Restoring Systemic Proximities

Towards the Re-territorialization of the Dutch Rivierenland

P5 Report 25/06/2020

Transitional Territories Graduation Studio Isabel Recubenis Sanchis

Restoring Systemic Proximities

"It is a paradox of modern time that collecting and storing big data to develop artificial intelligence mounts exponentially, while keeping up the evolutionary database for constant education of immunological intelligence is in danger, as humans are increasingly disconnected from natural environments." Haahtela, 2019

It is through the design of our territories, that we have constructed impervious forms of occupation and living, leading to a cultural, geographical and physical distance from an environment more and more unfamiliar, from which we are increasingly vulnerable.

The urban question today should be about the restoration of systemic proximities…

proximity between our bodies and the ground, between life learning evolutionary rituals and the collective management of the territory…
proximity in language with a changing environment that talks about new frequencies…

The urban question today should be about the design of different degrees and forms of porosity, that mentally, physically, culturally and geographically re-connect body, ground and territory with the ecology in which these are embedded.

to my dear and life-long mentors,

Diego, Taneha and Geert, who allowed me to grow and explore,

to Filippo, who submerged me in a world of inspiration,

thank you for the inspirational readings and the meaningful conversations,
thank you for allowing me to *create* a cloud of interrelations, of questions and notions crystallizing in this thesis,
thank you for allowing me to *draw* the best version and conclusion of this academic journey.

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to Simon, my rock and life partner, for your patience and endless support, for helping me learn from every step of the way.

Thank you all for your generosity and support.
This journey wouldn't have been as exciting, meaningful, and beautiful without you.

Restoring systemic proximities.
On the Re-territorialization of the Dutch Rivierenland

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Ex-ante positioning

Ex-ante problem
Ex-ante conceptual framework
Meta Aim
Thesis Aim
Theory Paper

Ex-ante conceptual framework

The thesis is framed under the following conceptual framework in which the biases coming from the scientific positivism have been translated into a particular way of occupation of the territory characterised by the perception of nature as a threat to control and as a resource to exploit, and leading to a territoliality (Raffestin, 2012) epistemologically de-attached from ecological embeddedness.

This worldview has resulted in te desynchronization of urban and ecological systems -in the shape of economical, technological and cultural systems- leading to the degradation of ecosystems and the increasing vulnerability of urban systems as more uncertain scenarios approach.

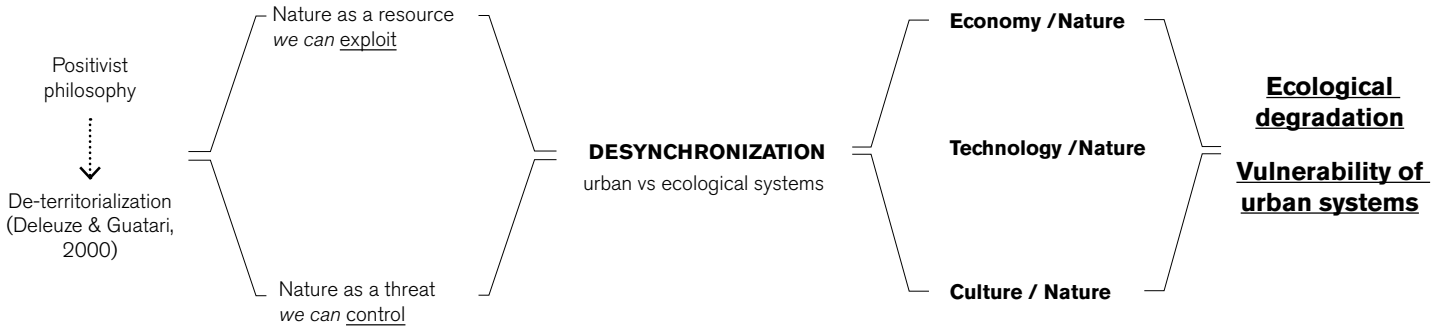


Figure 01.
Ex-ante conceptual framework
Elaborated by the author

Positivist approach to planning and design of the territory

Different paradigms in history have changed the way in which we perceive the world in which we live. Still today, as a consequence of the powerful scientific positivism, our speed of consumption is re-affirmed by the idea of control of nature. The idea of manipulating, softening climatic events, even the idea of restoring ecology so the same speed of consumption, the same economic, urban and spatial behaviour is rooted on the epistemology error that Bateson (1972) refers to.

Western philosophy and positivist approach

The biases coming from the scientific positivism[1] have expanded into the way in which we have *affected*, *influenced* and *control* the territory. This act of *territoriality* (Raffestin, 2012) has been characterised by a strong disconnection between natural and human sphere, both in its geographical and cultural sense. Impregnated in our epistemology, this has resulted into a positivist approach to nature as a resource *we can* exploit, and as a threat *we can* control. This process is linked and adapted from the notion of de-territorialization[2] (Deleuze & Guatari, 2000).

Planning and design approaches

The consequences of this wrong world-view – explored by Bateson in Steps to an ecology of mind in 1972 as epistemology error[3], but also as described in detail by Capra & Henderson, 2009; Boehnert, 2018; Moore, 2018 -, have resulted in the disengagement between economy, built environment and individuals from the natural environment and the acknowledgement of its ecology. These disengagements, loose of ties between the different anthropogenic systems –economic, spatial, individual- and ecology, are in the thesis analysed under the notion of de-synchronization.

This process has consolidated into planning and design approaches of the territory which are challenging the performance of the nature and ecology on which our systems depend.

Figure02.
Synchronizing times
Elaborated by the author

Figure 03.
Great Acceleration
Socio-economic and Earth System trends from 1750 to 2010 in globally aggregated indicators
Source: Adapted from Steffen et. al (2015 a,b)

1 According to Boehnert (2018) "both scientific positivism and post-modernism, form the theoretical building blocks of the dominant scientific, political and cultural institutions" (p. 51)
2 In anthropology, de-territorialization is the separation of social, cultural and political practices from a location.
3 Epistemology error is a term used by Bateson in Steps to an Ecology of Mind, and "posits that the Western premise of radical independence from no-human nature is wrong" (Boehnert, 2018, p.63)

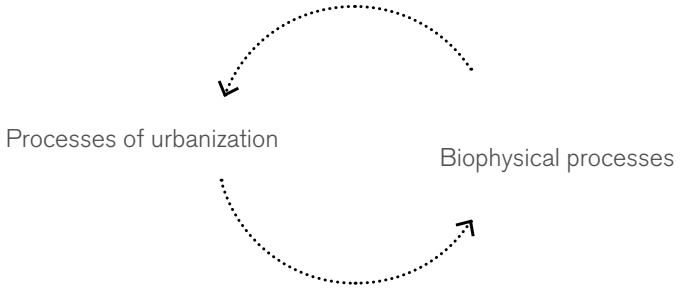
Desynchronization

In a broader sphere, the thesis project is positioned within the idea that the main problem driving the ecological crisis is the management of time, a problem of de-synchronization.

Our own anthropogenic relative time-scale, limits us to comprehend geological and ecological time-scales. This phenomena is translated into a de-synchronization between, for instance, our consumption rates and re-cycling rates (material dependent wise), between the rate at which urbanization processes take place, the rate at which resources are consumed and the rate at which natural replenishment of resources, or bio-geo-chemical absorption of chemical elements and nutrients (bio-geo-chemical cycles) takes place.

The ecological crisis is therefore dependent on our understanding and management of time, which the project aims at casting light.

¿How to synchronise urban and ecological time-frames and functions?



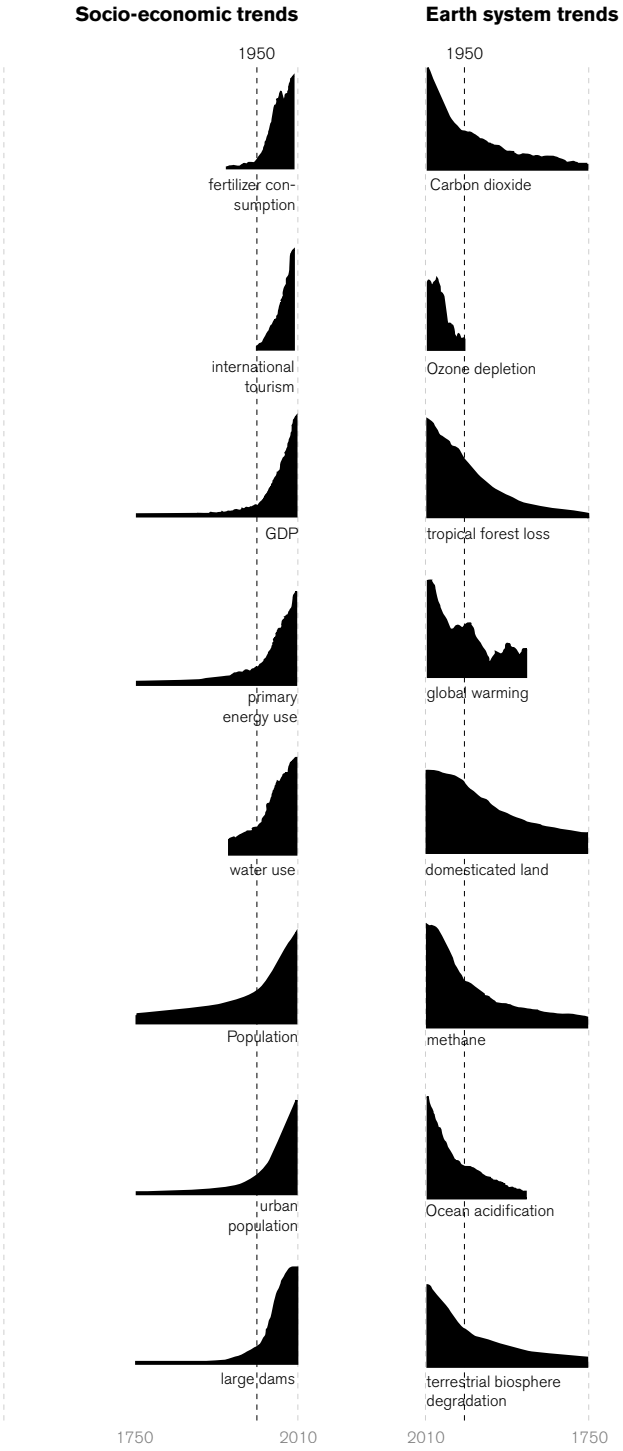


Figure 04.
Diagram on the relation between positivist philosophy, levels of de-synchronization and associated problems.
Elaborated by the author

De-synchronization and associated problems

Coming from the understanding of the time de-synchronization between the human and the ecological rates, and a specific philosophy, here I describe the consequent de-synchronizations between economy, built environment, individuals and ecology.

De-synchronization economy / ecology

The de-synchronization between economy and ecology comes after the fail in understanding that the economic system is a subsystem of the ecological system. The exploitation of natural resources that comes from the support of quantitative economic growth leads to “a state that is quickly destroying the possibility of long-term prosperity” (Boehnert, 2012, p. 3) as it is destroying the natural environment and ecology from which it depends.

Main problems: depletion of resources, $C0_2$ emissions, environmental degradation and diminishment of ecosystem services.

De-synchronization built environment / ecology

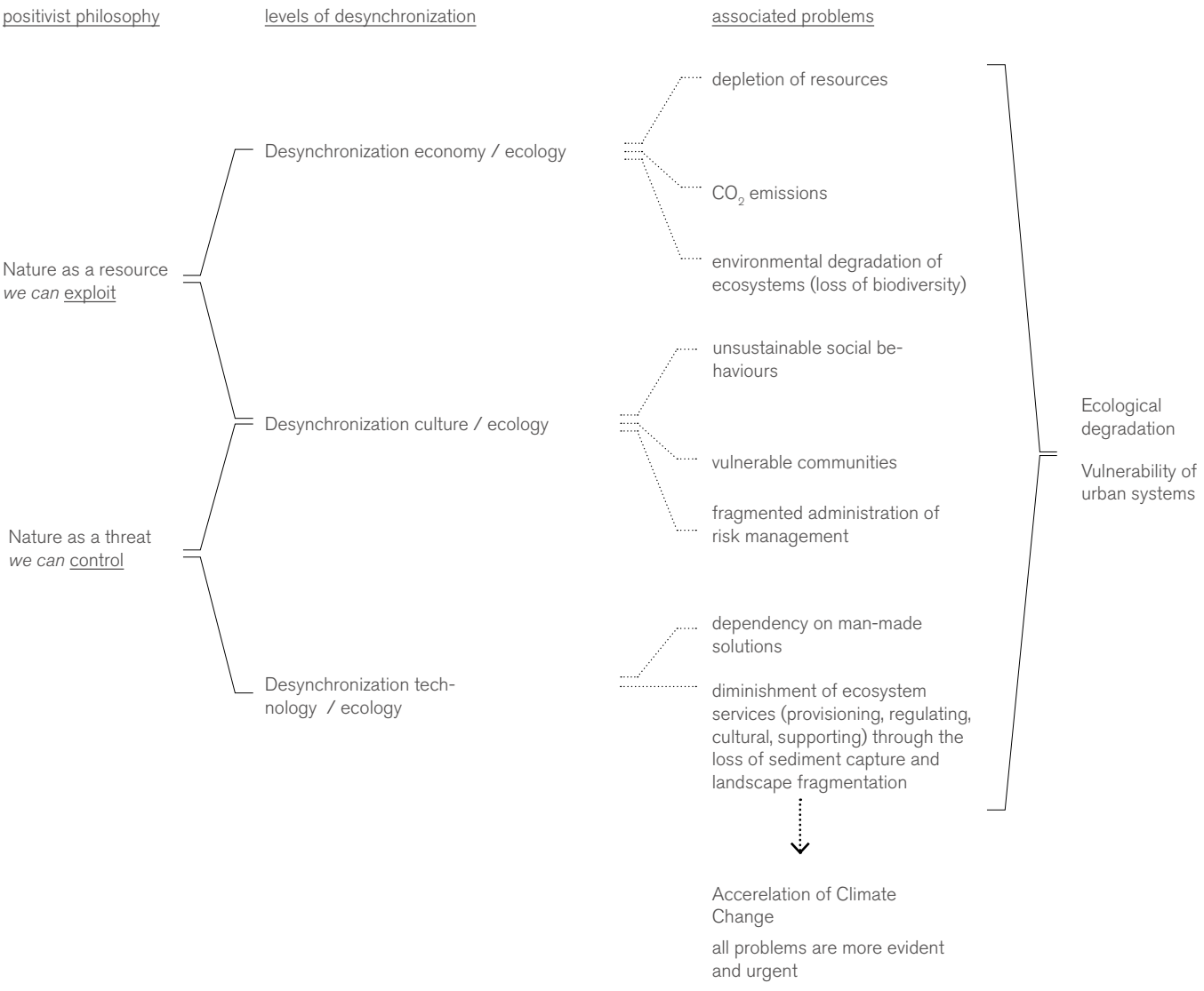
The de-synchronization between built environment and ecology refers to a way in which our cities –characterised by the sealing of the soil-, infrastructures -emphasized in mobility systems and water management– and flood protection systems –materialised with the construction of dykes and sluices-, have been built in denial of ecological processes. This de-synchronization is related to the perception of nature as a threat we can control.

Main problems: environmental degradation, diminishment of ecosystem services and dependency on man-made systems.

De-synchronization individuals / ecology

The de-synchronization individuals ecology, relates to a disengagement of individuals and communities from the management of the natural resources these consume, and a disengagement of individuals and communities from the perception and management of natural dynamics

Main problems: unsustainable social behaviours, vulnerable communities, and fragmented administration of the natural environment.


positivist philosophy
levels of desynchronization
associated problems
Nature as a resource
we can exploit
Nature as a threat
we can control
Desynchronization economy / ecology
Desynchronization culture / ecology
Desynchronization tech-
nology / ecology
depletion of resources
CO_2 emissions
environmental degradation of
ecosystems (loss of biodiversity)
unsustainable social be-
haviours
vulnerable communities
fragmented administration of
risk management
dependency on man-made
solutions
diminishment of ecosystem
services (provisioning, regulating,
cultural, supporting) through the
loss of sediment capture and
landscape fragmentation
Ecological
degradation
Vulnerability of
urban systems
Accerelation of Climate
Change
all problems are more evident
and urgent

Unearthing the scales of de-synchronization between economic, spatial and individual spheres and ecology

Planning, Governance and Design approaches to trigger a urban project on the re-territorialization of the Netherlands.

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Abstract

The paper is positioned in the idea that a *wrong* world-view based on a *positivist* philosophy has impregnated the way in which we have *affected, influenced and control* the territory characterised by a loose of cultural and geographical ties between natural and human systems. The aim of the paper is unearthing the scales of this process in which economical, spatial, individual (and collective) spheres are de-synchronized from ecological processes.

The central argument of the research is that the failure to perceive ecological embeddedness and systemic interconnections is the fundamental condition underlying our destructive ways of living, leading to converging crisis.

The paper argues that the present moment is one of re-organization, where there must be a creative re-configuration of harmonious relations among socio-economic-ecological systems as a path to a long-term prosperity. In order to answer how, when and who is to be involved in order to trigger this project of re-synchronization, planning, governance and design approaches are suggested. A*daptive co-management* of resources (on governance), *strategic planning revisited* (on planning) and the notion of *eco-revelatory design* (on design) are some of the key approaches studied to activate a process of reconciliation between human systems and the ground that sustain *us*.

Keywords

De-territorialization, re-territorialization, synchronization, ecology

1. Introduction.
And the notion of de-synchronization

"The nature/society split was fundamental to a new, modern cosmology in which space was flat, time was linear and nature was external." (Moore, 2018: 5)

The biases coming from the scientific positivism[1] have expanded into the way in which we have *affected, influenced and control* the territory. This specific way has been characterised by a strong disconnection between natural and human sphere, both in its geographical and cultural sense. This process is linked and adapted from the notion of *de-territorialization*[2] (Deleuze & Guatari, 2000).

Impregnated in our epistemology, this has meant the understanding of: nature as a resource *we can* exploit, and nature a threat *we can* control. The consequences of this *wrong* worldview – explored by Bateson in *Steps to an ecology of mind* in 1972 as *epistemology error*[3]*,* but also as described in detail by Capra & Henderson, 2009; Boehnert, 2018; Moore, 2018 -, have resulted in the disengagement between economy, built environment and individuals from the natural environment and the acknowledgement of its ecology. These disengagements, loose of ties between the different anthropogenic systems –economic, spatial, individual- and ecology, are in this paper analysed under the notion of de-synchronization. Beyond a matter of co-existence, this notion, and its inherent chorographical sense, expresses the lack of coordination and interdependencies between these and ecology.

The paper describes three levels of disengagements (economy, built environment and individual) with ecology, while answering to: What are the associated problems coming from these de-synchronizations? And what is the relation between them and current socio-economic-environmental crisis?

Beyond a matter of co-existence, the notion of de-synchronization and its inherent chorographical sense, expresses the lack of coordination and interdependencies between economy, built environment and individuals and ecology.

The paper explores in depth the meaning and associated problems coming from the de-synchronization between individuals and ecology and the interrelations among the different levels of disengagements.

How to re-construct harmonious relations between individuals and communities with ecology leading to long-term prosperity? What are the implications in governance, planning and design?

[1] According to Boehnert (2018) "both scientific positivism and post-modernism, form the theoretical building blocks of the dominant scientific, political and cultural institutions" (p. 51)
[2] In anthropology, de-territorialization is the separation of social, cultural and political practices from a location.
[3] Epistemology error is a term used by Bateson in Steps to an Ecology of Mind, and "posits that the Western premise of radical independence from no-human nature is wrong" (Boehnert, 2018, p.63)

2. Levels of de-synchronization
And converging socio-economic-environmental crisis

Our advanced societies, technologies, built environment and economies have mastered the building of intelligent clocks, cars, flood defence systems which probability of failure is set between 10000 and 1250 years[4] (Slomp, 2012, p.32), but have failed at understanding or managing complex systems (Boehnert, 2012). According to Boehnert (2018) the reason why our current systems are not able to perceive interconnectedness is epistemological.

This particular way to understand and describe reality is derived from both scientific positivism and post-modernism where nature is perceived as a mere resource and therefore is susceptible to be exploited. Its ontology is deterministic and its epistemology is objectivist, reductive and dualist (Sterling, 2003 in Boehnert, 2018). This philosophy creates "a split between subject and object, sensing and thinking, mind and body, humankind and nature" (Boehnert, 2018, p. 51). The idea that the dominant epistemological position is a poor reflection of reality has been described in detail in multiple fields and authors (Bateson, 1972; Capra& Henderson, 2009; Boehnert 2018, Moore 2018). In particular, Bateson in *Steps to an Ecology of Mind* (1972) refers to this phenomenon as *epistemological error* which Boehnert (2018) uses to explain a crisis of perception on the synergistic ecological relations.

This misconception is "encoded in the language we use, the objects we create and the cities we build" but also it is" designed into cultural artefacts, language and systems", and it is "reproduced in education, communication, media, policy, law and design". (Boehnert, 2018, p. 64). The path from science to a philosophical theory and world-view can be therefore traced until its last consequences: where our social-economic systems are in "conflict with the highly complex ecological systems on which we depend." (Boehnert, 2012, p. 3). The consequences of this *wrong* world-view leading to the perception of nature as a resource we can exploit and as a threat we can control have resulted in three levels of de-synchronization which are:

- De-synchronization economy / ecology
- De-synchronization built environment / ecology
- De-synchronization individuals / ecology

2.1 De-synchronization economy / ecology

> *"Our failure to recognize that economic prosperity depends on ecological well-being has developed from a reductive habit of mind that is unable to understand the relationships between complex systems. This has led to a state where we are quickly destroying the possibility of long-term prosperity."* (Boehnert, 2012, p. 3)

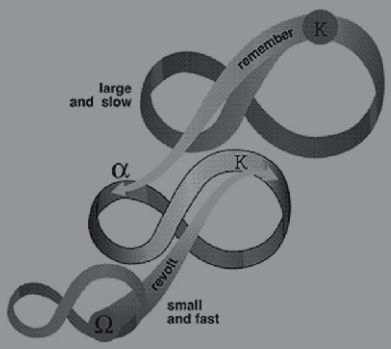
The de-synchronization between economy and ecology comes after the fail in understanding that the economic system is a subsystem of the ecological system, where the dynamics and interdependencies between both are not recognized. This disengagement comes as consequence of perceiving nature as a resource we can exploit (see figure 03). An example of this disengagement is given by Capra & Henderson (2009) when they refer to "every decrease of material over-consumption, which is good news ecologically speaking, entails human hardship through increasing job losses" (p. 1). The dysfunction generated from this particular

[4] An example of the high level of technification in flood safety infrastructure in the Netherlands.

disengagement or de-synchronization is based on a reductive view of economy and growth as it corresponds to the quantitative side of it.
The exploitation of natural resources that comes from the support of quantitative economic growth leads to "a state that is quickly destroying the possibility of long-term prosperity" (Boehnert, 2012, p. 3) as it is destroying the natural environment and ecology from which it depends. In words of Bateson (1972):

> *"I suggest that the last 100 years or so have demonstrated empirically that if and organism or aggregate of organisms sets to work with a focus on its own survival and thinks that is the way to select its adaptive moves, its 'progress' end up with a destroyed environment. If an organism ends up destroying its environment, it has in fact destroyed itself."* (p. 457 in Boehnert, 2018, p. 62)

figure: 01
The adaptive cycle
Source: adapted from Holling and Gunderson (2002, p. 34-41) in Davouidi et al., 2013



However when looking at ecology and how this works, Capra & Henderson (2009) describe how growth in organisms, ecosystems and societies is related to an "increase of complexity, sophistication, and maturity" (p. 5). This idea relates to Holling's *adaptive cycle* (figure 01) in which four phases of change in ecosystems are described: the *growth phase* characterised by its quick expansion (where modern economies have been and *want to be*), a *conservation phase* where resources are stored and used for the maintenance of the system, *creative destruction* phase and *reorganization phase* defined as a time for innovation and restructuring (Gunderson & Holling, 2012 in Davouidi, Brooks & Mehmood, 2013). As these phases occur in *panarchical*[5], phases co-exist across space and time ensuring the resilience of the whole system of systems.

By looking at growth from the point of view of biology and ecology, development corresponds to the acquisition of a *qualitative growth*[6], which opens a whole new spectrum in which economy and ecology can not only be coupled but also interdependent. Qualitative economic growth can be sustainable as long as "it involves a dynamic balance between growth, decline, and recycling, and if it also includes development in terms of learning and maturing." (Capra & Henderson, 2009, p. 8)

Implications on design:
This interdependence between economy and ecology is today defined as *bio-based economy*[7] and has been explored in design as exemplified in thesis projects of Myserli (2018), Moncrieff (2018), and LaFleur (2016). In their thesis, these authors design projective futures where economy is based on the cultivation of nature rather than its exploitation, leading to the engagement of individuals and communities to the ground that supports them (LaFleur, 2016) later on explored through the synchronization individuals & ecology.

[5] Panarchy, named for Pan, the Greek god of nature, refers to "how variables at different scales interact to control the dynamics and trajectories of change in ecological and socio-ecological systems" (Gunderson, 2009, p. 4)
[6] Qualitative growth is a term defined by Capra & Henderson (2009) inspired in Leonardo's science 500 of organic forms, of qualities, of patterns of organization and processes of transformation.
[7] Franz Fischler 2010, at the KBBE 2010 conference (http://www.kbbe2010.be) defines bio-based economy as […] production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste as all materials discarded by one process are inputs for another process and are reused in the ecosystem.

2.2 De-synchronization built environment / ecology

The de-synchronization between built environment and ecology refers to a way in which our cities –characterised by the sealing of the soil-, infrastructures -emphasized in mobility systems and water management– and flood protection systems –materialised with the construction of dykes and sluices-, have been built in denial of ecological processes. This de-synchronization is related to the perception of nature as a threat *we can* control. (see figure 03)

In the act of *territorialising*[8] (Raffestin, 2012) driven by the biases of the scientific positivism and a culture of permanence fed by the modernist reasoning which believed that the future could be predicted and controlled (Ogilvy, 2002 in Albrechts, 2010), the built environment has taken the shape of physical structures designed to last *forever*. In this pursue of permanence where urbanization has been about a "grand vision" instead of a "grand adjustment" (Mehrotra, 2019), humans are obsessed to resist change. In this sense, Mehrotra in his TED talk on "The architectural wonder of impermanent cities" poses some striking questions to reflect on this matter: "Are we trying to make permanent solutions for temporary problems? Are we locking resources into paradigms that we don't even know if they will be relevant in a decade? Can we accommodate climate change challenges with softer urban systems? Or are we going to continue challenging nature continuously with heavy infrastructure, which we are already doing unsuccessfully?" (Mehrotra, 2019)

"Are we trying to make permanent solutions for temporary problems?" (Mehrotra, 2019)

On the other side, the consequences of rivers "channelized, leveed, regulated upstream, and with little natural floodplain left" (Grimm et al., 2008 in Liao, Le & Van Nguyen, 2016) as seen in the Netherlands, have led to the loss of most ecosystem services associated to urban rivers. The loss of ecosystem services is by definition associated to a loss that individuals, communities but specially our economies suffer by having to compensate these *free services* that ecosystems give with man-made solutions, on which we *then* depend culturally and economically.

Implications on design:

The interdependence between the design of built environment and ecological processes have been experimentally explored by Mehrotra (2015) in his work on the Kumbh Mela, and in the Netherlands with experiences like "Room for the River", "River as a Tidal park" or the "Sand Engine".

Whereas Mehrotra advocates for the exploration of temporality and soft urbanism and the necessity to change planning urban design cultures to think of the temporal, the reversible, the disassembleable in a way that cities reserve more space for uses on a temporal scale (Mehrotra, 2019); the experiences of the Netherlands are more aligned with the concepts of *Building with Nature*[9] and *Nature Based Solutions*[10] which are based on the understanding of ecological processes and the use of them on our benefit – Sand Engine project-, and the importance of giving back to nature the space natural processes require – Room for the River project-.

[8] In Raffestin (2012), "Territoriality is best understood as a spatial strategy to affect, influence or control resources and people, by controllin area" (Sack, 1986, p.1 in Raffestin 2012, p. 126)

[9] Building with nature is a concept where nature is used to cope with climate change risks: floods, waves and sea level rise.

[10] Nature-based Solutions (NbS) are defined by IUCN as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits".

This sphere of de-synchronization is as well connected with the disengagement between individuals and ecology as explored in the notion of *ecological wisdom*[11] of Liao et al., (2016): "When the ecosystem services of flooding are appreciated, the design of the built environment works around as opposed to suppress flooding" *(p. 6).* A lack of visibility leads to a lack of awareness and appreciation of natural processes, a loop that is in turn retrofitted by a consequent created notion of *fear* (to the unknown). The fear is translated into the necessity to be protected constructing structures that put away the problem, and the loop starts again.

2.3 De-synchronization individuals / ecology

As explored in the previous spheres of de-synchronization, they are interconnected among themselves through the de-synchronization individuals and ecology that is at the core. As the scope of the paper is focused on the in-depth exploration of the meaning and associated problems coming from the last of de-synchronizations, between individuals and ecology, the definition will be given in the following section.

3. De-synchronization individuals / ecology

This level of de-synchronization corresponds to the individual sphere and projected into the collective, as the agents shaping the culture through which the act of *territoriality* (Raffestin, 2012) is performed. It is rooted in the perception of nature as a threat *we can* control and exploit as derived from the biases of the scientific positivism (see figure 03). For this reason, this sphere is the one with most implications in governance and planning while is also at the core of the rest of de-synchronizations.

The disengagement from individuals and ecology is aligned with the binary nature/society explained by Moore (2018), the *epistemological error* of Bateson (1972), and is linked to the notion of *de-territorialization* (Deleuze & Guatari, 2000). Whereas anthropologists use this term to refer to a weakening of ties between culture and place, in this case, this process of disconnection is adapted and concerned with the natural and the human sphere, both geographical and cultural. (LaFleur, 2016)

The explored associated problems coming from the de-synchronization between individuals and ecological processes are described in the following subsections:

3.1 Disengagement of individuals and communities from the management of the natural resources

The *cultural* and *geographical* gap between individuals and communities from the ecology they are embedded is intertwined with the disengagement from the management of natural resources these consume. This process ultimately triggers unsustainable social behaviours such as the demand of products that are exploiting the ground and all its resources, polluting the environment and damaging the ecosystems from which we depend.

[11] Ecological wisdom is a notion used by Liao et al., (2016) to refer to the knowledge of flood ecology, in order words the understanding of the ecosystem services of flooding. In the text, flooding can be generalized with all type of natural disturbances.

As the geographical distance between the *places of extraction* and *production* of resources and the *places of consumption* increases, so do the cultural distance between individuals and management of resources. This relation feeds a lack of sensibility towards Climate Change mitigation measures, as exemplified by the phenomenon of *NIMBY*[12], but also to the lack of ecological knowledge, and also to the misperception of ecological processes –such as flooding in floodplain areas- as threats.

3.2 Disengagement of individuals and communities from natural dynamics

> *"Reductionism and disciplinary isolation restrict our understanding of a world characterised by surprises and discontinuities"*
> (Levin, 1999 in Armitage et al., 2009, p. 1)

The aforementioned disengagement steers the present one, specifically referred to the act of controlling and protecting from ecological processes and natural dynamics that destabilise our economies and our *permanent* built environment (see section 2.1 and 2.2). In this sense, natural dynamics are framed as threats.

For this reason it is not surprising that policies on mitigation and adaptation to climate change treat communities as the object to protect instead of the participants and main actors in the continuous process of adaptation to climate change (Davoudi et al., 2012). This act of protecting, not only distances individuals and communities from the possibility to perceive natural dynamics as something they could benefit from (see section 4.2), but also eliminates the valuable *adaptive capacity* of *social-ecological systems*, resulting in vulnerable individuals and communities.

The lack of sensibility and knowledge of ecological processes and natural dynamics is related to the misperception of stability (Reed & Lister, 2014) and the notion of nature as threat. This results in the disengagement of individuals and communities from the governance spheres (lack of individual responsibility from environmental problems) but also the disengagement of governance from individuals, as a phenomenon that retrofits itself in both directions. Derek et al., (2008) talks about how neglecting "culture and the persistence of conventional assumptions about social and ecological stability, scientific certainty, and the place of experts in governance, create challenging decision-making conditions". (Armitage et al., 2009, p. 1).

[12] NIMBY is an acronym for the phrase "Not In My Back Yard") characterizing opposition of residents to the development of a proposed artifact in their local area.

Rather than the only source of disruption, climate change is a bio-geo-physical phenomenon that is making the consequences of these crises more evident, setting the urgencies to come up to solutions. Climate Change can therefore be considered as the arena, the table of conversation, to reconstruct harmonious relations between socio-economic-ecological systems.

4. About re-territorialization , synchronization and re-engagements

The present moment is one of *re-organization* (Gunderson & Holling, 2012 in Davouidi et al., 2013) where there must be a creative re-configuration of harmonious relations among socio-economic-ecological systems. Inspired by the notion of *re-territorialization*[13] (Deleuze & Guatari, 2000), the urban project should be characterised by a process in which lost connections between the human and natural sphere are regained.

This section will examine planning, governance and design approaches as tools to explore how, when and who is to be involved in order to trigger this re-organization and re-synchronization individuals & ecology:

4.1 Re-engagement of individuals with the management of natural resources

The negative consequences coming from the disengagement of individuals from the management of resources: unsustainable social behaviours, lack of sensibility towards climate change mitigation, and the misperception of ecological processes as threats (see section 3.2) demands the need for reconsidering the approach given to management.

Implications on governance

On the governance level, this re-engagement refers to the co-management of natural resources as "the sharing of power and responsibility between the government and local resource users" (Berkes et al., 1991:12 in Carlsson & Berkes, 2005). Moreover, when considering the cross-scale nature of environmental problems, the ecological and social uncertainty and the ubiquity of change, the notion of adaptive is supplemented to the notion of co-management.

Adaptive co-management, (Armitage et al., 2009) is an approach that holds complex social-ecological systems because is *"tailored to specific places and situations, supported by, and working in conjunction with, various organizations at different scales"* (p. 2). The emphasis of this approach to management of resources is built on trust building, institutional development and social learning. (Derek et al., 2008)

4.2 Re-engagement of individuals with the natural dynamics

The disengagement between individuals and natural dynamics as seen in section 2.2, leads to a misconception of stability where communities and individuals are more vulnerable to disturbances caused by natural phenomena. In this sense, the re-engagement of individuals with the natural dynamics requires *ecological wisdom* (Liao et al., 2016). In the case of the Netherlands, as an area prone to flooding, "such wisdom is rooted in the knowledge of flood ecology, the understanding of the ecosystem services of flooding". (Ibid)

[13] Regaining the lost connection through a re-projection of new relations

figure: 03
Flowchart Narrative
Source: Author

In fact, periodic flooding, with which native species co-evolve, is key to the ecological health of floodplain rivers (Ward & Standford, 1995 in Liao et al., 2016), yet this is largely eliminated through the construction of a built environment that is designed to protect from it (see section 2.2).

On the other side, the acknowledgement of natural dynamics can be a crucial tool in order to enhance the notion of a dynamic equilibrium –a state of balance between continuing processes-. A notion that inspires the evolutionary resilience of Davoudi (2012) when she defines a long-term adaptation to climate change based on an on-going adaptation to changes.

The sphere of planning and governance and design can give the tools to understand how, when and who to provoke this change in mind-set that re-establishes harmonic relations between individuals and natural dynamics.

The sphere of planning and governance and design can give the tools to understand how, when and who to provoke this change in mind-set that re-establishes harmonic relations between individuals and natural dynamics.

Implications on planning

The *strategic planning revisited* (Albrechts, 2010) can be a suitable approach to the planning of this shift as it is focused on developing openness to new ideas, and understand and accept the need and opportunities for change among sectors, time and space.

Implications on governance

The need for reducing vulnerability and construct *agile communities*[14] can be explored through one of the principles of flood resilience given by Liao et al., (2016): *localized flood-response capacity.* This principle gives more responsibility of the risk to the owners while increasing their *adaptive capacity*. This principle can however be very controversial in the Netherlands, where there is a prevalent perception that gives the sole responsibility for hazard mitigation to the government. This fact has prevented wider implementation of adaptation measures: "research in the Netherlands shows that most people would not invest to prepare for flooding because they consider the government responsible for flood control" (Bichard & Kazmiercza, 2012; Terpstra & Gutteling, 2008 in Liao et al., 2016, p. 9).

Implications on design

Urban design has a major role in this shift. Brown (1998) uses the term *eco-revelatory design* to define a design that reveals natural processes to the public. For example "a riverfront park that incorporates the ecological process of flooding could make visible a series of phenomena associated with flood dynamics, such as seasonal changes of the water level; increases in fish and other aquatic species; geomorphic processes such as sedimentation, debrid deposition, and erosion; water quality improvement, and the development of biotopes out of the sediments and debris brought by a flood over time" (Liao et al., 2016). As studied by Liao et al., (2016) and Brown (1998), the design of the build environment plays an important role on public education, helping cultivate public appreciation of the positive side of (for example) flooding in the city. (Liao et al., 2016).

[14] Agility is a capacity that can be built in communities when that enhance localized flood-response, timely adjustment and amphibious nature. (Liao et al., 2016)

5. Summary & Conclusion

The paper is positioned in the idea that a wrong worldview based on a *positivist* philosophy has impregnated the way in which we have *affected, influenced and control* the territory characterised by a loose of ties between nature and human spheres (see the notion of *de-territorialization*, Deleuze). This process can be traced through the notion of de-synchronization from ecology in three levels: economical, spatial and individual. Beyond a matter of co-existence, this notion, and its inherent chorographical sense, expresses the lack of coordination and interdependencies among these and ecology.

So, what are the associated problems coming from these de-synchronizations? And what is the relation between them and current socio-economic-environmental crisis?

The first part of the paper explores how every level of de-synchronization is a function of an environmental crisis and by extension a function of social and economic crisis.
The environmental crisis brought by the disengagement between economy and ecology is associated with the exploitation of resources, pollution and environmental degradation. In the short run this is being translated into the regulation of economic activities in order to reduce $C0_2$ emissions which in turn brings social crisis associated to a loss on productivity and jobs. In the long run, this trajectory of economic growth has a dead end, and while "economic collapse is painful, ecological collapse is terminal". (Boehnert, 2012, p. 3). On the other hand, the environmental crisis led by the spatial disengagement with ecology is associated to the substantial diminishing of ecosystem services as a consequence of landscape fragmentation, loss of sediment capture, and elimination of floodplains. The loss of ecosystem services is by definition associated to a loss that individuals, communities but specially our economies suffer by having to compensate these *free services* that ecosystems give with man-made solutions, on which we *then* depend. From a cultural and economic point of view, this relation of dependence is unsustainable and the fail of these systems can lead to social and economic crisis. Last in this section, it is explored how the disengagement between individuals and ecological processes leads to unsustainable social behaviours, vulnerable communities to natural disturbances and a fragmented administration in the management of natural resources.

The "contrived blindness to ecological relationships is the fundamental condition underlying our destructive and insensitive technologies and behaviour" (Plumwood, 2002, 8 in Boehnert, 2018, p.60), and so, how to re-construct harmonious relations between individuals and communities with ecology leading to long-term prosperity? What are the implications in governance, planning and design?

In the second part of the paper it is argued that the present moment is one of re-organization (Gunderson & Holling, 2001) where there must be a creative re-configuration of harmonious relations among socio-economic-ecological systems. In order to answer how, when and who is to be involved in order to trigger this re-synchronization between individuals and ecology, planning, governance and design approaches are suggested. On the governance side, the adaptive co-management of resources defined by Derek et al., (2008) is explored as an approach to enhance a re-synchronization between individuals and the management of natural resources they consume. On the planning side, the *strategic planning revisited* defined by Albrechts (2010) is contemplated as the strategy to develop openness to the idea of a reconciliation between individuals and communities to natural dynamics. Finally, the notion of *eco-revelatory design* conceptualized by Brown (1998) stands for the design sphere and its relevance in the role of public engagement in the appreciation of the positive side of natural dynamics.

The present paper unearths the different layers and scales of de-synchronization between economic, spatial and individual spheres and ecology, and its implications in converging socio-economic-environmental crisis of our urbanized world. It proposes ecology as a science of complexity associated to a worldview oriented towards preserving the commons. Inspired by the notion of *re-territorialization* (Deleuze & Guatari, 2000), it proposes that the urban project should be characterised by a process in which lost connections between the human and natural sphere are regained.

From nature as a resource we can exploit to nature as a resource we can cultivate. From and nature as a threat we can control, to nature as a dynamic process from which we can learn, evolve, mature, transform.

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From De-territorialization to Re-territorialization

The ex-ante poblem field is conceptualized through the lens of *territoriality* as defined by Raffestin (2012) "a spatial strategy to affect, influence or control resources and people, by controlling area" (Sack, 1986, p.1 in Raffestin 2012, p. 126) to frame the disconnection between natural processes (seen as threats to control) and occupational patterns.

Under this approach, the problem field is framed as a spatial process of deterritorialization Deluze and Guatari (2015) characterised by the loose of ties, the *extinction of experience* (Pyle, 2003), between human and natural spheres

In this sense, the urban question posed by thesis is about re-territorialization" (Deleuze & Guatari, 2000), the exploration of the active role that the occupation -through culture, technology and economy- should have in the delivery of more symbiotic relations with the ecology in which it is embedded

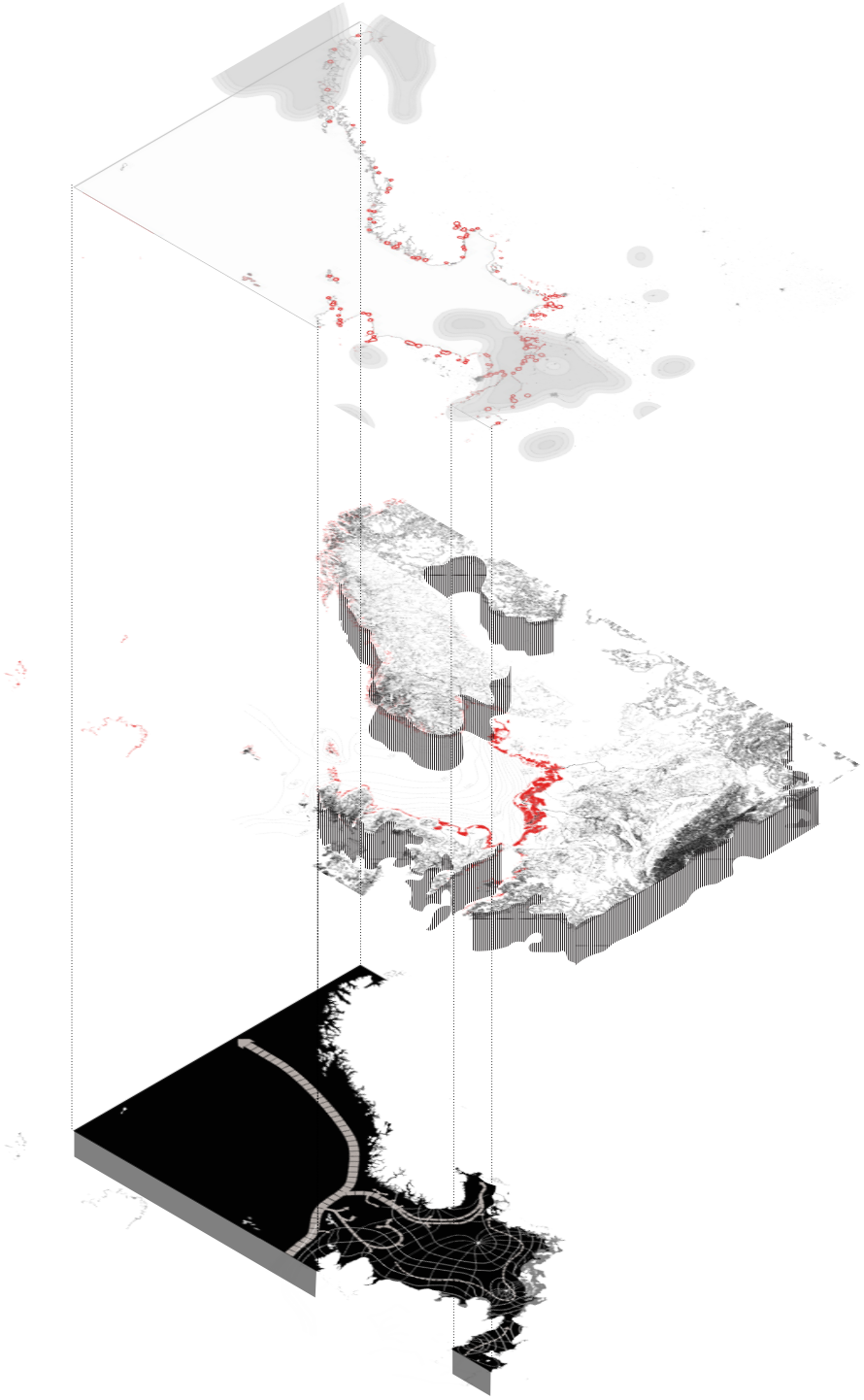
By researching on the specific case of the Rivierenland territory, the thesis informs the ex-ante positioning by reflecting in the following meta-questions:

How can the notion of uncertainty be introduced in the design and planning of urban environments in order to construct an evolutionary adaptation and mitigation to Climate Change?

How can the urban project trigger a cultural and geographical re-connection between human and natural spheres?

A

Problem field



NORTH SEA TERRITORY

control and exploitation narratives

The point of departure of this thesis is the territory of the North Sea under the framework of Transitional Territories studio topic “North Sea. Landscapes of Coexistence. A Topography of Chance”.

In this contested territory, the positivist approach to territolialization of land and sea have for centuries been their leverage, exporting it with pride to other parts of the world. In this section a reflection on how the control of natural dynamics and the exploitation of resources (in particular soil) is leading to higher vulnerability to climate change is done.

Figure A1 (previous page).
Axonometry on the formation of the Dutch Delta and the anthropogenic challenges today
Elaborated by the author (within the framework of collective research "Flux, Erasure and Terraforming" Transitional Territories 2019-2020)

Coastline
Main water corridors
Topography land surface
Intensity wind
Predominant wave directions
Tidal amplitudes
Areas prone to floodrisk (5m)
Affected ports and cities

The vulnerability of urbanized Deltas

The challenges coming from the defined de-synchronization (p. 9-25) are particularly evident in highly urbanized Deltas, where natural dynamics have been targeted as threats to control and avoid.

The formation of Deltas responds to a geological scale. For thousand of years an open interchange between riverine and sea dynamics conformed a changing landscape. Sea and wind dynamics, together with a low-lying topography, set the conditions for the settling down of marine and riverine sediments conforming one of the richest habitats for biodiversity.

With the *territorialization* of this rich and productive areas, a series of elements for territorial production raised in order to control and set a *stable and dry ground* to inhabit. The soil sealing of the ground caused by an intensive expansion of the built environment, together with a particular water management engineering to pump water and stabilization of natural dynamics (water channels) are examples of these elements of territorial production in Deltas.

As a consequence, urbanized Deltas are fragile systems suffering from: environmental degradation of ecosystems, and diminishing of ecosystem services through the loss of sediment capture and landscape fragmentation.

Rather than the only source of disruption, climate change is a bio-geo-physical phenomenon that is making the consequences of these crises more evident, setting the urgencies to come up to solutions.

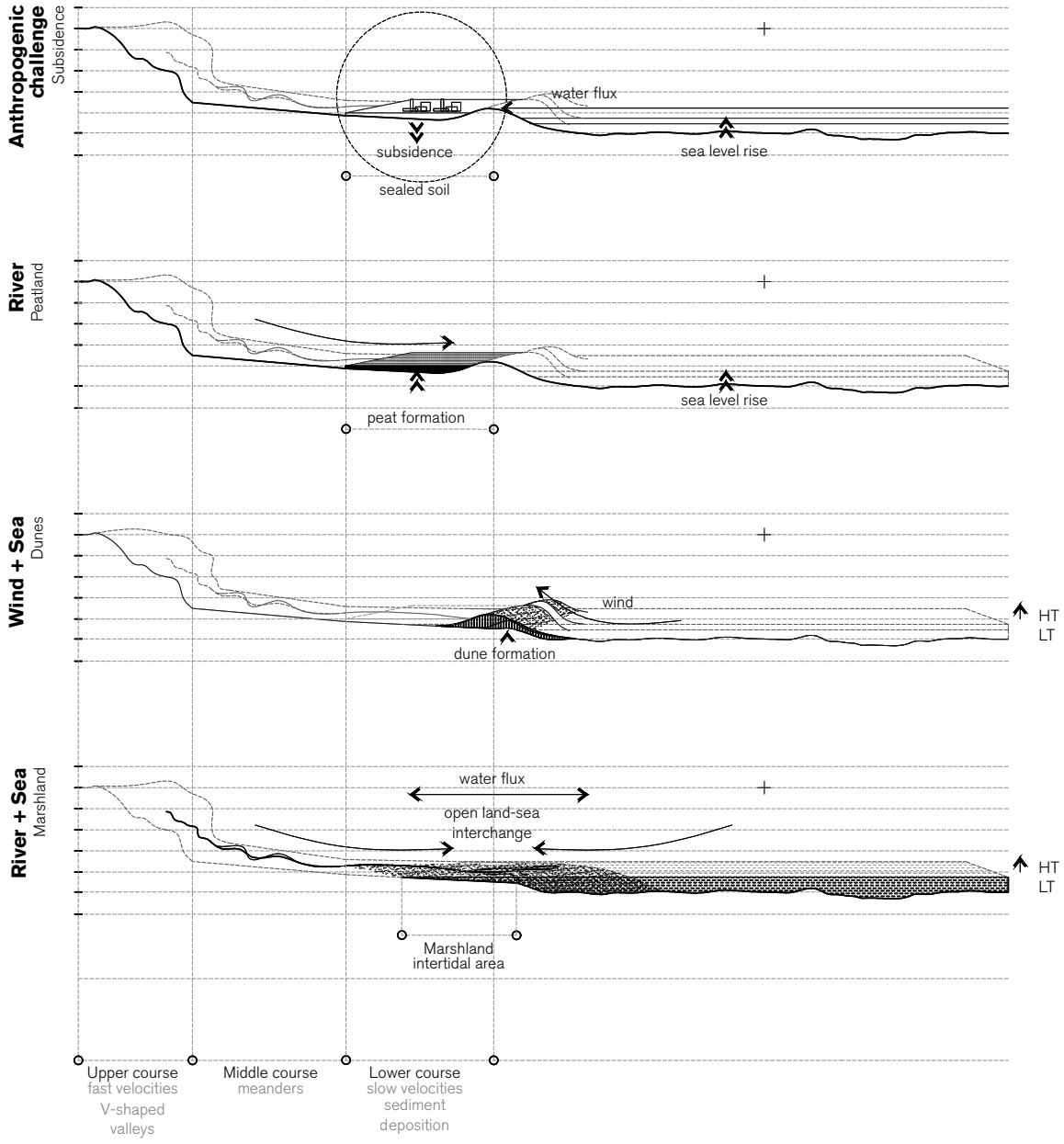
By altering the natural environment to make it controllable, we have erase the natural capacity of the natural system to auto-regulate, now being dependent of this man-made systems constantly outdated. In words of Reker (2006):

> *In a natural delta, the supply of sediment from the land is in a dynamic equilibrium with the sea level and the erosive processes at work along the coast. If anything changes on either side, the delta will find a new equilibrium. Inhabitants of deltas have been adapting their environment for centuries to suit their needs. Measures have been taken to prevent flooding (through the construction of dikes, dams and delta works), to make shipping possible (by canalising and damming rivers and constructing harbors), to enable farming (by de-foresting and draining the land), and to allow the extraction of natural resources (sand, clay, peat).*
>
> *Human intervention has generally led to the disruption or complete obstruction of the natural processes within a delta. Consequently, a delta can lose its natural flexibility and is no longer able to adapt to changing circumstances.* (p. 23)

Figure A2.
Section on the formation of the Dutch Delta and the anthropogenic challenges today
Elaborated by the author (within the framework of Transitional Territories 2019-2020 collective work "Flux, Erasure, Terraforming")

Land
Sea
Glacier
Process

Impacting relation



The soil sealing and dutch water strategy management (dependent on pumping water) generates a situation of land subsidence, more and more challenging with rising sea levels

The dunes set the conditions for fluvial sediments and organic matter to deposit on the delta. Peat is formed by the decomposition of organic matter with a rate of about 1 mm per year (Charman, 2002), which means 1 m deep peat needs 1000 years to form.

Sea and wind dynamics, together with the low-lying nature of the delta coast set the conditions for the settling down of marine sediments in ridges, sand dunes.

For thousand of years the interchange land-sea was open and free. From that interchange, a changing state of the coast was defined.

Figure A3.
Potential activities for soil biodiversity loss
Source: Adapted from Orgiazzi et al., (2016)

Table: Unclassified potential
High potential
Moderate potential
Low potential

Intensive soil exploitation

soil biodiversity loss

Due to the increasing pressures exerted on soil, below-ground life is under threat. In a study ellaborated by Orgiazzi, Panagos, Yigini, Dunbar, Gardi, Montanarella, and Ballabio (2016), a list of 13 potential threats to soil biodiversity are proposed:

1: Climate change (global warming) (Van der Putten, 2012);
2: Land use change (Spurgeon et al., 2013);
3: Habitat fragmentation (Halme et al., 2013);
4: Intensive human exploitation (Tsiafouli et al., 2015);
5: Soil organic matter decline (Heenan et al., 1995);
6: Industrial pollution (Hafez and Elbestawy, 2009);
7: Nuclear pollution (radioactivity) (Brodie et al., 2006);
8: Soil compaction (Whalley et al., 1995);
9: Soil erosion (Pimentel et al., 1995);
10: soil sealing (Setälä et al., 2014);
11: soil salinization (Sardinha et al., 2003);
12: use of genetically modified organisms (GMOs) in agriculture (Verbruggen et al., 2012);
13: introduction and diffusion of invasive species (Kourtev et al., 2002).

Fourteen out of the 27 considered countries have more than 40% of their soils with moderate-high to high potential risk for all three components of soil biodiversity (soil microorganisms, fauna, and biological functions) and the majority of soils at risk are outside the boundaries of protected areas.

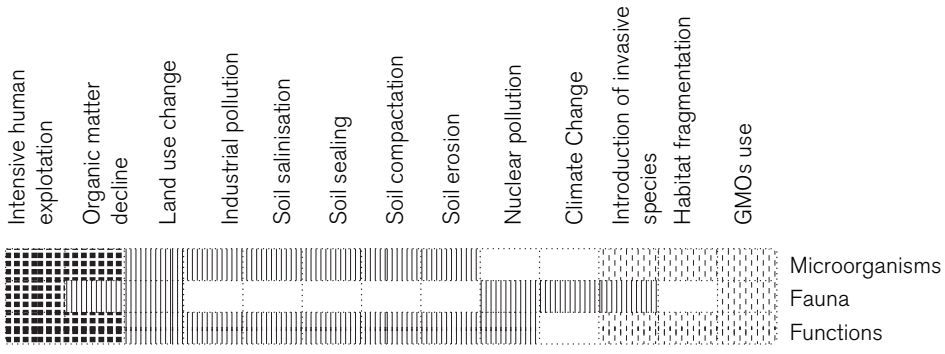


Figure A4

Soil biodiversity loss

Elaborated by the author (within the framework of Transitional Territories 2019-2020 collective work “Flux, Erasure, Terraforming”)

High threat:
Soil biological functions
Soil fauna
Soil micro-organism

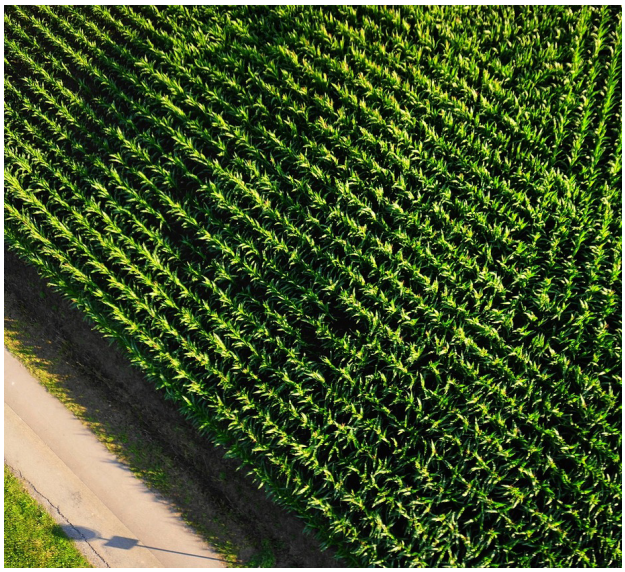
Intensive soil exploitation
monocultures

Among all the pressures, intensive human exploitation through intensive agricultural practices is the activity exerting more threat to the soil microorganisms, soil fauna and soil functions (Orgiazzi et al., 2016). In particular monocultures and their need for nitrogen deplete the soil, which ends up being a source of carbon instead of the natural sink it can be. According to Murakami (1991), in comparison with holistic and regenerative agricultures which imitate the productivity model of food forests, conventional land management and industrial agriculture lead to soils with:

-less ground cover
-fewer roots
-less carbon stored in soil
-less water retention in topsoil
-depleting groundwater
-more erosion
-less bioproductivity
-less diversity
-more carbon in the atmosphere

Figure A5.
Aerial view of cows in the meadow in The Netherlands.
Source: Reprinted from *Amazing Aerial Agency*. Retrieved from https://www.offset.com

Figure A6.
Aerial view of cornfield
Source: Reprinted from *shutterstock*. Retrieved from https://www.shutterstock.com



“Western patriarchy’s highly energy-intensive, chemical-intensive, water-intensive and capital-intensive agricultural techniques for creating deserts out of fertile soils in less than one or two decades has spread rapidly across the third world as agricultural development, accerelated by the Green Revolution and financed by international development and aid agencies”
Vandana Shiva in Murakami (1991)

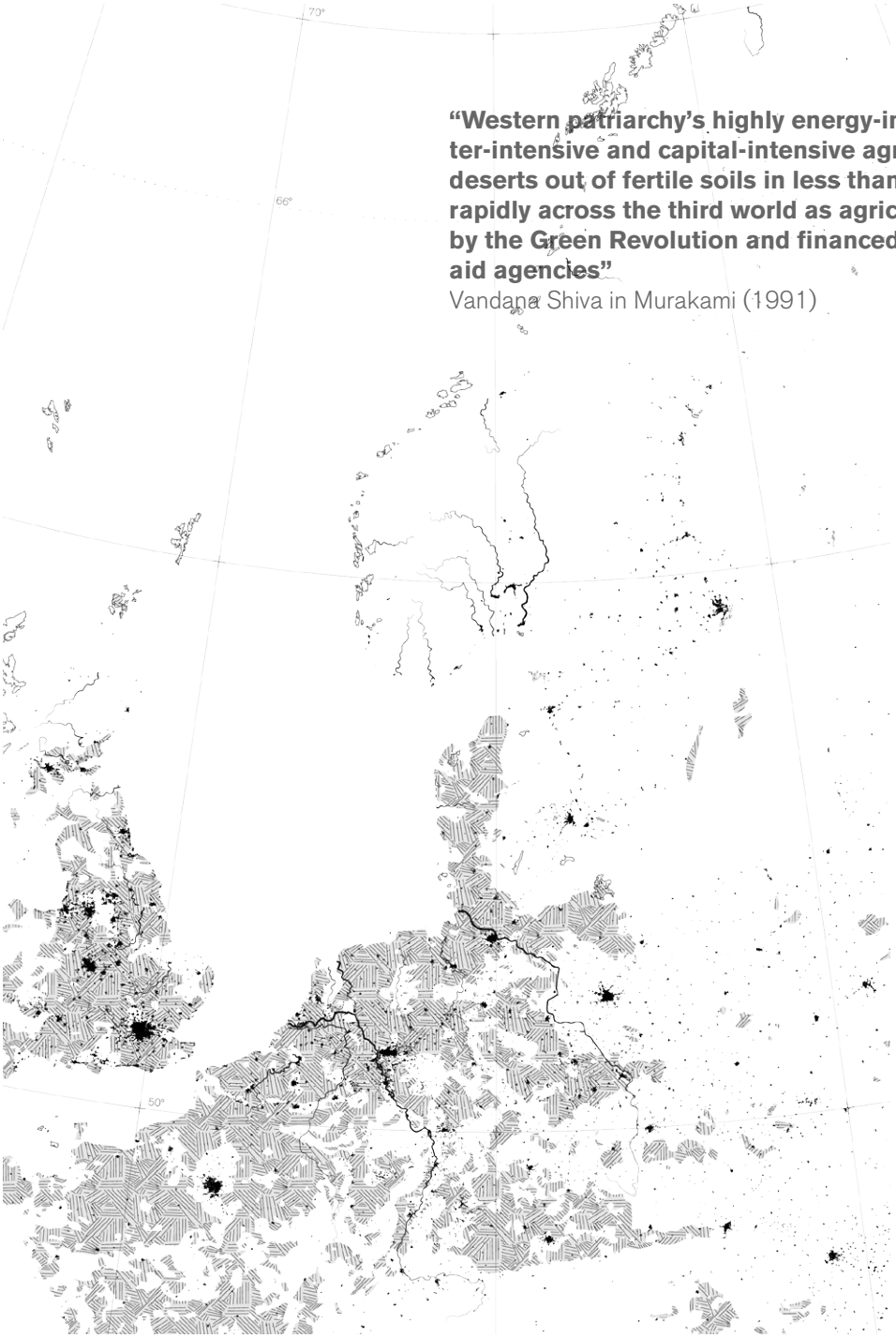
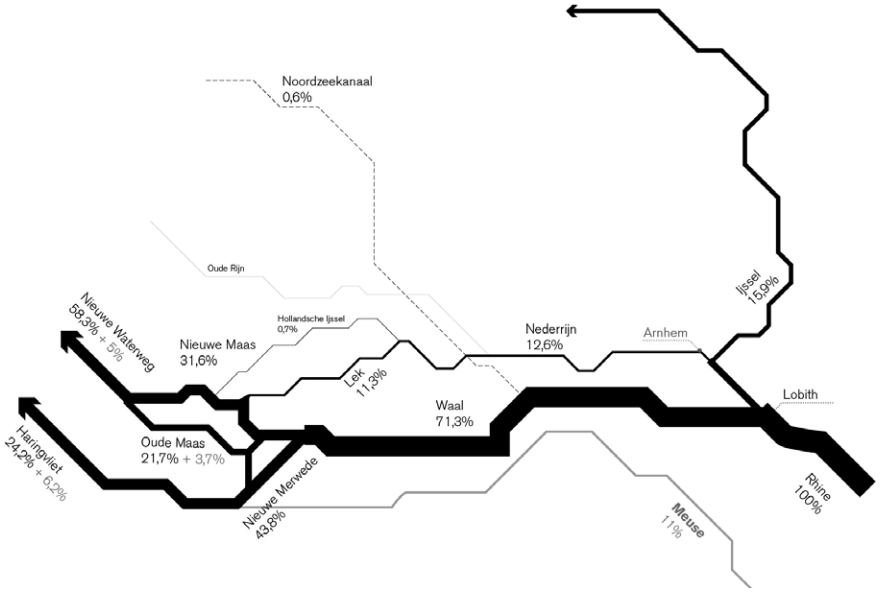


Figure A7.
Intensive human exploitation

The map shows the agricultural land use intensity (Temme and Verburg, 2011) that uses nitrogen application, associated to a set of environmental and socio-economic location factors, as appropriate indicator for the intensity of arable lands. For grasslands the intensity of use was estimated based on the local stocking densities with cattle.

Elaborated by the author (within the framework of Transitional Territories 2019-2020 collective work “Flux, Erasure, Terraforming”)

Map: High threat
Human exploitation


Noordzeekanaal
0,6%
Oude Rijn
Nieuwe Waterweg
58,3% + 5%
Hollandsche Ijssel
0,7%
Nieuwe Maas
31,6%
Nederrijn
12,6%
Arnhem
Ijssel
15,9%
Lek
11,3%
Waal
71,3%
Lobith
Haringvliet
24,2% + 6,2%
Oude Maas
21,7% + 3,7%
Nieuwe Merwede
43,8%
Meuse
11%
Rhine
100%

DUTCH DELTA

control and exploitation narratives

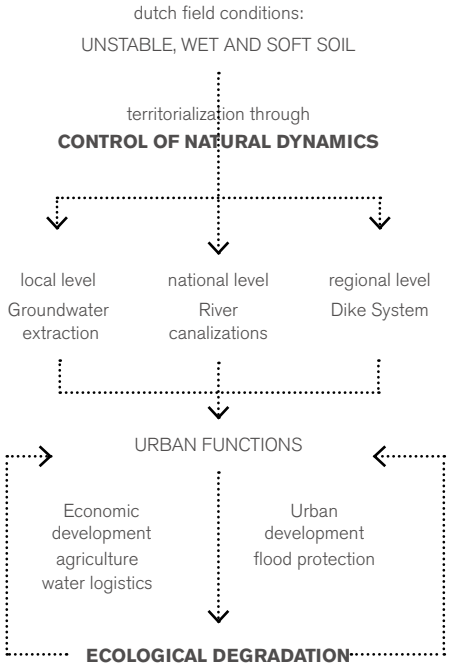
As a country with 29% of its surface below sea level and 26% prone to flooding (Huisman, 1998), the Netherlands is an exemplary case of this approach based on control

In this section a reflection on how the control of natural dynamics within the Netherlands and in particular within the Dutch River system is leading to higher vulnerability to climate change is done.

Figure A8 (previous page).
Annual average discharge of Rhine and Maas 2000-2011
Source: Adapted from *Wikimedia Commons*, by Maximilian Dorrbecker, Retrieved from https://upload.wikimedia.org

Figure A9.
Diagram on the Dutch model of territorial production
Elaborated by the author

Figure A10.
Urbanized Dutch Delta
Elaborated by the author (within the framework of Delta Interventions Research Group)



The Dutch model of territorial production

As a country with 29% of its surface below sea level and 26% prone to flooding (Huisman, 1998), the very formation of the Dutch state in the early nineteenth century was the result of a shared collective ambition to win the battle to water. This political and social moment was a crucial condition for the development of a national water management and spatial planning policy (Meyer, 2017).

Consequently, the very act of territoriality (Raffestin, 2012) in the Netherlands has taken place through the controlling natural phenomena such as river floods and tidal surges, transforming a dynamic condition into a controlled, dry and static ground.

Water management has been the main element of territorial production providing the conditions for the largest European port and the second largest net exporter of agricultural products in the world (OCDE, 2014). Performance that is being achieved at an overall cost of 1.26% of GDP covering water resources management, flood protection and other tasks related to water utilities (Ibid).

This model has pragmatically positioned economic and urban development as the leading forces in land use change, land use intensity and water management for centuries, leading to major threats to the ecology within which these systems depend.

At a local and regional level, a system for the extraction of groundwater managed by the waterboards (*watershaap* in Dutch) enables the construction of stable and dry ground to inhabit and cultivate. The construction of this system of dependence provokes seepage and subsidence but also annuls the natural capacity of the soil to perform under changing conditions transforming a living and productive system (wetlands) into artificially maintained lands.

At a regional and national level, the canalization of the main rivers (Rhine), essential for the development of water logistics and the construction of a system of dikes physically and mentally separates the occupied territory from the dynamics of water bodies (rivers and sea), the sources that for millennia have formed the country (page 33).

This system of dykes, designed for a failure probability of 1:10.000 to 1: 2.000 years -depending on the province-, allows for the construction of the “safest delta” against tidal and fluvial floods, at least in the short term. In the long term, the loss of gradients, the loss of lateral hydrological connectivity between the river system and its floodplain, the loss of processes of erosion and sedimentation annul the natural capacity of the delta ecosystem to be responsive and adapt to change, leading to increased severity to floods.

“The main source of problems regarding flood protection and nature development is not so much climate change and rising sea levels, as the deepening of navigation channels in the river estuaries.”
Meyer (2017)

"The slow but steady natural process of land formation and land rise changed into land erosion and land subsidence; extensive flood plains changed into narrow channels; gradual transition of fresh to brackish to salt water zones changed into sharp separations between fresh and salt water. Rivers lost their room to expand during peak discharges; the consequences of floods became more serious because of land subsidence; ecosystem were destroyed because of the loss of sediment and nutrients. Estuaries and delta, which represent some of the world's richest ecosystems, are threatened seriously with the loss of their richness"
Han Meyer in Urbanized deltas in transition, 2014

What we usually tend to forget is that this loss of ecosystem richness, as mentioned by Meyer (2014) directly shakes our existence, increasing our vulnerability to a changing and extreme climate.

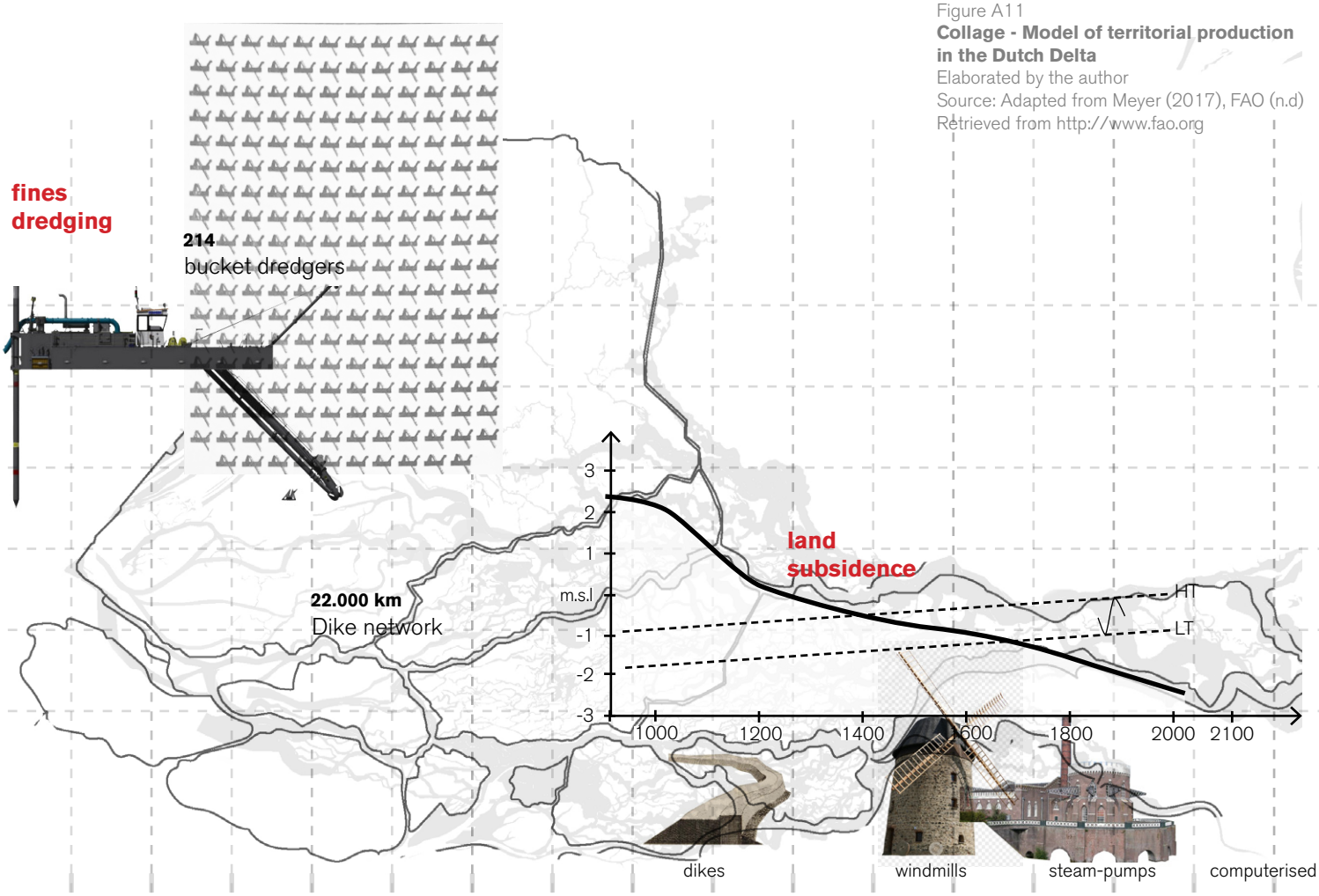
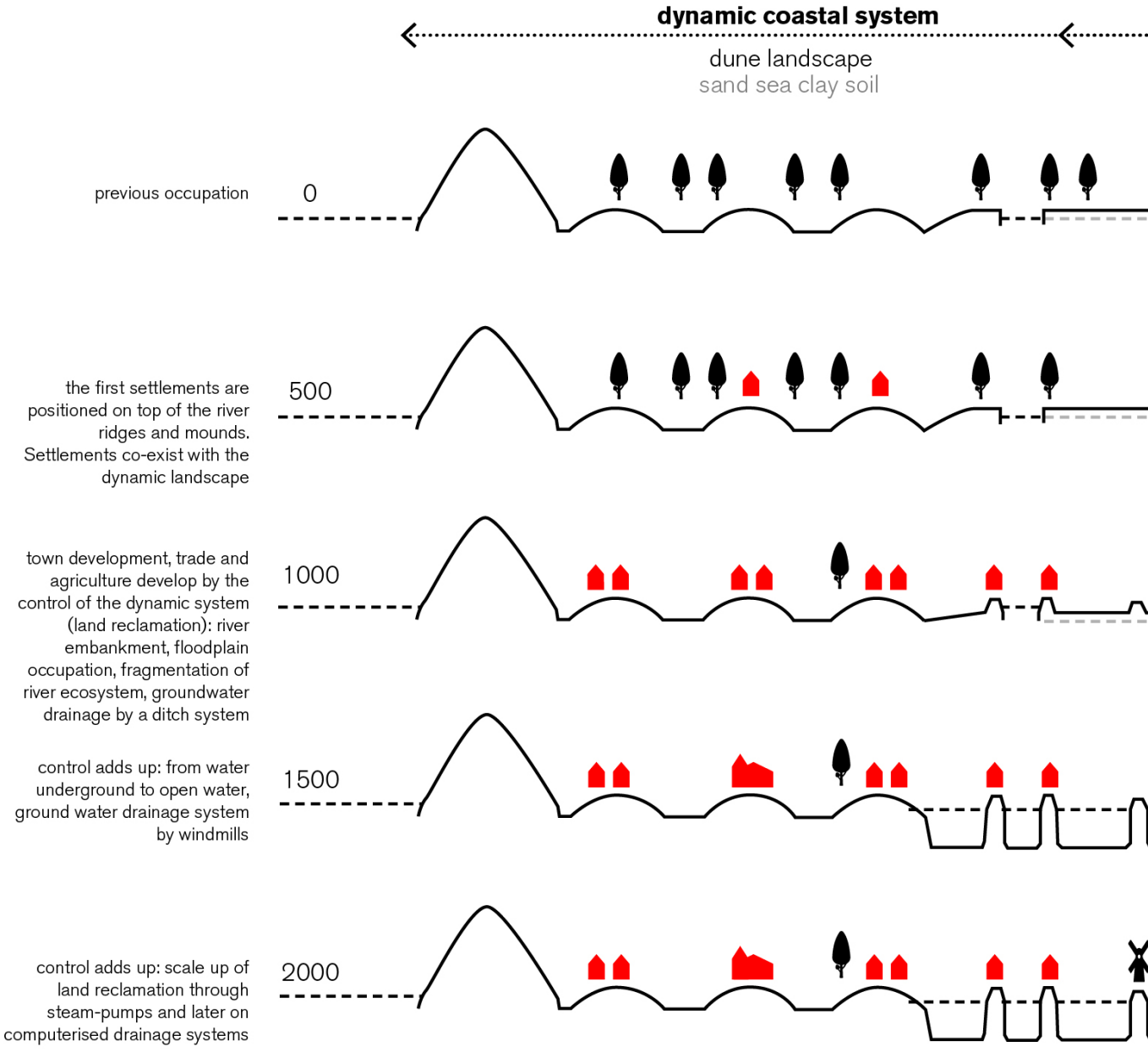
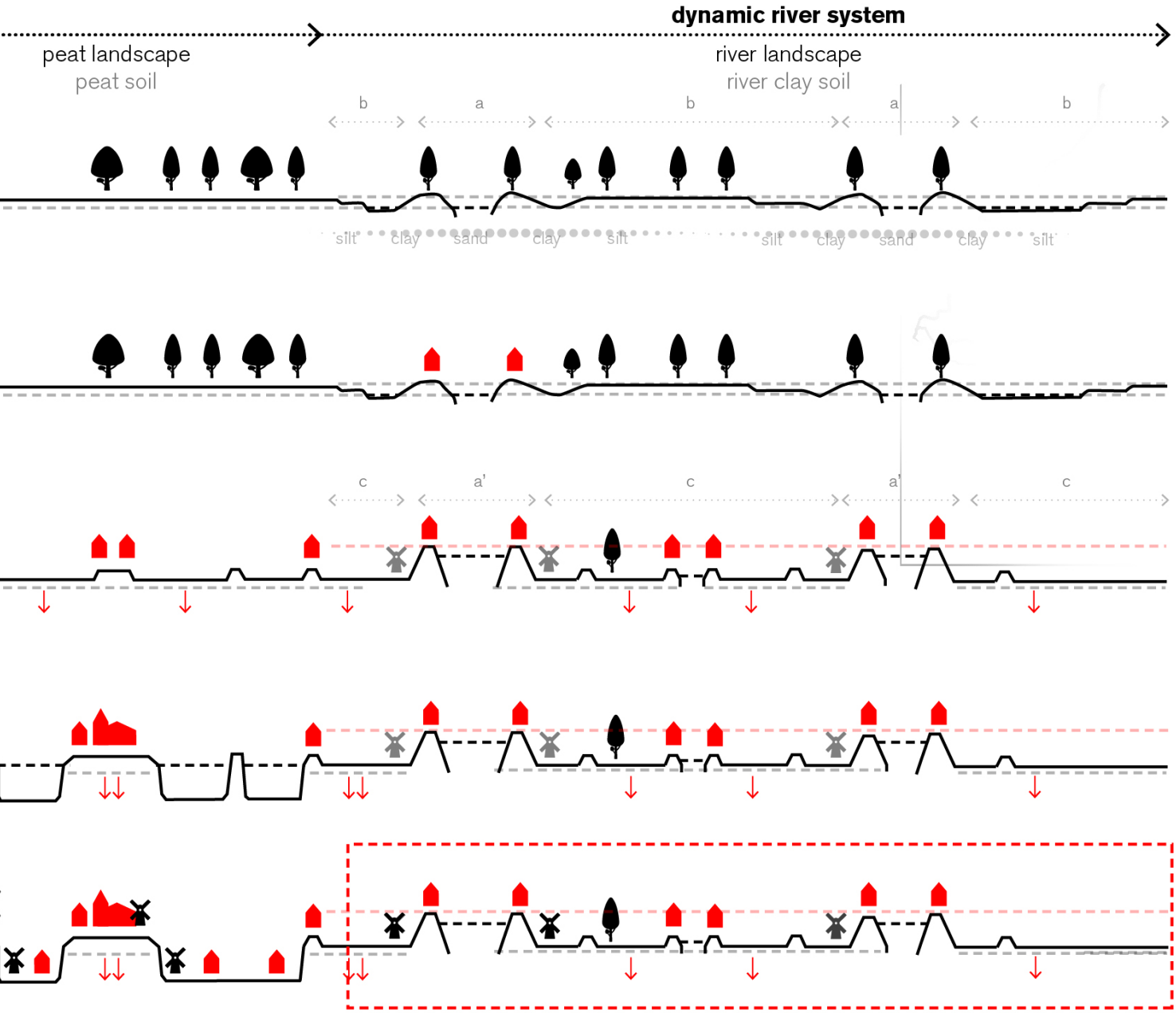


Figure A11
Collage - Model of territorial production in the Dutch Delta
Elaborated by the author
Source: Adapted from Meyer (2017), FAO (n.d)
Retrieved from http://www.fao.org

Figure A12
Diachronic analysis in section of the Dutch territory
Elaborated by author
Source: Adapted from Hooimeijer (2018)




dynamic river system
peat landscape
peat soil
river landscape
river clay soil
b
a
b
a
b
silt
clay
sand
clay
silt
silt
clay
sand
clay
silt
c
a'
c
a'
c

Vulnerability and the definition of protected safe areas

When studying the Dutch section (figure A12), it is clear how the Dutch approach to territoriality -the relation between occupation and the territory- is based on the construction of a stable and dry ground away from dynamics (sea, river and groundwater related), and the definition of protected/safe areas for occupation.

However, and since two serious high-water situations hit the river area in the mid 1990s, the control approach has been put into question as a future of extremes, given by climate change, has already changed the behaviour of the two rivers (Klijn et al. 2012 in Portugali, 2016), to hydrologically uncertain fluctuating discharges for which the system is not designed.

According to the most recent national and international studies and climate scenarios, the Rhine river discharge will increase in winter due to additional precipitation that cannot anymore be retained in the form of snow due to rising temperatures. These scenarios have been translated into increasing discharge levels from 17,000 m3/s to 22,000 m3/s or more by 2100 (deltacommissaris.nl).

Under this uncertainty of future pace of extremes, rigid systems defining protected safe areas -physically and culturally away from change- and functioning under certain levels of discharge cannot cope, and opposite to the purpose for which they were created, they set the ground for vulnerability.

Figure A13.
Discharge regime of the Rhine River a Lobith in 2100 in the various KNMI 20(scenarios in comparison to the current regime
Source: Adapted from Van Deursen (2006) Klijn et al., (2012)

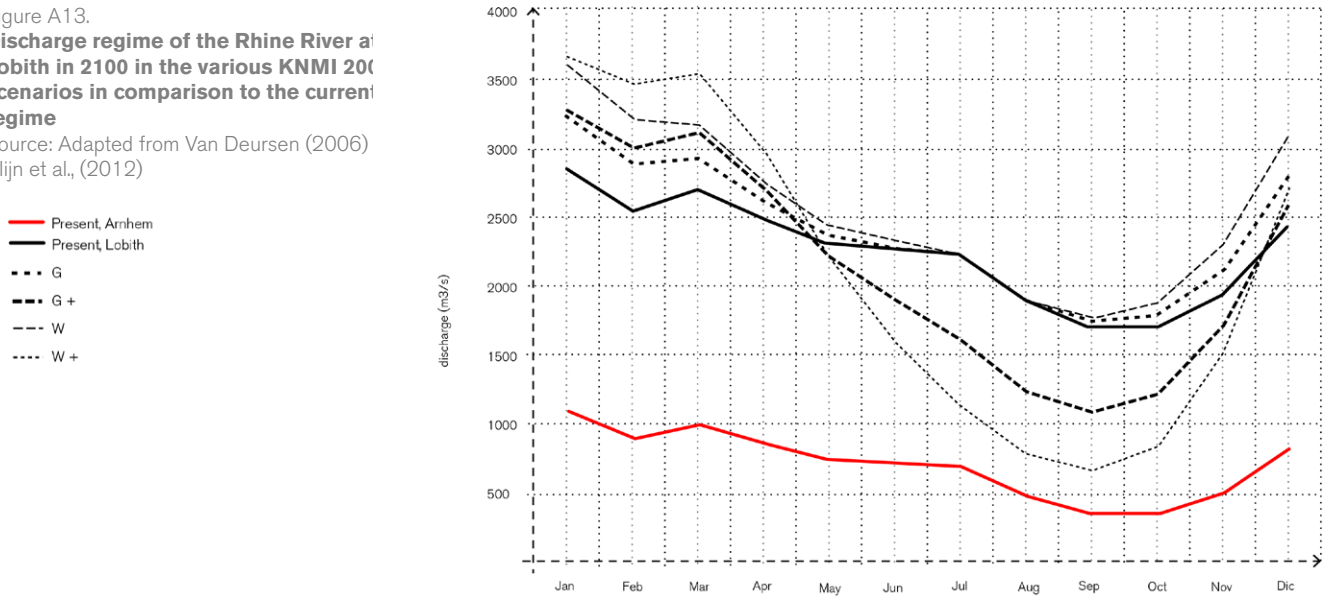


Figure A14.
1995 High water in the Waal River
Source: Reprinted from *Gelderlander*, by Jan Bouwhuis, Retrieved from https://gelderlander.nl

Figure A15.
1995 High water in Lobith
Source: Reprinted from *Rijkswaterstaat*, by Bart van Eyck, Retrieved from https://beeldbank.rws.nl

Embracing uncertainty
Planning and design challenges in the Netherlands

The traditional approach to planning is based on a worldview that believes in the control and prediction of nature. This worldview, in the Netherlands has for centuries been translated into a regulatory planning based of fixed plans, large infrastructure (dykes), a fixed long term and a top-down approach and translated into strategic actions, goals and design based on groundwater control -with the drainage of the surface-, flood control - with dykes-, erosion and sedimentation control.

After a series of catastrophes, and the increased concern with the environment as well as with the effects of climate change has triggered a transition to take place (Portugali, 2016). This transition is based on the one hand in the belief that uncertainty and extreme conditions posed by climate change are unavoidable, and on the other hand on the translation of complexity theories into the understanding of urban landscapes as complex adaptive systems (Meyer, 2013) that reveal how Socio-Ecologic systems are able to adapt.

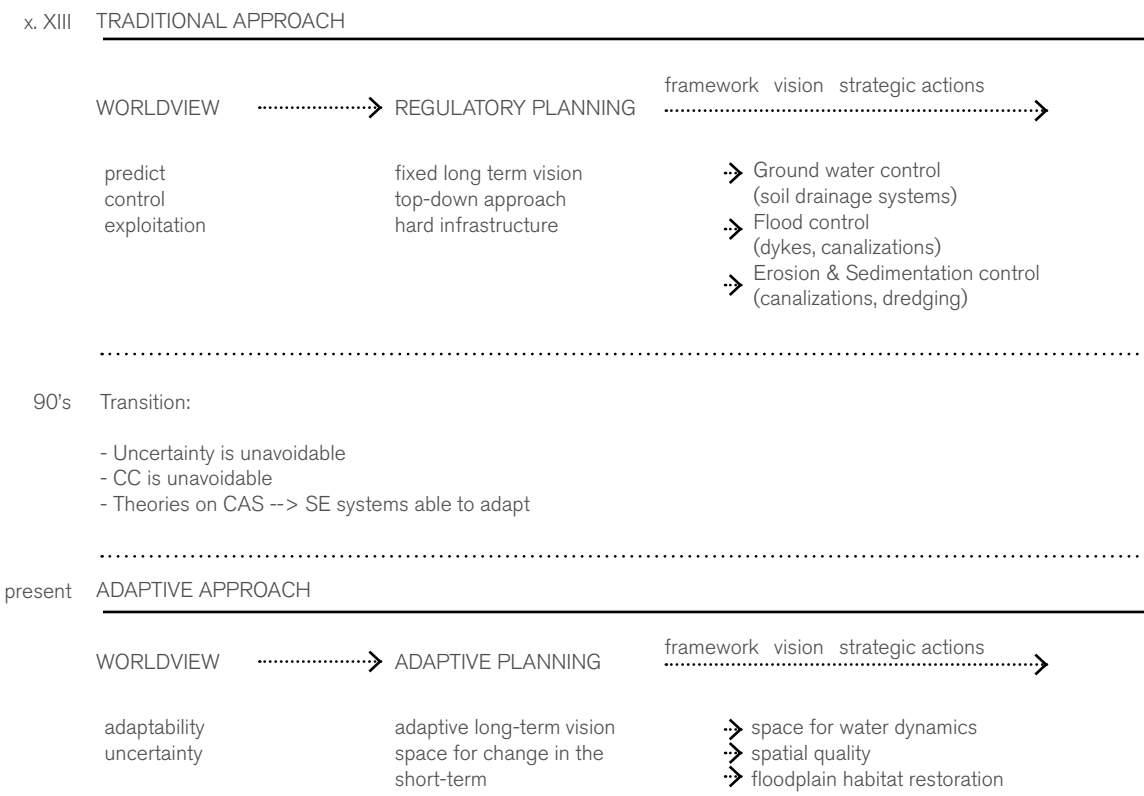


Figure A16.
Planning challenge
Elaborated by the author

This transition places uncertainty and adaptability as the starting point in adaptive planning approaches consisting in the re-formulation of long-term vision into adaptive long-terms with enough room to accommodate to changing circumstances in the short and medium term.

In light to increasing river discharges at an uncertain pace, the conviction for the necessity to overcome control narratives and find new approaches to spatial planning and hydraulic engineering resulted, in 2005, in the national planning policy project "Room for the River" (*Ruimte voor de Rivier* in Dutch).

In the following section I will summarise the challenges posed by this approach in the particular case of the Dutch river area addressing the gap this thesis wants to cast light upon.

DESIGN	Challenges
maximized for a given extreme condition diferentiation of protecting and protected spaces	Dependency on man-made solutions (hard infrastructure) that cannot cope with uncertainty
	Degradation of ecosystems
	Vulnerability to extreme natural events for which the system is not designed

DESIGN	Challenges
maximized for a given extreme condition (?) diferentiation of protecting and protected spaces (?) open ended (?)	Not including cultural adaptation
	Based on the definition of vulnerable areas rather than active ones. Lack of definition of the role of occupation within symbiotic framework with nature

RIVIERENLAND

beyond an adaptove approach

In this section I will frame the problematization into the specific area of the Rivierenland, synthesizing the challenges posed by the current adaptive approach to planning and design of the dutch river area, addressing the gap this thesis wants to cast light upon.

Beyond an adaptive approach

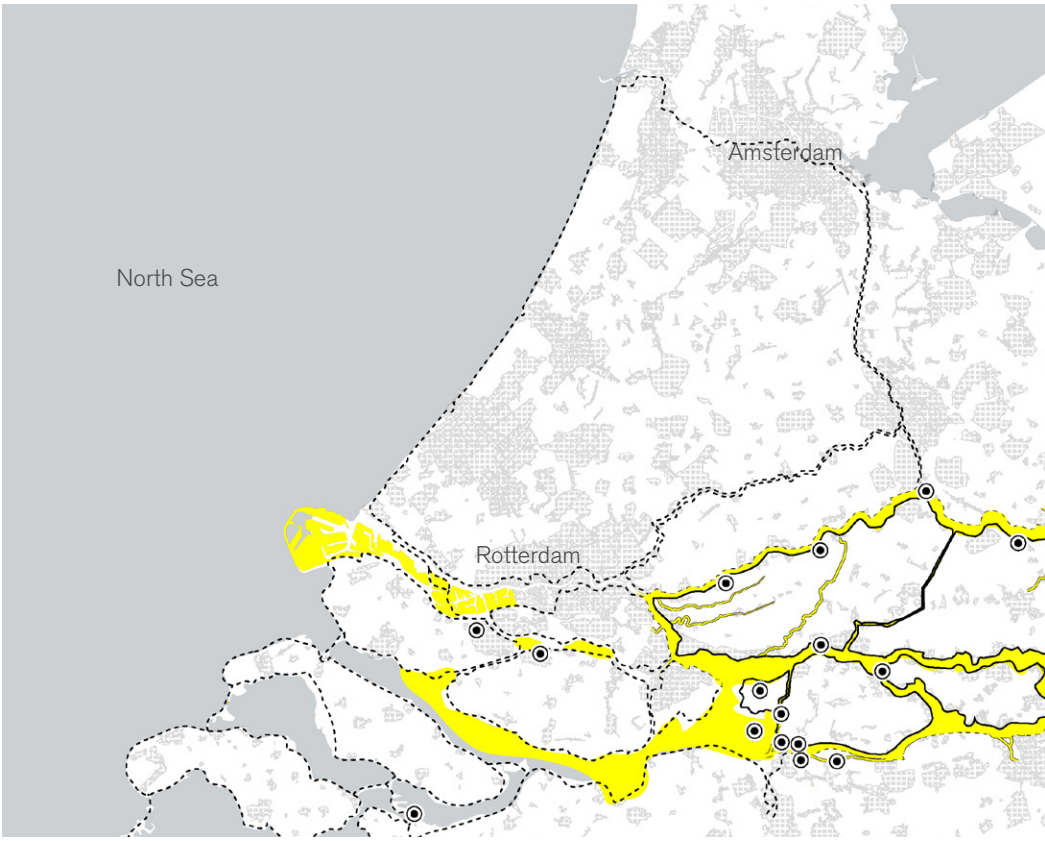
Room for the river (2005-2015) is one of the key dutch mitigation backbones that implements an adaptive approach based on the self-regulating potential of rivers when given enough room.

Its adaptive characterization comes from a design and planning perspective (Rijke, 2014): on the one hand, the design given for flood adaptation is based in providing space for water; on the other, the decision frameworks for establishing improved water safety and spatial quality are set by the national Government, whilst the plans and designs are formulated by local and regional stakeholders in 34 regional projects (figure A18).

As a project of reference, the analysis of its potentialities and limitations conforms the starting point of the thesis to propose a broader framework.

Figure A17 (previous page).
Room for the River and the Evolution of the Rhine
Elaborated by the author

Figure A18.
Active protecting corridors and the 34 locations of Room for the River
Elaborated by the author



As a project of reference, the analysis of Room for the River potentialities and limitations conforms the starting point of the thesis.

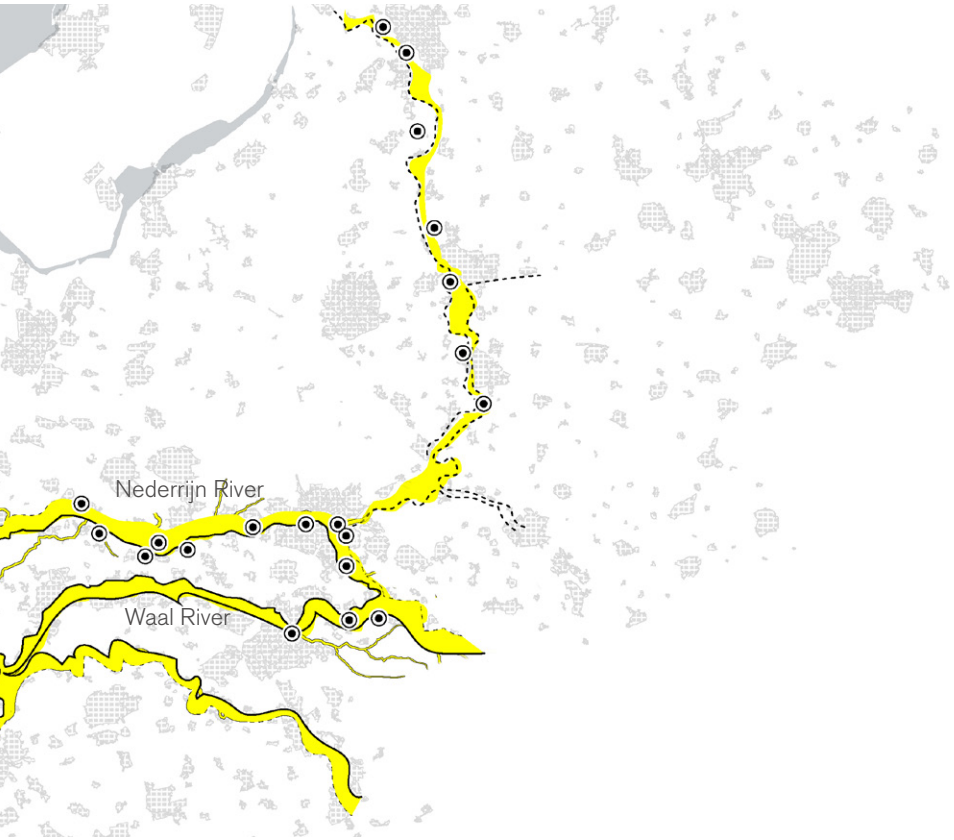


Figure A19.
Evolution of the Dutch Riverplain area
Elaborated by the author
Source: Adapted from Hooimeijer (2018)

Learning from Room for the River

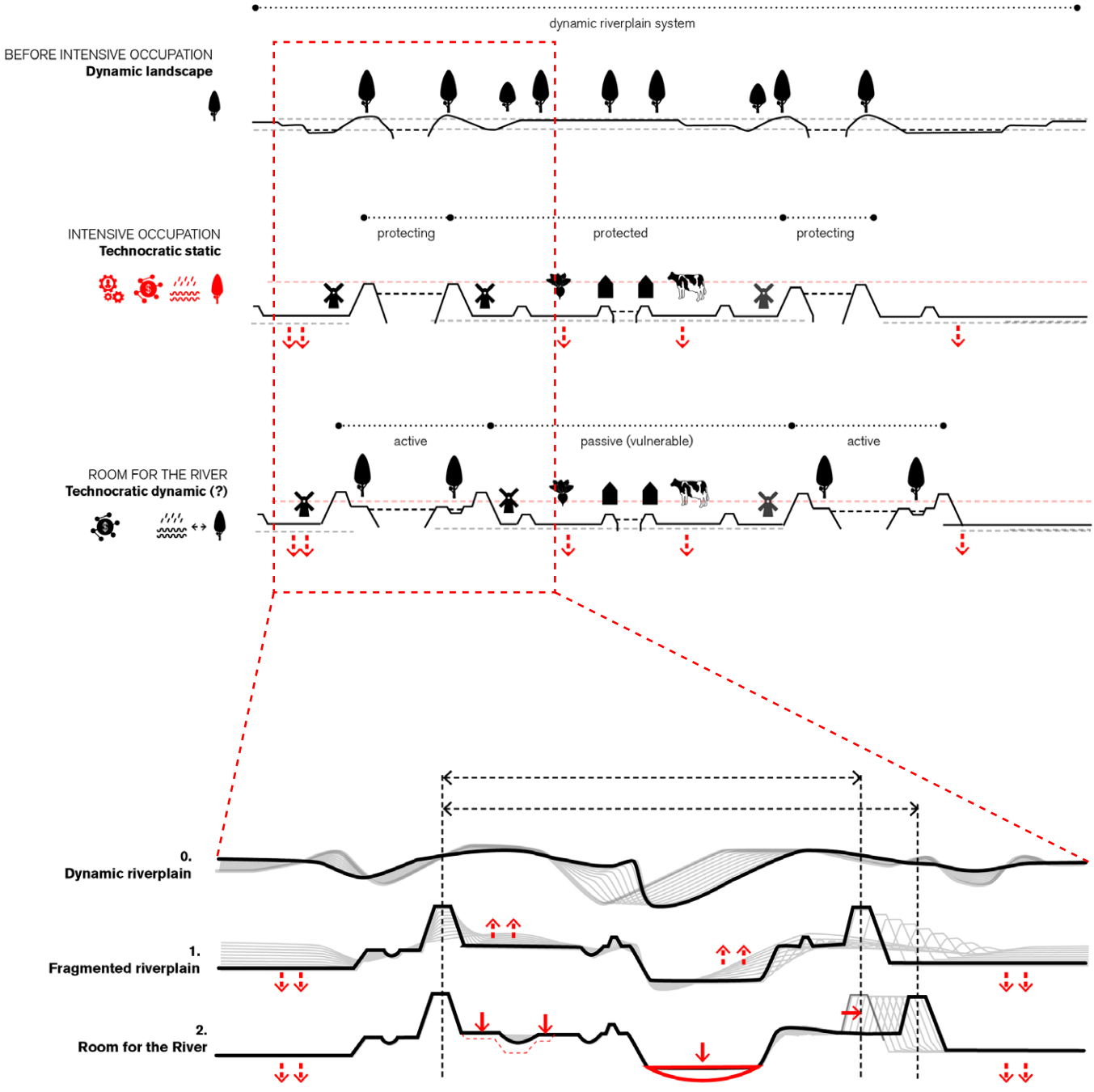
The paradigm change that RfR proposes can be reflected in the diagram on the right, where from a technocratic static system implemented to control the dynamic landscape characterising the Dutch Delta, a technocratic dynamic system is proposed by giving more space for the river, while restoring the riparian ecosystem and improving the spatial qualities of the affected areas.

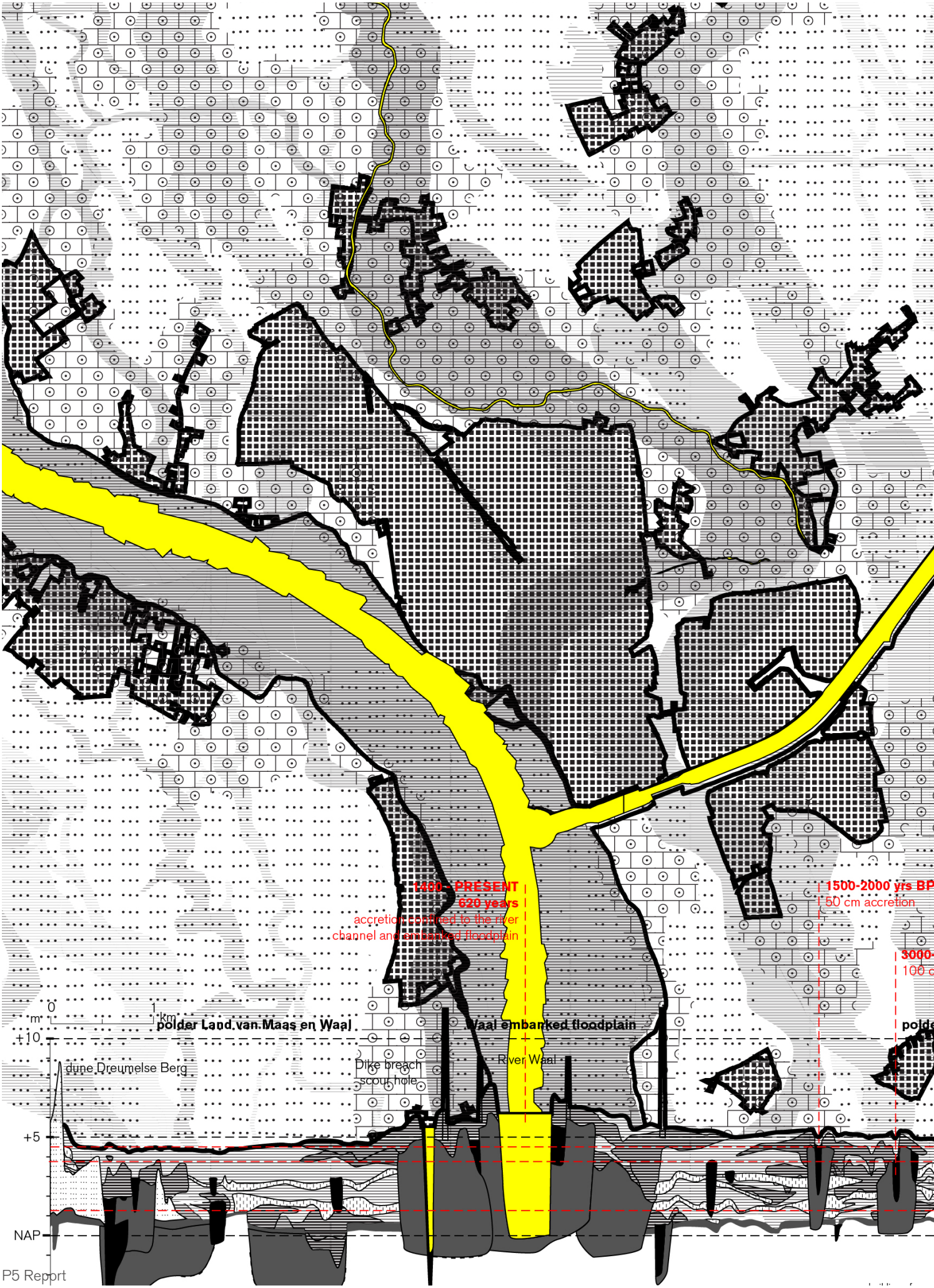
By the integration of water management and spatial planning into one program, RfR delivers a new way to deal with flood risk where 9 different types of measures are locally implemented in relation with the spatial quality of 34 projects. These strategies, aiming not only at reducing probability and consequences of floods but also improving local and regional spatial qualities (Busscher, 2019) are: lowering floodplains, lowering groynes, dyke relocation, removing obstacles, depoldering, water storage, deepening summer bed, high water channel and dyke reinforcement (figure A19).

The project also succeeds in integrating a multi-sectorial range of actors, from national, to local actors in a project that is conceived nationally, supported by Europe and implemented at a municipal level, where local opportunities for the development and regeneration of areas are seized.

It is a national and cross-national mitigation strategy that integrates the reactive capacity of multiple systems and connects with local adaptation strategies.

By the integration of water management and spatial planning into one program, RfR delivers a new way to deal with flood risk where 9 different types of measures are locally implemented in relation with the spatial quality of 34 projects.


dynamic riverplain system
BEFORE INTENSIVE OCCUPATION
Dynamic landscape
INTENSIVE OCCUPATION
Technocratic static
protecting
protected
protecting
ROOM FOR THE RIVER
Technocratic dynamic (?)
active
passive (vulnerable)
active
0.
Dynamic riverplain
1.
Fragmented riverplain
2.
Room for the River


1480- PRESENT
620 years
accretion confined to the river
channel and embanked floodplain
1500-2000 yrs BP
50 cm accretion
3000-
100 c
0
1 km
m
polder Land van Maas en Waal
Waal embanked floodplain
polde
+10
dune Dreumelse Berg
Dike breach
scour hole
River Waal
+5
NAP

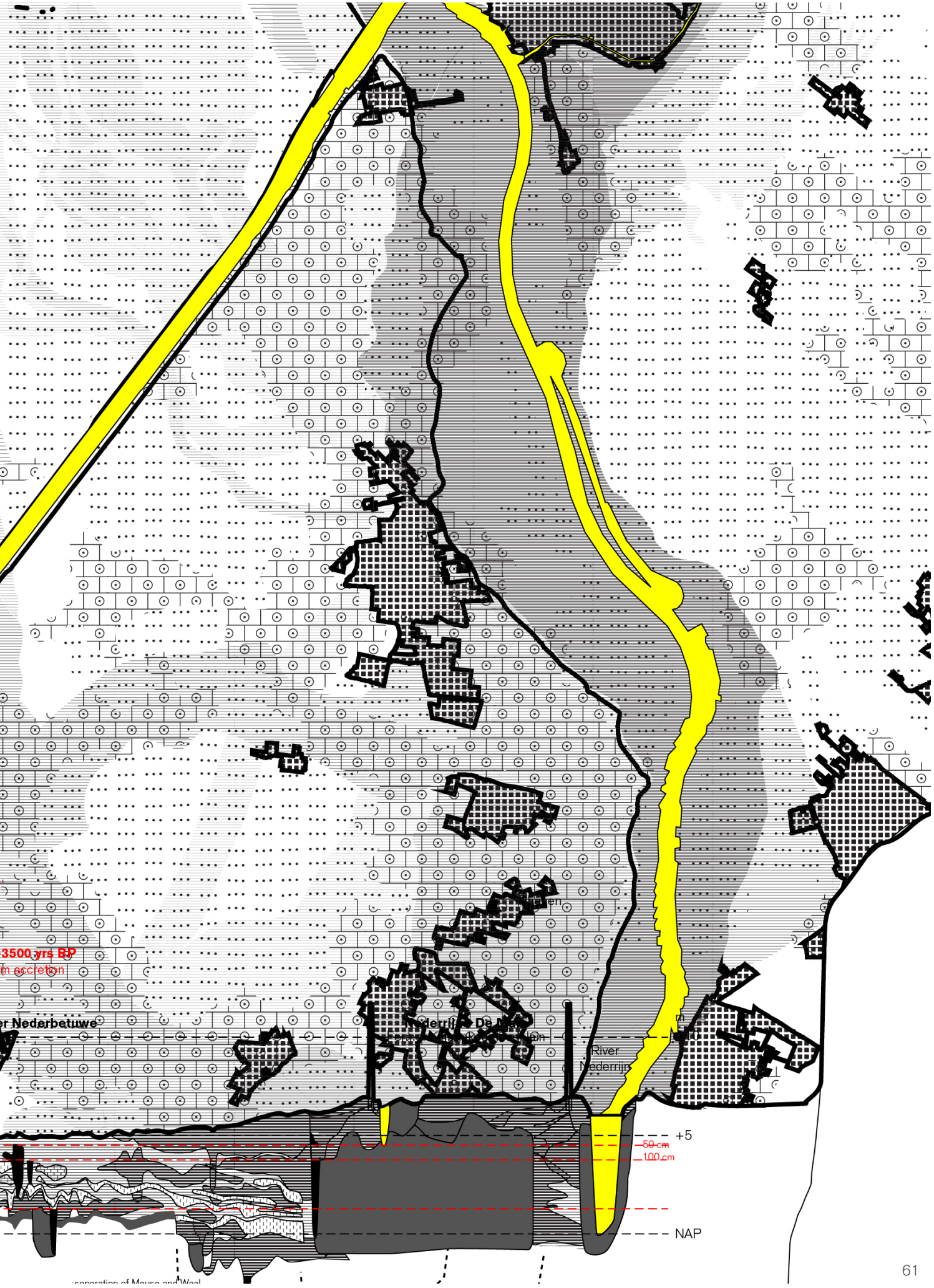

3500 yrs BP
n accretion
r Nederbetuwe
River
Nederrijn
+5
50 cm
100 cm
NAP

Figure A20 (previous page).
Geological analysis. Collage in the horizontal and vertical dimension
Elaborated by author
Source: Adapted from Cohen (2003)

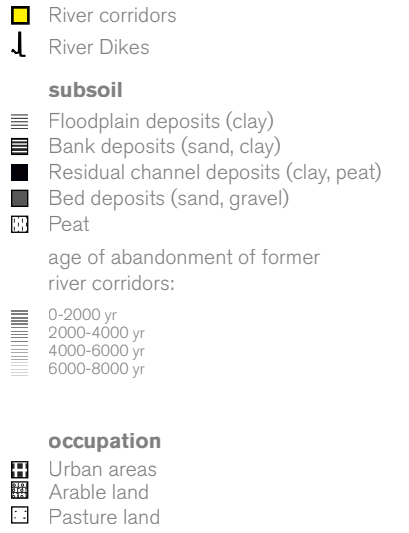
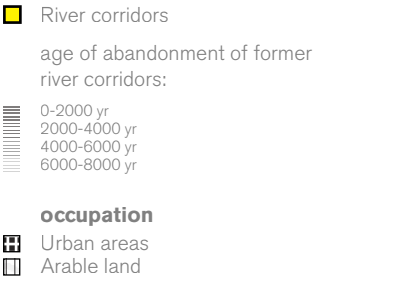


Figure A21
Landscape fragmentation between protected and protecting areas
Elaborated by the author



Limitations. Moving beyond RfR scope and scale

However, with a critical eye, we can realize how this approach keeps maintaining and feeding the duality of protected and protecting areas, where occupation is deprived from an active role in flood adaptation and ecosystem restoration.

The very establishment of this duality -by the physical and mental separation between protected/safe areas and protecting/active areas- no only sets the basis for vulnerability -functioning again under certain levels of discharge and keeping culture away from adaptation- but also keeps unsolved the problem of a fragmented landscape -inside and outside dykes- leading to the degradation of the delta ecosystem.

As seen in the geological section (page 57), a former migratory river landscape is revealed, where -at different heights from the surface- the vestiges of old water channels remain visible as accumulations of coarser material. A condition that, despite the fact of having been hidden, define the character of the occupation above, where the intrinsic relation between former floodplains and productive corridors questions the current separation, scope and definition of floodplains.

The study of the area, through geology, literature review and design thinking highlights the limitations of the approach taken by the RfR program in the following:

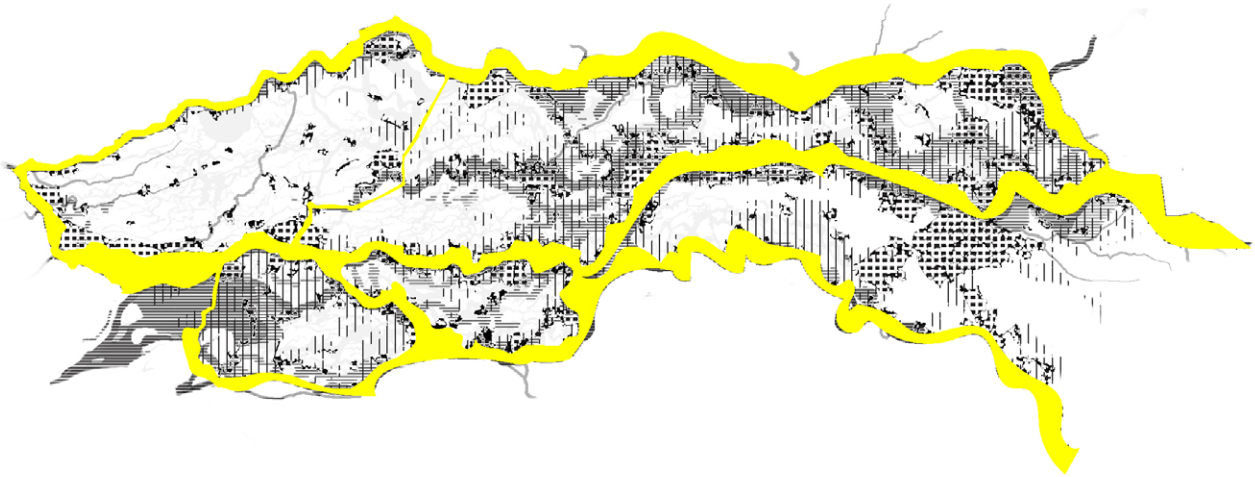
- The maintenance of accretion levels delivered by the naturalization of floodplains poses a conflict between hydraulic engineers and ecologists that is yet unsolved.

- The project does not include cultural adaptation because in fact it does not consider the transformation of occupied areas (protected and passive areas).

- The approach is still based on the definition of vulnerable areas, and therefore it is still based on a control worldview and a design maximized for a given extreme condition.

- There is a lack of definition of the role that occupation and productivity can play in flood risk management within a symbiotic framework with nature.

Under changing predictions and scenarios, it is the moment to truly embrace uncertainty through new forms of occupation and production aligned with the natural processes and events, through enhanced connectivity that upscales the scope of flood adaptation and ecosystem restoration by downscaling the interventions.



A4. Problem statement

Addressing the knowledge gap

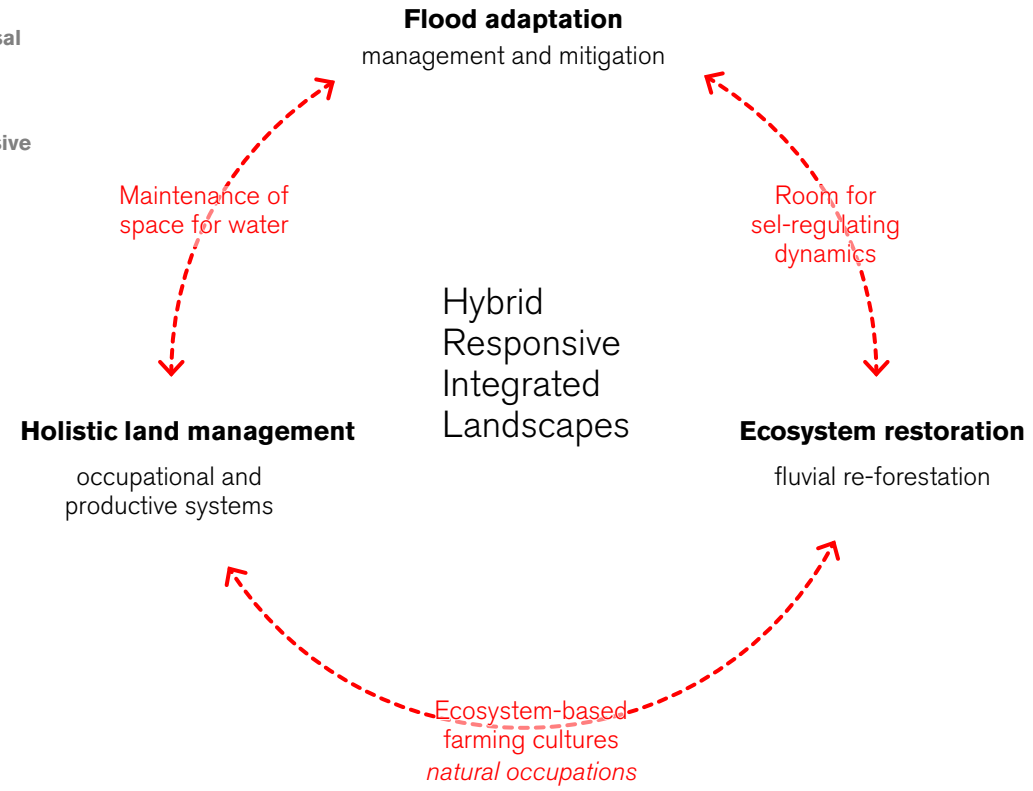
Coming from a traditional approach -rooted within the scientific positivism- planning and design of the Rivierenland territory is still based on a control approach to environmental processes and dynamics leading to unsolved vulnerability to climate uncertainty.

Having already shifted the narratives towards an adaptive planning, there is still the need to:

- **go beyond the traditional operational and physical separation between protected and protecting areas and beyond the physical separation from the ground that support us, that perpetrates a model based on vulnerability**
- **to re- consider the role that occupation and productive systems can play to trigger a cultural, operative and physical adaptation to changing conditions.**

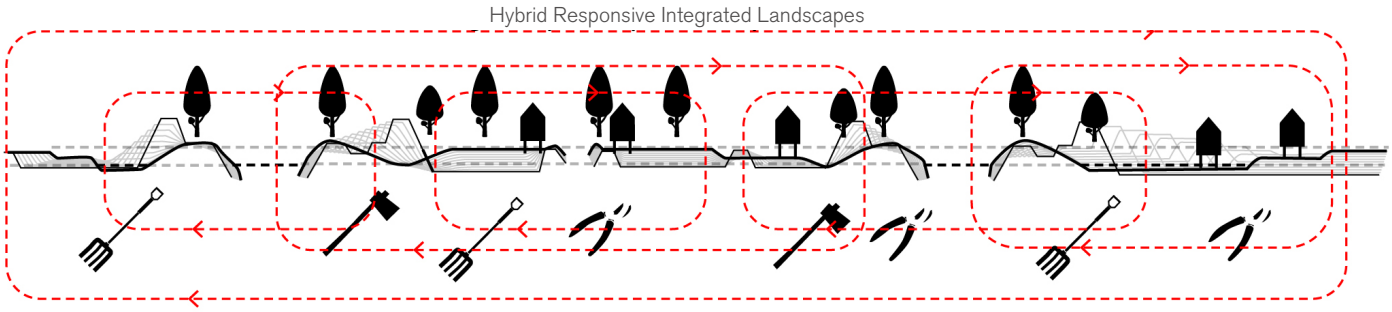
Figure A22
Conceptual framework of the proposal
Elaborated by the author

Figure A23
Concept diagram on Hybrid Responsive Integrated Landscapes
Elaborated by the author



In light of climatic extremes

What if *we went beyond the operational and physical separation and instead we enhanced a radical connectivity where the entire urbanized river landscape could perform an active role in flood adaptation and ecosyste restoration*?



A6. Hypothesis

The capacity of the Dutch Rivierenland territory to adapt to environmental uncertainy comes from the re-design / re-conceptualization of

the notion of hybridity that restores holistic approaches within urban and peri-urban systems by synchronizing flood risk management, ecosystem restoration, production, inhabitation, recreation

H **symbiotic relations between urban systems and the ecology in which they are embedded by reconnecting occupational and productive systems with flood risk management and ecosystem restoration**

H1 (operational connectivity) a multisystemic and multiscalar *fractal* network that gives the local scales the capacity to expand or contract according to changing conditions

H2 (physical connectivity with ground) occupational and productive forms of engagement with soil performance and water cycle as a tool to re-appropiate and re-connect with the processes of change

A7. Research questions

By researching on the specific case of the Rivierenland territory, the thesis informs the ex-ante positioning by reflecting in the following meta-questions:

How can the notion of uncertainty be introduced in the design and planning of urban environments in order to construct an evolutionary adaptation and mitigation to Climate Change?

How can the urban project trigger a cultural and geographical re-connection between human and natural spheres?

How to design and plan responsive urban environments to uncertain and extreme climatic conditions in the context of the Rivierenland watershed?

- How can land management/productive systems play a role in the restoration of symbiotic relations between human and environmental systems?
- What role can land management/productive systems play in flood risk management and ecosystem restoration?
- How can the notion of hybridity restore holistic approaches within urban systems by synchronizing flood risk management, ecosystem restoration, production, inhabitation, recreation?

H1 How can the notion of (operational) connectivity design a multisystemic and multiscalar network that gives the local scales the capacity to expand or contract according to changing conditions?

H2 How can the notion of (physical) connectivity design new forms of engagement with the soil performance and water cycle as a tool to re-appropiate and re-connect with the processes of change?

B

Methodology

B1. Research approach and philosophy
B2. Theoretical framework
B3. Conceptual framework
B4. Analytical & design framework
B5. Methods
B6. Overall methodology

B1. Research approach and philosophy

The thesis is carried out by means of a research by design approach. Given the complexity and extensiveness of research done within the particular territory, the Dutch River plain, this approach helps on the one side establish a dialogue between problem and solution, while opening the research to inspiring readings of the territory (Nijhuis, 2016). In other words, design is used as a vehicle to make wicked problems visual and spatial, exploring possibilities and generating solutions, and consists on the systematic exploration of multiple scales and dimensions of the territory: horizontal, vertical and temporal.

The overarching research philosophy guiding my thesis is phenomenological -humanistic and interpretative- as it prioritizes how we see over what we see. As learned with Calabrese (2019), phenomenological planning may involve seeing a house not as a "merely technological construction, but dwelling; not merely homogeneous and mathematized space, but place; not merely planetary raw material, but environment" (Seamon and Mugerauer, 2000, p.1-2). In contrast with the positivist philosophy in research, the phenomenological philosophy stresses the subjectivity of knowledge about the world.

For this reason, inspired by a relational thinking while collecting empirical data (quantitative approach), a design thinking approach à la Corner, will overlap different layers of complexity to de-codify hidden relations, qualities, and opportunities (qualitative approach).

Taking a theoretical and conceptual position on the understanding of territoriality from the point of view of the positivist philosophy, an ex-ante positioning, the research will take an exploratory approach. In order to test the established relations, I will take the exceptional research case of the Netherlands, learning from the extreme and informing the general theoretical position (figure B1).

Analytical research will be used to explain why and how the phenomena of de-territorialization in the Netherlands is happening through the lenses of water management. For this reason, the research will locate and identify the different factors and variables involved. Predictive research will be used to create scenarios and speculate on future possibilities. On a broader sense, the exploratory research is at the base of the thesis project, understanding it as a research case that will form the basis for further research on the broader context of Deltas and urbanized sensitive territories (figure B1).

Phenomenological planning may involve seeing a house not as a "merely technological construction, but dwelling; not merely homogeneous and mathematized space, but place; not merely planetary raw material, but environment"

(Seamon and Mugerauer, 2000, p.1-2)

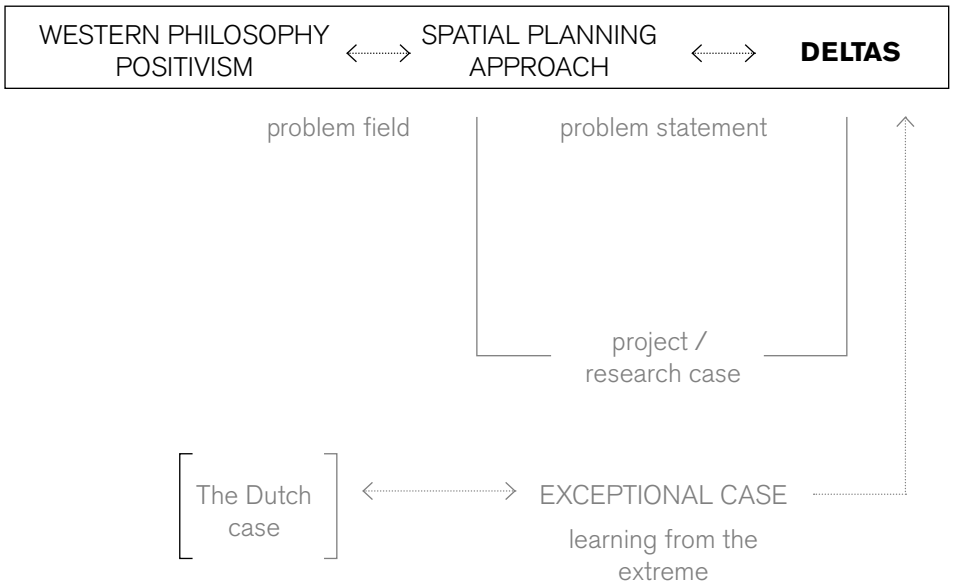
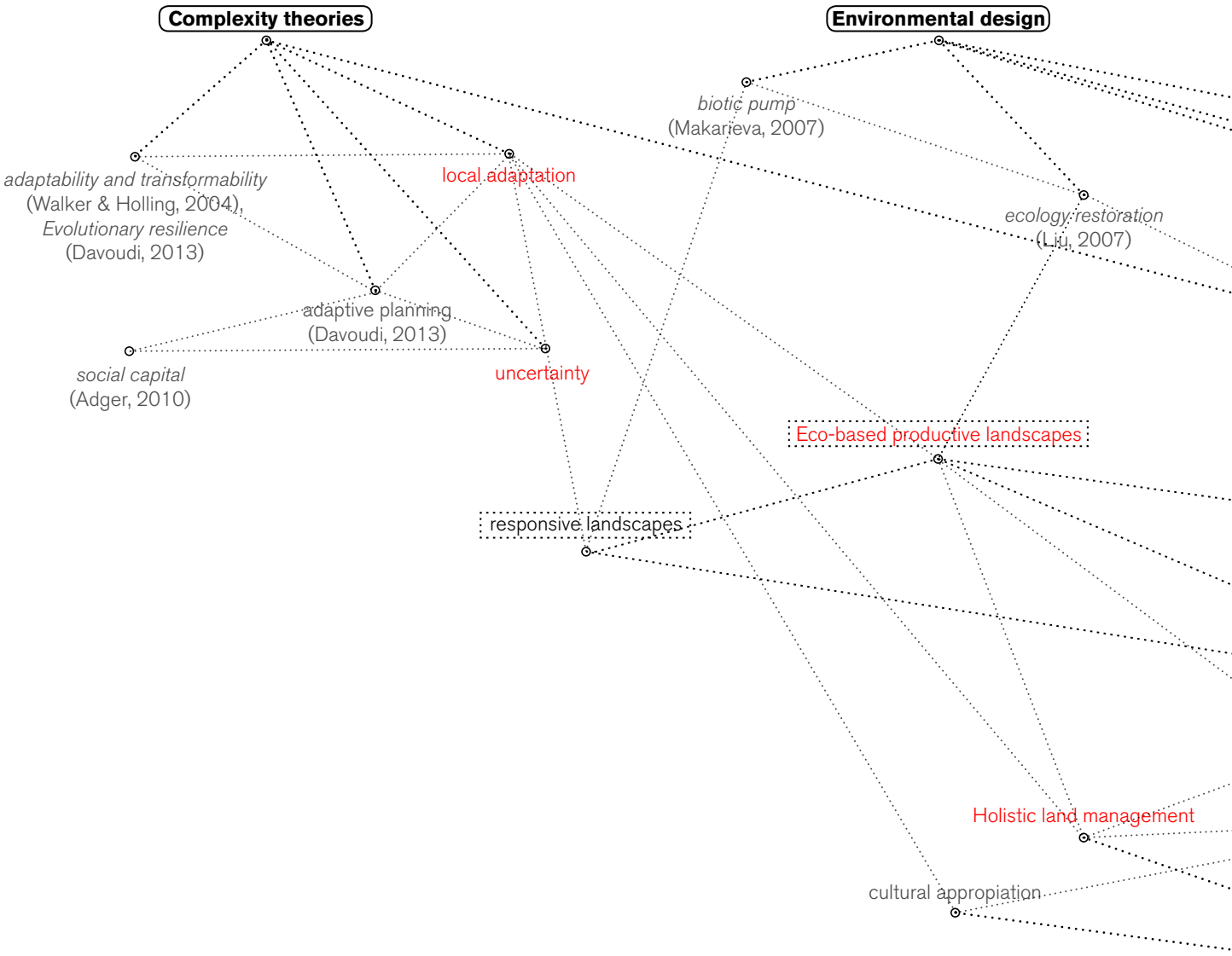


Figure B1.
Positioning of the project
The project is positioned under the premise of a positivist world-view, having an influence on spatial planning and design which is undermining the performance of ecologically delicate and intensively urbanized areas, such as Deltas. The project takes a exceptional case, the Dutch case in order to learn from extreme contradictions that can inform the performance of other Deltas and delicate and Urbanized Deltas.
Elaborated by the author

B2. Theoretical framework



The theoretical framework is formed by the main bodies of knowledge, related theories and concepts that compose the theoretical foundation of the thesis.
The framework might as well be represented as a constellation of hierarchies, a web of relations that connect everything at different levels and intensities, but where there is no begginning or end.

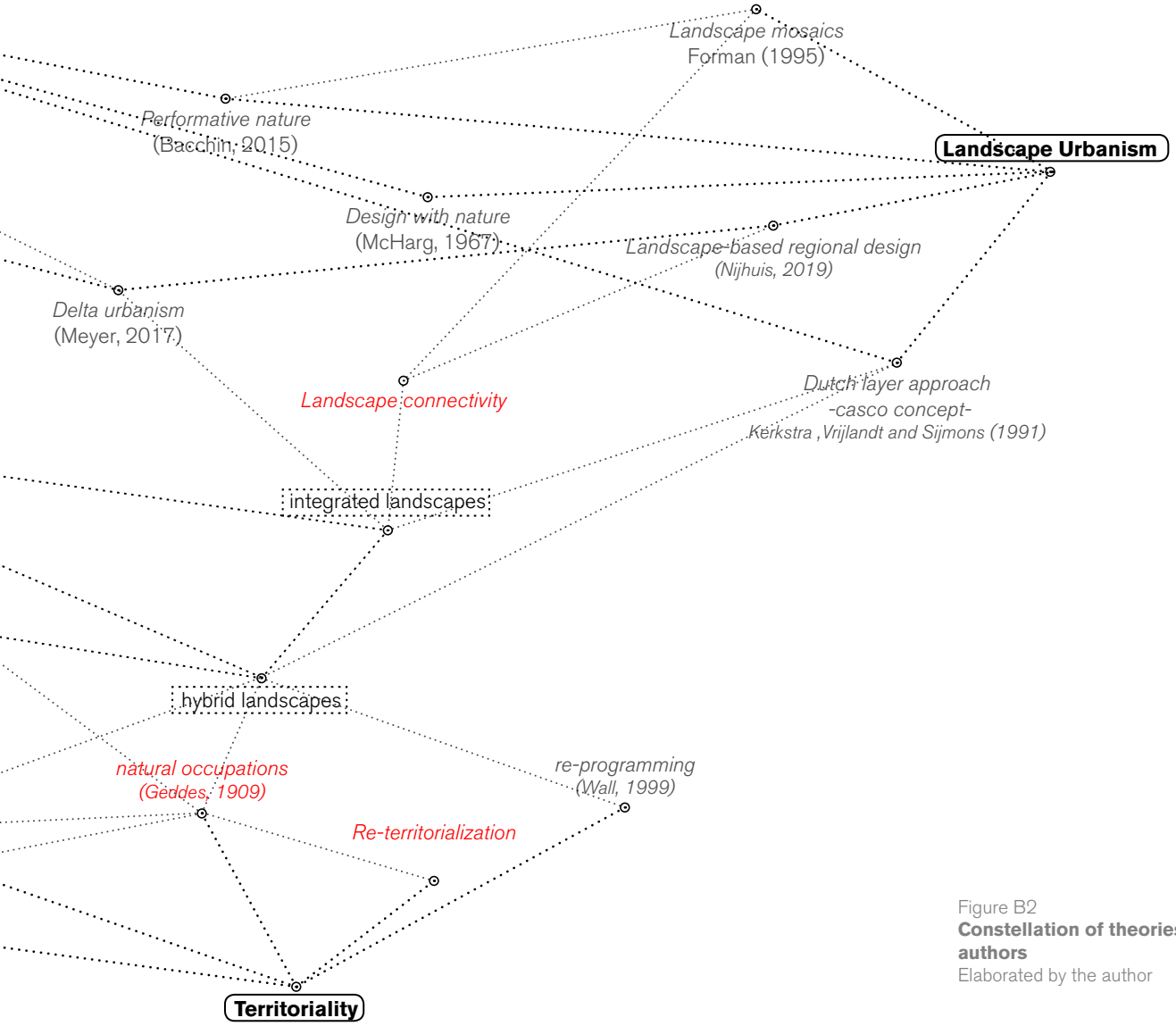


Figure B2
Constellation of theories, concepts and authors
Elaborated by the author

Points of gravety
how to read the theory constellation

The theoretical framework is formed by the main bodies of knowledge, related theories, authors and concepts that compose the theoretical foundation of the thesis. As a constellation of hierarchies where there is no begginning or end, the thesis has multiple (and interconnected) starting points.

From the point of view of bodies of knowledge:

- Complexity theories
From the mathematical world, complexity theories have been translated into the understanding of the interconnected and adaptable behaviour of Socio-Ecological Systems (Davoudi, 2013). This theories have been appropiated within the narratives of Landscape Urbanism where the urban landscape is described as a complex system composed of subsystems where each of them have their own dynamics and speed of change (Meyer & Nijhuis, 2013); but also within Adaptive Planning narratives as the ground from which embracing uncertainty. In this sense, local adaptation to change is explained through adaptability and transformability characteristics of SE systems.

This body of knowledge grounds the adaptable capacity of SE systems to embrace uncertain (climatic and socio-economic) change.

- Environmental Design
From the point of view of the understanding of biophysical systems and the necessity to connect these with urban systems, Environmental design is another point of entry of the thesis. Under this framework, theories on ecology restoration (Liu, 2007) but also concepts such as the biotic pump (Makarieva, 2007) converge to inform the necessity to design and plan not only with land uses but to conceive land / soil / and water as dynamic and interlinked entities that should be planned and designed synergistically.

- Landscape Urbanism
The body of knowledge of Landscape Urbanism builds upon Complexity Theories and Environmental Design. This is how authors such as Bacchin (2015), Nijhuis (2019), Forman (1995), Kerkstra and Vrijlandt (1990, 1991) and Sijmons (1991), Meyer (2017) and McHarg (1967) are in this thesis used as references for design thinking and sources of endless knowledge on: *performative natures, landscape-based regional design, land mosaics, caso concept, delta urbanism, designing with nature* (in order).

- Territoriality
Theories on territoriality, defined by Raffestin (2012) as “a spatial strategy to affect, influence or control resources and people, by controlling area” (Sack, 1986, p.1 in Raffestin 2012, p. 126) connect everything together and alignes the narrative with

the ex-ante framework.

This entry point links Environmental Design with the act of territoriality through the *natural occupations* notion of Geddes (1915), holistic land management and cultural appropiation of the land, all of which place a key role on *social capital* (Adger, 2010) and local adaptation through eco-based productive landscapes.

Another way of constructing the narrative on the theoretical underpinning of the thesis is by using the key words (in red). This words, mostly concepts, are the ones that I have used the most throughout the conceptualization and definition of the thesis: re-territorialization (Deleuze and Guattari), re-program (Wall, 1999), natural occupations (Geddes, 1909), holistic land management, local adaptation and cultural appropriation. Some specific concepts, like the casco-concept (Kerkstra and Vrijlandt 1990, and Sijmons,1991) acquire specific relevance in the development of some parts of the thesis, where they will be further developed.

Finally from the point of view of the theories composing the properties characterising and defining the landscape proposed by the thesis, the thesis can be explained through the notions of: responsive, eco-base and productive, integrated and hybrid landscape

The thesis has multiple (and interconnected) starting points, different points of gravety around which starting the narrative. In this way it aims at being able to be transmitted to different audiencies.

Figure B3
Conceptual framework of the proposal
Elaborated by the author

B3. Conceptual framework

The conceptual framework synthesizes the concepts and variables that define the main conceptual approach of my proposal: a multisystemic strategy consisting on flood adaptation, ecosystem restoration and land management that establishes symbiotic relations between occupation and nature. These concepts and the interrelations among them respond directly to the specific definition of the problem statement and hypothesis for the Rivierenland urban region (figure B3).

Flood adaptation & Ecosystem restoration
self-regulation
The interrelation flood adaptation and ecosystem restoration comes directly from Room for the River research and project in which the self-regulating capacity of the floodplain ecosystem mitigates the effects of floods and reduces its frequency

Ecosystem restoration & Holistic land management
ecosystem-based production
The introduction of holistic land management locates the responsability, but also the benefits of maintaining and delivering ecosystem restoration, in the local scales. The term holistic relates to the idea of hybridization and the synergistic benefits coming from it.

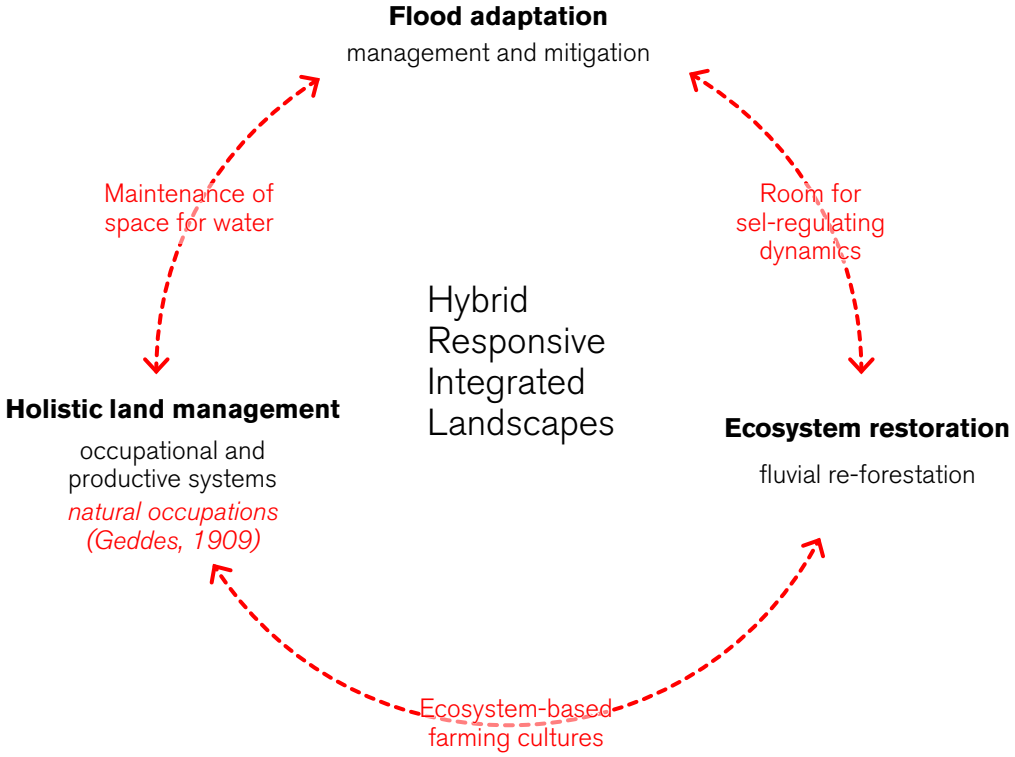
Holistic land management & Flood adaptation
maintenance regimes
The introduction of holistic land management locates the responsibility, but also the benefits of maintaining the buffer capacity of the territory, in the local scales. In this case, holistic land management adopts a second role in the maintenance of space for water key for the success of flood risk management.

The key role of land management
The association of land management into the equation *flood adaptation - ecosystem restoration* proposed by Room for the River, allows for the maintenance of space for water through ecosystem-based production. With this logic, the primary industry adopts another dimension, by giving it regional and national values related to the local implementation and maintenance of flood risk management and ecosystem restoration.

As a concept, the idea of relating the management and occupation of a territory with the geographical-geophysical contexts gets inspiration from the concept of “natural occupations” by Geddes (1909) in his proposal of the Valley Section. In the Dutch river-plain, an harmonious synchronization of occupations follow one another in time as different conditions arise. Exposure to river dynamics, type of soil and intensity of occupation define different intensities of “natural occupations” that are evolutionary (changing in time).

Re-territorialization, defined as the process of re-connecting (re-synchronizing) symbiotic relations between culture and nature crystallises as a collective management of the territory, where endogenous productive activities are aligned in time and space with natural dynamics, and where natural dynamics are adapted into the Delta culture.

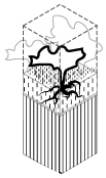
Re-territorialization as the process of re-connecting (re-synchronizing) symbiotic relations between culture and nature crystallices as a collective management of the territory, where endogenous productive activities are aligned in time and space with natural dynamics, and where natural dynamics are adapted into the Delta culture. In this sense the conceptual framework enables a multisystemic strategy consisting on flood adaptation, ecosystem restoration and land management.

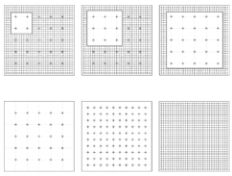


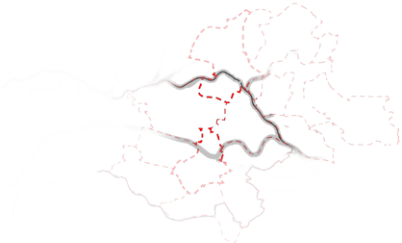
B4. Analytical and Design framework

Transcalar design

Figure B4.
Analysis and design scales
Elaborated by the author







Transcalar design frames the analysis and design of the project. Both in space and time, each spatial-temporal scale will look into different levels of relations, actors, and possibilities for the re-programing of the Dutch Delta. The knowledge gained from *Land Mosaics* by Richard Forman (1995) will be used to define a lexicon that defines the urban landscape into spatial and temporal units.

PROCESS SCALE:

This scale belongs to the biogeochemical cycles occurring through the vertical section: atmosphere, soil and water. It is the engineering scale, where the optimal design of the soil is drawn.
Boundary/unit - The boundary corresponds to an ecological unit. By using the vertical section, the unit relates land surface, top soil, water level and subsoil. It defines the three-dimensional unit of measure, design and planning of the project, the unit in which the territory is to be comprehended.
Design scale - At a process level, the vision defines how specific ways to engage with soil and water leads to more synergistic forms of occupation and production.

NANO SCALE:

This scale belongs to units of land uses and land ownership.
Boundary/unit - The boundary corresponds to the plot, which spatial unit of measure, analysis and designs is the hectare.
The temporal unit corresponds with 20 years, which is the average amount of time for a forest to develop.
Detail scale - This scale details the gradients of transformation per land use and functional layer -blue and green corridor and productive wetland.

MICRO SCALE:

This scale corresponds to De Buiten Park
Boundary/unit - The boundaries at this scale correspond to the land use
Implementation scale - The gradients of transformation are implemented according to the spatial morphology of the Park.

MESO SCALE:

This scale is defined by the city region (Arnhem-Nijmegen city region) in between the Nederrijn and Waal rivers, as a representative transect informing the detailing and implementation of the vision.
Boundary/unit - The municipalities composing the city region Arnehm Nijmegen and the municipalities wihin the biophysical borders corresponding the Nederriijn and Waal rivers.
Detail and implementation scale - In this scale the detailing of the vision is translated into the definition of the elements of design, which are then used to explore the implementation according to the behaviour of the river dishcarge and the intensity of transformation.

Ⓓ

PROCESS SCALE (1m³)
Soil section

Ⓐ

NANO SCALE (1Ha)
unit of land use

Ⓐ

MICRO SCALE (10 x 10 km)
De Buiten Park

····· fields
—— flood streams

Ⓐ

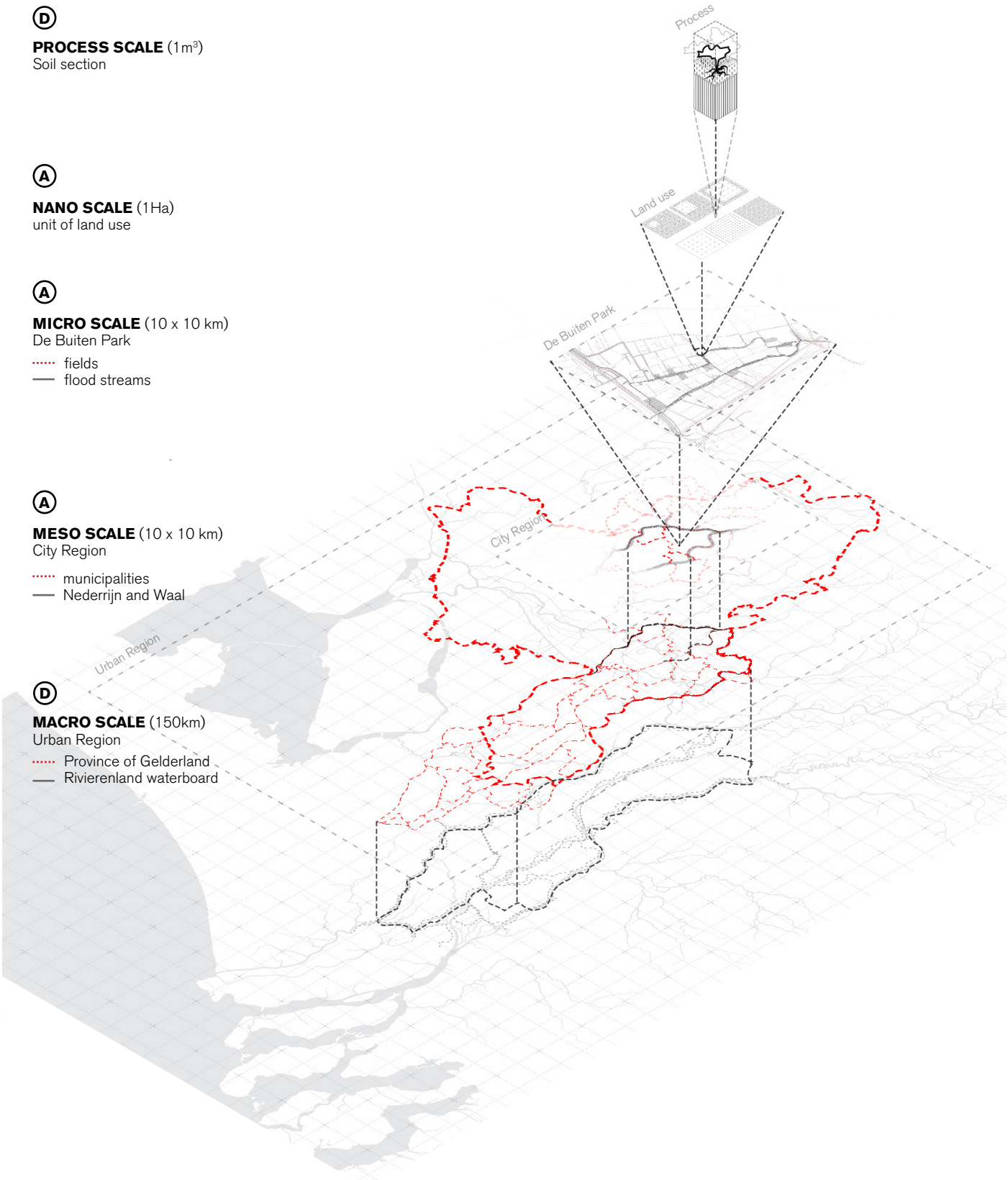
MESO SCALE (10 x 10 km)
City Region

····· municipalities
—— Nederrijn and Waal

Ⓓ

MACRO SCALE (150km)
Urban Region

····· Province of Gelderland
—— Rivierenland waterboard



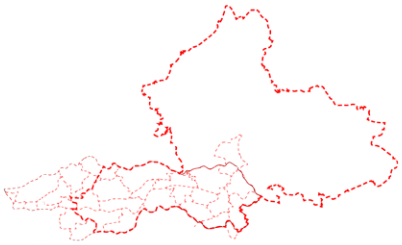


Figure B5.
Design dimensions
Elaborated by the author

MACRO:

This scale corresponds to the urban region level, defined by the Rivierenland waterboard, which can be assimilated to the watershed.
Boundary/unit - Two non-coinciding boundaries overlap in this scale, the geophysical (watershed or primary dikes) and the administrative (provinces). The re-programming at this level is informed / constrained / appropiate by the plans and policies concerning the province, the municipalities, and the waterboard.
The spatial unit at this scale is given by Forman (1995) when defining a radious of 150km in which ecology exerts its influence.
The temporal unit is defined by the socio-economical and climatic trends, therefore a period of 100 years.
Design scale - At a regional level (Rivirenland watershed), the vision provides with a framework based on how the substratum defines levels of dynamism that expand the scope of the riverscape, where flood risk and ecosystem restoration gain a new perspective on design and management (landscape-based regional design, Nijhuis, 2019)

Design dimensions

The design is articulated in three dimensions: horizontal, vertical and transversal (time).

Horizontal dimension: or plan, provides with the framework to plan transformations by the superimposition of layers with different levels of dynamism. This dimension is used as a tool to research and design the vision at the macro level but also to detail the vision into design elements (meso scale) and to implement it through different degrees of transformation.

Vertical dimension: or section, provides with the understanding of interrelations between elements corresponding to different levels of dynamism (layers), being geological, ecological, occupational, socio-economical and political. For this reason, the vertical dimension is used throughout the different scales as a tool to read and as a tool to design territory/region/city/process.

Transversal dimension: or time, provides with the functioning, change and performance of the proposal from the point of view of reading of the territory, design and implementation in order to read, design and plan the synchronization between urban and biophysical systems:
-Design-wise: It applies to the horizontal dimension of the territory by setting the full transition of transformation gradients/transformation pathways and to the vertical dimension providing an understanding of immaterial and hidden flows.
-Reading wise: through a diachronic analysis
-Planning-wise: among the different actors in time, but also in the setting of re-programming phases (short, medium, long term)

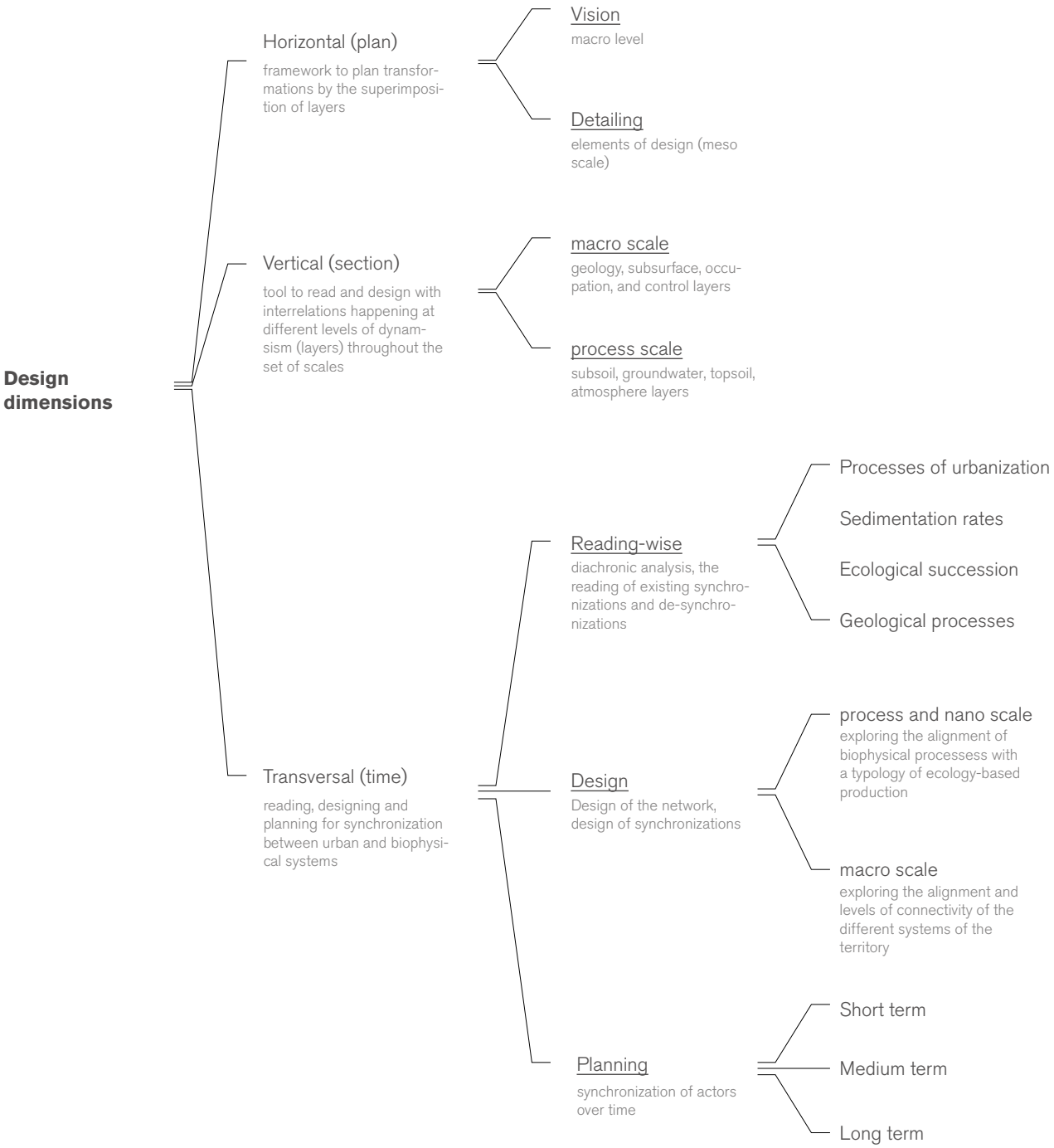

Design dimensions
Horizontal (plan)
framework to plan transformations by the superimposition of layers
Vision
macro level
Detailing
elements of design (meso scale)
Vertical (section)
tool to read and design with interrelations happening at different levels of dynamsism (layers) throughout the set of scales
macro scale
geology, subsurface, occupation, and control layers
process scale
subsoil, groundwater, topsoil, atmosphere layers
Transversal (time)
reading, designing and planning for synchronization between urban and biophysical systems
Reading-wise
diachronic analysis, the reading of existing synchronizations and de-synchronizations
Processes of urbanization
Sedimentation rates
Ecological succession
Geological processes
Design
Design of the network, design of synchronizations
process and nano scale
exploring the alignment of biophysical processess with a typology of ecology-based production
macro scale
exploring the alignment and levels of connectivity of the different systems of the territory
Planning
synchronization of actors over time
Short term
Medium term
Long term

Figure B6.
Designing with uncertainty
Elaborated by the author

Designing with uncertainty

The second overlaying element of the underpinning of the thesis will be the exploration of designing and planning with climatic (fluctuating river dishcarges) and socio-economic uncertainty. From the use of scenarios in the macro scale, to the search for open-ended operations on the nano scale.

Nano scale: "Transformation pathways"

At the nano scale, corresponding with a unit of land use and ownership, a gradient of possible transformations is given according to two axes:
- Ecological intensity or degree of vegetation intensity per land use
- Buffer capacity or degree of possible allocation of river discharge per patch size
These gradients are presented as transformation pathways leaving open the transformation intensity and type to the local landowners

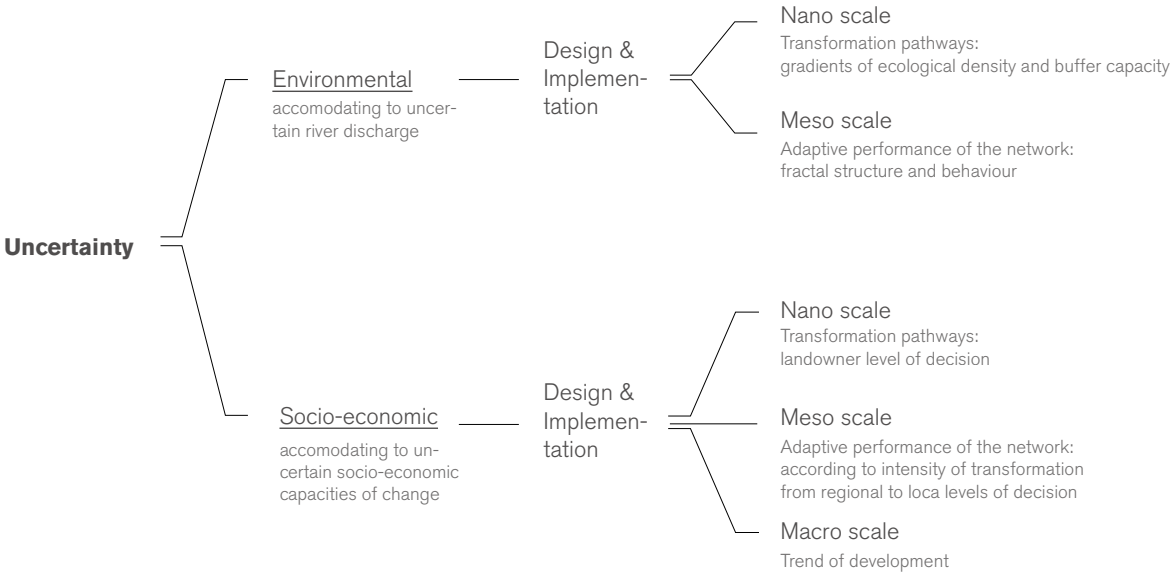
Meso scale: "Adaptive performance"

At a meso scale and corresponding with the city-region, the adaptive performance of the proposed network is explored where according to river discharge (climatic uncertainty) and intensity of transformation (socio-economic uncertainty), the interplay of layers and the expansion and contraction of the network to changing conditions is shown.

Macro scale: "Trend of development"

Taking the research conducted by the Delta Programme Commissioner, the vision at the macro scale is subjected to the drivers of change: Climate Change and Socio-economic trends. The understanding of the trends results in the proposition of 4 different matrix deviations according to the level of transformation provided by the trends:

- BUSY (slow climate change and high socio-economic growth): the level of transformation will be constrained to the ecological corridors (river canals).
- STEAM (fast climate change and high socio-economic growth): the level of transformation is strongly constrained or impeded.
- REST (slow climate change and low socio-economic growth): the level of transformation is the highest and driven by conscious decisions of the citizens (individual synchronization).
- WARM (fast climate change and low socio-economic growth): the level of transformation is high. It is mainly driven by the natural disturbance of climate change which might lead to the impedance or slow development of share (commons, safety, actors, appropriation)


Uncertainty
Environmental
accomodating to uncer-
tain river discharge
Design &
Implemen-
tation
Nano scale
Transformation pathways:
gradients of ecological density and buffer capacity
Meso scale
Adaptive performance of the network:
fractal structure and behaviour
Socio-economic
accomodating to un-
certain socio-economic
capacities of change
Design &
Implemen-
tation
Nano scale
Transformation pathways:
landowner level of decision
Meso scale
Adaptive performance of the network:
according to intensity of transformation
from regional to loca levels of decision
Macro scale
Trend of development

B5. Timing and Methods

Figure B7.
Phases and methods
Elaborated by the author

The diagram on the left shows the non-linearity of the time in the development of this thesis, where the phases structuring the research do not necessarily correspond to "P" moments (moments of examination) and where the contraction and expansion of the time varies as the proposal gets more clarity in an exponential way.

On the right of the diagram the research phases -divergence, convergence&design, detail, implementation and evaluation- are presented together with the produced deliverables per phase. On the left, the main scales used to reach and convey each phase of the process. In the middle and from 1-6, the methods used to produce the work

1. Literature review

Literature review is used as a tool to develop a theoretical (deductive) underpinning that can provide with the appropiate concepts and vocabulaty of the thesis.

2. GIS mapping

In order to collect layers of digital information already existing, GIS allows for the overlapping and processing of existing data.

3. Documentary research

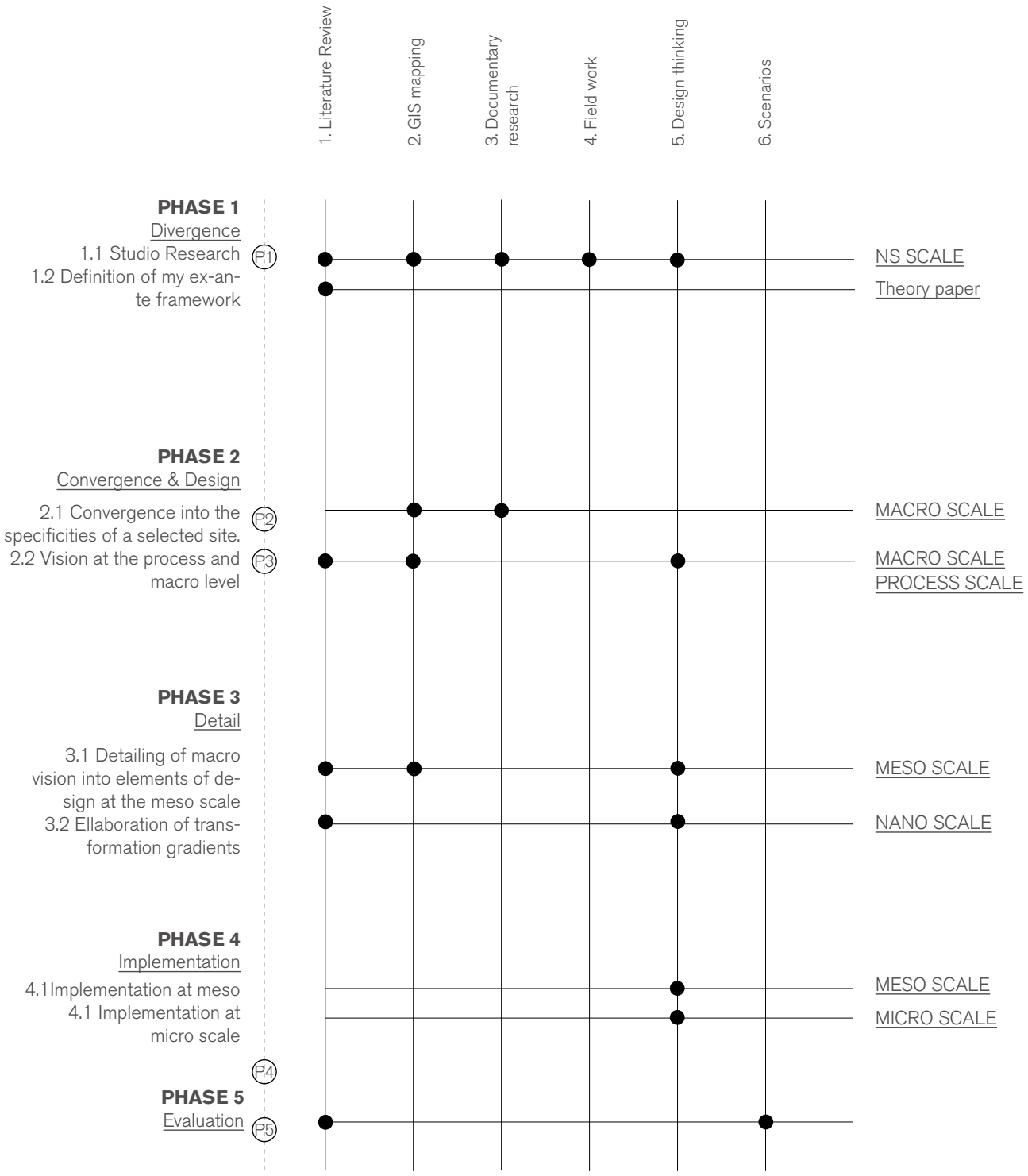
This method is used to collect quantitative data from external sources from different levels of the public sector, websites, reports, and other media to gain an understanding of *status quo* of the context (inductive), conditions and proposals.

5. Design Thinking

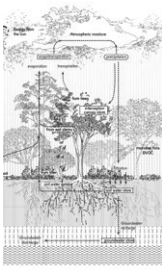
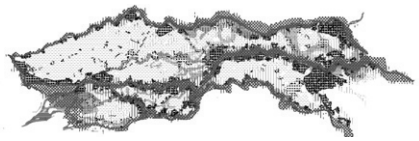
Design Thinking is an overall method or approach used throughout the phases as a tool to look into different relations and interplays between the imbroglio of layers composing the complex system.

6. Scenarios

The idea of developing scenarios as a method allows to grasp uncertainty and contingencies. This scenarios will align with the scenarios adopted by the Delta program where socio-economic growth/squeeze and moderate/rapid climate change define: busy, steam, rest and warm scenarios (Deltares, 2013).


1. Literature Review
2. GIS mapping
3. Documentary research
4. Field work
5. Design thinking
6. Scenarios
PHASE 1
Divergence
1.1 Studio Research
1.2 Definition of my ex-ante framework
P1
NS SCALE
Theory paper
PHASE 2
Convergence & Design
2.1 Convergence into the specificities of a selected site.
P2
MACRO SCALE
2.2 Vision at the process and macro level
P3
MACRO SCALE
PROCESS SCALE
PHASE 3
Detail
3.1 Detailing of macro vision into elements of design at the meso scale
MESO SCALE
3.2 Ellaboration of transformation gradients
NANO SCALE
PHASE 4
Implementation
4.1Implementation at meso
MESO SCALE
4.1 Implementation at micro scale
MICRO SCALE
P4
PHASE 5
Evaluation
P5

B6. METHODOLOGY summary

	How can the notion of (physical) connectivity design new forms of engagement with the soil performance and water cycle as a tool to re-appropiate and re-connect with the processes of change?	How can the notion of (operational) connectivity design a multisystemic and multiscalar network that gives the local scales the capacity to expand or contract according to changing conditions?
SCALE	*Design scale* **PROCESS SCALE** *About the relation with the ground*	*Design scale* **MACRO SCALE** *About the potential of the landscape*
		
LOCATION	Soil section	Rivierenland Urban region
MAIN ACTION	**Transformation:** Restoring soil/water/air exchange (water, carbon, nitrogen, phosporus, nutrient cycle) - activation of biophysical systems by re-designing the ground	**Transformation:** Upscale flood risk management and ecosystem restoration through enhanced connectivity
CONCEPTS / THEORIES	environmental design, biotic pump (Makarieva, 2007)	Casco concept (Kerkstra , Vrijlandt and Sijmons, 1990-1991), Landscape-based regional design (Nijhuis, 2019)
METHODS	Design Thinking, literature review	Design Thinking, GIS mapping, literature review

Problem statement

The Rivierenland territory is still based on a control approach to environmental processes and dynamics leading to unsolved vulnerability to climate uncertainty, where there is still the need to:
- go beyond the traditional operational and physical separation between protected and protecting areas and beyond the physical separation from the ground that support us, that perpetrates a model based on vulnerability
-to re-consider the role that occupation and productive systems can play to trigger a cultural, operative and physical adaptation to changing conditions.

Detail

Implementation per land use

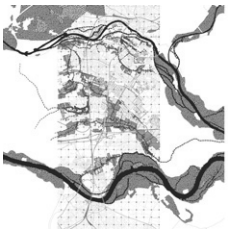
Detail (gradients)

Implementation (morphology)

Detail scale

MESO SCALE

elements of design



Arnhem-Nijmegen
City region

Detail:
- Regional water network structure
- Green network
- Urban network

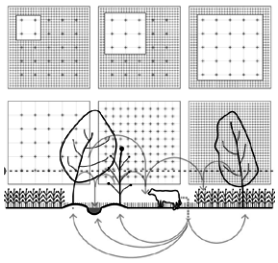
Enhanced connectivity, Hybrid-Responsive-Integrated Landscapes

GIS mapping, literature review

Detail scale

NANO SCALE

gradients of transformation: per land use



Land use

Implementation:
- Buffer capacity per patch
- Ecological density per patch

Local adaptativity, Re-programming, cultural appropiation, holistic approach to land management, natural occupations (Geddes, 1909)

literature review, design thinking

Implementation scale

MICRO SCALE

spatial morphology

De Buiten
(Lingezegen Park)

Implementation:
-Spatial morphology

GIS mapping, literature review, documentary research

How to design and plan responsive urban environments to uncertain and extreme climatic conditions in the context of the Rivierenland watershed?

How can productive systems play a role in the restoration of symbiotic relations between human and environmental systems?

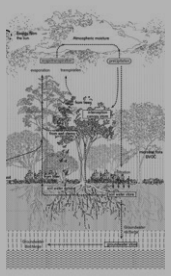
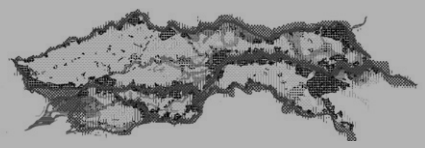
How can the notion of hybridity restore holistic approaches within urban systems by synchronizing flood risk management, ecosystem restoration, production, inhabitation, recreation?

What role can land management play in flood risk management and ecosystem restoration?

DESIGN SUMMARY
index

p. 87

p. 95

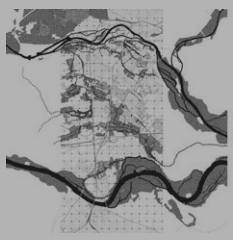
SCALE	*Design scale* **PROCESS SCALE** *About the relation with the ground*	*Design scale* **MACRO SCALE** *About the potential of the landscape*
		
LOCATION	Soil section	Rivierenland Urban region
MAIN ACTION	**Transformation:** Restoring soil/water/air exchange (water, carbon, nitrogen, phosporus, nutrient cycle) - activation of biophysical systems by re-designing the ground	**Transformation:** Upscale flood risk management and ecosystem restoration through enhanced connectivity
LAYERS/LEGEND	infiltration, evapotranspiration, interception, carbon and nitrogen fixation, decomposition	Blue corridor (B) Green corridor (G) Productive Wetland (W)
CONCEPTS / THEORIES	environmental design, natural occupations (Geddes, 1909) biotic pump (Makarieva, 2007)	Casco concept (Kerkstra , Vrijlandt and Sijmons, 1990-1991), Landscape-based regional design (Nijhuis, 2019)
landowner transformation role	*local restoration & maintenance* *cultural relation with the ground*	*local expansion of the G/B network*

p. 113

Detail / implementation scale

MESO SCALE

elements of design



Arnhem-Nijmegen
City region

Detail:
- Regional water network structure
- Green network
- Urban network

Green/Blue infrastructure
(B): main and secondary water channels, floodable areas (gradients)
(G): flood streams, ponds, agroforestry gradients
(W): open water, wetland fields
Grey infrastructure

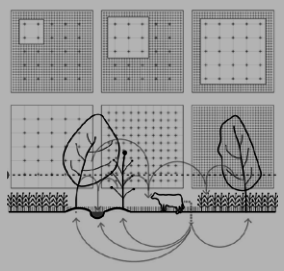
Enhanced connectivity, flexibility urban/periurban areas, hybrid landscapes

p. 127

Detail scale

NANO SCALE

gradients of transformation: per land use



Land use

Implementation:
- Buffer capacity per patch
- Ecological density per patch

Open Space Matrix: pasture, arable land, forest, no-use
Built up Matrix: discontinuous 0-10, 10-30, continuous 30-50, 50-80

Local adaptation, Re-programming, cultural appropiation, holistic approach

p. 179

Implementation scale

MICRO SCALE

spatial morphology

De Buiten
(Lingezegen Park)

Implementation:
-Spatial morphology

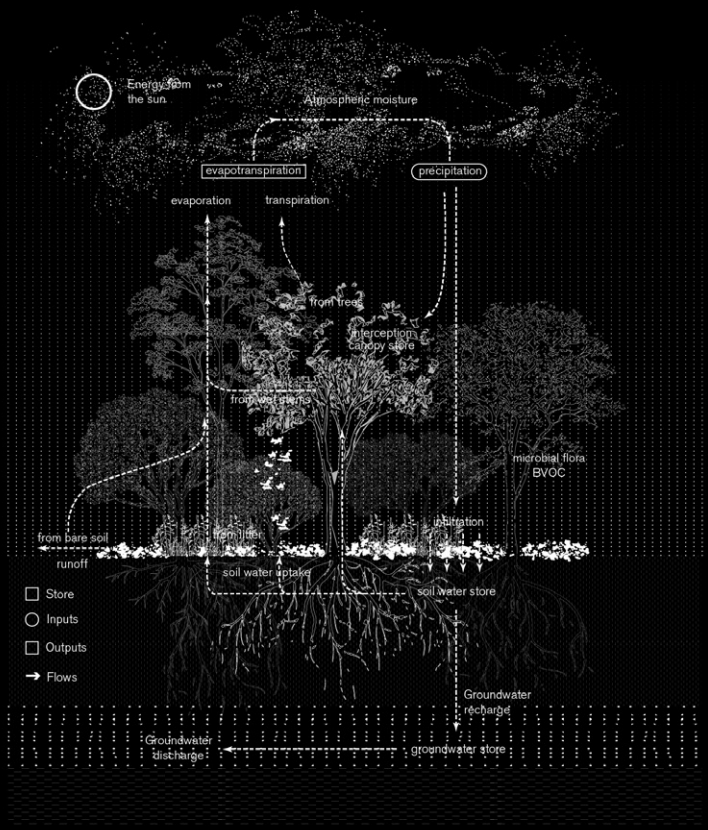
accesibility and built program, agroforestry-buffer gradients, tree structure, water structure

Spatial morphology, composition of the Open Space - hybrid landscape

local expansion of the G/B network

composition of future hybrid/adaptable landscapes

cultural relation with river dynamics


Energy from the sun
Atmospheric moisture
evapotranspiration
precipitation
evaporation
transpiration
from trees
interception
canopy store
from wet stems
microbial flora
BVOC
infiltration
from bare soil
from litter
runoff
soil water uptake
soil water store
Store
Inputs
Outputs
Flows
Groundwater recharge
Groundwater discharge
groundwater store

Design scale

PROCESS SCALE

SOIL SECTION

About the relation with the ground

main transformation	Restoring soil/water/air exchange (water, carbon, nitrogen, phosporus, nutrient cycle)
layers / legend	infiltration, evapotranspiration, interception, carbon and nitrogen fixation, decomposition
concepts / theories	environmental design, biotic pump (Makarieva, 2007)

Figure C1.
Soil section
Elaborated by the author (within the framework of NEXT-EXTREMES: Constructed Natures Beyond the limits of the city - Cultivating territories as a counteract to extreme weather and environmental loss (2018-2020, unpublished)

VISION: ON SYMBIOSIS AT A PROCESS LEVEL

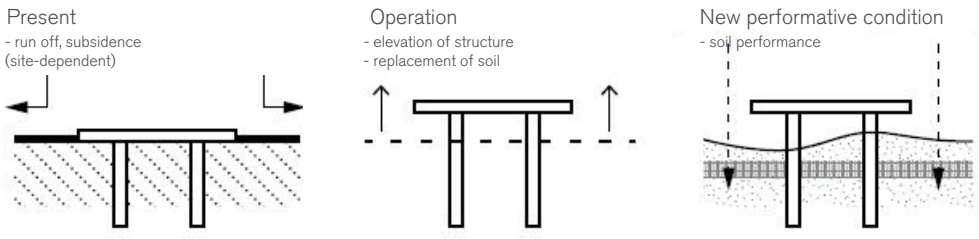
The thesis works with two parallel and retrofitting tracks of design thinking revolving around the notion of symbiosis/synergies and alliances, at a regional and process level. It provides with a multi-scalar vision on a new way of making the territory where occupation and production play active roles in the delivery of symbiotic relations with the ecology in which they are embedded as a way to design responsive environments to extreme and uncertain environmental conditions.

- At a regional level (Rivirenland watershed), the vision provides with a framework based on how the substratum defines levels of dynamism that expand the scope of the riverscape, where flood risk and ecosystem restoration gain a new perspective on design and management (*landscape-based regional design,* Nijhuis, 2019)
- At a process level, the vision defines how specific ways to engage with soil and water leads to more synergistic forms of occupation and production.

The hypothesis at the process level is a continuation on the research on NEXT-EXTREMES: Constructed Natures Beyond the limits of the city - Cultivating territories as a counteract to extreme weather and environmental loss (2018-2020, unpublished), within the framework of the Interdisciplinary Research Group Delta Urbanism.

Through research on environmental design, the understanding of the water cycle and its repercussion on carbon, nitrogen, phosphorus and nutrient cycle through soil (figure C1), the hypothesis lands on the Dutch context, where it is proposed the restoration of the ground as infrastructural living space responsive to the complexities and indeterminacies of urban and environmental change.

Figure C2.
Temporal strategies for environmental performance
Source: Reprinted from Hooimeijer (2018)



The process scale focuses on how specific ways to engage with soil performance and water cycle leads to more synergistic forms of occupation and production responsive to uncertain environmental conditions.

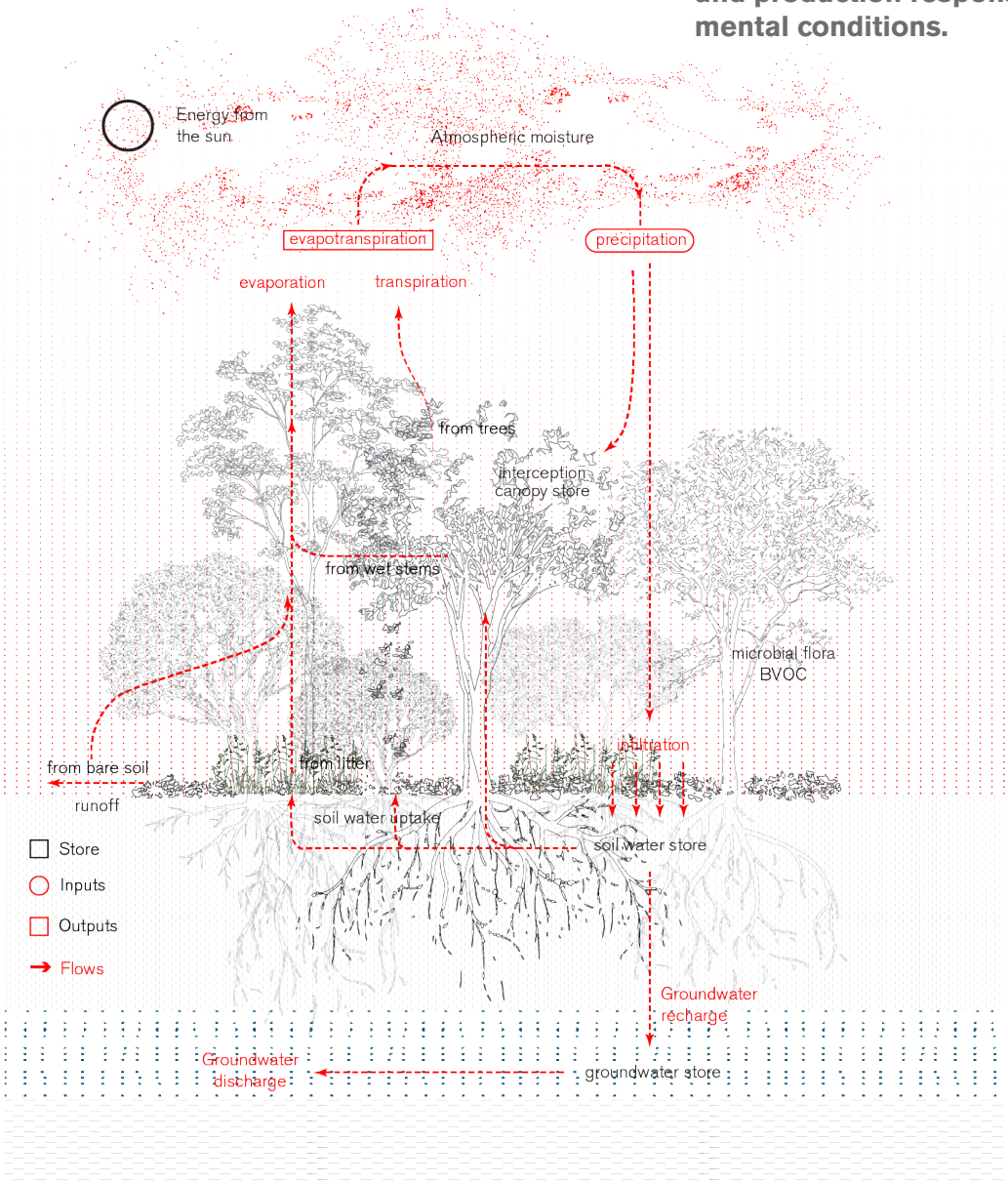


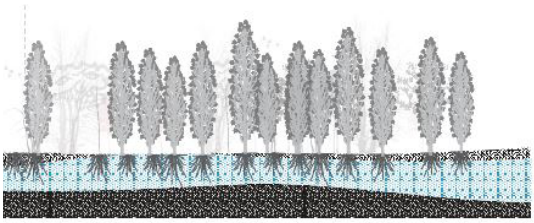
Figure C3.
River basin condition
Source: Reprinted from Hooimeijer (2018)

Figure C4.
River bank condition
Elaborated by the author
Source: Adapted from Wolters et al., (2001)

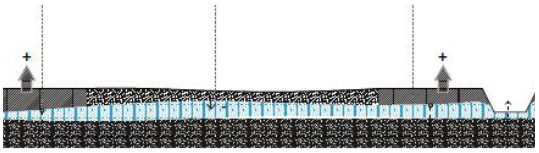
A NEW RELATION WITH THE GROUND
within the Rivierenland watershed context

The vision proposes the restoration of soil performance (figure C2) through operations on the surface lavel. The surface is here considered the space where interrelations can happen, an open-ended field, a living system subject to internal and external forces able to accommodate and adapt to change in time. The restoration of this capacity of the soil is crutial for our territories to adapt to change.

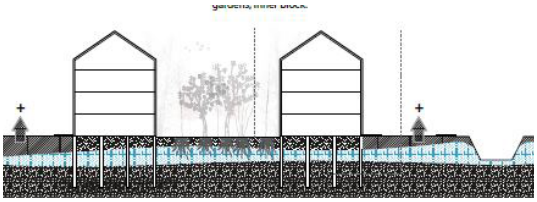
The strategies allowing for the restoration of soil performance are site-related. Within the context of the Rivierenland watershed, the strategies distinguish two main field conditions:



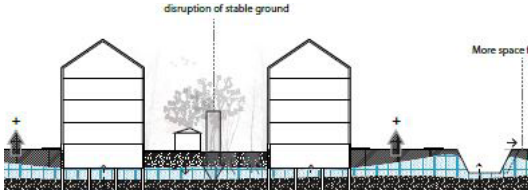
Pre-occupation condition



First level alteration:
- Draining the ground,
- Building site preparation, sand addition
- Preparing the ground, levelling



Second level alteration:
- Underground construction,
- Soil sealing,
- Prevention of infiltration
- Sand addition



Fourth level alteration:
- Pumping / draining the ground,
- Groundwater regime disruption,
-Sudsidence

- River bank condition (figure C4):
Characterised by water fluctuation (river dishcarge), sedimentation, erosion, succession and rejuvenation. In this case, the strategy consists on the provision of enough space for natural processes to happen

- River basin condition (figure C3):
Characterised by groundwater fluctuation. In this case, the strategy is translated in the de-engineering of the ground as necessary operations to restore the natural capacity of these wet and soft areas (wetlands) to regulate extreme climatic events and river discharges.

The restoration of the relation with the ground allows for the appropriation of the processes of change (sedimentation, succession and rejuvenation in the first case and groundwater fluctuations in the second case) into natural occupations (Geddes, 1909). Natural occupations in the shape of ecology-based production arising from environmental dynamics on site leading to the cultivation but also maintenance of a balance between flood risk, ecological density and productivity of the land.
In this sense, the restoration of the soil performance is the strategy to restore the capacity of our territories to adapt to environmental, societal and economic uncertainty.

The restoration of the relation with the ground allows for the appropriation of the processes of change into *natural occupations* (Geddes,1909).

In this sense, the restoration of the soil performance is the strategy that not only restores the capacity of our territories to adapt to environmental uncertainty but also societal and economic.

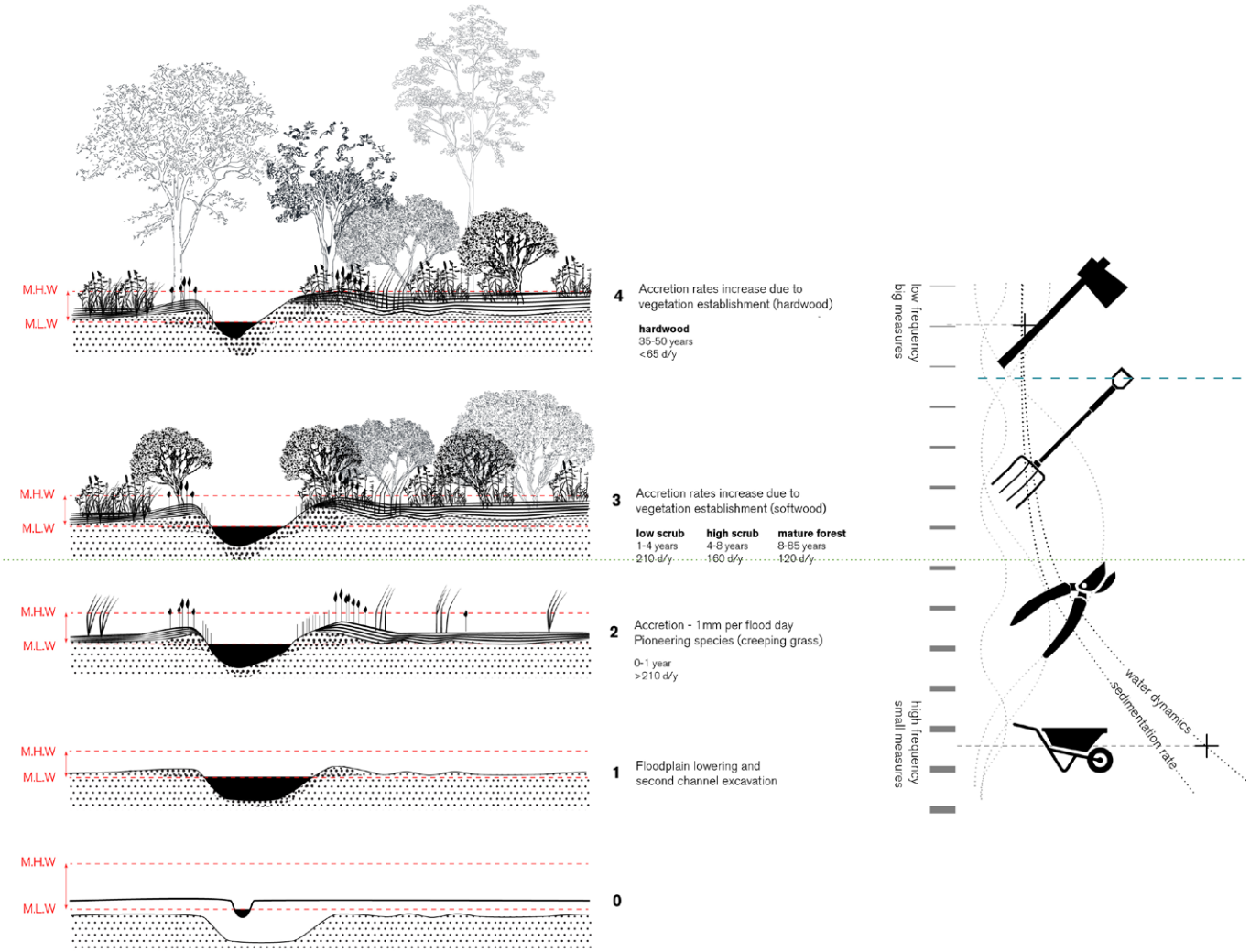


Figure C5.
Process vision implementation diagram through scales
Elaborated by the author

IMPLEMENTATION OF THE VISION THROUGH SCALES

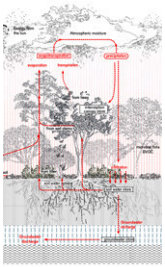
The different scales of the project engage in different forms with the vision at the surface level, informing the design and planning of the territory in the deliver of conscious spatial transformations / management / governance.
The vision informs and adds different values in a scale-dependance basis:

- At patch level (nano and micro scale), the vision is translated into a typology of new programs and ways of managing the land through regenerative practices leading to spacio-cultural engagement with the environmental dynamics. It is also related to increased fertility of the soil and diversification of the economy. The values here are therefore very connected to culture and socio-economic
- At a regional level (macro and meso scale), the restoration of the ground is related to the restoration of the biophysical system, allowing for the seek adaptation capacity to climate change.
- At a global scale, the restoration of the water cycle mitigates extreme clmiatic conditions (biotic pump, Makarieva, 2007)

Ultimately, the vision at the process scale it informs the evaluation of the proposal which performance goal is the delivery of a system with the capacity of auto-regulation. Using the understanding and measuring of systems performance by Odum, the proposal will be evaluated from the point of view of the open system (page 211).

Re-programming typology - cultural engagement and socio-economic values

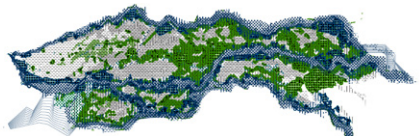
Restoration of the biophysical system - adaptive capacity



Design scale

PROCESS SCALE

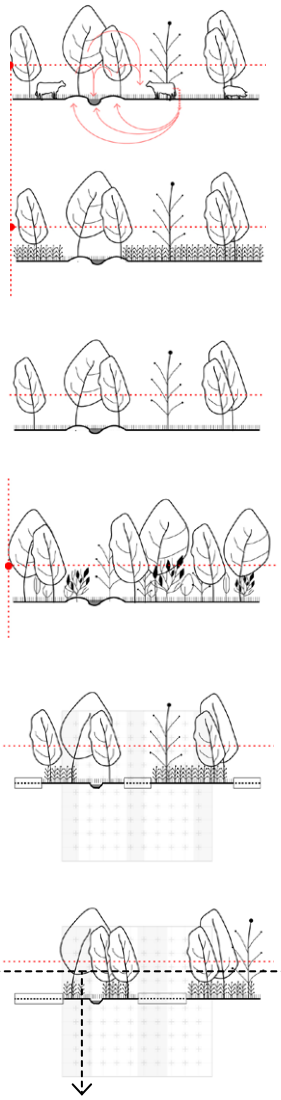
About the relation with the ground

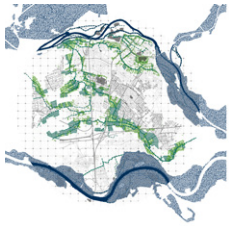


Design scale

MACRO SCALE

About the potential of the landscape

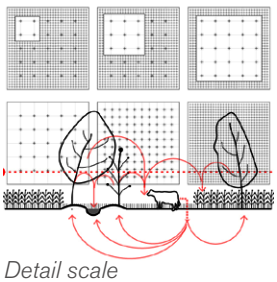




Detail / implementation scale

MESO SCALE

elements of design



Detail scale

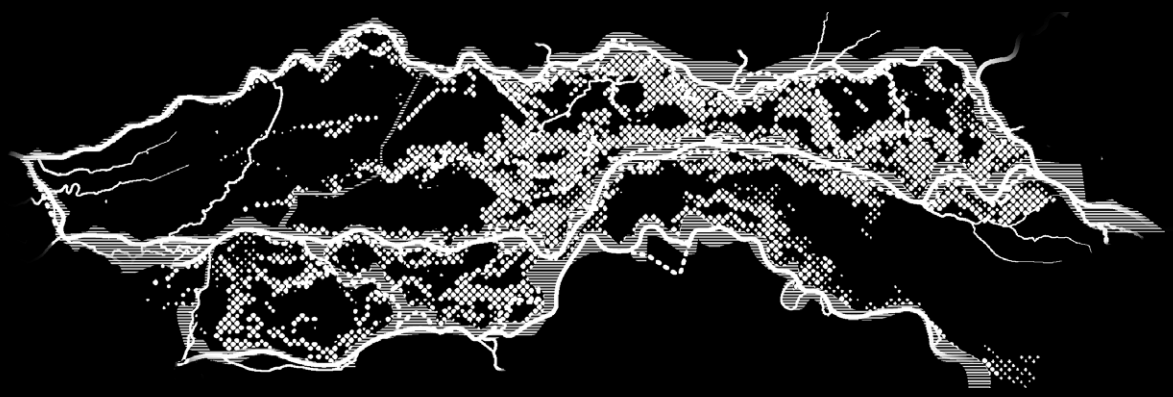
NANO SCALE

gradients of transformation: per land use

Detail scale

MICRO SCALE

spatial morphology



Design scale

URBAN REGION SCALE

RIVIERENLAND WATERSHED

About the potential of the landscape

main transformation	Upscale flood risk management and ecosystem restoration through enhanced connectivity
layers / legend	Blue corridor (B) Green corridor (G) Productive Wetland (W)
concepts / theories	Casco concept (Kerkstra , Vrijlandt and Sijmons, 1990-1991), Landscape-based regional design (Nijhuis, 2019)

Figure C6.
Rivierenland watershed and Rhine evolution
Elaborated by the author
Source: Adapted from Cohen (2003)

VISION: ON SYMBIOSIS AT A REGIONAL LEVEL

As seen in the previous chapter, the thesis works with two parallel and retrofitting tracks of design thinking revolving around the notion of symbiosis/synergies and alliances, at a regional and process level. It provides with a multi-scalar vision on a new way of making the territory where occupation and production play active roles in the delivery of symbiotic relations with the ecology in which they are embedded as a way to design responsive environments to extreme and uncertain environmental conditions.

- At a regional level (Rivirenland watershed), the vision provides with a framework based on how the substratum defines levels of dynamism that expand the scope of the river landscape, where flood risk and ecosystem restoration gain a new perspective on design and management (*landscape-based regional design,* Nijhuis, 2019)
- At a process level, the vision defines how specific ways to engage with soil and water leads to more synergistic forms of occupation and production.

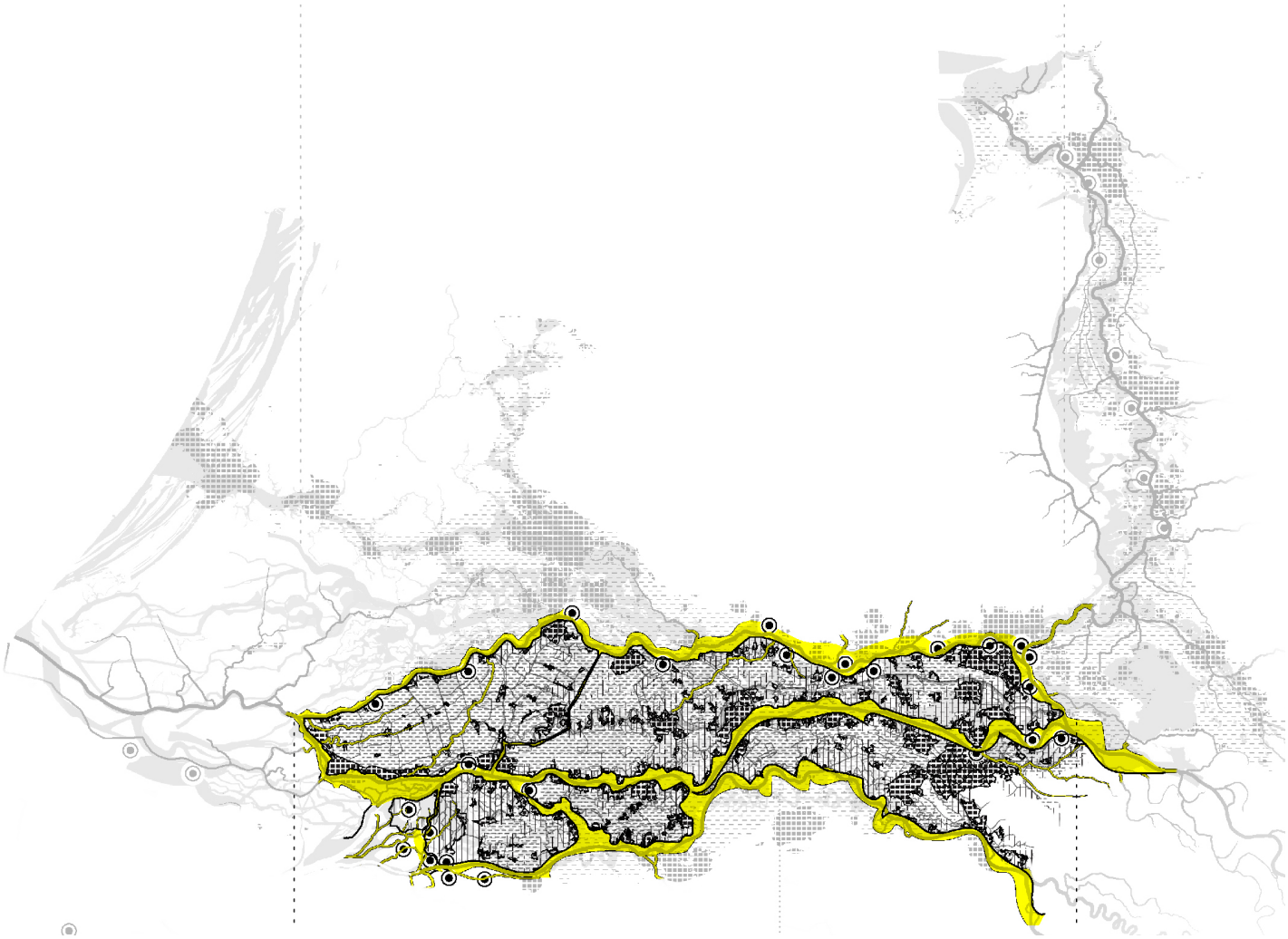
READING

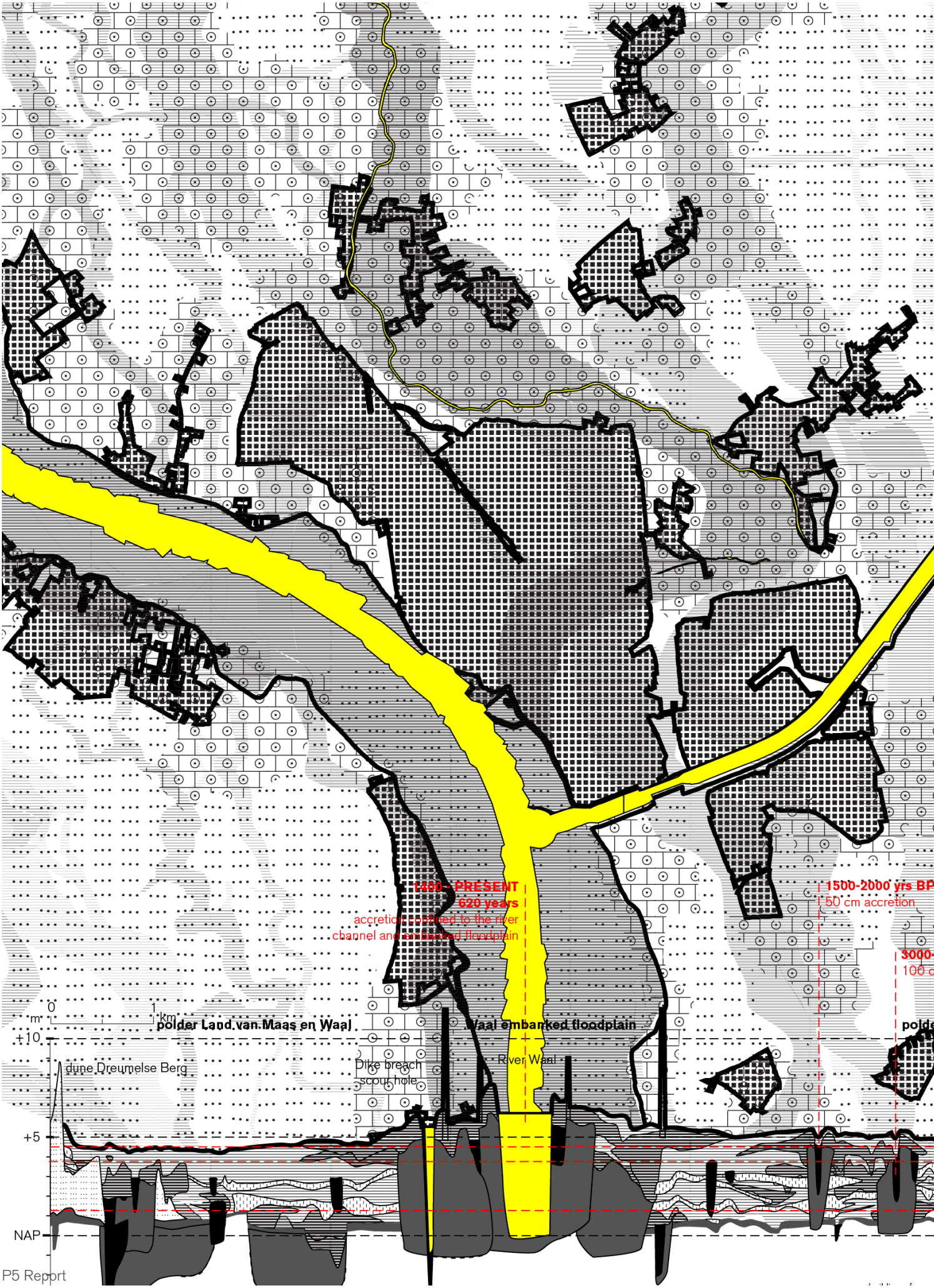
The Urban region scale is defined by the Rivierenland watershed and waterboard where administrative and biophysical boundaries come together. Its size is analogue to the 150 diameter of the "urban region" as explored by Forman (1995).

The reading of this territory comes from the understanding of the urban landscape as a complex system where different levels of dynamism and speed of change inteplay (Meyer & Nijhuis, 2013). The reading and overlapping of multiple layers allows for the re-definition of the river landscape, currently confined to the space in-between the dykes (in yellow, figure C6) and creating a cultural, biophysical and planning division between protected/passive and protecting/active areas.

The geological section (figure C7) reveals a former migratory river landscape where -at different heights from the surface- the vestiges of former water channels remain visible as accumulations of coarser material. In plan (figure C7), the superimposition of the geological map and the current occupation layer reveals an intrinsic relation between former floodplains and productive corridors, fact that questions the current scope and definition of Dutch floodplain.

The reading and overlapping of multiple layers allows for the re-definition of the river landscape, currently confined to the space in-between the dykes (in yellow, figure C6) and creating a cultural, biophysical and planning division between protected/passive and protecting/active areas.




1480- PRESENT
620 years
accretion confined to the river
channel and embanked floodplain
1500-2000 yrs BP
50 cm accretion
3000-
100 c
0
1 km
m
polder Land van Maas en Waal
Waal embanked floodplain
polde
+10
dune Dreumelse Berg
Dike breach
scour hole
River Waal
+5
NAP

Recognition of the full extension of the floodplain

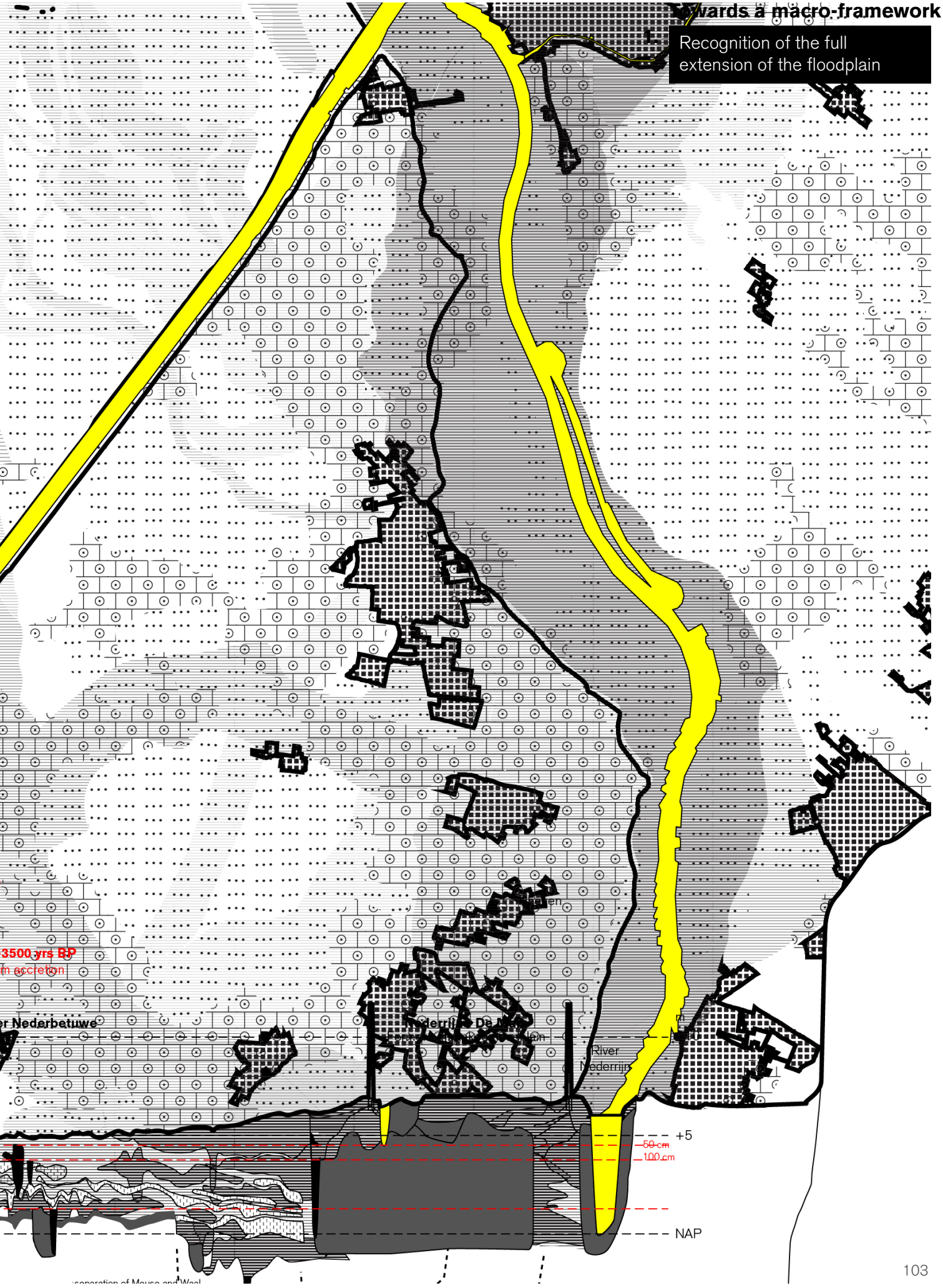


Figure C7 (previous page).
Geological analysis. Collage in the horizontal and vertical dimension
Source: Adapted from Cohen (2003)

River corridors
River Dikes

subsoil

Floodplain deposits (clay)
Bank deposits (sand, clay)
Residual channel deposits (clay, peat)
Bed deposits (sand, gravel)
Peat

age of abandonment of former river corridors:

0-2000 yr
2000-4000 yr
4000-6000 yr
6000-8000 yr

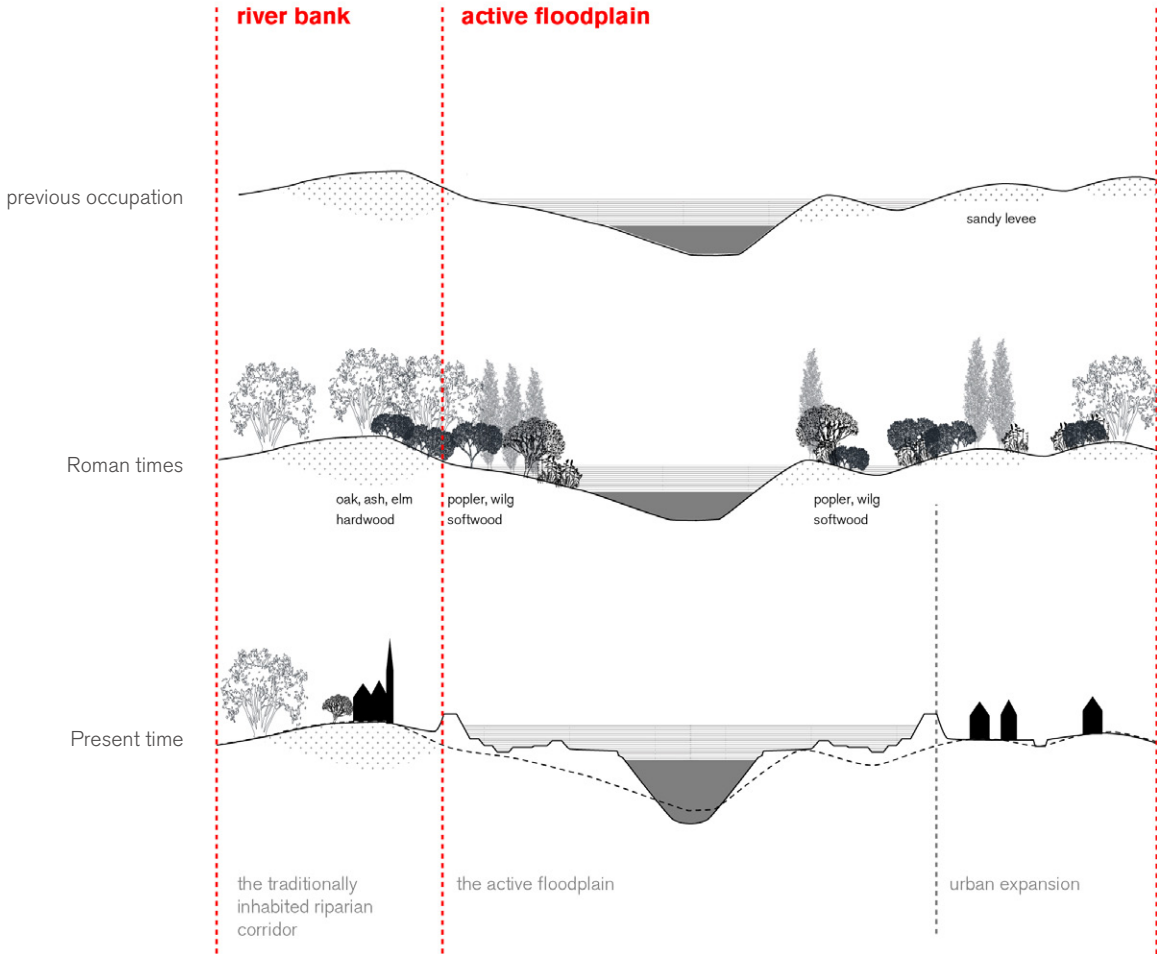
occupation

Urban areas
Arable land
Pasture land

READING

Diachronic analysis

The use of the cross section to track the process of change of the landscape shows the interplay between surface (occupation) and subsurface dynamics (geomorphological conditions). Coming from the geological map and section (page 98-99), the diachronic analysis of the Rivierenland territory here portrayed shows a unique dialogue between geomorphology and occupation, where it is possible to differentiate traditional occupation -on top of sandy belts corresponding to current and former rivers- and new developments -occupying artificially drained basins and fragmented



floodplains-. Heavy urbanization of the Rivierenland have created urban-productive systems completely dependent on regulation through drainage systems and dykes. (Bruin et al., 1987)

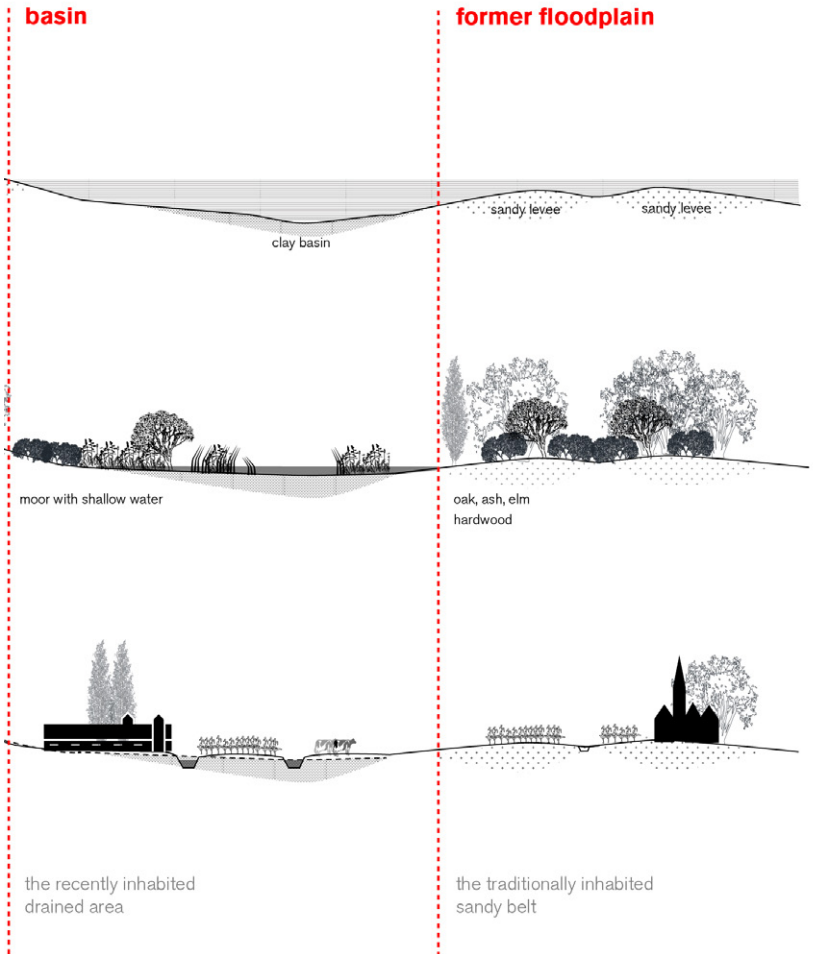


Figure C8.
Diachronic reading of the Rivierenland
Elaborated by the author
Source: Adapted from Bruin et al., (1987)

Figure C9.
Inhabitable and productive corridors of the Rivierenland
Elaborated by the author

Figure C10.
Functional layers of the Rivierenland
Elaborated by the author

READING

urban landscape as a complex system

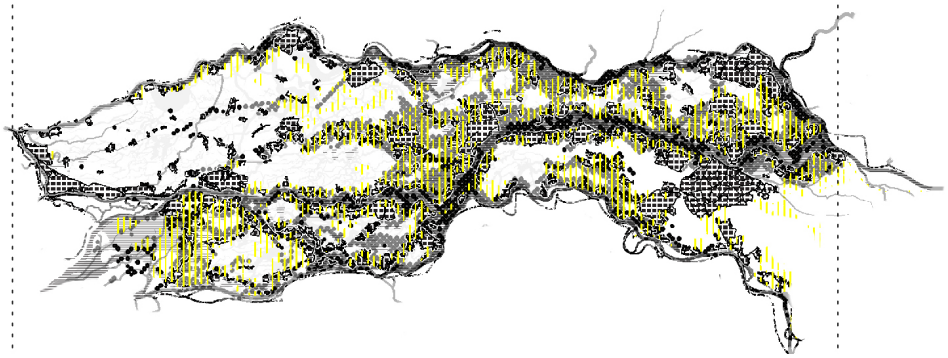
The urban landscape can be understood as a complex system composed of subsystems, each with their own dynamics and speed of change (Meyer & Nijhuis, 2013) as a complex system composed by a constellation of networks with multiple levels of organization at different spatial and temporal dimensions.

According to the dutch layer approach (and the casco-concept), the urban landscape can be structured according to high and low dynamics in relation to the pace of change of such layers. On the right, the Rivierenland watershed is decomposed in geomorphology, subsoil, occupation and control layers ordered accordingly to the dutch layer approach from slow to quick pace of change.

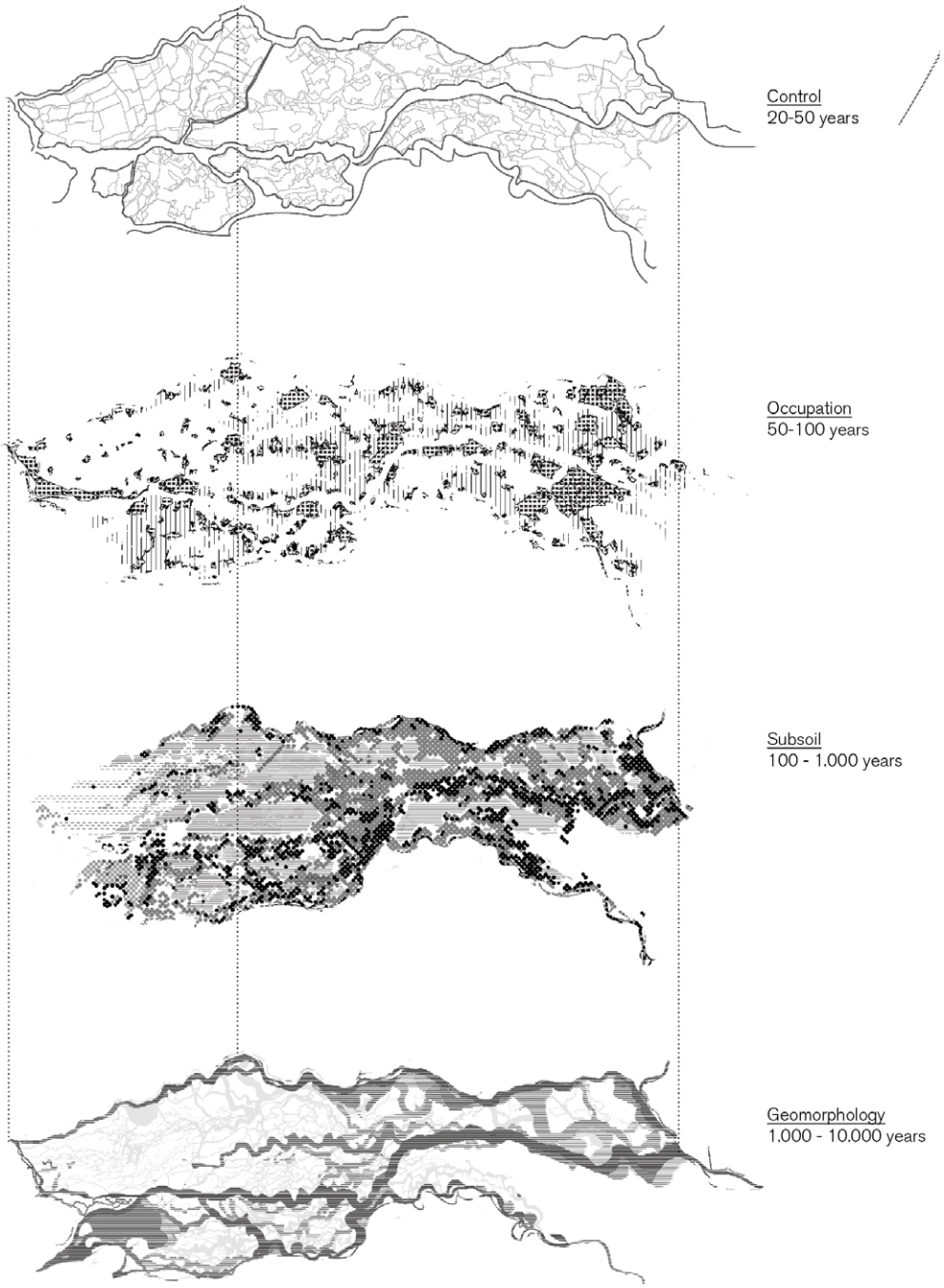
However, under the pressure placed by the uncertainty of Climate Change, the substratum gains a revealing dimension, providing with a new meaning to dynamism, now associated to a degree of potential change that is constrained by the level of staticity of occupation and control layers.

The diachronic and geomorphological analysis together with the reflection on the layer approach and the meaning of dynamism concludes the reading of this territory by embracing a new scope of the river landscape as an interconnected complex system that upscales flood risk management and ecosystem restoration throughout the territory.

Habitable and productive corridors
Good drainage of the soil -sand-, elevated topography -natural levees-, fertile -nutrients-



3. Recognition of the degree of potential change of the sub-stratum constrained by the level of staticity of occupation and control layers



READING

Dutch Layer Approach - Casco Concept

From the 1970s onwards, the “layer approach” and its theoretical backgrounds understanding the landscape as systems of natural and man-made structures became increasingly influential in Dutch design and planning experiments. The concept of designing strong frameworks for sustainable landscape development (Sijmons and Venema 1998; Sijmons 2002) resulted in the “framework-model” (casco-concept in Dutch), a regional design approach setting the general shape and guides for future detailed development (Portugali & Stolk, 2016).

The first application of the framework model was in a winning competition entry for a regional landscape design called “Plan Stork” (*Plan Ooievaar* in Dutch) in 1985 focusing on the area around the Rhine and Meuse rivers. The plan proposed a new structure for the area which would enhance and reinforce agricultural land-use in the former flood basins, mixed land-use on the natural levee deposits and nature development in the newly established riparian zones (Portugali & Stolk, 2016), structuring the landscape according to high (urbanization, recreation, agriculture) and low (nature reserves) dynamism according to the pace of change of such layers (layer approach).

Revision of the concept in the thesis

However, the moment we put the landscape under pressure because of the uncertainty of Climate Change, in my thesis translated into fluctuating river discharges, the substratum gains another dimension, allowing for a higher dynamism, now associated to a degree of potential change that is constrained by the level of staticity of occupation and control. The potential change provided by the stratum layer triggers the re-conceptualization of connectivity throughout the whole riverine territory.

Building from the knowledge provided by the dutch framework, the main change resides in the different association between land uses and landscape layers.

Because land uses are associated with a specific role in the management of floods and watershed ecosystem restoration depending on the ground conditions; productive wetland activies correspond with the river basin areas, agroforestry land uses in natural levees and floodplain-related productive activites in riparian corridors.

Figure C8.
Ooievar Plan
Source: Adapted from Bruin et al., (1987)

FUNCTION

the potential of the landscape

“Landscape-based regional design is considered an important strategy that shapes the physical form of regions using landscape as the basic condition” (Nijhuis, 2019)

From the reading of the territory, the macro-framework recognises:

1. The full extension of the floodplain that does not end with the dikes (pages 102-103).
2. The buried interrelation between geomorphology and occupation that is distinguishable by inhabitable and productive corridors on top of the coarser material deposited by former streams.
3. A typology of occupational-geomorphological patterns within the river landscape (page 104-105).
4. A new meaning to the substratum, that with the pressures of climate change is associated to a degree of potential change.

All of which is translated into the differentiation of three functional layers with a role during extreme discharges. A differentiation associated to the type and frequencies of flood disturbance, finding:

Blue corridor
As current active floodplain, the level of dynamism is the highest (high degree of disturbance given river fluctuations). This condition is translated into a strategy seeking for continuously maintained spaces for water. Ecological density is therefore maintained at juvenile stages.
This functional layer is therefore associated to the role of auto-regulation by providing space for inundation.

Green corridor / productive forest
As former river banks, the exposure to river dynamics is translated into small flood streams performing their buffer capacity during extreme discharges. The size and frequency of disturbances allows for the development of climax forests.
This functional layer is associated with the role of delay during peak discharges by distributing water through a series of ramifications and by absorbing water through vegetated soils.

Productive wetland
As former clay basins, the main drivers of change take the shape of groundwater fluctuations (underground river fluctuations). This layer sets the basis for the transition from drained agricultures to productive wetlands.
This functional layer is associated to the role of mitigation, by allowing groundwater fluctuations.

Figure C11.
Functional layers of the macro vision
Elaborated by the author

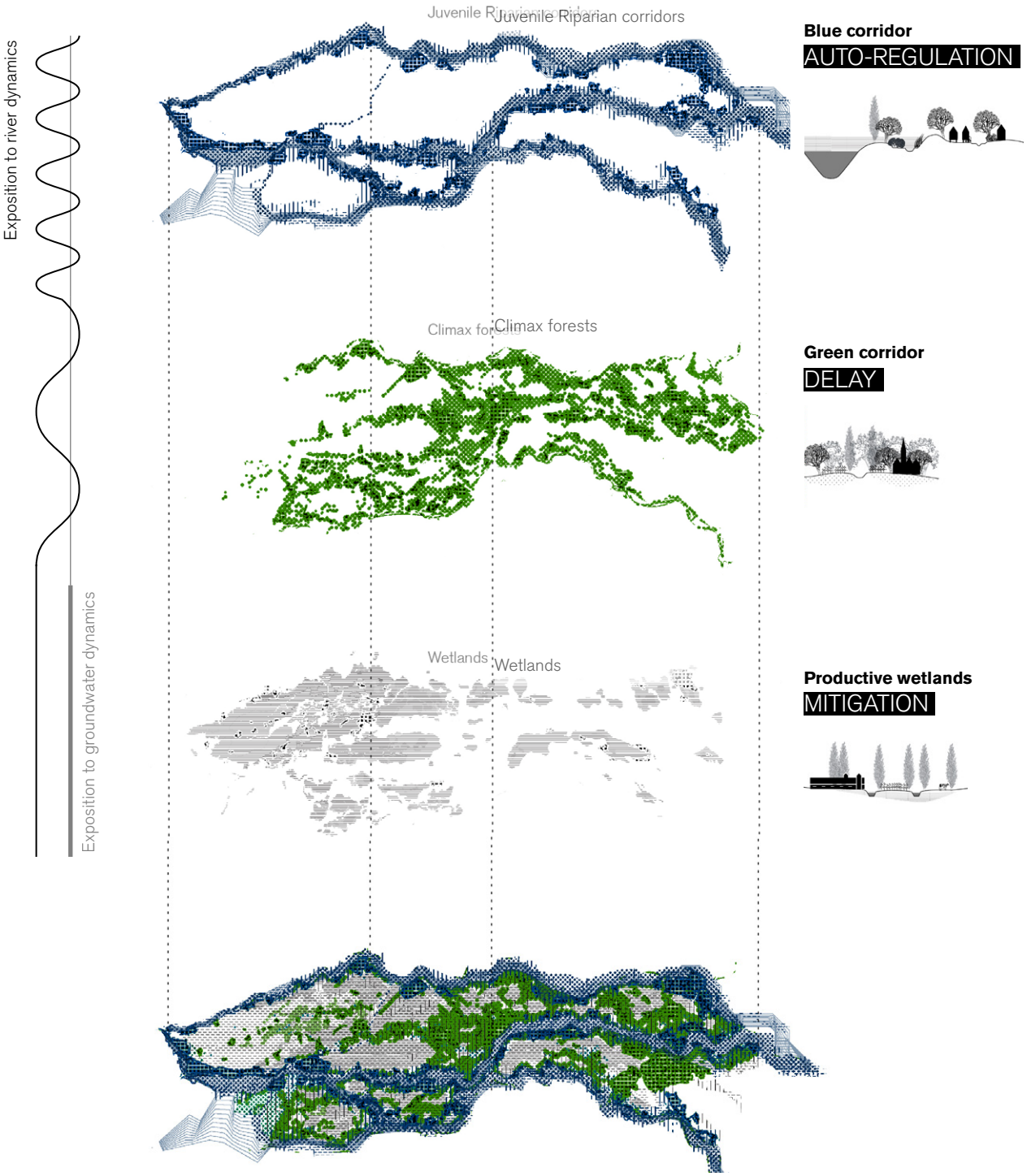

Exposition to river dynamics
Exposition to groundwater dynamics
Juvenile Riparian corridors
Climax forests
Wetlands
Blue corridor
AUTO-REGULATION
Green corridor
DELAY
Productive wetlands
MITIGATION

Figure C12 (on the right).
Re-programming intensities and operations per functional layer
Elaborated by the author

Figure C13 (below).
Conceptual framework of the proposal
Elaborated by the author

OPERATION

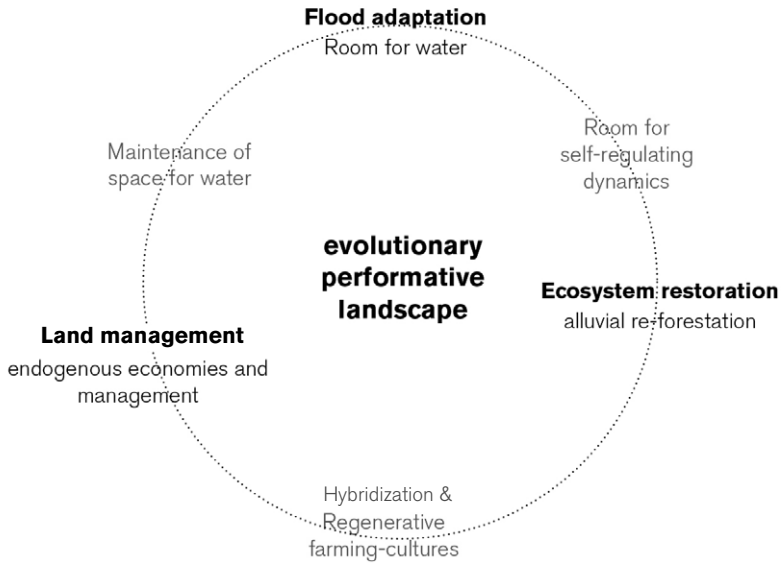
Each functional layer performs a different interrelation between flood adaptation, reforestation and agricultural intensities (figure C12) leading to different key operations. At this scale, the operations are defined as operations of extraction and addition affecting the topsoil, built environment and vegetation (blue and red diagram).

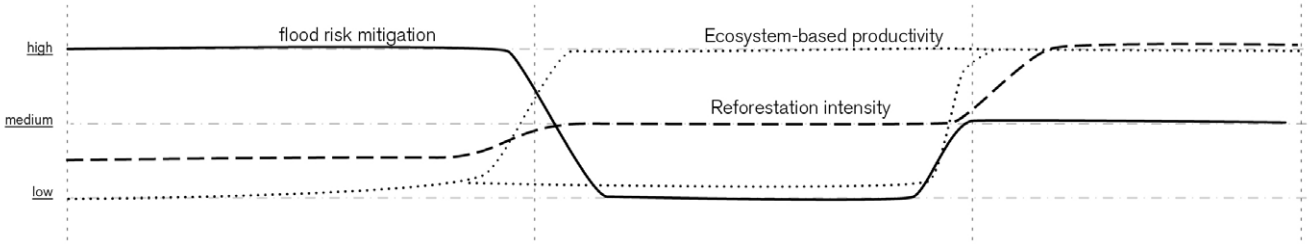
The understanding of this functional layers also gives an insight on the maintenance regimes through land management practices (associated to ecological-based productivity)

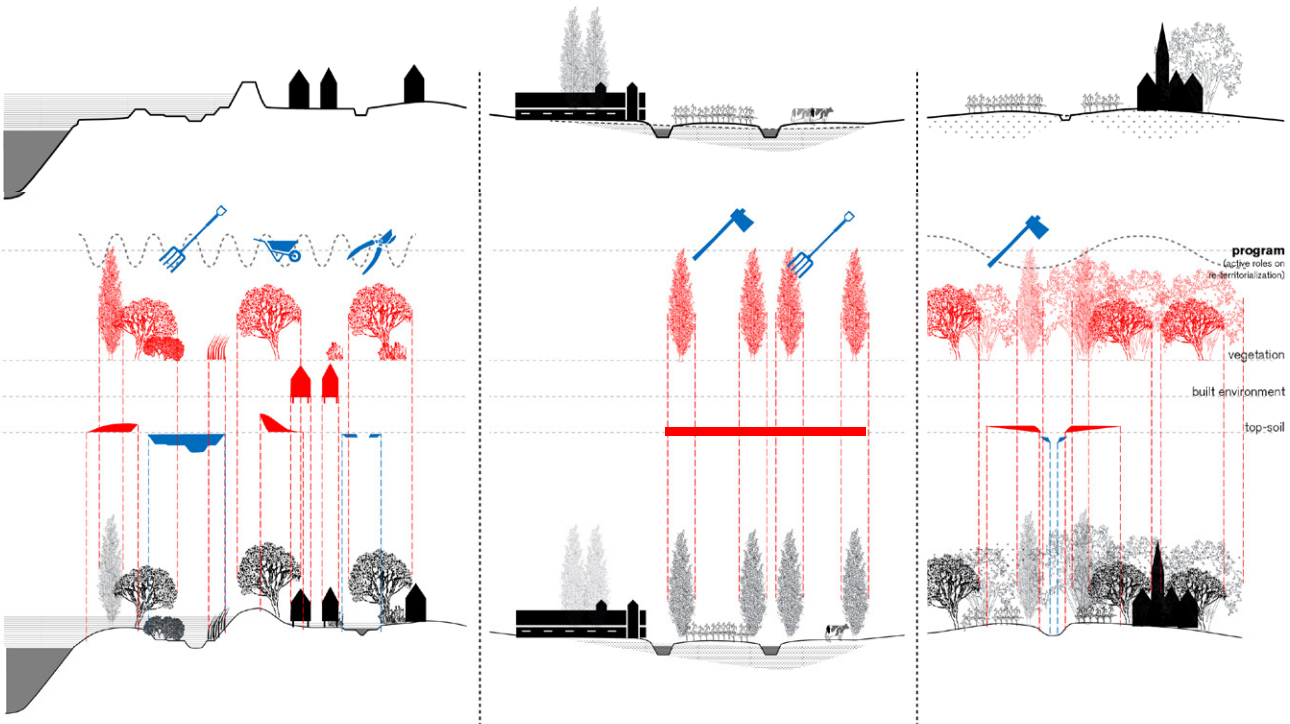
Blue corridor
Land management is associated to the maintenance of sedimentation rates through rejuvenation of vegetation and sediment extraction.

Green corridor
Land management is associated to the maintenance of high levels of ecological density through agroforestry strategies and eventual buffer performance (extreme river dishcarges)

Productive wetland
Land management is associated to the maintenance of a wetland ecosystem and high levels of productivity







Blue corridors
Land management: associated to the maintenance of sedimentation rates

Productive wetlands
Land management: associated to the maintenance of productive wetlands

Green corridors
Land management: associated to the maintenance of high levels of forestry and occasional buffer performance

STRUCTURE / interplay of layers

Proposed structural layers

The landscape-based regional design defines the structural layers of the proposed green/blue urban network. Based on the understanding of the river territory as an interconnected complex system, the green/blue network upscales the flood risk management by enhanced connectivity throughout the territory.

The functional layers of the territory interact with each other thanks to the structural designed network that comes from the re-definition of the river landscape and the understanding of the territory as a complex interconnected system
The green/blue urban network upscales the flood risk management by enhanced connectivity throughout the territory:

Water network
At this scale, the water network is defined as a structural layer compoed by main and secondary water channels and regional flood streams perfoming its buffer capacity during extreme river dishcarges.

Green network
Composed by riparian corridors along main water channels (floodplain) and flood streams. Within the floodplain areas, the Birds and Habitats Directive have defined N2000 areas where specific regulations control the quality and performance of the green network.

Urban network
The Urban network is composed by continuous areas and mobility infrastructure. Within the proposal, the built environment assumes higher levels of flood risk compensated over time by decreased vulnerability

Hybrid network
The hybrid network is the result of the combination of three. The highest degrees of hybridization take place in suburban areas where the Open Space Matrix allows for higher ecological densities (agroforestry system) and buffer areas (water network), proposing a new form of inhabitation and role of the countryside in relation to highly urbanized areas

Figure C14.
Structural layers of the proposal
Elaborated by the author

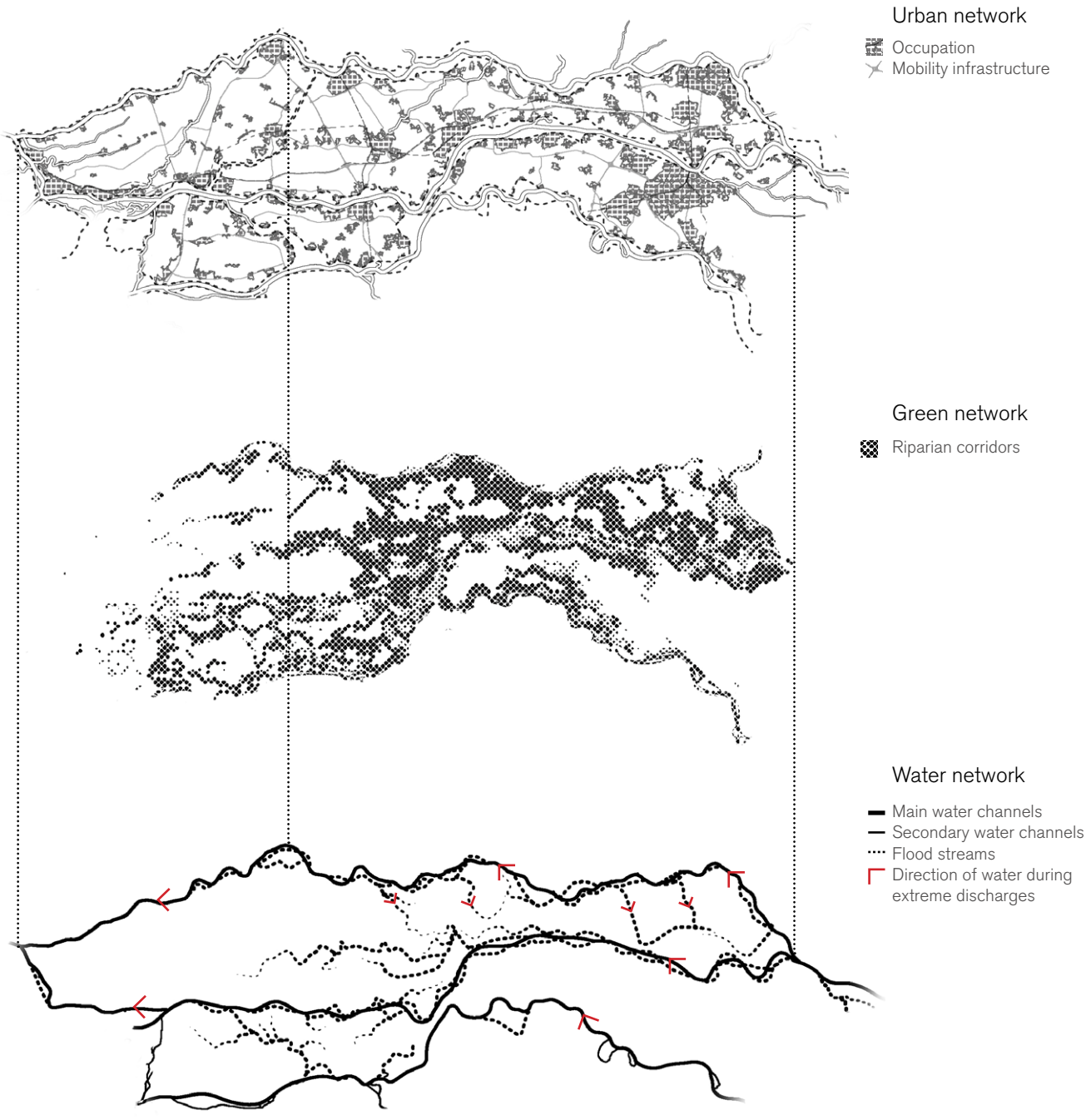

Urban network
Occupation
Mobility infrastructure
Green network
Riparian corridors
Water network
Main water channels
Secondary water channels
Flood streams
Direction of water during extreme discharges

Figure C15.
Macro vision implementation diagram through scales
Elaborated by the author

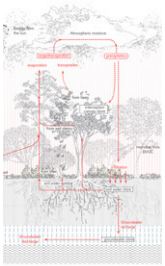
IMPLEMENTATION OF THE VISION THROUGH SCALES

The different scales of the project engage in different forms with the vision at the regional level, informing the design and planning of the territory in the deliver of conscious spatial transformations / management / governance.
The vision informs and adds different values in a scale-dependance basis:

- At patch level (nano scale), the vision defines three different categories on the re-programming typologies: the blue corridor category proposes a gradient of programs that is aligned with the different perturbances within the floodplain architecture. The values here are therefore very connected to culture and socio-economic
- At a regional level (meso scale), the functional capacities of the territory and main structure given by the vision are detailed and further explored.

The vision at the urban region level aims at "safeguarding sustaintable and coherent development, guide and shape changes brought about by socio-economic and environmental processes, and to stablish local identity through tangible relations to the region" (Nijhuis, 2019)

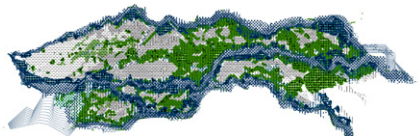
Defines the function and main structure



Design scale

PROCESS SCALE

About the relation with the ground

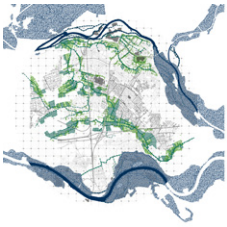


Design scale

MACRO SCALE

About the potential of the landscape

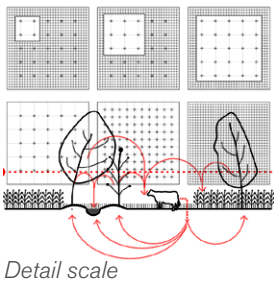
Defines three categories of re-programming typologies



Detail / implementation scale

MESO SCALE

elements of design



Detail scale

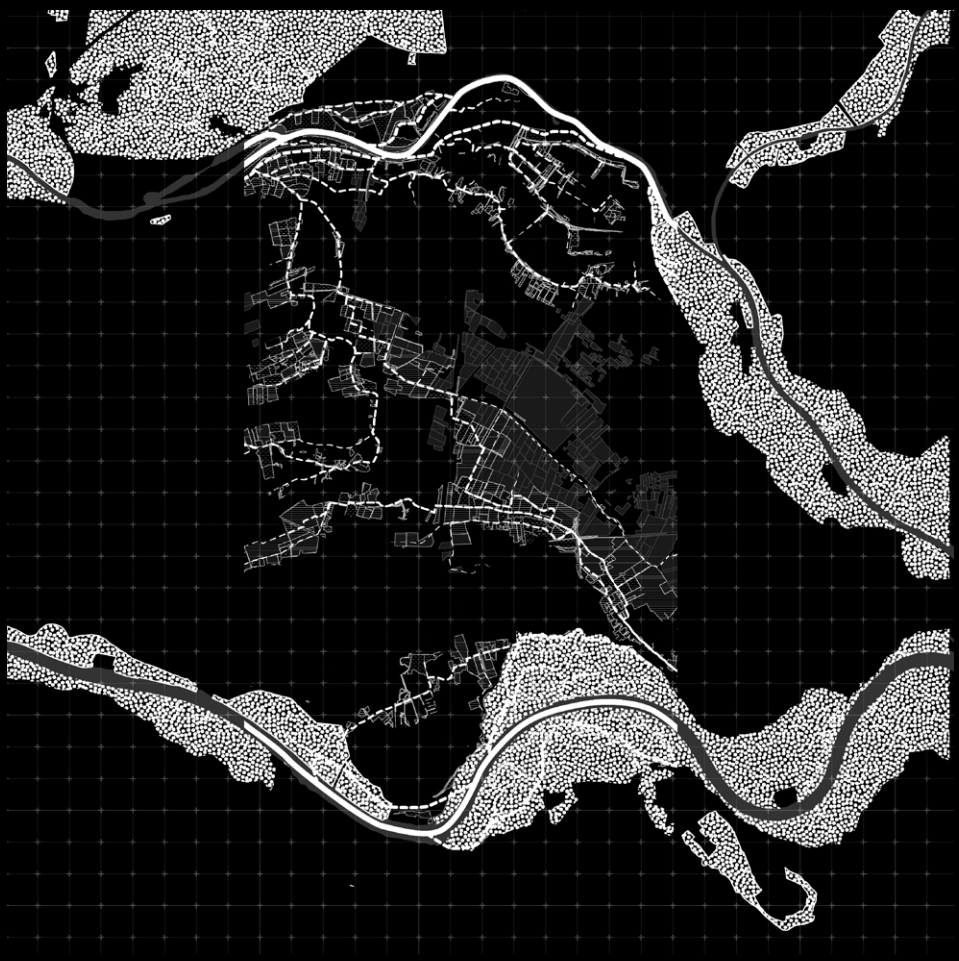
NANO SCALE

gradients of transformation: per land use

Detail scale

MICRO SCALE

spatial morphology



Detail / implementation scale

CITY REGION SCALE

ARNHEM NIJMEGEN city region

Identifying the elements of design

main transformation

- Regional water network structure
- Ecosystem restoration

layers / legend

Green/Blue infrastructure
(B): main and secondary water channels, floodable areas (gradients)
(G): flood streams, ponds, agroforestry gradients
(W): open water, wetland fields
Grey infrastructure

concepts / theories

Enhanced connectivity, hybrid landscapes (periurban)

Figure C17.
Urbsn sprawl between Arnhem and Nijmegen
Source: Reprinted from 44th ISOCARP Congress 2008, Retrieved from isocarp.net

Figure C18.
Location diagram macro and meso scales
Elaborated by the author

LOCATION

purpose of the scale and location choice

The purpose of the scale is detailing the regional vision by defining the elements of design of the blue corridor, green corridor and productive wetland.

The explored specific transect of the Rivierenland is the Arnhem Nijmegen city-region, a regional partnership between 18 municipalities -since 2015- which aim is the commitment to strengthen the economy of the region.

The location choice revolves around the overlapping of advanced national and regional initiatives towards a coherent development of the city region as a solid foundation supporting my proposal throughout the transect:

- The regional initiative Lingezegen park (page 191) explores a coherent project to frame urban sprawl (figure C17, page 115) and re-values the agricultural, cultural, and natural assets of the open space areas in between the two rivers Nederrijn and Waal.
The project includes the restoration of part of the wetlands, transforming current drained agricultural land into wetlands for water storage -aligned with the productive wetland layer of my proposal-, but also the inclusion of agriculture and nature in new forms of agroforestry systems in combination with recreation - in assonance with the green corridor layer-

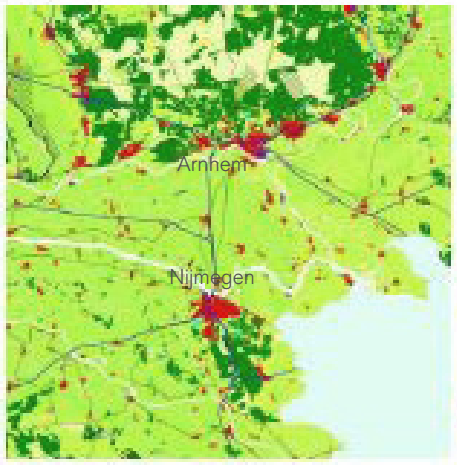
- The national initiative Room for the River (page 191) exploring the potential of auto-regulation of river ecosystems when given enough space, here concentrated in two specific project-locations given by the program: the excavation of floodplain areas and second channels in Arnhem (giving birth to a landscape project know as the biggest floodplain park in Europe) and

As already seen in the previous chapters, the project is about understanding the territory as an interconnected complex system, where connectivity plays a key role in flood risk management and ecosystem restoration. As such, in this chapter connectivity will be further explored as key upscaling of the above mentioned proposals.

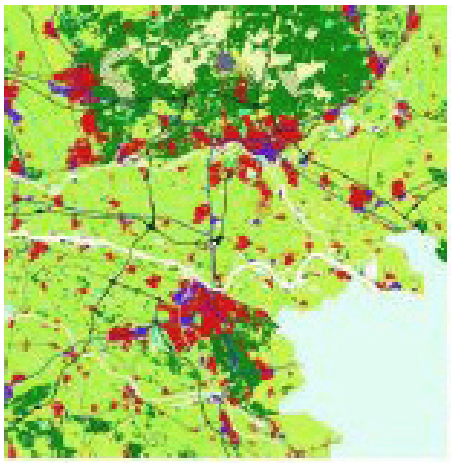
ON HYBRID LANDSCAPES

Challenging the compact city model

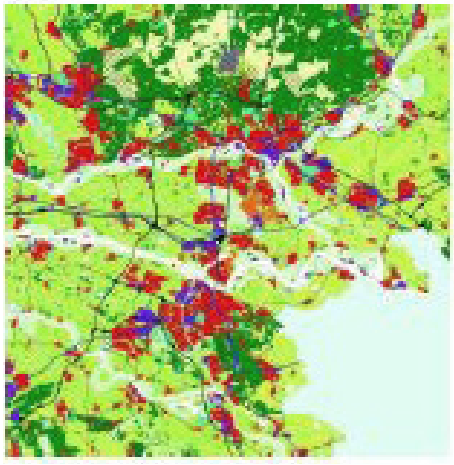
Aligned with the concerns driving the initiative for the Lingezegen Park on the one hand, but also broadly conscious on the discourses of the compact city and the current state of exploitation of the peripheries (local and global), the thesis explores the notion of hybrid landscapes.



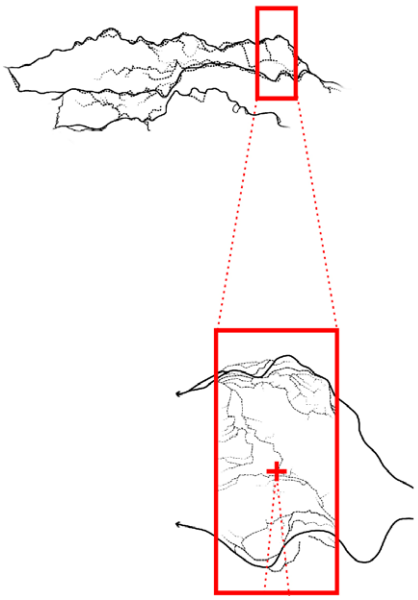
1950



1980



2010



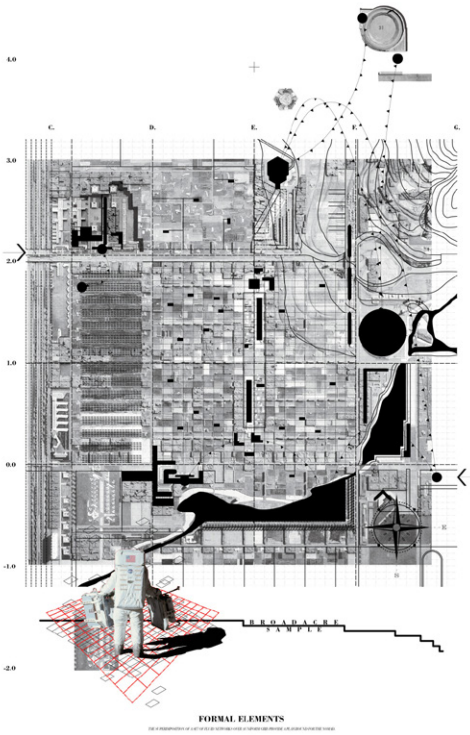


Figure C19.
Broadcare City Sample Map
Source: Reprinted from *tumblr* by Harry Thomas Day, Retrieved from https://harrythomasday.tumblr.com

The compact city model, with exploited countryside and economies of scale needs to transition to a more hybrid model where biodiversity is the highest. In this sense, the compact city model is challenged by new forms of diffusion and dispersion, where occupation has new built up typologies engaged with new forms of appropiation of the land.

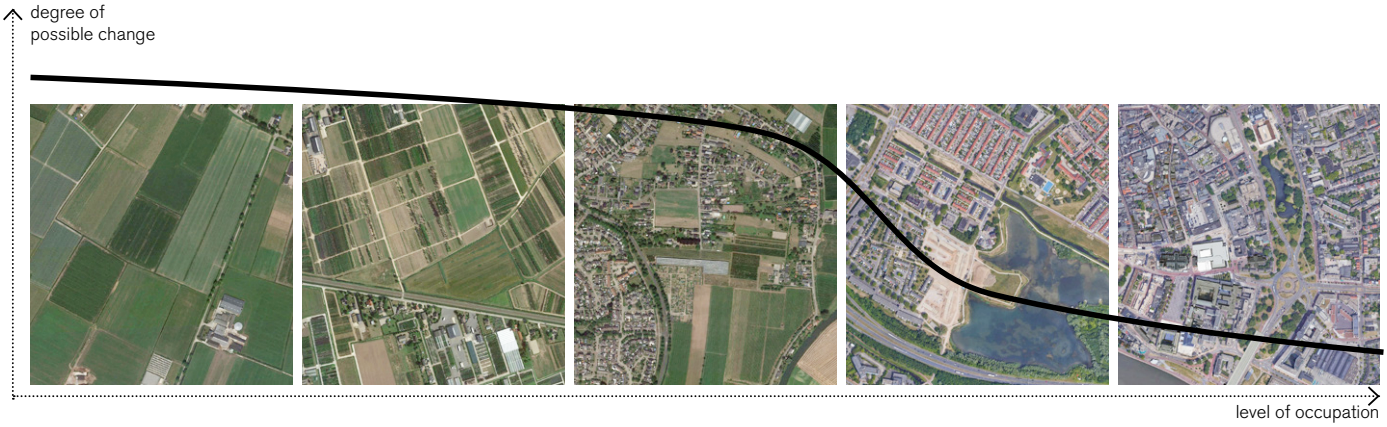
Key reference to the necessity of hybridization and reconnection with the land is the concept of the Broadcare City by Frank Lloyd Wright, a concept presented in his book The Disappearing City in 1932.

Hybridization in the thesis acquires another dimension related to the key role of land management -economically attached to new ways of ecologybased production- to maintain and expand -from local scales- the water and green network under new forms of land appropiation.

The thesis focuses on exploring the pathways towards the hybridization of the urban landscape (pages 128-177) with a particular focus on the countryside which, due to a question of flexibility in the degree of possible change (figure C20), has a higher potential of implementation of the proposal in the short-medium term.

Once the proposal works under uncertain river discharges regimes (pages 198-199), the hybridization can colonize the highly urbanized areas through new patterns and densities of buffer capacity, ecological density and land management, taking to these dense areas (in a smaller scale) the reconnection with natural dynamics.

Figure C20.
Diagram on the degree of possible change according to the level of occupation, Rivierenland watershed
Elaborated by the author
Source: Google Earth (n.d.)



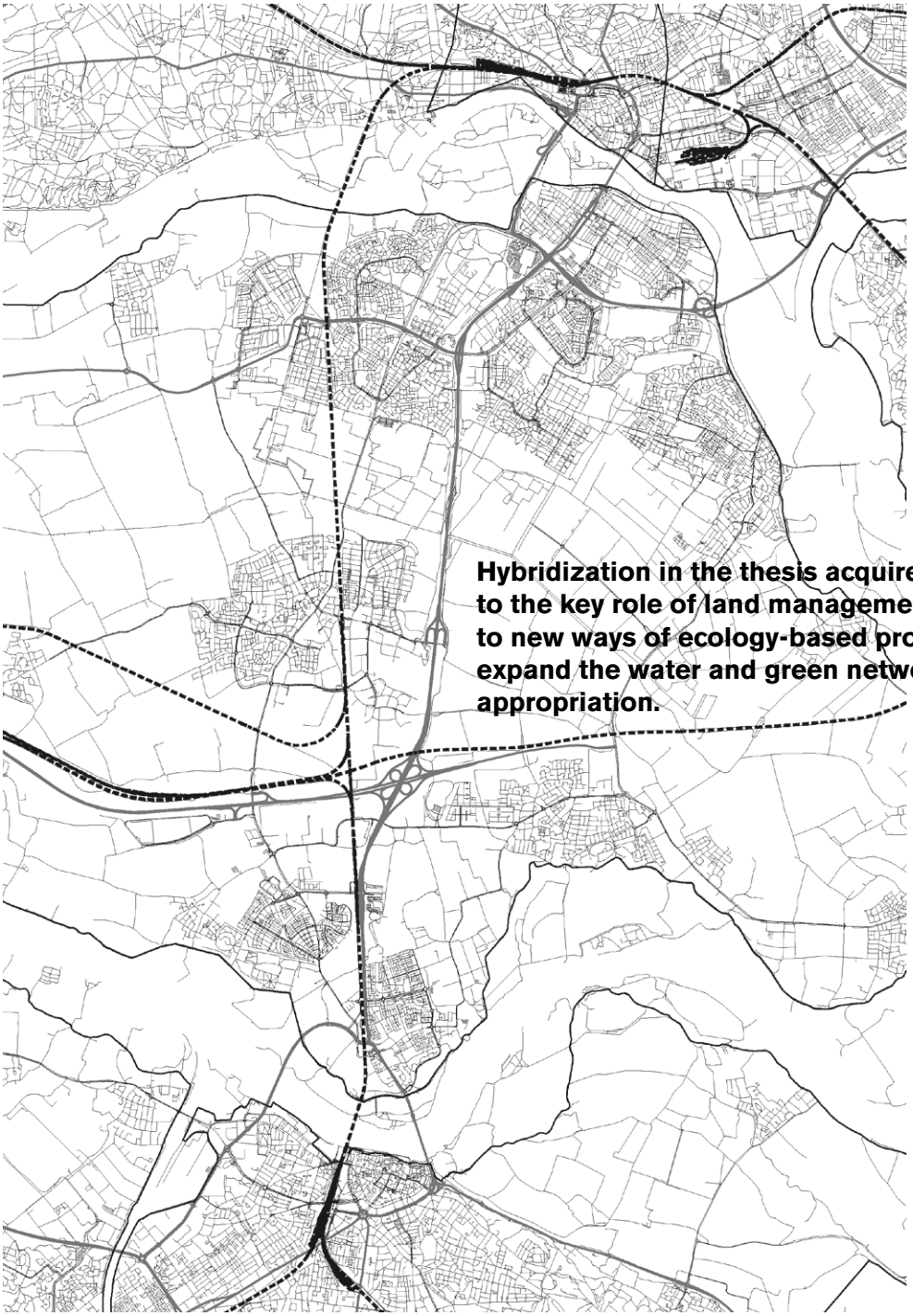
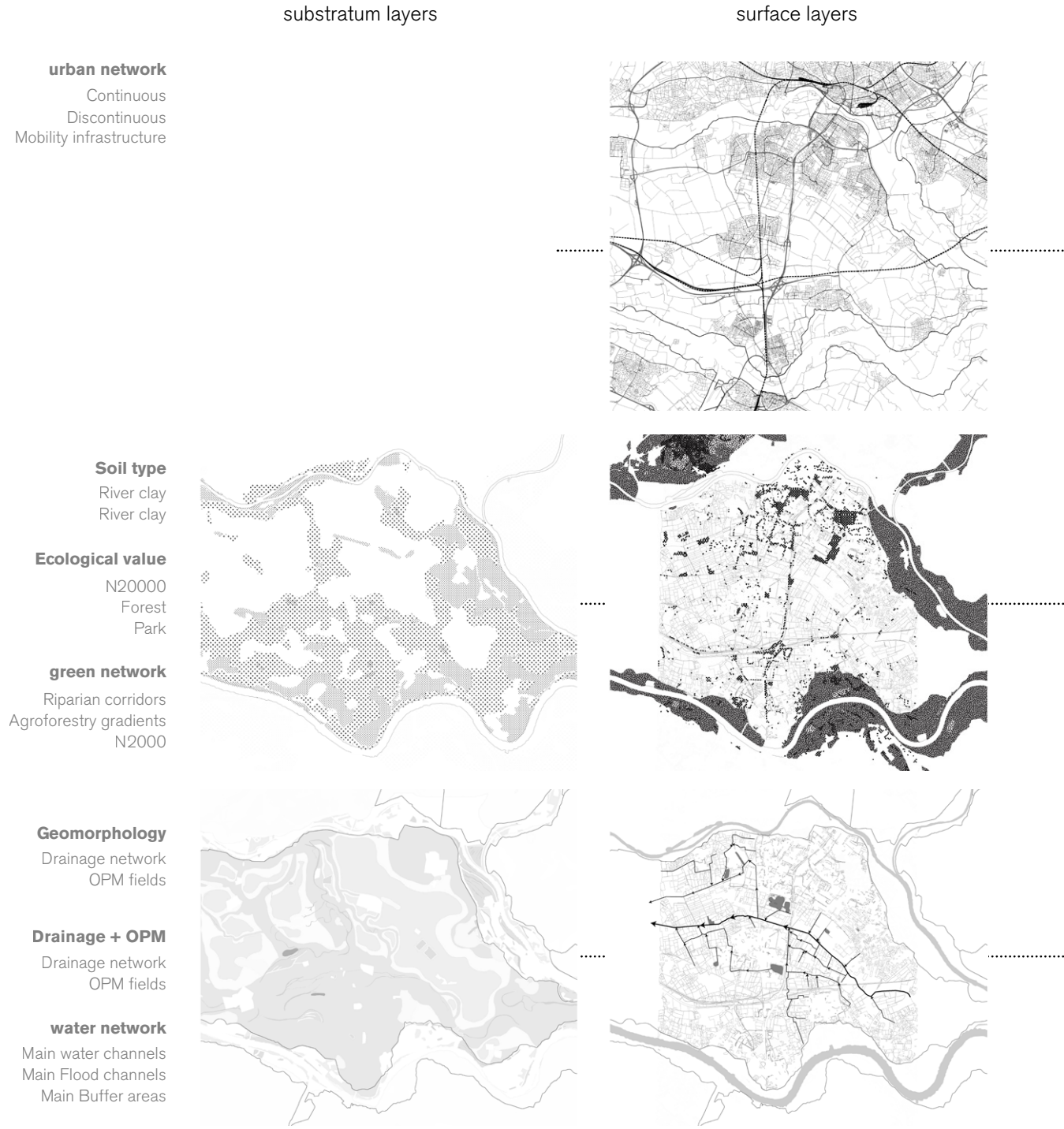


Figure C21.
Arnhem Nijmegen strip
Elaborated by the author
Source: BBBike extracts OpenStreetMap (2020)

Hybridization in the thesis acquires a new dimension related to the key role of land management -economically attached to new ways of ecology-based production- to maintain and expand the water and green network under a culture of land appropriation.

Figure C22.
Structure matrix
Elaborated by the author



STRUCTURE

logic matrix

proposed network

The proposed structural layers -water network, green network and urban network- are defined according to the analysis of subsurface and surface layers as follows:

Urban / hybrid network
The urban network takes as a base the existing continuous and discontinuous areas and the mobility infrastructure.

Green network
The green network is the result of superimposing:
-Soil type: in particular river light sand-clay and river heavy sand-clay, the coarser material characterising former river banks. The drainage capacity of this soil makes it suitable to the restoration of riparian corridors
-Areas with ecological value (N2000, forests and Open Space Matrix
The result is the green network:
The urban network takes as a base the existing continuous and discontinuous areas and the mobility infrastructure.
-Riparian corridors (defined at a city-region level)
-Agroforestry gradients (defined at a patch level) - expanding through hybridization the riparian corridors
-N2000 areas

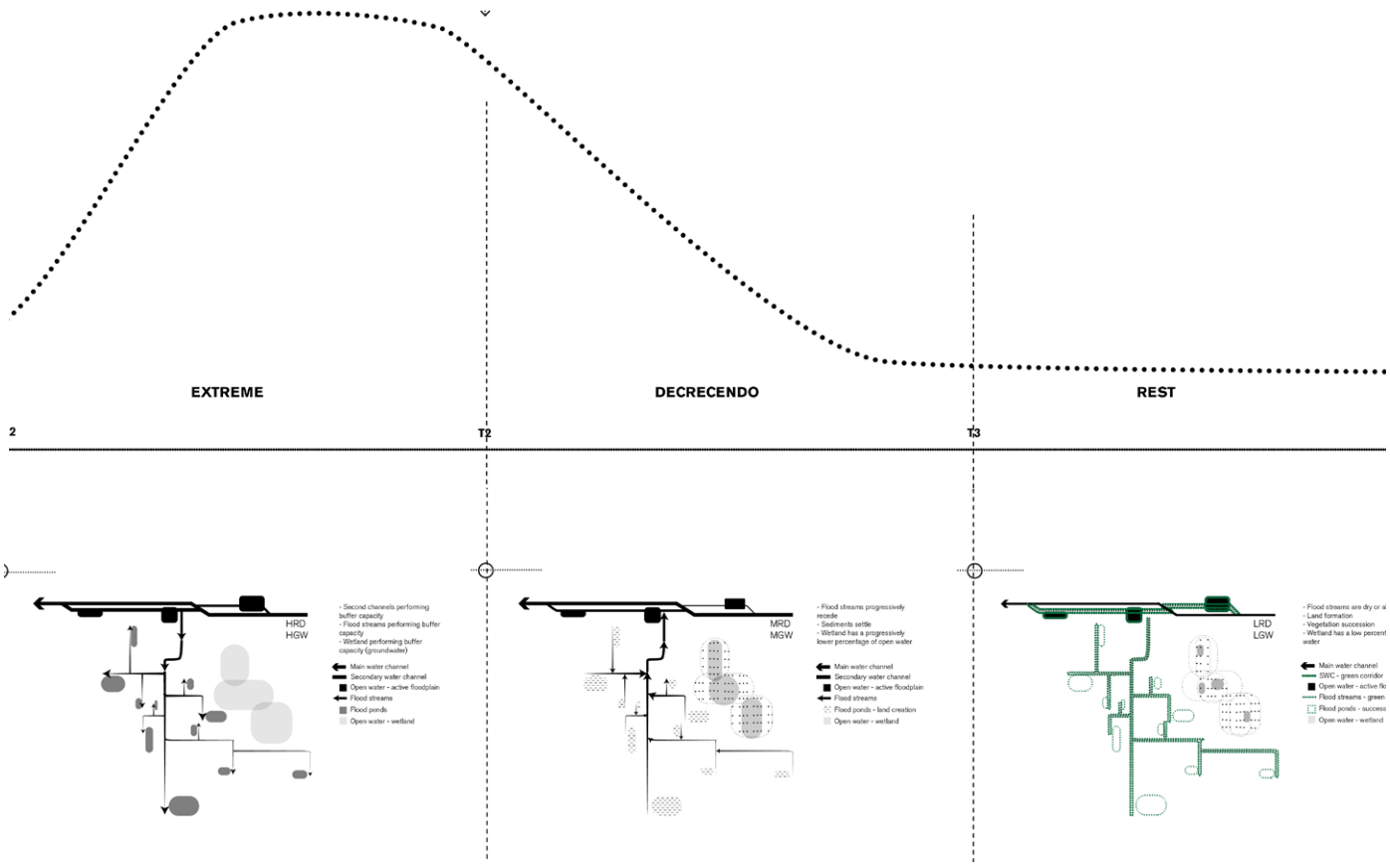
Water network
The water network performs a buffer and drainage capacity depending on the discharge phase (page 198-199)
Its design is the result of superimposing:
-Geomorphology
-Existing drainage system, open water and Open Space Matrix
Resulting in a fractal network composed of:
-Main and secondary water channels
-Flood streams
-Ponds

STRUCTURE

Proposed structural layers

The fluctuating river discharge is characterised in phases. Each phase sets in motion a different performance of the system responding to accomodating functions. This performance is allowed by the fractal-like designed network, where water network and green network

Figure C23.
Network performance according to river discharge
Elaborated by the author

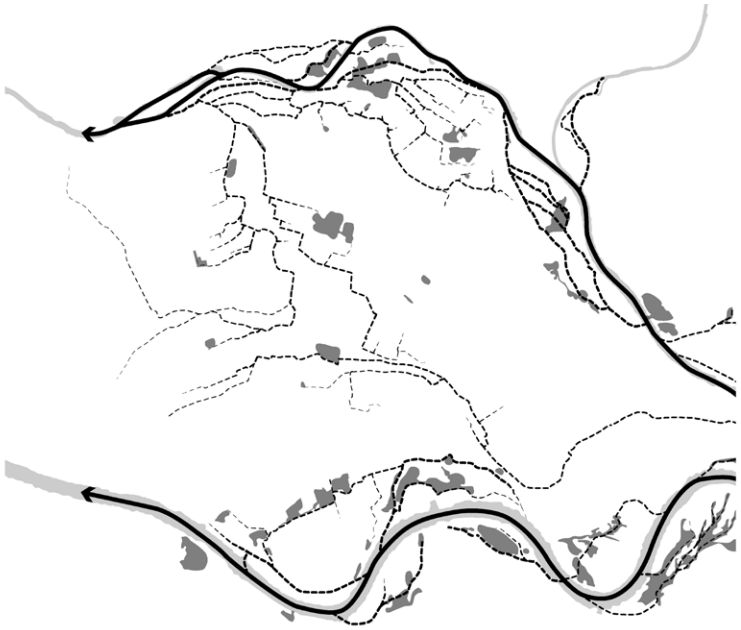


Urban network

- Railway
- Primary roads
- Secondary roads
- Drainage channels
- Dikes

Green network

- Riparian corridors (defined at a city-region level)
- Agroforestry gradients (defined at a patch level)
- N200 areas



Water network

- Main water channels
- Secondary channels
- Main Flood channels
- Main Buffer areas

FUNCTIONAL layers

Detailing functional layers

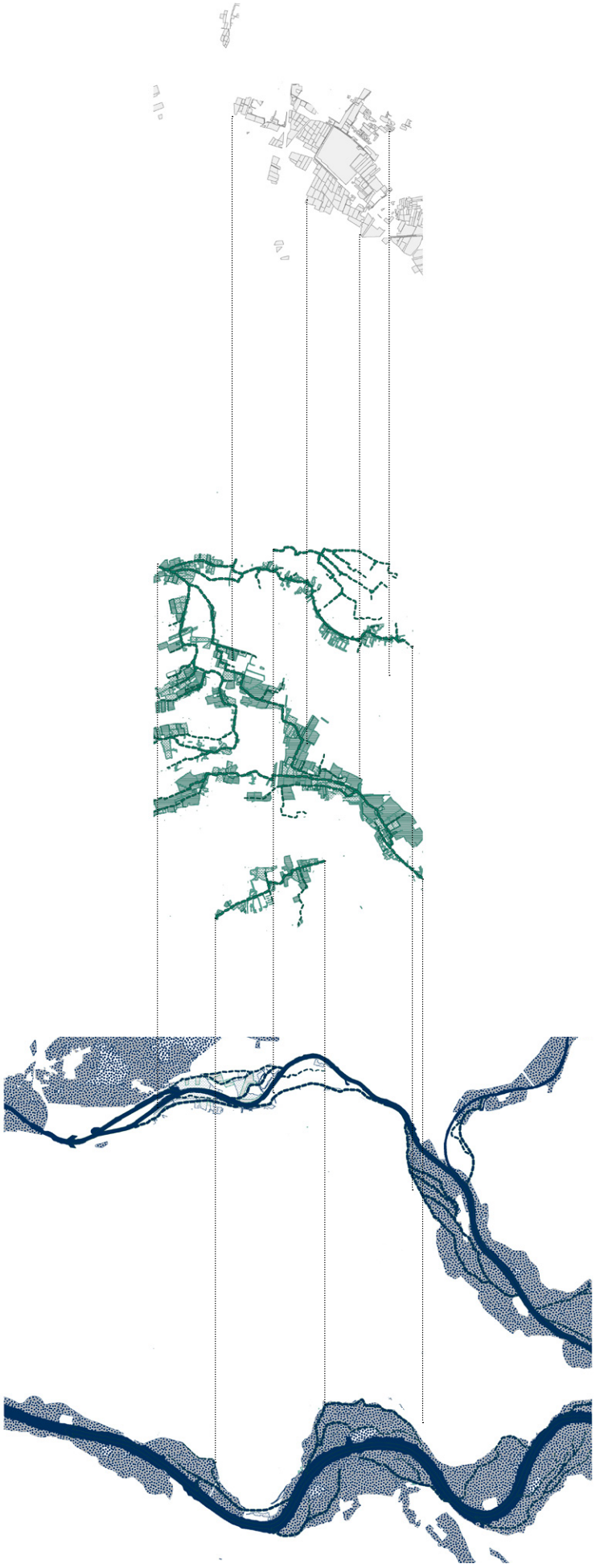


Figure C24.
Functional layers
Elaborated by the author

Productive wetlands

- Permanent Open water
- Flood wetland fields

Green corridors

- Flood streams
- Riparian corridors
- Agroforestry gradients

Blue corridor

- Main water channels
- Secondary water channels
- Flodable areas
- N2000 areas

LEGEND

urban network

- Railway
- Primary roads
- Secondary roads
- Drainage channels
- Dikes

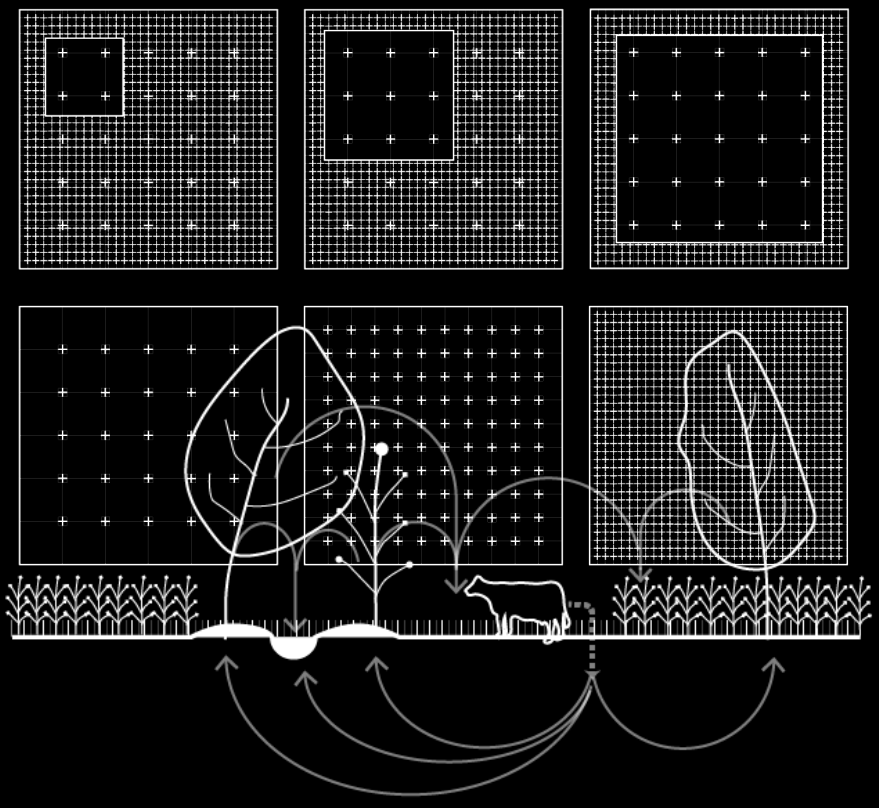
water network

- Main water channels
- Secondary channels
- Main Flood channels
- Main Buffer areas

green network

- Riparian corridors
- Agroforestry gradients
- N2000

Figure C25.
Functional layers
Elaborated by the author



Detail scale

NANO SCALE

PATCH / LAND USE

Gradients of transformation

main transformation

- Buffer capacity per patch
- Ecological density per patch

layers / legend

Open Space Matrix: pasture, arable land, forest, no-use
Built up Matrix: discontinuous 0-10, 10-30, continuous 30-50

concepts / theories

Local adaptation (Davoudi, 2013), Re-programming (Wall, 1999)

Figure C26.
Ecological density transformation legend
Elaborated by the author

TRANSFORMATION GRADIENTS*

Land use / Land cover

The transformation of the territory is not about a final design working for a specific maximum discharge, but open-ended. In this sense, the transformation is presented as gradients per land use type, where the landowner initiates the re-programming towards hybridization given the benefits and values this gives to their land and economy.

The chapter is structured according to the three functional layers defined by the regional vision: green corridor, blue corridor and productive wetland. Each layer is decomposed in a family of transformations that responds to the layer field conditions.

The general concepts used throughout the chapter are:

Buffer capacity (BC)
Corresponds to the capacity of the patches to receive water from the river to the land.
Ecological density (EC)
Corresponds to the intensity of aforestation in steps of 16m, 9m and 3m distance among trees.
Systemic performance
The systemic performance is a layer added in the sections that indicates the values coming from the hybridization of the land use of departure.
Transformation pathways
The pathways that the hybridization can take at the election of the landowner.

Diagram on performance of the soil / ecological density
The diagram is located above the genealogies to indicate how the below transformations towards higher degrees of ecological density are associated with better soil performances. This is beneficial at a global level, mitigating floods through high infiltration rates of the soil, but also at a local level, by delivering more healthy and fertile soils (see page 132-133)

* The investigation on the gradients of ecological density per land use as well as its innovative representation by modules of 1ha and section is extrapolated from the unpublished project on NEXT-EXTREMES: Constructed Natures Beyond the limits of the city - Cultivating territories as a counteract to extreme weather and environmental loss (2018-2020) within the framework of the Interdisciplinary Research Group Delta Urbanism. Building upon this research contextualized in the Dutch Randstad, the thesis explores its application for the different functional layers of the Rivierenland, adding a new complexity on the relation between ecological density and buffer capacity of the land use patches, and implementing the idea of the transformation pathways.

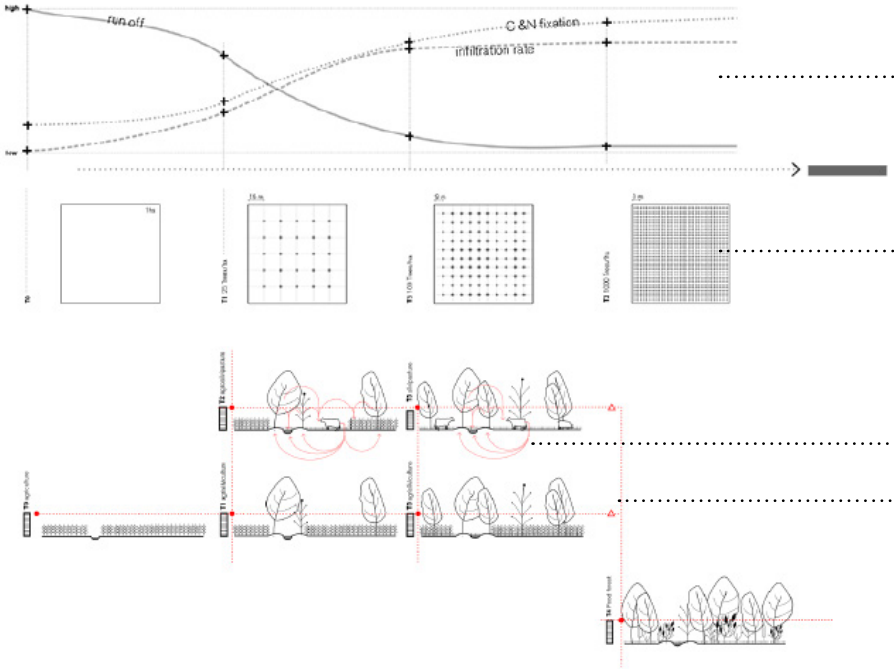


diagram soil performance / ecological density

ecological density gradients: 16m, 9m, 3m

systemic performance

transformation pathways

Figure C27.
Buffer capacity transformation legend
Elaborated by the author

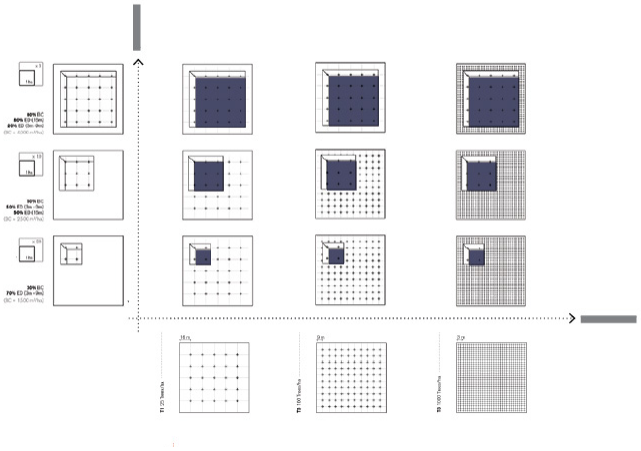
Figure C28.
Green corridor Arnhem Nijmegen city region
Elaborated by the author

GREEN CORRIDOR - HYBRIDIZATION GRADIENTS

Arnhem Nijmegen City Region

The hybridization gradients within the green corridor explore how the increase of ecological density per land use is translated into different programs and values, being the food forest the program with maximum ecological density (3m).

In this functional layer, the exploration on the relation buffer capacity / ecological density is key to the understanding of the role of the green corridor in the water network. As the diagram shows (figure 27), the buffer capacity has the potential to be highest when the tree density is low. The hybridization of this condition per patch is size-dependent and it is presented in a gradient of 80-50-30 % buffer capacity ratio. The smaller the patch is (3-10ha) the less interesting it is to have smaller buffer capacity ratios, as the contribution to buffer river discharge is less and less significant. The relation buffer capacity/ecological density is also explored in built environments.



Legend:

Open Space Matrix
pasture
arable land
forest
herbaceous / no use

Build Up Matrix
Discontinuous 10-30
Continuous 30-50

Flood streams
Main water channel
Secondary channels
1km grid

VALUES OF HYBRIDIZATION

On holistic land management

“The energies coming into our system are such natural forces as sun, wind and rain. Living components and somee technological or non-living units built into the system translate the incoming energies into useful reserves, which we can call resources”
Bill Mollison (Permaculture - A designer’s manual) in Murakami (1991)

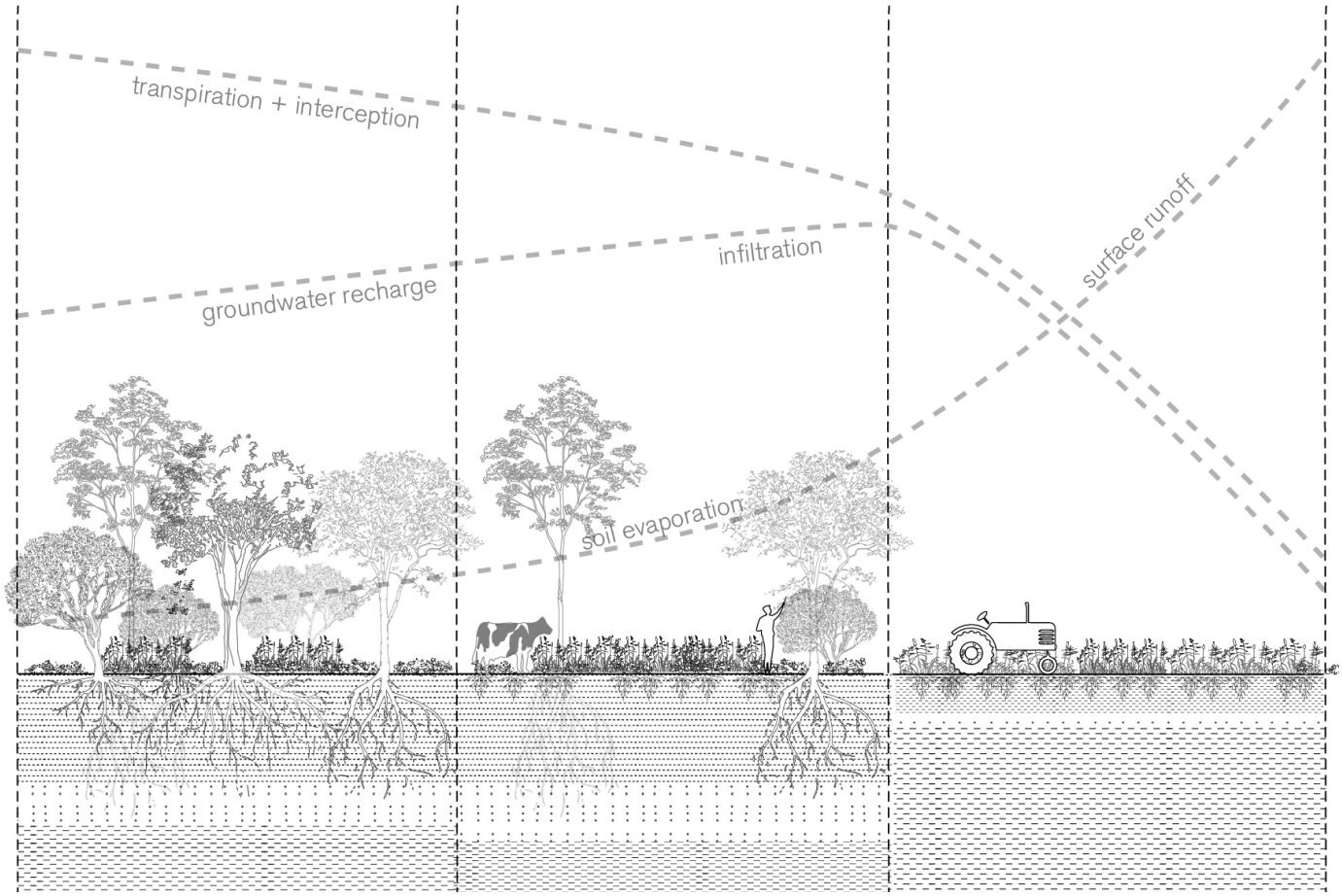
“Western patriarchy’s highly energy-intensive, chemical-intensive, water-intensive and capital-intensive agricultural techniques for creating deserts out of fertile soils in less than one or two decades has spread rapidly across the third world as agricultural development, accerelated by the Green Revolution and financed by international development and aid agencies”
Vandana Shiva (Staying Alive) in Murakami (1991)

Figure C29.
Soil Performance for different agricultural approaches
Elaborated by the author (within the framework of NEXT-EXTREMES: Constructed Natures Beyond the limits of the city - Cultivating territories as a counteract to extreme weather and environmental loss (2018-2020, unpublished)

According to Murakami (1991), in agricultural systems, the hybridization (increased of ecological density) is associated to a holistic land management and other techniques of regenerative agriculture. This systems mimic the systemic relations happening in the natural ecosystem, the forest characterised by:

- Continuous soil formation,
- Maximization of soil organic matter,
- Resistance to pathogens and insects,
- Nutrients retention,
- High functioning of soil microbiome,
- High precipitation use efficiency, and
- No fossil fuel dependence.

While current agricultural systems are annual-low diversity, the proposed hybridization gradients introduce a system of perennial-moderate diversity to perennial-high diversity (food forest) which creates the closest ecosystem to the forest.



Natural ecosystem

In the natural ecosystem characterised by perennial-High Diversity there is a continuous soil formation, maximization of soil organic matter, resistance to pathogens and insects, nutrients retention, high functioning of soil microbiome, high precipitation use efficiency and no fossil fuel dependance.

Within the gradients, this ecosystem is imitated to its maximum level by the food forest

Agriculture

Holistic land management & other techniques of regenerative agriculture

Healthy soil as carbon sink:
-More ground cover
-More roots
-More carbon stored in soil
-More water retention in topsoil
-Recovering groundwater levels
-Less erosion
-More bioproductivity
-More diversity
-Less carbon in the atmosphere

Conventional land management & industrial agriculture

Depleted soil as carbon source:
-Less ground cover
-fewer roots
-less carbon stored in soil
.Less water retention in topsoil
-Depleting groundwater
-More erosion
-Less bioproductivity
-Less diversity
-More carbon in the atmosphere

TRANSFORMATION GENEALOGY

Green corridor

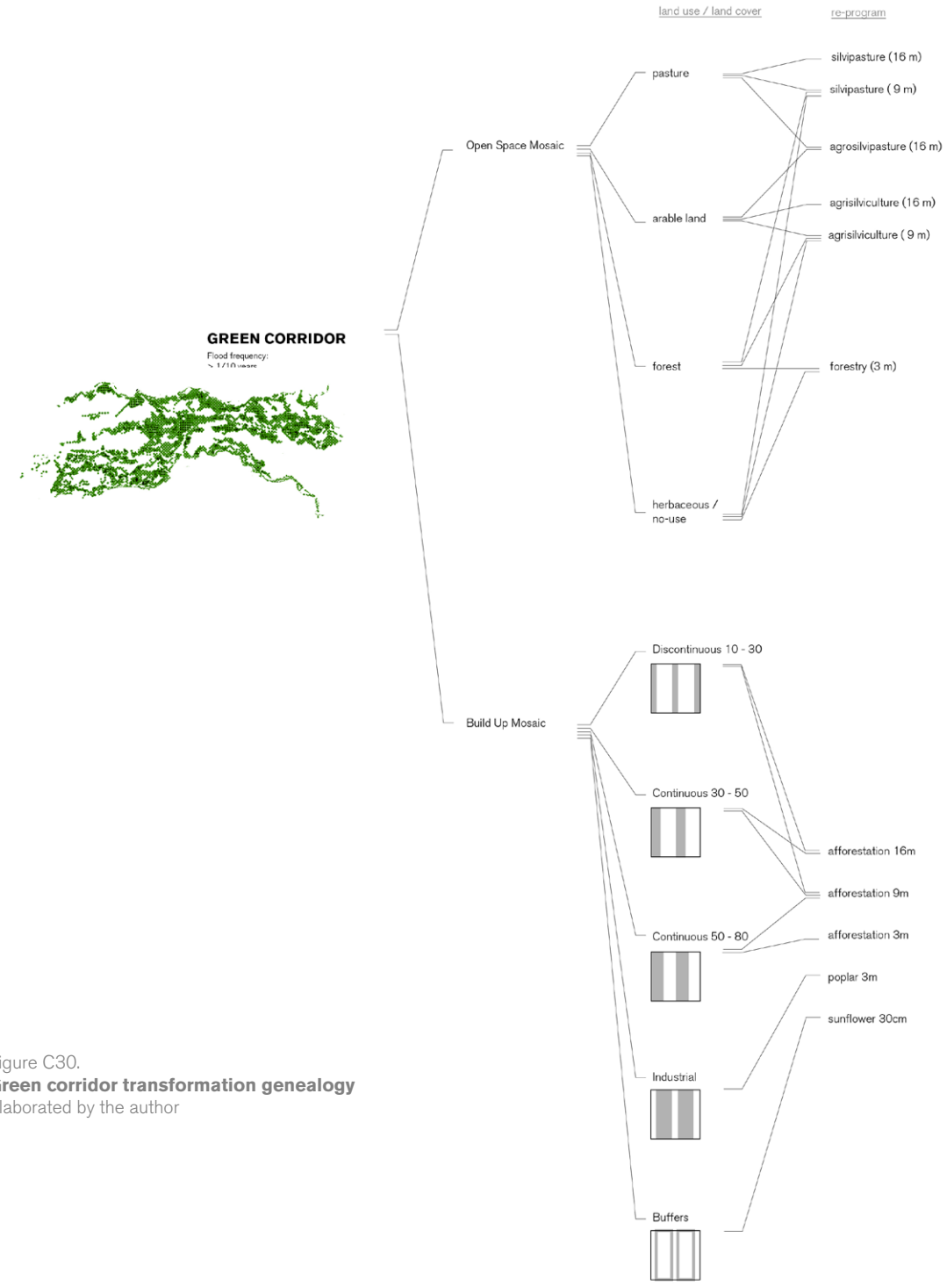


Figure C30.
Green corridor transformation genealogy
Elaborated by the author


T0 35% OSR
T0 60% OSR
T0 80% OSR
T0 no use
T0 forest
T0 agriculture
T0 pasture
T0
1ha
T1 35% Afforestation
T1 60% Afforestation 16m
T1 80% Agrosilviculture 16m
T1 park
T1 agrisilviculture
T1 silvipasture
T1 25 Trees/ha
16 m
T2 35% Agrosilviculture
T2 60% Agrosilviculture 16m
T2 80% Agrosilvipasture 16m
T2 agrosilvipasture
T3 35% Agrosilviculture
T3 60% Agrosilviculture 9m
T3 80% Agrosilviculture 9m
T3 park
T3 agrisilviculture
T3 silvipasture
T3 100 Trees/ha
9 m
T4 35% Food forest
T4 60% Food forest 3m
T4 80% Food forest 3m
T4 Food forest
T3 1000 Trees/ha
3 m

AGROFORESTRY GRADIENTS
pasture

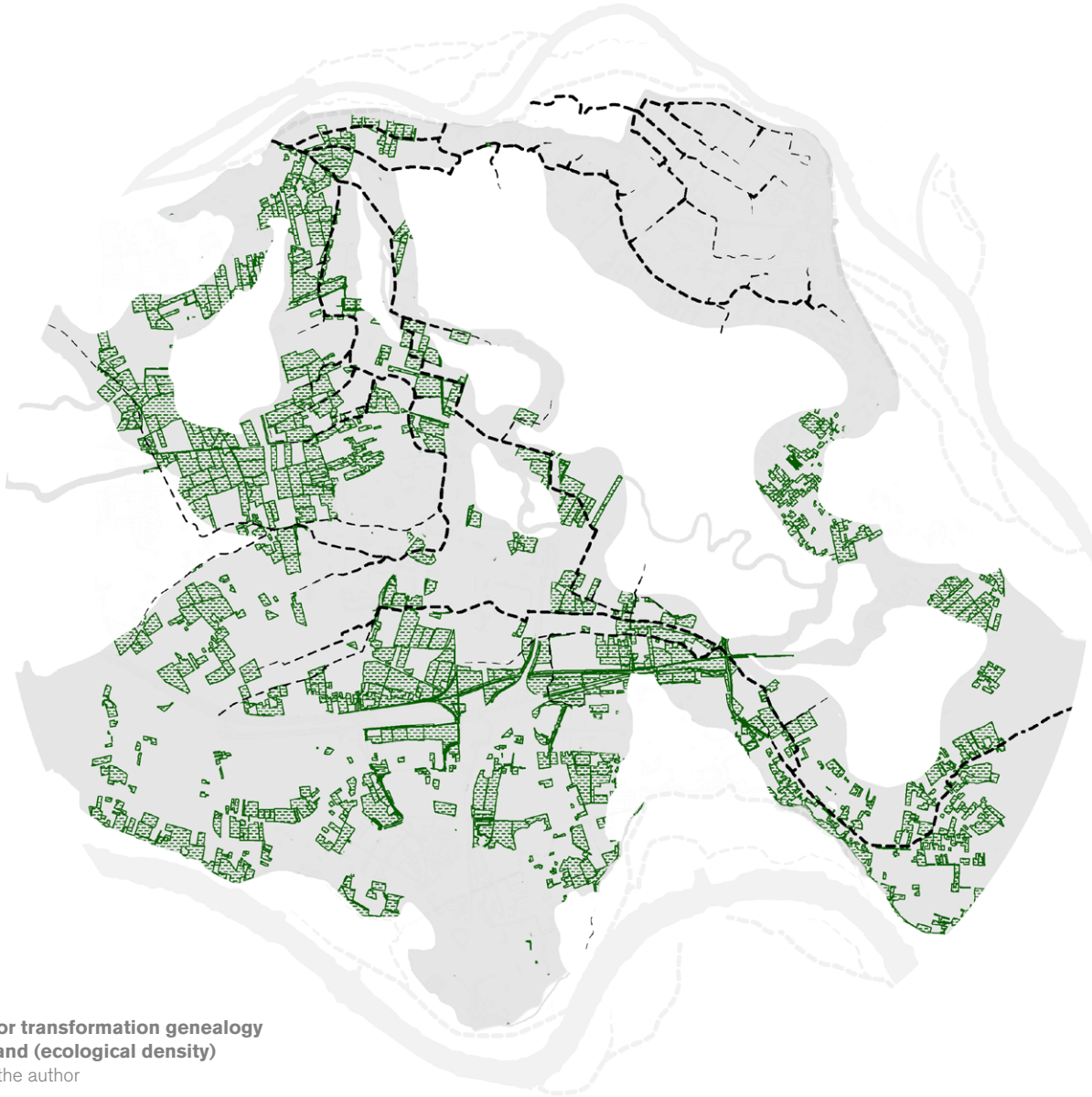
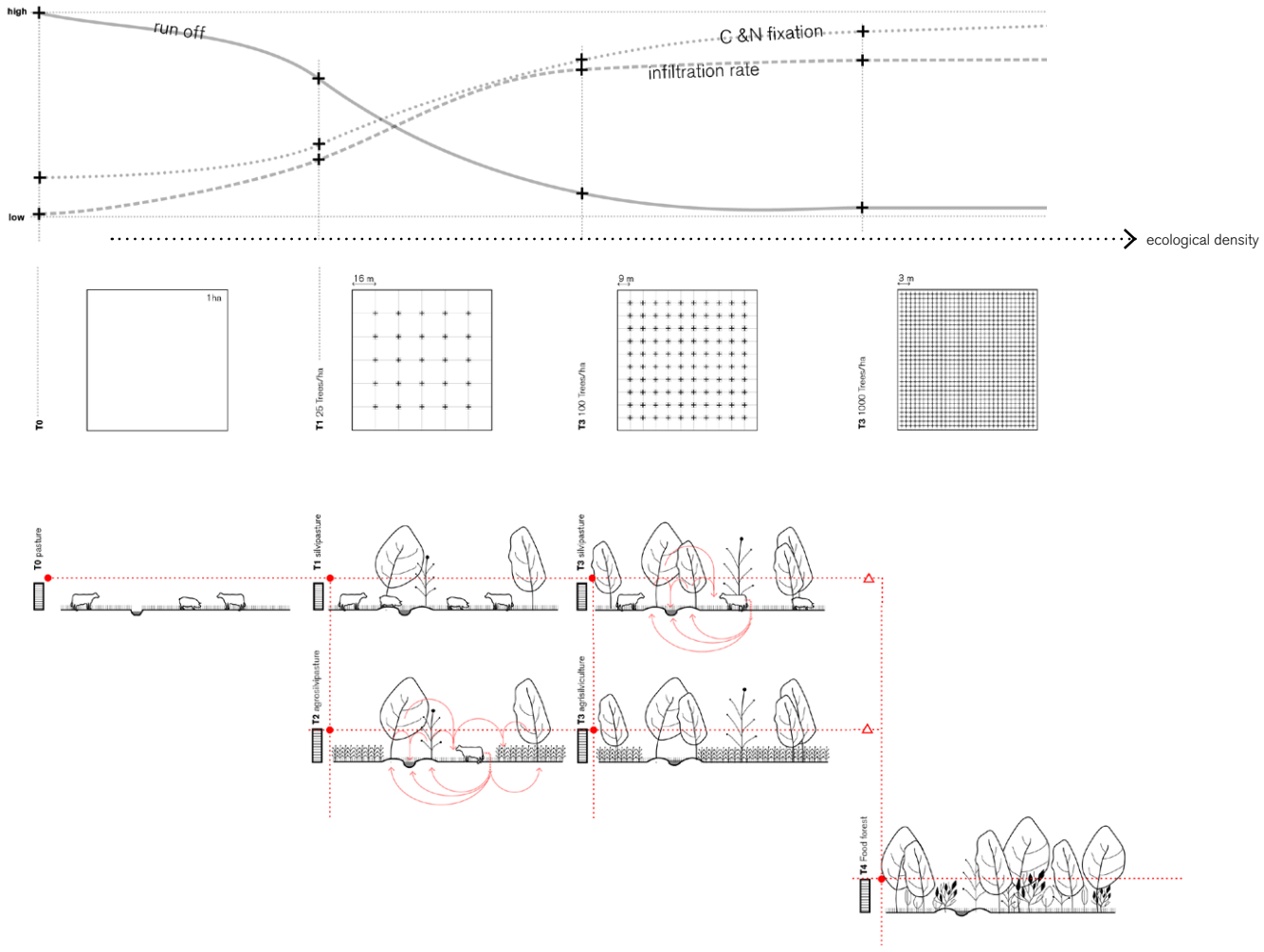


Figure C31.
Green corridor transformation genealogy for pasture land (ecological density)
Elaborated by the author


high
low
run off
C &N fixation
infiltration rate
ecological density
T0
1 ha
T1 25 Trees/ha
16 m
T3 100 Trees/ha
9 m
T3 1000 Trees/ha
3 m
T0 pasture
T1 silvipasture
T3 silvipasture
T2 agrosilvipasture
T3 agrisilviculture
T4 Food forest

BUFFER CAPACITY GRADIENTS
pasture

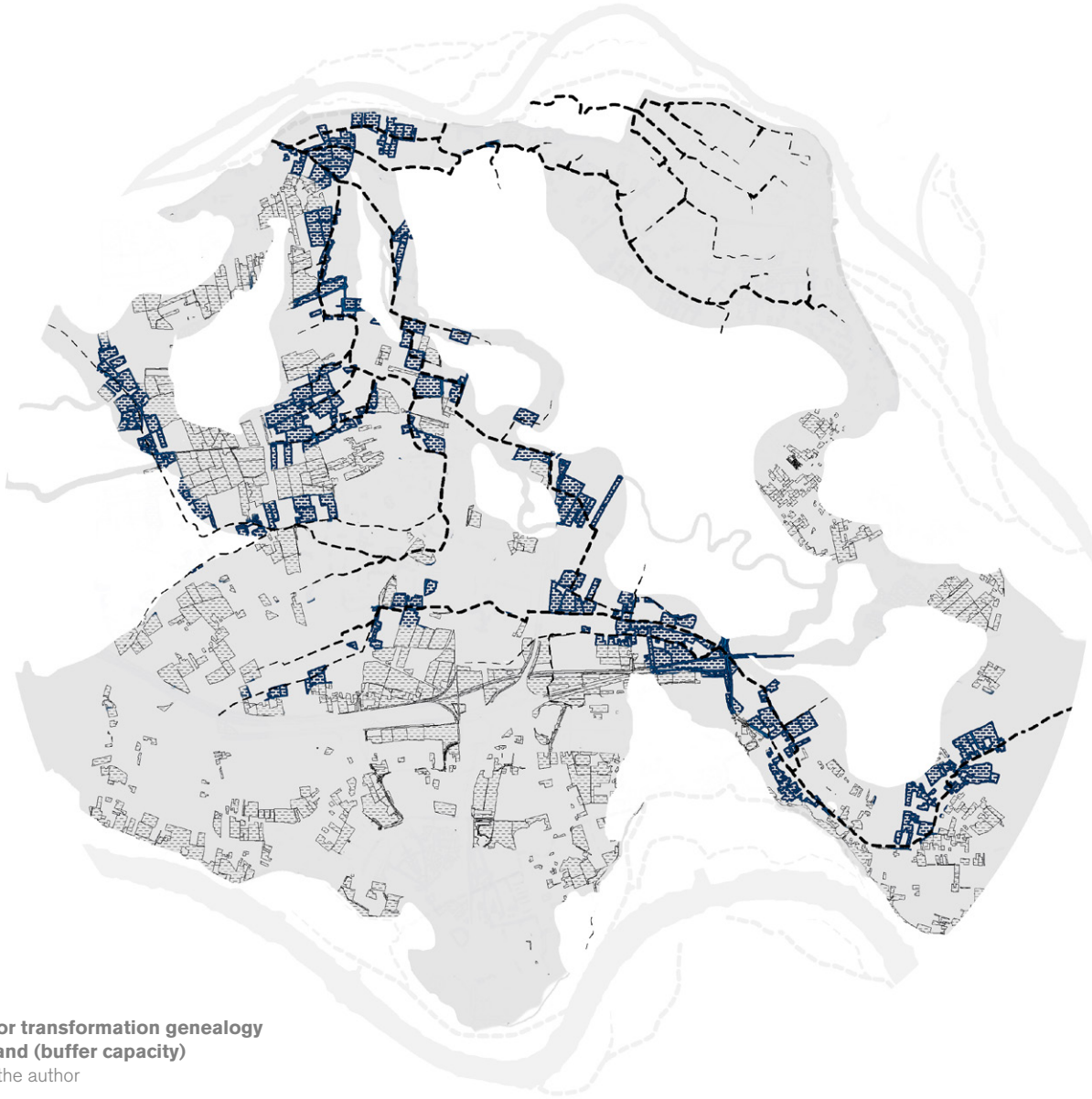
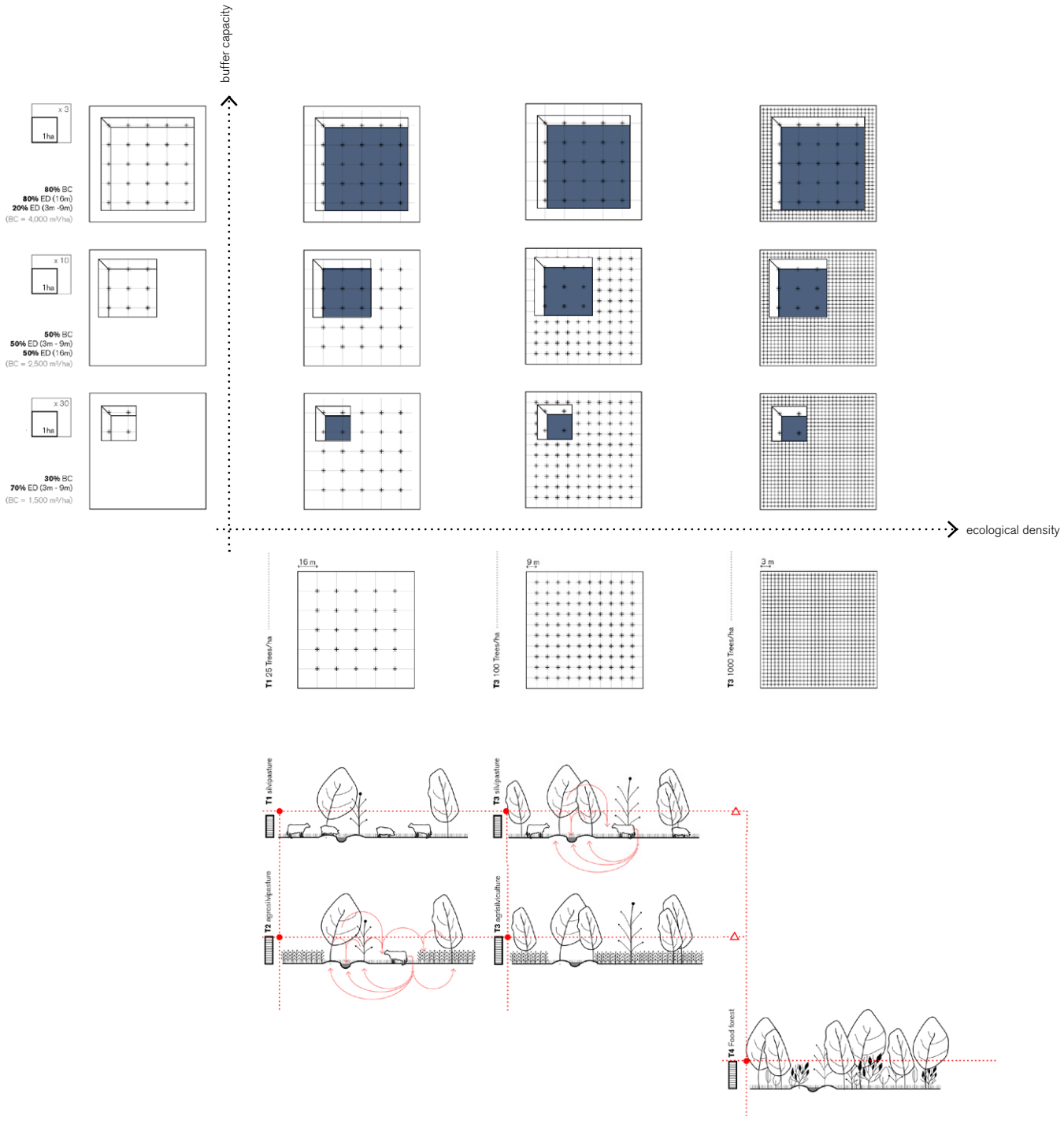


Figure C32.
Green corridor transformation genealogy for pasture land (buffer capacity)
Elaborated by the author


buffer capacity
x 3
1ha
80% BC
80% ED (16m)
20% ED (3m -9m)
(BC = 4,000 m³/ha)
x 10
1ha
50% BC
50% ED (3m - 9m)
50% ED (16m)
(BC = 2,500 m³/ha)
x 30
1ha
30% BC
70% ED (3m - 9m)
(BC = 1,500 m³/ha)
ecological density
16 m
9 m
3 m
T1 25 Trees/ha
T2 100 Trees/ha
T3 1000 Trees/ha
T1 silvipasture
T3 silvipasture
T2 agrosilvipasture
T3 agrisilviculture
T4 Food forest

AGROFORESTRY GRADIENTS
arable land

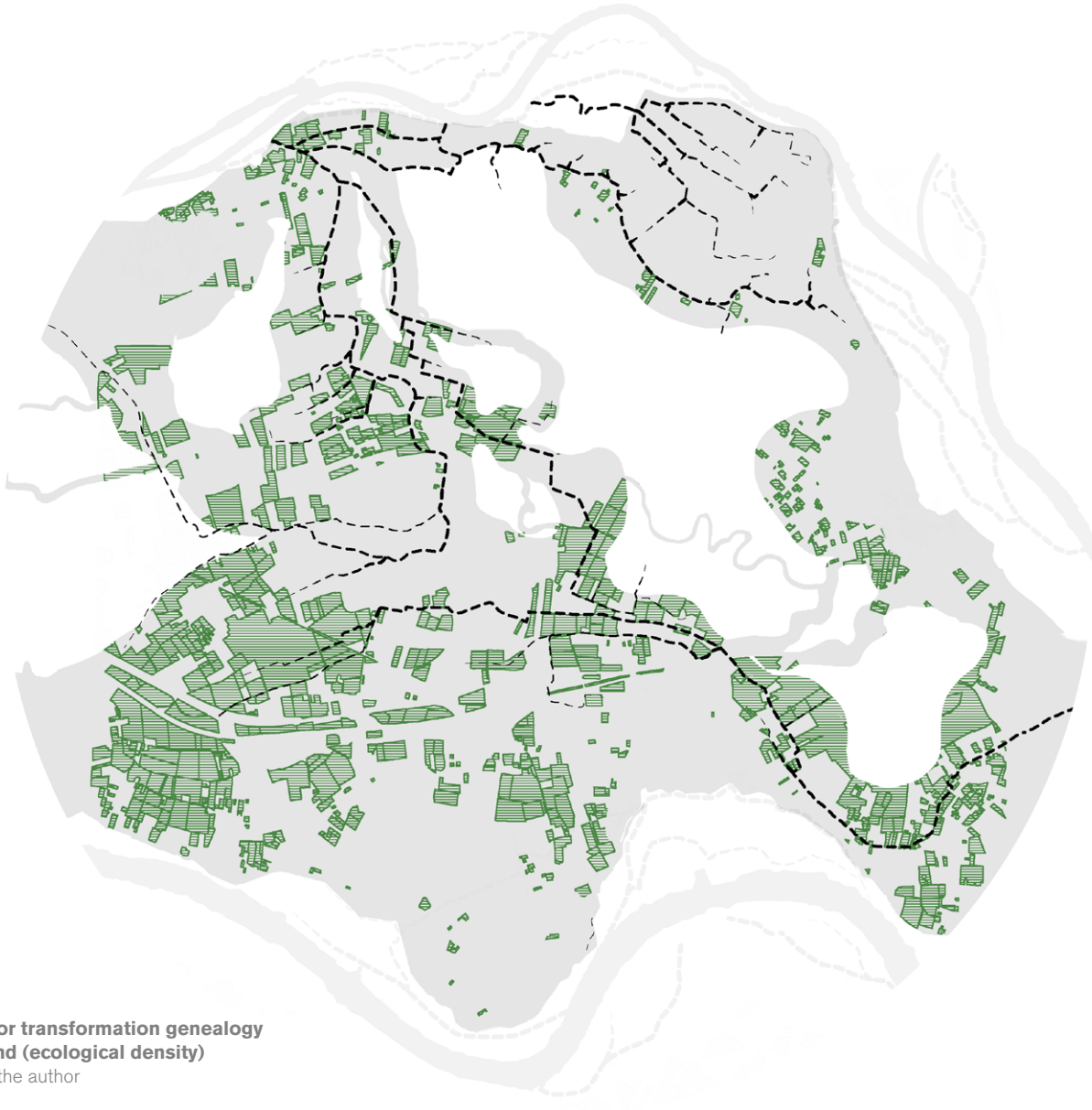
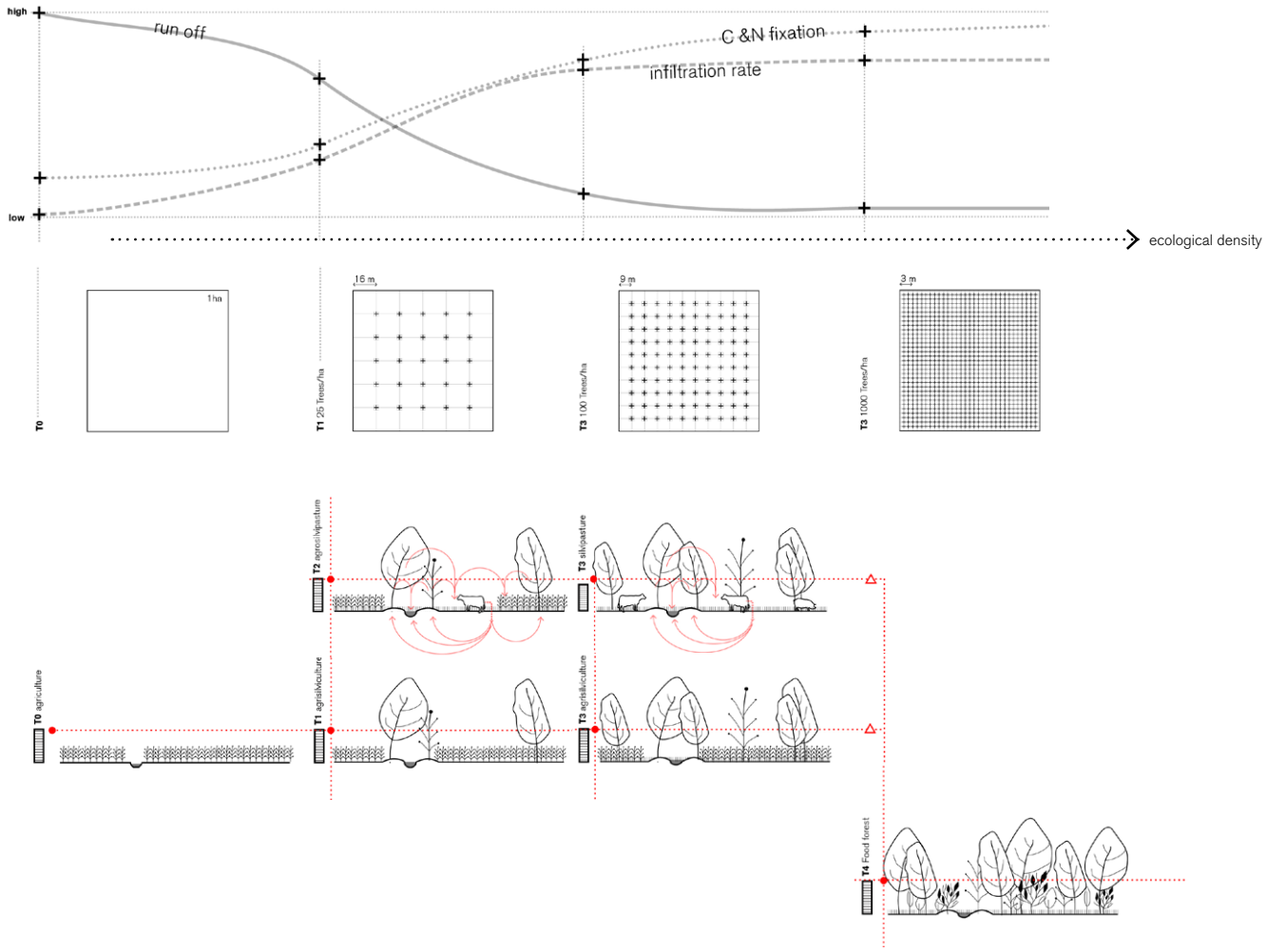


Figure C33.
Green corridor transformation genealogy for arable land (ecological density)
Elaborated by the author


high
low
run off
C &N fixation
infiltration rate
ecological density
T0
1 ha
T1 25 Trees/ha
16 m
T3 100 Trees/ha
9 m
T3 1000 Trees/ha
3 m
T0 agriculture
T1 agrisilviculture
T2 agrosilvipasture
T3 agrisilviculture
T3 silvipasture
T4 Food forest

BUFFER CAPACITY GRADIENTS
arable land

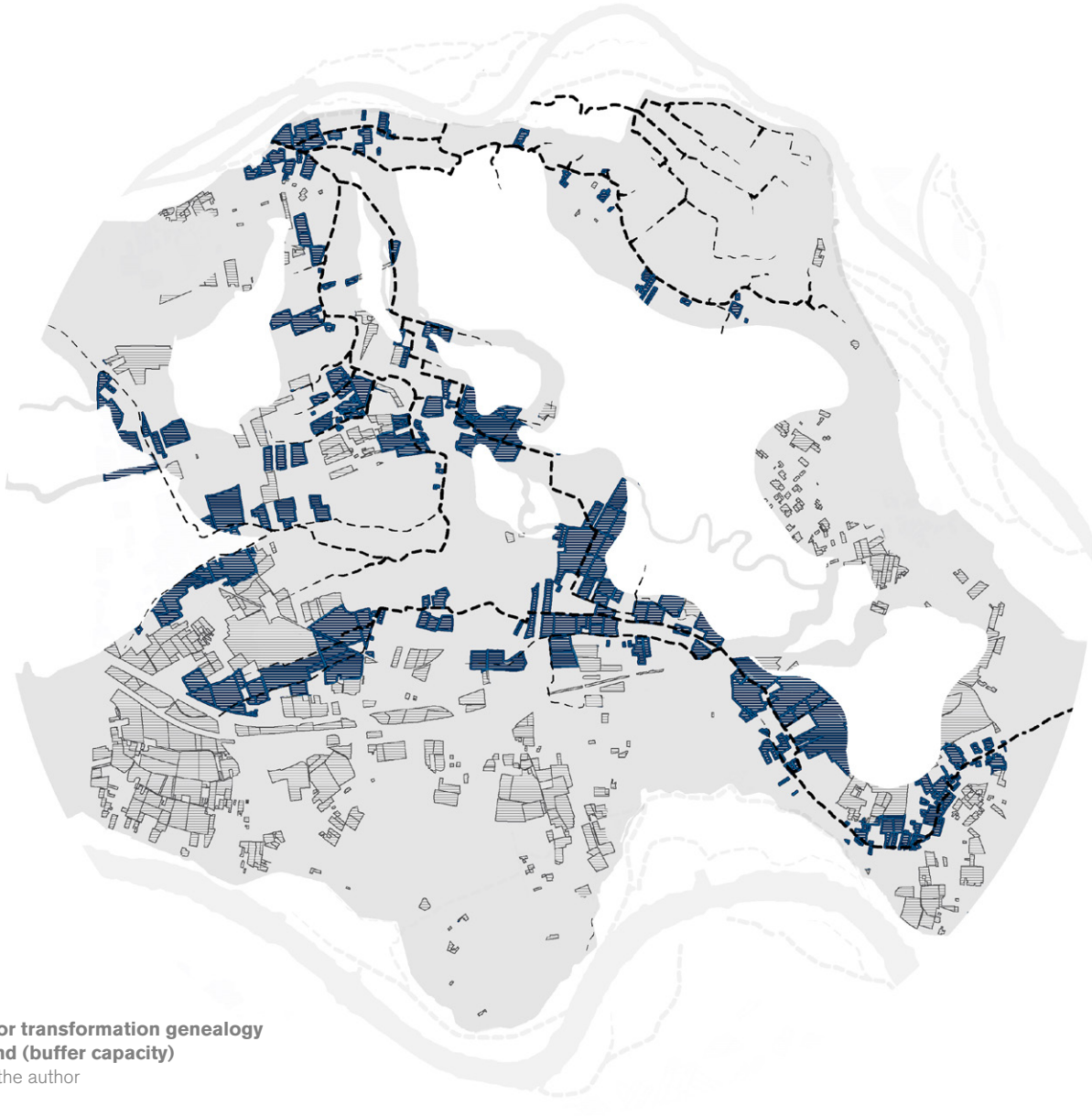
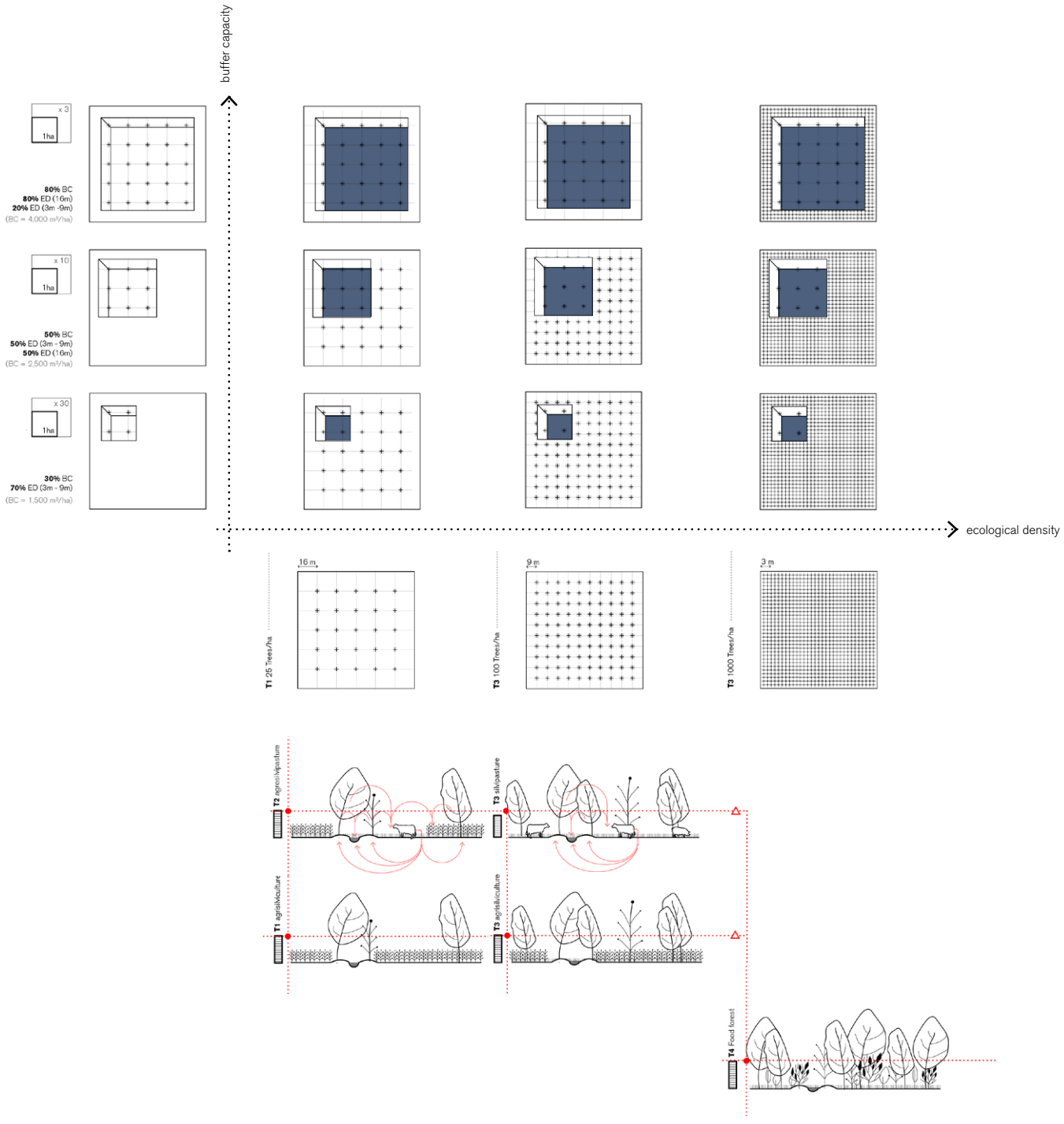


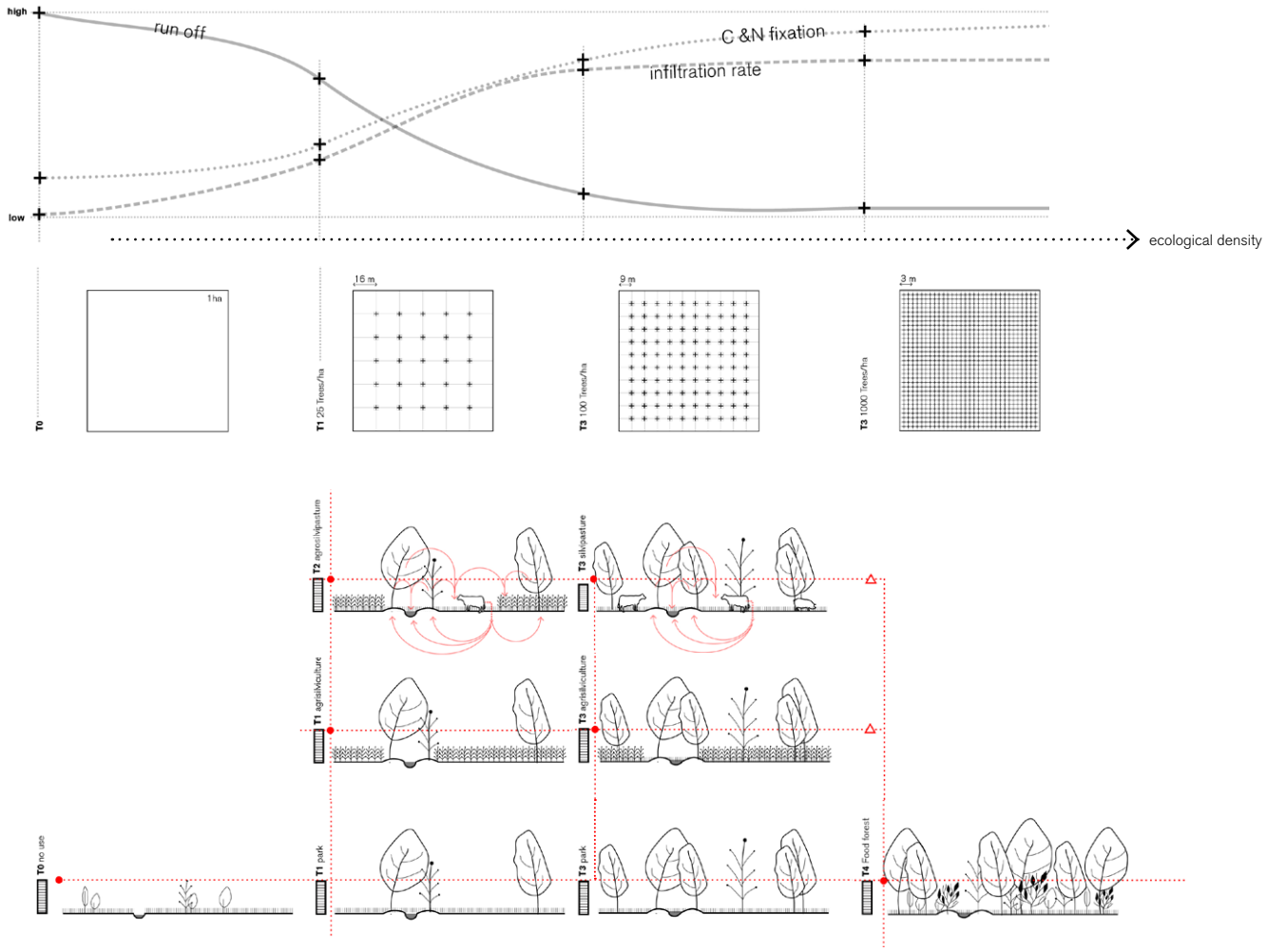
Figure C34.
Green corridor transformation genealogy for arable land (buffer capacity)
Elaborated by the author


buffer capacity
x 3
1ha
80% BC
80% ED (16m)
20% ED (3m -9m)
(BC = 4,000 m²/ha)
x 10
1ha
50% BC
50% ED (3m - 9m)
50% ED (16m)
(BC = 2,500 m²/ha)
x 30
1ha
30% BC
70% ED (3m - 9m)
(BC = 1,500 m²/ha)
ecological density
16 m
9 m
3 m
T1 25 Trees/ha
T3 100 Trees/ha
T3 1000 Trees/ha
T2 agrosilvipasture
T3 silvipasture
T1 agrisilviculture
T3 agrisilviculture
T4 Food forest

AGROFORESTRY GRADIENTS

no-use

Figure C35.
Green corridor transformation genealogy for no-use land (ecological density)
Elaborated by the author


high
low
run off
C &N fixation
infiltration rate
ecological density
T0
1 ha
T1 25 Trees/ha
16 m
T2 100 Trees/ha
9 m
T3 1000 Trees/ha
3 m
T0 no use
T1 park
T1 agrisilviculture
T2 agrosilvipasture
T3 park
T3 agrisilviculture
T3 silvipasture
T4 Food forest

BUFFER CAPACITY GRADIENTS

no-use

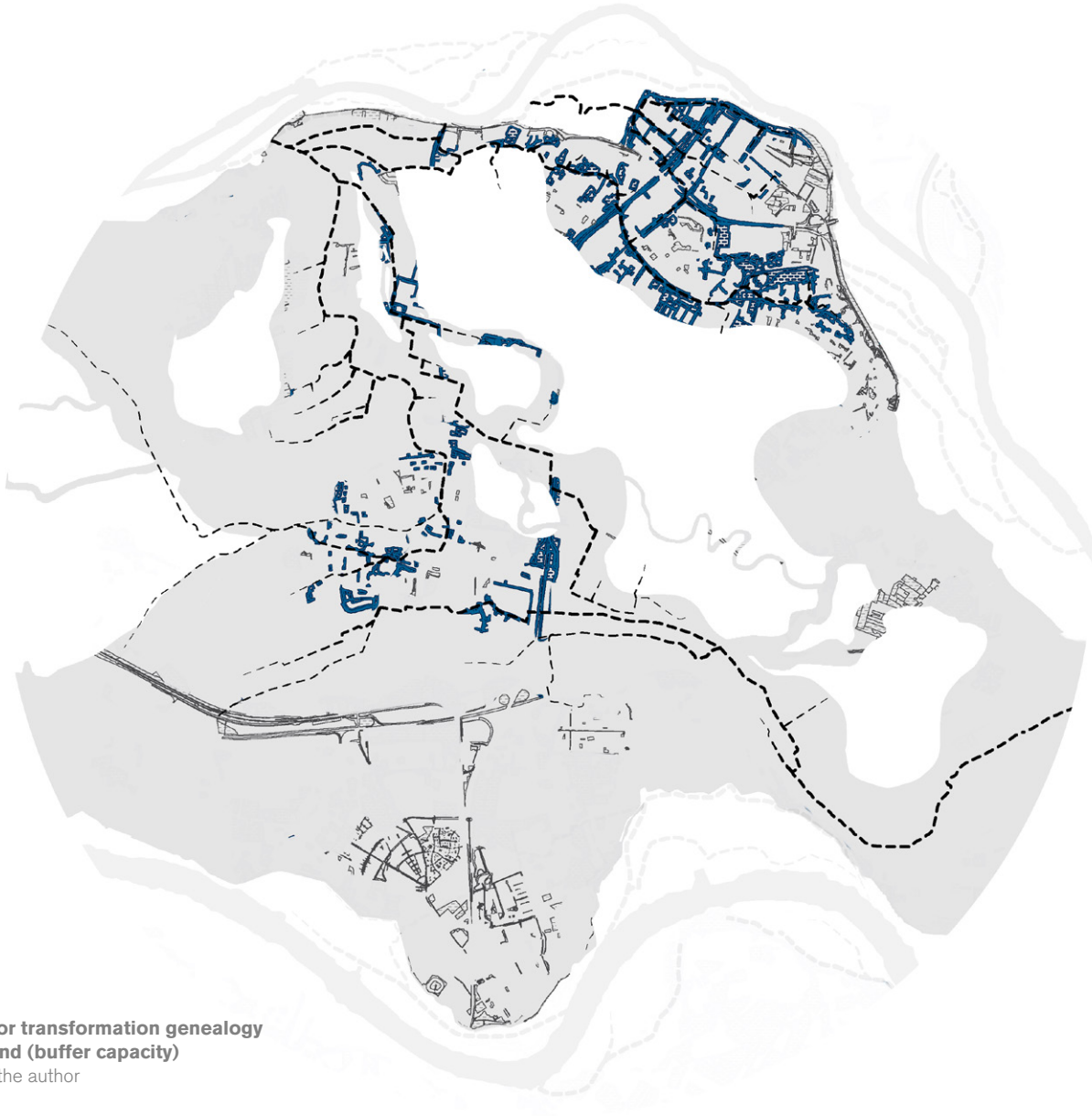
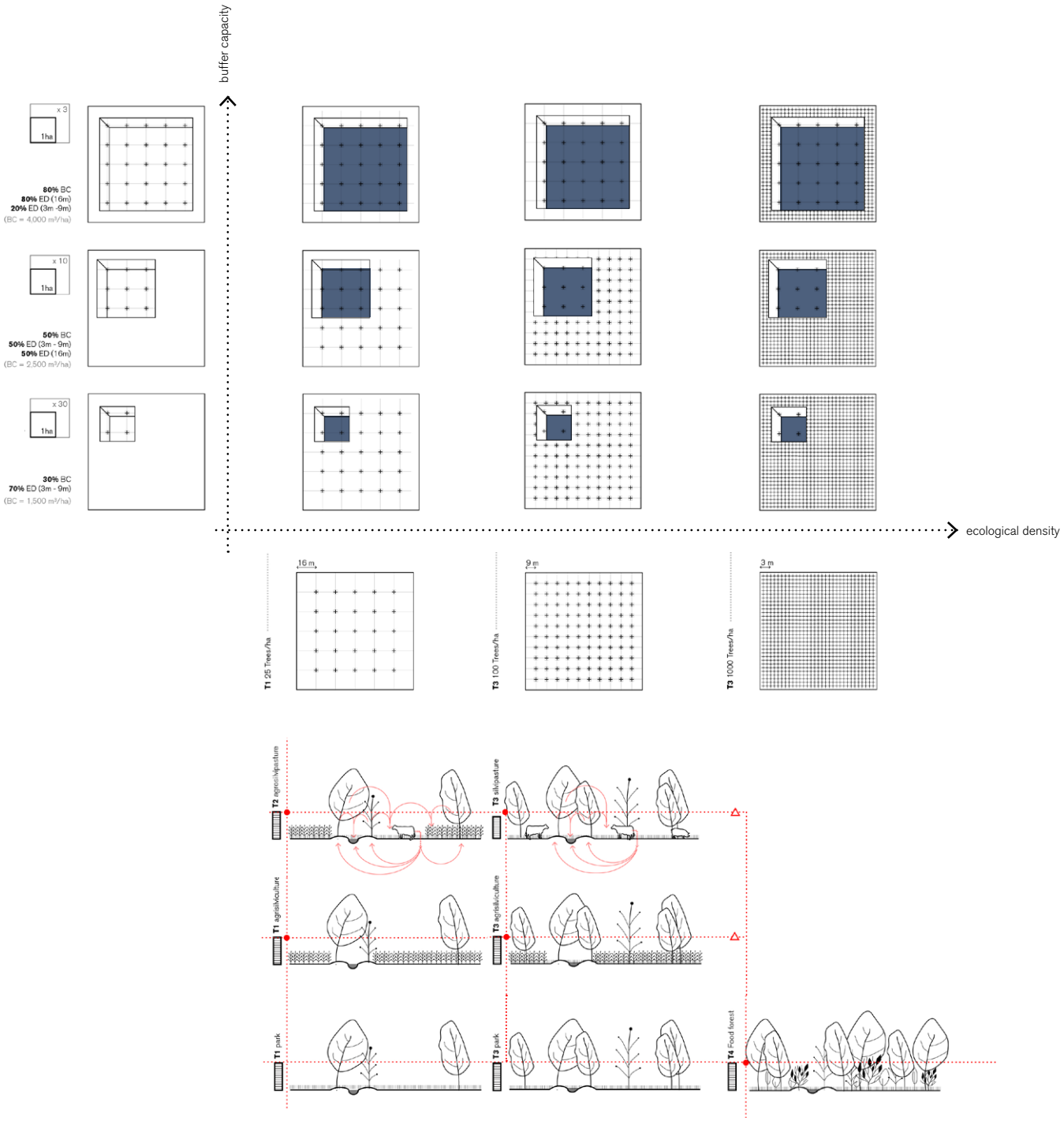


Figure C36.
Green corridor transformation genealogy for no-use land (buffer capacity)
Elaborated by the author


buffer capacity
x 3
1ha
80% BC
80% ED (16m)
20% ED (3m -9m)
(BC = 4,000 m²/ha)
x 10
1ha
50% BC
50% ED (3m - 9m)
50% ED (16m)
(BC = 2,500 m²/ha)
x 30
1ha
30% BC
70% ED (3m - 9m)
(BC = 1,500 m²/ha)
ecological density
16 m
9 m
3 m
T1 25 Trees/ha
T3 100 Trees/ha
T3 1000 Trees/ha
T2 agrosilvipasture
T3 silvipasture
T1 agrisilviculture
T3 agrisilviculture
T1 park
T3 park
T4 Food forest

AGROFORESTRY GRADIENTS
forest

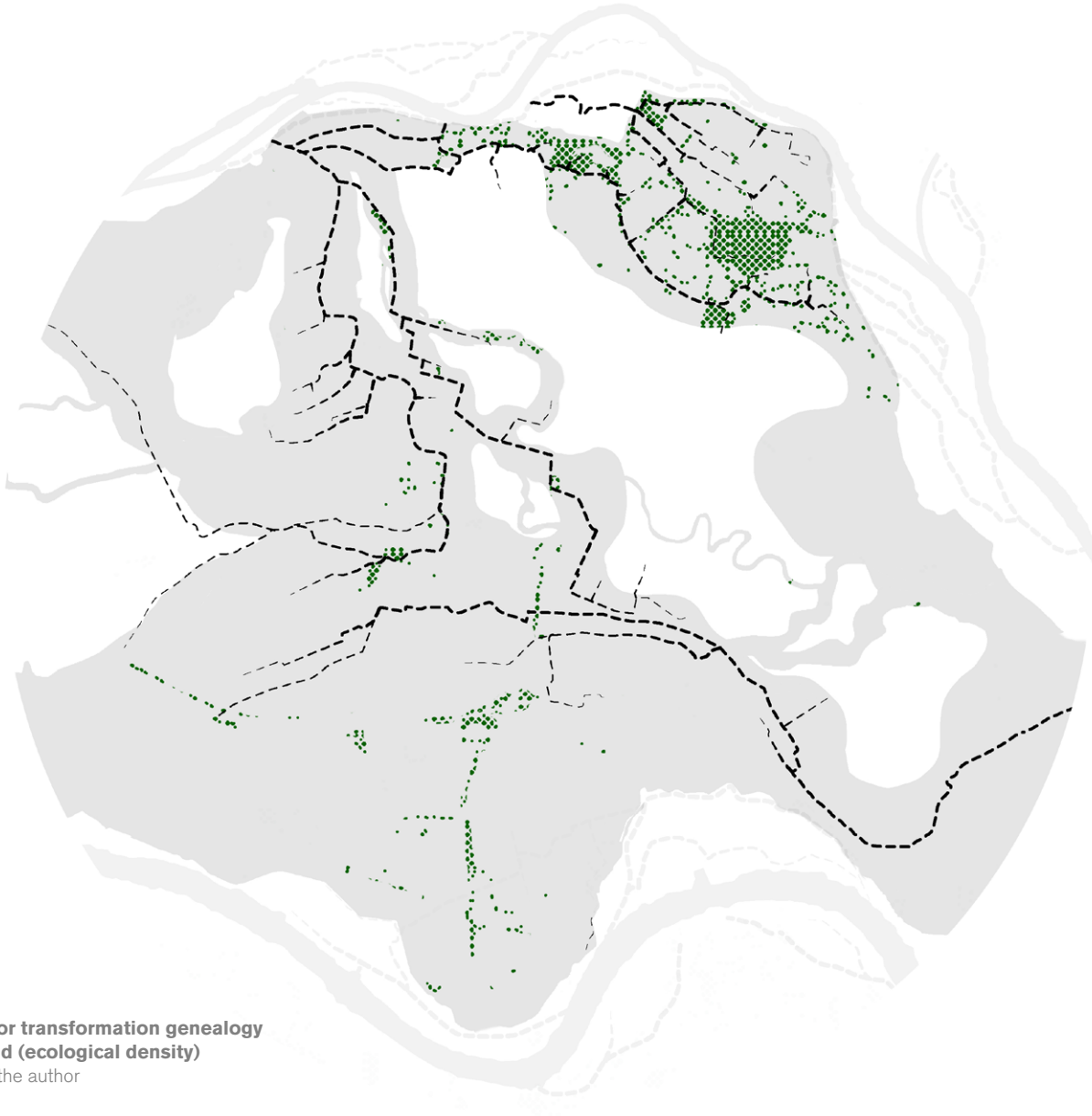
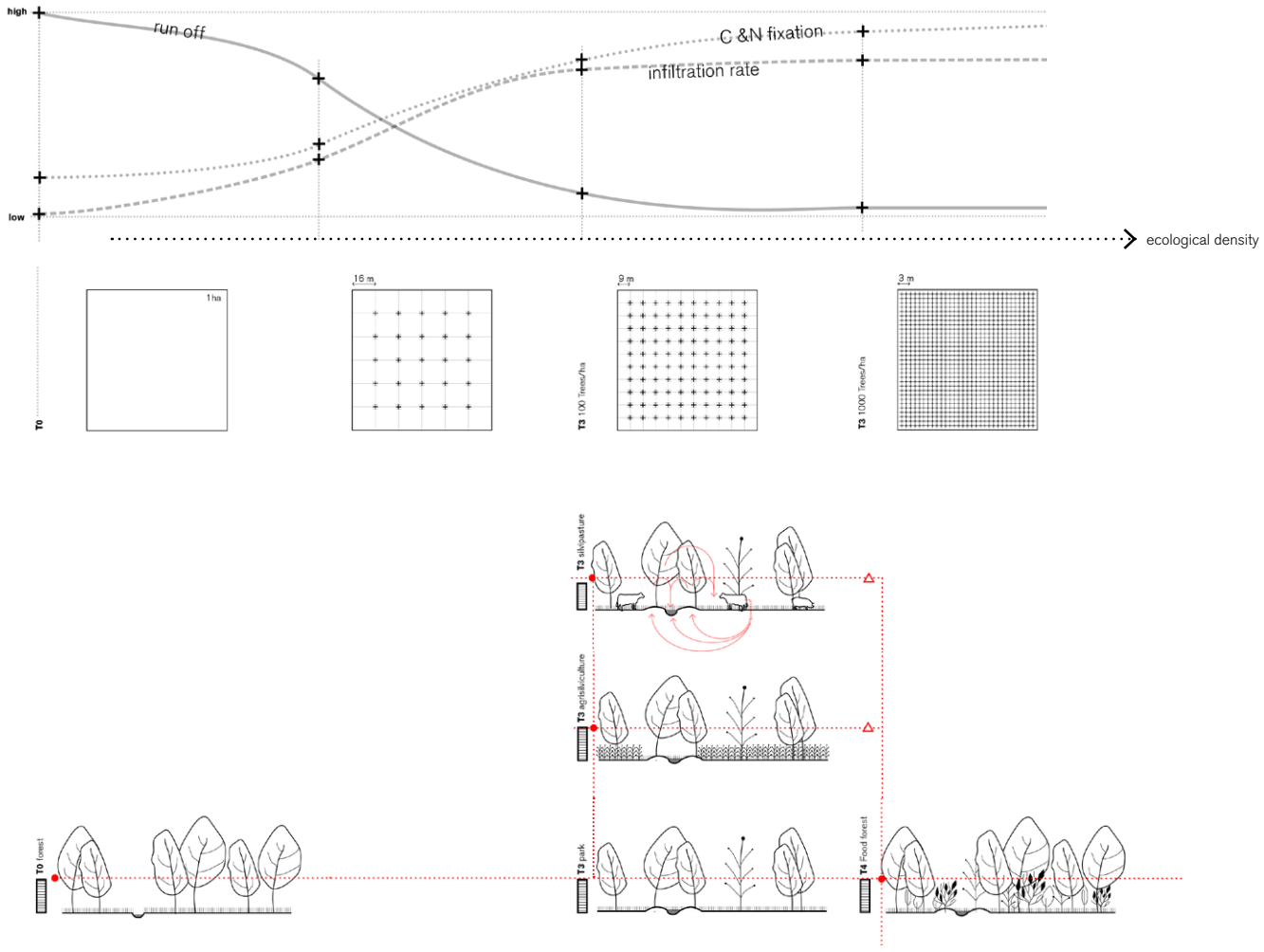


Figure C37.
Green corridor transformation genealogy for forest land (ecological density)
Elaborated by the author


high
low
run off
C &N fixation
infiltration rate
ecological density
T0
1 ha
16 m
T3 100 Trees/ha
9 m
T3 1000 Trees/ha
3 m
T3 silvipasture
T3 agrisilviculture
T0 forest
T3 park
T4 Food forest

BUFFER CAPACITY GRADIENTS
forest

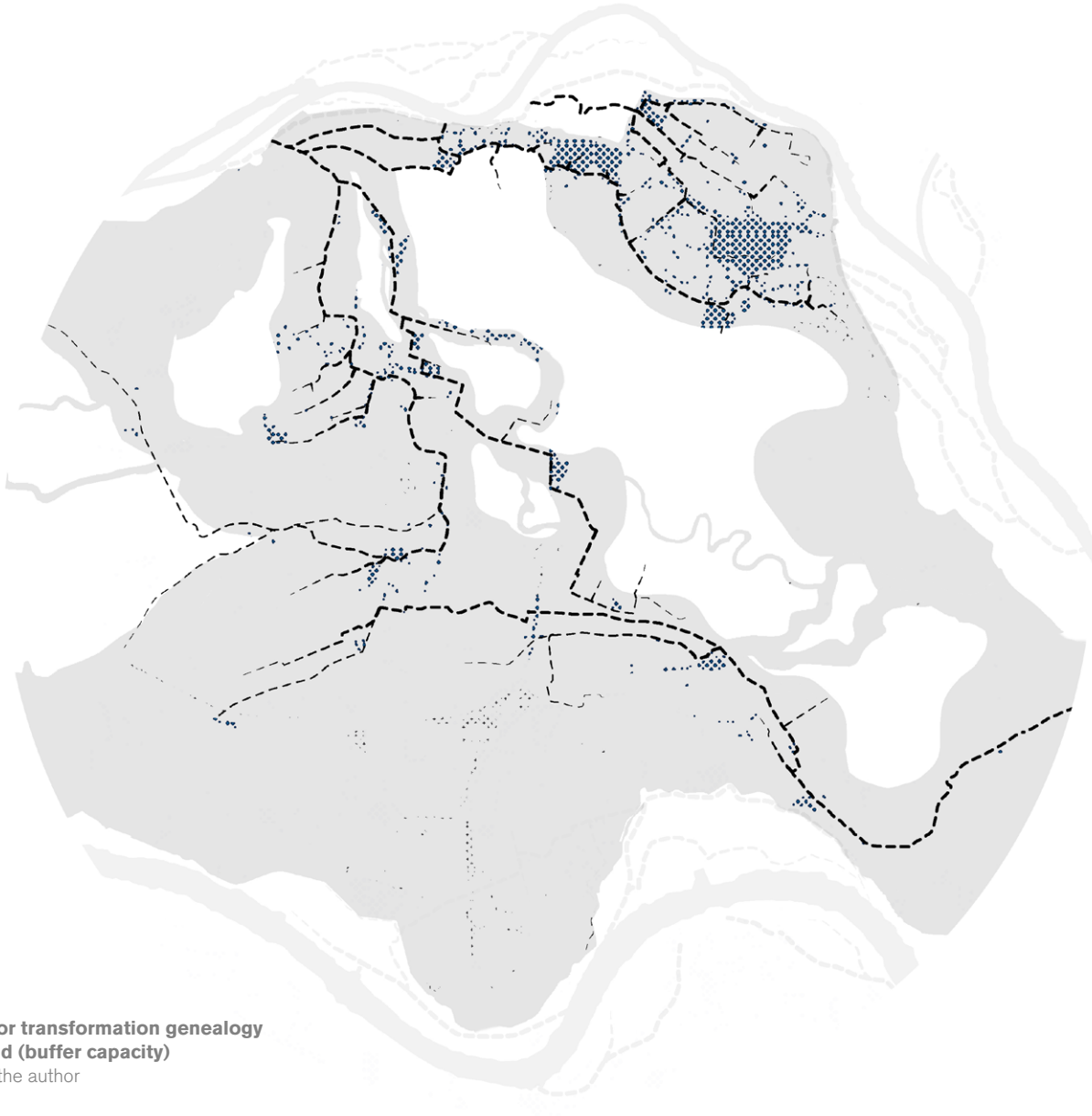
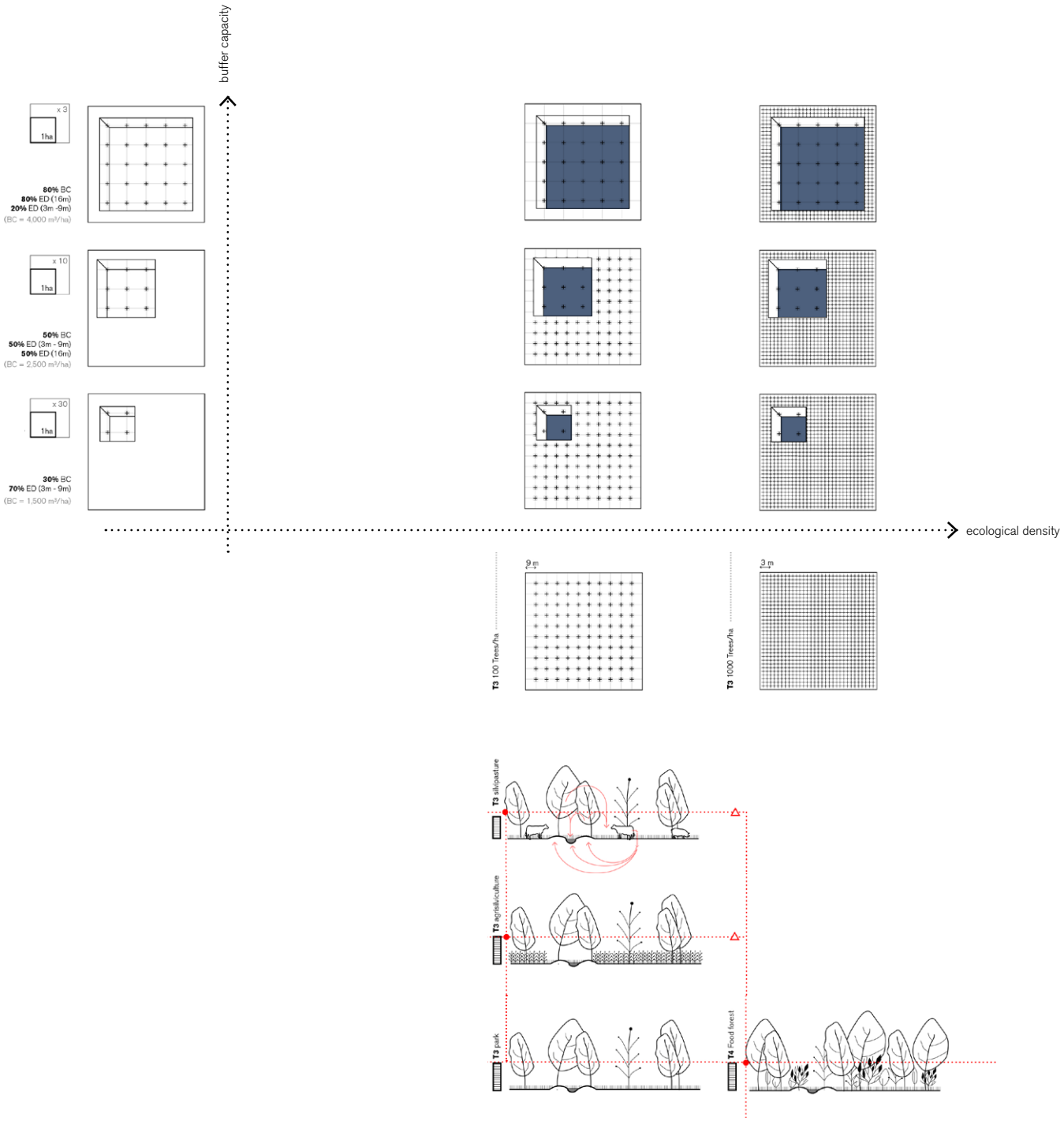


Figure C38.
Green corridor transformation genealogy for forest land (buffer capacity)
Elaborated by the author


buffer capacity
x 3
1ha
80% BC
80% ED (16m)
20% ED (3m -9m)
(BC = 4,000 m³/ha)
x 10
1ha
50% BC
50% ED (3m - 9m)
50% ED (16m)
(BC = 2,500 m³/ha)
x 30
1ha
30% BC
70% ED (3m - 9m)
(BC = 1,500 m³/ha)
ecological density
9 m
3 m
T3 100 Trees/ha
T3 1000 Trees/ha
T3 silvipasture
T3 agrisilviculture
T3 park
T4 Food forest

AGROFORESTRY GRADIENTS
discontinuous 10-30

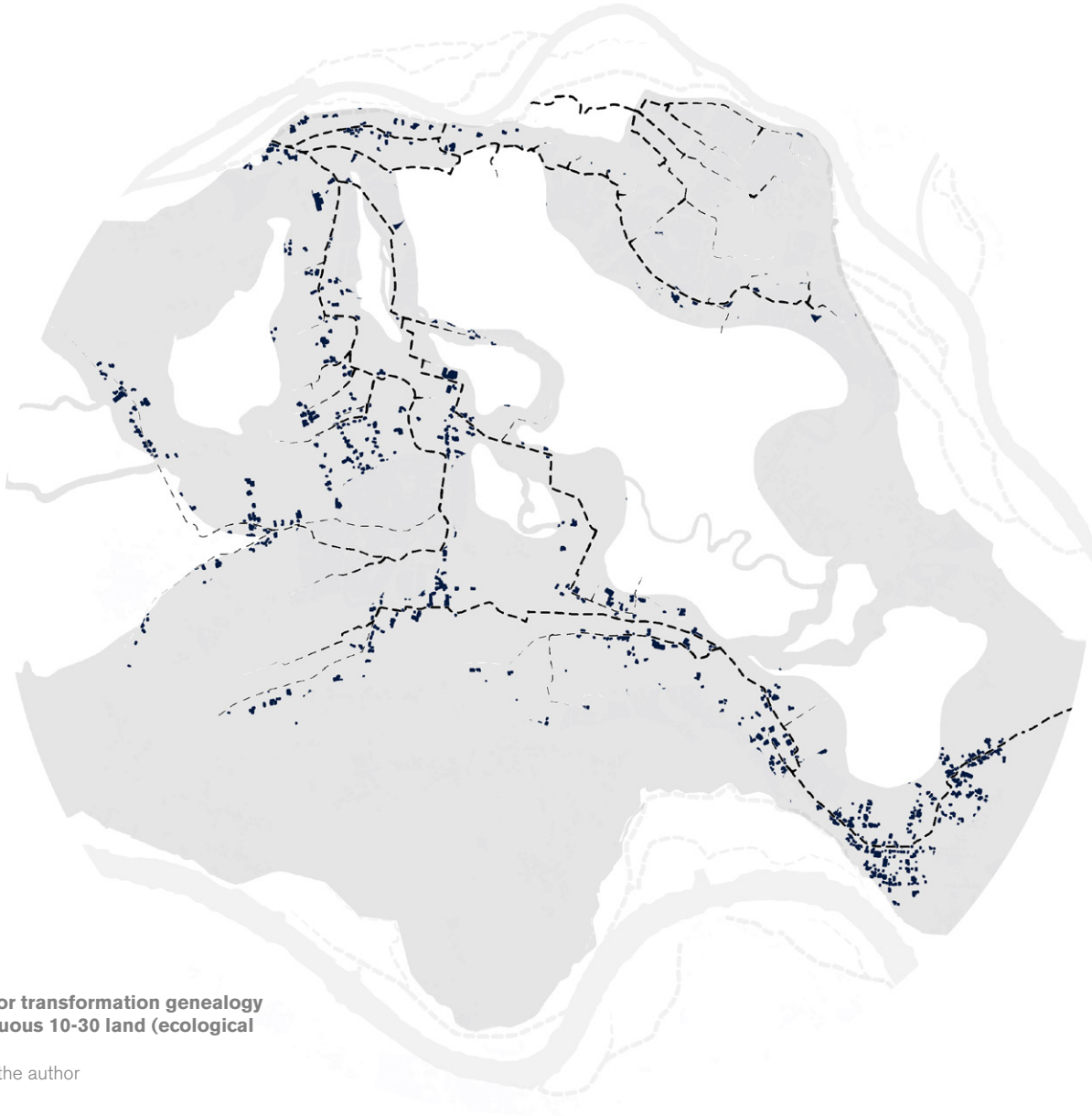
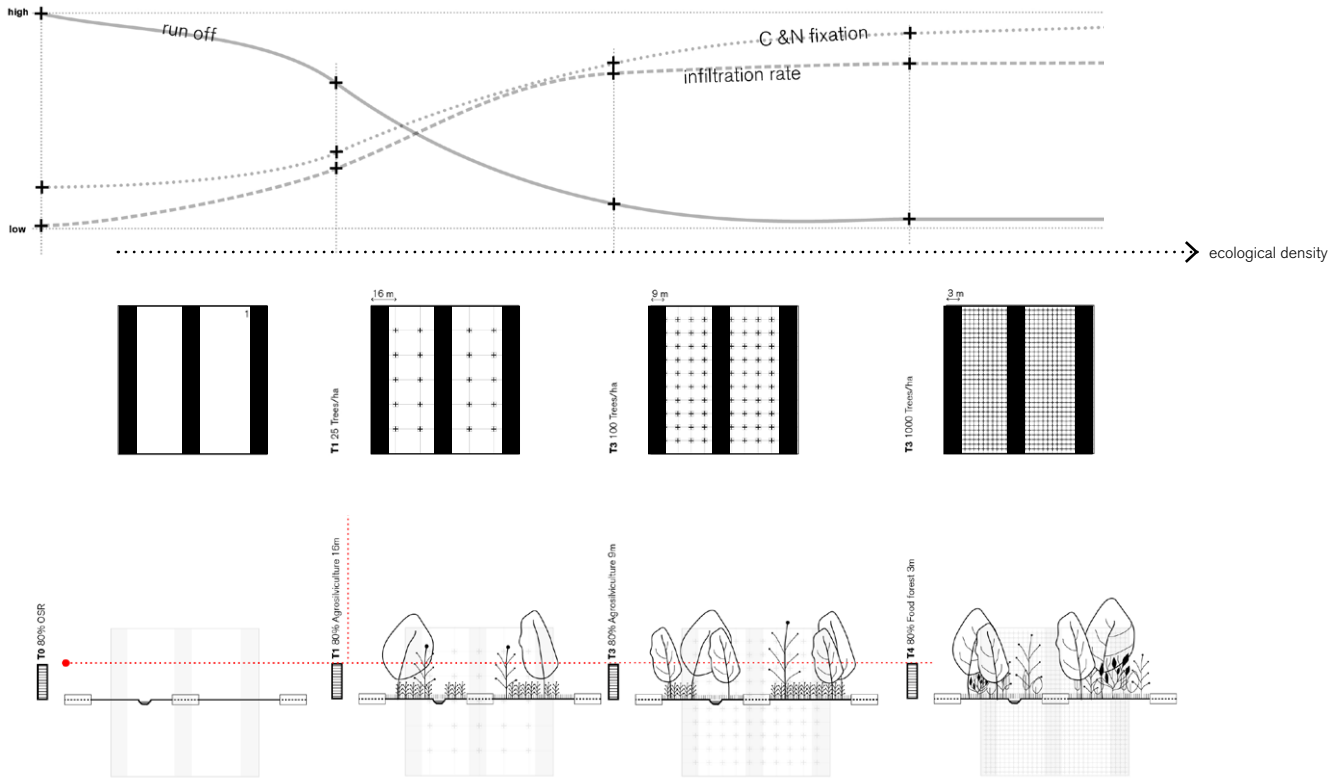


Figure C39.
Green corridor transformation genealogy for discontinuous 10-30 land (ecological density)
Elaborated by the author


high
low
run off
C &N fixation
infiltration rate
ecological density
16 m
9 m
3 m
T0 60% OSR
T1 25 Trees/ha
T1 80% Agrosilviculture 15m
T3 100 Trees/ha
T3 80% Agrosilviculture 6m
T3 1000 Trees/ha
T4 80% Food forest 3m

BUFFER CAPACITY GRADIENTS
discontinuous 10-30

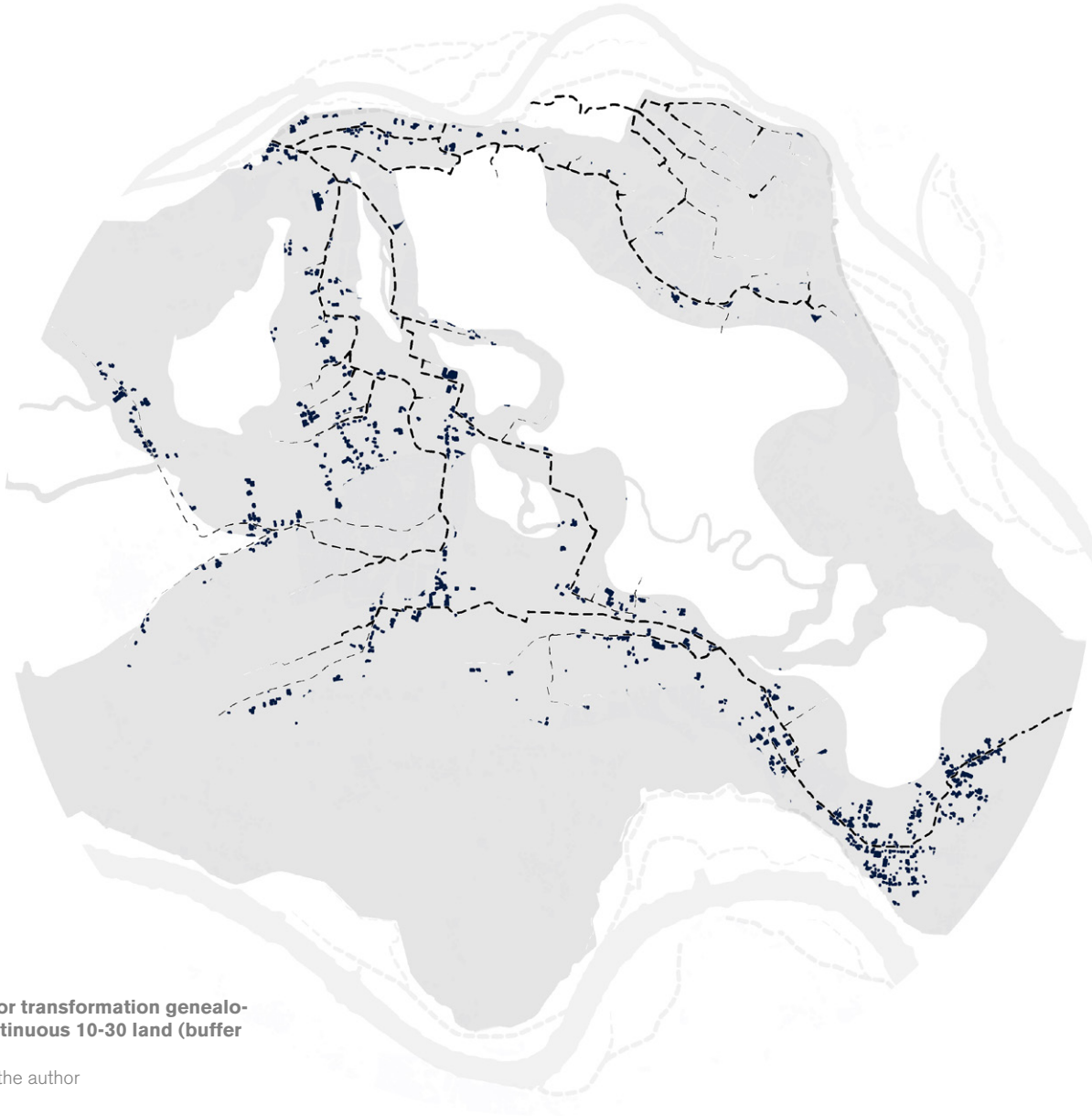
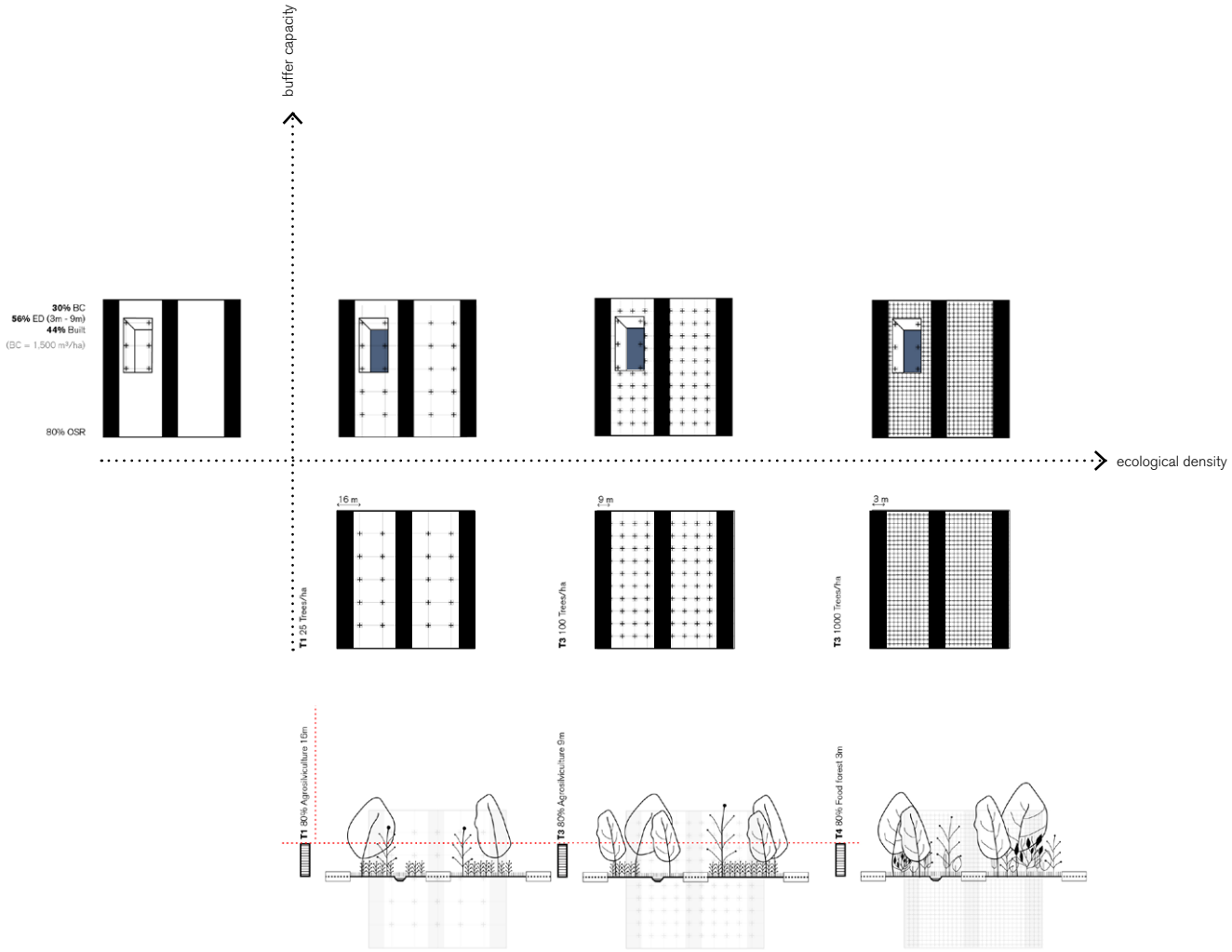


Figure C40.
Green corridor transformation genealogy for discontinuous 10-30 land (buffer capacity)
Elaborated by the author


buffer capacity
ecological density
30% BC
56% ED (3m - 9m)
44% Built
(BC = 1,500 m²/ha)
80% OSR
16 m
9 m
3 m
T1 25 Trees/ha
T3 100 Trees/ha
T3 1000 Trees/ha
T1 80% Agrosilviculture 15m
T3 80% Agrosilviculture 6m
T4 80% Food forest 3m

BLUE CORRIDOR - HYBRIDIZATION GRADIENTS

Arnhem Nijmegen City Region

The blue corridor extends along the defined floodplains of Nederrjin and Waal Rivers, areas which in their vast majority correspond with designated N2000 areas. According to Natura 2000, any land use is allowed as long that they provide the maximum space possible to either birds or/and habitats. Depending on the management objective of the area a list of protected species to maintain (Birds Directive) and a list of habitats (Habitats Directive) that cannot be below a certain percentage is provided.

The proposal complies with Natura 2000 requirements as the main objective is a transformation of current land uses where Buffer capacity (BC) and Ecological density (ED) are highest.

The re-programming gradient corresponds to the flood frequency of the area, and the ecological density refer in each case to the ecology and habitats of the specific wet/dry condition. Therefore, the maximum ecological density is not always a hardwood (as in the green corridor), but the wide range of vegetation stages found in floodplains: macroalgae, scrubs, softwood and hardwood.

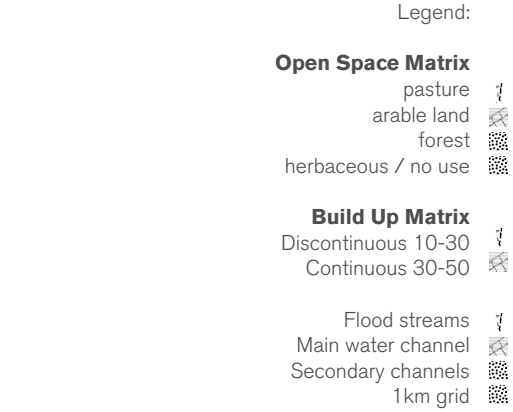
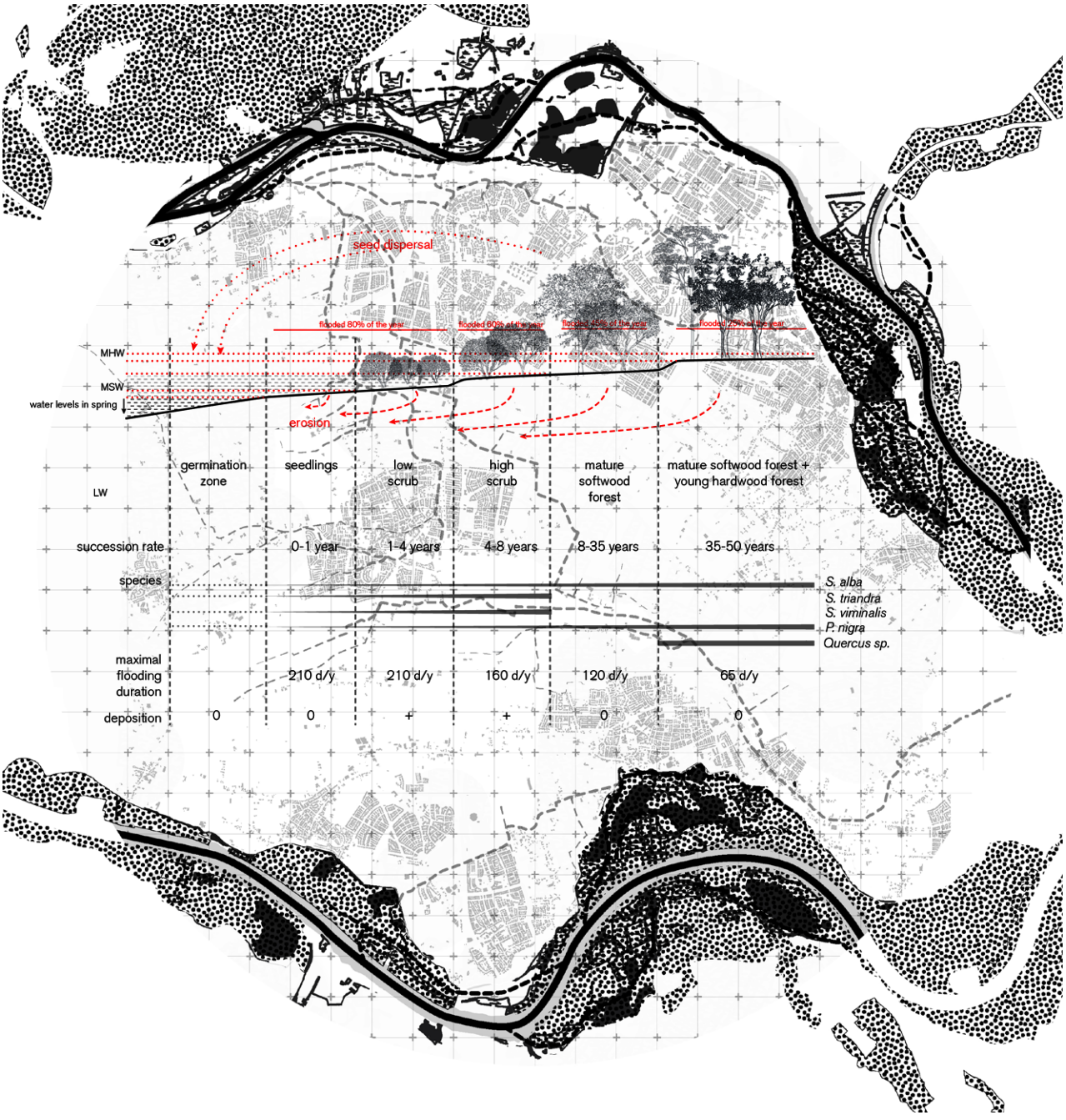


Figure C41.
Blue corridor Arnhem Nijmegen city region
Elaborated by the author


seed dispersal
flooded 80% of the year
flooded 60% of the year
flooded 45% of the year
flooded 25% of the year
MHW
MSW
water levels in spring
erosion
LW
germination zone
seedlings
low scrub
high scrub
mature softwood forest
mature softwood forest + young hardwood forest
succession rate
0-1 year
1-4 years
4-8 years
8-35 years
35-50 years
species
S. alba
S. triandra
S. viminalis
P. nigra
Quercus sp.
maximal flooding duration
210 d/y
210 d/y
160 d/y
120 d/y
65 d/y
deposition
0
0
+
+
0
0

TRANSFORMATION GENEALOGY

Blue corridor

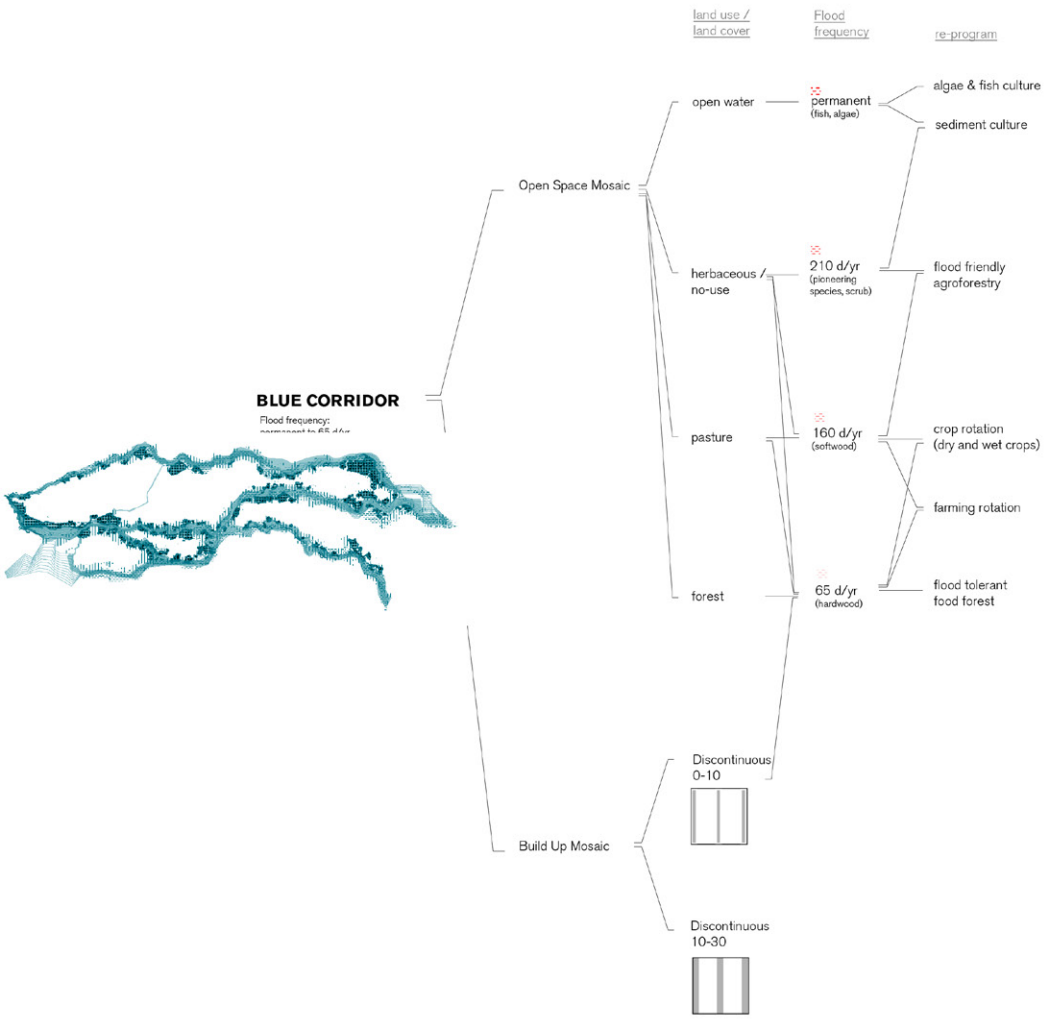
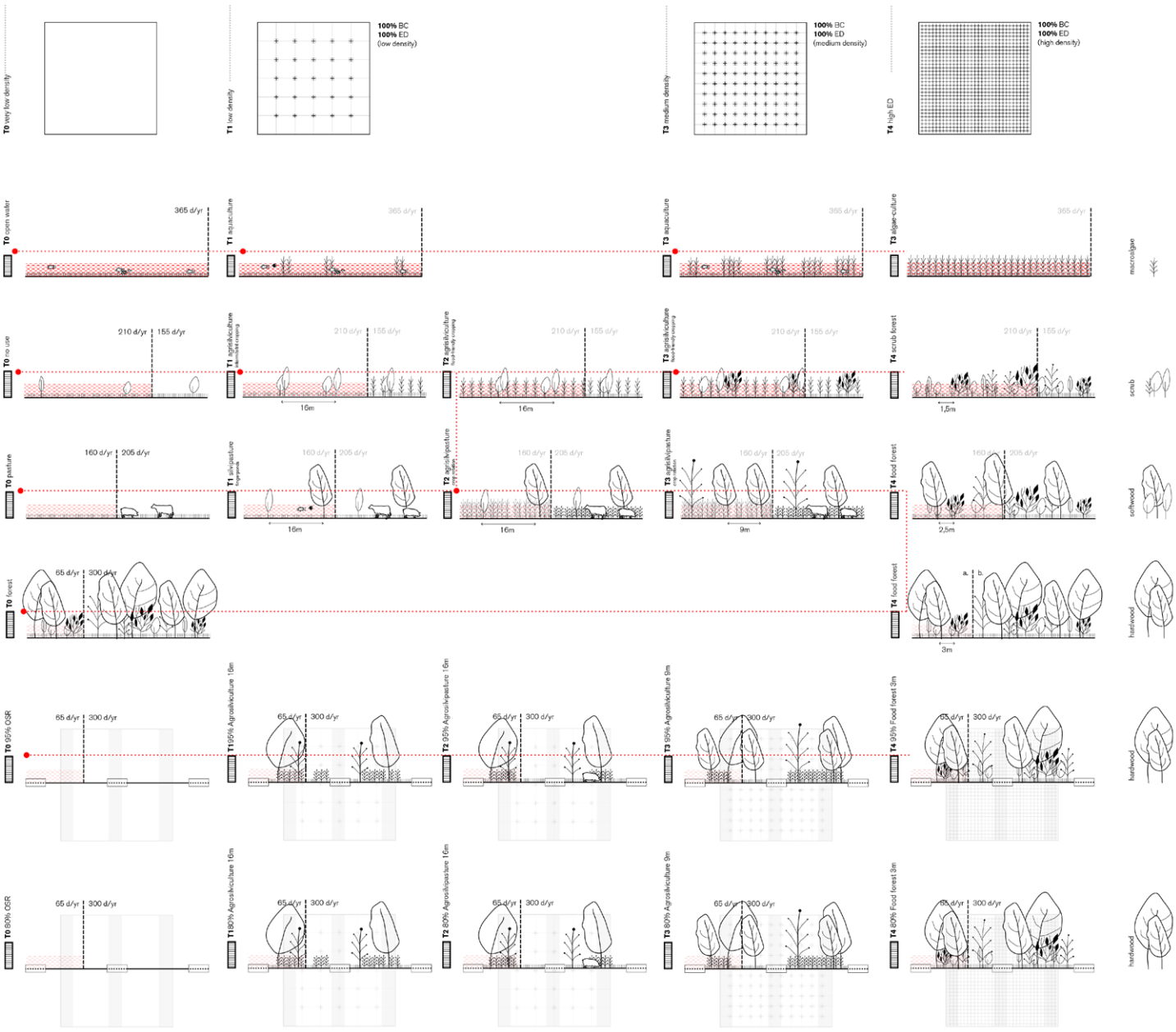


Figure C42.
Blue corridor transformation genealogy
Elaborated by the author


T0 very low density
T1 low density
100% BC
100% ED
(low density)
T3 medium density
100% BC
100% ED
(medium density)
T4 high ED
100% BC
100% ED
(high density)
T0 open water
365 d/yr
T1 aquaculture
365 d/yr
T3 aquaculture
365 d/yr
T3 algae-culture
365 d/yr
macroalgae
T0 no use
210 d/yr
155 d/yr
T1 agrisilviculture
210 d/yr
155 d/yr
16m
T2 agrisilviculture
210 d/yr
155 d/yr
16m
T3 agrisilviculture
210 d/yr
155 d/yr
T4 scrub forest
210 d/yr
155 d/yr
1,5m
scrub
T0 pasture
160 d/yr
205 d/yr
T1 silvipasture
160 d/yr
205 d/yr
16m
T2 agrisilvipasture
160 d/yr
205 d/yr
16m
T3 agrisilvipasture
160 d/yr
205 d/yr
9m
T4 food forest
160 d/yr
205 d/yr
2,5m
softwood
T0 forest
65 d/yr
300 d/yr
T4 food forest
a.
b.
3m
hardwood
T0 95% OSR
65 d/yr
300 d/yr
T1 95% Agrosilviculture 16m
65 d/yr
300 d/yr
T2 95% Agrosilvipasture 16m
65 d/yr
300 d/yr
T3 95% Agrosilviculture 9m
65 d/yr
300 d/yr
T4 95% Food forest 3m
65 d/yr
300 d/yr
hardwood
T0 80% OSR
65 d/yr
300 d/yr
T1 80% Agrosilviculture 16m
65 d/yr
300 d/yr
T2 80% Agrosilvipasture 16m
65 d/yr
300 d/yr
T3 80% Agrosilviculture 9m
65 d/yr
300 d/yr
T4 80% Food forest 3m
65 d/yr
300 d/yr
hardwood

AQUACULTURE GRADIENTS

flood frequency 365 d/yr

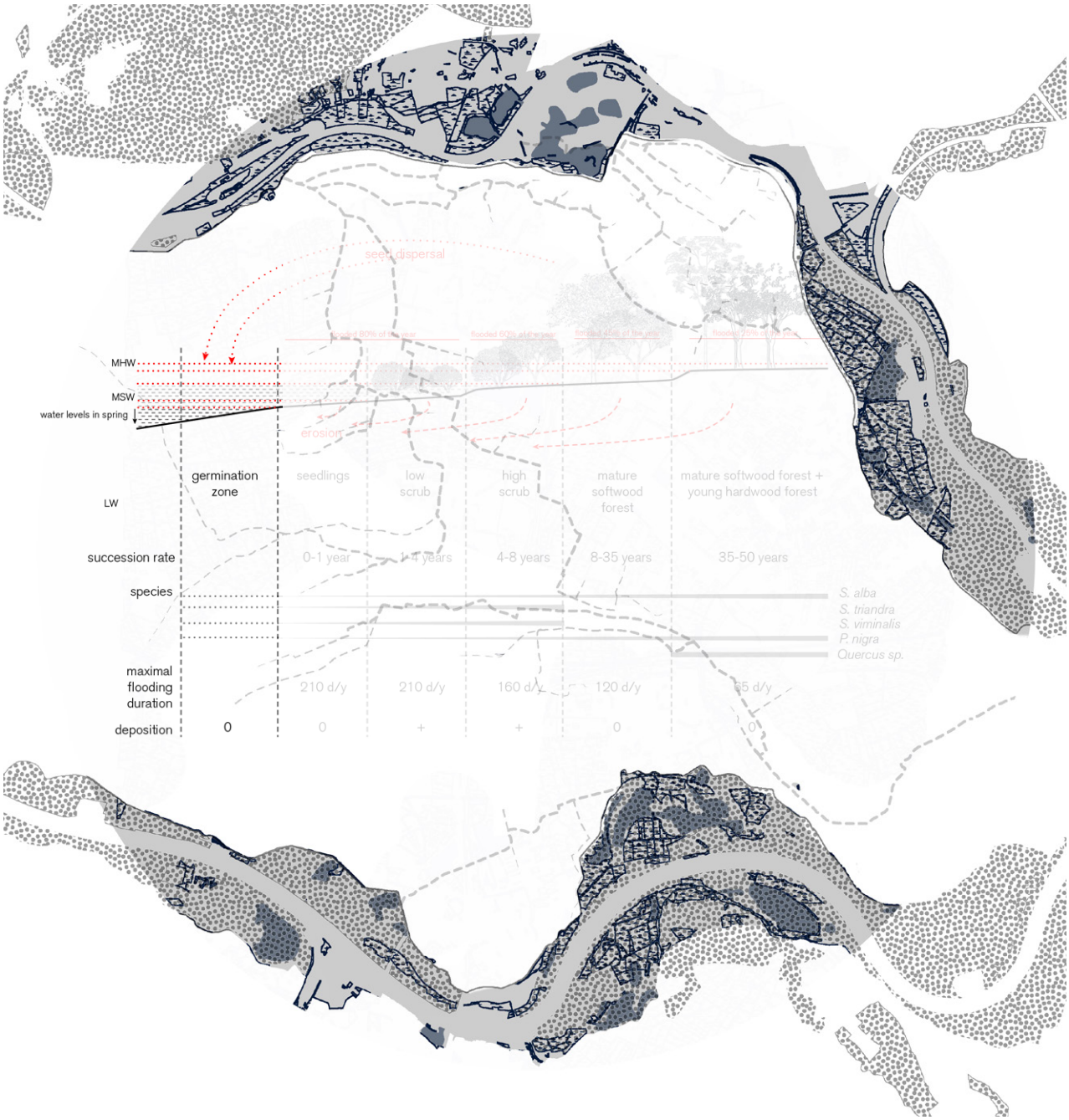
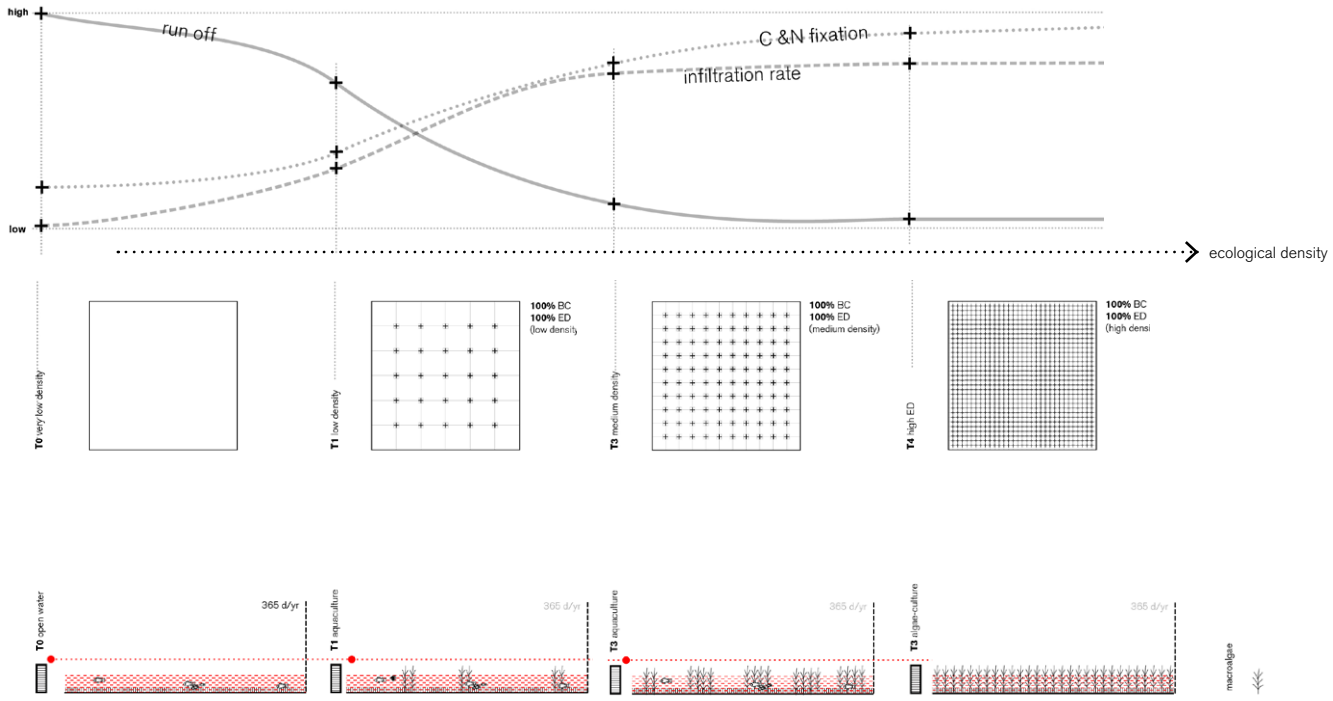


Figure C43.
Blue corridor transformation genealogy
Elaborated by the author



AQUACULTURE GRADIENTS

flood frequency 210 d/yr

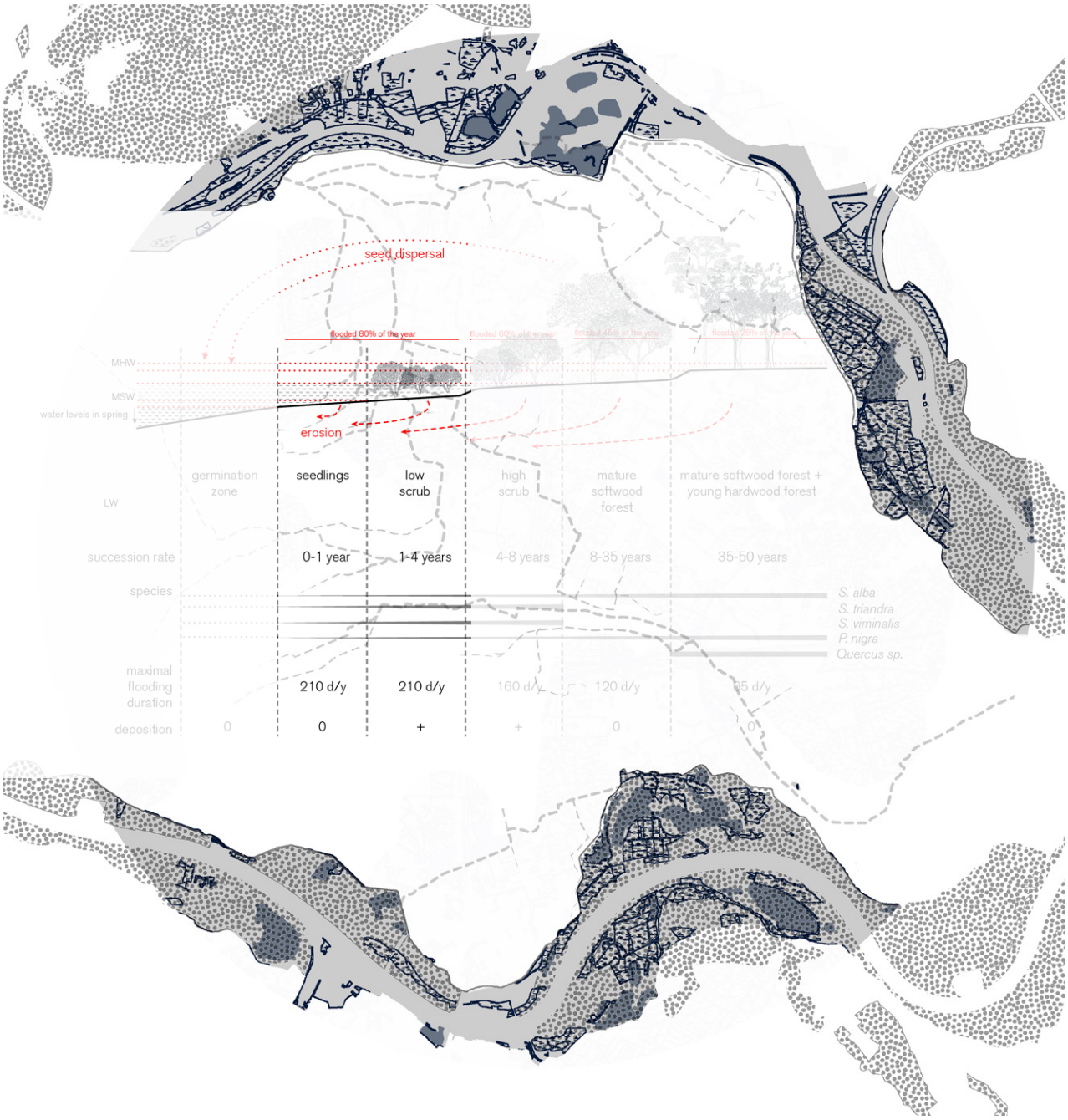
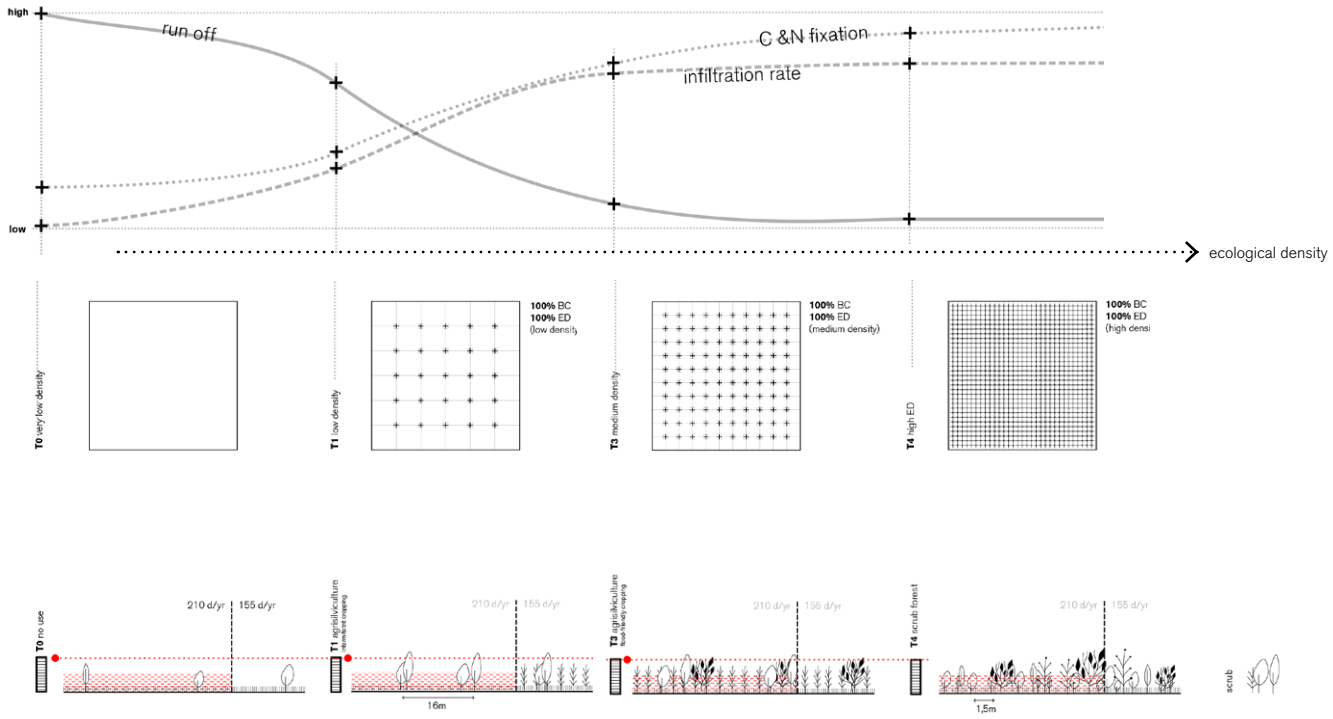


Figure C45.
Blue corridor transformation genealogy
Elaborated by the author



AQUACULTURE GRADIENTS

flood frequency 160-120 d/yr

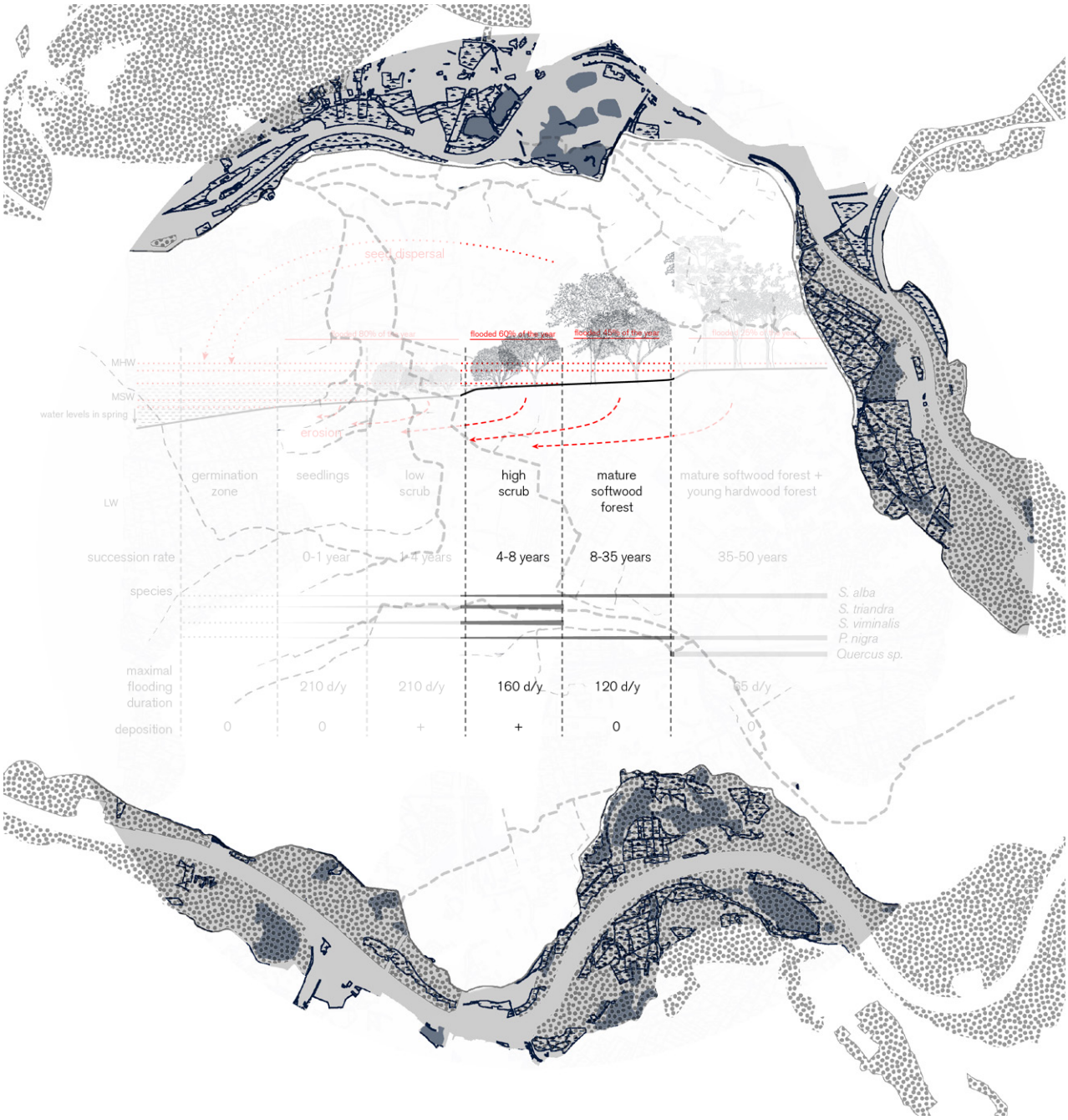
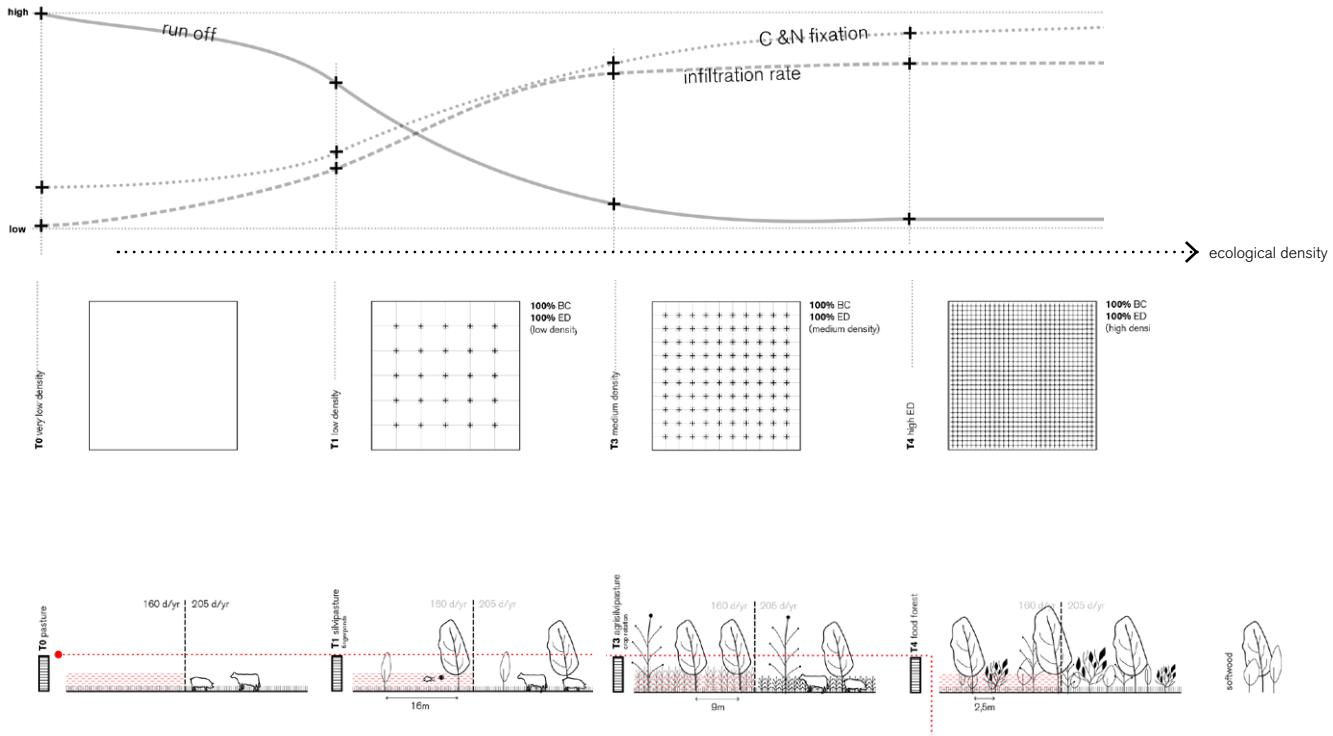


Figure C46.
Blue corridor transformation genealogy
Elaborated by the author



AQUACULTURE GRADIENTS

flood frequency 65 d/yr

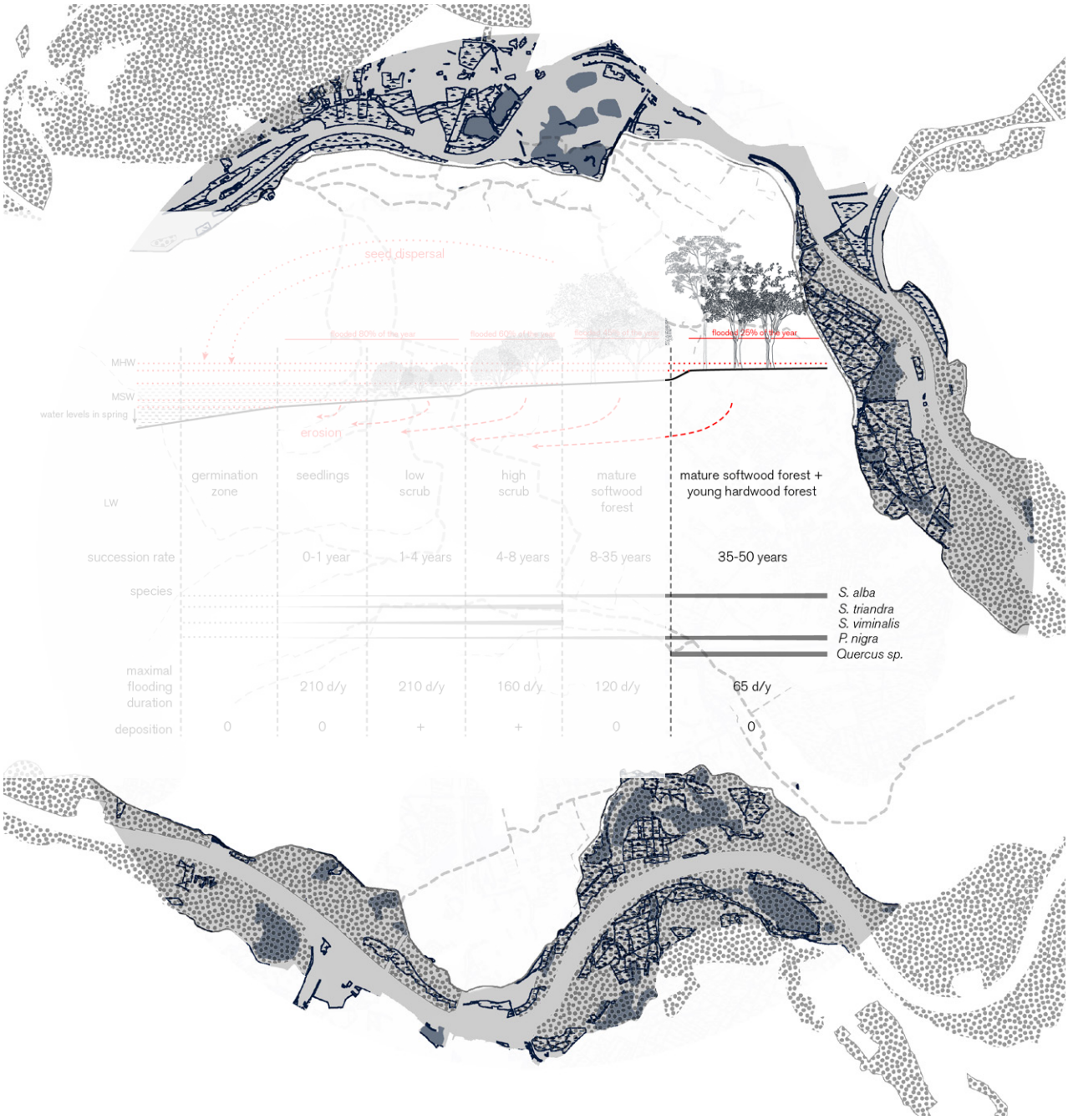
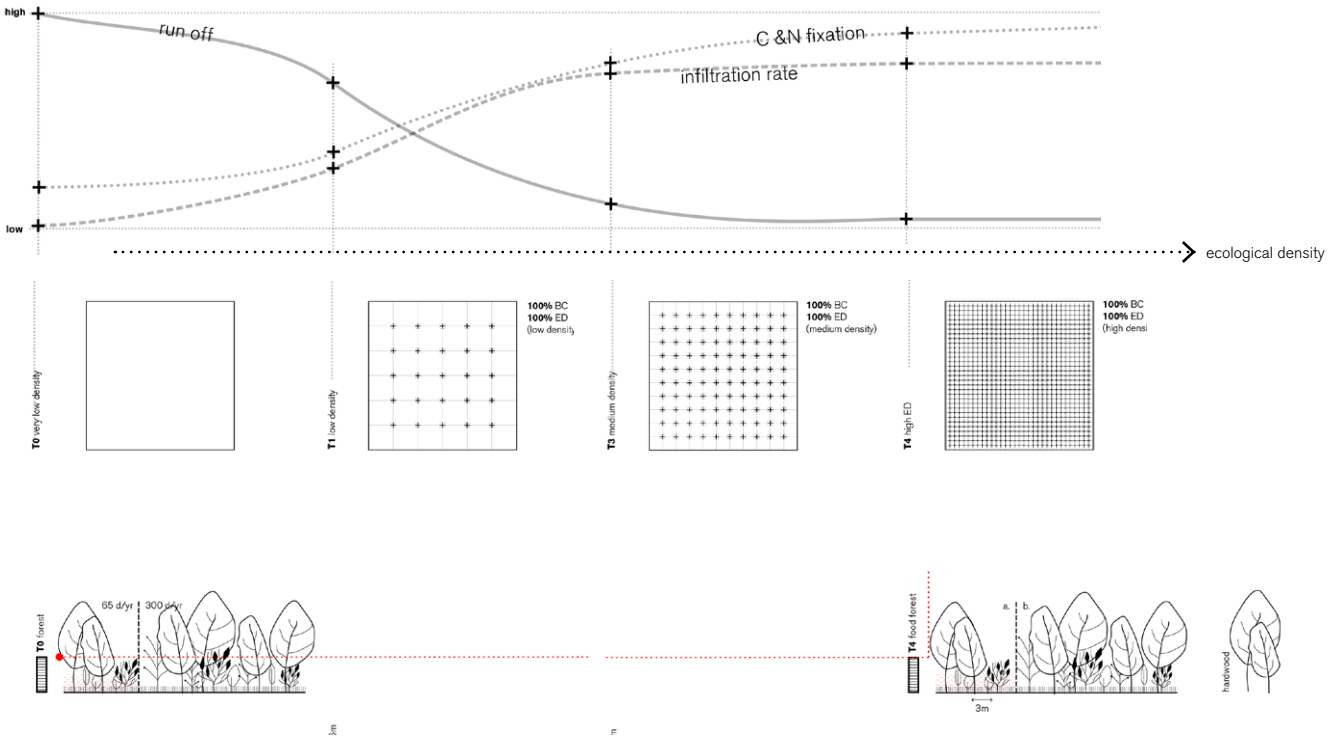


Figure C47.
Blue corridor transformation genealogy
Elaborated by the author



AQUACULTURE GRADIENTS

flood frequency 65 d/yr

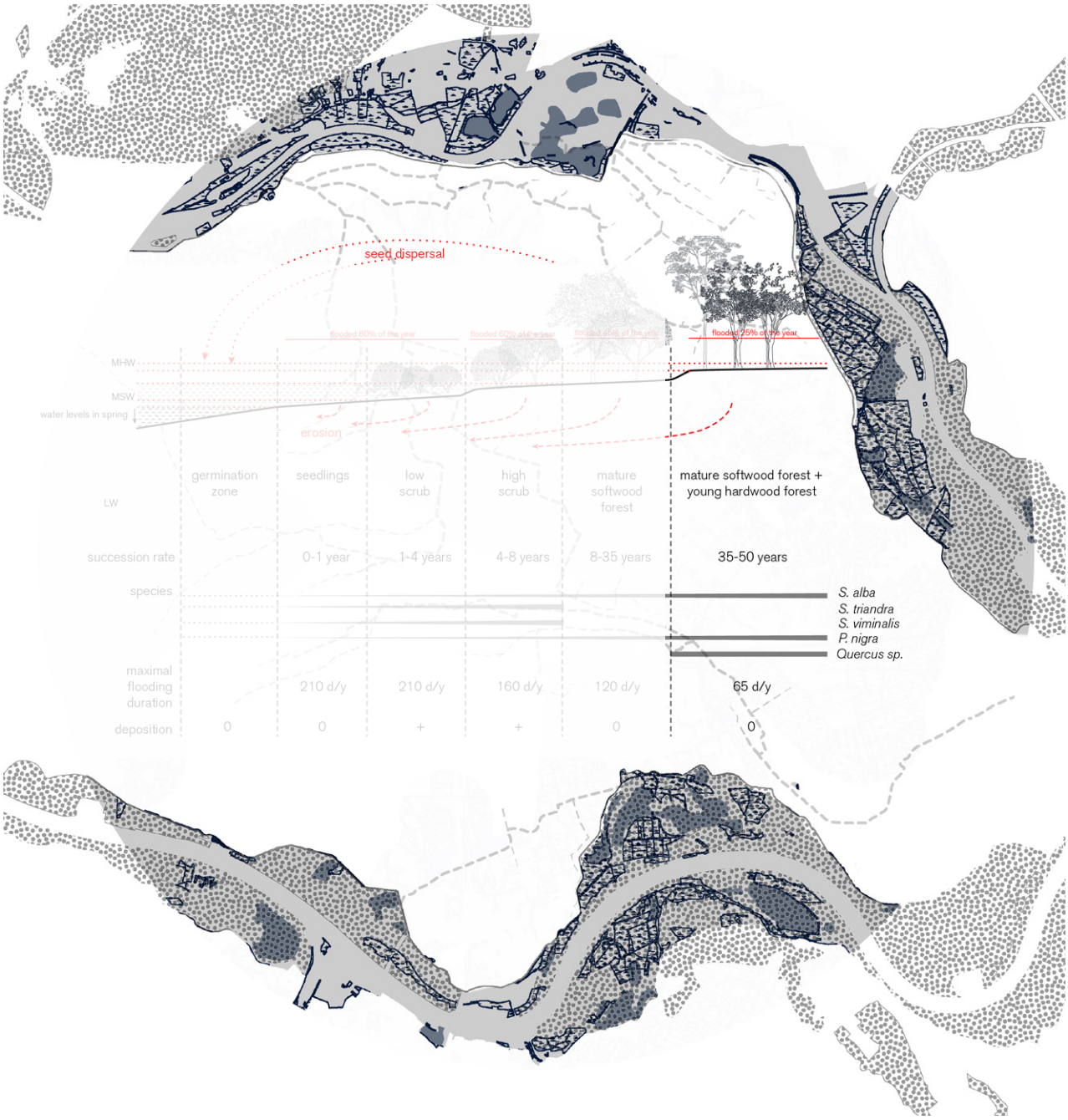
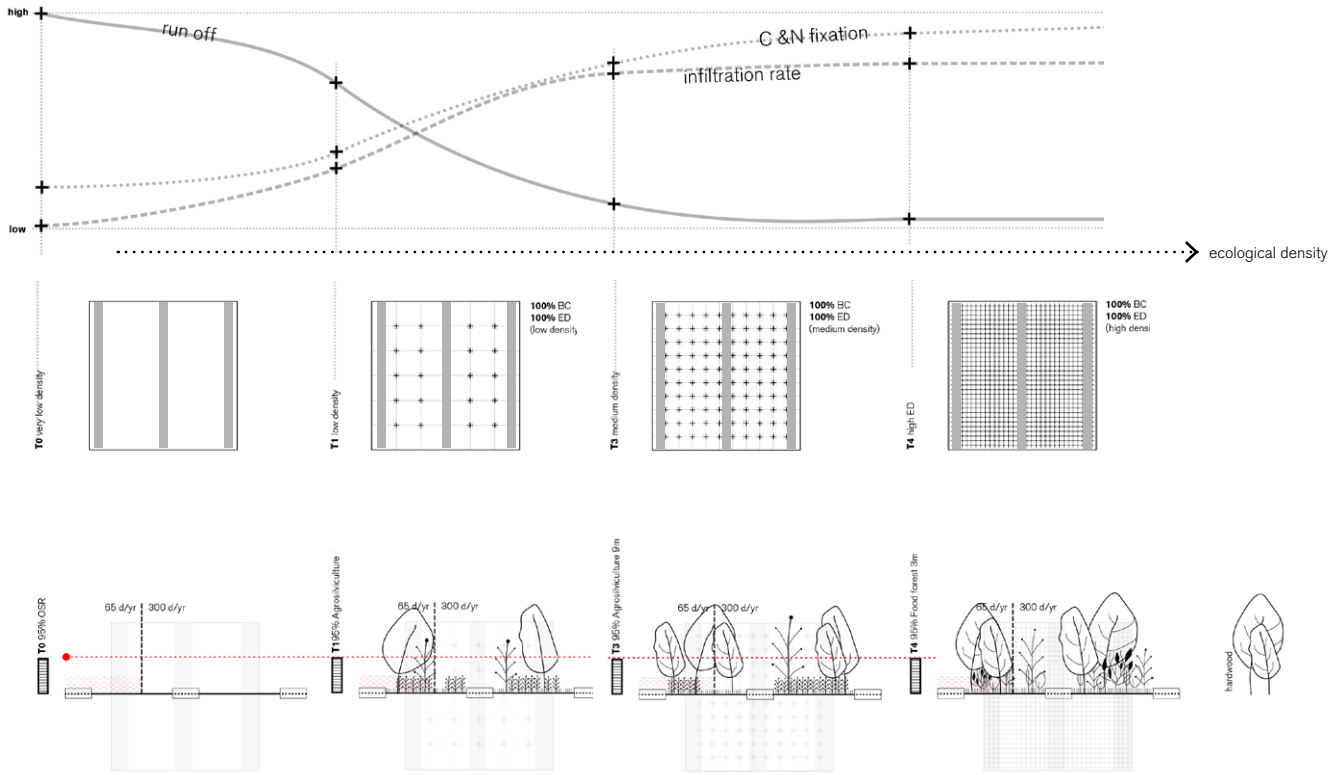


Figure C48.
Blue corridor transformation genealogy
Elaborated by the author



AQUACULTURE GRADIENTS

flood frequency 65 d/yr

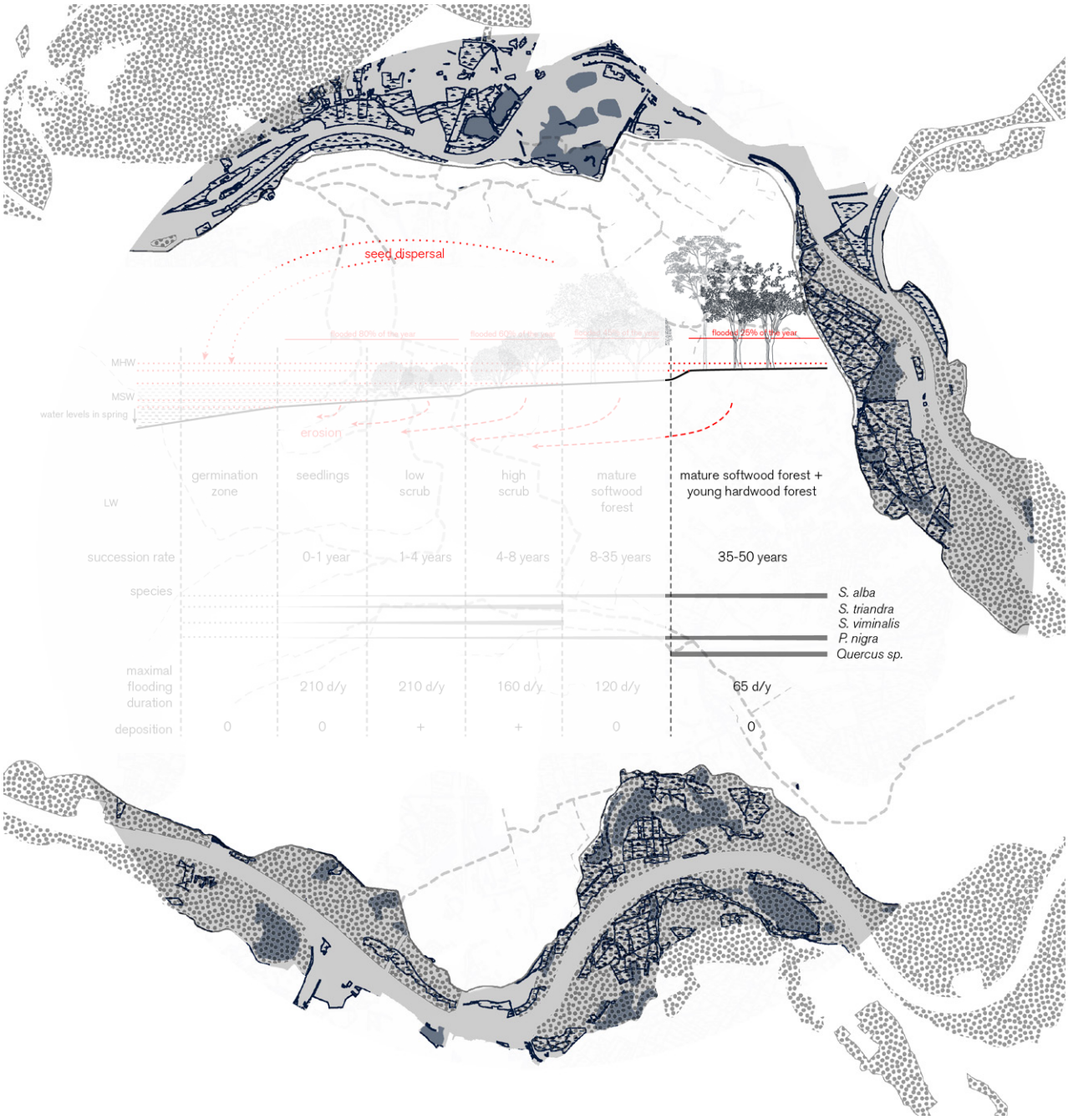
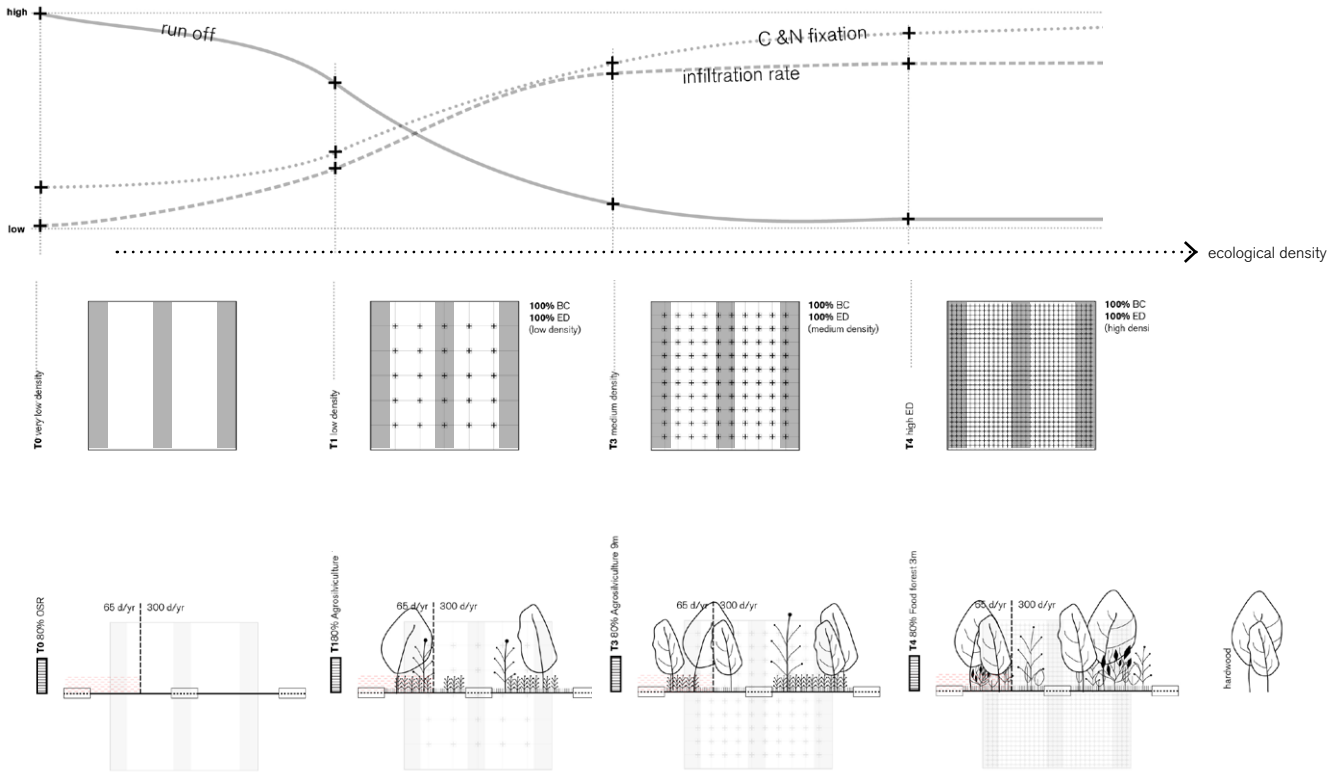


Figure C49.
Blue corridor transformation genealogy
Elaborated by the author



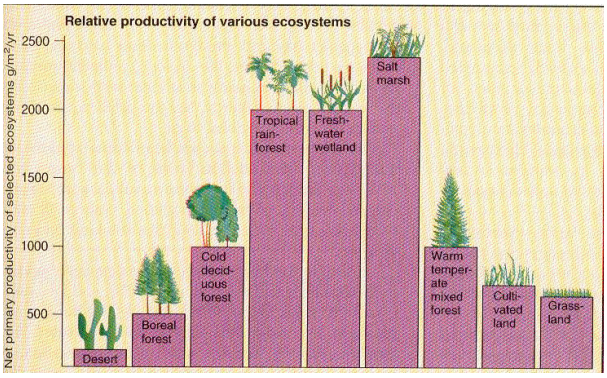
PRODUCTIVE WETLAND - RE-PROGRAMMING GRADIENTS

Arnhem Nijmegen City Region

The productive wetland plays a major role in flood mitigation, acting as a buffer and retaining water. The study on the relative productivity of various ecosystems shows that, below salt marshes, fresh-water wetlands have the highest relative net primary productivity in g/m²/yr (figure C50).

The re-programming of these areas as productive wetlands implies de-engineering its current drainge system in order to restore the wet condition of this land.
The re-programming gradients refer in this case to the degree of wetland restoration (ecological density) and the categories are articulated according to the different water depht and habitats found in wetlands.

Figure C50.
Comparison of Ecosystem productivity
Source: Reprinted from *Bryant College* by Gaytha A. Langlois (2002), Retrieved from https://web.bryant.edu



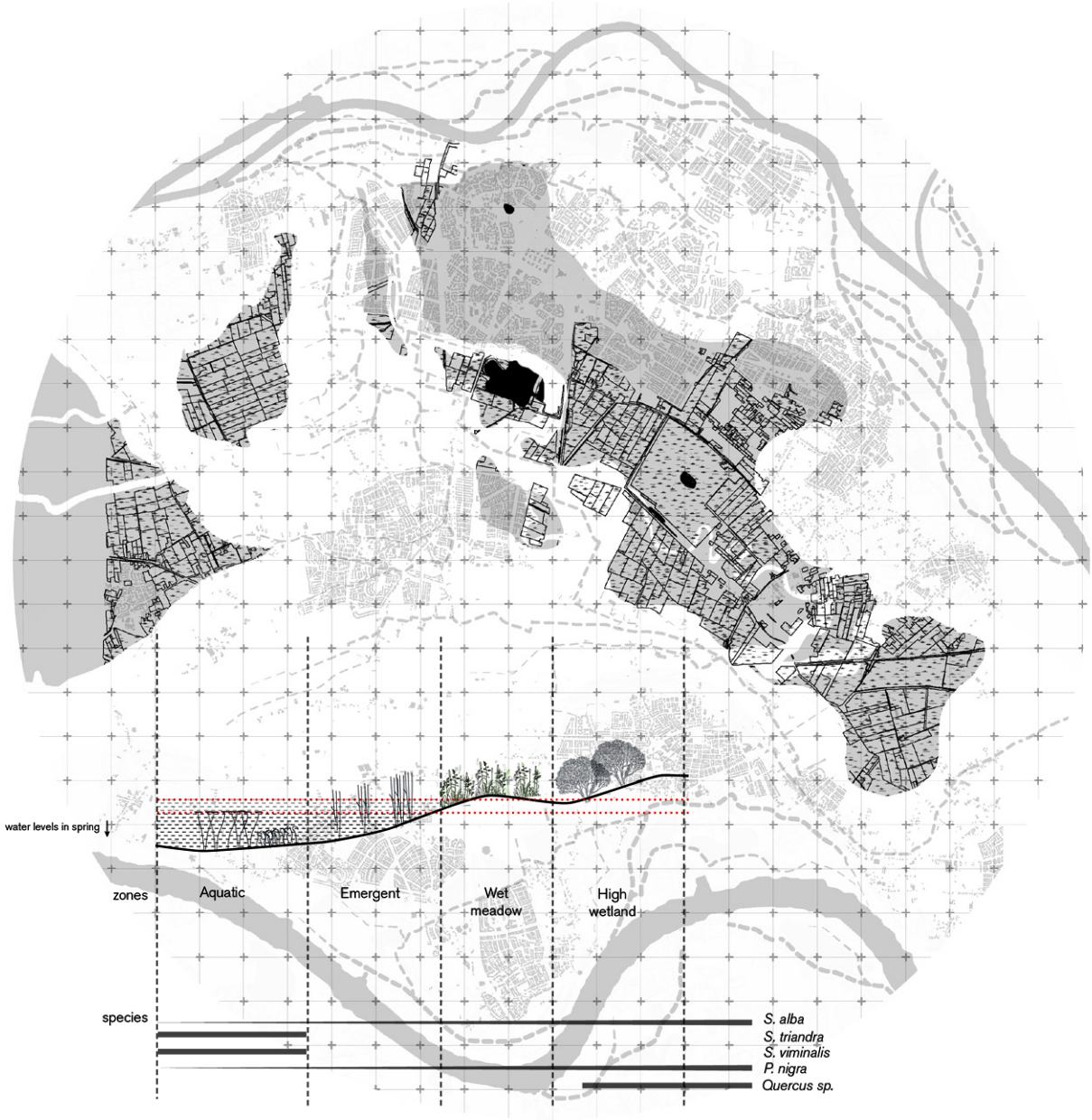
Legend:

Open Space Matrix
pasture
arable land
forest
herbaceous / no use

Build Up Matrix
Discontinuous 10-30
Continuous 30-50

Flood streams
Main water channel
Secondary channels
1km grid

Figure C51.
Productive wetland Arnhem Nijmegen city region
Elaborated by the author


water levels in spring
zones
Aquatic
Emergent
Wet meadow
High wetland
species
S. alba
S. triandra
S. viminalis
P. nigra
Quercus sp.

TRANSFORMATION GENEALOGY
Productive wetland

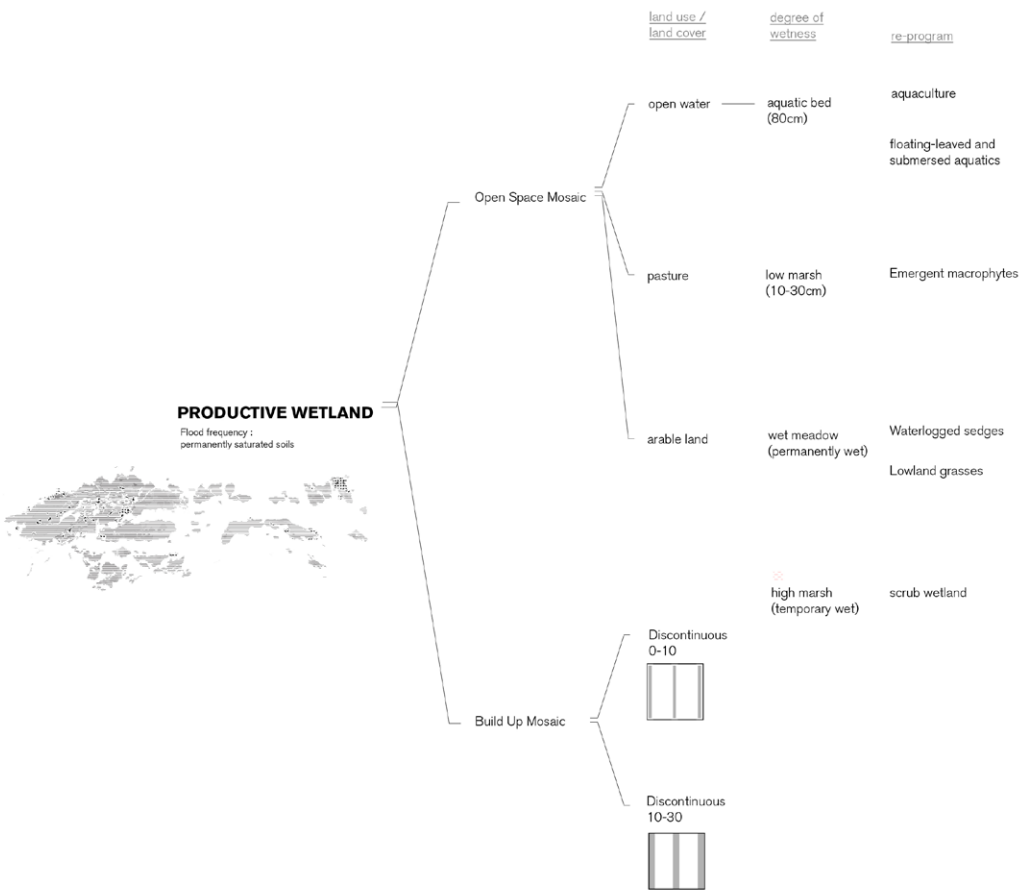
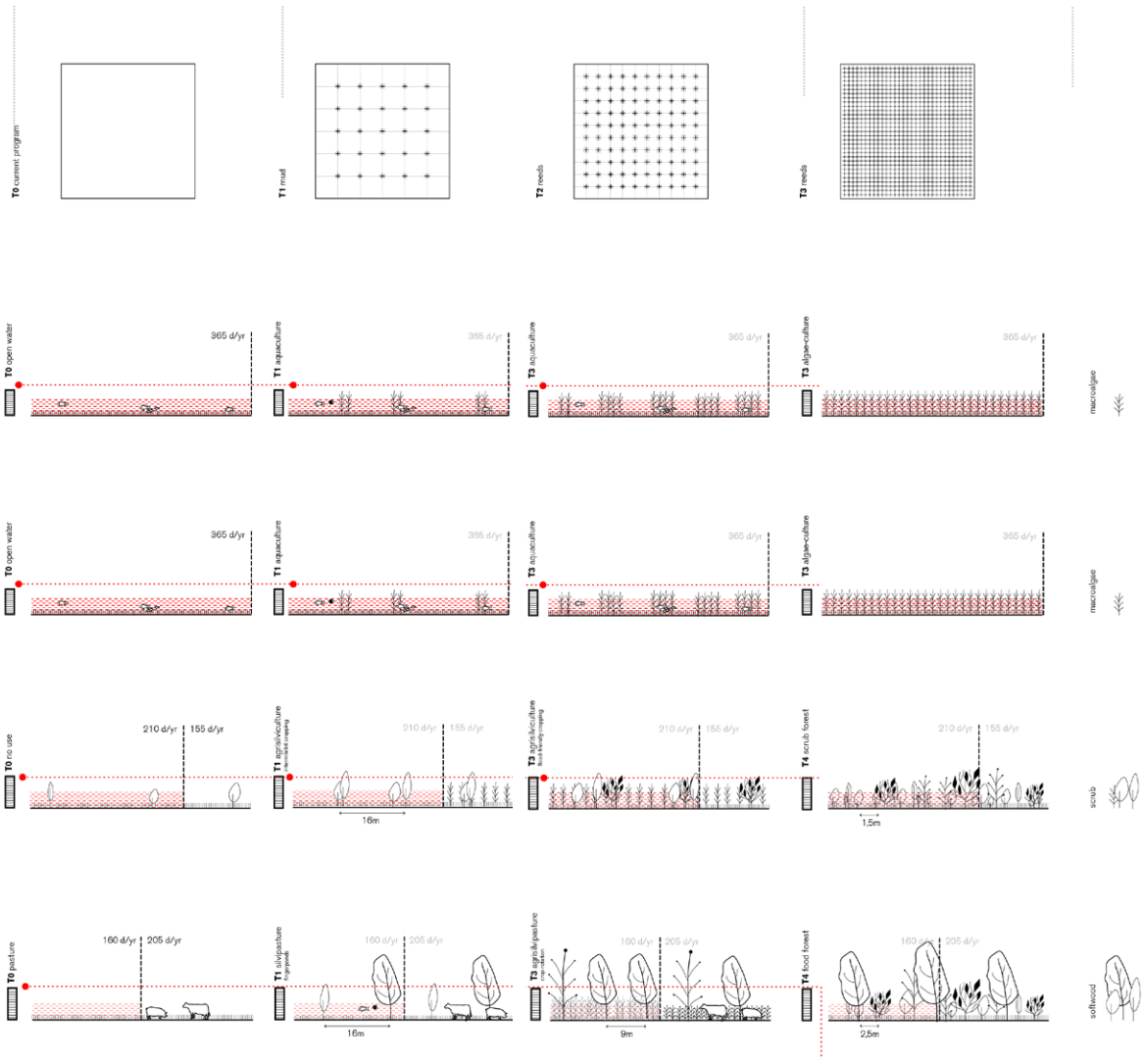


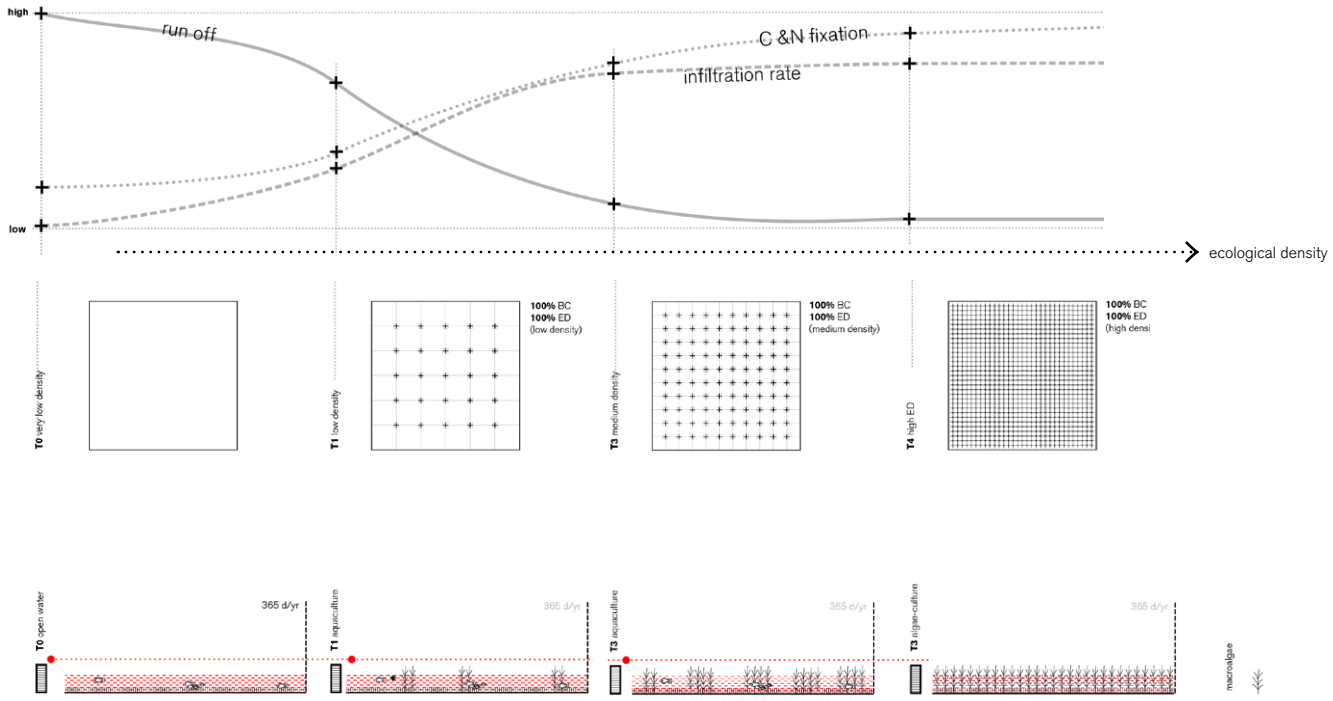
Figure C52.
Productive wetland transformation genealogy
Elaborated by the author


T0 current program
T1 mud
T2 reeds
T3 reeds
T0 open water
365 d/yr
T1 aquaculture
T3 aquaculture
T3 algae-culture
macroalgae
T0 no use
210 d/yr
155 d/yr
T1 agrisilviculture
16m
T3 agrisilviculture
T4 scrub forest
1.5m
scrub
T0 pasture
160 d/yr
205 d/yr
T1 silvipasture
T3 agrisilvipasture
9m
T4 flood forest
2,5m
softwood

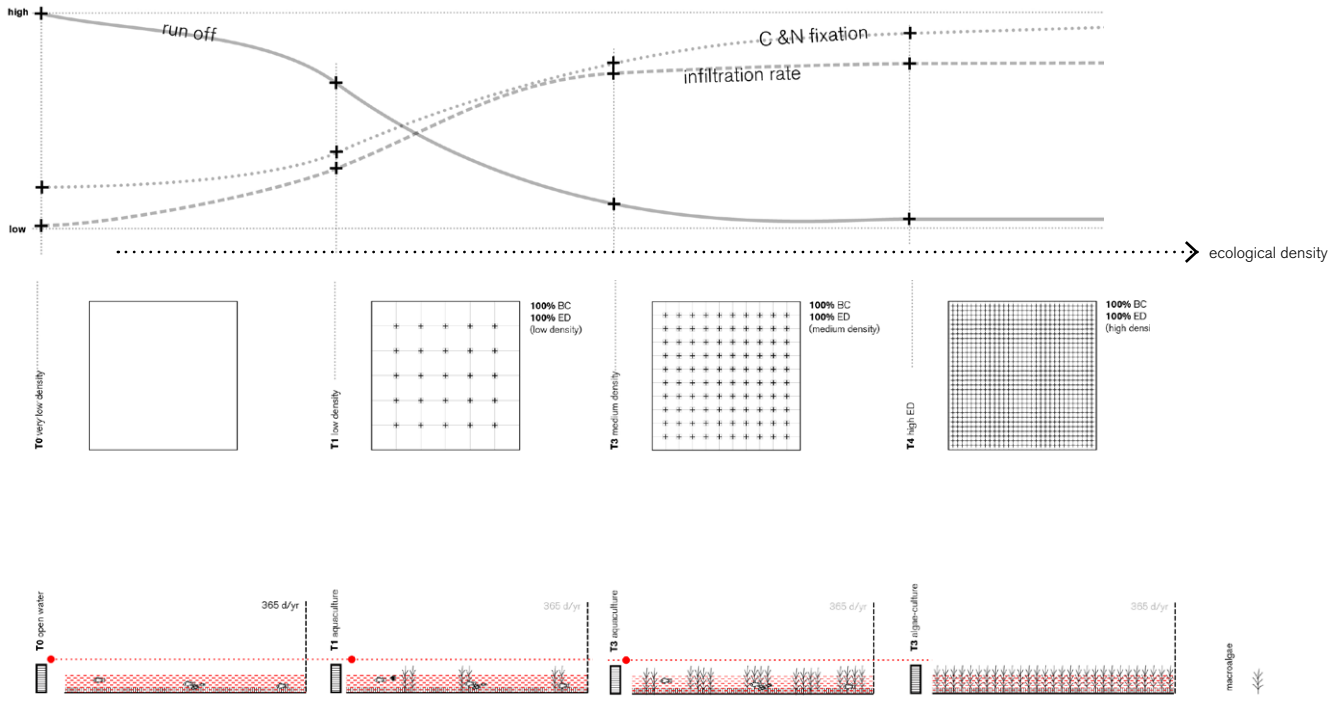
AQUACULTURE GRADIENTS

aquatic

Figure C53.
Productive wetland transformation genealogy
Elaborated by the author

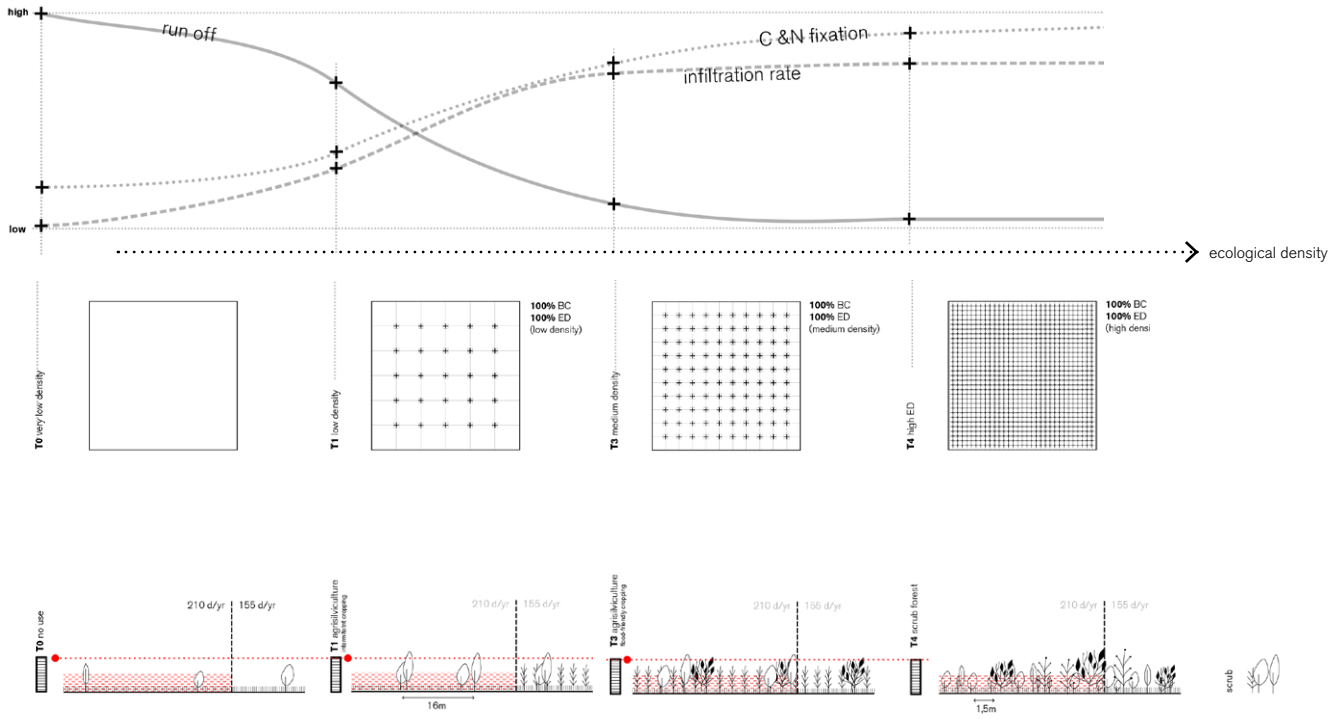


AQUACULTURE GRADIENTS
emergent


high
low
run off
C &N fixation
infiltration rate
ecological density
T0 very low density
T1 low density
100% BC
100% ED
(low density)
T3 medium density
100% BC
100% ED
(medium density)
T4 high ED
100% BC
100% ED
(high densi
T0 open water
365 d/yr
T1 aquaculture
365 d/yr
T3 aquaculture
365 d/yr
T3 algae-culture
365 d/yr
macroalgae

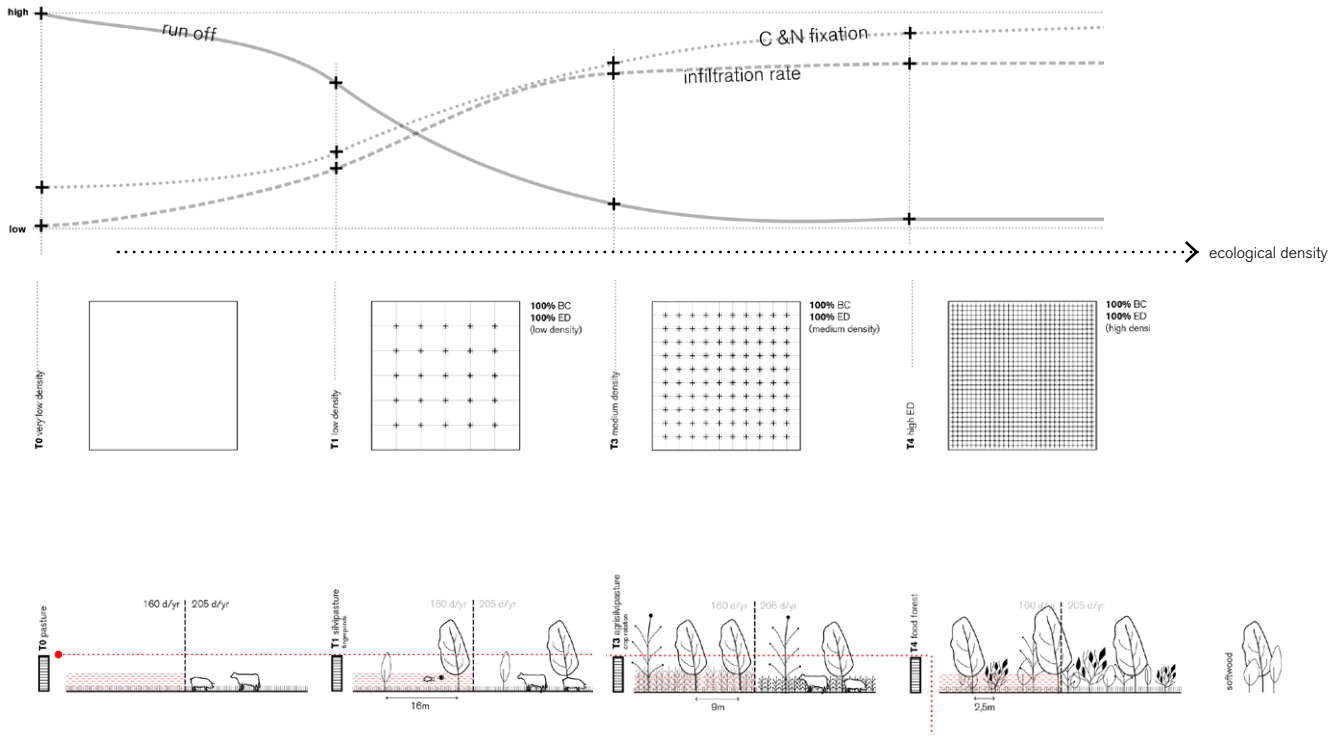
AQUACULTURE GRADIENTS

wet medow


high
low
run off
C &N fixation
infiltration rate
ecological density
T0 very low density
T1 low density
100% BC
100% ED
(low density)
T3 medium density
100% BC
100% ED
(medium density)
T4 high ED
100% BC
100% ED
(high densi
T0 no use
210 d/yr
155 d/yr
T1 agrisilviculture
T3 agrisilviculture
T4 scrub forest
16m
1,5m
scrub

AQUACULTURE GRADIENTS

high wetland


high
low
run off
C &N fixation
infiltration rate
ecological density
T0 very low density
T1 low density
100% BC
100% ED
(low density)
T3 medium density
100% BC
100% ED
(medium density)
T4 high ED
100% BC
100% ED
(high densi
T0 pasture
160 d/yr
205 d/yr
T1 silvipasture
16m
T3 agrisilvipasture
9m
T4 food forest
2,5m
softwood

Detail scale

MICRO SCALE

LINTEN PARK

Spatial morphology

main transformation

- Buffer capacity per patch
- Ecological density per patch

layers / legend

Open Space Matrix: pasture, arable land, forest, no-use
Built up Matrix: discontinuous 0-10, 10-30, continuous 30-50, 50-80

Figure C54.
Orchard
Source: Reprinted from *Dienst Landelijk Gebied* (2011), Retrieved from www.dienstlandelijk-gebied.nl

Figure C55.
Orchard planting 1944
Source: Reprinted from *Dienst Landelijk Gebied* (2011), Retrieved from www.dienstlandelijk-gebied.nl

Figure C56.
Location
Elaborated by the author

Figure C57.
De Buiten - Lingezegen Park
Source: Reprinted from *Dienst Landelijk Gebied* (2011), Retrieved from www.dienstlandelijk-gebied.nl

Figure C58.
Kapel de Heuvel
Source: Reprinted from *Dienst Landelijk Gebied* (2011), Retrieved from www.dienstlandelijk-gebied.nl

LOCATION

purpose of the scale and location choice

The micro scale is the scale to study the implementation of the proposal at a morphological level. The selected area corresponds to "De Buitens", one of the parks composing Lingezegen Park as studied in the meso scale. This area is at the heart of the *green corridor,* where its geomorphological condition as former stream ridges of sandy material is still visible in its topography and landscape of orchards so characteristic of the Betuwe's region. This condition, that represents the idiosyncrasy of the green corridor defining the character of the Betuwe, is the reason why it has traditionally been a densely inhabited area, and where today the planning of the Park allows new buildings as long as the typical landscape is preserved.

The proposal on the hybridization of the landscape by buffer and ecological density gradients accommodating to uncertain socio-economic and climatic conditions builds upon the planning of this park.
The current planning designs the character of the *singel* with cherry trees, highlights the location of two archaeological sites as small parks, and opens the opportunity for individuals to invest in its further development: by planting orchards, constructing new publicly accessible estates, walkaways, and public equipments such as selling points of regional products and built landmarks such as a Crystal Palace to exhibit the horticulture.

As park which main aim is the development of a mixed use "green lung" within Arnhem-Nijmegen Metropolitan Area for recreation, agriculture, nature, water and cultural heritage, the thesis' proposal takes the planning frame, structure and proposed ecological and cultural qualities, and adds the innovative program on the evolutionary hybridization of leisure, production and biodiversity with the regional buffer functions.

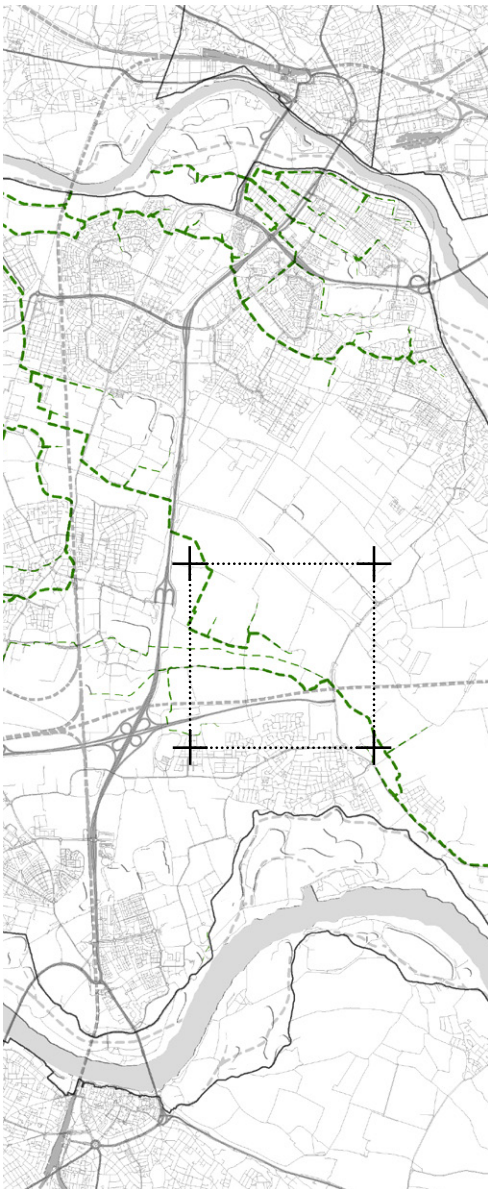
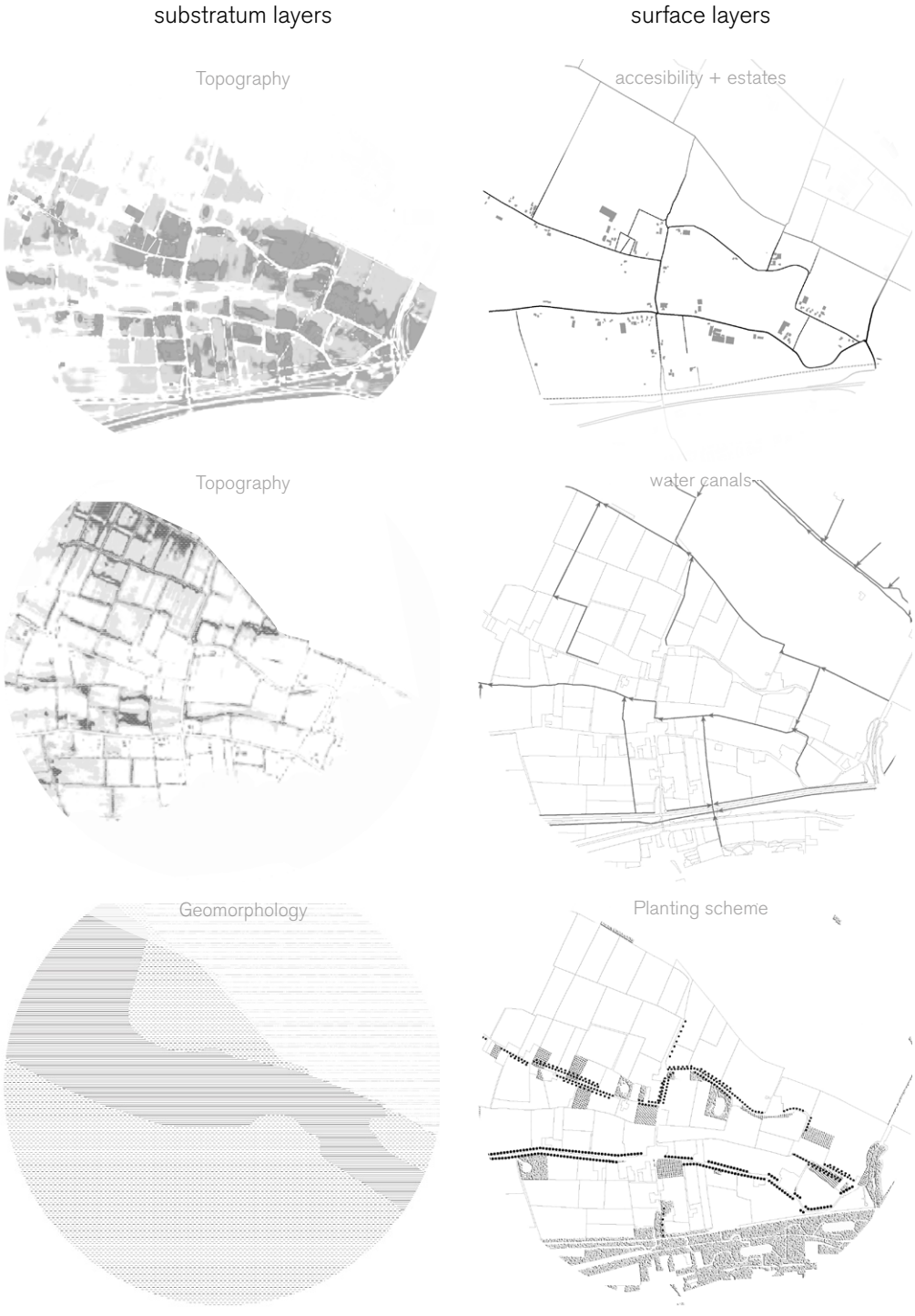


Figure C59.
Structure matrix
Elaborated by the author



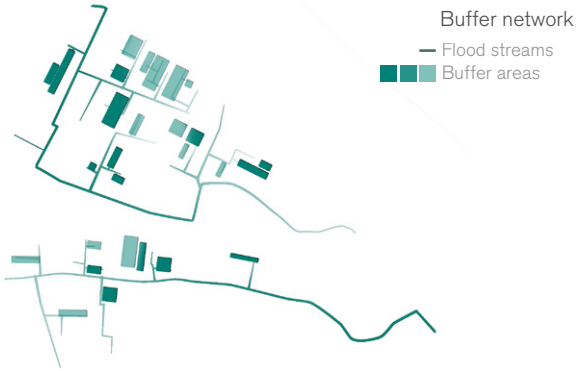
STRUCTURE

logic matrix

proposed network

Accessibility & built up program

The accessibility of the proposal understands the accesibility structure and program logic proposed by De Buiten, and together with a topographic analysis identifying the higher areas, the built up program is located as landmarks in the open space matrix.



Buffer network

The buffer network is composed by flood streams and buffer areas which logic is the result of the identification of lower areas (where the buffer gradients are proposed) and existing water canals.
Within the fractal ramification of the flood streams 3 levels can be identified:
- 1st level: corresponds to the regional structure maintained by the region
- 2nd level: corresponds to local streams maintained by a collective of landowners
- 3rd level: corresponds to the end ramifications within the land use patches, maintained by the same landowners

Green network

The green network is the result of superimposing:
- the planting scheme proposed by the Buiten plan,
- the riparian corridors stablished naturally thanks to the flood streams, and
- agroforestry gradients

TAXONOMY

Spatial morphology

Hybrid Space Matrix

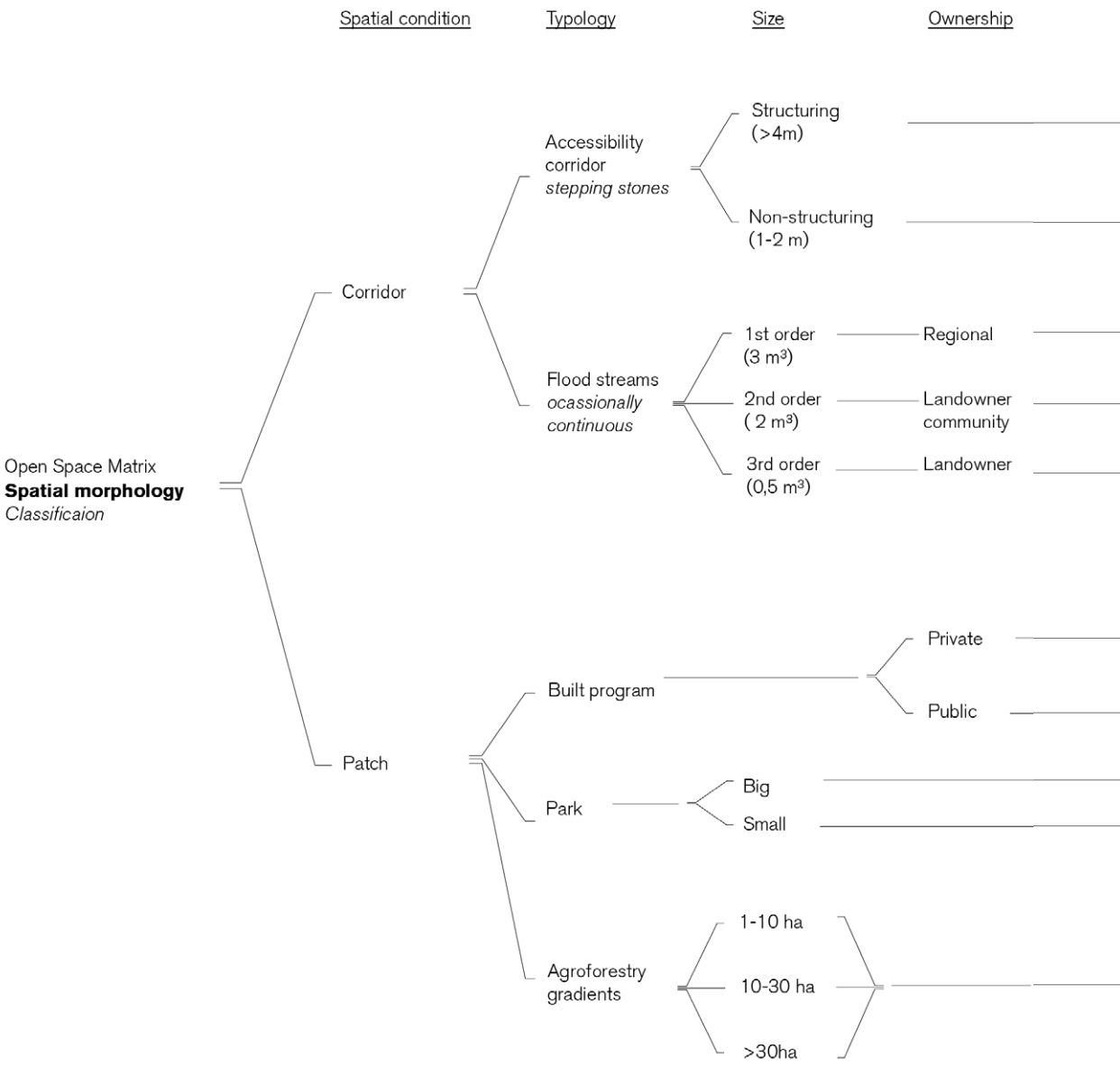
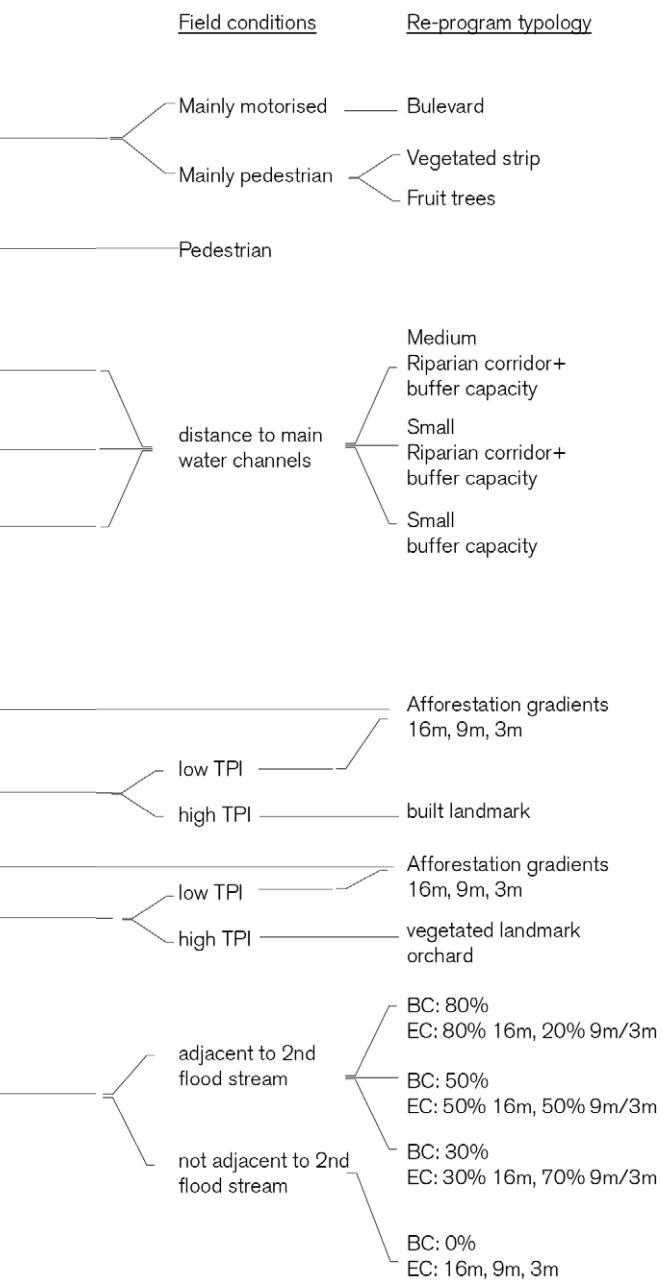


Figure C60.
Spatial morphology taxonomy
Elaborated by the author



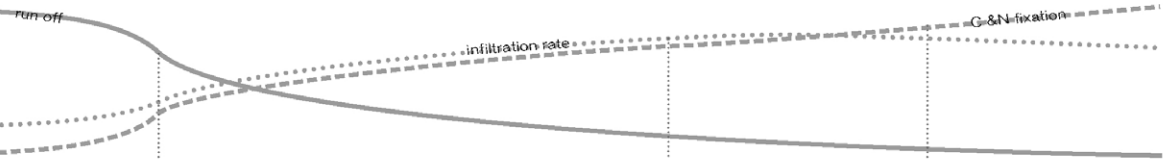
FUNCTION & CHANGE

Figure C61.
Function and change in De Buiten Park
Elaborated by the author

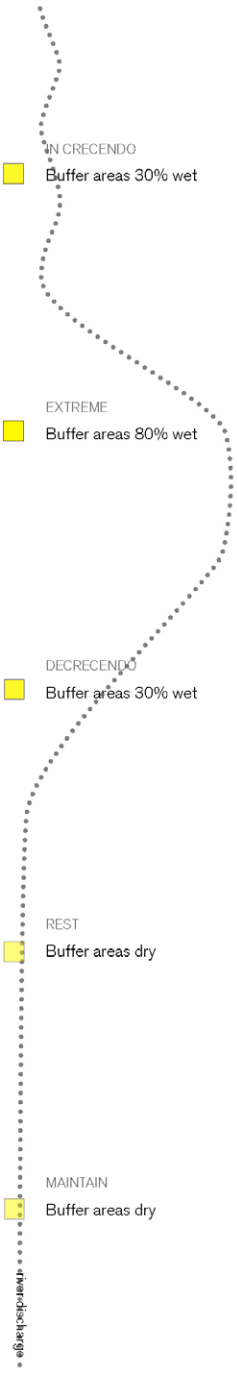
The process-based design approach (where macro, micro and nano scale processes are taken into account) lead to a specific local transformation tested in the design for the Buiten park, an area at the heart of the green corridor, planned within the Lingezengen Park initiative.

The role of planning and design of the urban project is not only about providing a future vision, but to embrace the pathways of such transformation.

In this sense, the image on the right can be used as a tool to understand the variables and systemic relations triggered by the proposal. The result is the overlapping of De Buiten Park plan in the background and the matrix of transformation on the foreground. Land uses are understood as evolutionary planning units.


run off
infiltration rate
C&N-fixation


T1 silvipasture
T1 agrosilviculture
T2 agrosilvipasture
T3 silvipasture
T3 agrosilviculture
T0 forest
T4 Food forest
T1 park
T3 park
T1 80% Agrosilviculture 16m
T2 80% Agrosilvipasture 16m
T3 80% Agrosilviculture 9m
T4 80% Food forest 9m
25 Trees/ha
25 Trees/ha
100 Trees/ha
1000 Trees/ha


IN CRECENDO
Buffer areas 30% wet
EXTREME
Buffer areas 80% wet
DECRECENDO
Buffer areas 30% wet
REST
Buffer areas dry
MAINTAIN
Buffer areas dry
river discharge

D

Implementation & Operability

D1. Room for the River as a planning platform
D2. Limitations and points of entry
D3. Implementation phases and operability
D4. Evaluation. The aftermath of extreme events
D5. Adaptive spatial performance

D1. ROOM FOR THE RIVER AS A PLANNING PLATFORM

The proposal here presented is articulated with the existing planning platforms, namely Room for the River Program.

The role and importance of this platform is unique as it constitutes a stepping stone in Adaptive Delta Management (Zevengergen et al., 2015).

By the adoption of a system approach, a participatory decision making and the promotion of flexibility through learning and experimentation, the program integrates a multiplicity of scales and objectives.

For this reason, Room for the River Program falls simultaneously under:
- "Integrated River Basin Management (IRBM)" practices, which take into account the interplay between both water and land use functions requiring integration across spatial scales (Zevenbergen et al., 2015), integrating and coordinating management of water while balancing goals and views of stakeholders
- Adaptive Management (AM) practices, rooted in the co-production of knowledge and acceptance of uncertainty.

By studying the operability of Room for the River, I will be able to have a complete overview of actors, instruments, existing programs and objectives, understanding the limitations and starting points of the project I put forward.

Governance levels in Room for the River

Room for the River is the first program in the Netherlands to adopt a multi-level governance approach in which NGO's and private stakeholders in different disciplines (water safety, planning, agriculture, nature) and authorities at national, regional and local levels are actively collaborating to reduce the flood risk and to increase the spatial quality by creating more space for the river (Van der Brugge, Rotmand, & Loorbach, 2005 in Zevenbergen etc al, 2015).

The decision frameworks for establishing improved water safety and spatial quality are set by the national Government, whilst the plans and designs are formulated and decisions are taken by local and regional stakeholders in 34 regional projects.

Actors and Roles:

Minl&E NATIONAL ENTITY - Dutch Ministry of Infrastructure and the Environment hold the ultimate responsibility for the programme fine tuning adjustments in accordance with regional developments, provincial executives, regional water boards and Rijkswaterstaat (Directorate-General for Public Works

and Water Management). The National entity is in charge of providing the financial resources needed to implement Space for the River measures (aprox 2.2 billion euros) in order to accommodate the increase discharge at Lobith from 15,000 to 16,000 m3/s.

PROGRAM OFFICE - The national government has established a central program office to manage and monitor progress, evaluate quality of designs, and facilitate the regional projects through guidelines, providing expert knowledge, community building, and, where needed, applying political pressure.

RWS NATIONAL IMPLEMENTATION ENTITY – The National Implementation entity is Rijkswaterstaat, which is in charge of design choices, risk management, permits, selection and management of market parties and creation of local support.

Prov WB Mun REGIONAL AND LOCAL ENTITIES - Regional and local governments are in charge of implementing plans within national boundary conditions (in charge of decide where, when and how to implement the measures so it can benefit to the maximum the in-site conditions) improving the quality of planning and likelihood of delays. This decentralised approach, whereby the initiator of spatial measures is a municipality, province or water board works and leads to good results.

Prov PROVINCIAL IMPLEMENTATION ENTITY – Provinces are responsible for permits, selection and management of market parties and creation of local support.

WB REGIONAL IMPLEMENTATION ENTITY - Regional implementation entities correspond to Water boards, which are in charge of assessing risk management and give permits.

Mun LOCAL IMPLEMENTATION ENTITY - The municipalities are in charge of the selection and management of market parties and creation of local support.

Lw IPCO LAND OWNERS and LOCAL BUSINESSES - Around 150 homes and 40 businesses are given a plan to transform (dwelling mounds known as “terps”), or relocate, and the flexibility to innovate different solutions.

Q-T QUALITY TEAM – The quality team is an independent figure created in order to secure the spatial quality objective. It consists of five independent experts in landscape, physical geography, urban planning, river scientist and ecologist. Together they provide advice on decisions during the planning, realization and delivery phase of the projects, writing a final assessment once the project is delivered.

Programs and plans

PROGRAM ORGANIZATION (PKB). The key planning decision (2000-2006) covers the planning area of the Rhine Branches and the diked part of the Meuse in North Brabant and contains 34 locations. The two main objectives of the PKB are bringing flood protection as main objective and making a contribution to improving spatial quality of the river area as a second objective. In this program, the safety objectives, function of the area and total budget of the program, time frame and type of measure is laid down. The spatial quality objective is not formulated per project, but at program level.

"Planning Kit" for Flood Management along the Rhine Branches is the planning tool that allows the user to make a selection of combinations of all available measures and immediately visualize the result of implementing measures in terms of river discharge accommodation. It is a useful tool to facilitate public discussion and identify measures in the initial phase of the program.

PROGRAM DIRECTION (PDR). The Programme Directorate for Room for the River (2006-2015) is the link between national government and the regions. It verifies compatibility of municipal plans with Room for the River policy, monitoring cohesion of measures. It ensures that the plans are within budget and timing. The responsibility to carry out this program belongs first to the Policy Directorate (DGRW) and the decision-making corresponds to the Program Office. Once the program is running, Rijkswaterstaat is responsible to review the proposal.

ASSESSMENT PROGRAM / EXPLORATION PHASES (SNIP). This program marks assessment phases within the PDR before going to the next project phase. In the SNIP Handbook attention is paid to assess the improvement of spatial quality within the different projects.

Compliance with other national and international programs

Room for the River complies with national and international programs, coordinating with other initiatives and measures:

- International Commission for the Protection of the Rhine (ICPR, IKSR, CIPR) is a trans-boundary international co-operation commission providing protection to the Rhine and coordinating various European directives and regulations that require coordinated implementation in the entire watershed such as the European Water Framework Directive, the European

Flood Management Directive, the Eel Regulation, and others. Within this commission, Room for the River coordinates flood management measures with Germany.

- Water Framework Directive (WFD) – This European framework sets water safety and nature objectives. In relation to the water safety objectives, Room for the River has stronger standards, however, in terms of nature objectives Room for the River needs to optimize.

- Natura 2000 - Whereas Natura 2000 goals have been included, opportunities have been missed according to Warner et al., (2011). On the other side, "Strategic Framework Birds Directive and Habitats Directive" (RfR, 2013) designates areas where absolutely none or only with extreme caution river-widening measures can be implemented

- Nature Ambition for great Waters (Natuurambitie Grote Wateren) a document released by the Ministry of Economic Affairs in 2014 painting a picture of the future nature in the great waters of the Netherlands in 2050 including the North Sea, the Wadden region, the Southwest Delta, the Coastal area, the Ijsselmeer area and the Waal and Rhine rivers. The document invites other governments, citizens, nature organizations and other involved parties to work towards the outlined vision of the future. The document is based in four principles: connecting to natural processes, stablish synergies with other uses; placing nature in the middle of society; and link up with autonomous developments.

- DELTA PLAN for the Major Rivers

- NURG (Further Elaboration of the River Area, 1991) – a national cooperation agreement for financing projects aimed at safety and nature development in the flood plains.

- Streamline (Stroomlijn) a program launched by the Rijswaterstaat that describes the maintenance of vegetation along the major rivers aiming at keeping the flow paths in the floodplains free from vegetation. This program is included in the scope of Room for the River projects.

- Ecological Main Structure (Nature Policy Plan by the Ministry of Agriculture, Nature and Food Quality, 1990)

Figure D1
Implementation per objective
Source: Adapted and translated from Twist et al., (2011)

Figure D2 (following page)
Room for the River Platform summary
Elaborated by author
Source: Adapted from Twist et al., (2011)

ACTIVITIES:

Compliance

Conceptualization

Monitoring

Design and Implementation

Maintenance

OBJECTIVES:

Water safety objective

Nature objective

Spatial quality objective

Implementation of Room for the River per Objective

The integration of Spatial Quality and Water safety as a paired objective is key to the success of the program. By unfolding the overlapping implementation of the two objectives in time, it is revealed how each objective is conceived, operationalized and assessed:

Spatial Quality (local level)
This objective is programmatically conceived at a national level and formulated locally per project. This objective has stimulated interlinking flood protection with local and regional investment agendas, where nature is implemented and expanded locally through the spatial quality objective.

The assessment of this objective takes place through the figure of the Quality team, providing advice on decisions during the planning, realization and delivery phase of the projects and writing a final assessment once the project is delivered.

Flood adaptation (national level)
The safety objectives are nationally conceived through during the PKB, or exploration phase, where the function of the area, total budget of the program, time frame and type of measure is laid down. The type of measures per project are elaborated in dialogue with citizens, NGOs and PCO, and evaluated by Deltares thanks to the "Planning Kit".

The assessment of this objective takes place through the figure of the Rikswaterstaat using the SNIP during the study phase by verifying the compatibility of municipal plans with Room for the river policy, and monitoring cohesion of measures, and during the realization phase until the final assessment.

Spatial Quality

Project Proces

Project Phases

Q-team
(spatial quality evaluation)

Time scale

Water safety
Implemented through
34 Projects

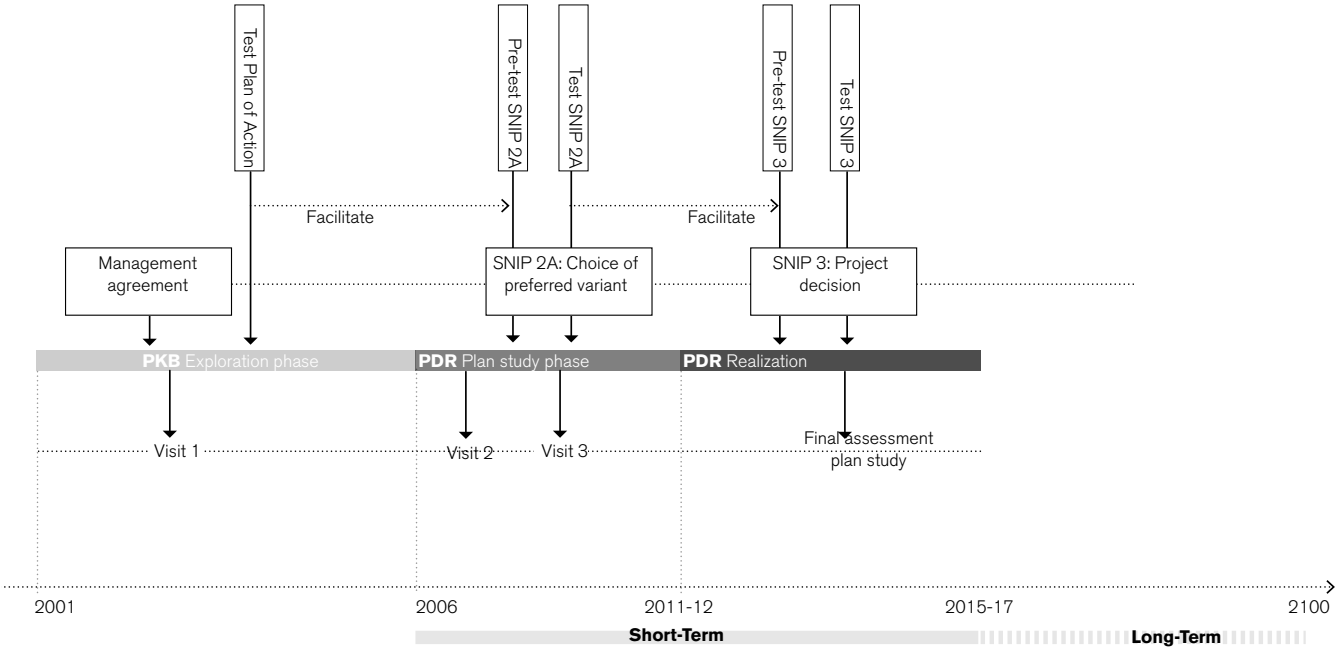
SNIP Milestones

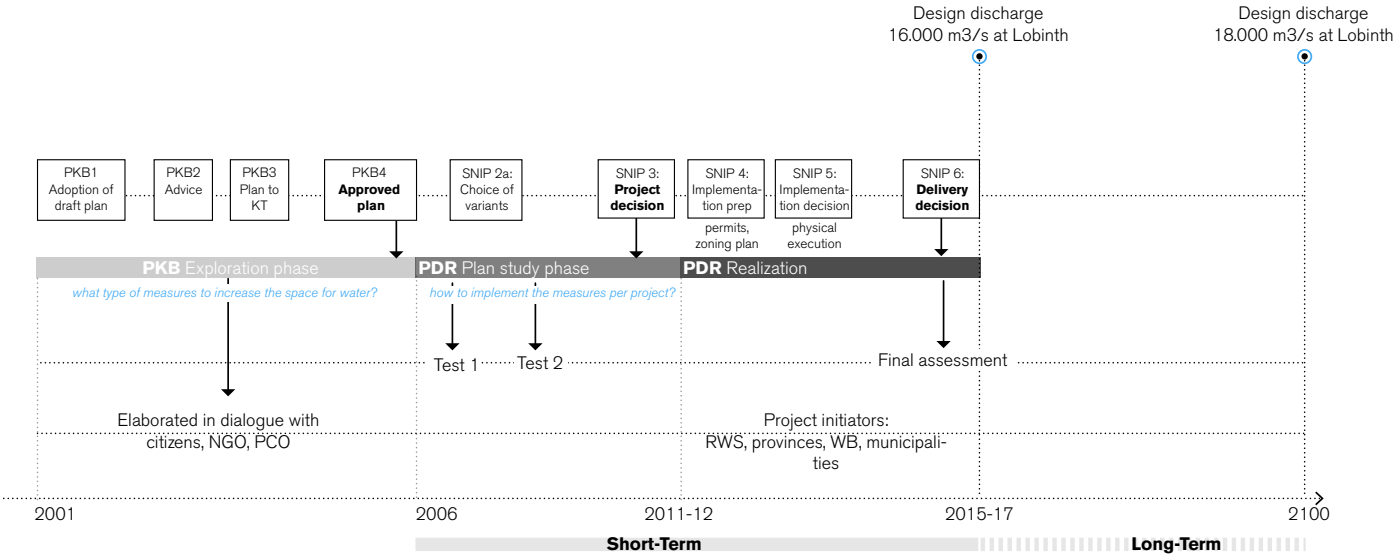
Project Phases

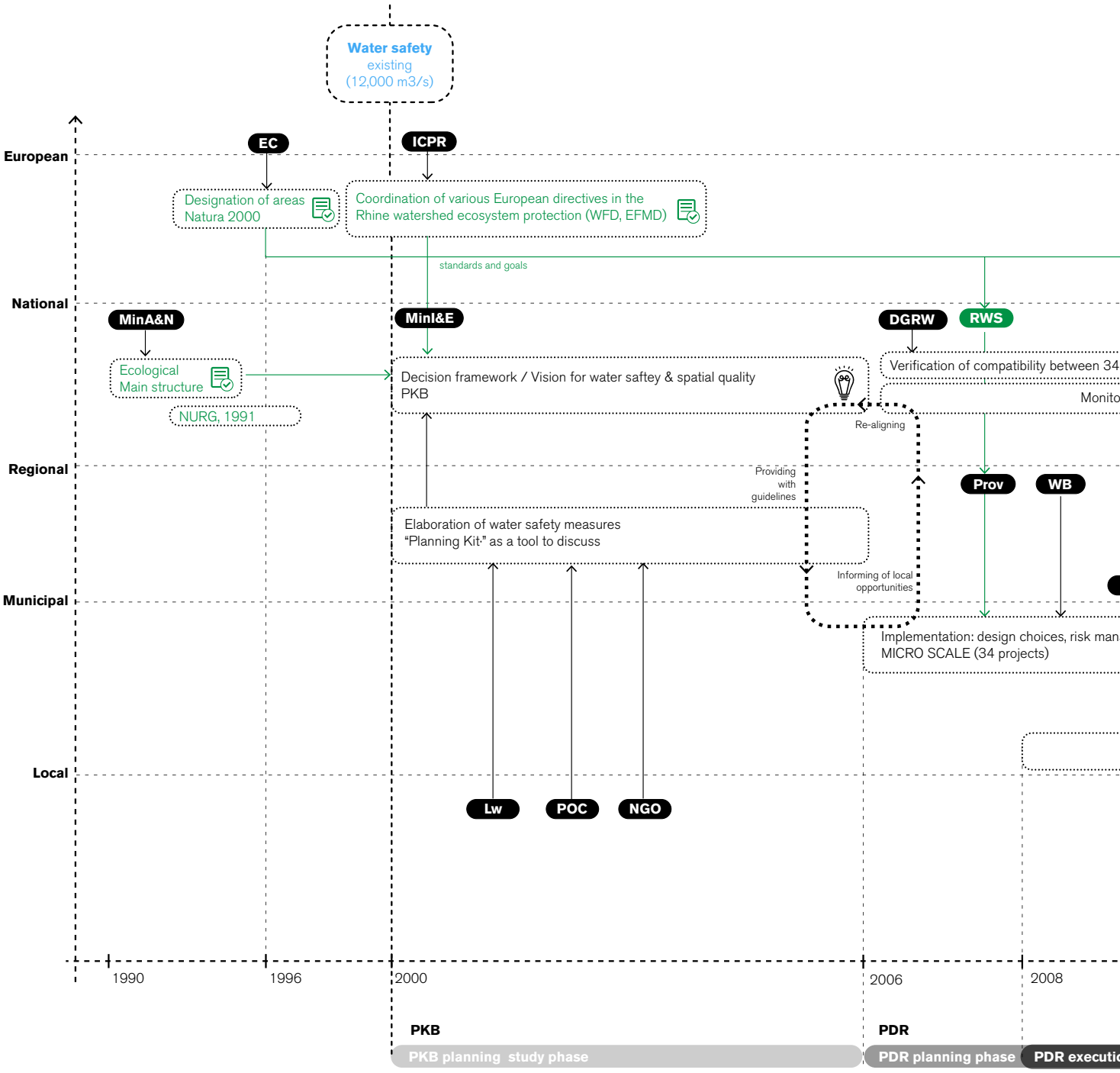
Deltares
(water safety evaluation)

Actors

Time scale


Test Plan of Action
Pre-test SNIP 2A
Test SNIP 2A
Pre-test SNIP 3
Test SNIP 3
Facilitate
Facilitate
Management agreement
SNIP 2A: Choice of preferred variant
SNIP 3: Project decision
PKB Exploration phase
PDR Plan study phase
PDR Realization
Visit 1
Visit 2
Visit 3
Final assessment plan study
2001
2006
2011-12
2015-17
2100
Short-Term
Long-Term


Design discharge 16.000 m3/s at Lobinth
Design discharge 18.000 m3/s at Lobinth
PKB1 Adoption of draft plan
PKB2 Advice
PKB3 Plan to KT
PKB4 Approved plan
SNIP 2a: Choice of variants
SNIP 3: Project decision
SNIP 4: Implementation prep
permits, zoning plan
SNIP 5: Implementation decision
physical execution
SNIP 6: Delivery decision
PKB Exploration phase
PDR Plan study phase
PDR Realization
what type of measures to increase the space for water?
how to implement the measures per project?
Test 1
Test 2
Final assessment
Elaborated in dialogue with citizens, NGO, PCO
Project initiators: RWS, provinces, WB, municipalities
2001
2006
2011-12
2015-17
2100
Short-Term
Long-Term



OBJECTIVES (per location and overall)
- Safety objectives
- Function of the area
- Total budget of the program*
- Time frame
- Type of flood adaptation measure
- Spatial quality at program level

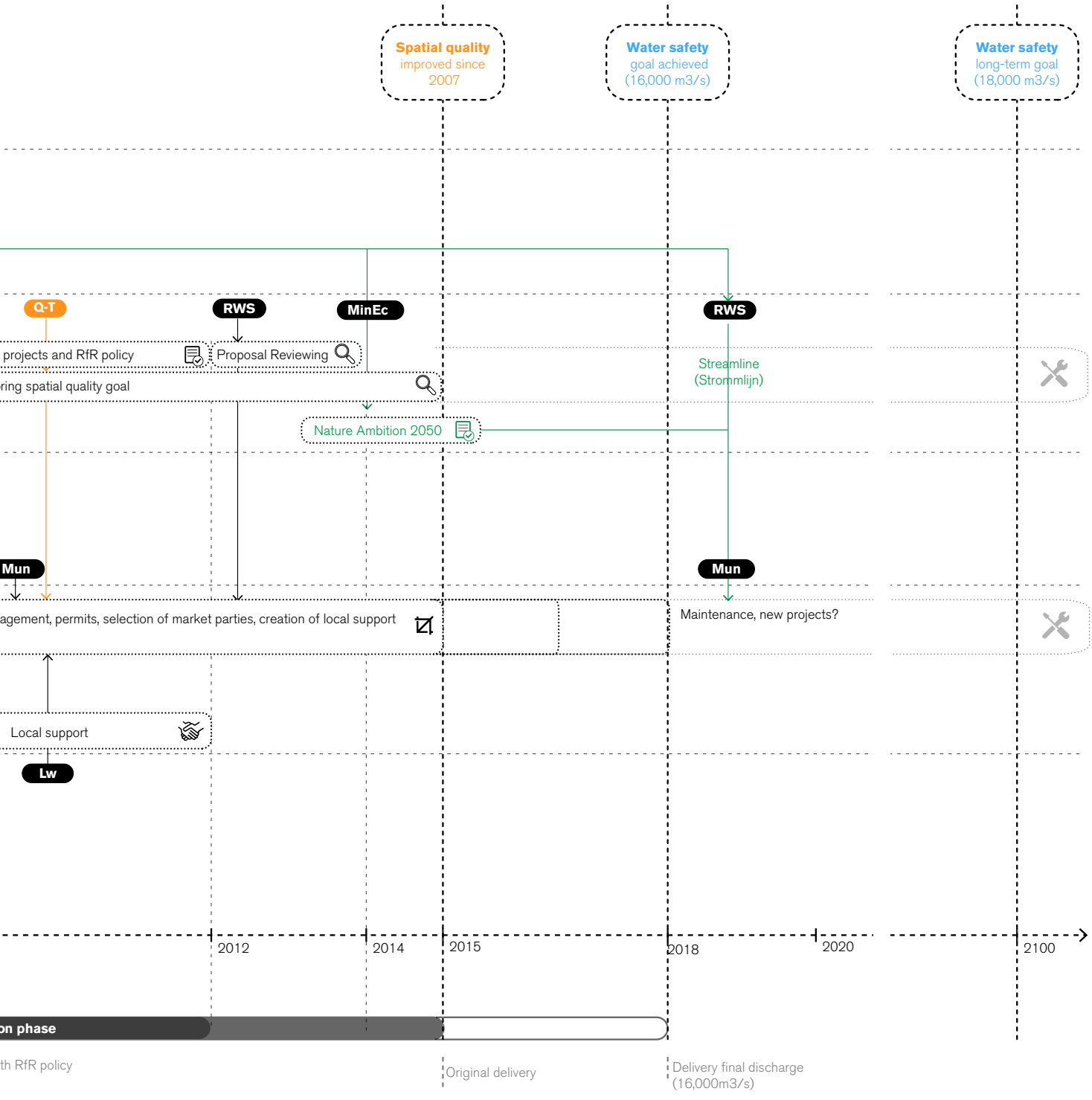
TOOLS "Planning kit" for Flood Management

ACTORS National government - Program Office

OBJECTIVES
- Verify compatibility of municipal plans wi
- Monitor cohesion of measures

TOOLS SNIP (Assessment Program)

ACTORS
Decision making:
Policy Directorate (DGRW)
Program Office
Proposal reviewing:
Rijkswaterstaat


Spatial quality
improved since
2007
Water safety
goal achieved
(16,000 m3/s)
Water safety
long-term goal
(18,000 m3/s)
Q-T
RWS
MinEc
RWS
projects and RfR policy
Proposal Reviewing
ring spatial quality goal
Streamline
(Strommlijn)
Nature Ambition 2050
Mun
Mun
agement, permits, selection of market parties, creation of local support
Maintenance, new projects?
Local support
Lw
2012
2014
2015
2018
2020
2100
on phase
th RfR policy
Original delivery
Delivery final discharge
(16,000m3/s)

Operability
key changes

From the study of Room for the River Program, a complete overview of actors, instruments, existing programs and objectives is dissectioned in order to be able to build upon existing Adaptive Management practices. The research identifies four main limitations and starting points that this project puts forward:

1 Fixed number of strategic projects

2 Local actors as participants of change

3 Adaptive long term vision but fixed long term design goals

4 Flood management confined to the area within the dikes

protecting the duality between active and passive areas

Open number of local projects

easier to expand and manage

Local actors as agents of change

cultural appropriation of the transformation

Adaptable long term vision and goals

evolutionary expansion and re-design of the network

Flood management integrated throughout the whole watershed

overcoming the vulnerability
coming from the dualistic approach

Figure D3.
Lingezegen Park
Source: Reprinted from *Park Lingezegen*, Retrieved from https://parklingezegen.nl

D2. LIMITATIONS &STARTING POINTS

Main changes with respect to Room for the River Program

The study of Room for the River Program operability gives me a complete overview of actors, instruments, existing programs and objectives that the proposal embraces in order to build upon existing Adaptive Management practices.
This research identifies two main limitations and starting points that this project puts forward:

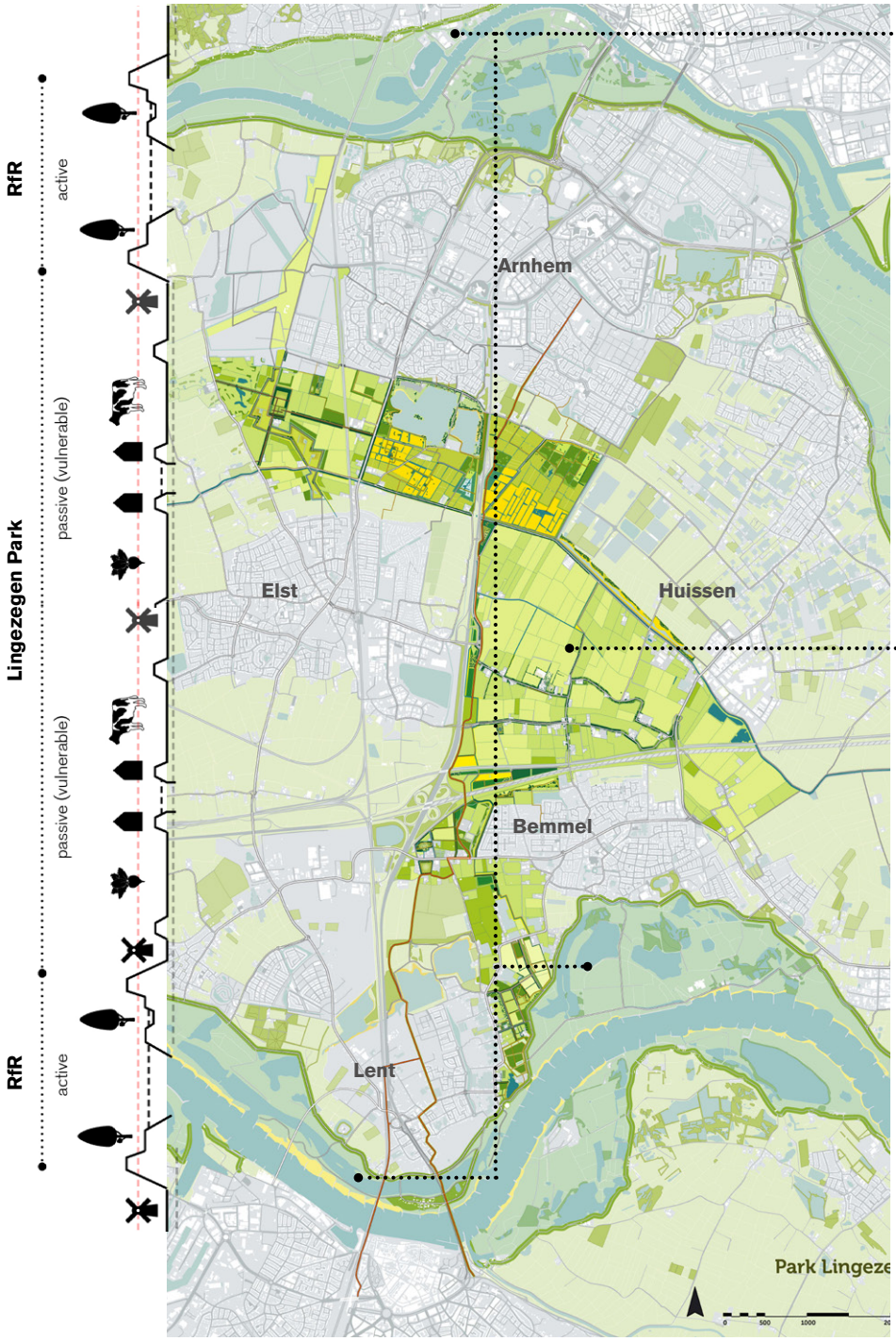
1.- From sectorial to integrated management
The first limitation and starting point consists on the overcoming of the duality between active and passive areas, by the co-definition of functional and physical connectivity between areas inside and outside dikes and redefinition of statutory flood protection standards into statutory robustness standards.

2.- An evolutionary approach
The proposal moves forward from the existing adaptive approach by including key elements in the definition of an evolutionary character through:

a) The democratization of the transformation to an open number of local and self-organized transformations (projects), in contrast to the fixed number of strategic projects proposed by Room for the River Program.
b) The democratization of the transformation to an open potential of synergistic functional variations.
c) The evolutionary co-definition of a long term transformation through a series of co-definition moments in the short and medium term as ongoing monitoring and evaluation of the evolution of the proposal.

1.- From sectorial to integrated management.
Aligning processes of change by aligning values

The selection of the regional strip corresponding to the City Region Arnhem Nijmegen, reveals the sectorial management of the area, distinguishing:
- The management of the areas within the dikes, corresponding to Room for the River Program,
- The management of the areas outside the dikes, corresponding, in this case, to the Lingezengen Park Program (2008-2015). A program, guiding the development of the territory in-between the two rivers, Nederrijn and Waal, with the aim of preserving the green/blue buffer against ongoing urbanization and sprawl. Developed by a collaboration between several local governments, representatives from the city region Arnhem-Nijmegen, water authorities, forest management agencies, where citizens and companies are involved in the decision-making during planning and design phase.



Room for the River

Threefold aim: spatial quality of the riverfront, safety and nature conservation

Lingezegen Park

The main aim of the proposal is the development of a “green lung” within Arnhem-Nijmegen Metropolitan Area characterised by a mixed use: recreation, agriculture, nature, water and cultural heritage.

Figure D4.
Section diagram
Elaborated by the author
Source: Adapted from Hooimeijer (2018)

While the governance and planning of these projects provides with a solid foundation for adaptive management enabled by a system approach, participatory decision making, learning and experimentation (Zevenbergen et al, 2015), a sectorial character in planning arises from the deliberate fragmentation of the Dutch landscape (figure D2).

This condition not only duplicates efforts and investments in the development of initiatives considered belonging to incompatible systems and regimes, but also obstructs social learning and prevents an active adaptation to climatic extremes.

Coming from the understanding of an interconnected river system, the proposed planning seeks for alignments in aims and values as a tool to deliver converging cohesive and integrated proposals. The planning proposal seeks for the alignment of different existing processes of change into an integrated proposal as a strategy to achieve a better performance at local, regional and territorial scales in flood risk management and ecosystem restoration. This idea also gives the proposal the leverage to be implemented and maintained: from conflicting interests to bridging interests, where the possible interconnection among actors leads to smarter investments.

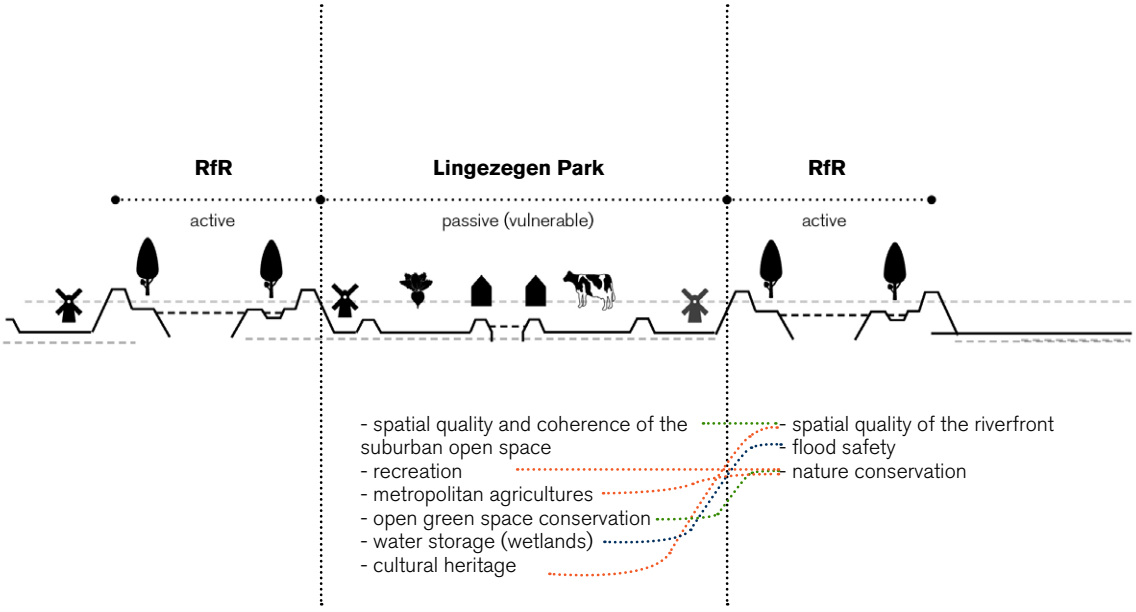
The interplay of flood risk management, ecosystem restoration and ecological-based production crystallises in a typology of transformations corresponding to different points of entry of the proposal. This family of transformations is associated to a multiplicity of values at different scales. In the following page (figure D3), the proposed typology of transformations is presented and translated into the delivery of different values which are aligned with the existing programs and processes of change and connected to a multi-sectorial and multi-scalar set of actors.

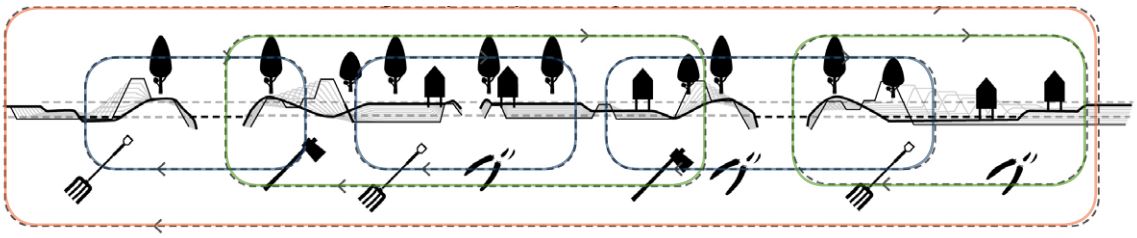
On the planning of hybrid landscapes

As seen in chapter C, the thesis focuses on exploring the pathways towards the hybridization of the urban landscape with a particular focus on the countryside which, due to a question of flexibility in the degree of possible change (figure C20, page 116), has a higher potential of implementation of the proposal in the short-medium term. Once the proposal works under uncertain river discharges regimes (figure D4, page 198-199), the hybridization can colonize the highly urbanized areas through new patterns and densities of buffer capacity, ecological density and land management, taking to these dense areas (in a smaller scale) the reconnection with natural dynamics.

In this sense, the implementation of the proposal will start from the transformation of the open space matrix into hybrid gradients (chapter C), acting as “defense” buffer areas reducing flood risk into the densely urban areas, that will eventually adopt new gradients of transformation.

Current planning strategies tend to give a sectorial answer per initiative and area (active, passive) to programs with the same aims and values due to a constructed fragmentation of the landscape. From the understanding of an interconnected system -an integrated river delta system-, the planning proposal explores the winning situations associated to converging synergies at multiple scales (see page 212-213).





Flood risk management
mitigation and adaptation

Ecosystem restoration
Climate Change mitigation

Holistic land management
(ecology-based production)

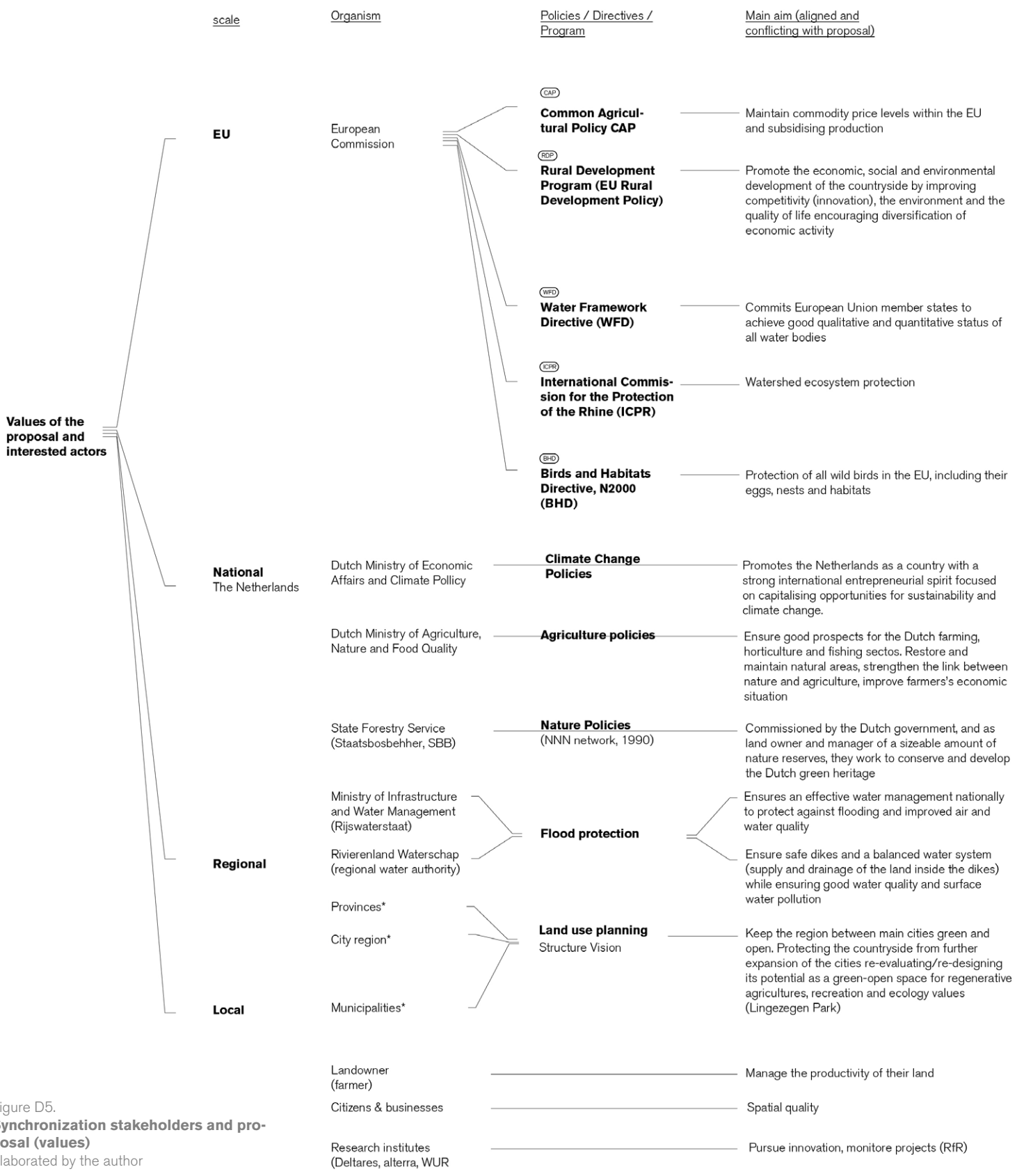
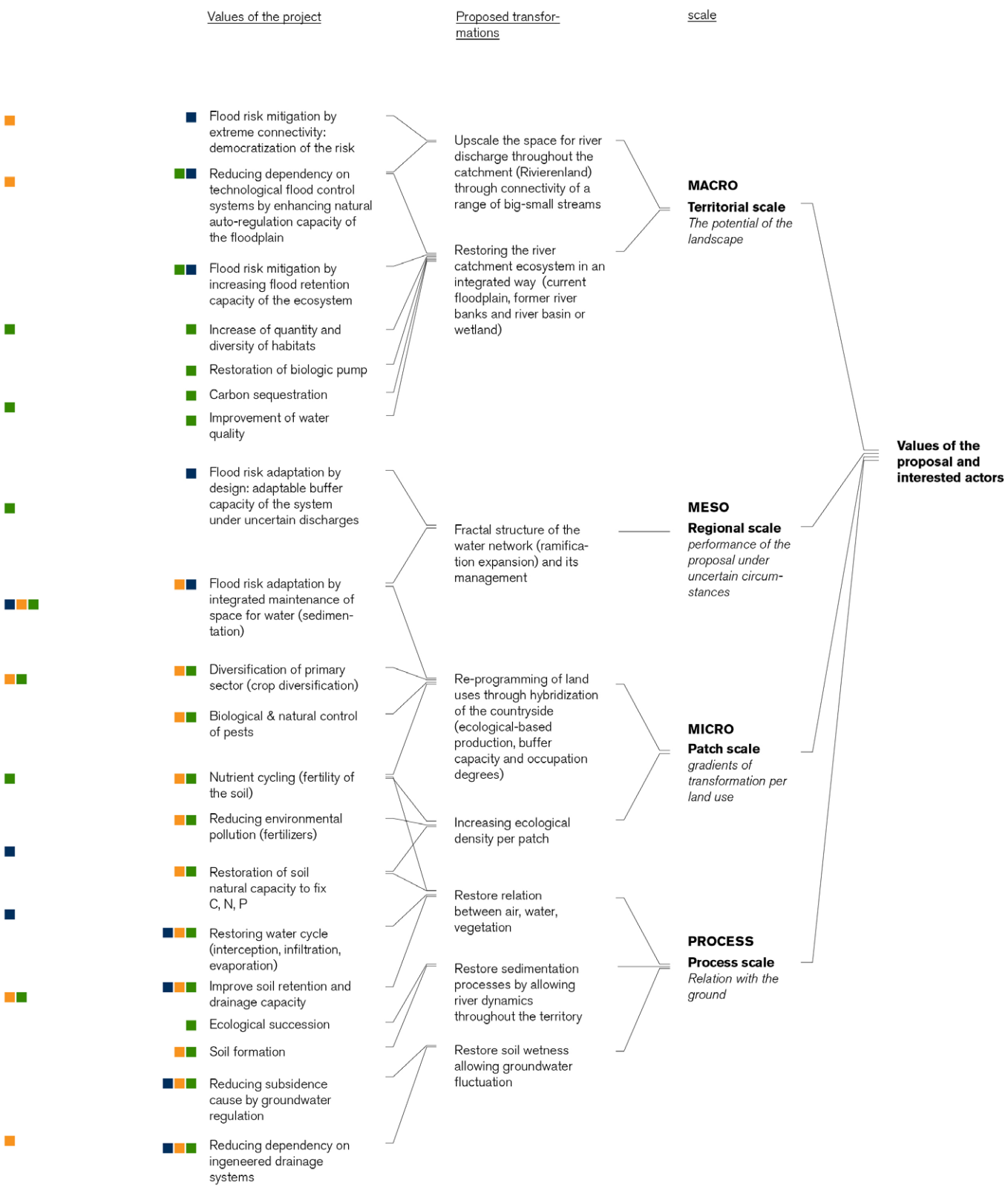


Figure D5.
Synchronization stakeholders and proposal (values)
Elaborated by the author


Values of the project
Proposed transfor-mations
scale
Flood risk mitigation by extreme connectivity: democratization of the risk
Reducing dependency on technological flood control systems by enhancing natural auto-regulation capacity of the floodplain
Flood risk mitigation by increasing flood retention capacity of the ecosystem
Increase of quantity and diversity of habitats
Restoration of biologic pump
Carbon sequestration
Improvement of water quality
Flood risk adaptation by design: adaptable buffer capacity of the system under uncertain discharges
Flood risk adaptation by integrated maintenance of space for water (sedimen-tation)
Diversification of primary sector (crop diversification)
Biological & natural control of pests
Nutrient cycling (fertility of the soil)
Reducing environmental pollution (fertilizers)
Restoration of soil natural capacity to fix C, N, P
Restoring water cycle (interception, infiltration, evaporation)
Improve soil retention and drainage capacity
Ecological succession
Soil formation
Reducing subsidence cause by groundwater regulation
Reducing dependency on ingeneered drainage systems
Upscale the space for river discharge throughout the catchment (Rivierenland) through connectivity of a range of big-small streams
Restoring the river catchment ecosystem in an integrated way (current floodplain, former river banks and river basin or wetland)
Fractal structure of the water network (ramifica-tion expansion) and its management
Re-programming of land uses through hybridization of the countryside (ecological-based production, buffer capacity and occupation degrees)
Increasing ecological density per patch
Restore relation between air, water, vegetation
Restore sedimentation processes by allowing river dynamics throughout the territory
Restore soil wetness allowing groundwater fluctuation
MACRO
Territorial scale
The potential of the landscape
MESO
Regional scale
performance of the proposal under uncertain circum-stances
MICRO
Patch scale
gradients of transformation per land use
PROCESS
Process scale
Relation with the ground
Values of the proposal and interested actors

2.- An evolutionary approach.
Building on the cultural appropriation of the proposal.

The second aspect that the thesis puts forward with respect to the existing programs and initiatives on Adaptive Management and planning are:

a) The democratization of the transformation to an open number of local and self-organized transformations (projects), in contrast to the fixed number of strategic projects proposed by Room for the River Program.
As a tool for including the uncertainty at the local level, the idea behind the flexibilization of the transformation is upscaling the extent of room for the river by downscaling the size of each transformation. The aim is not only facilitating the maintenance and management of the proposal in time, but also promoting spontaneous change throughout the territory.

b) The democratization of the transformation to potential synergistic functional variations.
As seen in Chapter C, the transformation pathways of local land patches varies according to the site conditions (functional layer).
The pathway of transformation opens a permanent process of change from monocultures to policultures, and from passive to active lands in the inclusion of buffer roles when needed.

This framework of change reveals the potential synergistic functional variations, inspiring innovation processes by placing the decision making in the local spheres (landowners and local businesses).

c) The evolutionary co-definition of a long term transformation through a series of co-definition moments in the short and medium term as ongoing monitoring and evaluation of the evolution of the proposal. In this sense, rather than an end goal, that can be outdated as new predictions come along, the proposal gives a flexible pathway of change, building increasing learning abilities and translated into the co-definition of the regional network and local maintenance regimes that accomodate to changing circumstances.

These co-definition moments correspond to:
- Connectivity co-definition (page 225)
- Co-assessment and monitoring (page 233)
- Collective transformation

Both a) and b) aim at the cultural appropriation of the proposal, embracing the local actors not only as participants and supporters of the proposal but also as actual agents of change.

The democratization of the transformation to an open number of local and self-organized transformations and as a pathway of change aims at the cultural appropriation of the proposal embracing the local actors no only as participants and supporters of the proposal but also as actual agents of change.

Evolutionary implementation of objectives

Even though the main objectives of the proposal are shared with Room for the River Program goals, their implementation and reach is different.

Together, water safety, spatial quality and ecosystem restoration goals are conceived strategically and implemented and maintained locally at a patch level, enhancing a territorial dimension through the cumulative processes of hybridization.

The system maintenance is integrated in the proposal through the holistic land management where the landowner maintains the ecological density that is compatible to the desired buffer capacity.

The objectives, and particularly the water safety objective is therefore not fixed to a specific quantity as it happens in the current planning. Through the cultural appropriation of the proposal, the network is aimed at expanding more and more so the activation of buffer capacity areas can accommodate to uncertain river discharges.

D3. MAIN IMPLEMENTATION PHASES

Co-definition moments, network upgrading assessment, and new roles

Planning phases, actors and instruments are adapted from Room for the River Program as described in the following pages. Important to note are the new roles adopted by existing actors and the co-definition moments characterizing the evolutionary character of the planning proposal.

Another aspect of relevance during the design of the operability relates to the quantification assessment in relation with key moments in the upgrading of the network. In order to do so, the proposal researches the order of magnitude that Room for the River works with, as a reference magnitude:

- From local transformations at patch level, to regional upgrading of the flood stream network that connects existing transformed patches, this order of magnitude corresponds to 50-100 Ha. This order of magnitude corresponds to transformed hectares of land per individual project within the Room for the River Program.

- From regional to territorial upgrading of the network, the total amount of provided buffer areas within land patches and flood streams should together be in the order of 1000 Ha.

PHASE 0

From limitation to starting point

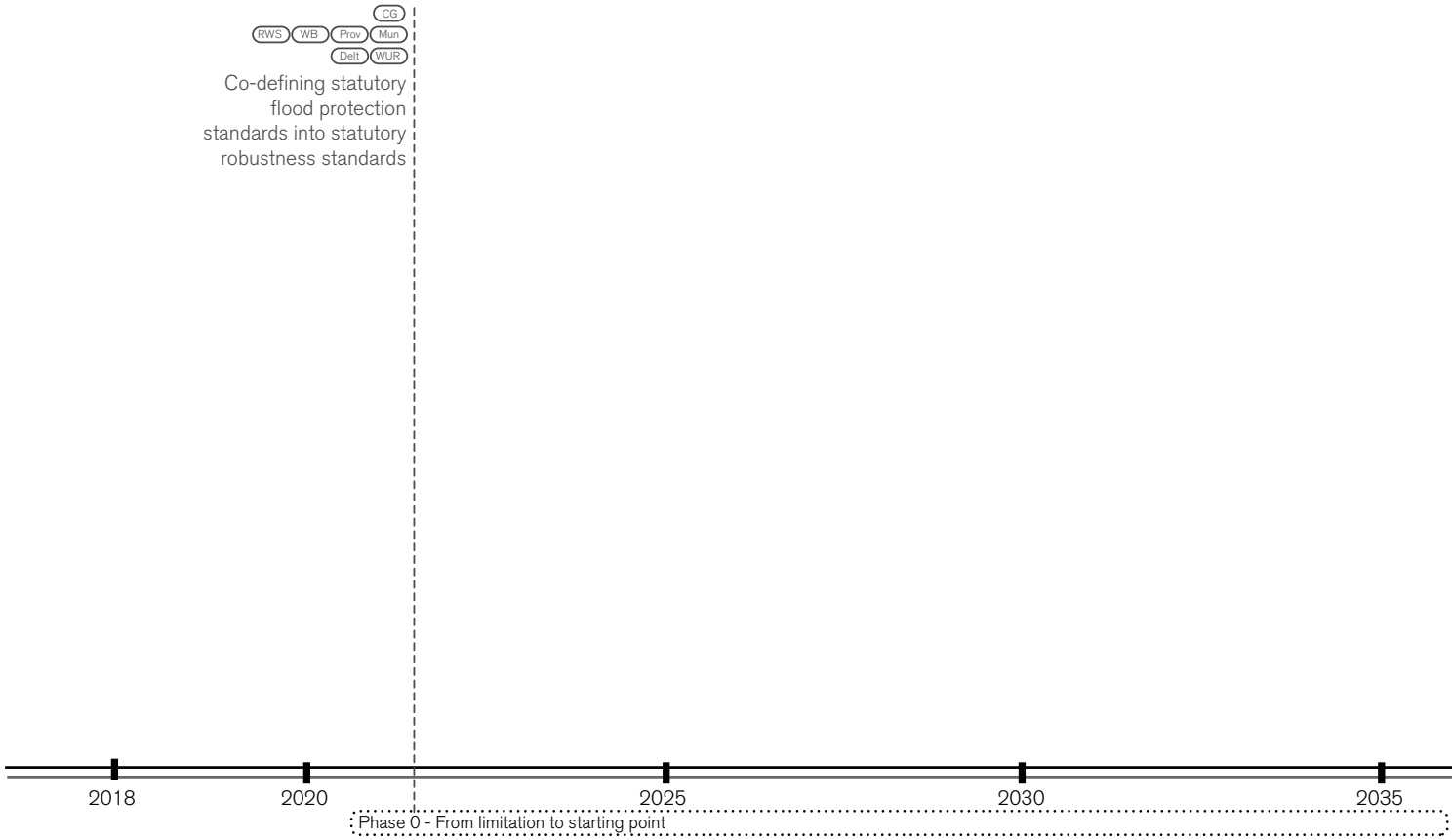
The Water Act of 2009 currently defines standards for protection from flooding for each levee system denoting the water level that the flood defences must be able to withstand. This legislation prevents the proposal from being fully implemented as it systematically prevents connectivity between blue and green corridor.

The objective of this phase is re-defining the *statutory flood protection standards* into *statutory robustness standards*[1] allowing connectivity and small floods within the green corridor in order to prevent disastrous floods.

\+ Existing roles / Existing Instruments

\+ New roles / New Instruments

Actors	Role	Instruments	Timing
CG Central government	+ Rewritting the law	+ Water Act	- Running through phase (compatible with exploration and study phase) - Progressive implementation per levee system
Mun Prov WB RWS Water authorities	+ Promote change		
WUR Delt Water research institutions	+ Promote change	+ Studies	
Electorate	+ Promote change	+ Voting tables	



"psychological research on risk perception shows that people value large consequences as much more important than frequency of occurrence" Klijn at al., (2018)

from protection standards, insuring protection from flooding
to robustness standards, allowing small floods in order to prevent disastrous floods.

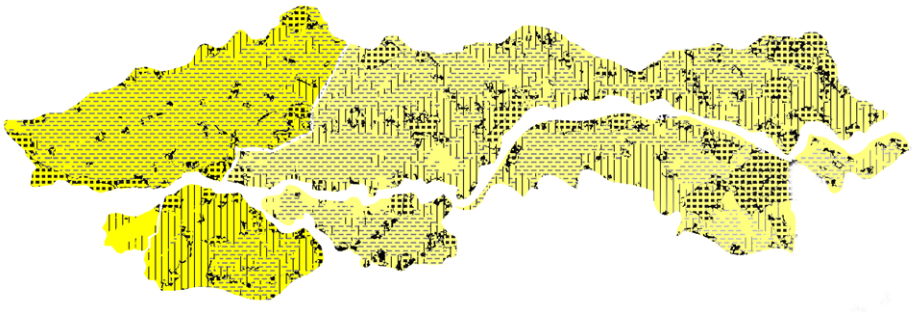


Figure D6
Flood safety standards
Elaborated by the author
Source:

levee system
1:4,000
1:2,500

2040 2045 2050 2100

PHASE 1
PKB
Exploration phase

Connectivity exploration - Draft plan

The objective of this phase is the exploration of the notion of connectivity, and its functional, spatial and perceptual typologies. This phase is necessary to build up the need for connectivity and trigger a cultural acceptance. Together with the ellaboration of a draft plan (PKB1), a first pre-assessment of suitable areas for connectivity (PKB2), ellaboration of Plan for Action and management agreement
This draft plan is elaborated in dialogue with citizens, NGOs and PCO

\+ Existing roles / Existing Instruments
\+ New roles / New Instruments

Actors	Role	Instruments	Timing
CG Central government Program Office	+ Collect workshop outcomes and pre-allocate a budget	+ Draft plan	2 years
Mun Prov WB RWS Water authorities	+ Provide with practical knowledge on connectivity		
WUR Delt Water research institutions	+ Provide with theoretical knowledge on connectivity		
NGO PCO Citizens and local businesses	+ Express concerns and ideas	+ Workshop sessions	

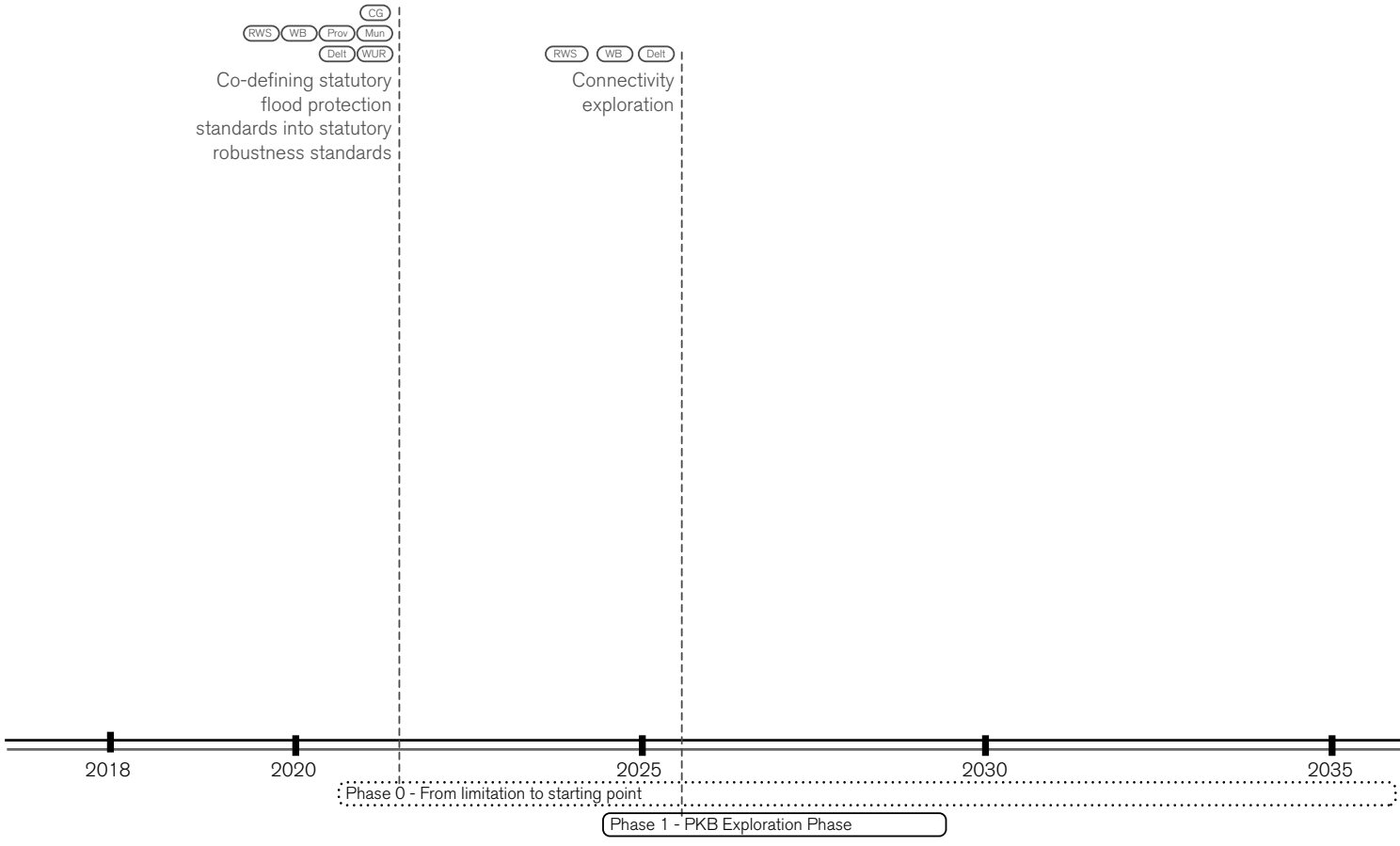
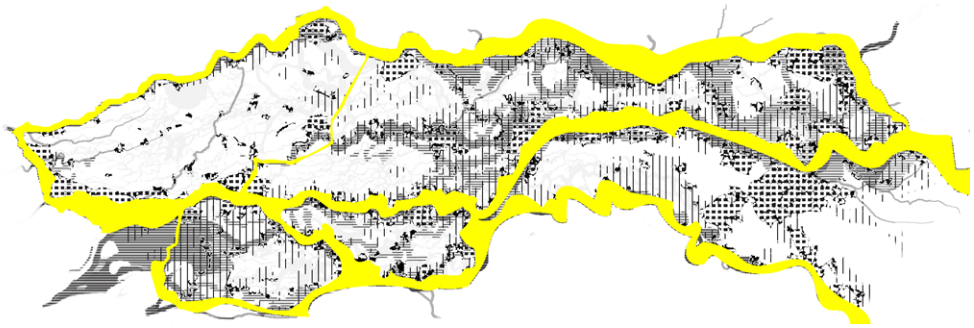


Figure D7
Connectivity exploration
Elaborated by the author



Systems at stake

Biophysical systems

Socio - economic systems

Governance systems

2040 2045 2050 2100

PHASE 2.1
PDR
Plan Study Phase

Design of strategic green blue network

The study phase draws the decision framework, the vision for water safety, ecosystem restoration and spatial quality. It sets the overall safety objectives, the functional layers of the territory (landscape-based regional design), total budget of the program in the short and medium term, time frames and overall standards for spatial quality. The compliance with national, transnational and european directives is implemented in this phase, creating from the beginning synergies and interests with converging investments.

\+ Existing roles / Existing Instruments
\+ New roles / New Instruments

Actors	Role	Instruments	Timing
(CG) Central government Program Office	+ Ellaboration of short, medium and long term budget + Convergence of national, transnational and regional investments + Water safety, ecosystem restoration and spatial quality vision	+ Decision framework + "Planning Kit"	5 years

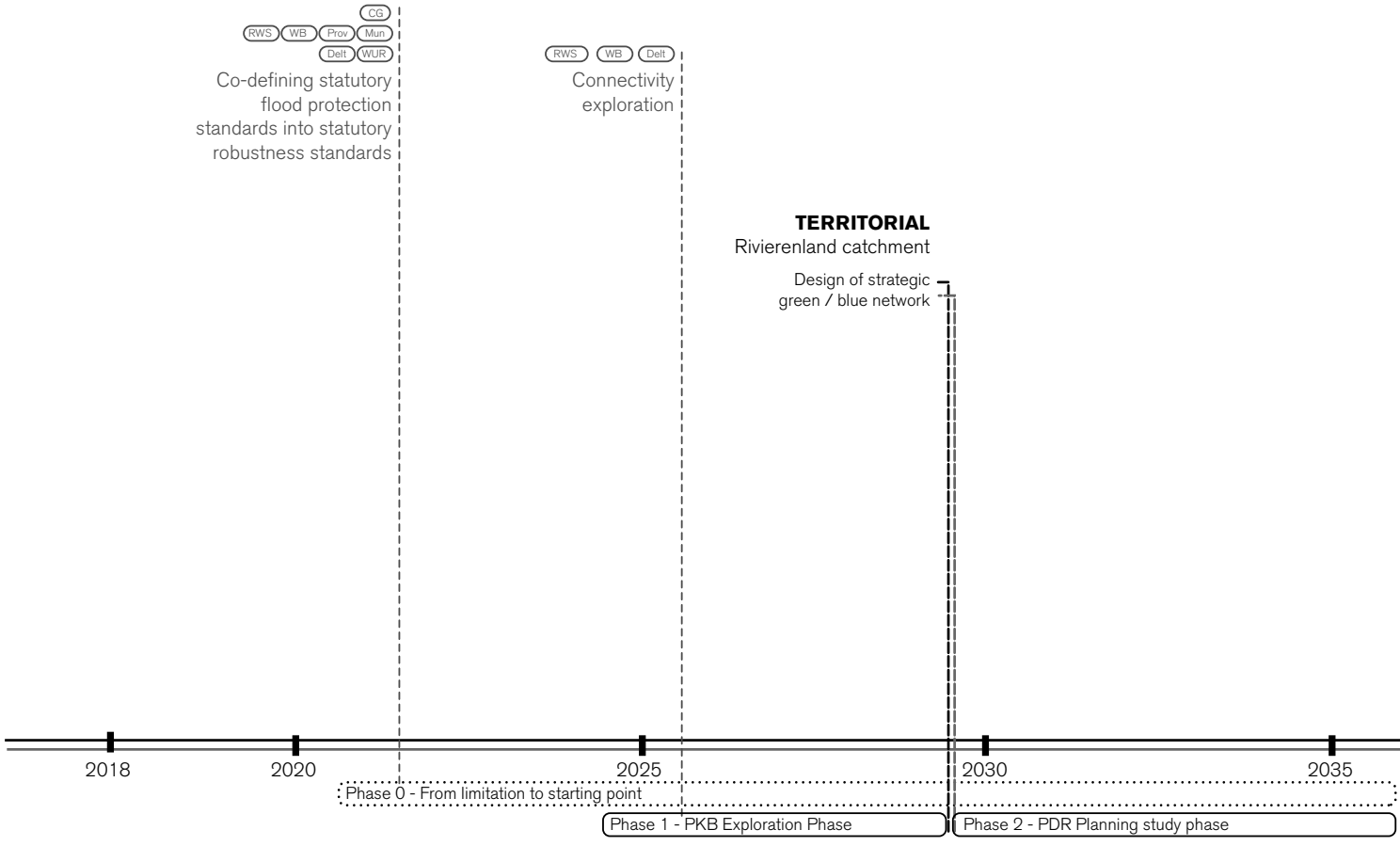
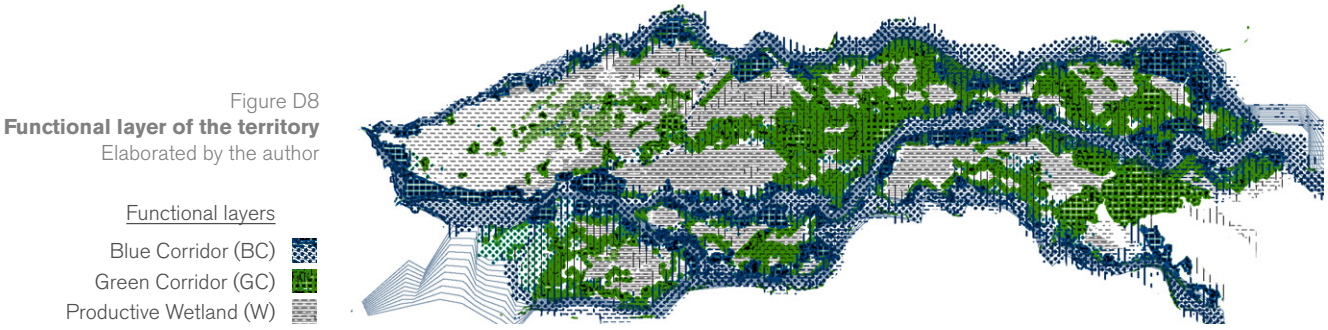


Figure D8
Functional layer of the territory
Elaborated by the author



2040 2045 2050 2100

PHASE 2.2

PDR

Plan Study Phase

Connectivity Co-Assessment

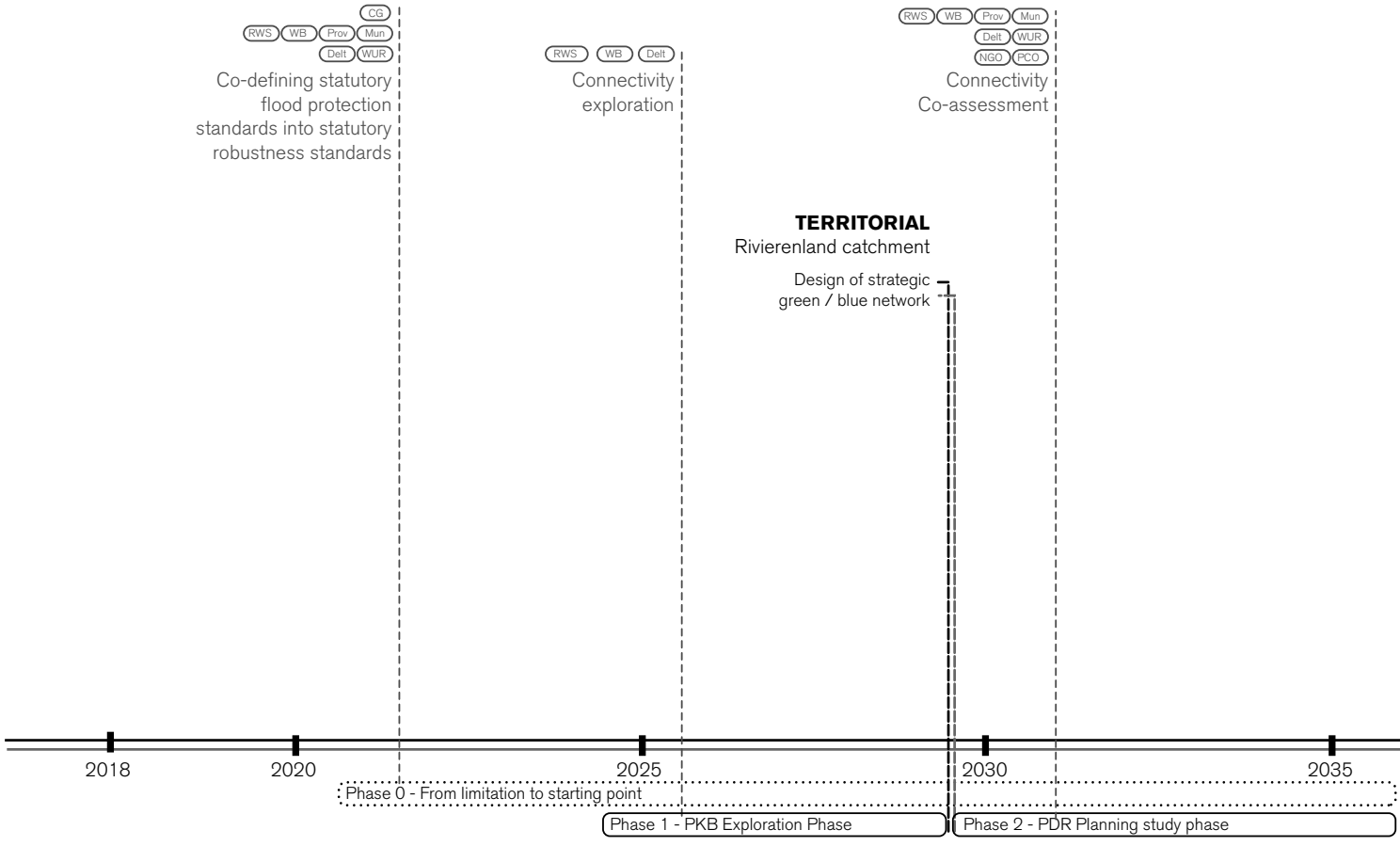
Within this PDR phase, the connectivity co-assessment takes place: the collective assessment of areas with initial higher potential of transformation due to biophysical, socio-economic and governance conditions.

The assessment uses existing flooding simulations database (FLORIS project) as a tool identify critical areas and to discuss with citizens and local business

\+ Existing roles / Existing Instruments

\+ New roles / New Instruments

Actors		Role	Instruments	Timing
Mun Prov WB RWS	Water authorities	+ Set general objectives from governance, biophysical and social perspective	+ Flooding simulations	1-2 years
WUR Delt	Water research institutions			
NGO PCO	Citizens and local businesses	+ Provide with socio-economic insight	+ Workshop sessions	



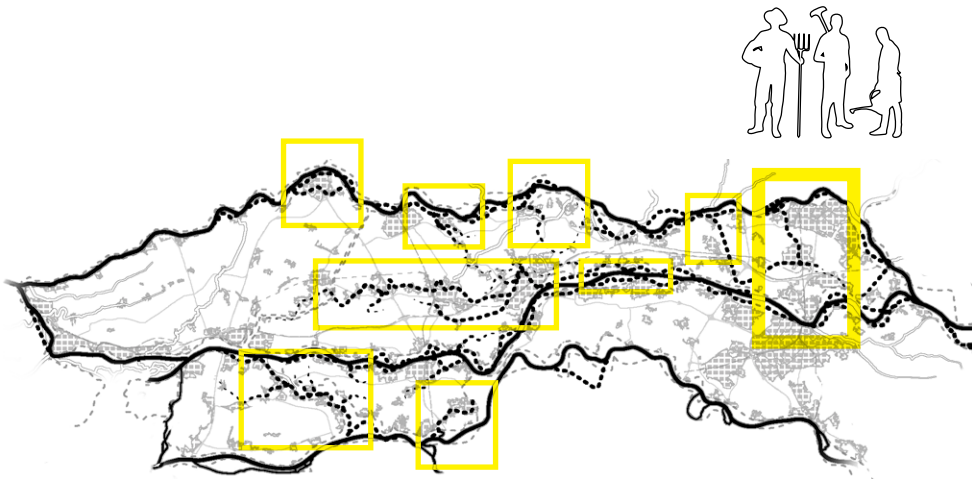


Figure D9
Connectivity co-assessment
Elaborated by the author

Functional layers

Pre-selected areas
Selected area
Socio-economic system
Strategic water network

2040 2045 2050 2100

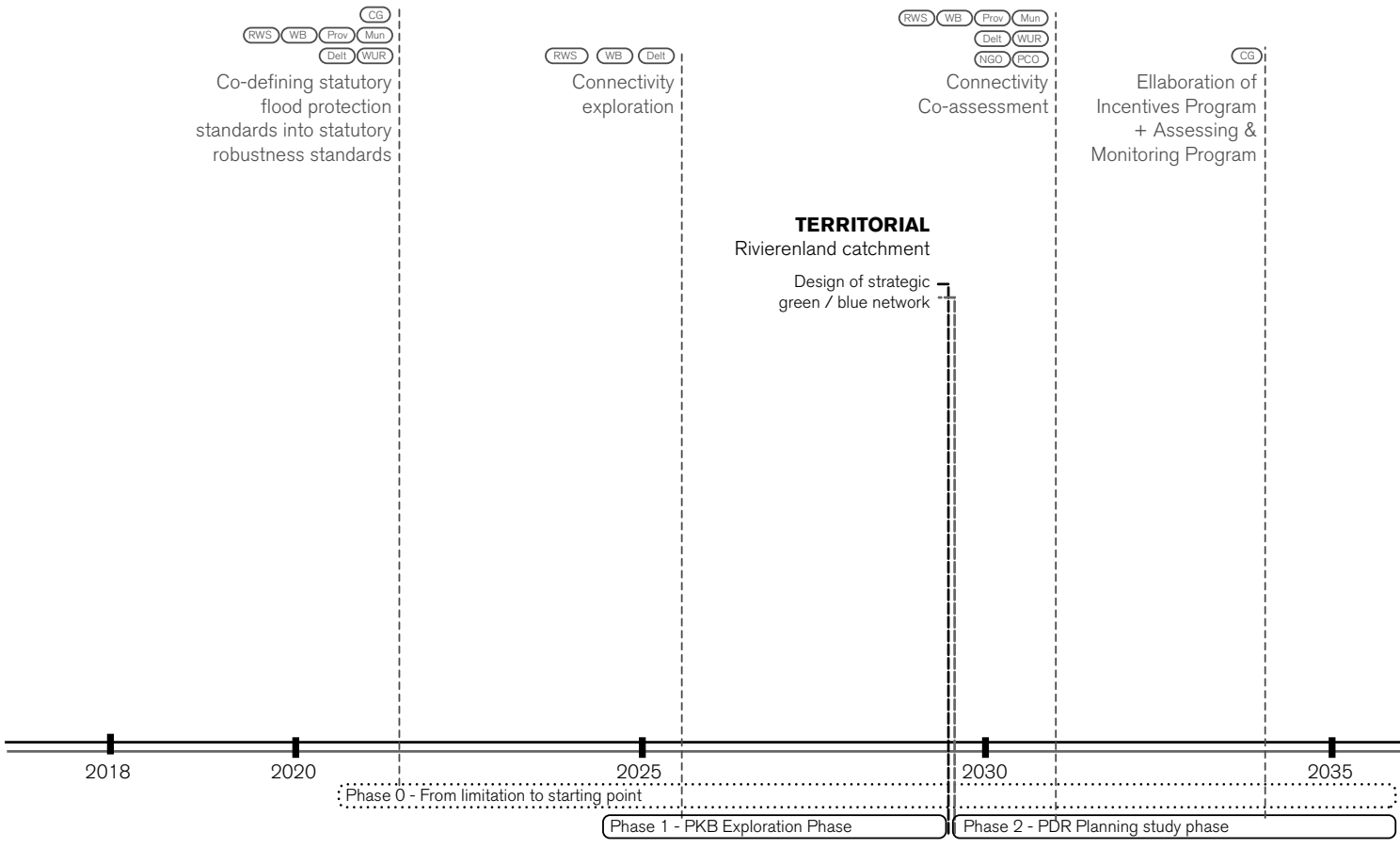
PHASE 2.3
PDR
Plan Study Phase

+ Existing roles / Existing Instruments
+ New roles / New Instruments

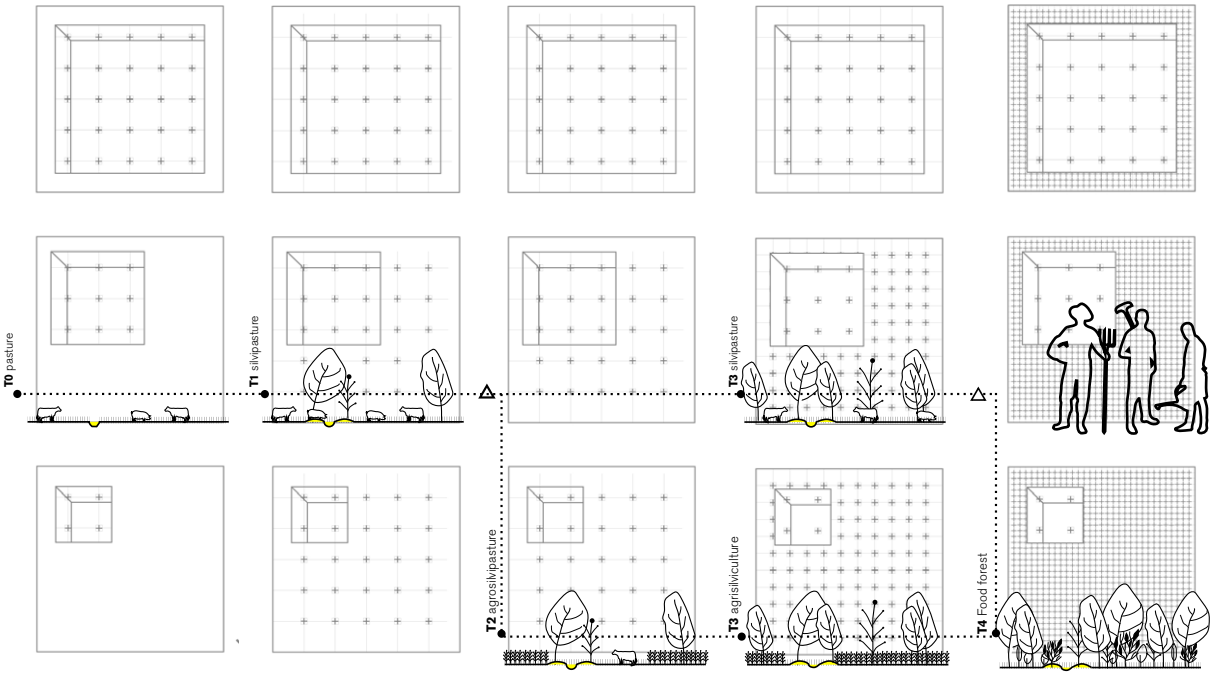
Incentives Program + Assessment & Monitoring Program (SNIP)

During this planning phase, an Incentives program is created together with an Assessment and Monitoring Program.
The Incentives Program seeks for the commitment of landowners to transform their lands into areas potentially used as buffer areas (very short term transformation), and to maintain them in time (medium to long term commitment). This commitment works for the implementation of buffer capacity and ecological density and it is assessed and monitored by the Quality Team (Q-TEAM) through the Assessment and Monitoring Program.

Actors	Role	Instruments	Timing
DGRW, CG Central government Program Office Policy Directorate	+ Ellaborate Incentives, Assessment & Monitoring programs + Nominate an external team for the Assessment and Monitoring (Q-TEAM) + Ellaboration of transformation scheme per land use	+ Incentives Program + Assessment & Monitoring Program	3-5 years



Transformation scheme for
current pasture land within
Green Coridor areas



2040 2045 2050 2100

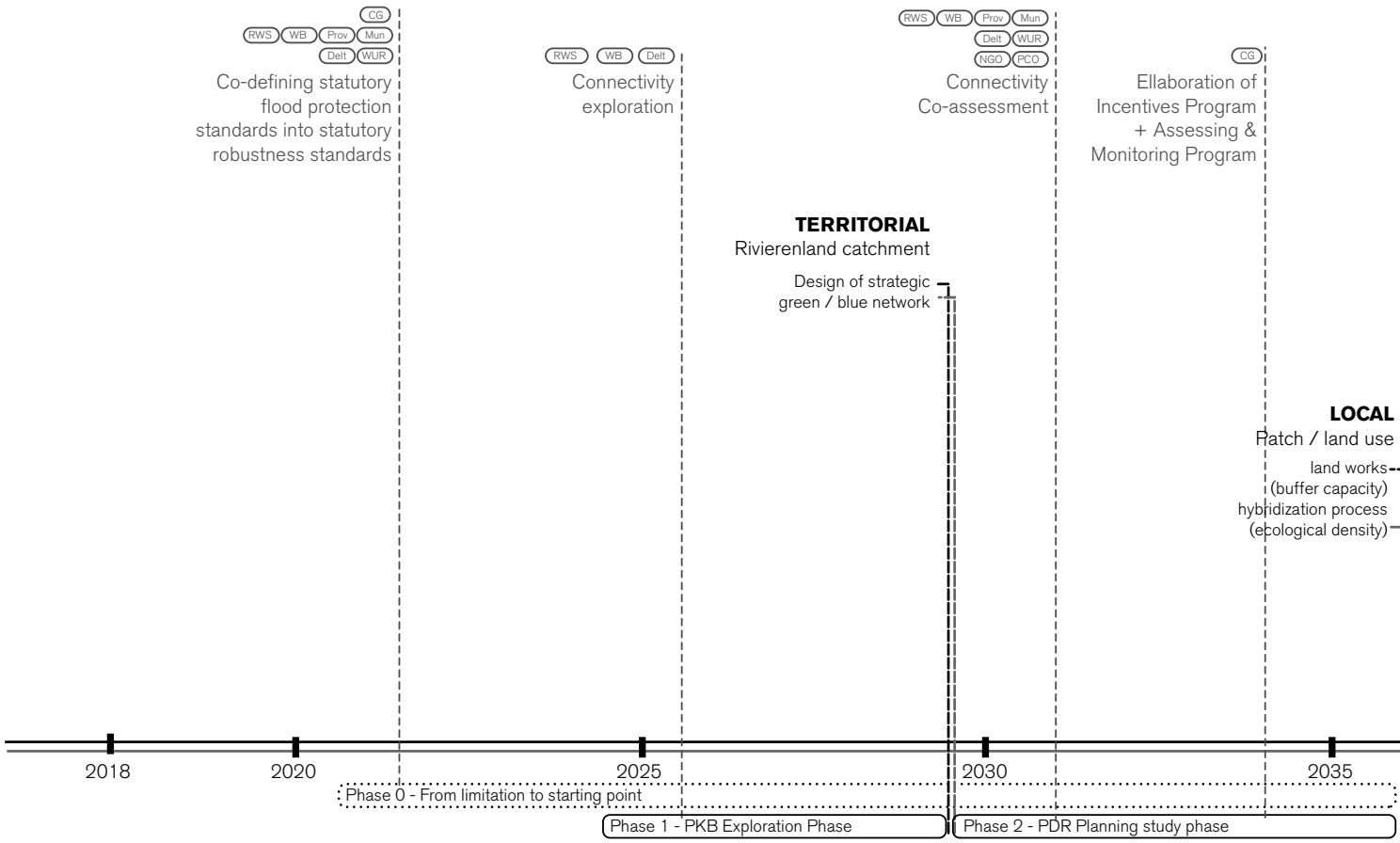
PHASE 3.1 **Local transformation**

PDR
Execution and maintenance

The transformation of the territory takes place through a cummulative process of land patches transformation through local strategies incrementing the buffer capacity (land works) and ecological density.
Whereas the buffer capacity of the patches belonging to the Green Corridor will only start performing once the connectivity with the main channel is working, the land patches belonging to the Blue Corridor and Productive Wetland play a role from the beginning. This reasoning might trigger incentives to be directed firslty to these areas.

\+ Existing roles / Existing Instruments
\+ New roles / New Instruments

Actors	Role	Instruments	Timing
DGRW CG Central government Program Office Policy Directorate	+ Promote transformation by providing with incentives	+ Incentives Program (central)	
Mun Prov WB Water authorities	+ Promote transformation by providing with incentives	+ Incentives Program (regional)	
PCO Landowners and local businesses	+ Managing local transformation, from execution to maintenance		land works (month) ecological density (years)



Regional Transformation:

Blue Corridor

Second channels

Assigned land patches

Transformed land patches

Productive Wetland

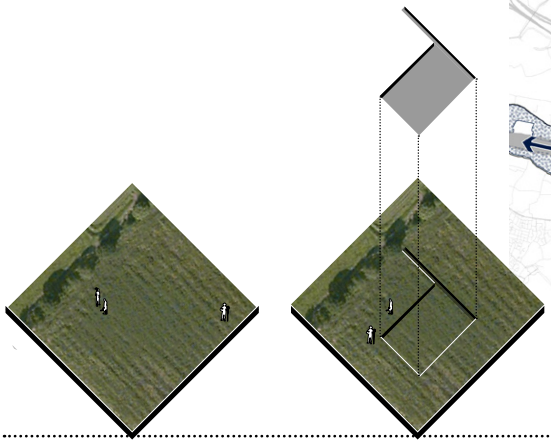
Assigned land patches

Transformed land patches

Green Corridor

Assigned land patches

Transformed land patches



starting point

1 month

land works for provision of buffer capacity

Functional variations

2040

2045

2050

2100

PHASE 3.2 **Regional connectivity GC***

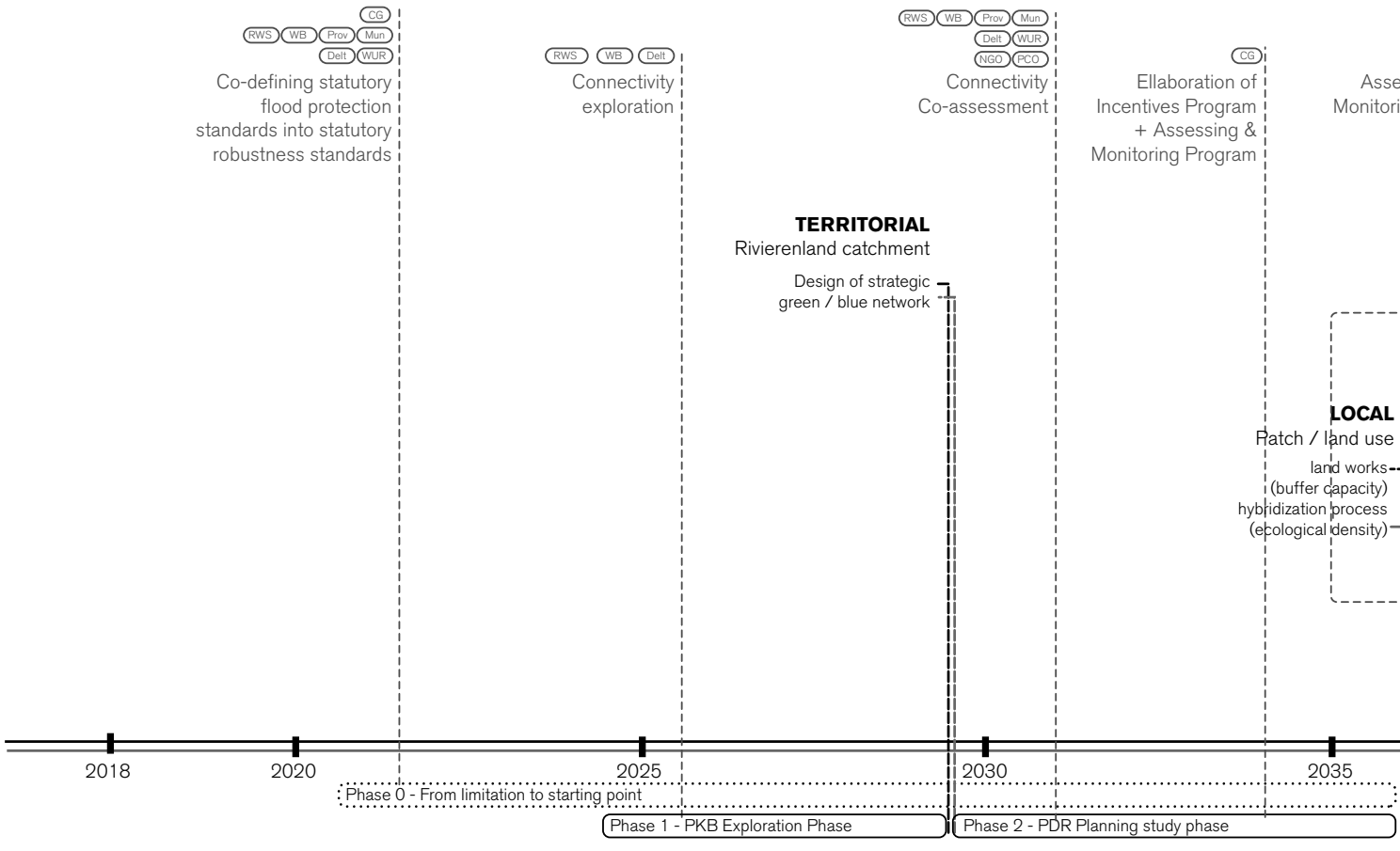
PDR
Execution and maintenance

*The Regional connectivity refers to the connectivity within the Green Corridor, in other words, the connectivity between land patches and regional flood streams**

Through the assessing and monitoring of patch transformations, the Q-TEAM informs regional authorities (water authorities and City region) of the degree of transformation and specific location of land patches to be connected. Once the degree of transformation corresponds to an order of magnitude of 50-100 Ha, the regional network of flood channels is designed, connecting the transformed land patches.

\+ Existing roles / Existing Instruments
\+ New roles / New Instruments

Actors	Role	Instruments	Timing
Q-T Q-TEAM	+ Assess and monitor transformation Inform central and regional authorities	+ Assessment & Monitoring Program	
Mun Prov WB Water authorities	+ Design of regional network of flood streams		The regional transformation is a cumulative process revised every 5 years
City Region Arnhem-Nijmegen	+ Managing regional transformation		

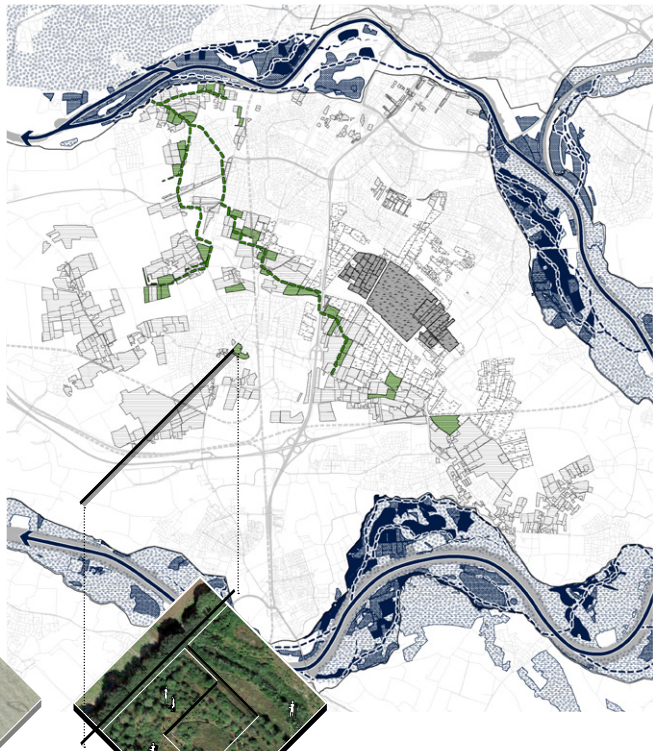


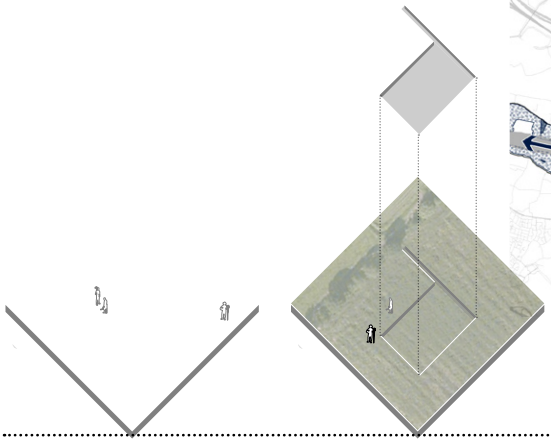
Regional Transformation:

Blue Corridor
- Second channels
- Assigned land patches
- Transformed land patches

Productive Wetland
- Assigned land patches
- Transformed land patches

Green Corridor
- Assigned land patches
- Transformed land patches
- Flood channels





starting point

1 month
land works for provision
of buffer capacity

1-5 years
connection with regional
network of flood channels

Functional variations

>100 Ha

O-T

essment and
ng Program

REGIONAL
City region A-N

design and execution of
regional networks connecting
executed patches

2040

2045

2050

2100

Phase 3 - PDR Execution & maintenance phase

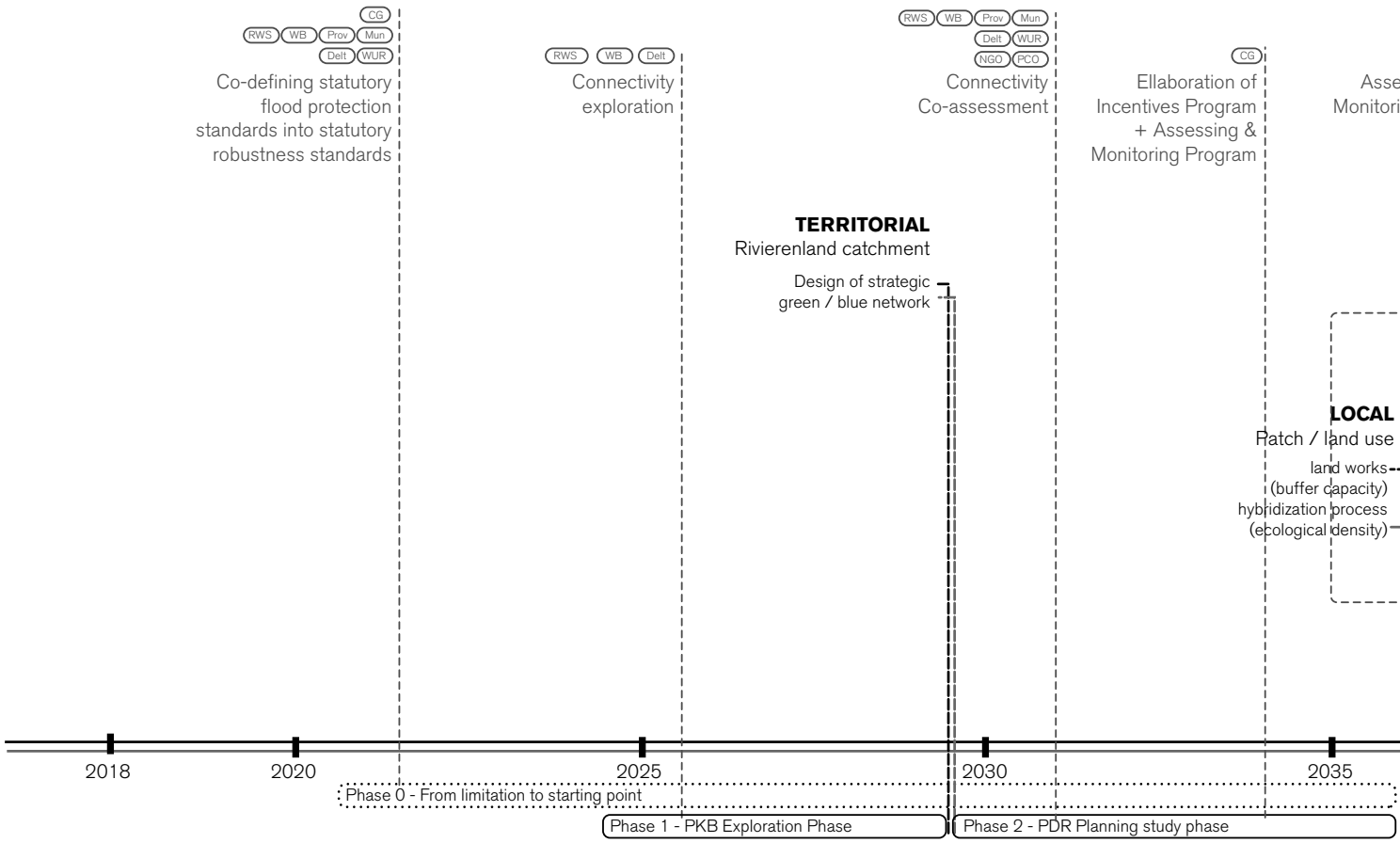
PHASE 4.n **Evolutionary transformation**

PDR
Execution and maintenance

The previous phases including local and regional transformations take part of an evolutionary transformation (cycles of adaptive transformation), in which the increasing local capacities are reflected into the re-design and expansion of the regional network.
Every 5 years, an assessing and monitoring of the maintenance and level of transformation is completed, informing regional and national entities for the renewal of incentives to locals.

\+ Existing roles / Existing Instruments
\+ New roles / New Instruments

Actors	Role	Instruments	Timing
DGRW CG Central government Program Office Policy Directorate	+ Promote transformation by providing with incentives	+ Incentives Program (central)	Cycles of 5 years
Mun Prov WB Water authorities	+ Promote transformation by providing with incentives	+ Incentives Program (regional)	
Q-T Q-TEAM	+ Assess and monitor transformation Inform central and regional authorities	+ Assessment & Monitoring Program	
City Region Arnhem Nijmegen	+ Managing regional transformation		Cumulative process revised every 5 years
PCO Landowners and local businesses	+ Managing local transformation		land works (month) ecological density (years)

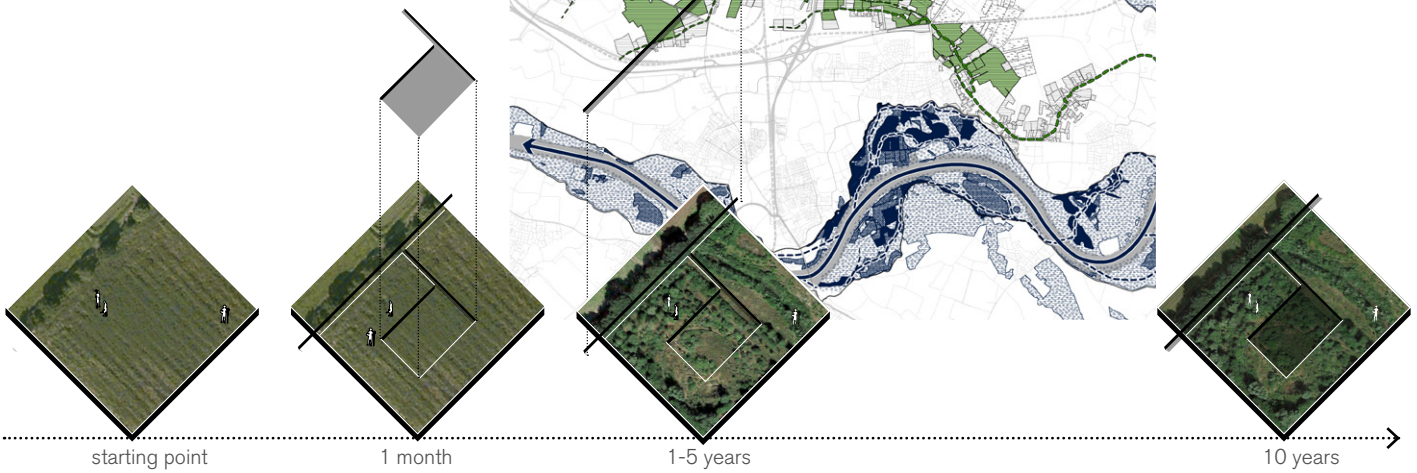


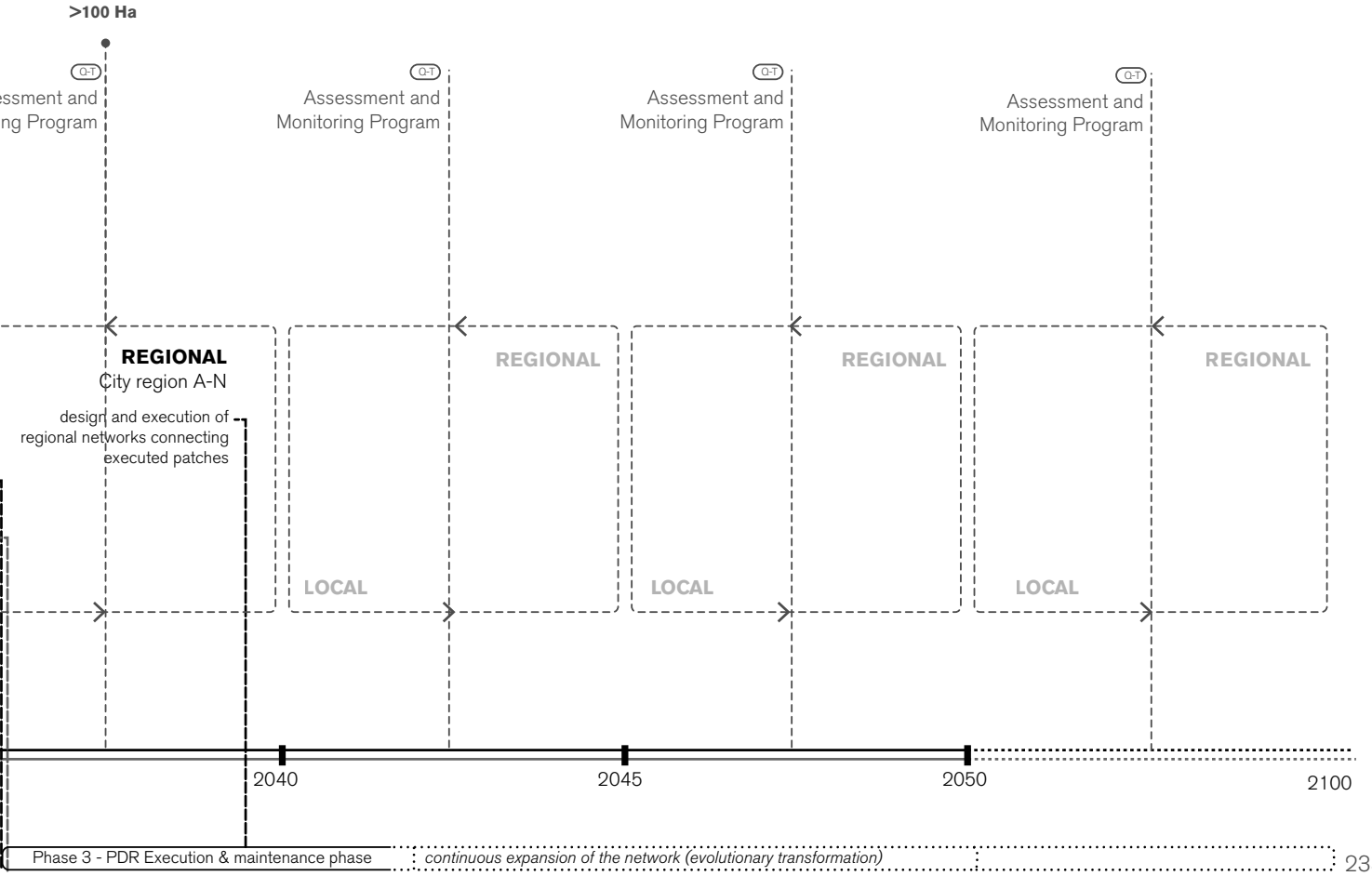
Regional Transformation:

Blue Corridor
- Second channels
- Assigned land patches
- Transformed land patches

Productive Wetland
- Assigned land patches
- Transformed land patches

Green Corridor
- Assigned land patches
- Transformed land patches
- Flood channels





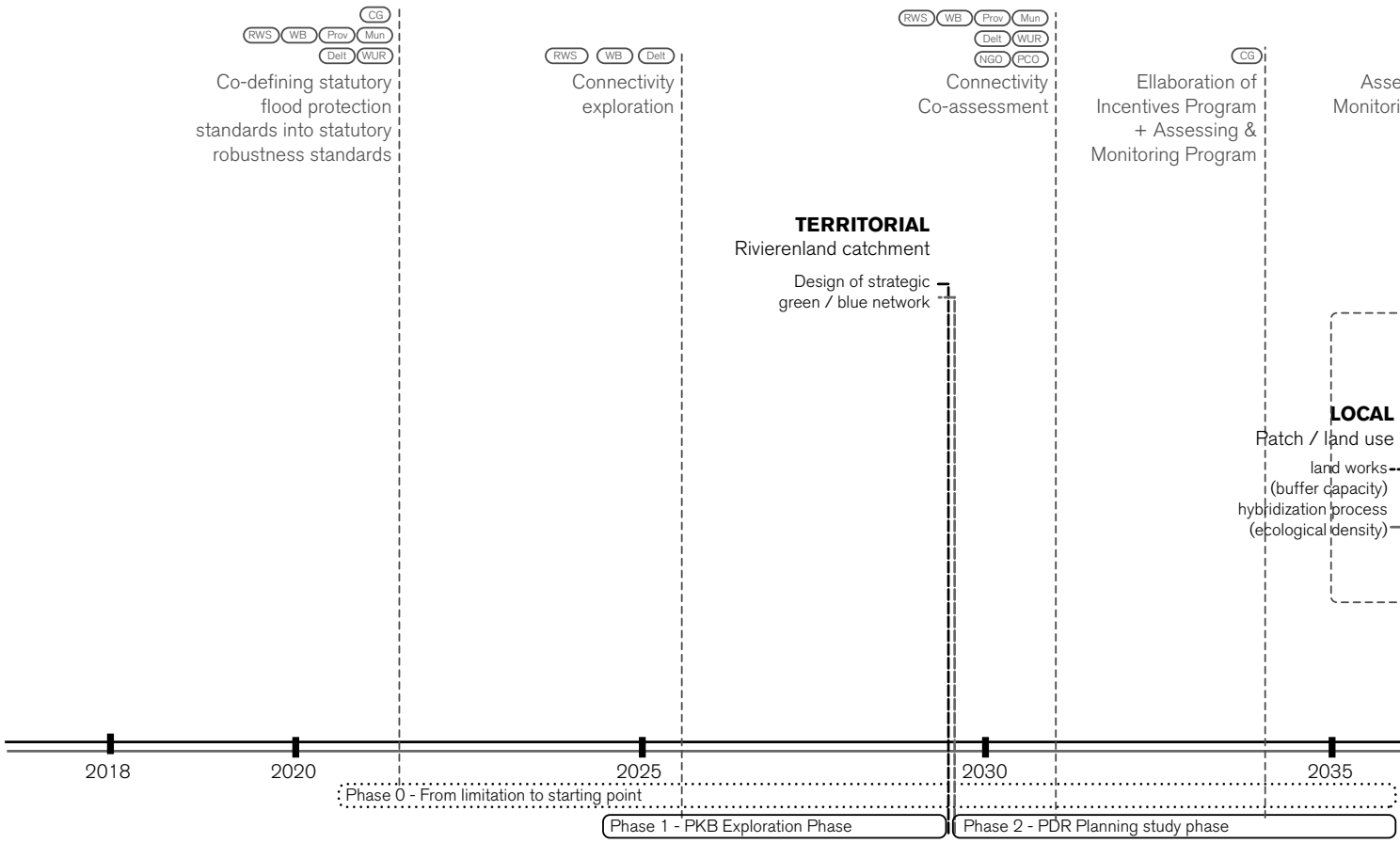
PHASE 4.n **Territorial connectivity***

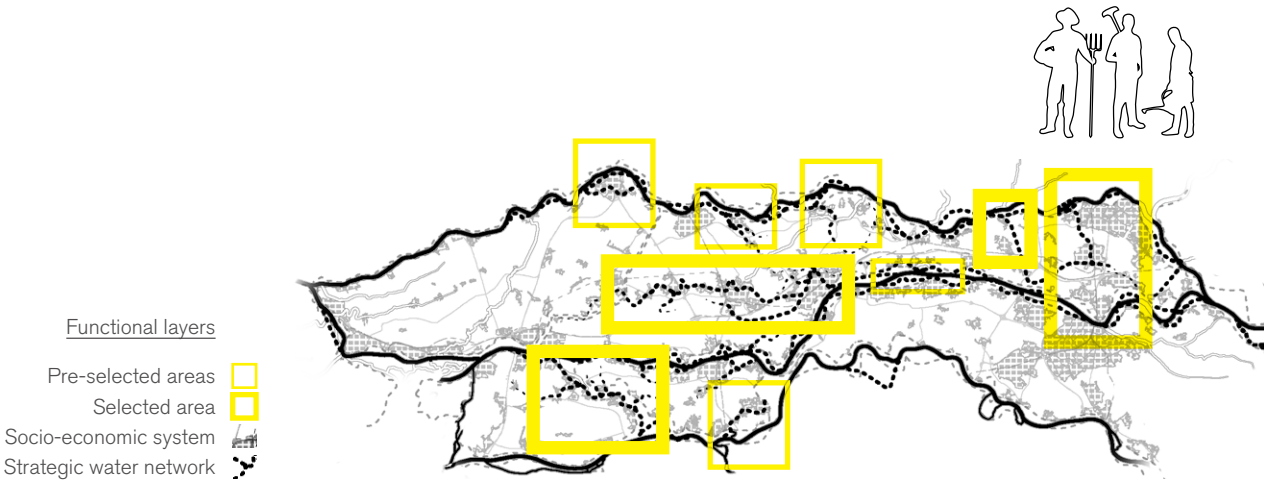
PDR
Execution and maintenance

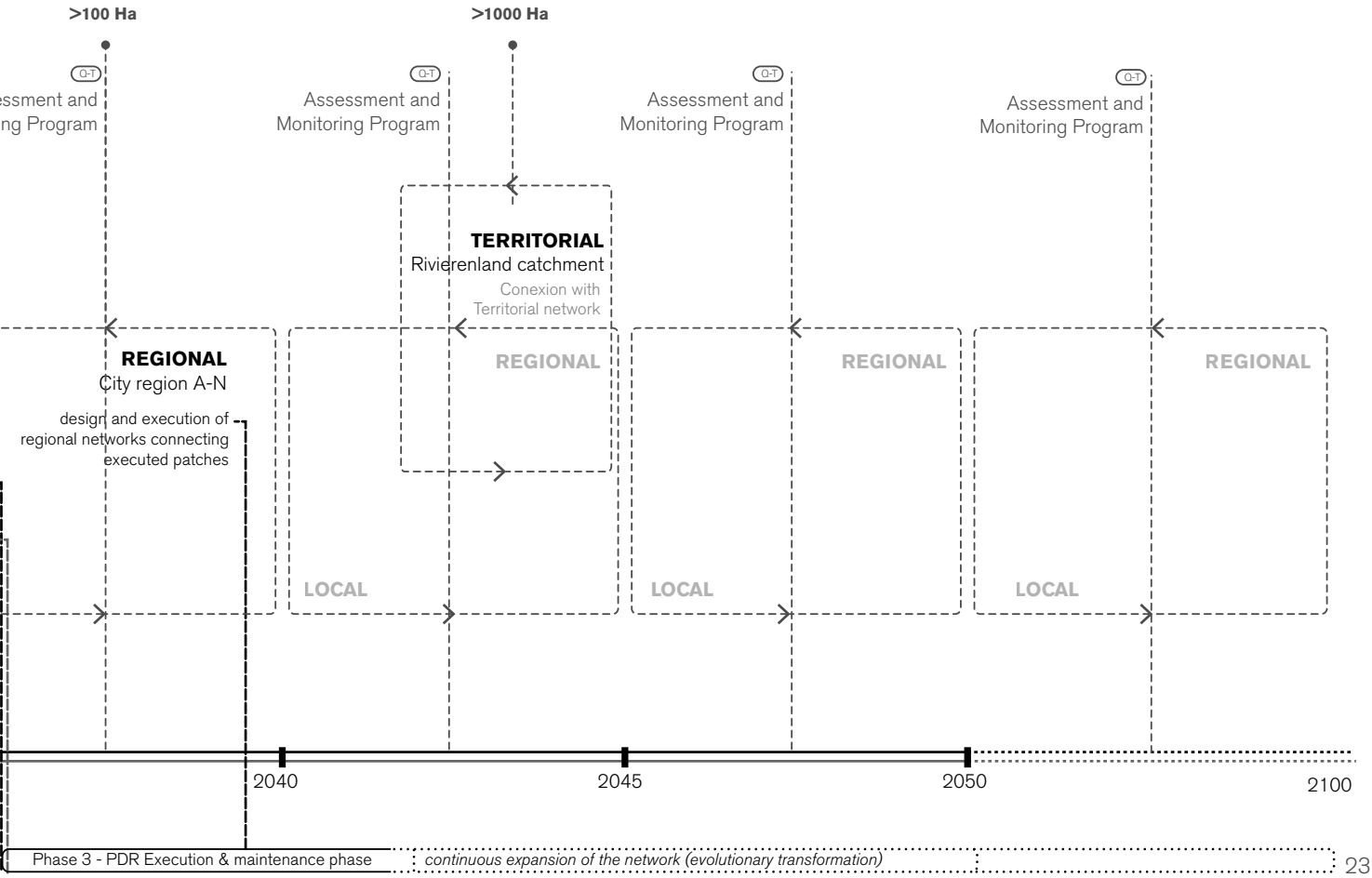
*The Territorial connectivity refers to the connectivity between Blue and Green Corridor, in other words, the connectivity between traditionally separated protecting and protected areas**
Once the the buffer capacity at a regional level reaches the order magnitude of 1000 Ha, the territorial connectivity is to be enhanced.
In a simultaneous manner, this process happens throughout the territory following the previuous phases.

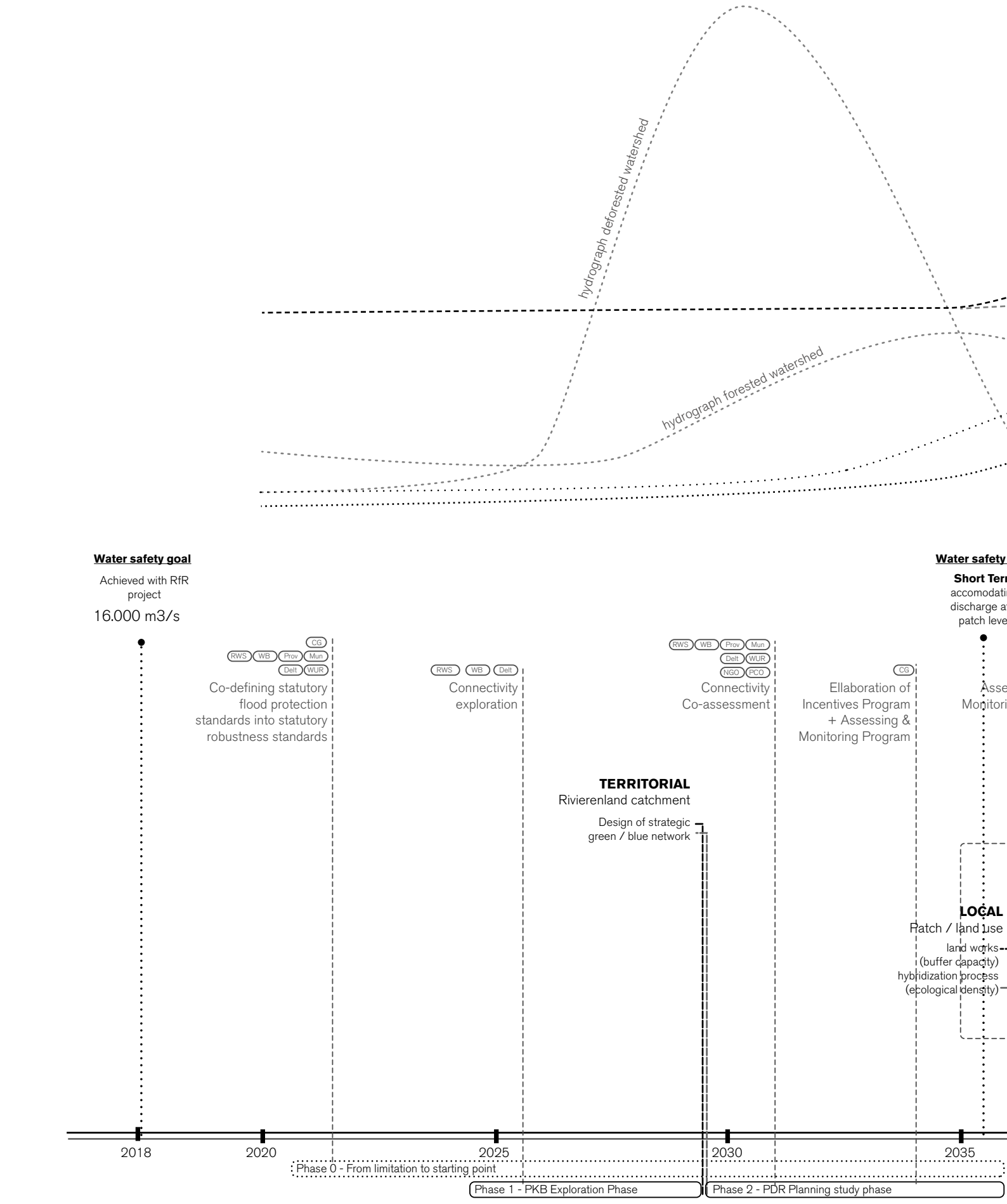
\+ Existing roles / Existing Instruments
\+ New roles / New Instruments

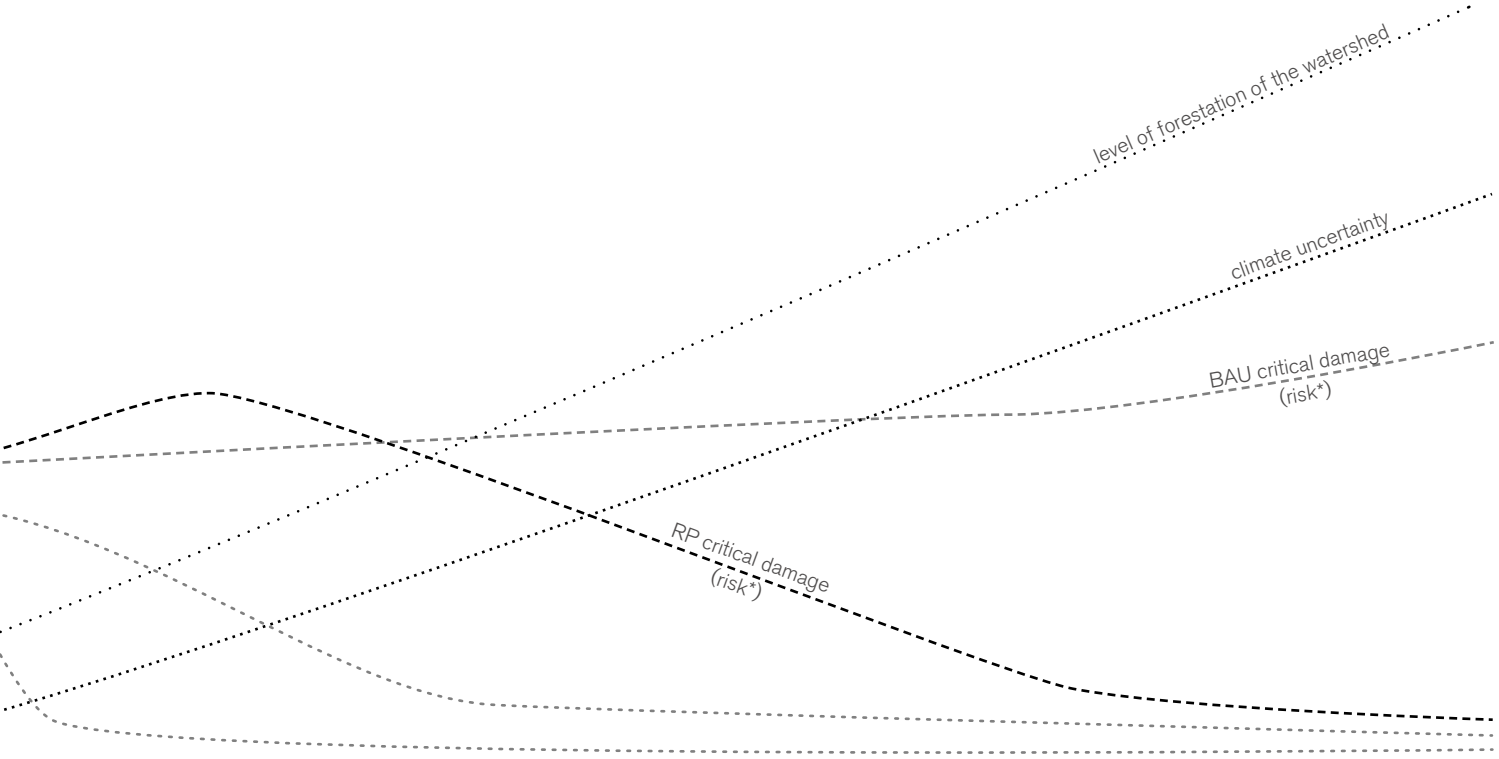
Actors	Role	Instruments	Timing
(DGRW) (CG) Central government Program Office Policy Directorate	+ Promote transformation by providing with incentives	+ Incentives Program (central)	Cycles of 5 years
(Mun) (Prov) (WB) Water authorities	+ Promote transformation by providing with incentives	+ Incentives Program (regional)	
(Q-T) Q-TEAM	+ Assess and monitor transformation Inform central and regional authorities	+ Assessment & Monitoring Program	
City Region Arnhem Nijmegen	+ Managing regional transformation		Cumulative process revised every 5 years
(PCO) Landowners and local businesses	+ Managing local transformation		land works (month) ecological density (years)

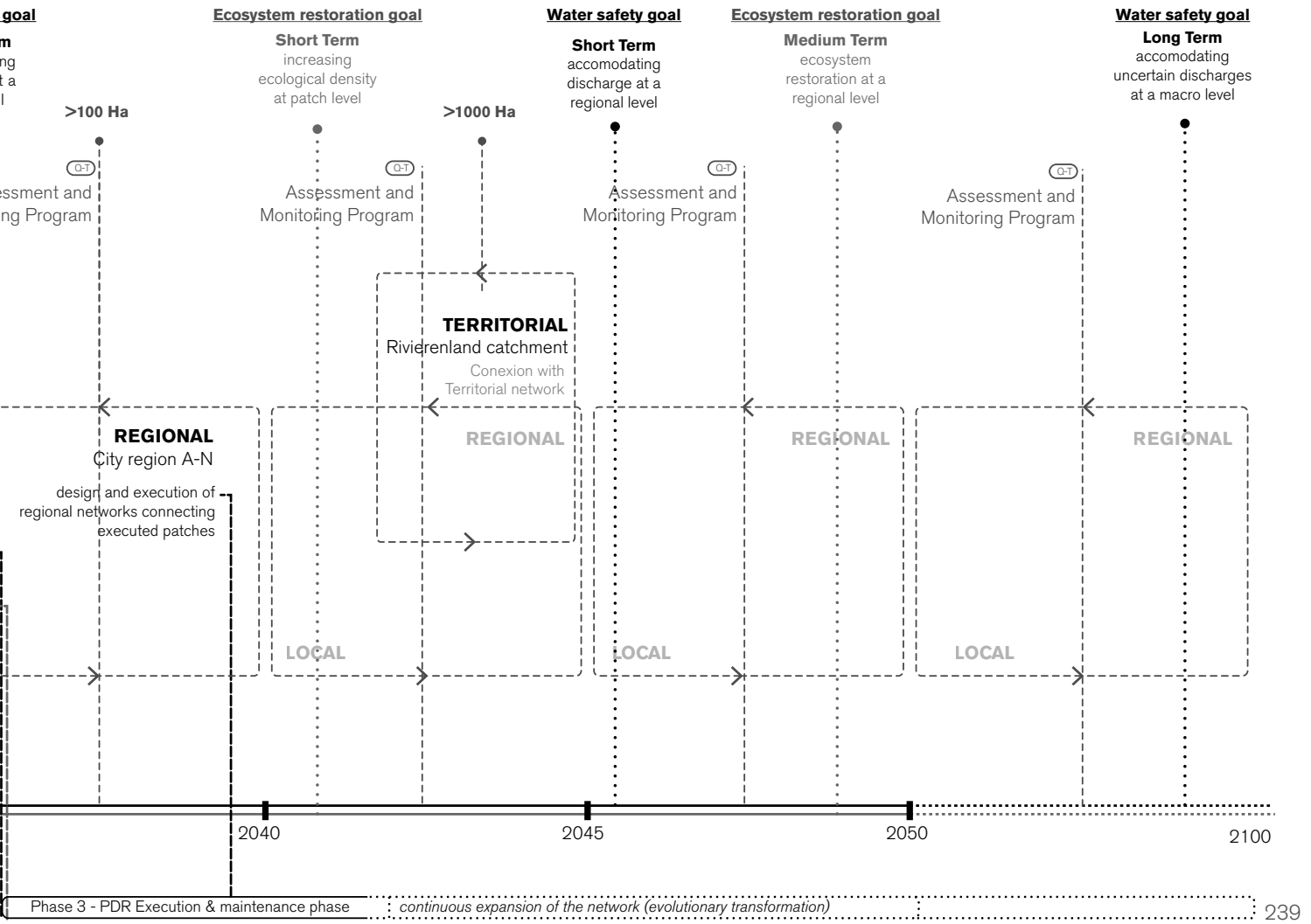



Functional layers
Pre-selected areas
Selected area
Socio-economic system
Strategic water network


>100 Ha
>1000 Ha
O-T
Assessment and Monitoring Program
TERRITORIAL
Rivierenland catchment
Conexion with Territorial network
REGIONAL
City region A-N
design and execution of regional networks connecting executed patches
REGIONAL
LOCAL
2040
2045
2050
2100
Phase 3 - PDR Execution & maintenance phase
continuous expansion of the network (evolutionary transformation)


hydrograph deforested watershed
hydrograph forested watershed
Water safety goal
Achieved with RfR project
16.000 m3/s
CG
RWS WB Prov Mun
Delt WUR
Co-defining statutory flood protection standards into statutory robustness standards
RWS WB Delt
Connectivity exploration
RWS WB Prov Mun
Delt WUR
NGO PCO
Connectivity Co-assessment
CG
Ellaboration of Incentives Program + Assessing & Monitoring Program
Water safety
Short Ter
accomodati
discharge a
patch leve
Asse
Monitori
TERRITORIAL
Rivierenland catchment
Design of strategic green / blue network
LOCAL
Patch / land use
land works
(buffer capacity)
hybridization process
(ecological density)
2018
2020
2025
2030
2035
Phase 0 - From limitation to starting point
Phase 1 - PKB Exploration Phase
Phase 2 - PDR Planning study phase


level of forestation of the watershed
climate uncertainty
BAU critical damage
(risk*)
RP critical damage
(risk*)


Ecosystem restoration goal
Short Term
increasing
ecological density
at patch level
Water safety goal
Short Term
accomodating
discharge at a
regional level
Ecosystem restoration goal
Medium Term
ecosystem
restoration at a
regional level
Water safety goal
Long Term
accomodating
uncertain discharges
at a macro level
>100 Ha
>1000 Ha
O-T
Assessment and
Monitoring Program
TERRITORIAL
Rivierenland catchment
Conexion with
Territorial network
REGIONAL
City region A-N
design and execution of
regional networks connecting
executed patches
REGIONAL
REGIONAL
REGIONAL
LOCAL
LOCAL
LOCAL
2040
2045
2050
2100
Phase 3 - PDR Execution & maintenance phase
continuous expansion of the network (evolutionary transformation)

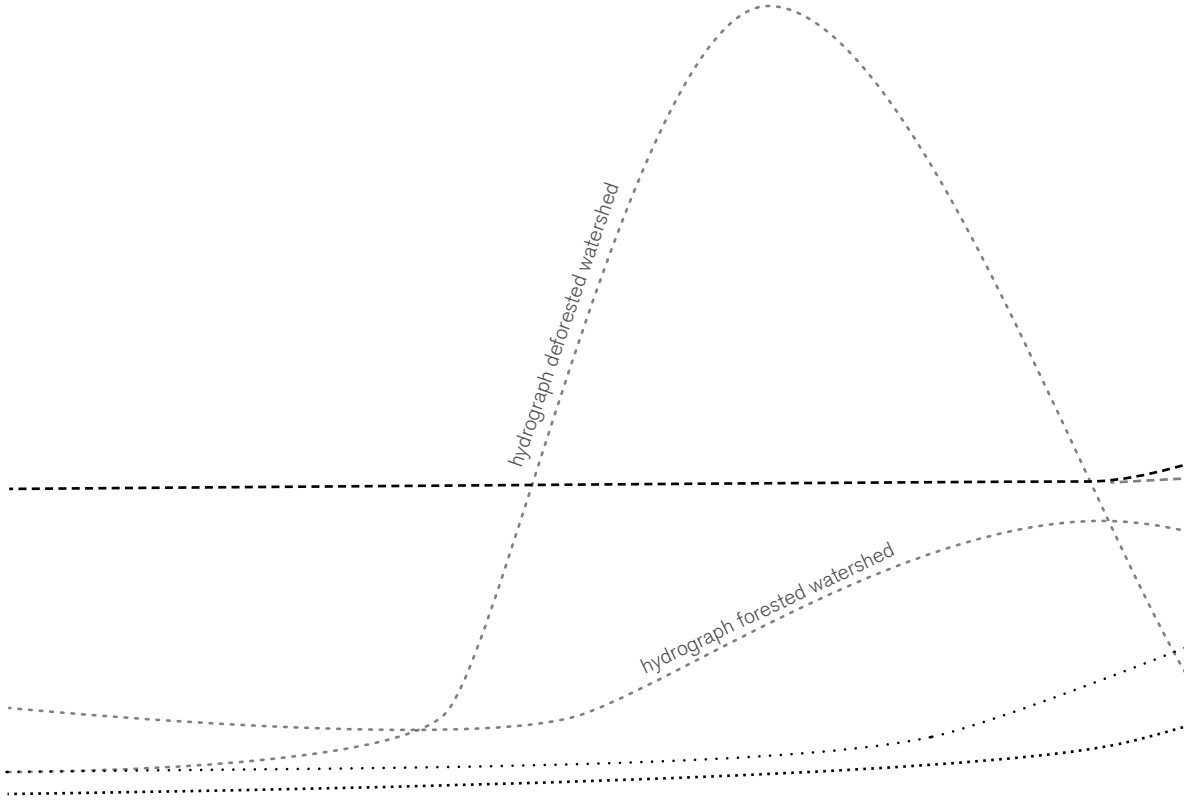
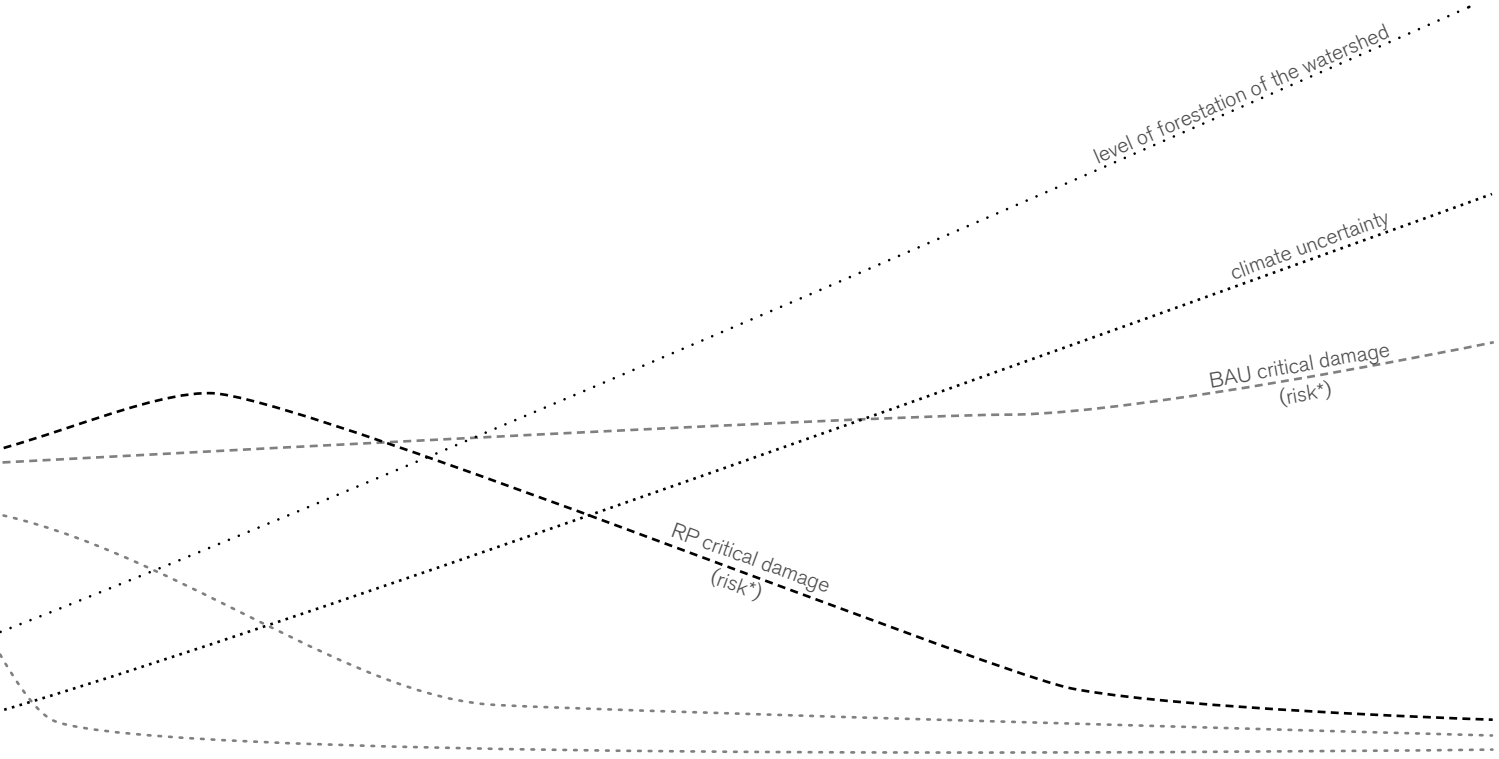


Figure D10.
Interpreted trends in time:
Hydrographs
River hydrograph under extreme events in deforested and forested watersheds
Source: The COMET Program
Critical damage
Critical damage refers to the damage caused by disaster events
RP, Restoring Proximities (thesis)
BAU, business as usual
*The lines are a free representation of the author's reflexion on the subject
Climate uncertainty
*The lines are a free representation of the author's reflexion on the subject
Level of forestation
*The lines are a free representation of the author's reflexion on the subject

Hydrographs
The river hydrographs here depicted are adapted from The COMET Program in order to portray the key role of ecosystem restoration leading to increasing levels of forestry throughout the watershed. As represented, deforested watersheds due to urbanization and the increased percentage of impermeable surfaces and compacted soils and channelized streams result in greater volumes of runoff, a faster flood of urban streams and greater peak flows. In comparison, for the same rainfall, the curve within forested watershed delays its peak reducing consistently its magnitude.

Level of forestation
With the transformation proposed by the thesis, the level of forestry will increases systematically, spreading throughout a hybrid territory in the shape of productive territories. The value of this transformation is here accounted for its role during flood events, increasing the infiltration capacity, decreasing flow speed and runoff, delaying and reducing peaks and therefore preventing disasters.

Critical damage
The critical damage is an interpretation of the author that responds to the idea of risk-reducing effects by making more room for the river throughout the urbanized watershed. Risk is usually



defined as a combination of the probability of flooding and its consequences, however, according to Klijn (2018):

> *combining probabilities and consequences into one metric for risk has a downside, namely that rare disasters with huge consequences are treated as equal to frequent floods with small consequences.*

Taking Merz's idea on robustness in relation with flood risk management (Klijn et al., 2018), the critical damage here refers to the prevention of disasters of a magnitude "beyond recovery". The critical damage line, or risk line, increases slightly during the first stages of the transformation due to the uncertain behavior that the opening of connectivity strategies might have initially. As the project is consolidated, and specially, as the connectivity is consolidated throughout the landscape and in time, this line drops drastically (see pages 240-245).

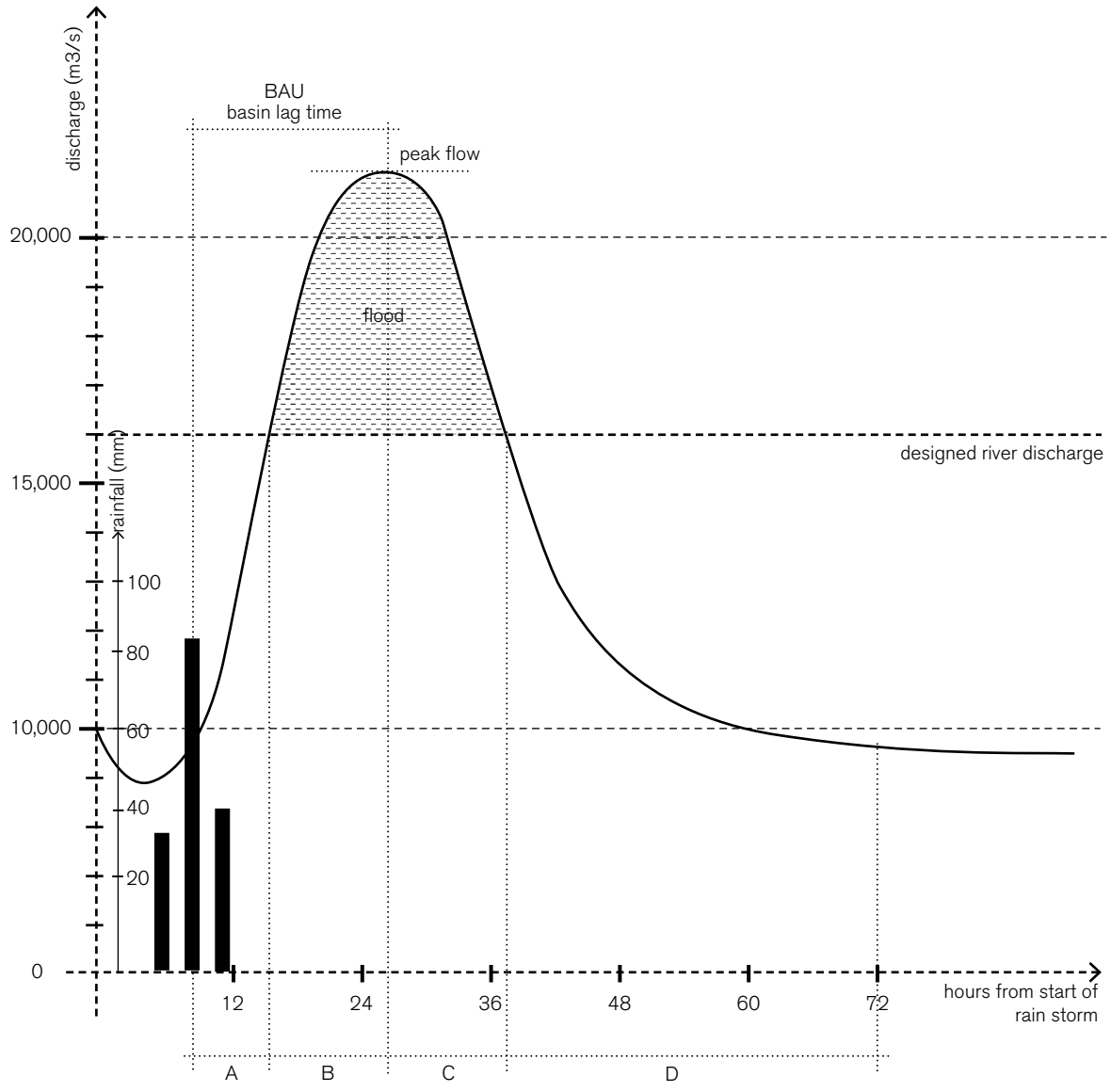
Climate Uncertainty

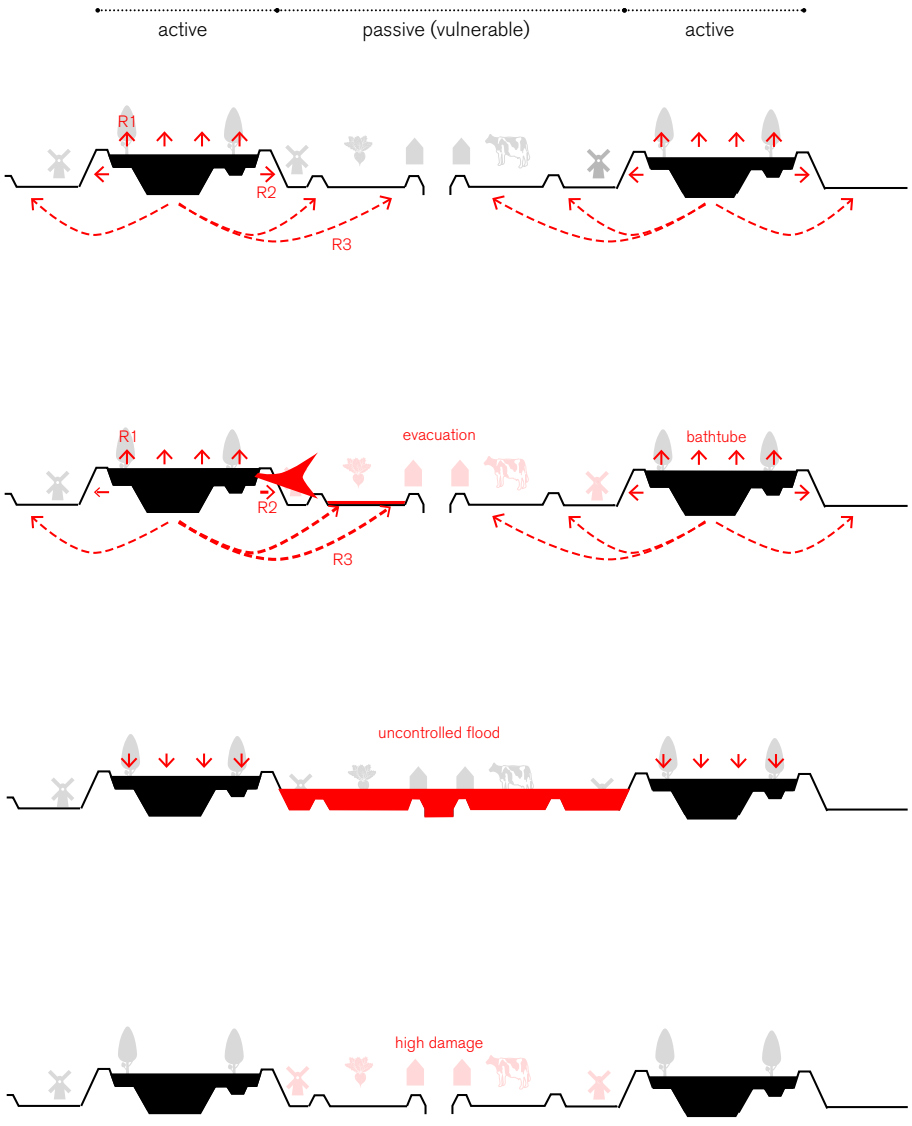
The only certainty we have about Climate Change is the fact that is happening, its pace and frequencies are however not possible to predict in the medium and long term.
This line is therefore a reminder for the necessity for proposals that are robust (Klijn et al., 2018).

D4. EVALUATION. THE AFTERMATH OF EXTREME EVENTS

Business as usual (BAU)

Figure D11.
Hydrographs during an extreme event
Source: Adapted from Lóczy et al., (2012)





Phases
Current system performance phases corresponding to the hydro-graph phases (diagram on the left).

A In crecendo
This phase corresponds to increasing discharges until bankfulll discharge. The risks arising from this phase are:
R1: overflowing, when the bank-full capacity is surpassed
R2: embankment fragility, arising from heavy flood loads
R3: seepage, arising from underground water movements

B Disruption (Part I)
This phase corresponds to discharges above the designed discharge. The system is disrupted as a consequence of R1, R2, or/and R3.
According to the "multi-layer safety concept" for flood risk management (Deltares), the strategy to overcome major disasters at this point correspond to evacuation plans.

C Disruption (Part II)
As a result from the disruption, the high discharge contained within the "active" areas is uncontrollably released over the "passive" areas.

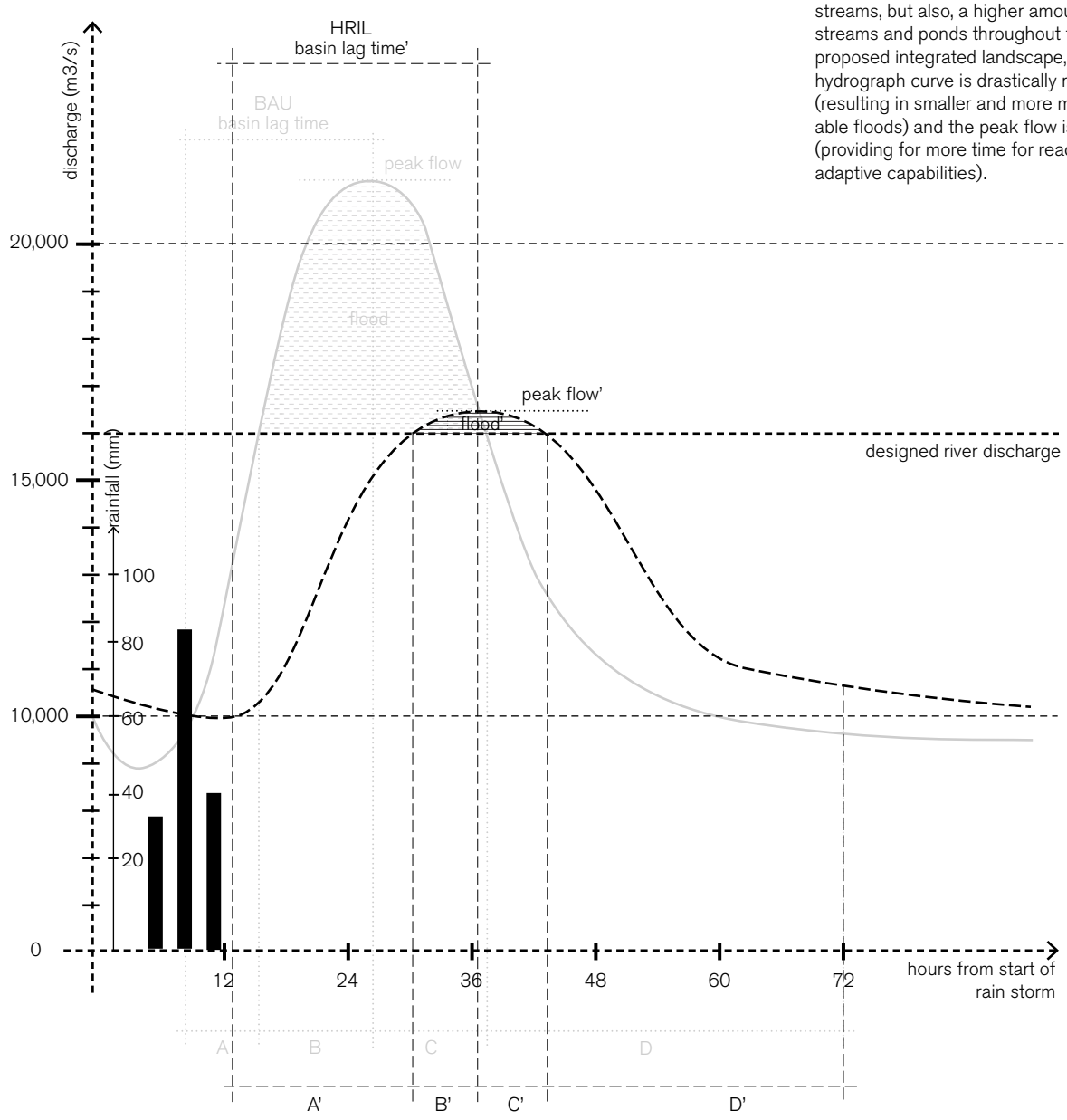
D Recovery
Even though casualties can be avoided with the "multi-layer safety concept", material damages are high after such an extreme event, resulting in a long recovery process.

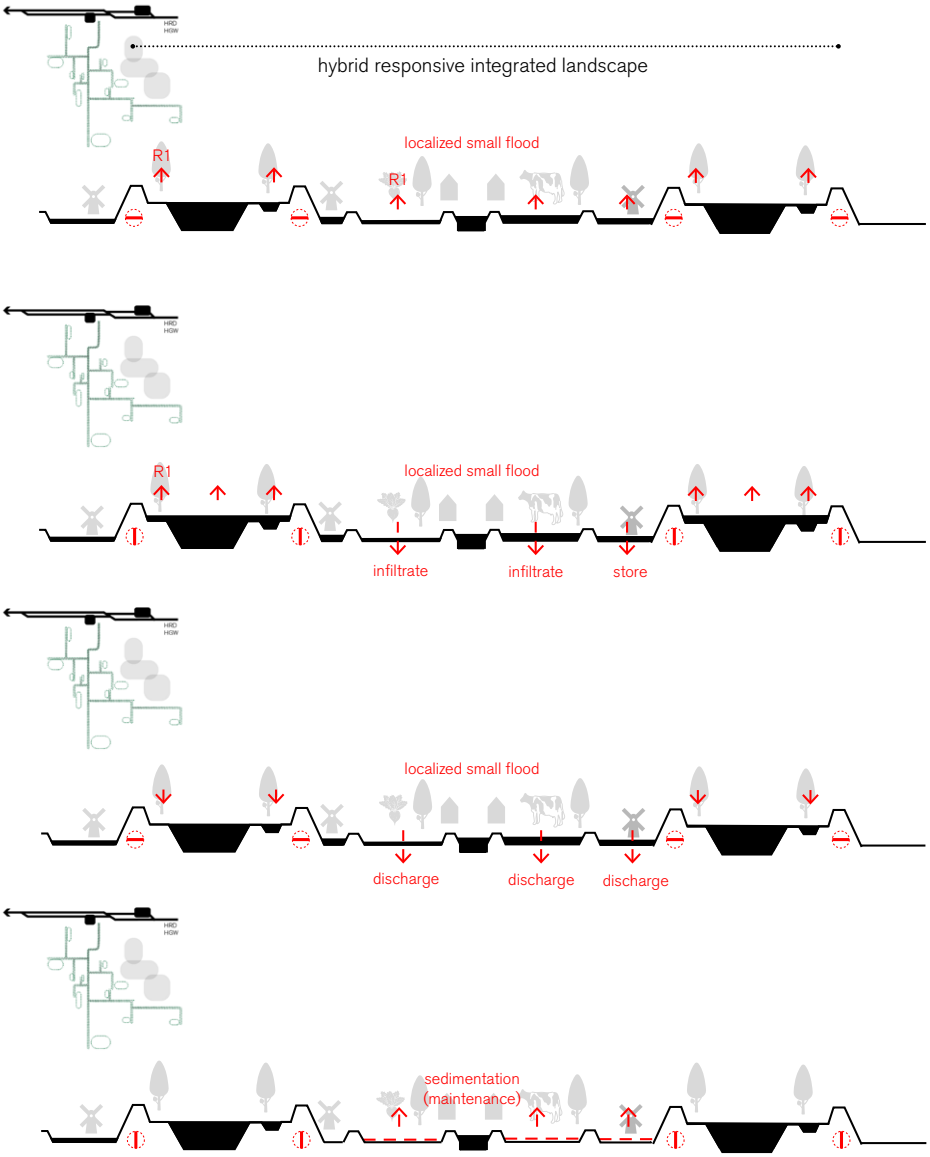
D4. EVALUATION. THE AFTERMATH OF EXTREME EVENTS

Hybrid Responsive Integrated Landscapes (HRIL)

Figure D12.
Hydrographs during an extreme event
Source: Adapted from Lóczy et al., (2012)

Hybrid Responsive Integrated Landscapes hydro-graph:
Due to a higher degree of forested streams, but also, a higher amount of streams and ponds throughout the proposed integrated landscape, the hydrograph curve is drastically reduced (resulting in smaller and more manageable floods) and the peak flow is delayed (providing for more time for reaction - adaptive capabilities).





Phases
Current system performance phases corresponding to the hydro-graph phases (diagram on the left).

A' In crecendo
This phase corresponds to increasing discharges until bankfulll discharge. Flood streams and flood-able areas spread throughout the territory are activated, performing their buffer capacity. This allows for R2 (no flood load) and R3 (free movement of groundwater thanks to wetland areas) to be negligible.

B' Peak discharges (Part I)
Corresponding to peak discharges, the disruption here is small and localized. Once the infiltration capacity (soil) and buffer capacity (areas) of the green corridor is reached, the connectivity is closed, and the capacities of the embankment start performing (R1). In the meantime, the infiltration curve can recover, providing for extra capacity if needed.

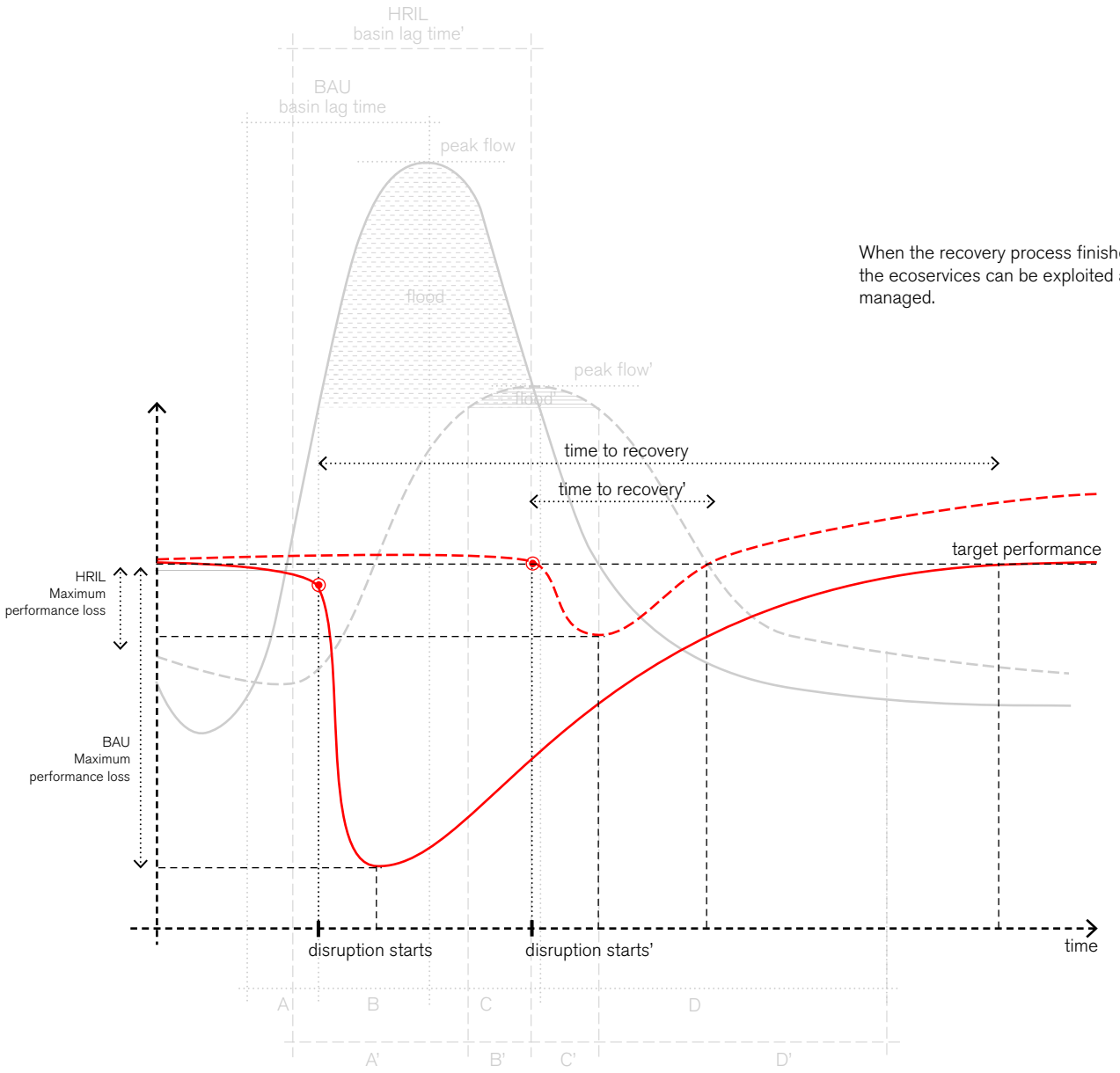
C' Peak discharges (Part II)
As the event moves away from the peak, the system can perform its discharge capacity, moment in which flood streams and flood-able areas within the green corridors can discharge their water back into the main stream.

D' Recovery
After the event, sedimentation processes take place within flood streams (regionally maintained) and flood-able areas (locally maintained).
The recovery process is therefore quicker and easily managed.

D4. EVALUATION. THE AFTERMATH OF EXTREME EVENTS

Recovery process

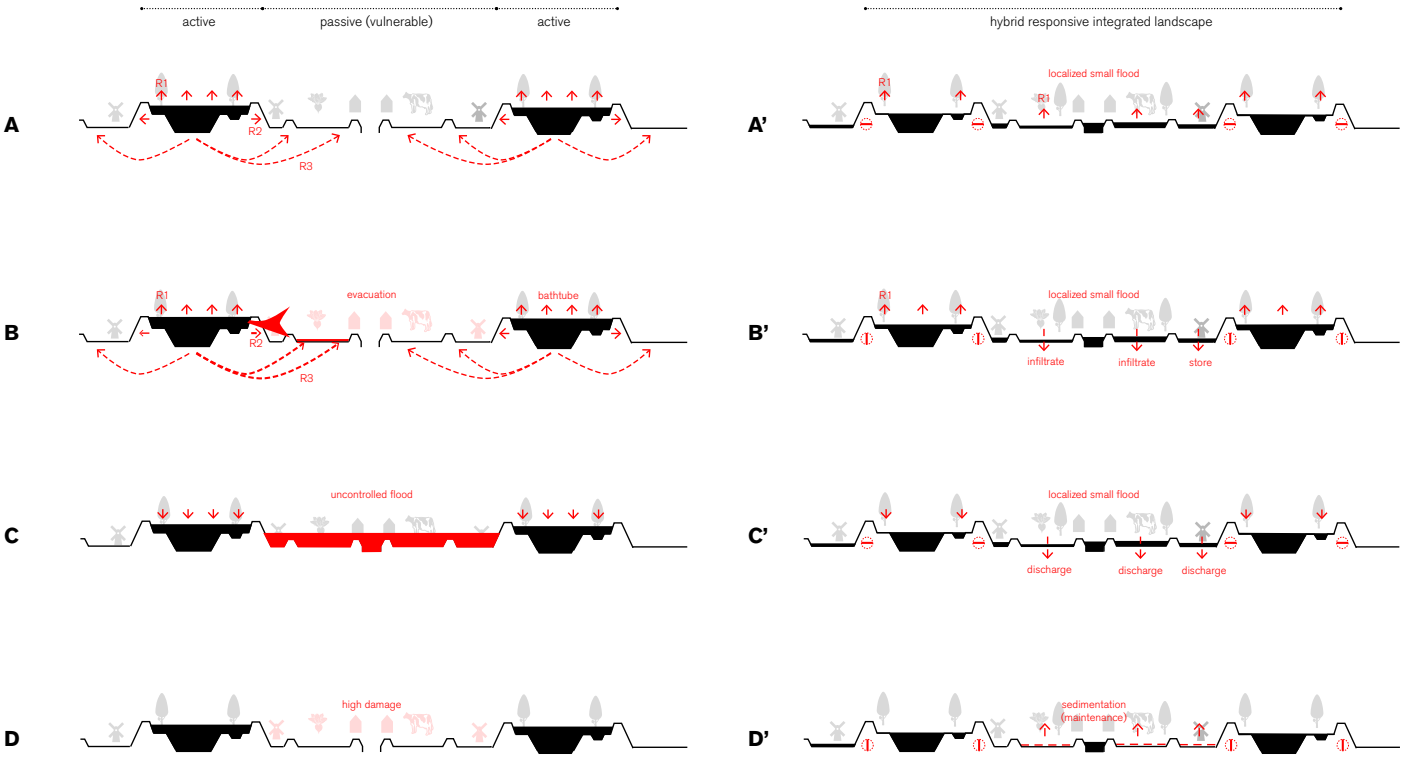
Figure D13.
Recovery process
— Business as usual Recovery process
--- Hybrid Responsive Integrated Landscapes Recover process
Source: Adapted from Cassattana et al., (2019)



When the recovery process finishes, the ecoservices can be exploited and managed.

“The recovery process is a key determinant of the system resilience because it describes the capability of a system to restore its performance after a disruption.”
(Cassottana, et al. 2019)

The comparison on the system performance during an extreme event between territories where the duality active/passive areas is still made (BUA) and where it is not made (HRIL), leads to the interpretation of the recovery process curve (on the right). These curves are adapted from Cassottana et al., 2019, where we can identify that HRIL systems have:
- A the **delayed disruption starting point**
- A **shorter time to recovery** (rapidity and ability of the system to restore its performance)
- A smaller maximum performance loss, or what is the same, a **higher robustness** (capacity to withstand shocks without losing performance).
- A **higher absortive capacity** or ability of a system to minimize the impacts of disruptions and quickly recover (Cassottana et al., 2019).
- A **higher adaptive capacity** or learning capacity of the system for the adoption of novel solutions and to self-organize after a disruption (Cassottana et al., 2019).



D5. ADAPTIVE SPATIAL PERFORMANCE

Interplay of systems

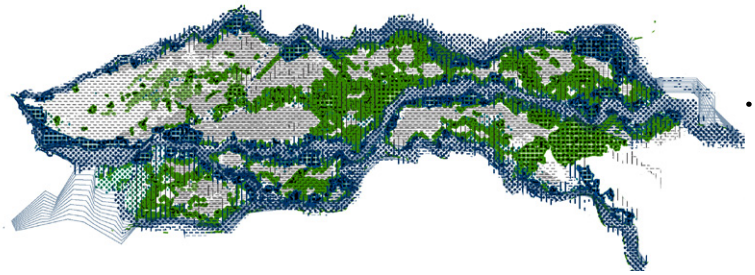
The performance of the proposed network (flood adaptation, ecology-based production and sedimentation) takes place through the interplay of the proposed territorial layers (page 105):

- Blue Corridor: corresponding to the Nederrijn and Waal rivers and their active floodplain of permanent water bodies, aquaculture gradients and secondary channels.
- Green Corridor: corresponding to the flood streams and agroforestry gradients in former river banks.
- Productive wetland: corresponding to restored wetlands

Below, from macro to micro scales, the different systems/layers are represented in comparable colors; on the right the conceptualization of the proposed network at a meso scale that will be used in the following pages to portray the interplay of these systems according to the phases and intensities of river discharge and according to degree of implementation.

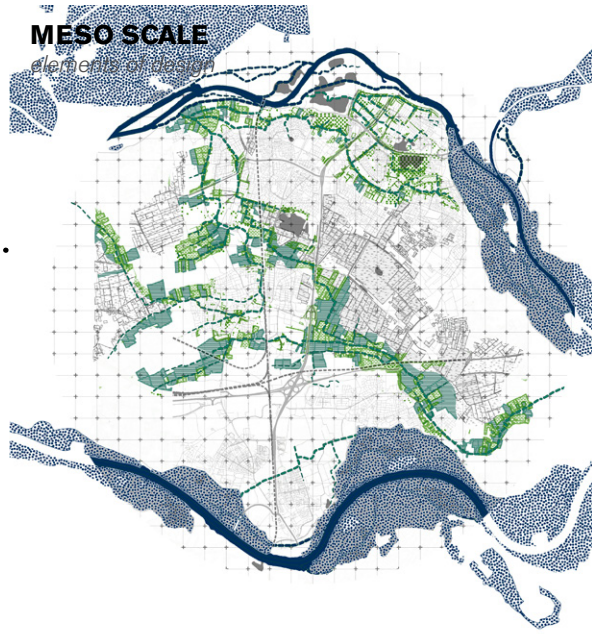
MACRO SCALE

About the potential of the landscape



MESO SCALE

elements of design



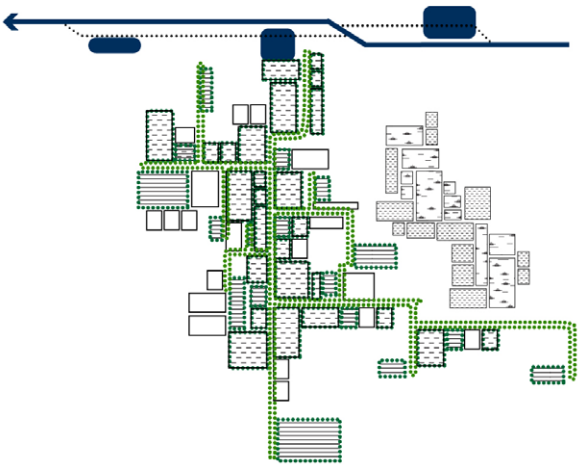
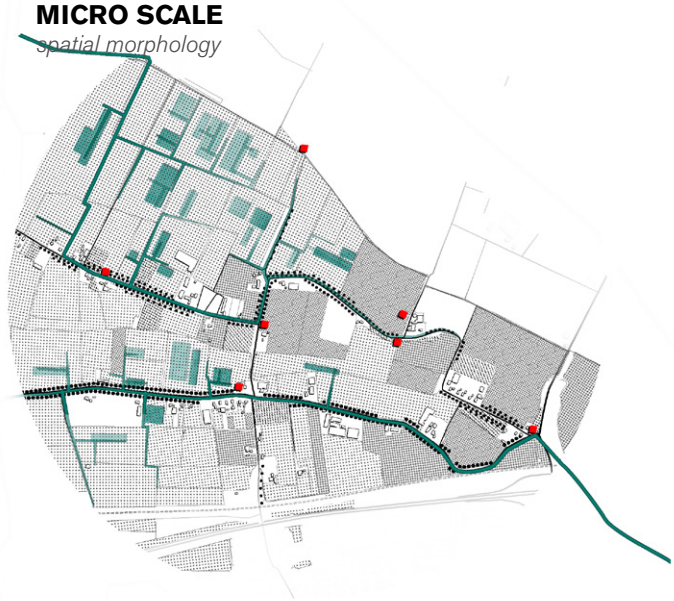
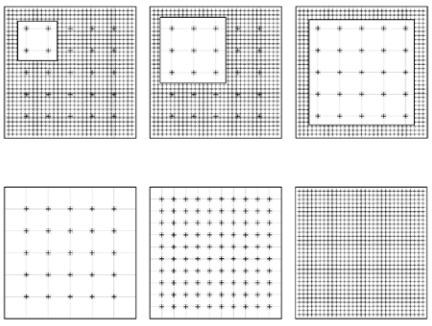


Figure D14.
Network conceptualization
Blue corridor
Main stream
Secondary streams
Land patches
Green corridor
Flood streams
Land patches
Productive wetland
Land patches

MICRO SCALE
spatial morphology



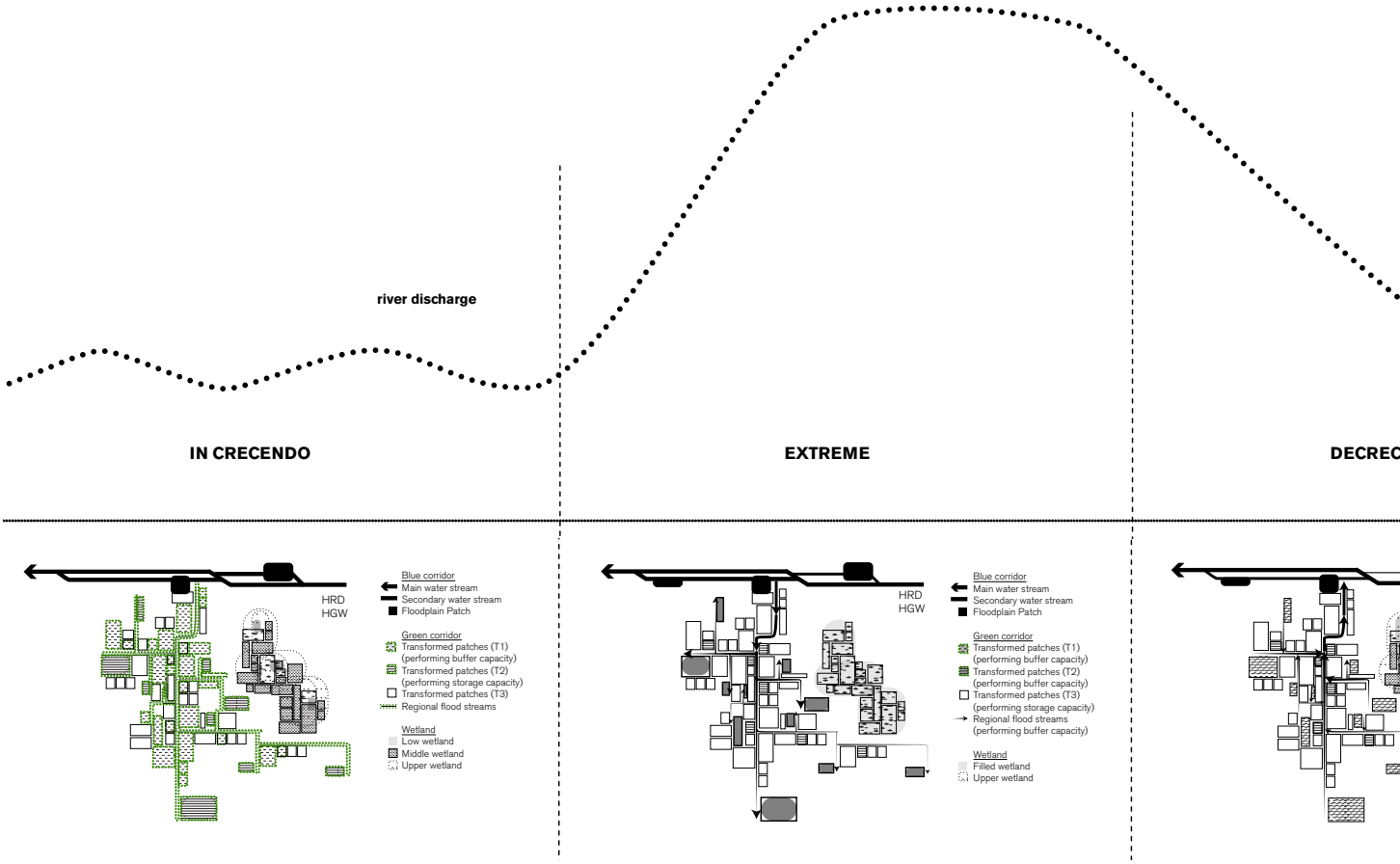
NANO SCALE
gradients of transformation: per land use



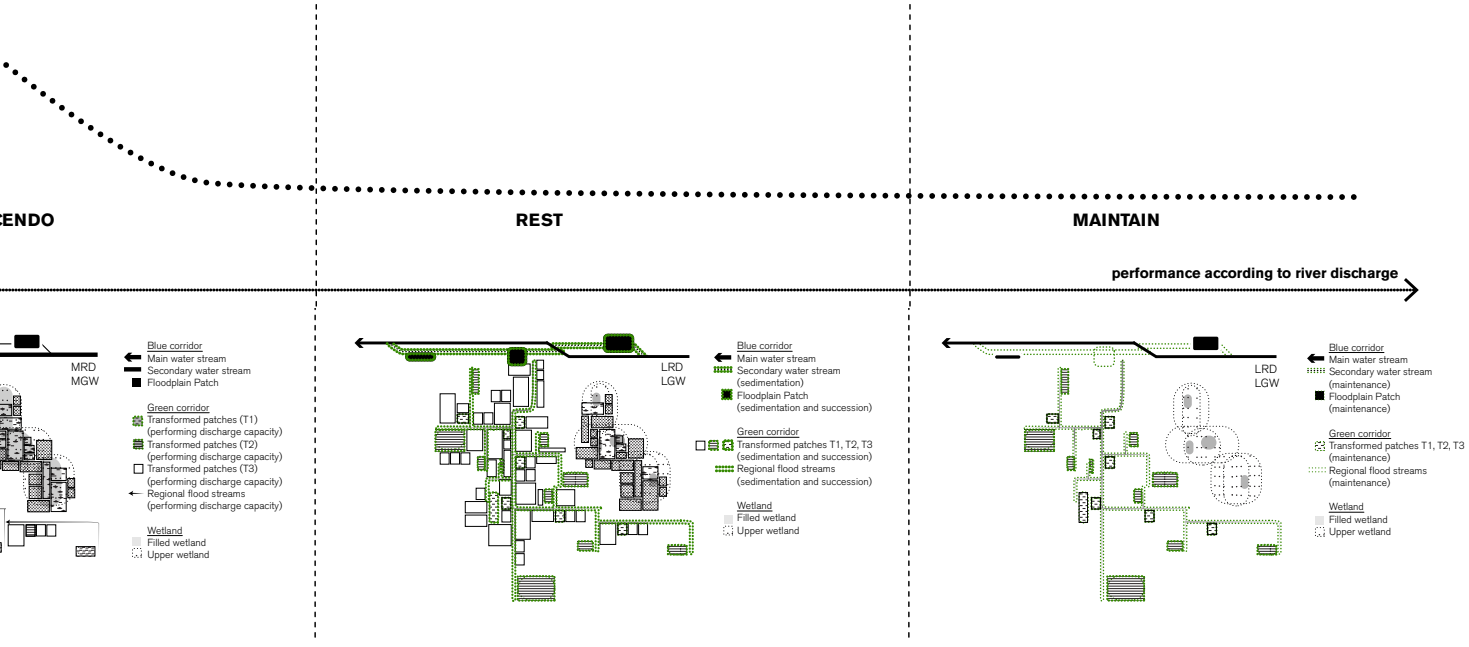
D5. ADAPTIVE SPATIAL PERFORMANCE

According to river disharge

Figure D15.
Adaptive performance according to river discharge
Elaborated by the author



The fluctuating river discharge is characterised in 5 phases - in crecendo, extreme, decrecendo, rest, maintain-. For each phase the interplay between the three systems: blue corridor -primary and secondary water channels and active floodplain-, green corridor -flood streams and agroforestry gradients-, and wetlands is different. Each phase sets in motiona different performance of the system of systems, responding to accomodating functions. Whereas *extreme* and *decrecendo* phases portray an interconnected system of buffer areas contributing to peak river discharges, *in crecendo* and *rest* phases show the idiosyncrasies of three different ecosystems.



D5. ADAPTIVE SPATIAL PERFORMANCE

According to degree of transformation

Starting from the transformation at the land patch level, the regional network is upgraded and re-designed as an increasing local capacity is enhanced. During this first stages of implementation, local and regional network are able to perform a storage and discharge capacity when needed.

Once the capacities of the regional network reach the order of magnitude of the 1000 Ha, the network is upgraded to the territorial level, moment in which the whole system can start performing a buffer capacity when needed.

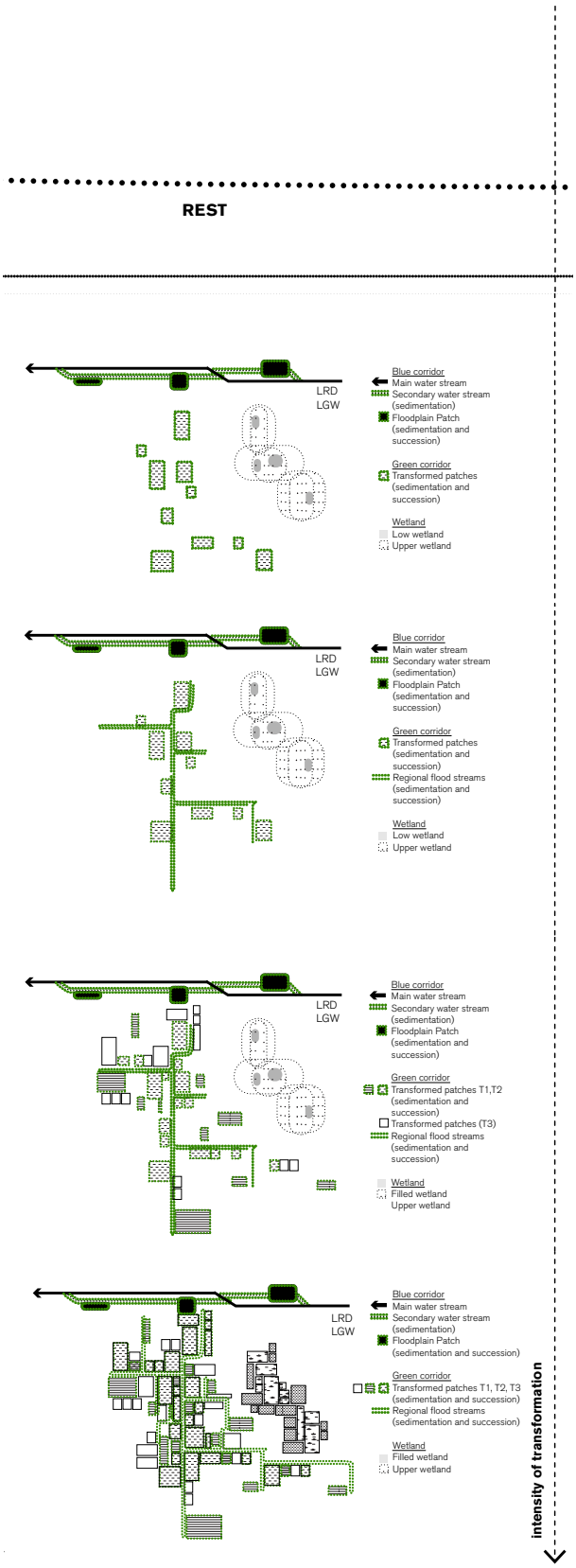
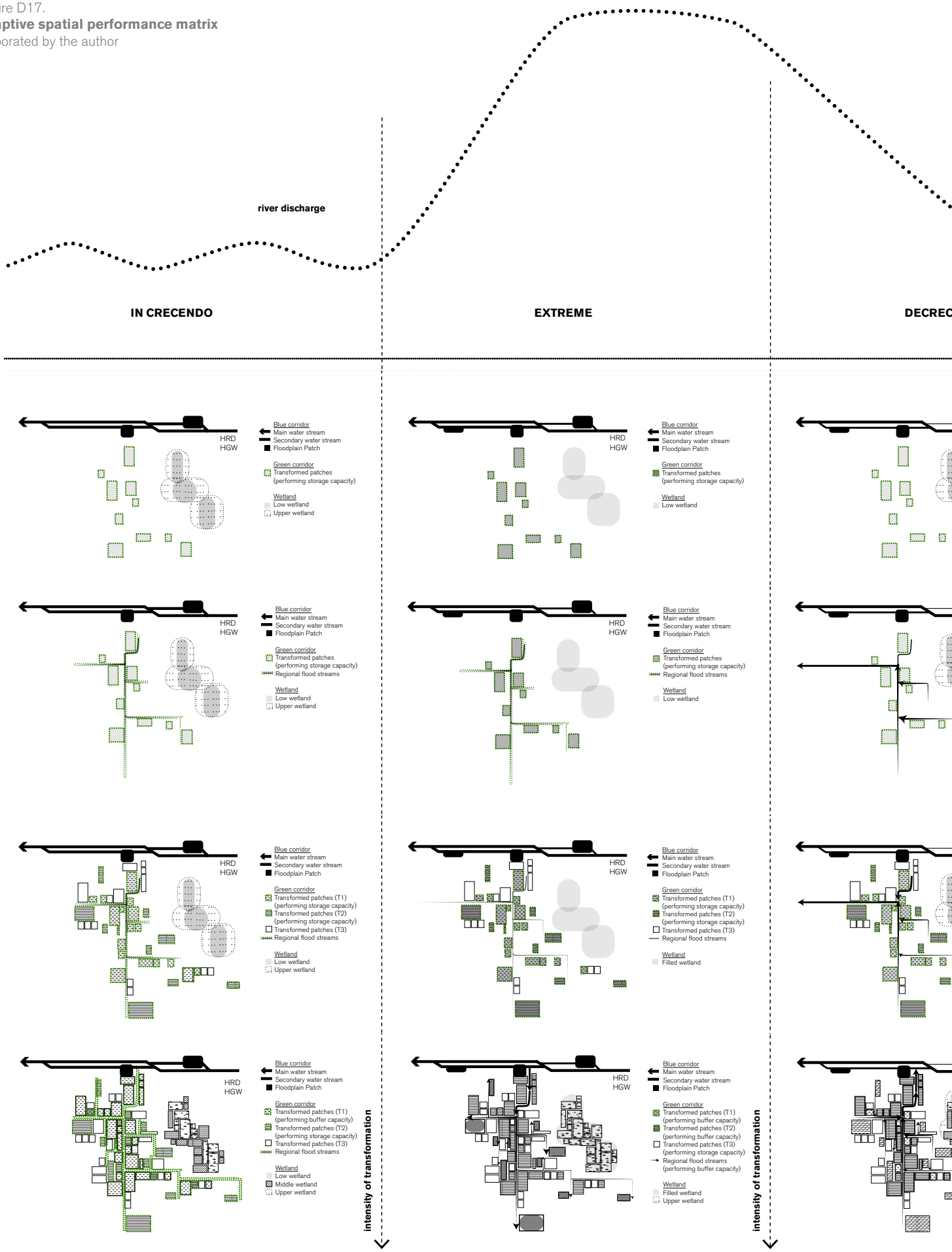


Figure D16.
Adaptive performance according to degree of implementation
Elaborated by the author

Figure D17.
Adaptive spatial performance matrix
Elaborated by the author



CENDO

REST

MAINTAIN

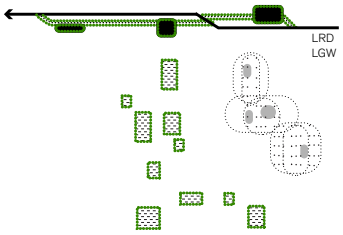
performance according to river discharge

intensity of transformation

Blue corridor
Main water stream
Secondary water stream
Floodplain Patch

Green corridor
Transformed patches
(performing storage capacity)

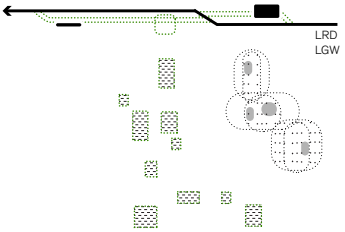
Wetland
Low wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(sedimentation)
Floodplain Patch
(sedimentation and succession)

Green corridor
Transformed patches
(sedimentation and succession)

Wetland
Low wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(maintenance)
Floodplain Patch
(maintenance)

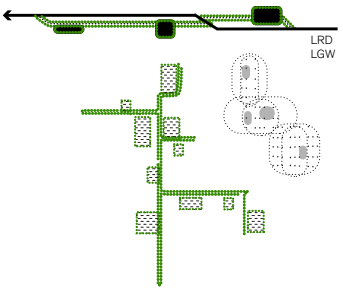
Green corridor
Transformed patches
(maintenance)

Wetland
Low wetland
Upper wetland

Blue corridor
Main water stream
Secondary water stream
Floodplain Patch

Green corridor
Transformed patches
(performing discharge capacity)
Regional flood streams
(performing discharge capacity)

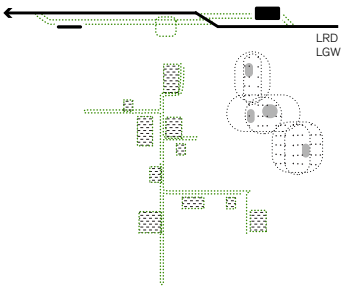
Wetland
Low wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(sedimentation)
Floodplain Patch
(sedimentation and succession)

Green corridor
Transformed patches
(sedimentation and succession)
Regional flood streams
(sedimentation and succession)

Wetland
Low wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(maintenance)
Floodplain Patch
(maintenance)

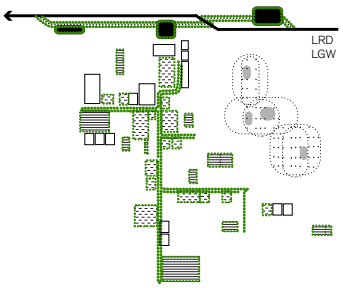
Green corridor
Transformed patches
(maintenance)
Regional flood streams
(maintenance)

Wetland
Low wetland
Upper wetland

Blue corridor
Main water stream
Secondary water stream
Floodplain Patch

Green corridor
Transformed patches (T1)
(performing discharge capacity)
Transformed patches (T2)
(performing discharge capacity)
Transformed patches (T3)
(performing discharge capacity)
Regional flood streams
(performing discharge capacity)

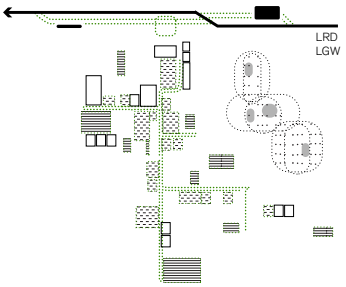
Wetland
Filled wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(sedimentation)
Floodplain Patch
(sedimentation and succession)

Green corridor
Transformed patches T1,T2
(sedimentation and succession)
Transformed patches (T3)
Regional flood streams
(sedimentation and succession)

Wetland
Filled wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(maintenance)
Floodplain Patch
(maintenance)

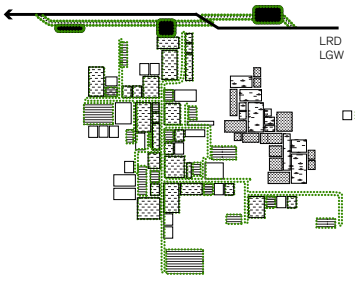
Green corridor
Transformed patches T1, T2
(maintenance)
Transformed patches (T3)
Regional flood streams
(maintenance)

Wetland
Filled wetland
Upper wetland

Blue corridor
Main water stream
Secondary water stream
Floodplain Patch

Green corridor
Transformed patches (T1)
(performing discharge capacity)
Transformed patches (T2)
(performing discharge capacity)
Transformed patches (T3)
(performing discharge capacity)
Regional flood streams
(performing discharge capacity)

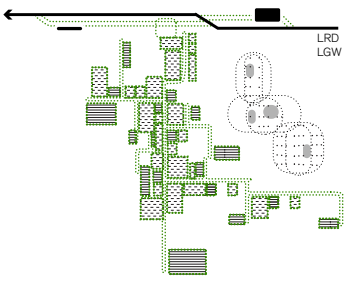
Wetland
Filled wetland
Upper wetland



Blue corridor
Main water stream
Secondary water stream
(sedimentation)
Floodplain Patch
(sedimentation and succession)

Green corridor
Transformed patches T1, T2, T3
(sedimentation and succession)
Regional flood streams
(sedimentation and succession)

Wetland
Filled wetland
Upper wetland



Blue
Main
Seco
(main
Flooc
(main

Gree
Trans
(main
Regi
(main

Wetl
Filled
Uppe

E

Closure and new beginnings

DISCUSSION & OVERALL EVALUATION

In this section I summarise the values that the thesis entitled *Restoring Systemic Proximities* bring forward, the scope of the results and the feasibility of the proposal.

VALUES

The project sets the basis for a pathway of transformation aligned with the restoration of systemic proximities related with:
- the proximity between production and consumption patterns (bioregionalism);
- the proximity between culture and *place* through the cultural appropriation of the specific opportunities and challenges coming from the biogeophysical conditions;
- the proximity between our bodies and the environment to which we are becoming more allergic restoring our immunological intelligence (Haahtela, 2019) through collective rituals that celebrate a re-connection with the soil biota.
- the proximity between local land management and territorial water safety
- the proximity between soil, water and air cycles and production cycles (food forest) leading to the total independency from external outputs, increasing soil performance (infliltration and productivity) repercuting in the local economy of farmers.

The values that the restoration of these proximities puts forward can be structured with a scalar approach:

Local Level

At a local level, the proposal sets the basis to restore higher degrees of consciousness and cooperation among individuals and communities in the collective management of the territory and among individuals and the environment.

The proposal gives an overview of the new conditions of life (image on the right) towards an *integrated view of life* (Geddes, 1985) as a

> *Dynamic ecological, social, and cognitive process in which humanity partici pates, raises awareness of the fundamental interconnection of nature and culture.*

Regional level

At a regional revel, the guidelines for the hybridization of the landscape are a regional planning tool that translates land uses into land roles, giving the uncontrollable sprawl a function and a shape.

National level

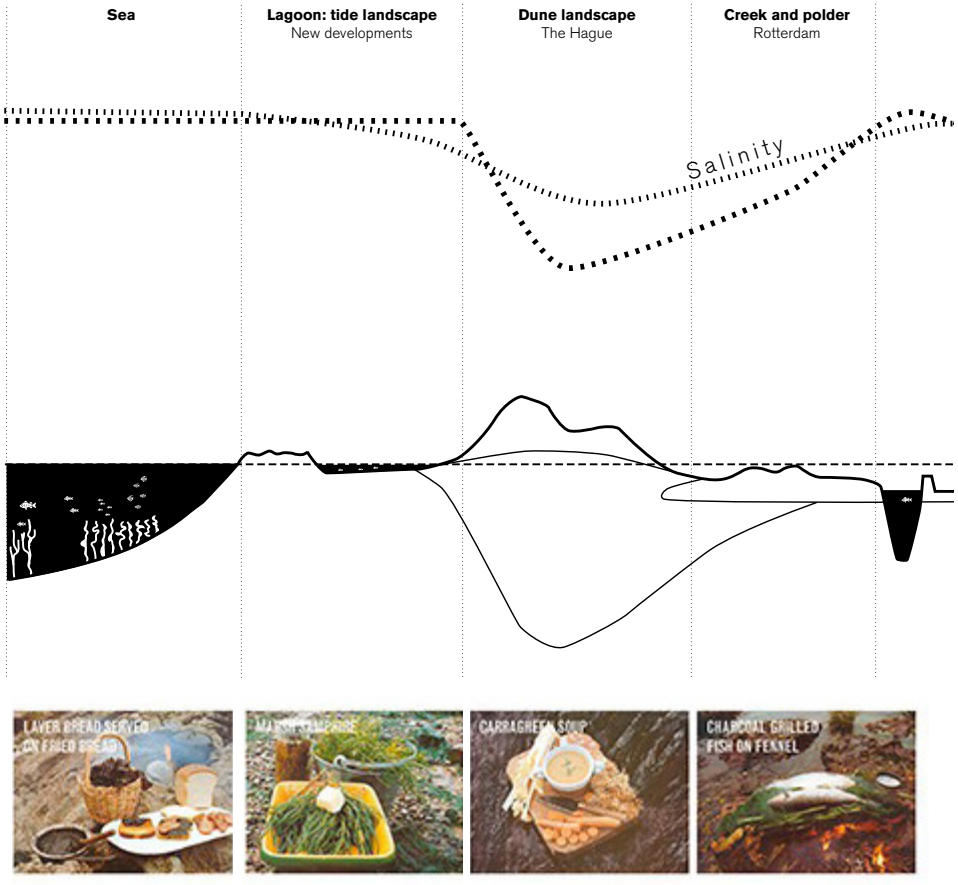
At a national level, the implementation of the proposal leads to a better performance in water safety on-site and downstream of the transformation (see pages 240-245)

International level

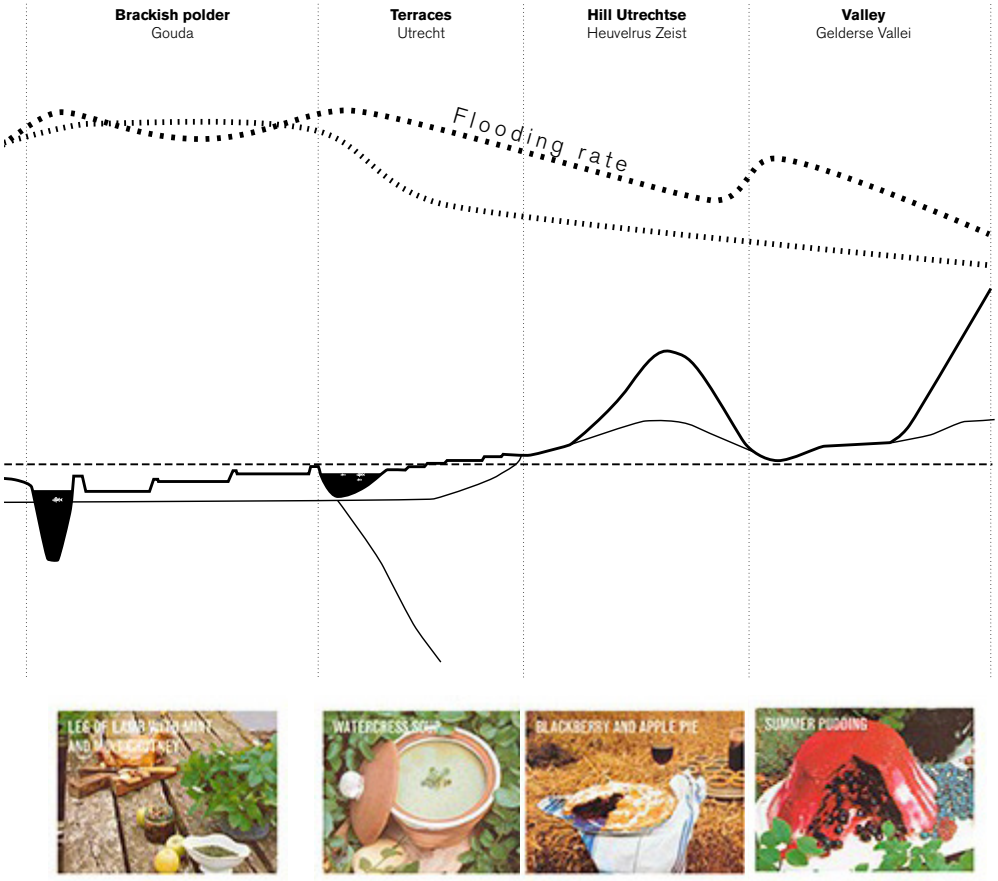
Looking at the big picture, the enhancement of higher degrees of ecological densities through the re-forestation of the Delta has climatic consequences in the mitigation of extremes.

Figure E1.
On an integrated view of life
Elaborated by the author

Figure E2.
"Flow-Food" and the culinary potential of new production landscapes coming from the enhancement of the Salinization and Water levels along the Dutch cross section
Source: Adapted from Lofvers and van Bergen schematic cross section for the International Architecture Biennale Rotterdam in 2005



The restoration of proximities between production and consumption patterns (bioregionalism) and the enhancement of the potential new water and salinization conditions of the landscape through new production landscapes is already in the Dutch table of conversation here represented in this "Flow-Food" exhibition and dinner by Willemijn Lofvers and Jago van Bergen.



EXTENT AND NATURE OF THE RESULTS

The thesis strength resides in its holistic approach, bringing together values aligned with seemingly different fields. More than giving specific solutions, the thesis provides with an evolutionary tool for the understanding, planning and design of the territory.

The depth of research in each field (agriculture, water management, ecology, risk management, sociology) responds to a conscious exercise of decision, shaping what this thesis can be regarding its limitations in time and resources. Most importantly, the scope of the results respond to the conscious decision of elaborating a planning and design framework rather than a specific design solution, with a special focus on systemic relations crossfields.

The main results of the research have a different nature:

Methodological.- The Thesis elaborates a research and design method in relation to the reading, re-programing and operationalization of the next territorial and urban model. A method that is transcalar and multi-dimensional as a tool to read interconnectedness.

Design (open-ended design)- The design result is a pathway to guide the transformation of the territory given the site conditions of the Rivierenland. This transformation involves the local re-programming of land management units increasing the buffer capacity and ecological density per patch. This transformation pathway is a tool for local actors to embrace the systemic and synergistic relations coming along rather than the design of specific solutions for agriculture, water management or ecology.

Implementation/Operationalization.- The operationalization of the proposal that the thesis develops is a tool guiding an evolutionary approach starting from local transformations that lead to territorial impacts.

FEASIBILITY

Cultural feasibility

The feasibility of the proposal is highly dependent on the cultural perception of connectivity and flood risk. As evaluated in the previous chapter (pages 242-247), the performance of the system and recovery process after an extreme event is substantially improved within systems that enhance connectivity than within systems that enhance separation.

Also, as explored by Klijn at al., (2018), psychological research on risk perception shows that people value large consequences as much more important than frequency of occurrence, therefore, if connectivity means the prevention of disasters, the cultural feasibility should in theory be possible. In practice, however, the cultural process of acceptance of change is much more complicated and long.

As seen after great floods in the Netherlands, only after a disaster has happened, people are much more open and demanding of innovative approaches. In the case of the river floods in1995, the conviction to overcome control narratives took 20 years until the national planning policy “Room for the River” was on the table.

The explored strategy to trigger this change is through an evolutionary approach in the implementation and operationalization of the proposal aiming at the cultural appropriation of the proposed transformation in time through:

a) The democratization of the transformation to an open number of local and self-organized transformations promoting spontaneous change throughout the territory.
b) The democratization of the transformation to potential synergistic functional variations opening a permanent process of change from a passive to active lands in the inclusion of buffer roles when needed, inspiring innovation processes by placing the decision making in the local spheres.
c)The evolutionary co-definition of a long term transformation through a series of co-definition moments in the short and medium term as ongoing monitoring and evaluation of the evolution of the proposal. In this sense, rather than an end goal, that can be outdated as new predictions come along, the proposal gives a flexible pathway of change, building increasing learning abilities that are translated into the co-definition of the regional network and local maintenance regimes that accomodate to changing circumstances.

The idea is including the local actors not only as participants and supporters of the proposal but also as actual agents of change.

This appropriation is also most likely to be related to and evolutionary co-definition of the notion and implementation of connectivity (page 225), opening the design to future re-inventions. For instance:
- If the connectivity is event dependent, the fractal network of the proposal performs a buffer, storage and discharge capacity
- If the connectivity is not event dependent, the fractal structure of dead ends evolves into secondary channels distributing water throughout the whole territory reaching the main river downstream.

Figure E3.
1995 High water in the Waal River
Source: Reprinted from *Gelderlander*, by Jan Bouwhuis, Retrieved from https://gelderlander.nl

TRANSFERABILITY

Increasing temperatures of water bodies are altering the global moisture circulation patterns with the expansion of Hadley cells and the so-called ' tropicalization' of mid latitudes geographies and territories. Through this process, Extra Tropical storms and higher winds are expected in typical 'non tropical' - mid latitude areas.

This new condition does not change the amount of water precipitation, but its distribution throughout the year. Less rainy days and more intense events as 'extratropical' cyclones (Catto et al., 2019).

In this sense, the new conditions can be translated into a change in land and water management.

Generic:
The logic behind the transformation of land uses into localized land management units of these extremes through the hybridization of the countryside regarding increasing ecological densities and buffer capacities, together with the logic behind enhancing new forms of connectivity with the main water streams, is aligned with the necessity to provide with an extensive network of storage and buffer areas, the necessity to restore the natural capacities of soils, wetlands and forests to delay, absorb and mitigate these extremes. But specially, the thesis logic is aligned with the necessity to integrate people and their livelihood to the new conditions (rainfall frequencies) of the place they inhabit (Wahl, 2016)

The urgency for adopting this logic that the thesis puts forward could be expanded to the whole water catchment (upstream, middlestream, downstream) within mid-latitude geographies and territories, where an intensive urbanization has been translated in the erosion of its soils (unable to store rainfall or not even moisture). But particularly, the urgency is striking for mid-latitude downstream Delta areas already with a history in floods where control approaches have constructed a physical, cultural and programmatic separation between blue and green corridors and highly urbanized areas.

Specific:
Coming from the understanding of bioregional design and planning approach pioneered by Geddes, regional and town planning is specific to the place. Therefore, the design (pathways of transformation) and planning (or operationalization) of the proposal are rather specific, accomodating to the particular biogeophysical, socio-cultural and governance conditions:

Place – The biogeophysical conditions coming from the specificities within upstream, middlestream and downstream catchment areas introduce a series of variables -topographic, geologic and climatic- influencing the type of ecosystem, therefore ecosys-

The logic behind the transformation of land uses into localized land management units of new extreme climatic conditions through an extensive storage and buffer capacity network is transferable to mid-latitude geographies and territories where intensive urbanization has destroyed storage capacity of the soil.

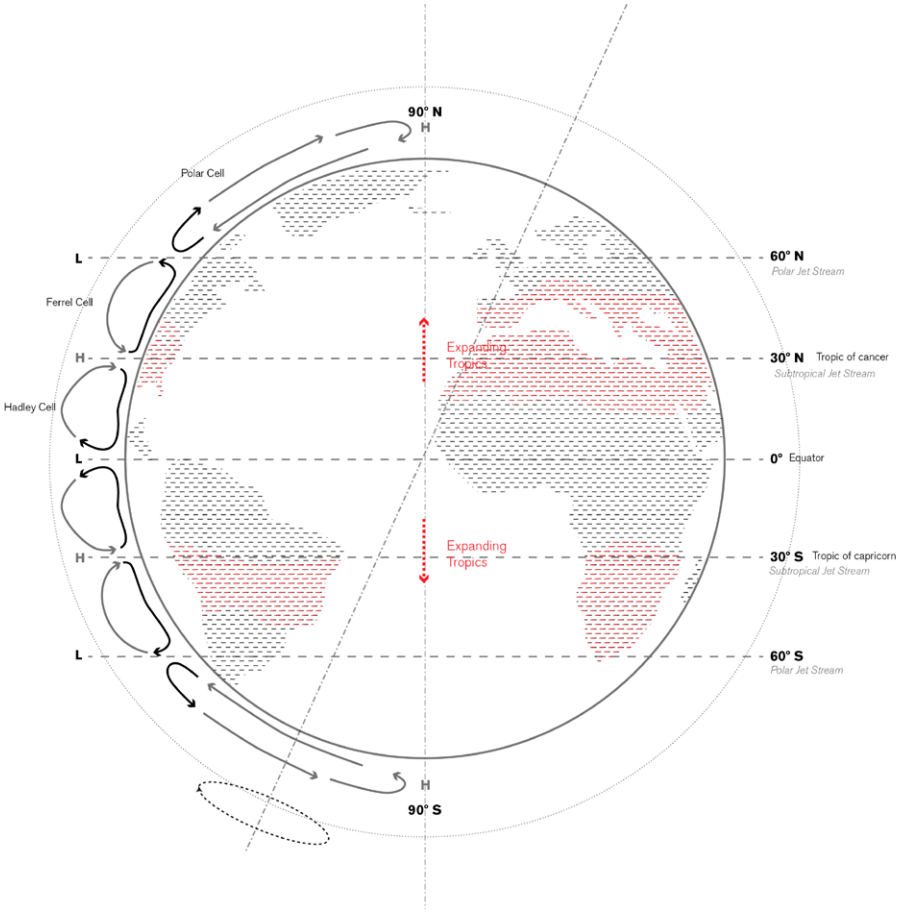


Figure E4.
Expansion of Hadly Cells
Ellaborated by author

tem-based economies. Even within the downstream catchment and Delta areas, the proximity to the sea introduces additional variables -salt intrusion, tidal influence- with a great impact in the specific water safety and ecosystem restoration transformation pathways.

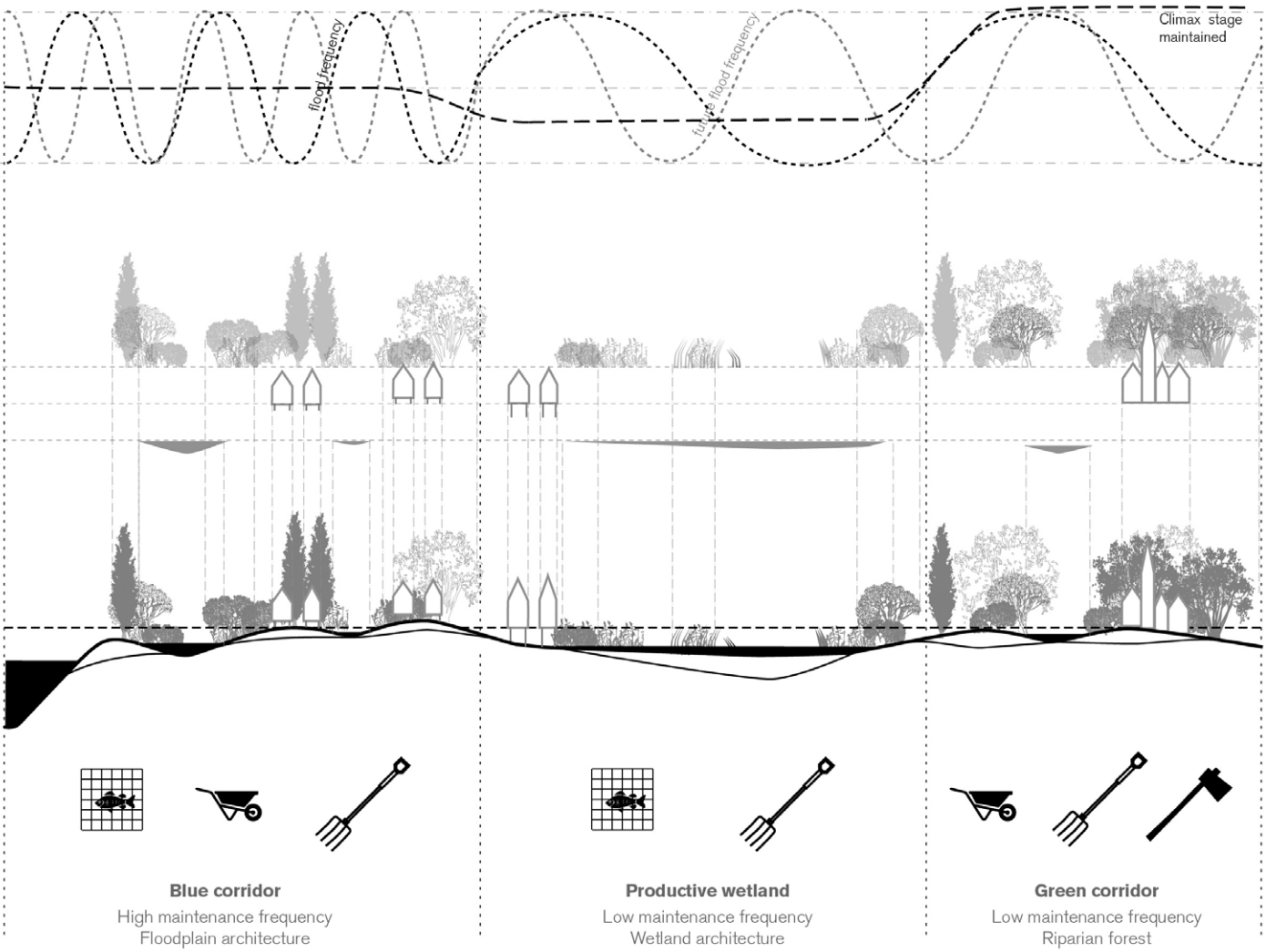
Work - The *place* conditions above described are associated with site-specific land management and maintenance regimes -associated to site-specific sedimentation and disturbance regimes associated to different succession processes- determining the conditions for ecosystem-based economies.

Folk – The cultural approach to risk is of great significance when it comes to the co-definition of connectivity, modifying the design, its implementation and feasibility (see previous section).

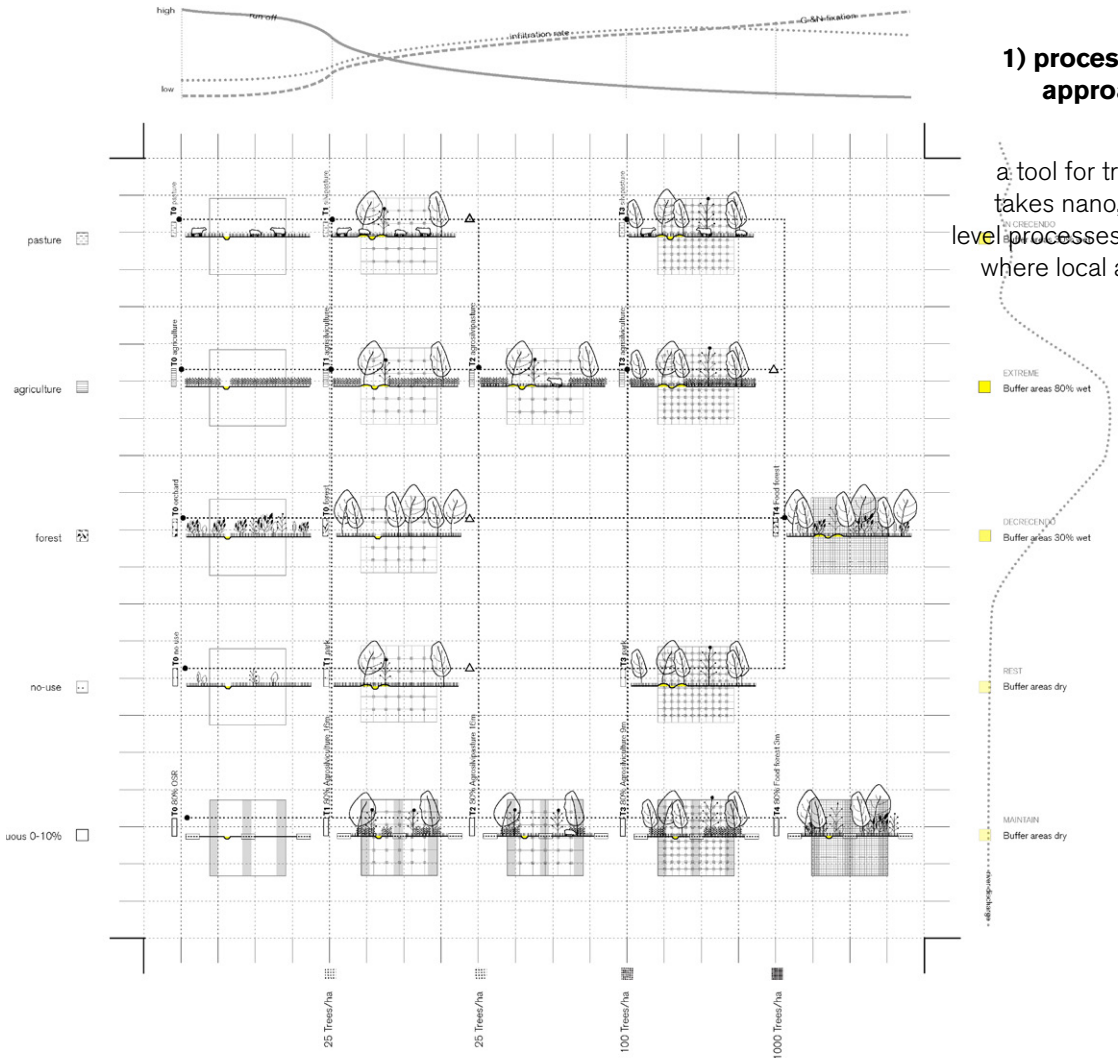
Finally, the operationalization of the proposal is rather specific for the existing platforms from which the proposal can be implemented. In the case of the Netherlands, a country very advanced in adaptive planning, the implementation of this proposal can be more easily be included and appropriated than in territories where adaptive approaches are not yet taken.

The design (pathways of transformation) and planning (or operationalization) of the proposal are rather specific, accommodating to the particular biogeophysical, socio-cultural and governance conditions of the place.

Figure E5.
On natural occupations
Ellaborated by author

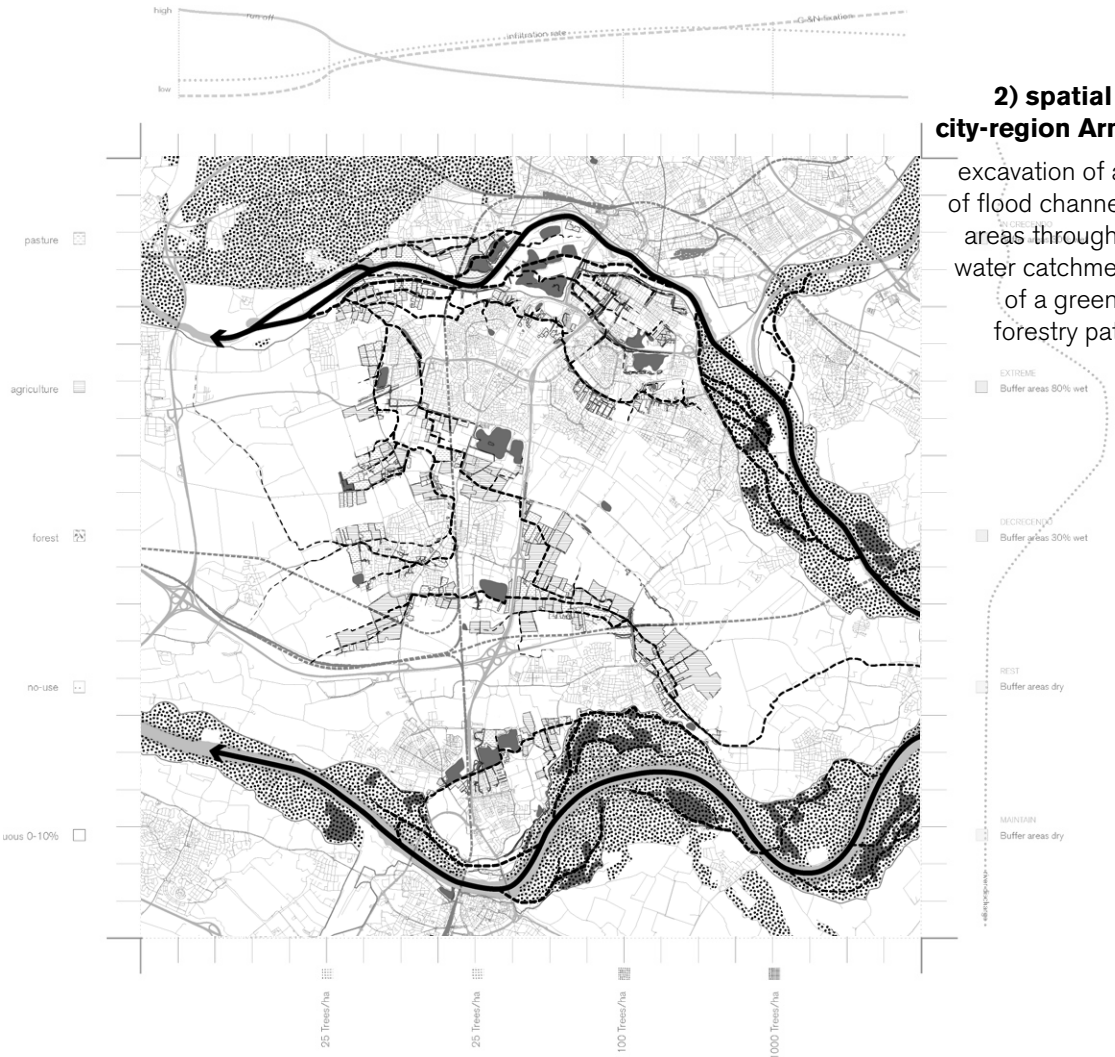


TANGIBLE OUTCOMES



1) process-based design approach to planning and design

a tool for transformation that takes nano, micro and macro level processes into account and where local actors are the key agents of change



2) spatial transformation city-region Arnhem-Nijmegen

excavation of a new topography of flood channels and depressed areas throughout the urbanized water catchment, and cultivation of a green network of agro-forestry patches and riparian corridors.

TANGIBLE OUTCOMES

2) spatial transformation
De Buitens, Lingezegen Park

excavation of a new topography of flood channels and depressed areas and cultivation of a green network of agroforestry patches, riparian corridors and *singels*

THESIS PROPOSITIONS

on urban design

1. The design of the urban environment can enable a symbiotic relation with the natural environment or on the contrary create a cultural, geographical and physical distance from a natural environment from which urban systems can be increasingly vulnerable.

on adaptive planning

2. Land uses and local actors have the capacity to be land management units and agents of change in the collective design, execution and maintenance of a hybrid responsive and integrated landscape.

from flood risk management

3. Decentralization and dispersion of the flood network throughout the water catchment continuum and through the downscaling of interventions locally managed, potentially reduces the likelihood for disasters "beyond recovery" in the aftermath of extreme discharge events.

from environmental sciences

4. Extreme climatic events require a different management of the land (use and cover) that restore and maintain soil capacity to delay, store and discharge water.

from cultural praxis

5. The provision of active roles to individuals and collectives in the management of flood risk and ecosystem restoration raises awareness, cooperation and responsibility towards the fundamental interconnection between nature and culture triggering processes of re-territorialization.

CONCLUSION

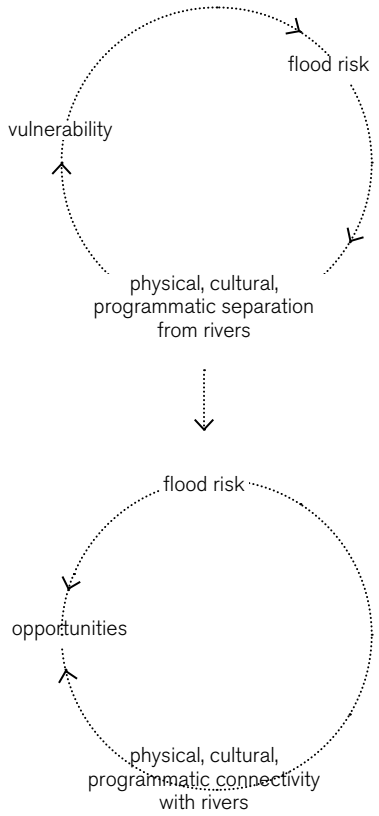


Figure E6.
From vulnerabilities to opportunities
Ellaborated by author

The thesis puts forward an opportunistic view regarding the climatic extremes and new rainfall frequencies that Climate Change brings. It embraces extreme rainfall intensities into opportunities to adopt new land management frequencies and maintenance regimes but also as an opportunity to restore better relations with our quickly changing environment.

For the particular case of the Dutch Rivierenland, a complex and fluid territory of riverine-deltaic conditions, the thesis brings forward the necessity to change the approach given to territories at flood risk, where the physical cultural and programmatic separation between rivers (active areas in flood management) and the urbanized territory (passive areas in flood management) are constructing communities and urbanized territories increasingly vulnerable. In contrast it proposes the operationalization of an approach based on enhanced connectivity throughout the territory, where every part of the territory is part of a whole in the active management of floods and ecosystem restoration. An approach aiming at restoring systemic proximities among individuals and communities, between culture and nature and between local and territorial scales.

The main design outcome of the thesis is a transformation pathway where synergistic coupling of functions are activated locally, triggering processes of innovation and cultural appropriation as opportunities for ecosystem-based production models.

The graduation research is positioned within the incipient next Urbanism paradigm, one that re-defines the act of urbanization as an act of re-territorialization, where land uses are associated to evolutionary land roles that different occupation patterns perform in the establishment of a more symbiotic relation with the ecology in which these are embedded.

RECOMMENDATIONS FOR FURTHER RESEARCH

Given the proposed methodology, logic and operationalization of the proposal, possible pathways for further research are below indicated:

A) Evolutionary pathways of the notion of connectivity. Spatialization and values
The thesis indicates the importance of operationalizing the co-definition of connectivity and its revision over time as a tool for cultural appropriation of a notion that initially is unsettling. A proposition of its functional definition is given by the thesis in order to portray how the proposal could unfold and perform, however, time limitations have constrained the further exploration of its ecological, spatial, perceptual and cultural values, and how these could change over time as new approaches to such connectivity unfold. As such, a potential research question could be:

RQ: What are the typology of potential spatializations that the notion of connectivity can have within the Rivierenland and what are the evolutionary values these unfold?

B) Business models and economic feasibility in time
At a national level, the current approach to water safety and water management in the Netherlands has a consolidated business model making possible that the areas with higher economic value are *safe* regardless of its vulnerable geographic position below sea level and prone to sea and riverine floods.
With the proposal, this business model would need to transition from its current functioning to a new model that not only can afford the proposed changes, but can actually benefit form them in the medium and long term.
On the other side, at a local level, the transition from the current economic model behind monocultures to the proposed hybridization of landculture (food forest) would need to be clarified in order to allow economic feasibility at this level. As such, another potential research direction could be the clarification of the economic feasibility of the proposal in the medium and long term.

Taking the synergistic bridging of values across scales and fields that the proposal brings (page 212-213) as a starting point, future research could be done regarding the spatial and economic transition to new productive models, bridging macro and micro economies through localized management of water safety and ecosystem restoration.

RQ: What type of transition in governance and planning can enhance the process of restoration of systemic proximities?

F

Reflection

Restoring Systemic Proximities
Towards the re-territorialization of the Dutch Rivierenland

Abstract

Uncertainty posed by Climate Change brings control approaches to environmental processes and dynamics into question. In the Netherlands and particularly in the Dutch River area (Rivierenland in Dutch) narratives have already shifted towards an adaptive planning (Davoudi, 2013). However, there is still a need to go beyond the physical cultural and programmatic separation between rivers -active areas in flood management- and the urbanized territory -passive areas in flood management-. The definition of these dualities in the Dutch territory not only feeds a model based on vulnerability, but it also leaves the problem of a fragmented landscape unsolved. Aiming at the enhancement of adaptive territories and the embracement of uncertainty, the thesis proposes the operationalization of an approach based on enhanced connectivity throughout the territory, where every part of the urbanized territory takes a role in the active management of floods and ecosystem restoration. An approach aiming at restoring systemic proximities between culture and nature and between local land management and territorial water safety.

The main design outcome of the thesis is a transformation pathway towards the hybridization of the territory by increasing ecological densities and buffer capacities per land management unit. A pathway where synergistic coupling of functions are activated locally, triggering processes of innovation and cultural appropriation of the proposal, as opportunities for emerging ecosystem-based production models.

The graduation research is positioned within an emerging urban paradigm, one that re-defines the act of urbanization as an act of re-territorialization (Deleuze and Guatari, 2000), where land uses are associated to evolutionary land roles that different occupation patterns perform in the establishment of a more symbiotic relation with the ecology in which these are embedded.

Sources: Davoudi, S., Brooks, E., & Mehmood, A. (2013). Evolutionary resilience and strategies for climate adaptation. Planning Practice & Research, 28(3), 307-322. Guattari, F., & Deleuze, G. (2000). A thousand plateaus: capitalism and schizophrenia. London: Athlone Press.

Key words
climate extremes, flood risk management, adaptive planning and design, maintenance regimes, enhanced connectivity, watershed management

REFLECTION

The choice of my method (on the how and why)

The Thesis proposes/builds upon the elaboration of a research and design method in relation to the reading, re-programing and operationalization of the next territorial and urban model. The definition of a design-related question and the unfolding of its proposal is, rather than the end goal, the tool to test and further detail the reach of the method.

The method of research is rotted within a conceptual ex-ante positioning, defining a meta problem -on the desynchronization between urban and ecological systems as a result from planning and design approaches based on control- that the thesis casts light upon by learning from an exceptional case, the Dutch case.

The method is, above all, an inquiry on a different urban and territorial development based on the active role that occupation needs to perform in the establishment of a more symbiotic relation with the ecology in which it is embedded.

In order to reflect on the nature, scope, transferability and relevance of the thesis I will elaborate on 5 different aspects:

Aspect 1.- Relationship between research and design

The thesis is carried out by means of a research by design approach. Given the complexity and extensiveness of research already developed within this particular territory, the Dutch River plain, this approach helps on the one side establish a dialogue between problem and solution, while opening the research to inspiring readings of the territory. In other words, design is used as a vehicle to make wicked problems visual and spatial, exploring possibilities and generating solutions, and consisting on the systematic exploration of multiple scales and dimensions of the territory: horizontal, vertical and temporal.

The trans-scalar approach strategizes the analysis and design of the aimed transformation taking into consideration different time-scale conditions / processes and boundaries (administrative and geo-physical) intrinsic of each scale. The trans-dimensional approach is the tool meant to comprehend the complex territory:

The horizontal dimension (plan) is used for the design of large scales (macro, meso, micro) and gives the framework to design and plan the proposed transformation. Within the thesis, the horizontal dimension involves the design of spatial strategies and relations established on the same layer (substratum, infrastructure, occupation). Its scale-dependence is portrayed in the 1977 documentary film “Powers of Ten” written and directed by Charles and Ray Eames.

The vertical dimension (section) allows for the understanding of the inter-relation among different layers of the territory (dutch layer approach). Within the Thesis, this dimension reveals the intrinsic relation between occupation and substratum, a dialogue between different spatial-temporal scales (from decennial to millennial)

that allows for the classification of different urban-landscape types –blue corridor, productive forest, productive wetland- in the definition of the proposed re-territorialization regimes.

The temporal dimension is a transversal one that is used in plan and section to track the functioning and change. It applies to the plan in the sense that it sets the pathways for transformation (meso scale), and to the section, involving the understanding of the immaterial and hidden flows, exchange and possible streams of biological and physical / material resources between land and territory (watersheds, sheds, bioregion), between ground, water and atmosphere over time. It is the dimension allowing for the portray of cultural adaptation, and the evolutionary aspect of the proposal.

The design thinking approach, is focused on invention, on the development of new knowledge by synthesis and spatial translation (Nijhuis, 2015)

Aspect 2.- Relationship between graduation topic, studio topic, master track and master programme

Graduation topic: Restoring systemic proximities. On the re-territorialization of the Dutch Rivierenland
Studio topic: North Sea Landscapes of Coexistence. A Topography of Chance
Master track: Urbanism
Master program: Msc 1-2-3-4

[Graduation topic & Studio topic]

The studio topic “North Sea. Landscapes of Coexistence. A Topography of Chance” focuses on the agency of design in territories at risk between land and water (maritime, riverine, delta landscapes), and the inseparable relation between nature and culture. Closing a three year-long cycle on the North Sea, and after having represented and analysed its past, present and future geography over the past two years, the studio topic sets in motion a conversation between six lines of inquiry for the future of the North Sea region. A conversation about the coexistence between different claims in the sea, ranging from extractivism, energy, fishery, ecology, logistics and migration to carbon storage and climatic shifts and the specific relational power of each individual project.

Within this framework, my graduation topic on the re-territorialisation through the re-programming of a hybrid integrated and responsive landscape builds upon the notions of territorialization (Deleuze and Guattari, 1980), natural occupations (Geddes, 1909), landscape ecology (Forman, 1995), environmental risk (fluctuating river discharges) and complexity (Holling, 1986) synthesizing and re-defining them within the narrative of the proposal. A proposal that establishes a conversation with the different claims of the territory of the North Sea, highlighting the assonances with:

“Dual nature of externalities” in the sense of embracing the extreme weather and new climatic frequencies not as vulnerabilities to protect ourselves from, but as

opportunities to adapt and change translated into new land management and maintenance regimes. Opportunities to adapt while restoring better relations with our quickly changing environment.

"Crisis of representation" and the need to design a different palimpsest of land programs that allow for cultural appropriation and higher degrees of cooperation among individuals and communities, among people and nature, among local, national and international scales.

"Flux, erasure, terraforming" as the intrinsic characteristic of a dynamic territory whose program defines different regimes of occupation or *natural occupations* (Geddes, 1985)

Concurrently, the thesis is as well crafted by the understanding of dissonant voices, in particular one-dimensional voices coming from "the pervasive ecology of flows" in the understanding of rivers as logistic routes, where processes of change (flux, erasure and terraforming), are detrimental and therefore designed to be avoided.

In this sense, the thesis positions itself within holistic approaches, distancing itself from one-dimensional/dualistic ones. Only from holistic perspectives the economic and socio-cultural feasibility of the proposed framework can be enhanced.

[Graduation topic & Urbanism]

The graduation research is positioned towards the definition of the next Urbanism paradigm, one that re-defines the act of urbanization as an act of re-territorialization, where land uses are associated to evolutionary land roles that different occupation patterns perform in the establishment of a more symbiotic relation with the ecology in which these are embedded.

[Graduation topic & Master program]

Coming from the knowledge provided by Msc 1 -oriented towards the construction of a rich theoretical base aligned with my personal inquisitiveness in Landscape Urbanism and Environmental Design- and Msc 2 - oriented towards the construction of a solid and thorough knowledge in infrastructure design, water and soil systems and complexity- the project is conceived as the continuation and synthesis of the learned knowledge, in such a way that defines my positioning towards the profession and approach to future projects.

Aspect 3.- Elaboration on research method and approach chosen in relation to the graduation studio methodological line of inquiry, reflecting upon the scientific relevance of the work.

The studio is founded on the notions of complexity, territorialism, infrastructure space, (landscape) ecology, environmental risk (extremes), geo-philosophy, bio-politics, transition and policy analysis.

The "Transitional Territories" methodological line of inquiry proposes a holistic

approach where humans and nature, cities and countryside, infrastructure and urban form, ecology and economy, risk management and inhabitation are not sides of a dualistic approach, but the integrant components in the definition of the hybrid urban condition that re-defines the planning, design and imagination of the next urban phenomenon.

Based on the notion of "altered natures", the studio proposes a proactive approach that goes beyond the mitigation of climate change effects and causes. It proposes the understanding of extreme conditions as the primary conditions of life from where we have to establish the urban project.

In this regard, my research attempts to position itself within this line of inquiry, following the research on the integration of natural processes within the design and planning of the future urban condition within the complexity and fluidity of riverine-deltaic conditions. By defining a design-related question within the Dutch Riverplain, the thesis is able to further detail the reach of the method by proposing the site-specific interrelation among flood adaptation, ecosystem restoration and land management.

Aspect 4.- Elaboration on the relationship between the graduation project and the wider social, professional and scientific framework, touching upon the transferability of the project results.

[Societal relevance]

The thesis aims at contributing and benefiting to society by improving the safety and robustness of their living environments, resilience provided by more endogenous socio-economic systems, and individual and collective capacity to adapt to change, one that is inevitable and uncertain.

The idea to transition from the current static/fragile systems to dynamic/adaptive ones is strongly dependent on a cultural shift that is currently still rooted in a worldview based on control and prediction, and that leads to virtually safeguarded and (consequently) threatened territories and communities.

As a thesis centred on the idea of local adaptation and cultural appropriation, the research provides with guidelines and insights in how the urban project can trigger a different cultural relation with nature (and its intrinsic uncertain and extreme condition).

The hypothesis of interrelating flood adaptation and ecosystem restoration with land management as the formula for the re-territorialization of the Dutch Riverplain proposes how different maintenance regimes have an impact on program and culture.

[Scientific relevance]

The scientific relevance of the work is related to the framing of the next urban paradigm, one that re-defines the act of urbanization as an act of re-territorialization, where land uses are associated to evolutionary land roles that different occupation

patterns perform in the establishment of a more symbiotic relation with the ecology in which it is embedded.

The thesis builds upon the recent adaptive approach to planning and design as a tool to deal with uncertainty (environmental, social and economic), identifying its current challenges -in the implementation, in the inclusion of culture and in the definition of vulnerability narratives- and proposing a pathway to go beyond the current scope:

- (in the implementation) up-scales the scope of adaptive planning and design by down-scaling the strategies to more manageable actions.
- (in the inclusion of culture adaptation) defines different maintenance regimes with an impact on program and culture.
- (in the definition of vulnerability narratives) erases the duality between protecting and protected areas through a gradient of new land roles

[Transferability]

Generic:
The logic behind the transformation of land uses into localized land management units of these extremes through the hybridization of the countryside regarding increasing ecological densities and buffer capacities, together with the logic behind enhancing new forms of connectivity with the main water streams, is aligned with the necessity to provide with an extensive network of storage and buffer areas, the necessity to restore the natural capacities of soils, wetlands and forests to delay, absorb and mitigate these extremes. But specially, the thesis logic is aligned with the necessity to integrate people and their livelihood to the new conditions (rainfall frequencies) of the place they inhabit (Wahl, 2017)

The urgency for adopting this logic that the thesis puts forward could be expanded to the whole water catchment (upstream, middlestream, downstream) within mid-latitude geographies and territories, where an intensive urbanization has been translated in the erosion of its soils (unable to store rainfall or not even moisture). But particularly, the urgency is striking for mid-latitude downstream Delta areas already with a history in floods where control approaches have constructed a physical, cultural and programmatic separation between blue and green corridors and highly urbanized areas.

Specific:
Coming from the understanding of bioregional design and planning approach pioneered by Geddes, regional and town planning is specific to the place. Therefore, the design (pathways of transformation) and planning (or operationalization) of the proposal are rather specific, accomodating to the particular biogeophysical, socio-cultural and governance conditions:

Place – The biogeophysical conditions coming from the specificities within upstream, middlestream and downstream catchment areas introduce a series of variables -topographic, geologic and climatic- influencing the type of ecosystem, therefore ecosys-

tem-based economies. Even within the downstream catchment and Delta areas, the proximity to the sea introduces additional variables -salt intrusion, tidal influence- with a great impact in the specific water safety and ecosystem restoration transformation pathways.

Work - The *place* conditions above described are associated with site-specific land management and maintenance regimes -associated to site-specific sedimentation and disturbance regimes associated to different succession processes- determining the conditions for ecosystem-based economies.

Folk – The cultural approach to risk is of great significance when it comes to the co-definition of connectivity, modifying the design, its implementation and feasibility (see previous section).

Finally, the operationalization of the proposal is rather specific for the existing platforms from which the proposal can be implemented. In the case of the Netherlands, a country very advanced in adaptive planning, the implementation of this proposal can be more easily be included and appropriated than in territories where adaptive approaches are not yet taken.

Aspect 5.- Ethical issues and dilemmas encountered in (i) doing the research, (ii) elaborating the design and (ii) potential applications of the results in practice

(i) ethical issues arised while doing the research

By ellaborating the research, some dilemmas have arised regarding its involvement with areas of knowledge beyond my academic expertise such as agriculture, water management, or ecology, and the need for an equilibrium escaping from superficiality or (on the contrary) technocratic design. This equilibrium has been possible through a systemic approach aiming at the comprehension of systemic relations rather than the design of specific solutions for agriculture, water management or ecology.

(ii) ethical issues arising from elaborating the design:

By elaborating the design, some decisions regarding what could be the regional design of flood streams (connected uptream with the main rivers) arises ethical issues in relation with possible initial withdraws of the proposal, specially in its initial phases by putting areas at risk areas that are currently under different protection standards.

(ii) ethical issues arising from the potential application of the results in practice:

From the potential application of the proposal, I foresee ethical issues regarding the current cultural understanding of risk and protection that the proposal puts in question, effects on people and land properties (as described in the previous

paragraph), effects at a governance level in the sense of measuring the costs on investing in this proposal as opposed to investing the development of more traditional planning, and lastly effects on the mental and cultural cost of adapting to the new proposed condition.

Aspect 6.- On what I have learned from the making of the thesis

During the process of elaboration of the thesis I have certainly develop my analytic, critical and conceptual approach to design. But most importantly for me, I have learned how to use the project as a knowledge producer (Vigano, 2016) by means of cartography, system analysis, narration, and systems thinking (uncertainty).

The journey of the making of the thesis as the end stage of the masters has altered my perception on the next urban question, shifting in the course of these two years:

From a question of dealing with the adaptation and mitigation of social, economic and environmental uncertainty, a question of accommodation to changing conditions; to a question of understanding the opportunities coming from this changing conditions in the restoration of a better relation with our environment.

A question on the active role that occupation needs to play in order to be part of the change (and not the solution of a problem).

Final remarks

As a final reflection I will come back to Haahtela, who quotes:

> *"The critical question is why urbanized populations respond with inflammation in contact with natural elements such as pollen, food or animals? They seem to be increasingly allergic to nature, the evolutionary home of Homo sapiens"*

As urban designers, we hold a big responsibility in the design of territories that restore different degrees and forms of porosity with an environment from which WE ARE becoming increasingly vulnerable.

This thesis was an attempt to explore ways of enhancing this porosity, particularly by restoring he proximity with the river and the subsequent opportunities coming from there.

A journey of multiple readings

Intense and productive, intellectually and personally fruitful,
a constellation of questions/notions and points of entry for future research.
Non-linear in time, extremely divergent, an exercise of creativity

constantly inspired by life-long mentors.

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“The critical question is why urbanized populations respond with inflammation in contact with natural elements such as pollen, food or animals? They seem to be increasingly allergic to nature, the evolutionary home of Homo sapiens”

Haahtela, 2019

As urban designers, we hold a big responsibility in the design of territories that restore different degrees and forms of porosity with an environment from which WE ARE becoming increasingly vulnerable.

This thesis was an attempt to explore ways of enhancing this porosity, particularly by restoring the proximity with the river and the subsequent opportunities coming from there.