industrial Areas (SMIAs) and Industrial Business Zones (IBZs), as shown in New York City's Comprehensive Waterfront Plan. The SMIAs are the largest remaining concentrations of maritime commerce and waterfront industry in New



5 Significant Maritime and Industrial Areas

Source: Own image adapted after Vision 2020: NYC Comprehensive Waterfront Plan NYC Department of City Planning

York City. Newtown Creek's SMIA has a strategic location in the middle of the City (PlaNYC 2007).

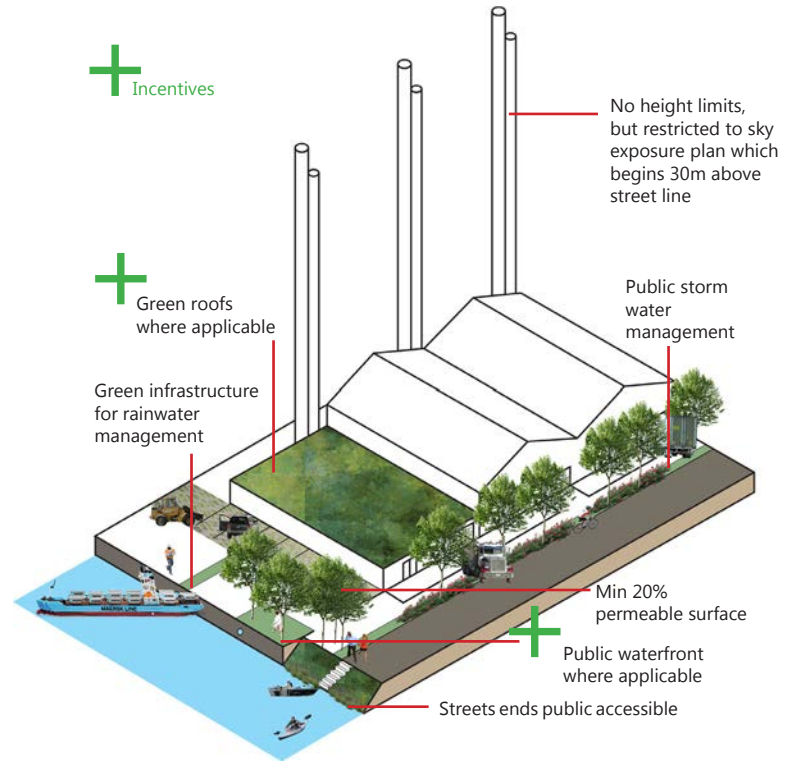
Newtown Creek is mostly zoned as M3—a zone reserved for the most intense and noxious industrial uses while still allowing for all light industrial uses, office uses and limited retail. The M3 zoning type is most incompatible with residential areas and community facilities since it allows manufacturing and commercial industries that generate noise, traffic, odor, vibration, or pollutants. Uses found in the Newtown Creek BOA include power plants, solid waste transfer facilities, recycling plants, and fuel supply depots (Newtown Creek BOA 2012).

New York's powerful zoning code provides a valuable tool to defend manufacturing zones against the risk of residential encroachment. The BOA's continuation as an M3 zone with a surrounding M1 buffer is necessary to preserve these lands for industrial use' (Newtown Creek BOA 2012, p. 71).

However, there is a local employment shift away from manufacturing and wholesale trades to office-based

and professional services sectors. The remaining manufacturing in the area depicts mostly artisanal and specialty manufacturing, warehousing, delivery, and wholesale as well as recycling/waste related uses.

Since professional services and information based businesses lend themselves to more dense urban environments given that they typically do not require large parcels of land in order to operate, buffer zones should react to these new trends and give new opportunities for service orientated and high tech industries in order that Newtown Creek SMIA remains competitive. As well, the boom in green economy represents a chance for Newtown Creek, however, to be credible also the companies itself should act as role models and promote green infrastructure which can also help to revitalise the ecology of the creek system. Special incentives policies could promote green infrastructure and public accessibility in industrial zones along the creek (see image 6).

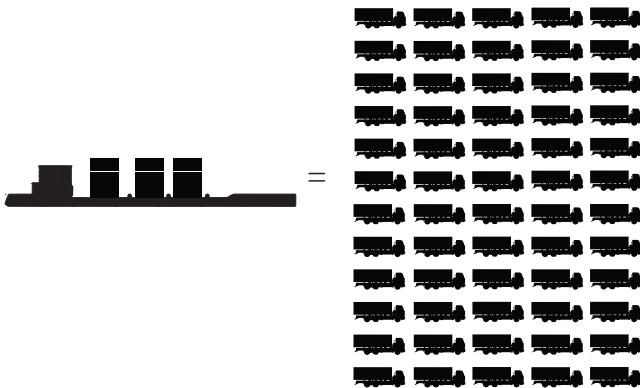


6 Zoning incentives for industrial M3 zones

Source: Own Image adapted after NYC Department of City Planning

Why sustain a working waterfront?

1. The largest sources of greenhouse-gas emissions are the trucks that move cargo from marine terminals to distribution centres and regional markets. Currently, nearly 85 percent of all cargo leaving the Port of New York and New Jersey is moved via truck. Through a greater reliance on domestic ocean-borne commerce, known as short-sea shipping, and rail transport, these impacts could be dramatically reduced.



7 A dry barge can carry the equivalent of 60 truckloads in cargo
Source: Own image

2. Recycling and waste water industries use increasingly shipping for transferring goods.

3. New York Port is the premier maritime complex on the East Coast—as well as the many tugboat and barge operators, marinas, and ship-repair outfits that provide maritime support services to the port.

4. The maritime industry is directly dependent on the availability of waterfront space and the use of the waterways to do business.

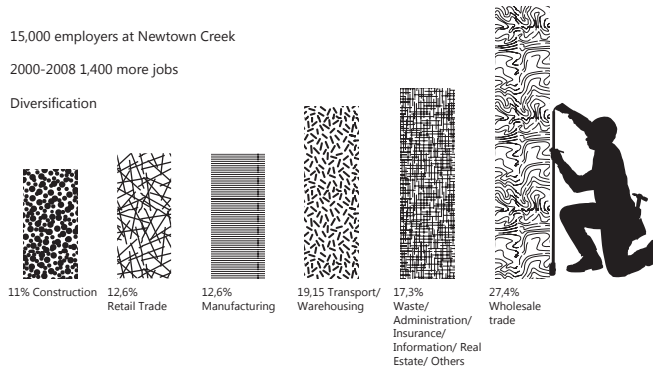
5. Maritime industry are typically well paid and offer an important diversity for the city's economic base.

'Newtown Creek is a **navigable waterway** under the jurisdiction of the Coast Guard, and the channel must be maintained for **shipping purposes**.'

Interview Ayala Wanda

Community Involvement Coordinator for the Newtown Creek
Superfund Site, U.S. Environmental Protection Agency

‘On a longer perspective the **edges and especially the mouth of the river** which are very interesting due to its location close to Manhattan will probably **transform into residential uses**. But in the last year many companies and the New York City government have **invested in new factories** here, as the Newtown Creek Wastewater Pollution Control Plant which carries a lot of new **economic opportunities** in the area. These new factories are very essential for whole New York City so in the future there will be a tremendous effort to **keep manufacturing and jobs in the city** area and also **essential infrastructure** has to be located somewhere. I am sure that in the future, manufacturing will remain essential for the Newtown Creek.’



8 Employment structure at SMIA Newtown Creek

Source: Vision 2020: NYC Comprehensive Waterfront Plan
NYC Department of City Planning

Interview Michael Heimbinder
Chair of Newtown Creek Alliance
Founder and Executive Director Habitat Map

Waste water

Newtown Creek Water Pollution Control Plant represents the largest of the 14 wastewater treatment plants in New York City (treating 18% of the city's wastewater) (PlaNYC 2013).

The renovation of the plant from 2009-2013 costed an estimated \$2.2bn and is designed to provide treatment for a higher capacity (PlaNYC 2013). Therefore, it helps to overcome the major problem posed by a lack of treatment capacity when storm water swells the inflow. Newtown Creek plant will have a capacity to serve an estimated 1.33 million residents of the drainage area by 2045 (PlaNYC 2013).

All of the city's 14 wastewater treatment plants are located along the waterfront at relatively low elevations. Waterfront locations significantly reduce the cost and environmental impact of treating wastewater in New York City, making it easier for flow to arrive by gravity and providing nearby waterways to discharge treated effluent. Secondly, but also importantly, the waterfront location further allows sludge to be transported efficiently by boat

to DEP facilities for additional treatment.

As Sandy demonstrated, the city's water and wastewater system has vulnerabilities to extreme weather that must be addressed, particularly as climate change increases the likelihood of storm surges and heavy rains that can result in overflow of untreated sewage into the city's waterways.

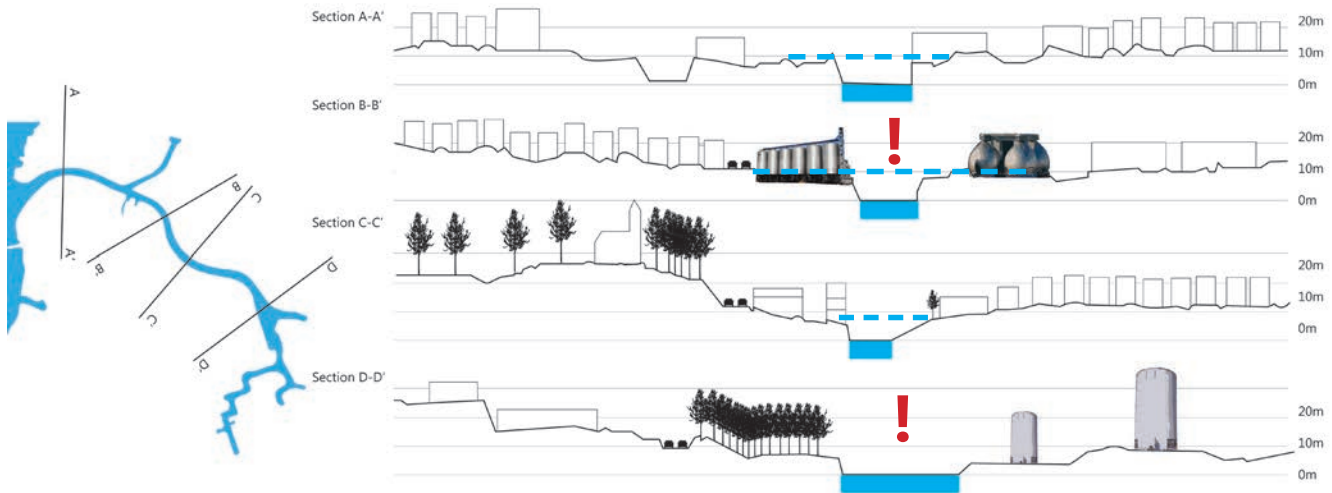


9 Newtown Creek Water Pollution Control Plant

Source: Own image

Also the Newtown Creek control plant is located on a highly vulnerable site (see image 10). The emergency closure during a flood would have regional impact and depicts a threat for the water quality and liveability of New York City. But also other essential and expensive

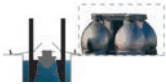
infrastructure is located within the flood plains of Newtown Creek which causes uncertain economic conditions but can also cause environmental problems if contaminated soil is washed into the water system while heavy rainfall or inundation.



10 Topography of Newtown Creek reinforces flood hazard for infrastructure of regional importance

Source: Own image

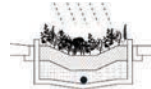
Comprehensive urban strategy



In order to **protect the vulnerable and expensive economic assets** a storm surge barrier at the mouth of the creek is suggested in the comprehensive urban strategy. A storm surge barrier allowing for tidal movement and only closing during extreme weather events can help to mitigate ecological risks and provides security for new investment. Besides, the storm surge barrier can serve as a pedestrian bridge to connect Queens and Brooklyn and also allow ship traffic.



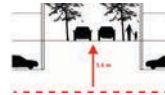
The reconstruction of former marshlands at the end of the creek where the water depth is too shallow for shipping can help to **improve the water quality** and depicts a measure to create a **habitat for flora and fauna** and creating **accessibility** towards the creek system. The implementation of pocket parks at dead end streets towards the creek originate furthermore places for people.



Next to reduce significantly flood risk also the **ecological restoration** is addressed. Implemented bioswales using the natural slope towards the creek can catch rainwater, slow and filter it and provide fresh water inflow to the creek and help to minimize combined sewage outflow.



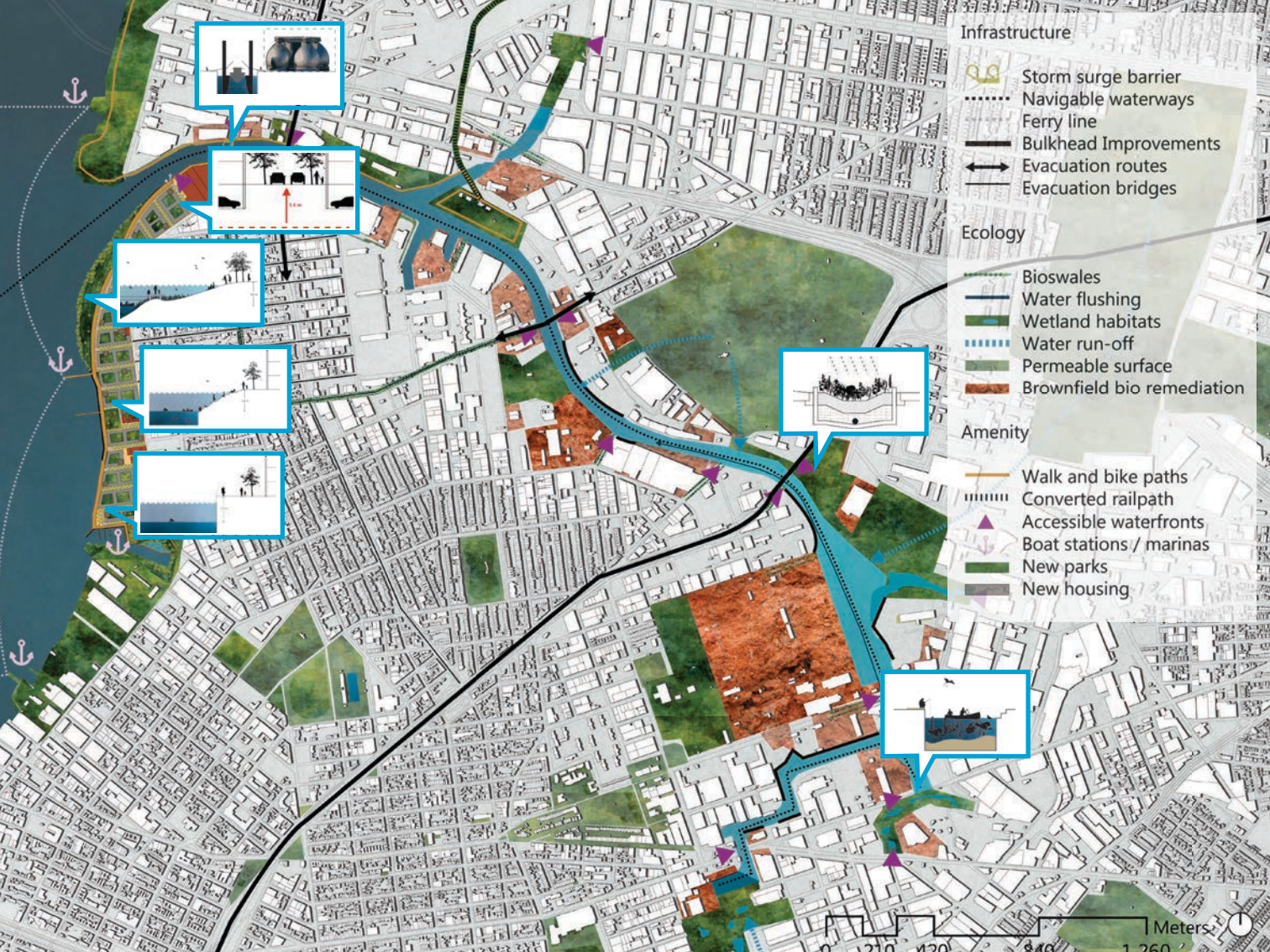
Towards the open coast line a new flood protection defence integrated in an backbone of varied public space stimulates new residential development.



Elevating only the streets without filling the entire coast line contributes to minimize the ecological impact and costs. Through a smart basement system the level between street and buildings is maintained.

11 Comprehensive urban strategy based on multi-layer safety approach

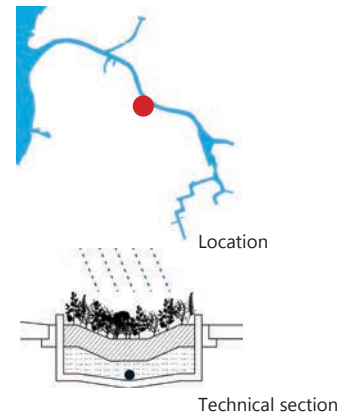
Source: Own Image



Bioswales and increased access at street ends

Many streets in the Newtown Creek area are in desolate conditions. A renewal of the streets provides the possibility to install bioswales. However, the contaminated soil has to be taken into consideration. In most cases the bottom of the bioswales has to be impermeable to filter the water into the creek but not into the soil. Secondly, dead end streets provide opportunities to install rare point

of access to the creek where most plots are privatized. Landmark observation towers provide visual bird's eye gateways and inform the public about the industrial activities taking place in the Newtown Creek area. Small implemented pocket parks depict a lunch place for the workers and recreation place for the adjacent population which minimizes the risk of illegal dumping.



← 12 View towards the street end
13 Small pocket park to allow creek access →
Source: Own Image





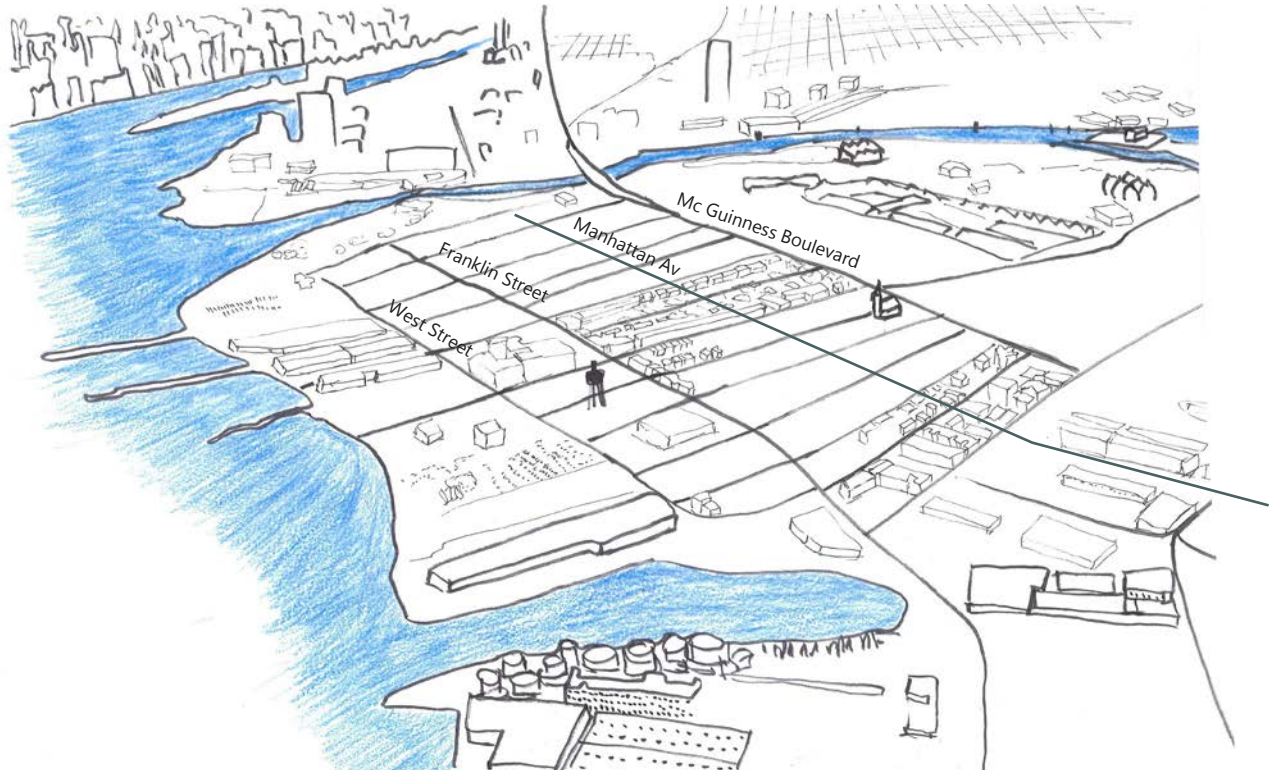


14 Reconstruction of marshlands at creek end
Source: Own Image

**1 Location of Greenpoint in North Brooklyn
facing Newtown Creek and the East River**

Source: Own image

Waterfront Design



History of Greenpoint

Greenpoint was long time an isolated island separated from the rest of New York through the industrial waterfront at Newtown Creek and the East River and from the rest of Brooklyn by marshlands (see image 1). In the 19th century, most residents worked in Greenpoint's warehouses, refineries and factories. The marshlands but also the industrial heydays are the past. However, the neighbourhood still feels the effects of its industrial heritage, in both positive and negative sense. Many water

towers, historic factories, such as the Eberhard Faber Pencil Factory (see image 2), and magnificent apartments for the former workers (Astral Apartments, see image 3) can be discovered. On the contrary, Newtown Creek has been also used by oil companies over the past century, and over time about 17 million gallons of petroleum seeped into the ground around the waterway (Mooney 2009). Today its residents aiming for environmental justice, parkland and access to the water.



2 Eberhard Faber Pencil Factory

Source: Own image

Still today there is no direct subway line to Manhattan but that also has the effect that gentrification does not happen as fast as in adjacent neighbourhoods as Williamsburg. Greenpoint remains largely unaffected by the recent building boom and is presenting low-rise buildings within perimeter blocks (see image 4) which create a pleasant atmosphere and presenting a New York which is today almost vanished. The Greenpoint Historic District comprises substantial and modest row houses, numerous walk-up apartment buildings, commercial buildings, churches and two banks which were built between 1850 and 1900 (see image 5).



3 Astral Apartments at Franklin Ave

Source: Own image

Greenpoint is still known for its large Polish community but also young people are moving now into the area which slowly changing the neighbourhood to new liveability and urban quality. Manhattan Avenue, represents the main commercial strip in Greenpoint (see image 6). However, Franklin Street, which runs parallel to Manhattan Avenue, has developed its own commercial district, with bars and restaurants, a wine store, coffee shops and clothing boutiques.



4 Urban perimeter block in Greenpoint

Source: Own image



5 Greenpoint Historic District / Kent Street

Source: Own image



6 Manhattan Ave as commercial centre

Source: Own image

View lines

One of the biggest potential is the magnificent view from Greenpoint to Manhattan due to the low-rise building structure (see image 11). New residential development along the waterfront could cause an impermeable wall of high rise disconnecting the existing neighbourhood from the riverfront and resulting into over shadowing and a loss of living quality (see image 7+8). The case study of the Manhattan riverfront shows that the skyline of Manhattan is constructed through a layered view which means that high rise is not located on the river's edge

but rather in the middle of the island which creates the advantages of better air circulation, viewpoints towards the water from many buildings and a relation towards the rivers (see image 9). In Hoboken exactly the opposite is the case - high rise towers were built on the rivers edge while buildings in the second row do not have any interaction with the waterfront. Now the question is what will happen on the opposite site, in North Brooklyn?



7 Current situation of abandoned plots at riverfront

Source: Own image



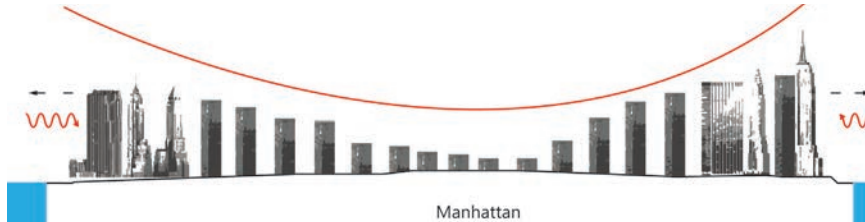
8 Worst case scenario with a wall of high rise

Source: Own image

Case study: Manhattan

Expected situation

- No air ventilation
- Blocked views



Actual situation

- + Air circulation
- + Viewpoints
- + Relation to waterfront



Relation of waterfronts

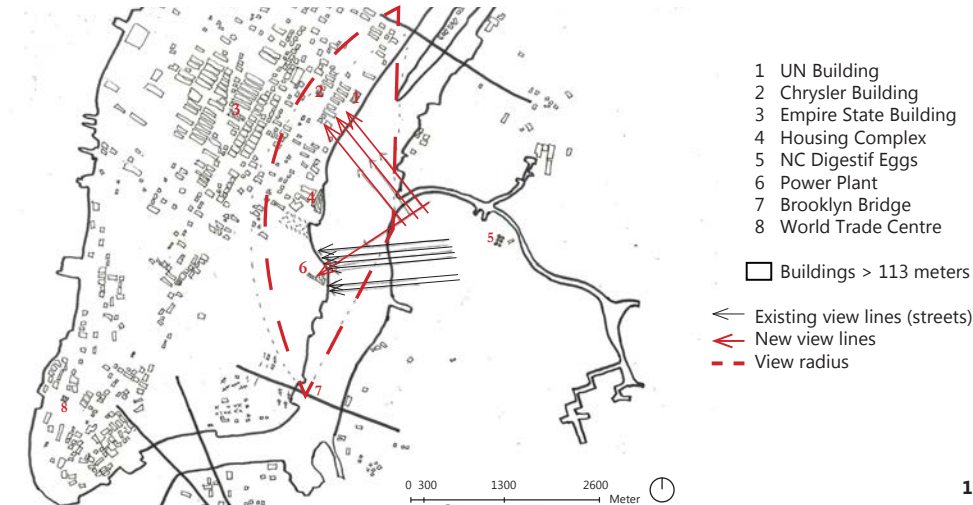


9 Case study Manhattan

Source: Own image

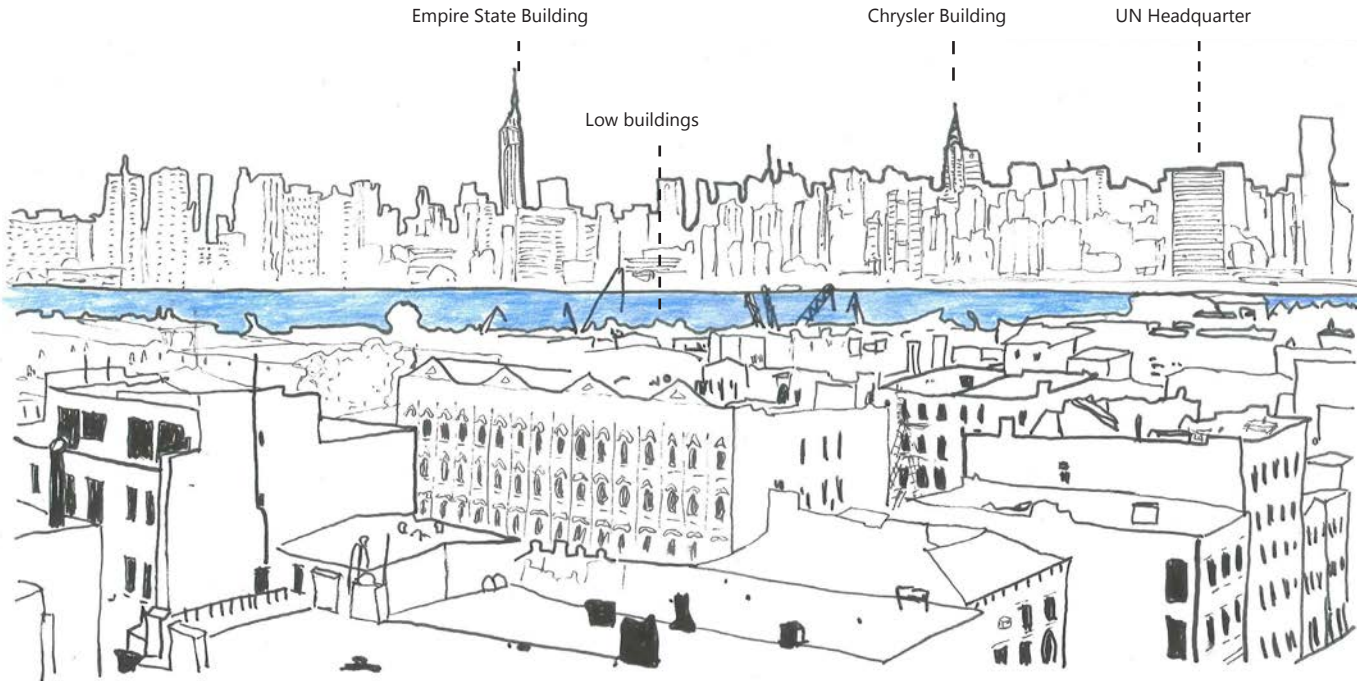
In order to successfully maintain the identity of Greenpoint and the visual connection towards the water the view lines with the most prominent buildings in Manhattan were carefully studied (see image 10). Due to the vast irreclaimable water surface almost the whole width of Manhattan can be seen from Greenpoint.

Especially the linear streets of the grid system which are declining towards the water creating water related view lines from the upland. While creating a new development plan for Greenpoint's waterfront the visual axes and also the building heights and densities have to be considered. Besides there is the change to establish new view lines (red).



10 Study of view lines towards Manhattan

Source: Own image



11 View from Greenpoint towards Manhattan

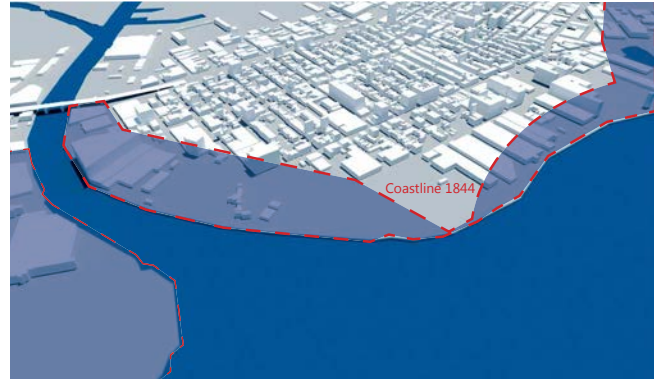
Source: Own image

Climate change and flood hazards

Large vacant lots and buildings typify the Greenpoint riverfront (see image 12) which uses such as warehouses, factories, utilities, and storage buildings. Beyond the industrial buffer lay the dense residential and mixed-use neighbourhood of Greenpoint. A reason while this very attractive riverfront is not redeveloped is related to the flood risk and eroding shorelines. Most of the coastline was ultimately altered through low-lying landfill during the 19th century industrialisation (see image 13). Nowadays



12 Current land use
Source: Own image



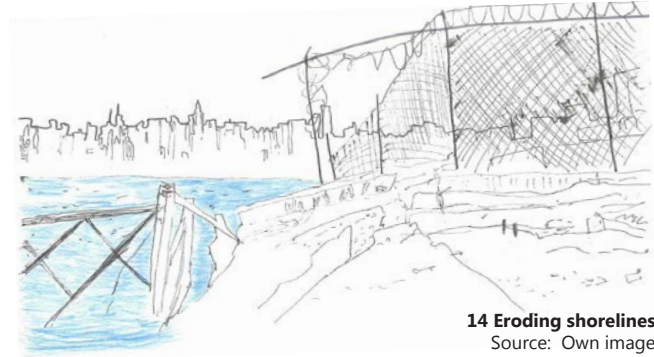
13 Alteration of coastline from 1844
Source: Own image

most of the waterfront plots are vacant which has the consequence that bulkheads are not maintained resulting into erosion (see image 14).

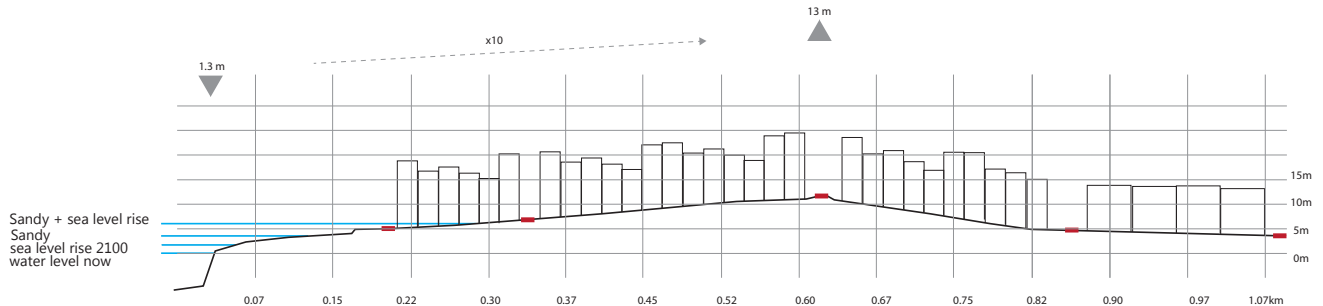
Looking at the topography of Greenpoint (see image 15) it indicates that only the land filled area is at risk of inundation while around 220 meters upland the land elevation is already 7 meters reaching its peak at 13 meters. Therefore, the most economic solution to protect the

waterfront from flooding is to alter the low lying landfills artificially to connect them to the upland.

The previous page (see image 16) depicts that the landfill has to be heightened by 5.6 meter from the existing water level to withstand a storm surge of a probability of 1/500 (3.5 meter) considering sea level rise of 0.76 meter and daily tidal fluctuation of 1.4 meter.



14 Eroding shorelines
Source: Own image

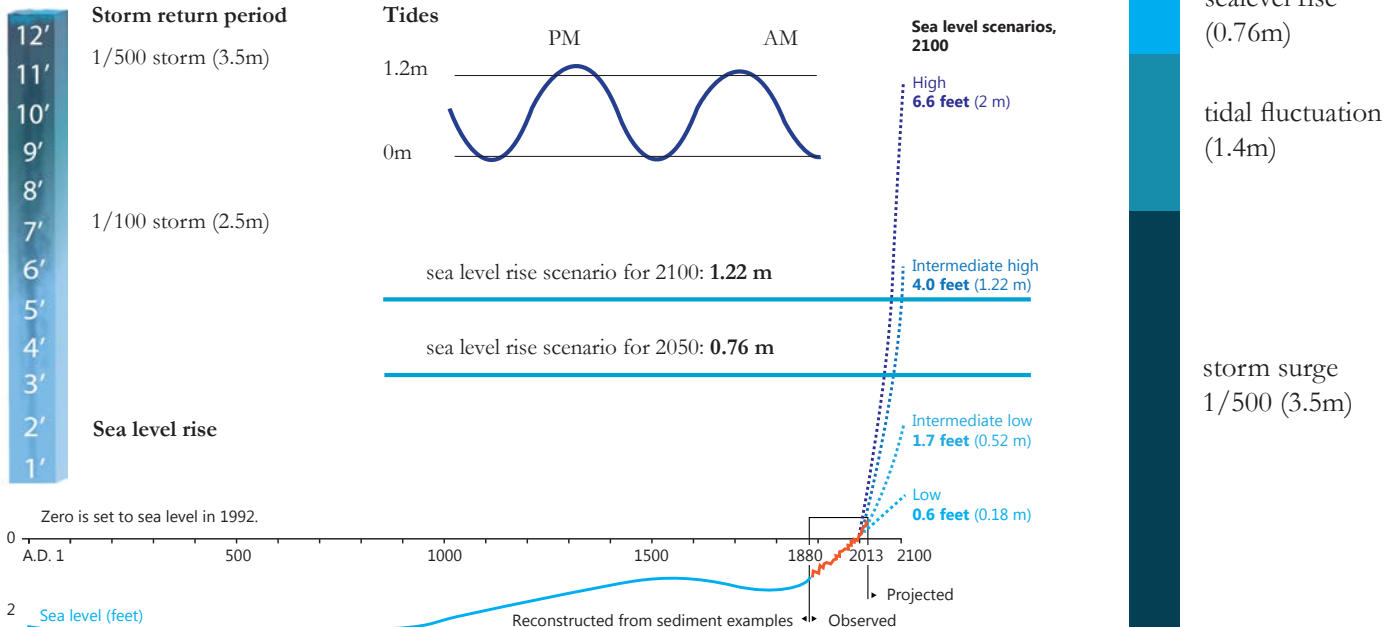


15 Topography of Greenpoint
Source: Own image

Design Height Waterfront



Time frame: 2050 Safety Standard: 1/500 = 0.76 + 1.4 + 3.5 = 5.66m
 (Above sea level)



16 Calculation Design Height

Source: Own image adapted after NOAA / NYC Planning Department / <http://tides.mobilegeographics.com>

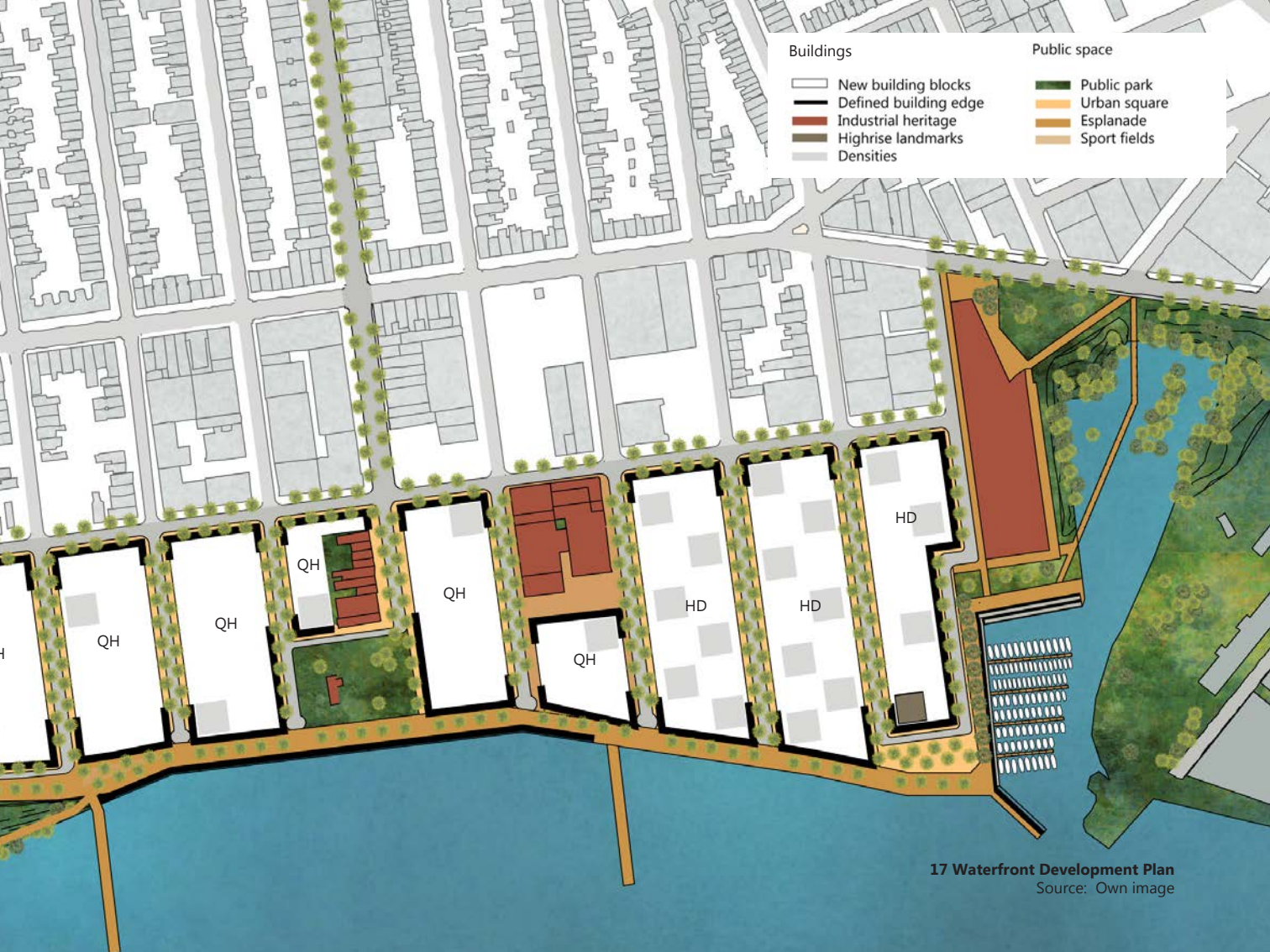
Waterfront Development Plan

The time planning framework for the waterfront development amounts until 2050, therefore rather than a master plan, a waterfront development plan (see image 17) is chosen as a tool to not fully anticipate the future demands but to facilitate different typologies, densities, programme, functions, lifestyles and expectations within the urban block. The waterfront development plan takes into account the dynamics and variety of planning policy but as well socio-economic trends. It addresses where the urban blocks are located without determining the whole programme and typology and hence the building stock can be developed in a longer process without disturbing the overall idea of the linear waterfront and the public space.

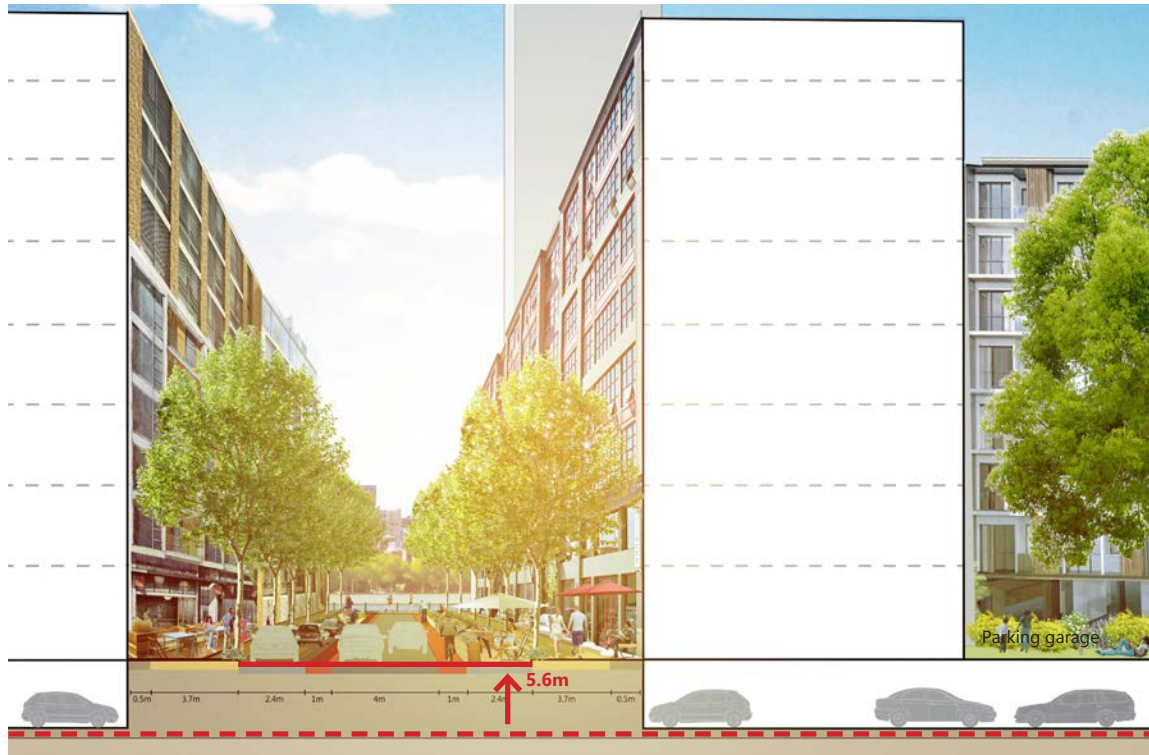
In order to develop reasonable typologies and a vivid and attractive quarter zoning provides a powerful tool to anticipate living quality. The zoning not only determines densities but also incorporates the best elements of urbanity in NYC: a mix of uses, high residential density with a network of parks and public space carved out of the building stock, the combination of high-rise and low-rise

on traditional streets which extend the existing urban grid (see image 20+21). To make the neighbourhood streets a vivid public space special guidelines were developed (see image 18+19). On the edges the building lines were defined to create the aimed urban block structure which determines the public and private space and allowing façades with street interaction. In the middle of the block permeability and the creation of pocket parks is possible. The plan is developed in careful consideration of the existing qualities of the neighbourhood of Greenpoint with regards to demands of new waterfront access and public space of the present population (see page 22). The new waterfront development should be integrated in the neighbourhood and profit from the development through rising living qualities and economic opportunities. Furthermore the public space networks is integrated in the flood defence structure with the boulevard elevated on 5.6 meters and protecting the neighbourhood. The streets are elevated without filling the entire coast line to minimize the ecological impact and costs. Through a smart basement system the level between street and buildings is maintained.





Elevated streets



Material for elevated streets



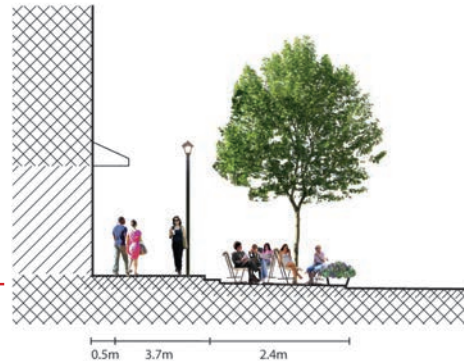
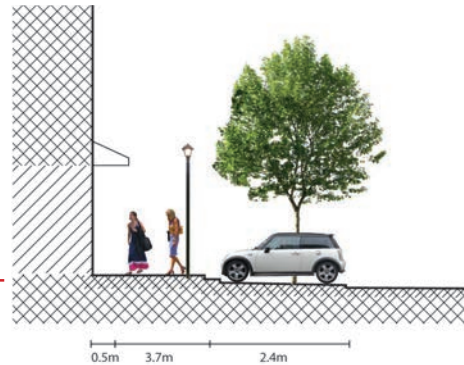
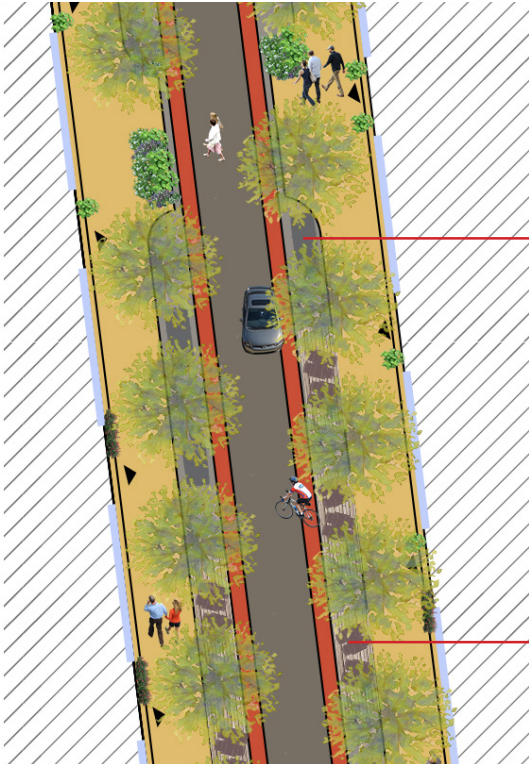
Blended crushed glass from NYC recycling programme



Crushed stone from building demolition and NYC tunnelling operations

18 Elevated streets
Source: Own image

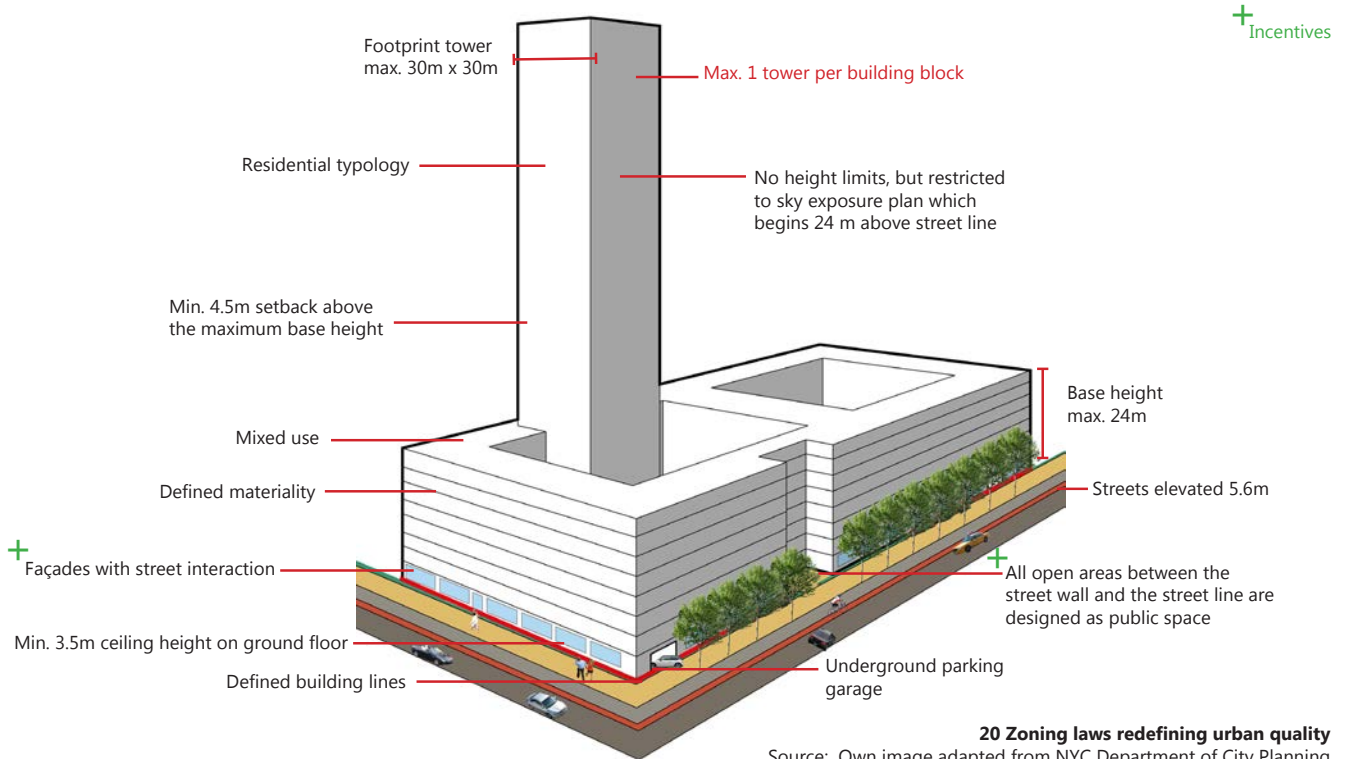
Streets as vivid public space



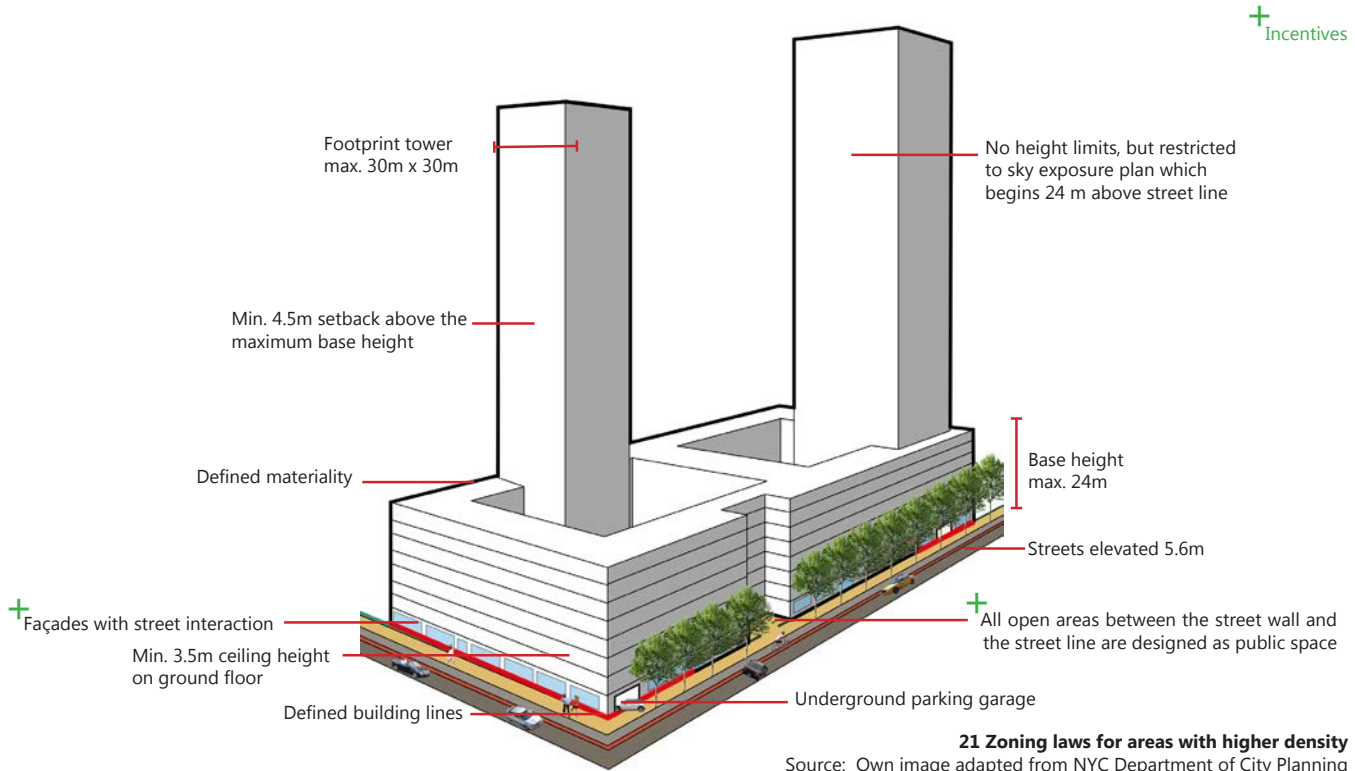
19 Section of street with flexible space for parking or cafés

Source: Own image adapted from Jacobs, 1995

Zoning laws: Quality Housing



Zoning laws: Higher density



21 Zoning laws for areas with higher density

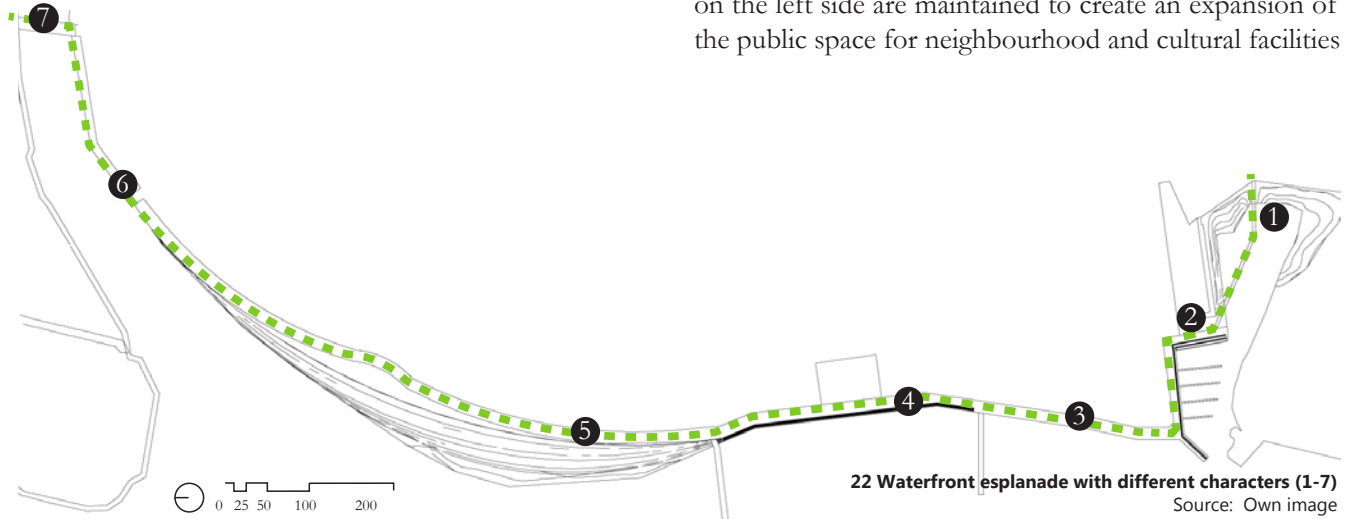
Source: Own image adapted from NYC Department of City Planning

Public Space and Flood Protection Concept

The public space network is integrated in the flood defence structure with the esplanade elevated on 5.6 meters and protecting the neighbourhood. Due to different space demand and orientated on the natural morphology of the coast line a variety of defence systems is applied which is in line with the multi-layer safety approach. The different episodes creating a bandwidths of atmospheres for a

variety of uses and interactions with the waterfront.

① The first episode is marked by a tidal inlet which will be surrounded by parks in the future. Here the former marshland is reconstructed and heightened creating a peaceful place for nature and recreation with a view to the ConEd Plant in Manhattan. The industrial buildings on the left side are maintained to create an expansion of the public space for neighbourhood and cultural facilities





The Marina

② The mouth of the tidal inlet provides perfect conditions for the establishment of a local marina where residents can store their small boats and sailing ships. A terraced structure allowing the marina users easy access

to their ships and offer seating possibilities for strollers. The adjacent inhabitants can enjoy a wonderful view over the marina and the skyline of Manhattan. The parkland surrounding the marina acts as a storm water filter and

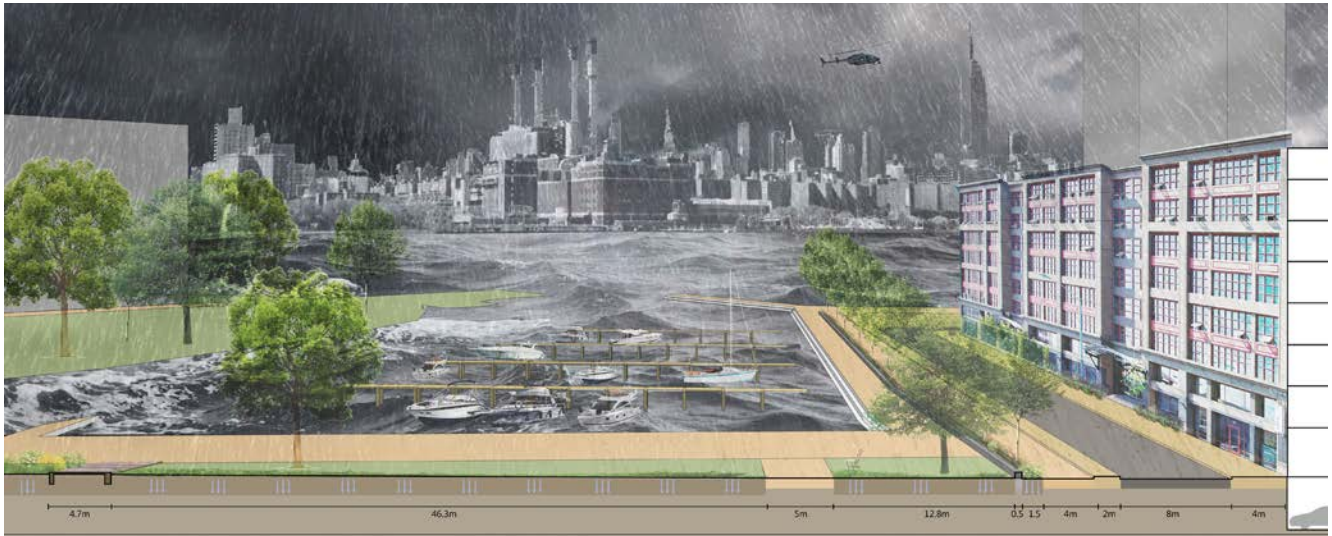


24 The marina with good weather conditions

Source: Own image



minimizes CSOs. In times of storm the 5.6 meter elevated esplanade acting as a flood protection withstanding also storms with a probability to happen only every 500 years.



25 The marina with a 1/500 storm surge in 2050

Source: Own image

The Esplanade

- ③ In the most dense part of the waterfront a raised bulkhead giving space for a 16 meter wide water promenade with separated lanes for strollers and an active lane for bikers and skaters. They are physically divided by a bioswale filtering the rainwater and a seating walls for people to enjoy the view towards Manhattan. The viewer



26 The urban esplanade creating space to stroll, view, relax and sport

Source: Own image



can already enjoy a look towards the next episodes of the boulevard. In times of natural hazard the raised bulkhead realizes dry feet.



27 The raised bulkhead protecting the buildings from a 1/500 storm surge in 2050

Source: Own image

The Brooklyn theatre

④ In the episode where the waterfront opening up to Transmitter Park the natural bended shape of the waterfront is enhanced by creating an urban theatre. The stage is the Manhattan skyline but the terraced

stairs structure can also be used for concerts and cinema screenings. Besides they give access to the water, perform as a sun bathing platform for harbour seals and residents, informs about the water level and break the waves in times



28 The Brooklyn theatre inhabited on a summer's day

Source: Own image



of storm surge. Here the waterfront presents a vibrant hub where also the public East River Ferry connects Brooklyn to Manhattan.

⑤ On the next page the waterfront park can be seen. Here the park opens up until the existing grid structure to provide a magnificent view from the inside and allow a permeable, transparent entrance structure. The wide



29 The Brooklyn theatre indicating in times of storm how high the water rises and breaks the waves

Source: Own image

The Waterfront Park





30 The gentle slope of the waterfront park creating perfect conditions to relax

Source: Own image

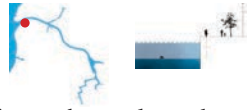
amount of space can be used to create a natural slope acting as a flood buffer in times of flood but with its orientation towards south west most of the time it is just a pleasant area to enjoy the sunshine and the view. The waterfront park is unprogrammed to give back a piece of nature to New Yorkers. The lower part which is

influenced by daily tidal movement is separated through a wooden path that flora and fauna, inhabiting this rich eco-habitat, can be undisturbed. The plants are especially chosen to withstand salinisation and are robust against flooding. In winter the slope can be used for sledging and other winter sport activities.



Source: Own image

The Boat House

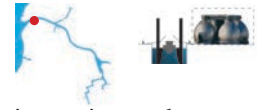


⑥ An existing industrial building is partly used as a boat house. A slope giving the possibility to access the creek with canoes. Here the creek begins and the esplanade is replaced by a more narrow wooden path.



Source: Own image

The Barrier



⑦ The inter-tidal storm surge barrier, acting at the same time as a pedestrian bridge and allowing ships to pass, will keep the water level during a storm equal. During normal conditions it provides a view inside the creek.



Source: Own image

Evaluation

The relationship between the theme of the studio and the subject of my graduation project

The Delta Interventions Studio was this year embedded in the Rebuild by Design competition initiated by the US government after the vast destruction Hurricane Sandy has caused in the New York region. Consequently, my project was involved with flood defence in a dense urban area in NYC. However, my site in Brooklyn was chosen independently from the competition to obtain more freedom in my master's thesis.

The relationship between research and design

The studio was focused more on design, however it was crucial to build up a strong theoretical framework to evaluate different flood protection approaches and understand the advantages and disadvantages of single measures. Therefore, I consulted many water management experts at the civil engineering faculty, as well as professional waterfront urbanists and local stakeholders. Furthermore, I think the design is altered

while the theoretical argument is build up strongly. For example, the NYC government is using the term resilience to promote their flood defence strategy – but in order to make a resilient design, it is vital to understand the term resilience in its full meaning and also discuss the pro and cons of a resilient approach in comparison with, for example, the flood protection approach in the Netherlands. For me it was very interesting to learn more about the differences in flood protection regarding the shifts in risk perception and mentality.

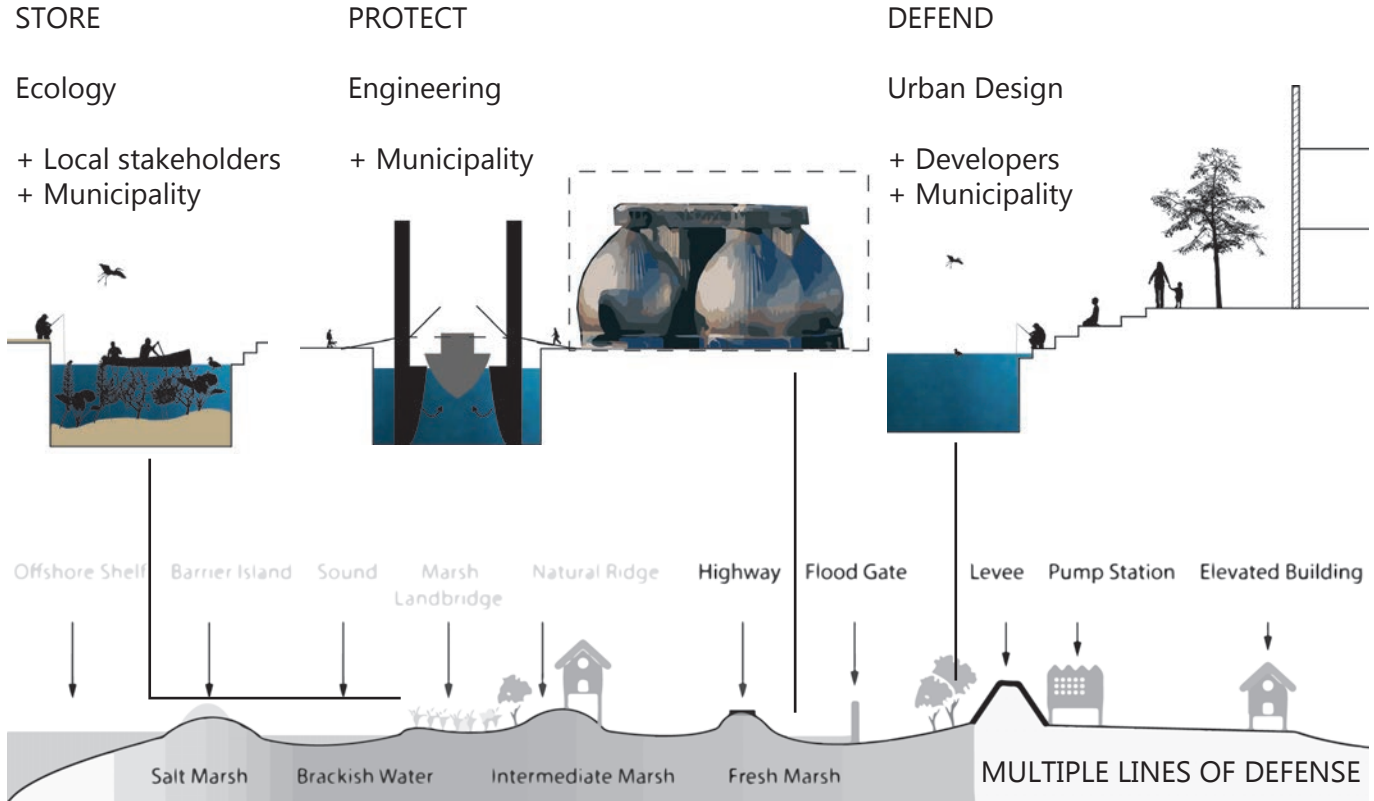
The relationship between the methodical line of approach of the studio and the method I choose in my framework

The method of the studio was the combination of design and research and to learn how to efficiently analyse and have immediate conclusions out of the study. I think it was very useful to learn not to analyse every single aspect but to draw the essential conclusions out of the analysis

1 The design is directly deriving out of the research

Source: Own image

Research by Design



and use them consequently in the design. Within the studio it was crucial to understand flood risk and which effects it has for the urban fabric and its inhabitants. Another important aspect was to understand the natural layer, as topography, soil conditions, effects of human alteration and different approaches towards flood prevention from man-made structures to designing with nature to emerge with well-conceived design solutions. Additionally, drawing and retracing the coastline, as a method, comparing its scale and peculiarities with other waterfronts and understanding which qualities and atmospheres this particular waterfront contains helped me a lot to connect different aspects and to build up my design.

The relationship between the project and the wider social context

For my design it was very important to design from the human as a universal standard – to design in a small entity to elaborate the perception from an eye-level-perspective. Similarly, I integrated existing conditions and spatial

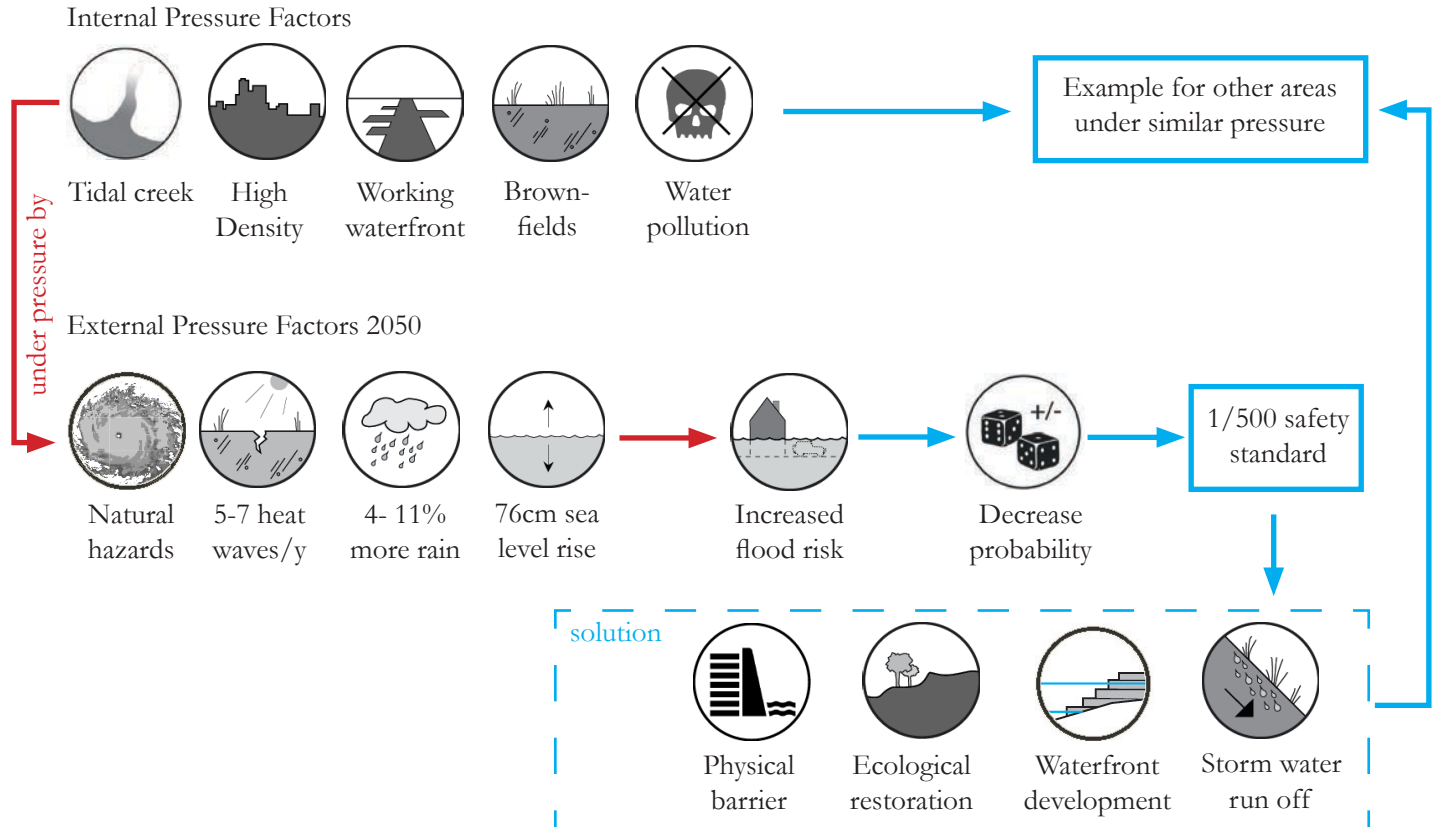
qualities as view lines, topography and the morphology of the coast to alter the design and make this splendid space accessible for a wide range of inhabitants and visitors of NYC. For me it was of significant importance to embed the design in the existing structure, function and identity of the present dense urban fabric and make the flood defence part of the first linear and consistent waterfront of whole New York City. The concern was not only to make a safe flood proof environment to defy future sea level rise and natural hazards but to create a public good – an access to the water and a public space designed for present and future New Yorkers with a magnificent view towards the skyline of Manhattan.

My graduation project is hand crafted for this particular space building up on existing conditions. However, the framework I used to understand the natural layer and what makes the site particular vulnerable towards flood risk and finding local scale solutions can also applied in other areas (see image 2).

2 How can theoretical framework be applied for other areas?

Source: Own images

Conclusion



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Appendix



XII. Expert Interviews



**Interview Peter Washburn: Policy Advisor,
Environmental Protection Bureau,
Greenpoint Community Environmental
Fund, New York State Attorney**

**1. You are a policy advisor for the NYS Attorney.
What is your role in the Greenpoint Community
Environmental Fund (GCEF)?**

The New York State Attorney and the New York State Department of Environmental Conservation are responsible to receive the resolution and settlement against the Exxon Mobile oil spill in Greenpoint and take responsibility of the \$ 19.5 million to create a fund and select projects. We are taking responsibility that the GCEF is appropriate spend and to ensure high quality projects. Furthermore we ensure that the process is well, we oversee the administration, select the best projects and make sure that they are funded. The Greenpoint community plays an active role in the entire project. We

ensure that people are not only informed but also that they participate.

The Newtown Creek Alliance has some of their members in the Greenpoint advisory group. The Greenpoint advisory group was formed because it is impossible for the NY State Attorney to be present at all time, so they are responsible to inform people and answer questions. They are all working on a voluntarily basis.

**2. The \$19.5 GCEF to be distributed to
community projects represents the largest single
payment of its kind in New York State history.
However, is not actually that much money when
it comes to infrastructure improvements – such
as major bulkhead repairs – which could help
industrial retention and expansion. Which projects
does the GCEF prioritize?**

We do not prioritize any particular projects. The request for proposals is explained at the GCEF.com website. It talks about the criteria, but it does not define

the kind of project. We wanted to create the process as open as possible that the community tell us what they need and not that we already make a preliminary decision. The only assignment is that the project has a significant environmental benefit for the community.

Any project which presents well arguably a value for the community can be funded. It is a bottom up rather than a top down process, the community determines the significant issues. We created a very broad base to see which kind of ideas people bring up. However, the basic reason is the environmental benefit as its primary purpose.

3. The GCEF aims at giving the local community financial resources to address environmental concerns, such as water quality, groundwater, open space, reduction of toxic pollution, and air quality. That means a very high responsibility for the involved community and requires knowledge about project management, green infrastructure, etc. Do you think that the

Newtown Creek community is prepared for this responsibility?

The kick-off project started in early 2011. Since then there were three community meetings. The first meeting was about what the community would like to implement with the funded money. The ideas should evolve from community rather than outside the community. The second one was to champion their projects and how to speak about their project ideas. The third, now in September, introduce the competitive process. We talked to the community how they can work together to advance their proposals, what the proposals have to consist of and how they can apply for funding. We emphasise as well technical assistance to help them to put together a competitive proposal and to complete the application. We are offering service to support good ideas. Additionally, we had two applicant meetings to walk them through as a group to answer their question, two webinars and meetings for network opportunities. Indeed, it is a challenge for the average Greenpoint resident to develop a competitive project proposal but we provide them with

technical assistance.

This bottom-up process is ground breaking for a state environmental project. We cooperate with the community advisor group and turn these ideas into solid implementation with the support of technical expertise.

4. Will the community get professional support with cost calculation and organization in order to implement the funded projects, e.g. by project management consultancies, environmental and engineering companies or architecture offices?

There are two types of projects: smaller projects with a budget up to \$ 25,000 and projects over \$ 25,000. For example, with smaller projects we assume that they are fairly straight forward projects which do not need a lot of external expertise. Bigger projects have to demonstrate that they have an additional partnership and can state a solid project proposal how to successfully implement the idea. On 18th of December three proposal with a bigger budget than \$ 25,000 will be invited to submit a

full proposal. They have then to provide technical details how to implement the project. However, what we will do is to provide assistance including external technical advisors to support technical issues, such as, which people have to be involved, or to receive the necessary permits. But ultimately it is the responsibility of the proposer to implement the projects.

From a philosophical and practical point of view, the past has shown that when you do not have to invest as a participant in your own project you will be less committed. Certain responsibility ensures that the project is successfully implemented and sustained. The project ideas have to come up with further matching funds, that not all money is coming from GCEF. If all the money coming from the fund and people do not have to invest themselves, the lack of additional investment shows that people are not as committed to the project and others, neither. History shows, the greater extent of commitment, the greater chance that projects are more successfully implemented and sustained. With free easy money people do not have to take as much obligation as

when the money is hard earned. Hard earned money is more valued.

The GCEF is organised as bottom up process and projects derive from the community itself. The ideas reflect the interest of the community rather than what the government think they need. The community is a better judge than the state is.

5. Regarding the program boundary it only contains Greenpoint. Why is the upper side of Newtown Creek not considered since it is also affected by the oil spill?

First of all, the funding arose because of the settlement of legal action against Exxon mobile. The settlement related only to on-land contamination. The Newtown Creek specific oil spill is under responsibility of the superfund site. The GCEF is only for on-land contamination to benefit the Greenpoint community.

Superfund and GCEF present separate activities. The

\$ 19.5 million are only one aspect of the settlement with Exxon mobile, other aspects are that Exxon is cleaning up the site, mitigating their oil spill. We ensure that they take the responsibility to clean up. None of the money of the GCEF can be used for cleaning-up.

The notion is that Exxon mobile spill the oil and therefore they need to clean it up. In addition, the Greenpoint community have had for years the negatives effects of living with this oil spill. Therefore, it was appropriate for Exxon mobile to provide money to compensate the community for living with this soil for so long. And that is where \$ 19.5 million comes in. It is an acknowledgment that it has adversely affected the community and by giving them something back, it ensures to improve the environment in the future because they had to live with the degraded environment for so long.



Interview with Michael Heim binder: Chair of Newtown Creek Alliance, Founder and Executive Director Habitat Map

1. The Newtown Creek Alliance (NCA) is active since 2002 even though it is an area where hardly anybody lives and which suffers from a lot of environmental problems. It aims at restoring the natural, economic and social conditions of the Creek. Who is active in the NCA and what was already achieved since its establishment?

The Newtown Creek Alliance became a response to the Exxon mobile oil spill which was ‘discovered’ in 1978 by coastal safe guards. Until now the soil and the groundwater are polluted with 110,000 m³ of oil spill and raw sewage. Most local residents and businesses already knew before from the oil spill but it was no matter of importance. It took 24 years more until the NCA was established through the initiative of Riverkeeper.

Since then the NCA became a well-known institution

and has a good level of success by involving residents, local businesses and elected officials. It is not only about clean-up efforts but also the importance of the creek as an asset for the local community.

Since the establishment of NCA the access to Newtown Creek was increased, e.g. there is a nature walk route. Also the Newtown Creek is involved in establishing green infrastructure with local businesses, e.g. green roofs. Another project is dealing with increasingly using ship traffic instead of trucking to carry goods within the creek.

2. The Newtown Creek as one of the nation’s most polluted canals became a superfund site in 2010. How the NCA is involved in this process and was there already some success noticed since the cleaning efforts?

Starting from day one of the NCA the goal was to become a superfund site in order to clean the creek with the help of the enterprises which are responsible for the oil spill which happened long time ago but has still

tremendous effects on the ecological system of the Creek. It was the effort of the NCA that the Newtown Creek is now cleaned up through the Superfund programme while we fighting that the problems of the oil spill raised public and governmental awareness. The NCA represents now a community advisory group and we support the Superfund programme with testing the water quality etc. Furthermore, now a similar project is started at Gowanus Canal with whom we share ideas and support.

3. From an European perspective of view it is very fascinating that community engagement plays a very significant role in planning processes in the US. Which role does the NCA take when it comes to decision-making with developers or the planning department?

It still remains a non-profit organization which has no full-time employers. Sometimes it is hard to see the progress and from various stakeholders we are largely ignored. But if you look from the long-run the Alliance had a big impact regarding the establishment of the

superfund site and the increased accessibility and public awareness.

4. There was recently an article published (Just Green enough: contesting environmental gentrification in Greenpoint, Brooklyn by Curran and Hamilton) dealing with environmental gentrification. Your interest field is also environmental justice. The NCA is enhancing a future for the Creek with active working waterfront creating job opportunities in the maritime and manufacturing industries. Developers are probably more interested in mixed-use/ high-density residential areas. How is the NCA dealing with the threat of gentrification and what are the possibilities to restore a working waterfront?

Gentrification represents a big issue all over New York City. Long term residents in popular areas or areas with successful community engagement are pushed out and are forced to move to other areas. Especially Brooklyn areas close to Manhattan have therefore an increased pressure

of gentrification since more and more people are forced to leave their former neighbourhood in Manhattan. Districts as Bedford Avenue in Brooklyn experienced a lot of gentrification and previous ethnic minorities who used to live there have to move away.

However; this is not the case at Newtown Creek, since there are, firstly, almost no people living there and secondly the zoning of the area allows only for manufacturing purposes. Nevertheless, there are some long-term residents, pioneers and artists living at Newtown Creek.

5. The waterfront of Brooklyn was rezoned from a former industrial area to a zoning where residential towers are possible. Aren't you thinking that when the Newtown Creek is cleaned and the accessibility is increased that there will be a new zoning law as well?

That's true. The waterfront of Brooklyn was rezoned in 2006 but also here you cannot speak literally from gentrification since vacant sites will be used to be

transformed into residential purposes which are very much needed in New York City.

On a longer perspective the edges and especially the mouth of the river which are very interesting due to its location close to Manhattan will probably transform into residential uses. But in the last year many companies and the New York City government have invested in new factories here, as the Newtown Creek Wastewater Pollution Control Plant which carries a lot of new economic opportunities in the area. These new factories are very essential for whole New York City so in the future there will be a tremendous effort to keep manufacturing and jobs in the city area and also essential infrastructure has to be located somewhere. I am sure that in the future, manufacturing will remain essential for the Newtown Creek.

6. During Sandy the Newtown Creek was very vulnerable concerning floods and the pollution and combined sewage outflow worsened the damage for the surrounding neighbourhoods. What are your

ideas for minimizing the flood risks at Newtown Creek?

Indeed, flood protection is very essential for the future of existing and new companies along Newtown Creek. There are many different ideas, how to achieve flood-proof environments. One is to construct flood gates at the river mouth, another one to have more green infrastructure that can store water and as well local businesses are thinking to raise the bulkheads. However, the latter is not the best idea, since the problems during Sandy were not mostly caused by river overflow but by sewer discharge which has reached its capacity and flew into surrounding streets.

Many of these ideas are possible, but before implementation detailed research has to be done what is physical possible, how much it will cost and which impacts it has on local businesses, ship traffic and the aquatic ecosystem of the creek. Only after a careful assessment of the research a decision can be made.

7. The \$19.5 million Greenpoint Environmental Fund is accepting proposals for community and clean-up efforts at the moment – is the NCA applying for funding? And if yes, for which type of project?

Indeed, we are applying with a range of projects. One where I am personally involved in is a pilot project about air quality monitoring within the area. Other projects are, for example, dealing with community gardens and another one with the idea how to use the power of plants, fungi and compost to remediate some of the trickiest toxins that pollute the watershed.

8. Finally, I would like to ask if you recommend me a person from another institution I should talk to? And do you think my findings and design can be of any value for NCA? Would you like to get my report?

I would like to forward you to the New York City Environmental Justice Alliance. They are involved in a

project called Significant Maritime Industrial Areas, or SMIA's. SMIA's are zones designed to encourage the clustering/concentration of heavy industrial and polluting infrastructure uses. They are working on a reform agenda to increase climate adaptation and community resiliency strategies for SMIA community designations. I think they would be of valuable asset for your project. I wish you a lot of success with your master's thesis and, please, forward us your final project.



Interview Frank de Graaf: Urban planner and expert of waterfront planning and coastal development, Royal Haskoning DHV, Rebuild by Design competition

1. You are an urban planner and expert at waterfront planning and coastal development. What is your role in the RHDHV?

I did my master's degree in urban planning at TU Delft and I am working since eight years on the integration of engineering and nautical aspects in relation to urbanism.

These worlds are two different worlds, or include two different cultures – my aim is combine them. Currently I am working with OMA on the Rebuild by Design competition in Hoboken, New Jersey. I did many projects to connect technical aspects with urbanism and worked on master plans for Chinese cities. At the moment I am also involved at a project at the Philippines and the development of a masterplan for Qatar with UN Studio.

2. What should I consider for my master's project?

You are in between the architect and the engineer. To deal with water management issues you sometimes have to lose your sense as a designer in order to have a realistic outcome. You have to understand all the technical aspects of your site – the wave force, water heights, storm surge, canal depth and the water related infrastructure in order to implement this in your masterplan. Most designers make the mistake that they make a plan beforehand and only after this they hand it to engineers. I regard water related planning from a water to land perspective that means

first to look at the technical aspects and fully understand them and then integrate them in your design. Concentrate on the technical and planning aspects – you can make a scheme of the different stakeholders, but don't lose yourself in it. The cooperation of municipality, private owners and communities is too complex - it is hard to get a grip on it. Rather, focus on the technical and planning aspects. Think from a development point of perspective – develop a strategy how the area can develop in the future, what are the possibilities? Talk to the engineering experts and ask the right question. Try to understand all the technical aspects. I am working now since eight years with water related issues and what I learned is that I collect a lot of knowledge about water management and I can integrate it into the design but at the end it is the engineer who you are cooperating with. Therefore you should see your role more as the role of the design manager. Constructing on water side is five to 10 times more expensive than on land side therefore it is important to make a qualitative and feasible design. Building with water is a very exciting topic and very important for the cities of today.



Interview Ayala Wanda: Community Involvement Coordinator for the Newtown Creek Superfund Site, U.S. Environmental Protection Agency

1. Which results do the conditions of Newtown Creek show in the current phase of investigation?

The Remedial Investigation (RI) for the Newtown Creek Superfund site is currently ongoing. We have completed the Phase 1 of the RI. We are planning the Phase 2 investigation. All RI Phase 1 sampling data have been submitted and are being reviewed. The enormous volume of data collected means that this review effort will be ongoing for some time.

2. When will the actual cleanup process start and which time span will it take to clean up the creek?

Estimated completion of study is 2017 to 2019. Proposed Plan could be issued ~ 2018 to 2020; + ~3-4

year design; + ~10 years of cleanup. (Conclusion: The Newtown Creek will be only completely cleaned by ~2034).

3. To clean up the creek - what does it mean exactly? Which techniques are used to clean up the creek? Will the layer of polluted sludge just be dredged or will there be also green infrastructure measurements as oyster restoration in order to regenerate the aquatic life of the creek?

Newtown Creek was proposed for NPL site listing on September 23, 2009 and finalized on the NPL on September 29, 2010. EPA has completed been negotiating with the Newtown Creek Group and the City of New York on the implementation of the RI/FS for the Site. The Creek is a 3.8-mile long tidal water body located in the City of New York, having five principal tributaries (Dutch Creek, Whale Creek, Maspeth Creek, East Branch and English Kills) and is itself a tributary of the East River. The creek is a part of the New York – New Jersey Harbor Estuary that forms the north-south border between the

New York City boroughs of Brooklyn and Queens. In the mid 1800s, the area adjacent to the 3.8 mile Newtown Creek was one of the busiest hubs of industrial activity in New York City. More than 50 refineries were located along its banks, including oil refineries, petrochemical plants, fertilizer and glue factories, sawmills, and lumber and coal yards. Newtown Creek is a navigable waterway under the jurisdiction of the Coast Guard, and the channel must be maintained for shipping purposes.

4. One major problem of Newtown Creek is the combined sewer outflow if wastewater treatment plants reach their capacity due to heavy rainfall and, hence, increases the contamination. Will the Superfund site also take solutions for another rainwater management into account?

The combined overflow issue will be a major part of Phase 2 of the RI. Under the federal Clean Water Act, combined sewer discharges are prohibited without a permit. Congress amended the Clean Water Act in 2000 by adding a section that requires each permit or enforcement document issued for a discharge from a

municipal combined sewer system to “conform” to the CSO policy. The CSO policy is a comprehensive national strategy to ensure that local governments, permitting agencies, entities that establish water quality standards and the public engage in a comprehensive and coordinated planning effort to achieve CSO controls that ultimately meet appropriate health and environmental standards. The strategy has three objectives: 1. Ensure that if CSOs occur, they are only as a result of wet weather; 2. Bring all wet weather CSO discharge points into compliance with the technology and water quality based requirements of the Clean Water Act; and 3. Minimise the impact of CSOs on water quality.

regarding the remediation of the Creek. It consists of approximately 30 members whose goals and objectives are to develop a thorough and objective understanding of the Site from the standpoint of environmental and health implications, remediation options and overall community objectives and to offer EPA and other pertinent agencies informed realistic recommendations on actions to be taken regarding the cleanup of the site.

5. The Newtown Creek Alliance is aiming for swimmable water in the creek – is this also a goal EPA wants to achieve and is this goal even possible?

A Newtown Creek Community Advisory Group was established by EPA and stakeholders to represent the interests of the communities and stakeholders, to receive and share information and to provide advice and input



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