Oliver Parodi (ed.)

Towards Resilient Water Landscapes

Design Research Approaches from Europe and Australia

Proceedings of the international Symposium on Water Landscapes at the University of New South Wales, Sydney, October 2009

Directed by Prof. Gini Lee and Prof. Henri Bava

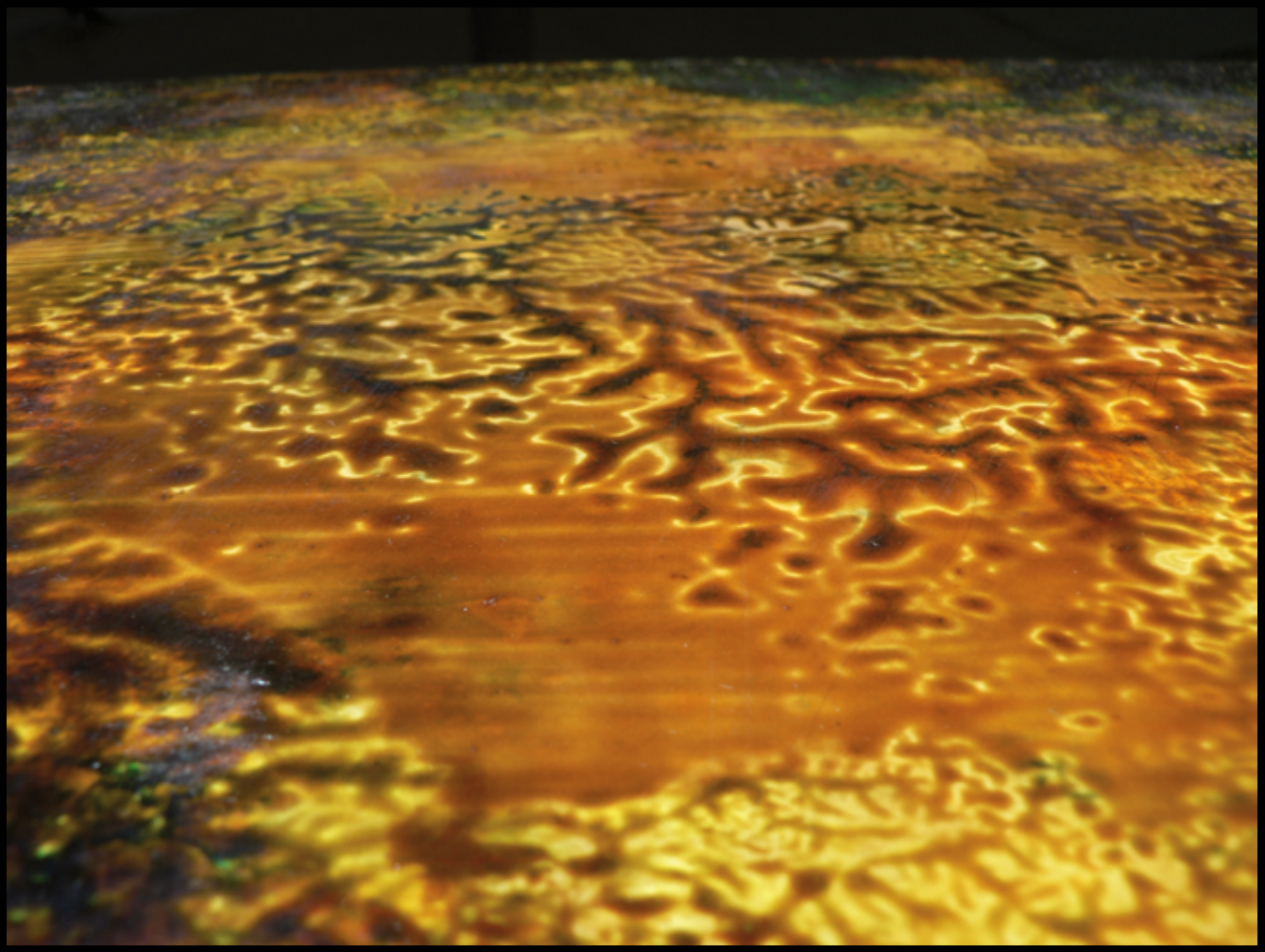

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Image at Cover

K M Simon (2009)
Detail from Land Surface Study. Ink on board, 300 x 300 x 18 mm

This oblique-angle detail is from of a series of drawings that experiment with the conventions of cartographic representation via the use of colour and different liquid media to create new kinds of landscape images. Rather than apply colour and texture as taken from a pre-determined graphic key, the drawings are constructed directly and intuitively through layering and inter-mingling of different coloured inks and the application of pressure. The drawing process takes cues from large-scale landscape processes and the resulting images have an ambiguous quality somewhere between solidity and fluidity.

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Oliver Parodi
(ed.)

A Cooperation of

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Department of Landscape Architecture, Karlsruhe Institute of Technology,
Karlsruhe, Germany

Landscape Architecture Program, School of Design,
Queensland University of Technology, Brisbane, Australia

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About the Transect project's genesis

The symposium to which this book serves as proceeding is the topical academic summit of a design education initiative that started some two years ago arising from the ideas of two of the symposium speakers, namely QUT adjunct professor and by then KIT senior lecturer Lisa Diedrich and landscape architect and QUT senior lecturer Julian Raxworthy. Wishing to improve professional exchange between Australia and Europe on design education and the role of current climate change in landscape design, the two first collaborated in 2007 on a thematic issue of 'scape the international magazine of landscape architecture and urbanism, of which Diedrich is editor-in-chief. They saw that exchange could be best identified through active investigations of the different conditions of these continents regarding the presence or absence of water in the respective landscapes. Inspired by a student study trip called "The Big Transect" that Raxworthy organised earlier when lecturing at RMIT in Melbourne, the two academics moved to deliver a European-Australian Big Transect leading European students to Australia, followed by return Transects in Europe, driven by the aim to understand the interaction of water and land respectively. The project gained form when Diedrich travelled to Australia in 2008, exploring the desert as well as a line of a potential Transect along the Australian East coast, intended to create a broader understanding of the impact of aquatic systems on urban areas, and of urbanisation onto water conditions. She came to the conclusion that one would not understand the coastal urban landscapes without experiencing their vast hinterland that even if far away and far from being urbanised has a direct influence on the coastal territories and their water conditions. Under the auspices of QUT Professor Gini Lee, head of the QUT School of Design's landscape architecture program, Diedrich and Raxworthy decided to trace a line of exploration of what they hitherto called the "Big Transect Too" from the arid, non-urban New South Wales outback towards the watery New South Wales coastal metropolis, Sydney. Back at KIT and encouraged by Henri Bava, Professor and Head of the Institute of Landscape and Garden, Diedrich engaged in upgrading the intended study tour from an educational project for undergraduate and master's students, toward a research and research educational project involving multi-disciplinary researchers dealing with water landscapes. Landscape architects and landscape technology professionals, urban planners, geographers, water and infrastructure engineers, technology assessment researchers, philosophers came to constitute a corresponding group of researchers across the cooperating universities of KIT Karlsruhe, QUT Brisbane, and UC Copenhagen. A core group of these researchers came on board on the "Big Transect Too" tour as a first collective activity of exploration within the perspective of common research on the resilience of water landscapes, also necessitating an academic event along the trip which became the 2009 Sydney Symposium.

Lisa Diedrich and Julian Raxworthy

Content

Preface

Gini Lee, Henri Bava

During the Australian spring of 2009 a group of researchers interested in constructed landscapes were brought together to cooperate in new design research, generated by concern for the critical need to identify, design for and manage water and water systems influenced by the possibilities unleashed by climate change scenarios. The first offering of this newly constituted research group is the publication of these proceedings, Towards Resilient Water Landscapes: Design Research Approaches from Europe and Australia; the contributions have been presented at an occasional symposium, hosted by the landscape architecture program at the University of New South Wales (UNSW). Encapsulated in the approaches taken by the writers are clues into how researchers and designers – who must engage with the complexities of the landscapes, infrastructures and ecologies of cities and their communities – can contribute to growing design knowledge and critical debate in these times of rapid environmental, spatial and cultural change.

The Sydney 2009 Symposium was held at a time when writing on wetness and the issue of managing too much water from the European perspective seemed far away from the condition of dryness that was currently being experienced in Australia. At the time many of us were unappreciative that the decade-long drought was beginning to break in some places across the continent. A number of themes and approaches to gaining awareness of concepts of resilience emerge from the presentations, yet an underlying sense of urgency around our collective need to work within the possibilities presented by extreme conditions pervades our research; which at this stage is based upon individual and propositional project based knowledge with the intent to negotiate an ongoing cooperative approach. The realisation that a multi-disciplinary approach is essential to gain knowledge and to propose new solutions based upon design thinking underpins this collaboration between academics and designers from Karlsruhe

Institute of Technology (KIT), Copenhagen University (UC) and Queensland University of Technology (QUT).

The 2009 Sydney Symposium

Urban water landscapes are the key foci of concern for most in these proceedings, yet there are also offerings regarding water-formed and water-dependent landscapes remote from urban conditions. The first two papers set the scene for Towards Resilient Water Landscapes through presenting European and Australian conditions and projects. Lisa Diedrich's review of European urban projects for water landscapes identifies new themes for landscape research through looking critically at the novel solutions demonstrated by collaborative design and technical teams in their realised projects. Diedrich suggests that ongoing design research is essential in order to effectively uncover and disseminate the techniques and tactics crucial to creating resilient future water landscapes. She also asserts that such research is necessary to stimulate an academic design discourse that is still lacking in continental European universities and should complete the outstanding contemporary built European oeuvre. The tendency for water plentitude in the European condition is contrasted by Julian Raxworthy's essay on dryness and its influence on landscape design in Australia; in particular on the aesthetics of designed urban landscapes as response to issues of water shortage and sustainable water management. Expanding upon his concerns that the cultural desire for greenness in a dry country has resulted in the historical transplantation of inappropriate public landscape design, Raxworthy presents four perspectives where water-influenced design is contributing to new urban forms and processes, that in turn influence public perception and support for appropriate water based regimes.

Resilience is a concept that provokes varied reactions across the design and technical disciplines engaged in refashioning urban landscapes. Five papers present varying perspectives and languages drawn from engineering, landscape architecture, urban design, architecture, hydrology and philosophical practices, where resilience is either the primary focus or is implicated by association. One of the important outcomes of this cooperation seeks to address the meaning and relevance of resilience – as a conceptual guide or as a method – as it contributes to design, practise and the generation of new methods and techniques for transforming urban landscape conditions.

Through reflecting upon historical and cultural perspectives in constructed riverine systems Oliver Parodi presents models for future practise that embrace and capitalise upon both technical and cultural mores. He establishes a link between contemporary technology and the history of ideas of our occidental culture. Based on the shortcomings of contemporary hydraulic engineering in Germany he offers suggestions for future practices that propose a reasonable, more hermeneutical, culture-sensitive hydraulic engineering, with always perceptible buildings and technological constructions.

Torben Dam is a landscape architect interested in recording the character of places through attention to the detail, the materiality and the temporal traces found in urban landscapes. For designed water landscapes to approach desired conditions of resilience Dam draws our attention to the necessity to develop techniques to 'read' the complexity of such landscapes and for designers to embrace a multidisciplinary perspective through immersion in regional knowledge and detailed research.

An "urban landscape atlas", Katrina Simon's samples of her analytical work with UNSW students on intend to give insight into the ways urban forms and transformations are represented in relation to landscape conditions of cities and metropolitan regions in different continents and cultures; water being one of the major landscape conditions to look at. This atlas is a work in progress, not

yet ready for publication, so Simon has contributed a work of art that constitutes the cover of the present publication. This work illustrates how relationships of water to land inspire artworks as forms of research by design.

Helmut Lehn, an expert in sustainable urban water management, works in diverse geographical locations to provide water systems advice to developing countries. He stresses that safe and reliable water systems are essential components of sustainable development programs. The provision of effective, accessible and water sensitive infrastructure is key to achieving access to good quality as affordable water is everyone's right. His technological approach to the design and management of such regimes also recognises the importance of a multidisciplinary methodology to providing both resilient delivery systems and also constructed projects that facilitate the cultural and social qualities of – and access to – water in the landscape.

Towards identifying and gaining understanding of the impacts of future change on climatic, economic and social systems, Andreas Kron reflects upon the relationships between local scale and knowledge and the development of effective management regimes. He suggests that perspectives for future water landscapes must derive from interdisciplinary cooperation to ensure that the range of issues and conditions and their imagined impacts are identified, debated and planned for. Four conditions are posited to inform the management of responses to extreme conditions – preparedness, prevention, protection and resilience.

Ian Weir lives, works and practices in the south-western zone of Australia in a landscape of great physical beauty and of high biodiversity. His presentation on the Fitzgerald Biosphere catchment describes his practise of making speculative works as conceptual landscapes of resistance that are constructed over time. This work is a subtle response to a highly complex natural environment – one that is rich with cultural association even if only sparsely occupied – through the design processes of tuning, reading and representing.

An important driver in the intent to cooperate between countries, environments and practises lies in the impetus and opportunity for research and collaboration on new projects driven by developing new scenarios for working in urban and other water landscapes. Gini Lee and Henri Bava describe current design research projects and recent works of landscape architecture that involve a range of collaborators, albeit in widely differing contexts.

Lee's WaterFieldWork project is an account of an ongoing multidisciplinary project involving scientists and landscape architects in fieldwork; recording, assessing and proposing scientific and design management scenarios for a critical river system in central Australia. This arid water landscape project records landscapes from many dualistic perspectives; insiders/outsiders, science/design, tradition/progress, indigenous/settler culture, so as to negotiate future expectations, lives and landscapes towards a resilient strategy for resources development and occupational longevity. An associated element presents a photographic account from the air in order to commence a lexicon for critical water landscapes for this remote land.

Henri Bava explores his oeuvre as practising landscape architect and partner in Agence Ter in order to examine where and how landscape architecture becomes the vector for the development of urban water landscapes. Through presenting various urban, intercity, and transregional projects Bava develops the concept of "urban water landscapes of resilience" contextualising project sites as "large scale territory in motion". His realised projects demonstrate how ecology in general, and hydrology in particular, can be integrated into – and even sustain – an urban strategy. With resilience as the main objective, these projects seek an innovative outcome through involving interdisciplinary research and practises that encompasses government, infrastructure and ecological aspects that

operate within and influence the dynamic structures of urban systems.

The Symposium's speakers focused on finding scenarios for ways to address resilience in water landscapes through altered disciplinary perspectives; landscape architecture, engineering, urban planning, architecture and hydraulic engineering, towards forming multidisciplinary groups interested in developing future scenarios. Discussions around potential projects and implications for research often seemingly appear as studies in contrasts – between urban and remote, wet and dry, settled and unsettled, material and ephemeral and practiced and raw. Such works of practice and/or research operate within diverse agendas. From landscape design leading to constructed water landscapes, to landscape systems monitoring, through traversing and representing landscapes – with such agendas often leading to re-working destroyed water-formed places through engaging in collaborative design processes.

Critical aspects arising from this publication in relation to resilience in the face of climate change range from the very local to the universal. In particular the concept of resilience is up for question. The need to approach water landscape projects with a multidisciplinary eye and suitable methodology is also seen as critical. Perspectives gained from drawing upon a range of expertise in order to evaluate projects that uncover new themes and theoretical underpinnings for landscape research are tied to establishing appropriate methods for representation and dissemination of such knowledge. What is clear is that there is a great deal to be learnt from immersion in familiar and unfamiliar landscapes across hemispheres, climates, ecologies and territories. Through collaborative and negotiated application of design thinking and scenario-based principles, the collective aim behind this publication is to facilitate, design and document projects for water landscapes that aspire to both ameliorate current challenges and to demonstrate technically effective and aesthetically pleasing solutions.

The present book unites the papers of the 2009 Sydney Symposium and has been produced by KIT Publishers in Karlsruhe as a special edition of the publication series of KIT's Institute for Technology Assessment and Systems Analysis, edited by one of its members, the engineer and philosopher Oliver Parodi, who is centrally involved in the process of construction of the collaborative research project between KIT, QUT and UC.

Setting the scene for international landscape architectural research

European landscape architecture and territorial strategies for water landscapes
Lisa Diedrich

Dryness: The aesthetic condition of landscape design in Australia
Julian Raxworthy

European landscape architecture and territorial strategies for water landscapes

Lisa Diedrich

This article sums up the author's lecture at the 2009 Sydney Resilient Water Landscapes Symposium and presents a series of realised or planned European landscape architectural and urbanistic projects on water landscapes taken from the recently published book On Site/ Landscape Architecture Europe (LAE). The author proposes them for scientific evaluation, recommends detecting research topics in the broad field of European practise and suggests exploiting the triennially published volumes of the LAE book series as a source that offers a representative selection of quality projects and accompanying reflections. The hypothesis is that further scientific research can help defining weaknesses and strengths of the existing water landscape designs in terms of resilience, extract principles and tools, improve the weak ones and communicate the strong ones and develop general quality criteria and tools for future resilient water landscapes.

Adj. Prof. Dipl.-Ing. Lisa Babette Diedrich, born 1965, studied architecture and town planning in Paris, Marseille and Stuttgart. From 1993 to 2000, she has been editor of Topos European Landscape Magazine. From 2000 to 2006, she worked as personal consultant of Munich's Chief Architect at the city's public construction department. Since 2006, she has been editor-in-chief of Landscape Architecture Europe (Fieldwork/ On Site) and of 'scape: The international magazine for landscape architecture and urbanism. She has been teaching in various European universities and is currently working as researcher at the Centre for Forest and Landscape, University of Copenhagen. She is Adjunct Professor at Queensland University of Technology, School of Design.

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In this speech, I want to give you an insight in contemporary European design and ideas for water landscapes. I'm doing this first and foremost from my observing position as chief editor of the book series Landscape Architecture Europe. Since 2005, our team involves European practitioners and academics in the selection and interpretation of best practise and burning questions of the European landscape production. We aim at defining our common design approach and at creating a representative publication of European landscape architecture, more and more precise with every book of the triennial series. So far, two volumes have been published: Fieldwork in 2006, including projects of the years 2002 to 2005, and On Site in 2009, featuring projects built from 2005 to 2008. They are covering a period of production of six years, which is a very contemporary one, and show a total of around 80 projects, carefully discussed and selected by two juries of practitioners out of 1.000 freely submitted entries.

Water projects play an important role in the whole. As they are so carefully selected, they can be considered as representative for the state of the art in water landscape design in Europe. However, only a few of them have been subject to academic evaluation under the topic of resilience. The water projects of Fieldwork and On Site all give answers to design questions and for this reason, a lot of them merit disciplinary and cross-disciplinary research in order to sort out if and to what extent they are resilient. If so, how, and if not, what could be improved? How can resilience be defined and achieved? What is the role of design within the striving for resilience? My suggestion is to use the strong European production as a primary source for project oriented research whose outcome enriches the design of future water landscapes and their resilience.

1. Projects

Let me show some striking water projects from the On Site book and explain their characteristics that seem to lend them resilience and that would merit further academic inquiry. On Site presents two different categories of projects, and I start with the classical production, the objects of landscape architecture in the scale of parks, squares, and streets.

1.1 Lettenareal, Zurich

In On Site, we present the project as follows [1]: "For a long time, the northern banks of the river Limmat in Zurich were not held to be a reputable part of town. Since the 19th century, this area had been part of the booming industrial zone, cleft by the railway tracks which ran in a semicircle across the river. A very visible drugs scene moved in subsequently along the river banks. Modernisation plans for the urban quarters behind Zurich's main railway station also provided for a redesign of the river Limmat's banks and those of the city's canal running parallel to the river. Out of a co-operative planning process comprising all stakeholders, arose the idea of integrating spatial as well as historical elements with new forms of use as unobtrusively as possible. One of the key objectives was to create a habitat for a threatened lizard species which have been here for a long time.

Sun and warmth are equally important for the two new target groups: the lizards as well as the hip Zurich crowd who like to use the river banks as a catwalk in summer to see and be seen. The lizards' habitat was covered with coarse railway gravel to make it difficult for humans to walk there; and soft sandy banks were used to create bathing areas. Even if the area appears overused on hot summer days, the net result is one of a peaceful coexistence of humans and nature, free of walls and fences. Design elements were used to invoke the memory of the railway tracks which earlier ran along the waterside. A rhythmic, stepped seating facility runs between rows of birch trees which

Location Zurich (CH)

Lettenareal

Programme Redesign of the urban riverbanks along the former railway site
Designer Rotzler Krebs Partner
Commissioned by Grün Stadt Zürich
Area 1.35 ha (including a conservation zone of 0.55 ha)
Design 2003–2004
Implementation period 2005
Budget € 1,000,000

- See and be seen at the Lettenareal. (Photo: Livio Piatti)
- Situation plan.

For a long time, the northern banks of the river Limmat in Zurich were not held to be a reputable part of town. Since the 19th century, this area had been part of the booming industrial zone, cleft by the railway tracks which ran in a semicircle across the river. A very visible drugs scene moved in subsequently along the riverbanks. Modernization plans for the urban quarters behind Zurich's main railway station also provided for a redesign

Fig.1: Rotzler Krebs Partner: Lettenareal, Zurich, as published in: LAE Foundation 2009 (Ed.). On Site. Landscape Architecture Europe. Basel: Birkhäuser: 194-195

Fig. 2: NPK Arquitectos Paisagistas Associados, Rosário Salema: Parque Ribeirinho, Benavente, as published ibid.: 24-25

Location Benavente (P)

Parque Ribeirinho

Programme Reshaping of the riparian zones
Designers NPK Arquitectos Paisagistas Associados, Rosário Salema
Commissioned by Câmara Municipal de Benavente
Area 5.7 ha
Design 2003
Implementation period 2004–2005
Budget € 1,850,220

The small town of Benavente is situated about 40 kilometres northwest of Lisbon in the marshland plains of the Lezíria do Tejo and is known for its traditional festivals. The flat region is crossed by several waters, which in spring flood parts of the meadows where cattle and Lusitanian horses graze. The new riverside park consists of two parts. It comprizes on the one hand the banks of the river Sorraia in Benavente itself, and on the other the Vala Nova which is located further north at another arm of the river.

By simple means, the southern bank of the river Sorraia in Benavente received a new enclosure. The defining element is the site of the picaria, the Lusitanian bullfight on horseback, enclosed by wooden railings, the grounds of which contain a number of fences for the horses and a small pen. As a pedestrian or cyclist, one can reach the north shore of the river via a new swing bridge, from where the Caminho do Sorraia leads to the Vala Nova, crossing the road N118 twice. Cantilevered over the waters, a platform with a bar-cum-pavilion and a landing stage arose here next to the parking lot. A spacious picnic area lies beyond the river among trees. In addition to the spiral path connecting the individual picnic islands, there are stone tables and duckboard walkways, so that the accessibility of the place is maintained even when the area is flooded.

The jury was not only impressed by the fact that the designers' concept could be pushed through against the political pressure, but also by the successful strategy of how the park – with its piers, pens resting on pontoons and flooding areas – reacts to the continual change of the landscape with the seasons. The planners have used robust elements to resist the flooding. Their interventions are simple, but substantial;

- Flooded picaria.
- Overall plan of both sub-areas connected by the Caminho do Sorraia.
- Picaria – site of the Lusitanian bullfight. (Photos: António Bettencourt)

spread a natural, leafy curtain overhead and provide welcome shade." (Fig. 1)
The key issue in the project is to give access to the urban water at a site that was heavily disturbed. Further monitoring of this project could study the following questions: Can designed river landscapes improve life quality in the city? Is free access to the water a quality factor for cities? How can urban open spaces foster human leisure activities and at the same time enhance biodiversity? How can design contribute to overcome the disturbances of the industrial period and of neglect, are there probably two key factors, namely the clever economy of means and material, and the insight in the desires of the inhabitants?

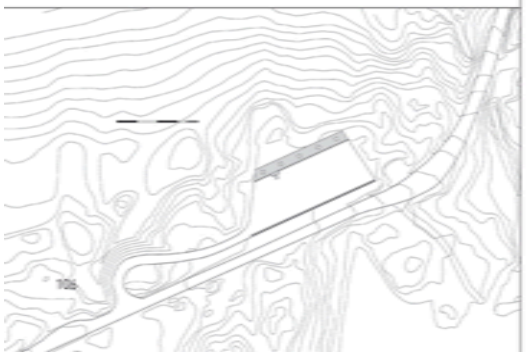
1.2 Parque Riberinho, Benavente

In On Site, we present the project as follows [2]: "The small town of Benavente is situated about 40 kilometres northwest of Lisbon in the marshland plains of the Lezíria do Tejo and is known for its traditional festivals. The flat region is crossed by several waters, which in spring flood parts of the meadows where cattle and Lusitanian horses graze. The new riverside park consists of two parts. It comprises on the one hand the banks of the river Sorraia in Benavente itself, and on the other the Vala Nova which is located further north at another arm of the river. The concept initiated by the landscape architects, had to be enforced against the initial resistance of a notoriously conservative municipal administration.
By simple means, the southern bank of the river Sorraia in Benavente received a new enclosure. The defining element is the site of the picaria, the Lusitanian bullfight on horseback, enclosed by wooden railings, to the grounds of which a number of fences for the horses and a small pen are connected. As a pedestrian or cyclist, one can reach the north shore of the river via a new swing bridge, from where the Caminho do Sorraia leads to the Vala Nova, crossing the road N118 twice. Cantilevered over the waters, a platform with a bar-cum-pavilion and a landing stage arose here next to the parking lot. A spacious picnic area lies beyond the river among trees. In addition to the spiral path connecting the individual picnic islands, there are stone tables and wooden plank walkways, so that the accessibility of the place is maintained even when the area is flooded." (Fig. 2)
The first key issue in this project is the creation of a system of leisure and representational places by the water in a rural environment that traditionally features such systems only in its agricultural logic and prohibited them for other societal expressions. The second key issue is to make these places flood-proof or flood-inviting in the context of a clever distribution of possible and impossible uses. Further monitoring of this project could study the following questions: How can old agricultural logics in rural water landscapes be updated for nowadays social needs while maintaining atmosphere and identity of the site? What is the role landscape architecture can play in finding sense, structure, space, materials of these places? What hydraulic techniques can be combined into the design to master the capricious waters?

1.3 Viewpoints along the Norwegian tourist route, Akkarvikodden and Hellåga

In On Site, we present the project as follows [3]: "Two picnic areas at water sites are shown here, and they are part of a larger Tourist Route project, promoted by the Norwegian Public Roads Administration. The project included eighteen road sections passing through the unique Norwegian natural landscape, mostly along the coast, with the ambition to develop them into attractive tourist routes. This endeavour has resulted in an enhancement strategy that could very well also be applied elsewhere. The authorities have invested in a series of rest areas which aim to heighten and cultivate the experience of the trip. Many of these architectural interventions have redefined the Norwegian tradition in responding to topographically demanding terrain,

- The terrace, the sea and the horizon.
- Strengthened contrasts: the pure lines of the terrace and the rugged coast.
  (Photos: Steinar Skaar)
- Site plan of Akkarvikodden picnic area.



Both picnic areas are part of a larger Tourist Route project, promoted by the Norwegian Public Roads Administration. The project includes eighteen road sections passing through the unique Norwegian natural landscape, mostly along the coast, with the ambition to develop them into attractive tourist routes. This endeavour has resulted in an enhancement strategy that could very well also be applied elsewhere. The authorities have invested in a series of rest areas which aim to heighten and cultivate the experience of the trip. Many of these architectural interventions have redefined the Norwegian tradition in responding to topographically demanding terrain, although sometimes their presence has an exaggerated impact. LANDSKAPSFABRIKKEN takes part in this project with quite a few interventions, on the clear understanding that these are infrastructural objects – the purpose of which is to enable one to admire the magnificent scenery – and that they should not become objects of admiration themselves.

The examples presented here are two of the most subtle ones, combining functional requirements with a respect for the sites' splendour, without imposing any uncalled-for design. In both, the jury sees a sensitivity to the sites, a clear and careful reading of their potential, fitting them into the landscape in a way that helps to bring out their qualities and enables the visitor to first recognize them and then experience them to the full.

The picnic areas are designed to withstand a very harsh climate and to be maintained at a low budget. At Akkarvikodden, along the E10 on Lofoten, Norwegian landscape architect Inge Dahlman has created a distinct platform in the landscape that is in dialogue with the sea's horizon, contrasting with the rugged features of the coast and the mountains behind

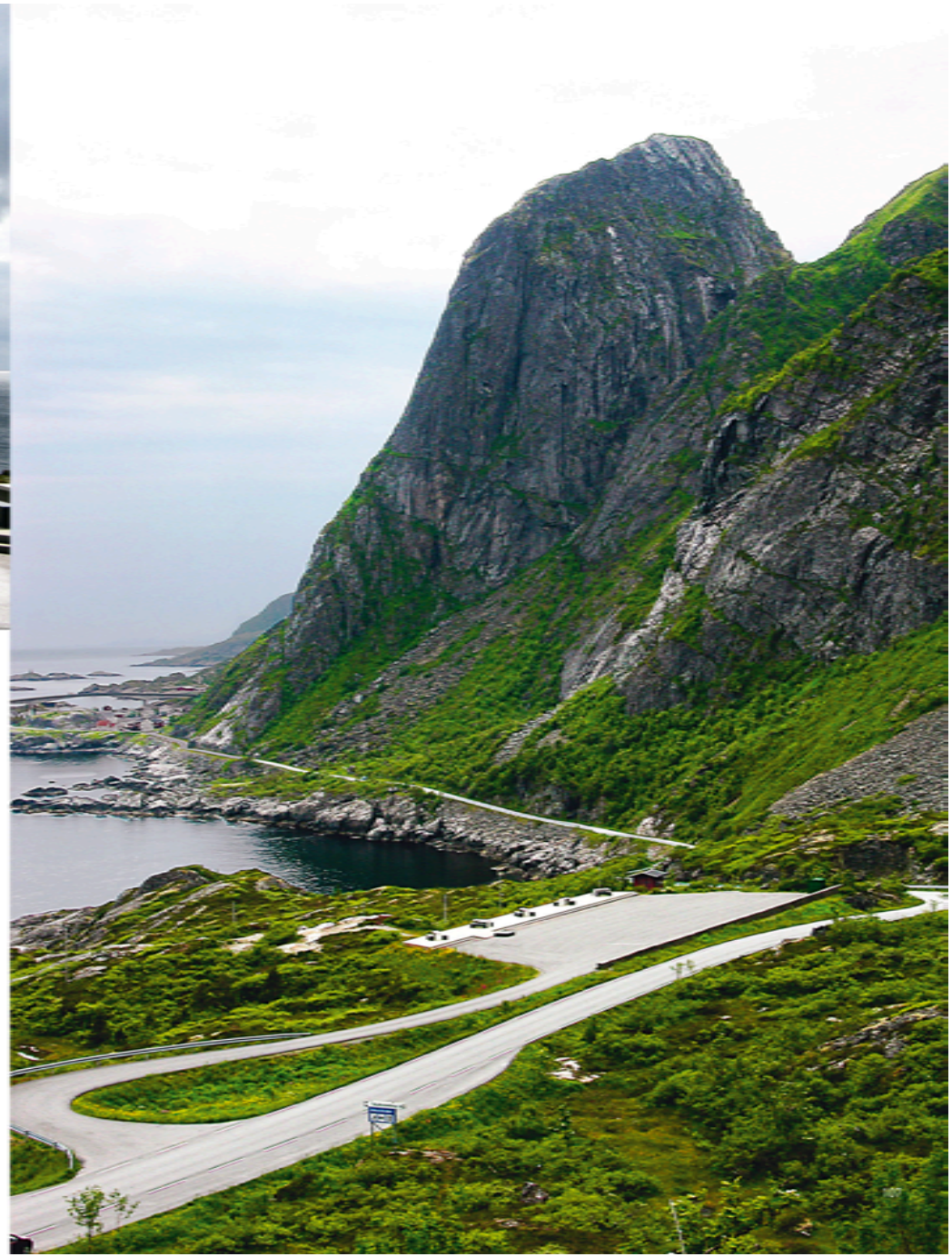
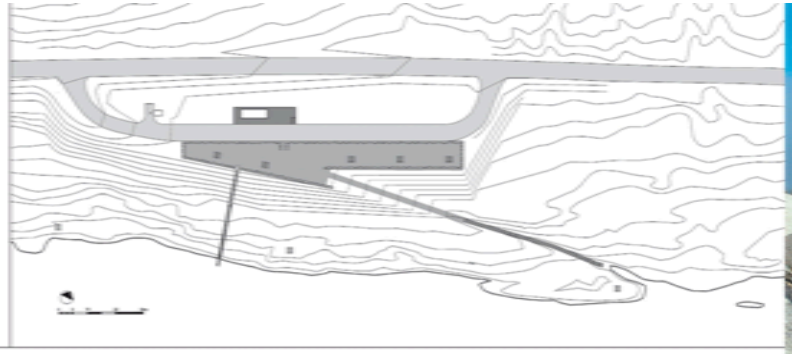


Fig. 3: Inge Dahlman, Landskapsfabrikken: Picnic area and viewpoint at Akkarvikodden, Lofoten, as published ibid.: 106-107



the site. A long cast-concrete terrace has been built on the brink of the site, close to the sea. On the terrace, groups of furniture facing various directions invite the visitors to choose how they want to sit in relation to their surroundings and view. At Hellåga, on the shores of the Sjonafjord, the intervention is even more subtle. From the gravel terrace, the public are directed down to a more intimate landscape experience, with sloping bare rock, shoreline and fishing spots. Groups of furniture and steps are adapted to the shape of the rocks. There is no attempt to conceal the robust, technical origin of the elements positioned in these carefully chosen spots, and yet they certainly reveal the hidden nature of these sites.

- Site plan of the Hellåga picnic area.
- Steps following the shape of the rock. (Photo: Roger Mathisen)
- The inviting steps. (Photo: Jarle Wæhler)
- Groups of furniture and steps, carefully arranged within the site. (Photo: Steinar Skaar)

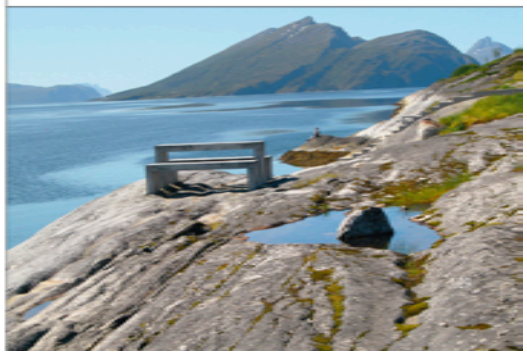


Fig. 4: Inge Dahlman, Landskapsfabrikken: Picnic area and viewpoint at Hellåga, Helgeland, as published ibid.: 108-109

Location Coimbra (P)

Mondego Green Park's western entrance

Programme A park entrance as a flood protection and public area
Designer PROAP (João Ferreira Nunes and Carlos Ribas)
In collaboration with Joana Barreto and GB Arquitectos (Gonçalo Byrne and José Laranjeira)
Commissioned by Coimbra Polis, Sociedade para o Desenvolvimento do Programa Polis em Coimbra, S.A.
Area 1.6 ha
Design 2004–2006
Implementation period 2006
Budget € 940,000

• Flagstone-paved walkway on top of the embankment. View of the steps leading towards Mondego Green Park. (Photo: Fernando Guerra)

Fig. 5: Proap: Mondego Green Park's western entrance, Coimbra, as published ibid.: 52-53

although sometimes their presence has an exaggerated impact. The office Landskapsfabrikken took part in this project with quite a few interventions, on the clear understanding that these are infrastructural objects – the purpose of which is to enable one to admire the magnificent scenery – and that they should not become objects of admiration themselves.
The picnic areas are designed to withstand a very harsh climate and to be maintained at a low budget. At Akkarvikodden, along the E10 on Lofoten, Norwegian landscape architect Inge Dahlman has created a distinct platform in the landscape that is in dialogue with the sea's horizon, contrasting with the rugged features of the coast and the mountains behind the site. A long cast-concrete terrace has been built at/on the brink of the site, close to the sea. On the terrace, rotated/circular groups of furniture invite the visitors to choose how they want to sit in relation to their surroundings and view. At Hellåga, on the shores of the Sjonafjord, the intervention is even more subtle. From the gravel terrace, the public are directed down to a more intimate landscape experience, with sloping bare rock, shoreline and fishing spots. Groups of furniture and steps are adapted the shape of the rocks. There is no attempt to conceal the robust, technical origin of the elements positioned in these carefully chosen spots, and yet they certainly reveal the hidden nature of these sites."
(Fig. 3, 4)
The key issue in this project is to create a car infrastructure along an extremely elongated coast through landscapes of an extreme natural beauty. Instead of closing access to these natural sites in order to protect them, the project invites to admire them. Further monitoring of this project could study the following questions: Can access to and admiration of natural water landscapes foster their resilience and protect them better than impeding access? How can landscape architecture with its language and techniques mediate between bold infrastructure buildings and fragile natural landscapes?

1.4 Mondego Green Park's western entrance, Coimbra

In On Site, we present the project as follows [4]: "The intervention lies within the reclaimed territory of Coimbra's river Mondego, as part of a system of urban parks and pedestrian walks on both sides of the river. Aside from connecting the area to Mondego Green Park under the roadway, the aim was to protect the Santa Clara Convent from flooding by building an embankment and thus opening up new views towards the convent.
Three pathways define this park entrance: one that gives access to Mondego Green Park, another crossing the intervention's lower area and the third one running on top of the embankment. The raised walkway is made of white stone and lit by linear lighting just off the paving. As a result of the differences between the height levels of the street, the convent area and the main pathway leading to the park, several slopes have been generated with various degrees of steepness and solar orientation. A carefully modulated topography with strict lines creates a grassy enclosure of quiet dignity, which forms a tribute to the convent." (Fig. 5)
The key issue of this project is the combination of two uses in the same space, first as a retention basin for the capricious river in the middle of the city, second as a broad expanse of urban open space complementing the narrow spaces of the old town. Further monitoring of this project could study the following questions: How can landscape architecture enhance the resilience of such spaces in the city that belong to conflicting partners, namely to the natural element of water and to the city dwellers? What methods help combining conflicting interests, ranging from hydraulic techniques to process oriented design?

1.5 Nørresundby harbour's urban garden, Nørresundby

In On Site, we present the project as follows [5]: "In their design for this new urban garden in the redevelopment area

- Old situation.
- Water creates various patterns on the asphalt.
- View of Aalborg harbour.

shapes are wittingly controlled: the unintentional has been fitted into an urban context. The same happens in the shell paths which are meant to present as flowing and non-hierarchical a form as possible, a structure of evenness and equality. At the same time these shapes possess a visual, graphic quality when seen from above from the surrounding flats.
The plan met with nothing but praise from the entire selection committee. Apart from the sublime conceptual and architectural quality of the scheme, the urban garden demonstrates that large-scale redevelopment procedures need not by definition be structured as large interventions at a municipal level, but may also be a sum total of 'acupunctural' interventions.

- Cross-section.

Fig. 6: SLA: Nørresundby harbour's urban garden, Nørresundby, as published ibid.: 142-143

Fig. 7: Michel Corajoud, Pierre Gangnet, Jean-Marc Llorca: Miroir d'Eau, Bordeaux, as published ibid.: 42-43

around Nørresundbyhaven in Aalborg in Denmark, the designers of SLA have tried to find a place for natural processes in the urban tissue. According to Stig L. Andersson, SLA's creative director, the unpredictability of nature reinforces the interaction between the residents, the square and the weather. 'Organizing physical matter within a spatial context and then waiting to see what happens, thus allowing for unforeseen coincidences, should always be the starting point of landscape architecture', is what Andersson wrote in an essay some time ago. This natural dynamism arises when the ponds reflect the passing clouds, when the water makes various patterns as it streams across the wavy asphalt on rainy and windy days, and when the mist of water hangs above the square on hot days.

The shapes of the asphalt pools are inspired by actual mistakes in the construction work that can be found on parking lots, although here the shapes are wittingly controlled: the unintentional has been fitted into an urban context. The same happens in the shell paths which are meant to present as flowing and non-hierarchical a form as possible, a structure of evenness and equality. At the same time these shapes possess a visual, graphic quality when seen from above from the surrounding flats." (Fig. 6)

The key issue of this project is to shift the sense of this water landscape from a purely functional one, a port, into a deliberately aesthetic one, an urban garden. Downtown port areas are often abandoned by the shipping industry and fall into neglect. Further monitoring of this kind of harbour transformation project could study the following questions: Can landscape architecture be a vector for the transformation of those port areas into resilient urban water landscapes? What qualities can landscape architecture lend to those areas compared with those transformed according to standard urban planning methods?

1.6 Miroir d'Eau, Bordeaux

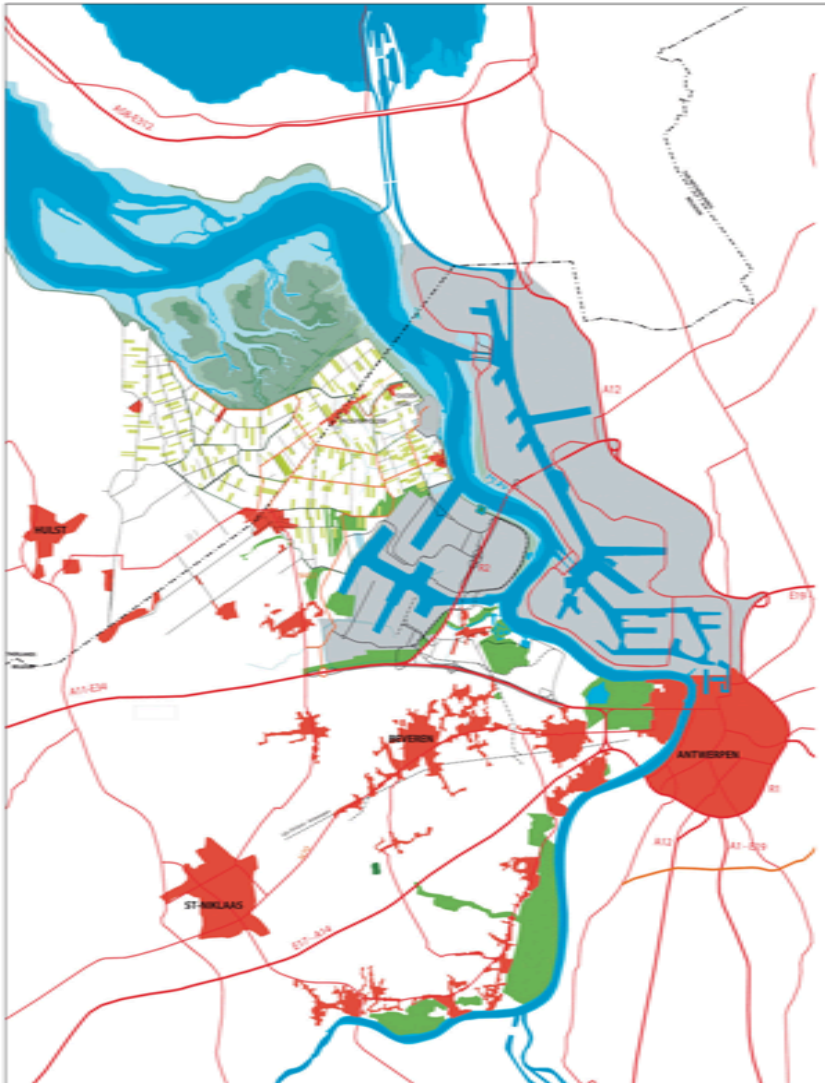
In On Site, we present the project as follows [6]: "With an area of 3.450 square metres, the Miroir d'Eau represents the heart of landscape architect Michel Corajoud's open space design in front of the historical Bordelaise Stock Exchange, an esplanade almost 6.000 square metres in size that opens up towards the river Garonne. Reflected in the absolutely level sheet of water, depending on the line of sight, are either the neoclassical facade, the clouds in the Aquitaine sky, Bordeaux's new tram, the playing children or the strollers. As a mirror covered by a two-centimetre deep film of water, the square's appearance undergoes a computer-controlled change to a blanket of fog that can reach up two metres high. In fact, set up according to plans by fountain engineer Jean-Max Llorca, the square is on top of a reservoir with a capacity of 800 cubic metres, from which water is pumped into numerous channels running underneath the granite paving. Through the joints between the granite slabs, it gushes up to the square's surface and spreads, being discharged again by way of valves. The patch of mist is created likewise by 900 nozzles embedded in the granite slabs." (Fig. 7)

The key issue of this project is to be the emblematic piece of a comprehensive urban development strategy aiming at freeing the river banks from former industrial installations and developing urban open spaces and an effective public transport system as new identification factors of the city [7]. Further monitoring of this project and other strategic waterfront projects could elucidate the following questions: How can landscape architecture deliver the vector for a comprehensive urban planning strategy for a water city and at the same time translate the strategy into built spaces? How can planning processes be organised over time, where does landscape architecture intervene, what forms of gouvernance and management do such comprehensive water projects need?

Location Beveren (B)

reCreated Nature

Programme Depoldering (returning reclaimed land to the river) as a compensation for the Antwerp harbour development
Designer Research Group Urbanism and Architecture (OSA) – Katholieke Universiteit Leuven (Kelly Shannon, Bruno De Meulder and Cathérine Villequin with Naween Kulshreshta, Hubert Gulinck, Charlotte Hvidevold Hystad, Katrijn Persoons, Ruth Byloos, Dana Bogdan)
Commissioned by Beveren municipality
Area 1150 ha
Design 2007–2009
Implementation period starting 2008
Budget not specified



On the Dutch-Belgian border in the municipality of Beveren, between Antwerp harbour and Verdronken Land van Saeftinghe ("Drowned land of Saeftinghe"), both the Prosper Polder and the Doel Polder are to be returned to nature. The intervention is a consequence of European regulations which stipulate that any extensions to Antwerp's harbour are to be compensated for in the neighbouring area.
Depoldering is almost always a purely civil-engineering procedure, which would have been the case here as well. Dykes are cut, dismantled or moved, so that room is created for the flow dynamics of the surrounding water, in this instance the river Scheldt.

At the initiative of Beveren municipality and supported by the Flemish Chief Government Architect, it was decided to appoint environmental designers to the team of technical engineers. OSA, the Research Group Urbanism and Architecture at Leuven University, winner of an open competition, has since been working with the municipality in order to develop a "visual quality plan" for the area. One proposed to transform the agricultural cultural landscape of the Prosper Polder and Doel Polder into three types of natural landscape: a submerged landscape of mudflats and salt marshes, a controlled tidal area and a semi-polder with reservoirs. Working with the new system of engineer-proposed dykes, OSA concentrated their vision on the spatial possibilities of the three hamlets in the area.
In this vision, the area is viewed as "the end of the world" because of its isolated position at the harbour landscape's centre and because of the water's renewed dominance. The vision sets out guidelines for development possibilities that are in tune with the area, making it a place of great tranquillity and naturalness, where urban naturalists can ramble, where youth clubs can camp on diversified farms and where artists can "pitch their tents". Access to the area needs to be excellent, certainly for walkers and cyclists, but it should be restricted to car-bound tourists.
In the least natural landscape, near the hamlet of Prosper, low dyke compartments are proposed around the most important buildings (church, farmsteads and the school). Outside this artificial boundary, what once were geometric plots of land will change into reed lands or grasslands with brackish and saltwater vegetations, and inside the dykes settlements will be able to start a second life.

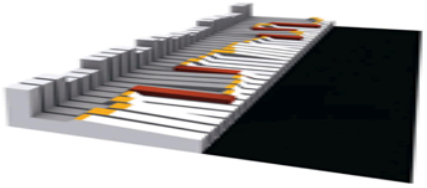
- The Prosper and the Doel Polder in Noord-Beveren, with Antwerp harbour's most recent extension (below).
- OSA's plan proposal and existing situation.
- One will rid the agricultural area of the polders, thus creating a natural landscape with lots of water.

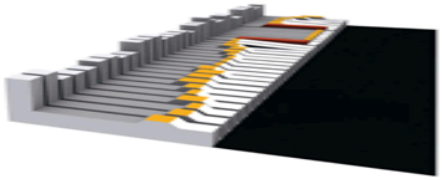
Fig. 8: Research Group Urbanism and Architecture OSA, Katholieke Universiteit Leuven: reCreated Nature, Beveren, as published ibid.: 204-205

Location Antwerp (B)

Scheldt quays

Programme Masterplan for the riverfront
Designers PROAP (João Ferreira Nunes, Carlos Ribas, Iñaki Zoilo, António Poças and others), WIT (Guido Geenen), d-recta (Andrea Menegotto)
Commissioned by Antwerp municipality and Waterwegen en Zeekanaal nv
Area 6.5 km
Design 2006–2009
Implementation period 2009–2025
Budget not specified





The concept for the Scheldt's eastern and southern bank in Antwerp does not involve any designing in the classic sense. The jury was therefore initially uncertain whether the idea could be adequately assessed – what Proap presents here is more of a strategy or a toolbox than a genuine draft. However, the proposal convinced because of its variety of scenarios and the flexibility with which it can respond to alterations, without the concept itself being disavowed. Ultimately, the jury considered the proposal to be more interesting than the one of a romantic redesign of the bank of the Garonne by Michel Corajoud in Bordeaux, following a very horticultural concept.

Improved flood control was the starting point for the redevelopment of the river Scheldt. The total length of the intervention area covers 6.5 kilometres – it stretches from the old waterfront areas in the north along the city's centre as well as its nineteenth-century expansion to the new industrial and service districts in the south. The necessary renewal of the quay walls offers the opportunity to completely redesign the riparian zone. Like many other cities, Antwerp has also been cut off from its riverbank for a long time. This is supposed to change – a street line and a pedestrian promenade will guarantee public access in the future. The proposal's truly innovative idea, however, consists of a 'modular system' of linear elements from which the new quay zone will be assembled. Depending on the high-water level, these elements – which often only have a slight gradient towards the river – can be flooded by varying degrees; the surface is differentiated in dry and flooded areas. Thus, the tidal range is not intercepted by a monumental quay wall, but simply changes the shoreline.

- Existing quay wall (8.25 metres) and new flood line (9.25 metres).
- Current situation.

Fig. 9: Proap: Scheldt Quays Masterplan, Antwerp, as published ibid.: 200-201

2. Strategies

The second category of the book On Site features the less classical field of action of landscape architecture, namely projects on a territorial scale. However, we think that this field is to be conquered by landscape architects as their vision of a territory can be different from the vision the usual actors formulate, such as regional and urban planners, developers and administrative bodies. The landscape architectural vision often takes into account ecological and cultural factors which all together may tend to stimulate the resilience of a territorial water landscape. This again calls for academic discussion. Let me introduce you to two outstanding strategic projects of our book.

2.1 reCreated Nature, Beveren

In On Site, we present the prject as follows [8]: "On the Dutch-Belgian border in the municipality of Beveren, between Antwerp harbour and Verdronken Land van Saeftinghe ('Drowned land of Saeftinghe'), both the Prosper Polder and the Doel Polder are to be returned to nature. The intervention is a consequence of European regulations which stipulate that any extensions to Antwerp's harbour are to be compensated for in the neighbouring area.
Depolderment is almost always a purely civil-engineering procedure, which would have been the case here as well. Dykes are cut, dismantled or moved, so that room is created for the flow dynamics of the surrounding water, in this instance the river Scheldt. At the initiative of Beveren municipality and supported by the Flemish Chief Government Architect, it was decided to appoint environmental designers to the team of technical engineers. OSA, the Research Group Urbanism and Architecture at K.U. Leuven, winner of an open competition, has since been working with the municipality in order to develop a 'visual quality plan' for the area. One proposed to transform the agricultural cultural landscape of the Prosper Polder and Doel Polder into three types of natural landscape: a submerged landscape of mudflats and salt marshes, a controlled tidal area and a semi-polder with reservoirs. Working with the new system of engineer-proposed dykes, OSA concentrated their vision on the spatial possibilities of the three hamlets in the area." (Fig. 8)
The key issue here is to admit water on land again and to compose the resulting urban peripheries according to the dynamics of the water and the desires of city dwellers. Further monitoring of this project could elucidate the following questions: Is this way of less heavy engineering creating more resilient water landscapes that are both secure and attractive for city dwellers? What tools can landscape architecture deliver in the planning process and what qualities can be created? What forms of gouvernance can foster such landscape oriented territorial planning?

2.2 Scheldt Quays, Antwerp

In On Site, we present the project as follows [9]: "Improved flood control was the starting point for the redevelopment of the river Scheldt. The total length of the intervention area covers 6.5 kilometres – it stretches from the old waterfront areas in the north along the city's centre as well as its nineteenth-century expansion to the new industrial and service districts in the south. The necessary renewal of the quay walls offers the opportunity to completely redesign the riparian zone. Like many other cities, Antwerp has also been cut off from its riverbank for a long time. This is supposed to change – a street line and a pedestrian promenade will guarantee public access in the future. The proposal's truly innovative idea, however, consists of a 'modular system' of linear elements from which the new quay zone will be assembled. Depending on the high-water level, these elements – which often only have a slight gradient towards the river – can be flooded by varying degrees; the surface is differentiated in dry and flooded areas. Thus, the tidal range is not intercepted by a

monumental quay wall, but simply changes the shoreline.
The different outlines – Proap proposes twelve variations – allow an arrangement that responds to the respective adjacent areas of the city. Parks and recreational areas alternate with buildings or land for temporary uses. Consequently, usage optimization and adaptability, territorial particularity, planning flexibility and sustainability are the criteria which the authors of the master-plan consider to be essential." (Fig. 9)
The key issue here is that the concept for the Scheldt's banks does not involve any designing in the classic sense. What Proap presents here is more of a strategy or a toolbox than a genuine draft. The proposal convinced the On Site jury because of its variety of scenarios and the flexibility with which it can respond to alterations, without the concept itself being disavowed. Ultimately, the jury considered the proposal to be more interesting than the one of a romantic redesign of the bank of the Garonne by Michel Corajoud in Bordeaux, following a very horticultural concept. Further monitoring of this project and comparison with others could therefore elucidate the following questions: What are the new landscape architectural design methods for waterfront projects of a territorial size? What concepts does landscape architecture bring into the design that tend to lend resilience to the waterfront projects? How can a cross-disciplinary culture of landscape architecture and hydraulic engineering emerge from this kind of project?

3. Conclusions

In my final essay of On Site, I propose the hypothesis that Europe can profit from its specific building practise and offer a form of strategic planning that I call landscape-oriented urbanism [10]. If we talk about water sites, this could become a water landscape oriented urbanism, and in order to make its design resilient, knowledge has to be raised on the role of design in mediating the effects of urban developments on aquatic systems, and the effects of changing water conditions on urbanised and urbanising areas. Resilience should be understood as the capacity of a system to absorb disturbance and reorganise while undergoing change. On a territorial scale, landscape can become a common asset, which provides the people of neighbouring towns with a shared identity, an asset they can see and feel, and from which they can derive a common perspective, both seductive and appealing to the senses while at the same time solving the purely technical issues of resource economics, climate adaptation and everyday life. If landscape delivers the vectors of regional development, then it acts as a guiding model, specific enough to create graspable images in the minds and abstract enough to leave sufficient margin to reality, which every territorial city with its many actors and decision makers needs. In this respect, landscape architecture constitutes a discipline which is capable of resolving the fuzziness of contemporary urban planning and gives the territorial city structure and matter.
Many a project in Europe shows that the guiding principles of the landscape – visible, tangible, fascinating, ecologically and economically convincing – have opened up the budgets, even for the privately operating actors. An example from water-resource management: with its enormous contract price of 4.4 billion euros, the Emschergenossenschaft's redevelopment of the Emscher in the German Ruhr area also finances the landscape architecture, without which the water-construction project would not make sense and would not be visible. This big project is just at the start and would definitely merit academic monitoring [11]. An example from tourism: tourist developments in Europe are only effective when they respect the special cultural landscapes from which they arise, and with their investment volumes (tourism is one of the strongest forces in the European economy!) they can promote landscape-oriented urbanism instead of sanctioning uncontrolled and destructive growth, as former Dutch government advisor for the

landscape Dirk Sijmons explains in his essay [12] in On Site. An academic study of coastal leisure landscapes would deepen this initial discussion. The climate change may in this respect become an ally of landscape architecture, as Yttje Feddes [13], Knut Eirik Dahl/ Kjerstin Uhre [14] and Maria Goula [15] point out in their essays on adaptation strategies for different geographical regions in Europe. All these issues are essentially linked to water landscapes and merit exploration in more than one research project. In 50 years' time, when the rivers threaten to swamp many an urban region with extreme floods and the sea will swash into the coastal cities because of its rising level, all governments are bound to acknowledge the forces of nature and the landscape's logic in their city and regional planning processes. We could provide them with elaborate knowledge from the field of cross-disciplinary research under the guidance of the transversal approach of landscape architecture.

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Dryness: The aesthetic condition of landscape design in Australia

Julian Raxworthy

Despite having a band of greenness around the edge, Australia is fundamentally a dry country. Australian vegetation has developed a huge range of mechanisms to cope with this dryness, but after 200 years of white settlement, Australians still have not really come to terms with the real dryness of their country, and still exploit European paradigms that attempted to transplant European aesthetic conditions, greenness, to the brown land of Australia. Australia is going through serious water shortages that are and will continue with the Greenhouse effect, to become a major factor in the location and extent of urbanisation, and also Australia's carrying capacity. While such aesthetic concerns might seem ornamental, until the population changes its attitude to the real condition of the country, it will keep using water and operating unsustainably. The design of the public landscape, however, offers the opportunity to contribute to changing people's aesthetic perception of the country, which might in turn help to redirect their water use practices.

This essay develops a language for discussing dryness based around the experience of water. After having developed this sensibility it then discusses a range of different approaches that landscape design in Australia has used to try to develop geographically appropriate design languages, including the Bush Garden and the Mediterranean Garden. It then discusses four design projects, one from the 1970's, the other three from the last five years that demonstrate what such an aesthetic might look like.

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On a map of the world, Australia is enormous, and seems empty because development is concentrated around its edges. Its heart must be red, in the cultural projections of the world from images of Uluru, "the Rock", set in a flat desert with no relief. Of course the country is not really all desert – surely? – with low shrubs pretty much throughout. Inhabitation seems to cling to the edges where the continent feels microclimatic effects from the adjacent oceans and edging mountain ranges, which screen the population from the real state of the environment – dry, harsh, amazing, unique. Australia is rightly proud of this harsh difference to its edges, but prefers the harshness to be "out there". At the moment however, the country is pretty much universally in drought, and the contrast between green and brown, that it has celebrated, even built its identity around, is disappearing to become brown throughout. With the browning of Australia, some areas, such as tropical Queensland, are having their designed public landscapes and gardens revealed as an elaborate mythology, a landscape fraud.

Queensland is seen as a tropical, palm clad paradise, but is increasingly revealed as tropical in climate, but not tropical in terms of availability of drinking water. Queensland is on level five water restrictions with reservoirs down radically, and level six is predicted. These water restrictions have serious implications on the landscape, which is seen as a water indulgence compared with the necessity of household uses. In the last year these restrictions have moved from allowing hosing only at night; to at night only on two days of the week; to with buckets only; to now no watering, only the use of water that can be caught and recycled from household uses such as showering. Now even showering is restricted to four minutes. Surprisingly the palm trees are surviving, giving an elevation of lushness, so long as one does not look down at the ground, which is now denuded of grass (the favorite green surface covering for Australians), and most other vegetation is crispy. The drought is now revealed as the benchmark condition of Australia, and the landscape architects had better start dealing with it. Even as the various state governments of Australia (each dealing with their own levels of the water crisis) propose specific water saving solutions, it is only through advertising that the real properties of water are being dealt with. Punitive advertisements chastise citizens for wasting water, suggesting they are "water-wasters" (a brand new type of "bad" person) or simply as un-Australian(a more established type of bad person). These educational ads on bus shelters use graphics made from cracked earth to make us FEEL the dryness that is coming, desiccating us, because only if we feel it will we deal with it.

Water is measured on a graduating scale of wetness, with more water being more positive. Wet is green, bountiful, quenching. When water is present it is always a quality. When we imagine the qualities of water we imagine it sensually, being immersed in it, the feel of it against our skin. While water has all these sensual qualities however, of itself it is almost entirely without qualities. Water is an odorless, colorless liquid – the very quality of nothing. At the same time as being nothing, though, it is the fuel of life, and it is testament to the revelation of nature that life has adapted to run on something so seemingly neutral. If wetness is about qualities then dryness is about quantities, because we want to know we have enough of it to survive. Scarcity of water makes water seem like a quantity, but even as water is a quantity, it is also always a quality. Dryness is not the opposite of wetness, it is totally different. Dryness is a quality of quantity, because as water evaporates or transpires it changes the constitution of organisms. Plants crisp, people dehydrate, movements slows, and then... Dryness can only be appreciated as a quality, rather than a quantity, when we can see it from a perspective of water richness, which is the romance, the Eidetic potential of the Oasis. However, in the Oasis, it is the dryness of the desert that provides the contrast to the lushness of the oasis, without which the Oasis would be palm jungle. To appreciate dryness more than wetness seems ludicrous, and negative

– appreciating a glass half empty rather than a glass half full. Yet for Australia to find a long terms solution to the issue of water it has to recognise that water is not just another factor to be dealt with in design – it is the substance without which no other factor exists. No technical solution alone will change the situation, because what is required is a complete change of cultural perception of the natural environment of Australia. To appreciate the qualities of dryness we must assume that we can survive, but that we will never have an excess of water again. Perhaps it will never again rain, so we may as well surrender ourselves, and embrace dryness. The landscape of Australia and some of its stereotypes might provide clues to how this might be done.

Some of the most productive cultural periods of Australia's history have been accompanied by successive re-discovery of the Australian landscape. At the time of the Federation of Australian states in 1901, newspapers regularly featured illustrated supplements about Australian flora and fauna, and flora motifs began to illustrate publications and children's stories started to feature Australian animals. This period represented an acceptance that Australia was not England (which had deported the convicts to the "timeless land"), but maybe that was also a sort of liberation. Later, in the 1980's and 1990's Australian rock band Midnight Oil produced numerous albums that were themed around the real qualities of the Australian landscape, with titles such as "Diesel and Dust". In recent times Australia has been more immersed in developing and celebrating its cities, their new urbanity and their culture, rather than looking to the landscape for cultural definition. Yet it is probably the indigenous landscape that again will provide the source for landscape architecture to create a new language for "dryness".

Landscape architecture in Australia also had a renaissance that developed from rediscovering the Australian landscape, pioneered in the 1940's by garden designers such as Edna Walling. In the 1960's and 1970's, Australian landscape architects including Bruce Mackenzie and Harry Howard defined a landscape design language that used materials and plants from the indigenous Australian landscape. Parks produced by these designers featured Eucalyptus trees, native grasses and shrubs and timber edging, and used a variant of the English landscape park as the design language, with an emphasis on tree clumping and mounding. Perhaps the most clear design exemplar of these projects was Bruce Mackenzie's Long Nose Point Park, on Sydney Harbour, from 1974

Fig. 1: View of the Sydney Harbour Bridge through Casuarina glauca at Long Nose Point, by Bruce Mackenzie

The design zones the site into clear functions with simple materials such as grass and gravel, and then planting is used between these zones, with native gum trees and shrubs. The understated design works much like the natural bush land on the harbor, which is austere but in being austere emphasises the incredible beauty of Sydney Harbour. The design carefully worked with the existing site which had been occupied with industrial buildings by grading earthworks around the platforms, keeping tracts of the sandstone bedrock as paving surface and rock embankments. The epiphany of the project is where the park meets the water with a point of made of rock walls, occasional She Oaks (Casuarina glauca) emerging from sparse gravel. The design is a moment of fusion with

diverse design traditions: the environmental frameworks of Ian McHarg; functional site diagramming made form from Eckbo et al.; the sense of the composed view of the English Landscape Garden; the scattered poise of the Japanese garden unbalanced but precise; but all brought together in an utterly Australian manner. It looks like it has always been there, and this was always the intention, but for devastated sites such as this invisibility was no mean feat.

These projects together comprised Australia's first true landscape design form language. The projects were sustainable, requiring little irrigation, however intensive and brutal public use, combined with maintenance regimes that sought to make gardens out of these native landscapes, over time made them appear harsh battlegrounds. While these parks looked like the Australian landscape, the garden in Australia was always supposed to be a tonic, a relief from a landscape that was fearsome and inhospitable to European eyes accustomed to green rolling pasture.

Over the last ten years the level of design discussion, and the quality of design projects in Australia has increased, and the seemingly naturalistic or Picturesque landscapes of "the Bush School" (as it was sometime called) were derided as being under-designed, their producers even characterised as anti-designers. In retrospect these projects undoubtedly do have their own design language, but it is one of a studied formlessness, still misunderstood and beyond comprehension, but a design language nonetheless. As this seemingly endless drought takes its toll on the public (and the private) landscape, it is these bush projects that remain closest to their designed intention. Their dryness, which was previously one of their least desirable qualities, has become an indicator of the direction that landscape design must take in Australia if it is to produce projects that can survive. Culturally, this is potentially a return to the fly swatting, squinting Aussie – sun-burnt and loving it – that this same period, the 1970's, celebrated.

In many respects, the profession of garden design, rather than landscape architecture, has been pioneering responses to dealing with a reduction in water in the landscape, and defining an appropriate design response. In the 1990's, two garden design "styles" were pursued in Australia to this end, Xeriscape and Tuscan gardens, that looked to California and the Mediterranean respectively. This type of response examined plant material from other climates and microclimates around the world that could grow in similar environmental conditions to those found in Australia. Xeriscape, from the Greek, xeros 'dry', was a style that featured desert plants such as succulents and cacti, plants that had adapted to low levels of water through mass storage in foliage and stems and reduction of transpiration. With this plant palette came gravel and pebble mulches, already familiar from 1950's Modernist gardens such as those from the popular Sunset Garden magazines. The Tuscan garden was also based around plant use, this time substituting herbs such as rosemary and lavender. This style, like Xeriscape, also had an accompanying hard landscape language, which included "Tuscan" materials such as terracotta tile and pots, even mosaic. Neither of these "styles" were adopted by landscape architecture, both staying in the realm of garden design, precisely because they were "styles". Garden design has long been defined by the use of "style", an approach attempts to copy places or historical periods. Stylistic gardening gains value not through design innovation, as landscape architecture ideally would attempt to do, but through accuracy of mimicry. A "styled" garden attempts to be a rendition of the original, even if, as in the case of the Tuscan Garden, the style has no real similarity at all to what really exists in the places in attempts to mimic. The net effect of these styles, and the reason that stylism failed to make the change it needed to, is that the mimicry agenda dominates at the expense of innovative adaptation through design, which would allow these styles to better "adhere" to the landscape in Australia. From Xeriscape came a wide spread use of succulents, though more in landscape architects gardens than in their landscapes per se, as well as a rediscovery of mineral mulches. From the Tuscan

garden, perhaps better described as the Mediterranean, comes a much more useful precedent, drawn from the cultural history of the west. In an eidetic sense, the dryness of the Mediterranean is a harsh light that is also bountiful, the gnarled olive tree surrendering sensual oil.

What is appropriate about the model of the Mediterranean garden is not the Mediterranean per se, but an aesthetic or material language that is appropriate to the climatic conditions of the place. This language that can be learned though observation of the under-designed landscape, as Mackenzie did, but not creating naturalism from it is challenging and requires abstraction. A recent project for a reserve in Raglan Street, South Melbourne by SITE OFFICE demonstrates how such a language might work, even while the project is not "about" dryness.

Located on a street closure, an angled curving timber wall separates the reserve from traffic making a space in an intersection, inside the nexus of which a deck, shade structure is located. These two measures are important because they engage with the conditions of the climate by shaping microclimate, the structure recognising Melbourne's potential for burning hot summer, and the untreated timber wall showing a patina of drying, as much as dryness. The vegetation of the existing tree and the indigenous plants set in granitic sand set a colour palette of grey-ness and grey-blueness that reflects the real colours of the native landscape unpretentiously, a benchmark. Historically the default material for public spaces, the grass at Raglan Street is concentrated into a small area with the trim of sand and grey planting around it, making it special, a distinct surface for use, a gaudy green foreground in contrast to the subtle colour palette of the bush that Australians both love and hate.

In landscape architecture, the primary responses to the water issue have generally been of a technical nature, the most dominant response being Water Sensitive Urban Design (or WSUD). WSUD provides methods for conserving or reusing water in urban situations. It is effectively an "overlay" on top of existing urban design and streetscape practises, so it does not change the design methods or operations fundamentally but is an adjunct to existing ways of designing in the urban context. Common features of WSUD include mechanisms to allow surface water to return to the aquifer, including permeable pavements and grading solutions that direct surface water to planting areas. In Australia this has lead to the development

Fig. 2: Dry granitic sand and a structure that crafts shade at Raglan Street, by Site Office

of certain characteristic formal configurations and qualities: vegetation gets aggregated into masses (rather than individual trees) in swales that car parks drain into; reeds and grasses are used in these swales. This has given WSUD a particular "bushy" quality, a little ragged. To counter this designers have juxtaposed the loose and unkempt form of the reeds with straight edged concrete forms against which the organic difference becomes ornamental. The necessity of WSUD is unquestionable, making previous urban design practises seem wasteful, but as a positive response to dryness, it is still an appliqué on existing "wetness" based methodologies. It begs the question "if we had to redesign urban design as a practise completely, from scratch, on the basis of valuing dryness, what would it look like?" It may look exactly the same but such a paradigm shift is nonetheless what is required.

The central tenet of a water sensitive approach is to catch and clean up what water there is available, and then hold and reuse it. The central tool for this is the ubiquitous "designed wetland", a carefully organised hydrological mechanism that directs water through a series of stages using speed, water depth, oxygenation, and light to make dirty water clean. One ambitious project of this type is the Royal Park Wetland, in Melbourne, by Rush Wright Associates, which collects all the urban storm water from an enormous urban catchment and cleans it before it discharges into the bay. The language of these projects generally tends toward replicating the form of a natural wetland, but in this project RWA have exaggerated that language to become blatantly zoomorphic – the biomorphic motifs of Noguchi and Burle-Marx on drugs, with a nod to Smithson's Spiral Jetty. This form however is an aerial effect and on the ground level it is felt more subtly, like Hargreaves idea of "the fuzzy edge". In the context of a language of dryness this project demonstrates that the landscape is more like a mosaic, with a uniform background of the dry making the moments of moisture, again like an oasis.

There are some theoretical problems in attempting to establish what an aesthetic or formal language of "dryness" might be for Australia. The most basic of these is that to ask such a question is to expect an issue to be visibly recognisable in a design outcome. This expectation is the same as, for example, expecting structure to be visible in a building, which is to say that expecting dryness to be visible in a design language is a kind of Modernism.

Fig. 3: Aerial view of Royal Park Wetlands by Rush Wright Associates

Fig. 4: The desert image from Cranbourne Botanic Gardens by Taylor Cullity Lethlean

It's a "form follows function" (or issue) type of argument, which might hijack the conceptual and formal development of potentially complex, deep and multifaceted projects, and instead hinges them around a single issue, in this case "dryness". In fact dryness is not a singular issue at all, but a myriad of other issues, and as such the formal or aesthetic language to deal with it should not be singular either. What is needed is a whole new design sensibility, where sensibility is understood as feel or, as was famously said in the great Australian film "The Castle", a "Vibe". If we start to mentally overlay Xeriscape, Tuscan style, WSUD, and "the Bush School", and then a thousand project specific objectives, we might start to visualise this language. The technical approaches to dryness will only form part of that language, so it will be more than the sum of its parts, incorporating this technicality as well as diverse cultural issues about landscape, identity and colonialism – that is all those things that make up the disappointing, wonderful, complex reality of being Australian.

The Cranbourne Botanic Gardens project, in Melbourne, by landscape architects Taylor Cullity Lethlean is an important exemplar in the aesthetic move toward embracing dryness, even while it is an extreme caricature of what the landscape is really like. This project continues the indigenous landscape movement initiated by Bruce Mackenzie, et al. in the 1960's to 1980's, but rather than attempting to design an under-designed landscape, copying the natural, the Cranbourne Botanic Garden instead represents the myth of the landscape. The project centres, physically and metaphorically, around an area of bare sand, making reference to "the Red Centre", not really the centre but truthfully nowhere apart from "outback". The material for the area is red sand, with areas of other sands and spinifex grass. While the area is an exaggeration (there is very little of this red sand landscape in Australia, and even less that has no plants), the project recognises that it is the power of this image that is significant, not its accuracy. This image has proved pervasive, and already this project has become a strong "brand" for the Australian landscape. Its importance for a move toward dryness is obvious, but worth saying out loud. By recognising that this landscape is beautiful but harsh, and that at its core it is dry, we move closer to seeing the quality of dryness as an identifiable material specificity of this place.

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Post-script

As this essay on Dryness from three years ago is reprinted in 2010, recent heavy rainfall and refilled reservoirs in Australia might seem to make its claims alarmist. However a review of drought information from the Australian Bureau of Meteorology (or the BOM as it is affectionately known by Australians, who habitually check the weather on the Bureau's website) suggests that on average Australia has three years of drought in any given ten year period. Consequently while the issues that this essay discusses were more immediately pertinent at the time it was written, when much of Australia was in drought, as the saying goes ‚make hay while the sun shines'. The Bureau of Meteorology makes the key distinction that drought does not describe a lack of rain but insufficient water for users regular needs. Thus the primary proposition of the essay is that designers and users need to embrace dryness as an aesthetic language of expression not simply as a technical issue remains important as we tune our eye to the look of landscapes that do not need so much water, and in them find a design language to suit that is contemporary but builds on earlier conceptions of what constitutes an appropriate aesthetic for Australian landscape architecture.

Scenarios and ways of addressing resilience in water landscapes

Water landscapes: Human footprints via technology

Oliver Parodi

In the context of water landscapes I place three different spotlights on reflections in the field of hydraulic engineering. At first I present some philosophical thoughts about technology and culture in general. The second aspect leads us from today's hydraulic engineering and existing buildings at rivers back into history – not into the history of hydraulic engineering but that of the ideas of our occidental culture. I demonstrate several close links between the practise of hydraulic engineering (in the last 50 years) and our cultural roots. The third spot highlights the future of hydraulic engineering. Based on some lacks of today's hydraulic engineering in Germany I'll offer four suggestions for a future practise: a reasonable hydraulic engineering, a more hermeneutical one, a culture-sensitive hydraulic engineering, with always perceptible buildings and technological constructions.

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Throughout human history men have changed water landscapes and have left their mark on them. With increasing organisational and technical abilities human collectives have shaped surface and structure of water landscapes more and more. Thereby complex interactions have taken place between the cultural human or rather the human collectives, the available techniques and technologies and the regional ecosphere. Only with the interplay of these elements landscapes have occurred – and not only landscapes but also societies. Karl Wittfogel, for example, impressively describes how nearly all ancient civilizations have sprout out of the challenge of a large-area management of waters [Wittfogel 1962]. In the following essay I want to look at the human footprints via hydraulic engineering focusing on the connection between culture and technology.

1. Introduction – Linkages between Culture, Technology and Society

First I have to place a few words on the concept of "culture" and "technology" applied here. I start this approach against the background of a contemporary understanding of "culture", where the difference between nature and culture is no longer constitutive for the description of "culture", but just the simultaneous existence of three elements: collectivity, communication and convention. [This concept is worked out very well in Hansen 2000.]

When I'm talking about "culture" in the following, I do not refer to a separation from other collectives, from the culture of the Poles, the Chinese, and also, I do not point to that part of the 'high culture' that includes arts, theatre and film. I'm talking about something much more general and basal: Culture is inherent in every collective and holds it together. Culture also affects us and is an incessant part of our everyday life.

What is also important for the following statements is the fact that basic, collective interpretive patterns of the world (like world views, knowledge, but also attitudes, values as well as ideas and concepts of the world) are laid down ('stored') within every culture. And these culturally stored patterns influence our exposure to the world [Parodi 2008: 69-121].

A very rough example: a secularised, materialistic world view, highly influenced by science and humanism, forms the general basis of our occidental culture and with it our collective exposure to the world – e.g. by technology.

This leads us directly to the concept of technology. I do not want to discuss the concept of technology; I just want to point out that I will refer in the following to a very general idea of technology. The term "technology" does not only refer to things, tools and machines (artefacts), but also to eco-technological and socio-technological systems and processes [e.g. Ropohl 1999; Tondl 2003; Parodi 2010]. However, the quintessence of "technology" in a wide sense can be seen in "reproducible intended action" [cp. Grunwald 2003].

Bringing those two concepts together, the basic idea behind this essay can be summarised to the following: Technology in a wider sense can be seen as a cultural approach, as a material, institutional and mental/spiritual product and production under the conditions of culture. And: Hydraulic engineering as an action (doing, forming, producing) under the conditions of culture [Parodi 2010; Parodi 2008].

Now I would like to give just a few philosophical flashlights on hydraulic engineering from different perspectives.

Spot on.

Technology as thesis of society

Technology is not only viewed as cultural undertaking together with society but – to a certain degree – also as reflection (as mirror image) of society. Thus the cultural concept of technology and the focusing on world views allow a view that is complementary to the usually applied functional societal perspectives of technology.

It can be stated: Technology – even large-

scale technology like hydraulic engineering – is reflecting to a high degree the certainties of a society, and namely not only in the form of obtained knowledge but also in the form of collectively shared imaginations, worldviews and unscrutinised convictions. Following Adorno's statement that art is the antithesis of society [Adorno 1972: 336-338], technology can be seen as thesis of society [Parodi 2008: 45]. Architecture, by the way, is swinging in between these two opponents.

The purpose of and the meaning behind technology, especially large-scale technology, correspond to a high degree with our contemporary cultural self-conception. Large-scale technology is to be sure, its whole purpose often quite trivial. So for example nobody would argue today about the purpose of supplying the inhabitants of Sydney with a wastewater system. Almost the same applies to technical infrastructure to supply people with electricity or mobility. These are considered that much self-evident and trivial that even scientific or philosophical discussions on technology often do not mention the cultural certainties of technology.

But as I said before: Large-scale technology is only a thesis of society – not its truth. It's a statement, something that is been said, expressed. It is a thesis and no truth can be seen, for example, in the way energy is produced. Nuclear power as ('old') thesis of the society of Germans is definitely controversial today. The next spot will give some illustrative material for this thesis.

2. Two Styles of Hydraulic Engineering and their Cultural Roots

This next spot also bases on the idea of technology as cultural undertaking. I want to bring this to a point in two directions: On the one hand I will now come to hydraulic engineering, or to be more precise, to river engineering, and will concentrate on two styles of hydraulic engineering: Naturnaher Wasserbau: "ecological" or perhaps "near-natural hydraulic engineering" and Massivwasserbau: "massive hydraulic engineering". On the other hand, in the field of "culture" I will focus on the world views behind technology, the collective ideas expressed in technology and the collective attitudes of builders and operators of hydraulic technology. So this spot points [according to the Weizsäcker scheme, Weizsäcker 1977: chapter 1.1] to the mental or spiritual regions of socio-psychological and cultural conditions, where cognition and (technological) intended action can be under-

Fig.1: An example of massive hydraulic engineering: stream course Saar [Photo: Bernhart]

Fig.2: An example of near-natural hydraulic engineering: stream course Donau [Photo: Bernhart]

stood embedded in cultural processes and world views.

The questions are: Can world views be reflected in a collective practise of hydraulic engineering? And if so, how would these world views concretely look like in the case of Naturnaher Wasserbau and Massivwasserbau? And is there a connection between these world views and our cultural history of ideas? Concerning the world views we will ask: Which concepts and assumptions of the world are part of these styles of hydraulic engineering? Where is the human being perceived in the world? Which understanding of nature, technology, and so on, does he have?

2.1 The two styles of technology: Massive hydraulic engineering and near-natural hydraulic engineering

To answer these questions, I will first distinguish between – ideally – two styles of hydraulic engineering: Massivwasserbau and Naturnaher Wasserbau. In the first instance, I define Massivwasserbau by the compactness of the building material and the massiveness of the technological interference with nature and/or ecology. (Examples would be straightened, concreted rivers or big weir systems). Naturnaher Wasserbau uses biogenic materials that are typical for the waters; the interferences are much more "smooth" (examples could be every kind of "renaturalised waters").

Figures 3 and 4 illustrate the differences between these two construction styles. From the historical point of view, in Germany both styles can be located: on the one hand in the 1950s when Massivwasserbau reached its pinnacle, on the other hand at the beginning of the millennium (today), as Naturnaher Wasserbau is very popular.

2.2 The world views linked to the styles

Which world views can now be reconstructed to these styles of technology? I addressed this issue among others in more detail in my PhD theses [Parodi 2006]. All in all, this reconstruction of world views based on more than 200 sources (text passages – paragraphs from laws, handbooks, curricula, Leitbilder, also interviews – and pictures of hydraulic buildings and water landscapes). They were contrasted and compared against the background of common world views from our history of ideas [Parodi 2008: 123-206].

Fig.3: Massive concrete weir [Photo: Henn 1998: 4]

Fig.4: Near-natural Pendelrampe ('weaving chute') instead of a concrete weir [Photo: Grober]

Let us quickly come to the conclusion that arose from the analysis and interpretation of these numerous sources. In general, two things can be stated:
1) A lot of significant differences can be identified in the world views of Naturnaher Wasserbau and Massivwasserbau. And:
2) There is a considerable relation between the characteristics of our technology and our cultural history of ideas.
Concepts, ideas, attitudes and thought patterns (let's say motives of world views) from the pool of European history of ideas are expressed in hydraulic practise. Some of them can be traced back to ancient times. These motives are often detached from their 'original' former contexts and are recombined in the technology styles as new world views.
Table 1 shows one part of the determined motives of world views which can be reconstructed in the two hydraulic styles. However, this table should be taken with a pinch of salt since it simplifies and condenses what I discussed in my thesis in detail on approximately 100 pages. Just a few – much too short – explanations: While Massivwasserbau pursuits a possessive attitude to nature, Naturnaher Wasserbau is characterised by a predominantly sympathetic one. In Massivwasserbau, nature is subject and antonym, something external which can be used and one has to protect himself against. On the contrary, in Naturnaher Wasserbau, nature serves as a role model, is desirable and seen as something positive. Nature as antonym (of man, culture, technology) diminishes. Referring to the possessive and/or sympathetic attitudes to nature, each hydraulic engineering style can be identified as part of a line of history of concepts of nature: In case of Massivwasserbau as sequel to the line of Descartes, Bacon, materialism, predominance of economy. In case of Naturnaher Wasserbau continuing the alternative drafts of the history of ideas and subcultures from Rousseau to romanticism and finally predominance of ecology.
Taking a closer look at the individual motives, the natura naturans motive of a creative and active nature can be identified as central element of Naturnaher Wasserbau, while Massivwasserbau puts the human being in the centre of attention. Here Naturnaher Wasserbau shows Aristotelian ideas while Massivwasserbau continues with Platonic-Christian views. Where Naturnaher Wasserbau works on the assumption of a perfect nature which should be emulated, Massivwasserbau considers nature as imperfect. Nature has to be improved and put in a straight order. While man considers himself as creation's crowning glory here, he is there just an ecologically imperfect being that hinders the development of nature or if at all can only support its development.
In Massivwasserbau the concept of a machina mundi can be identified, whereas Naturnaher Wasserbau shows the idea of a systema mundi. For example, the (engineered) river is seen as a machine in Massivwasserbau, the near-nature river however is described as living being or individual.
The concepts of technology of the different technological styles correlate with the respective ideas of nature.

Massivwasserbau	Naturnaher Wasserbau
Motives of 'nature' and 'human being' (1)	
Possessive concept of nature	Sympathetic concept with possessive aspects
Imperfect nature Is being improved by the human being	Perfect nature Is imitated by the human being The human being interferes with natural development
The human being as master of nature	The human being as guardian and partner
human being is afraid of nature	The human being feels guilty and obliged to nature
natura naturata (most of the time)	natura naturans Nature is moving, alive and teleological
Human being is creative, moves nature	Nature is creative
Nature as subject/instrument Exploitation of nature No moral obligation towards nature Emphasis on explanation of nature	Nature as end in itself Restricted use of nature Moral (and legally defined) obligation towards nature Emphasis on understanding of nature
The human being as creation's crowning glory	The human being as ecological Mängelwesen* * imperfect being, lacking ecological conduct
Motives of technology	
Eutop concept of technology Technology as chance	Differentiated dystop concept of technology Technology also as threat
Mechanistic understanding of technology Technology is unambiguous, static and determined Machine as role model	Complex understanding of technology Stochastic, dynamic, multifaceted Organism as role model
machina mundi Predominant physical-chemical perspective Exact description, strictly mathematical	systema mundi Predominant ecological perspective Fuzzy description, also by words and pictures
Expertocratic concept of technology (predominant)	Democratic concept of technology (predominant)
Autonomy of technological development Do what is possible	Control of technological development Wish for intended – normative, limiting – public regulation
Other Motives	
Anthropocentrism Attribute values to human existence	Extended anthropocentrism to ecocentrism Attribute values to non-human entities and inherent value of nature
Linear patterns of thinking Linear patterns of movement predominant in time and space	Cyclical patterns of thinking Cyclical patterns of movement predominant in time and space
Generalisation	Individualisation
Analyses (predominantly)	Synthesis (increasingly, predominantly), holisitc view
Motives of 'nature' and 'human being' (2)	
Me-it-relation to nature	Rising me-we-relation to nature
Overcoming of nature, control of nature Nature threatens the human being To work against the river The fight of the human being against nature	Strive for nature, protection of nature The human being threatens also nature and has to be restrained To work with and for the river Leave free space to nature
The human being in search of the distance to nature	The human being in search of nearness to nature
Dichotomous separation of nature and culture Nature as part of the world The perspective on nature from an external observer	Econature as all-embracing Culture as part of econature The perspective on econature from a participant
Natural growing and fading has to be prevented	Natural growing and fading is appreciated
Mathematical or mathematically describable nature, Variety and strictness of geometry as a symbol for the rule of the human mind over nature	Mathematical description of nature is limited Variety of nature can never be completely reached and understood by human beings
The human being as scheduler and designer	Human b. as initiator and participant in creation

Table 1: World view motives of massive and near-natural hydraulic practise

Massivwasserbau shows a clearly eutop approach to technology. Technology is seen as chance and promise. It is a productive tool of prosperity, improves living conditions and is an expression of human power. On the contrary, Naturnaher Wasserbau mixes the elements of eutopic and dystopic concepts of technology. Technology is seen as a chance, but the potential danger is also critically recognised. As opposed to Massivwasserbau, technology is seen in a nuanced light and a distinction is drawn between 'good' (near-natural) and 'bad' (massive) technology. The destructiveness of the human potential is also recognised, and it is thus tried to apply technology with caution. According to the concept of Naturnaher Wasserbau, improved living conditions can also emerge from the abandonment of massive technological measures.

Massivwasserbau is also dominated by a mechanistic understanding of technology. Hydraulic engineering is identified as a definite, geometrical, static and deterministic system at the waters, which are described strictly mathematically. Naturnaher Wasserbau, in contrast, shows a complex idea of technology. Large emphasis is put on dynamics and diversity. Waters are defined stochastically and described illustratively. The realisation of technology is carried out interdisciplinarily.

In general, it can be said that the horizon of comprehension broadened from Massivwasserbau to Naturnaher Wasserbau. Apart from changed assessments and preferences within the world view, the world view of Naturnaher Wasserbau just includes more 'content' than that of Massivwasserbau. This is also reflected in the (disciplinary) dimensions of technology that are covered. Compared to Massivwasserbau, the natural dimension of Naturnaher Wasserbau has been expanded by the biological and ecological perspective. Also the focus within the natural dimensions was shifted from the physical perspective to the ecological perspective. However, the human and the social dimension play a minor role in both styles of hydraulic engineering.

From the perspective of a typology of human concepts of nature [according to Oldemeyer 2005], a pronounced distinctive me-it-relationship ("me" as "human being"; "it" as "nature") can be identified in Massivwasserbau. Nature is something opposed to the human being. It is an external object to work on, for unlimited use. In Massivwasserbau the world is divided into "nature" and "culture". The exalted position of the human being is explicitly pointed out as it can be distinguished from nature by its mind, identity and culture. Autonomy and separateness from nature are experienced as something pleasant and should be strengthened – also by the constructions of hydraulic engineering.

In Naturnaher Wasserbau, on the contrary, a change of perspective from a "me-it" to a "me-we-relation" emerges ("me" as "human"; "we" as "nature"). The ongoing changes in this relation generate contradictions and some sort of disorientation. In the transition to a we-relation, the dichotomous separation of nature and culture backs out in favour of a (hierarchic, but at least theoretically all-embracing) entire ecosystematic 'nature'. The human being identifies himself – including his cultural sphere – as interweaved in an ecological collective of being of all natural things, as part of – I named it "econature" ["Ökonatur", Parodi 2008, chapter 4.2.2] but that's another story, not to be told here. However, the development of the relationship to other members of this eco-natural we-world differs considerably. So in Naturnaher Wasserbau anthropocentric as well as ecocentric positions are being taken up.

The concept of an econatural world can be seen as a total in Naturnaher Wasserbau. Accordingly, econature is understood from the inside, from the perspective of the participant and can thus never be completely perceptible for the human being. The transition to a me-we-nature-relation does not take place in a radical negation and complete overcoming of the me-it-relation, but in some sort of reshaping.

3. Suggestions for a Future Practise of Hydraulic Engineering

While the first two spotlights concentrated on reflections for the better understanding of hydraulic engineering and technology, this third and last spot focuses constructively on the future of hydraulic engineering. I make four suggestions to hydraulic engineering, which try to remedy deficits in the current hydraulic engineering practise in Germany. Let's come to my first suggestion.

3.1 Cultural Hydraulic Engineering

Hydraulic engineering today is determined by the dealing with nature and therefore the knowledge of natural sciences. In future more attention should be given to the cultural side. Just like Massivwasserbau has changed from a physical-mechanistic view into an ecological one, it is now important to develop a kind of sensitivity and sensorium for cultural aspects of hydraulic engineering and the world changed by it. (That's, for example, exactly what I tried to do in the last spot: take a cultural glance on hydraulic engineering.) The importance of such a culture-sensitive hydraulic engineering increases, the more "culture" and technification are getting ahead, the more our life environment turns into a technotope and accordingly, the more hydraulic engineering with its technology and constructions does not only encounter nature, but, increasingly, civilisation, human beings and culture.
For hydraulic engineering this means the active, intentional turning to culture in the development of technology. More and, above all, cultural aspects should shape the development of technology. This would make hydraulic engineering, and the river landscapes surrounding us, much more comprehensive, much more human.

3.2 Reasonable Hydraulic Engineering

The second suggestion is to practise hydraulic engineering in the most reasonable way (cf. German philosophical term "Vernunft, vernünftig"). For that purpose a 'holistic' understanding of the world – or rather hydraulic engineering's world with its rivers, landscapes, technology, etc. – by hand, head and heart is required and not only one by mind. Moreover a moderate and reasonable dealing with nature and self-image is necessary.[i] Following this it might be appropriate in some cases not to realise given technological possibilities. Now and then the achievement of hydraulic engineering is lying in the renunciation of technology. Such a reasonable and moderate hydraulic engineering thoroughly follows an emancipatory aim, not – like Massivwasserbau did – to free man from the shackles of nature but further more to preserve man from the restricting consequences of his own careless actions.

3.3 Hermeneutical Hydraulic Engineering

The third suggestion is that hydraulic engineering should be practised not less analytically but more hermeneutically. A hermeneutic hydraulic engineering could bring two essential aspects of hermeneutics into technical acting: dialogue (with the given situation) and distance (to the planners' action). The (planning) hydraulic engineer could come to a deeper understanding of the given situation at the river, the landscape, etc. by getting into dialogue with them. On the other hand the engineer could step back from the process of cognition to gain a new view on his own work. With the back stepping of the results performing subject (the engineer) appropriate and reflected technological solutions would be enabled.
To integrate these three aspects into hydraulic engineering a significant change of the training of hydraulic engineers is – among others – necessary. On the one

[i] In history of ideas and of hydraulic engineering both have weaved between over- and underestimation.

hand they need a deeper understanding of technology and their technological action, especially against the background of culture; on the other hand teaching should not only feed the brain but involve heart and body, too. Aesthetic and physical aspects should be increasingly included in teaching. Water, river, landscape and technology should not only be conceived with the brain and on paper or computer, but should be comprehensively experienced in person.

3.4 Perceptible Technology

The last point is that technology as artefact should be perceptible for everyone. Technology should be transparent, because technology – and most large-scale technology like hydraulic engineering – as thesis of society has to be discussed if necessary. Technology as artefact is witnessing our dealing with our "Umwelt", "Nachwelt" and "Mitwelt" (our dealing with the environment, posterity and the beings with us). Technology shows our values, preferences and imaginations. It is always to be asked if this dealing is still appropriate, if the technological thesis of society is collectively carried on. Technology should serve us as a mirror of our way to live and our self-image. Only through the realising contact to technology, to its shape, function and content, can we decide which technologies we want to live and surround ourselves with, and which not.

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Technologies for sustainable urban water management – dissolving the antagonism between urban comfort and hygienic pollution of urban environs

Helmut Lehn

Infrastructural systems of cities should comply with the requirements of a sustainable development. From the ecological point of view saving drinking water in water scarce regions, recovery of energy (e.g. from waste water), and protection of waterbodies from eutrophication are important challenges. High investment and running costs for sometimes disintegrated systems for sewage and solid waste contribute to the desolate municipal financial situations. Social aspects of the non-sustainability of water sercives encompass e.g. unequal water treatment requirements for water users upstream and downstream, or the hygienic pollution of streams and rivers, which does not allow swimming.
Examples for new technological solutions to dissolve the antagonism between urban comfort and overusage of the catchment are are presented and discussed. The urgent need for social acceptance of new sanitation techniques is emphasized.

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Introduction

In the year 2007 the number of people living in cities exceeded the amount living in a rural environment for the first time in the history of mankind. According to UN-World Population Prospects the urban population will increase tenfold between 1959 and 2050 [UN 2007]. Therefore urbanisation can be called a global phenomenon of 21st century, and sustainable urban development is a prerequisite for any sustainable development at all.

The development of the urbanisation process varies significantly between the continents. In Asia the proportion of urban population still is below 50%, whereas in Northern and Latin America urban population reaches 75% and more (compare fig. 2). In 2010, 89% of the Australian population live in cities [UN 2007].

Life in cities is strongly dependent on an exchange of materials and energy with the surrounding hinterland. This is true as well for many resources flowing from rural areas into the cities as for different kinds of waste material resulting from different activities within the cities, which is foreseen to be absorbed by the surrounding ecosystems. Table 1 gives some illustrating examples as far as natural resources are concerned.

Within the debate about a sustainable urban development the relationship between the city and its environs is a central topic. This exchange between central and peripheral or rural spaces embodies both common interests and contradictions. E.g. the emissions of sewage to streams and rivers are still an example of a contradiction all over the world despite the efforts in purification technology.

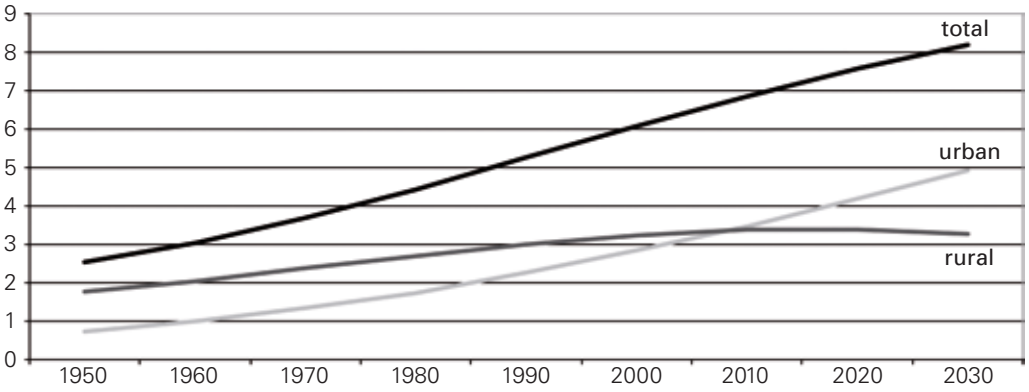

Fig. 1: Global population development 1950 - 2030 (billions) [Source: UN 2007]

Sources from the hinterland feeding the city	Wastes from the city to be absorbed by the hinterland
energy	heat
fresh air	exhaust fumes
building materials	solid waste
nutrients	biodegradable waste
…	hazardous waste
fresh water	sewage

Table 1: Exchange of natural resources between cities and their hinterlands

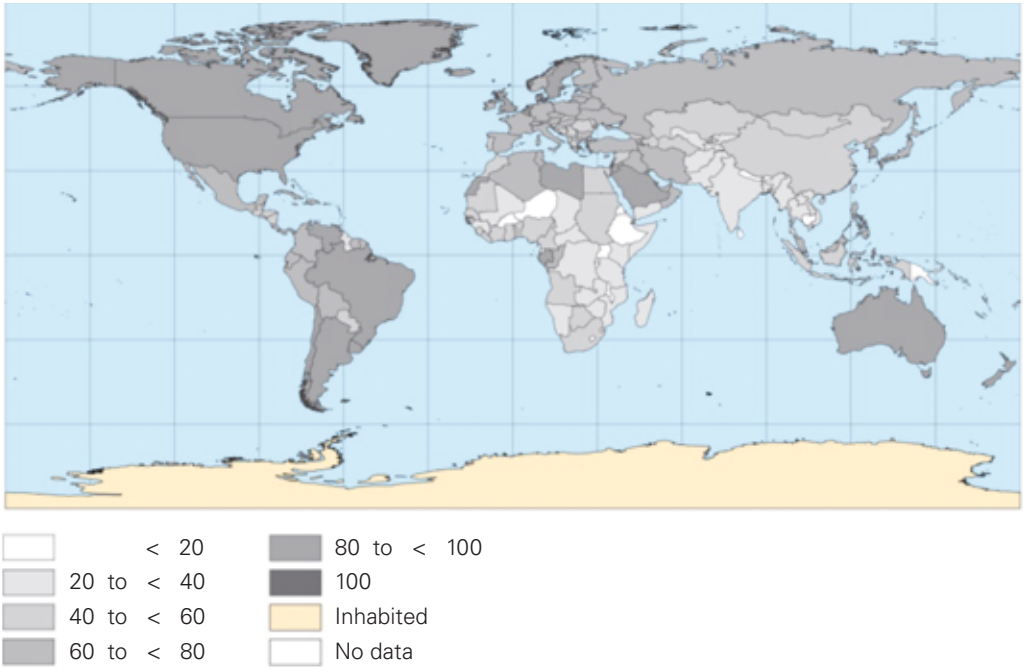

Fig. 2: Urban Population 2005 (% of total population by country) [Source: UN ESA Population Division. World Urbanisation Prospects: The 2005 Revision Population Database http://esa.un.org/unup/ (accessed 2007-7-10)]

1 Ecological point of view
1.1 Prevention of eutrophication of the sea
1.2 Avoidance of high fluxes of material and energy as long as based on non-renewable resources
1.3 Water quality similar to primordial condition (groundwater and surface water)
2 Economic point of view
2.1 Prevention of nutrient losses
2.2 Avoidance of nonflexible systems with high capital commitment
2.3 Low vulnerability by war, terrorism or natural catastrophes
3 Social point of view
3.1 Dry and hygienically unobjectionable settlements
3.2 As much comfortable as the present system
3.3 Internalisation of toxic and hygienic risks
3.4 High-quality usage of water bodies

Table 2: Requirements of sustainable sanitation systems (SuSan)

1. Requirements of Sustainable Sanitation

Urban infrastructural systems should comply with the ecological and socio-economic requirements of sustainable development. Despite the fact that sewerage infrastructure is as important as transport or communication infrastructure for the society to function smoothly, there is no public discussion about the chosen technology. The sewerage systems are hidden in the underground and new technological developments come to public mind with a considerable delay compared to e.g. mobile telephones in communication or electric cars in transport.

In order to "meet the needs of the present generation without compromising the ability of future generations to meet their own needs" [WCED 1987] and to meet the needs of a certain region without compromising the ability of regions situated downstream to meet their own needs a sustainable sanitation system should be in accordance with the requirements listed in table 2.

2. The non-sustainability of the present urban sanitation system

Three technical components are designating the present sanitation system: sewer system network, purification plant and storage pond – compare fig. 3.

2.1 Sewer system

The sewer system comprises urban sewers and private house drains. In the year 2001 urban sewers in Germany added up to a total length of about 445.000 km. The combined drainage and sewerage system in the south of Germany has a total length of about 227.000 km. In the north of Germany the system is divided in sewers of about 135.000 km, and culverts for drainage of about 85.000 km. The private house drains are estimated to have double to triple the length of the urban networks [ATV 2001]. Because of severe damages 7% of the urban sewers (31.000 km) have to be repaired immediately or in short term, additional 10% (45.000 km) in the medium term. If leaky

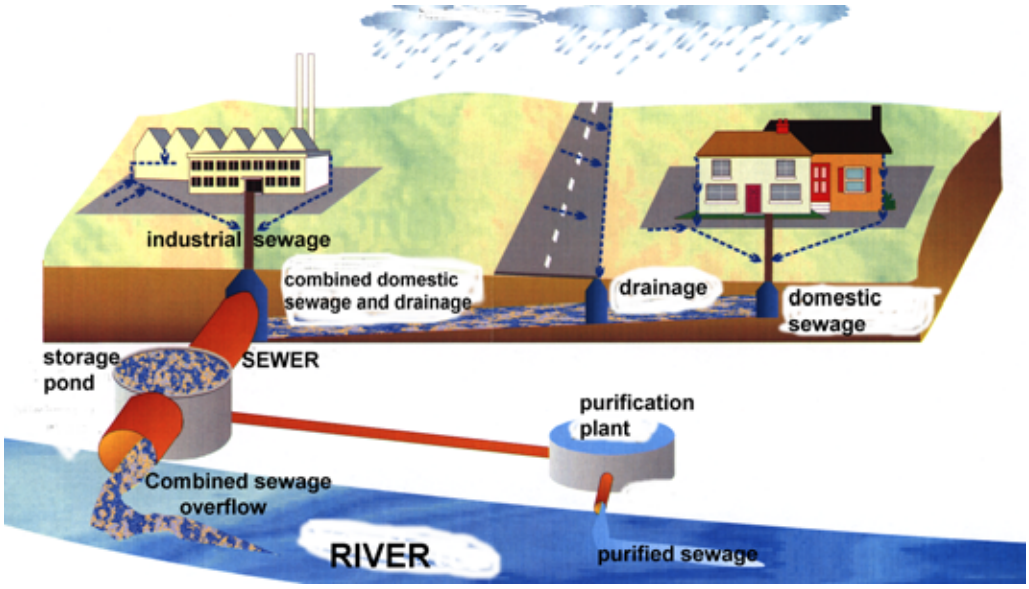

Fig. 3: The conventional urban sanitation system (combined sewerage system) pollutes run-off capabilities (brooks and rivers) during rainfall by the outlets of purification plants and by combined sewage overflow. [Lehn 2007]

sewers are situated above the groundwater table the sewage exfiltrates into the groundwater. Dohmann and colleagues estimated for the former Federal Republic of Germany an amount of 31 to 445 mn m^3 of exfiltrating sewage [Dohmann et al. 1999]. If the sewers are below the ground water table ground water infiltrates and dilutes the sewage. As a result of this dilution the purification process in the purification plants is less effective. In both cases groundwater or surface water will be polluted, a violation against requirements 1.1 and 1.3 of table 2.
The restoration costs for these 17% of the total urban sewerage system are estimated to sum up to 45 billion Euro. In the year 2000 1,6 billion Euro were spent for restoration and replacement, an amount which seems only to be sufficient to maintain the actual conditions but which is not enough for any improvement [ATV 2001]. About 500.000 km (40%) of the private house drains are estimated to need rehabilitation. Considering these data the question arises whether the current sewer system network complies with requirement 2.2 (table 2). More than 90% of the sewer material is stone ware or concrete. Both materials need a lot of energy during construction – a violation against requirement 1.2 (table 2).

2.2 Purification plants

In Germany more than 90% of the population is connected to one of approximately 10.000 purification plants which clean up a volume of about 10 billion m^3 waste water each year. Despite the subsequent retrofitting with second and third purification stages, the purification process is still incomplete: Polar hydrophilic substances like boron compounds from washing powders [Lehn et al. 1996], a number of pharmaceuticals, disinfectants and endocrine disruptors [Kümmerer 2004] or faecal bacteria and viruses [Overath et al. 2001] cannot be detained or destroyed by conventional purification techniques. The systematic pollution of surface waters by the emissions of purification plants is contrary to the requirements 1.3, 3.3 and 3.4 of table 2 The aerobic degradation of substances in the biological stage needs a lot of oxygen. The necessary aeration consumes considerable amounts of electric energy (about 1 kWh/m^3 sewage), which does not correspond to requirement 1.2.
Within the nitrification/denitrification process, nitrate is converted to gaseous nitrogen which leaves the process and gets lost. Phosphorus is bound to sewage sludge. Because of its pollution (e.g. by heavy metals) less and less sewage sludge can be used in agriculture; it has to be burned to an increasing extent. The loss of nitrogen, phosphorus and potassium during the purification process is a contradiction to requirement 2.1 (table 2). To reduce this loss actual research is done on the recovery of phosphorus (and potassium) from sewage sludge and from incineration ashes respectively.

2.3 Rainfall treatment systems and combined sewage overflow

Purification plants are designed for double the volume normally flowing in during dry periods. In case of heavy rainfall the mixture of rain and waste water in combined sewers increases up to 100 times and more of the normal volume. The excess volume of sewage bypasses the purification plants and reaches streams and rivers without any cleaning – compare figures 3 and 4.
In the meanwhile in Germany roughly 20.000 storage ponds have been installed with a volume of about 13 mn m^3 to clip at least the first peak of combined sewage overflow in the beginning of a rainfall event. It is estimated that additional 20.000 to 30.000 ponds are necessary to be built. In these ponds only the first flush of a rainfall event can be stored and later been transported to the purification plant. The overflow goes on to bypass any treatment process. The emission of untreated sewage via combined sewage overflow contradicts the requirements 1.1, 1.3, 2.1, 3.3 and 3.4 in table 2.

Fig. 4: Overflow structure in the sewer network of Vienna (Austria). If the combined wastewater sewer a the left side of the picture is brim-full with the mixture of sewage and stormwater the excessive volume gets discharged directly to the Danube river by overflowing the dividing wall in the middle of the picture. The residues on the wall coping show that it is waste water which gets discharged and not rain water, even though this phenomenon is often called "stormwater overflow" in the literature. [Photo: H. Lehn 1996]

3. Urban comfort at the cost of hygienic problems and environmental pollution

As shown in previous chapters both the outflows of purification plants and combined sewage overflows of the sewer network contribute to environmental pollution. In the case of two tributaries to Lake Constance in South Western Germany it is obvious that the purification plants cause a constant hygienic basic pollution level (ca. 1.000 E. coli in 100 ml), whereas after rainfall and combined sewage overflows the content of E. coli increases up to 12.000 per 100 ml for some hours or a few days – compare figure 5.

As a consequence of hygienic pollution, swimming is not allowed in nearly all German rivers. The capital of the state of Bavaria, Munich, had to close down river baths in 1998 because of hygienic risks. In the meantime, the strategy is to treat the outlets of upstream purification plants by disinfection via UV-rays and to accept a temporary worse hygienic quality during the days immediately after rainfall events. Results for the river Neckar in the state of Baden-Württemberg show, on the basis of the European guideline concerning the quality of bathing waters, that none of the examined places from the source in the Black Forest to the mouth into the river Rhine at Mannheim complies with the required water quality.

From this one can conclude that the current urban sanitation system does comply neither with the ecological nor with the socio-economic demands of a sustainable infrastructure system. With regard to these sustainability deficits, the German Research Association (Deutsche Forschungsgemeinschaft DFG) states: There are justified doubts about the resource efficiency and sustainability of today's water management for settled areas. Accordingly, the resource efficiency of existing – but improved – and alternative systems should be reviewed [Deutsche Forschungsgemeinschaft 2003].

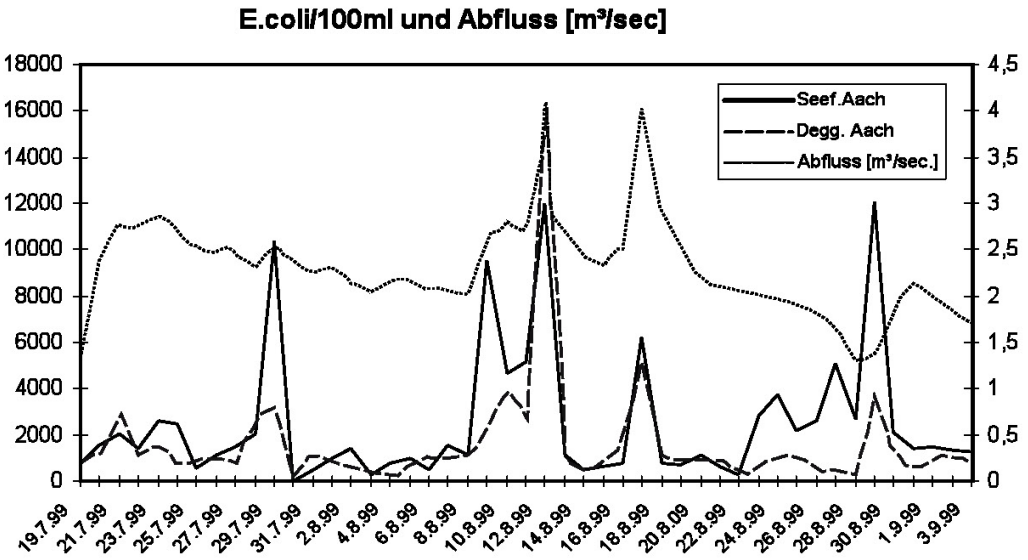

Fig. 5: Concentration of E. coli (per 100 ml) and flow (m^3/sec) in two tributaries (Seefelder Aach and Deggenhäuser Aach) to Lake Constance in a 6 week periode in summer 1999 [Güde et al. 2000]

4. SuSan – Sustainable sanitation

To achieve the goals listed in table 2 three principle strategies can be seen:

1) Further optimisation of the present system on the centralised level

2) Establishing alternative systems on a decentralised or semi-decentralised level

3) Establishing the sewage-free house on the individual level

This classification shows that SuSan-technologies have to pay attention to specific local or regional situations. This means the systems will probably differ between rural and urban situations or between water rich regions and regions under water scarcity. Sustainable sanitation in the future is unlikely to consist of one standardised system for all needs.

4.1. Adaptation to extreme weather conditions instead of water saving

Water saving strategies may not be the central issue all over Europe. Low water consumption conserves heavily extracted water resources on one hand. On the other hand it can mean long periods of stagnation in the pipes. The installation of a new water pipe network with reduced dimensions could be the consequence. In this case a new system for water supply for fire fighting has to be found. An alternative could be to use the water in the existing pipe work only as service water and to distribute bottled drinking water. Because of the fact that 80-90% of the costs for the water distribution system are fixed costs, water saving will often lead to higher specific prices. One result could be that the costs for drinking water will not decrease absolutely. Because of these facts SuSan should contribute to water saving strategies whenever necessary but water saving is no central precondition for sustainable sanitation systems in general.

Up to now the observed climate change and prognoses of experts indicate that the climate in many parts of the world tends to more extreme situations: dryer summers but presumably with severe tempests, milder winters with less snow but more rain. The implications for river systems are that the dilution capacity of run-off capabilities (brooks and rivers) will decrease during summer months as it could be seen in Germany in the year 2003. If glaciers should be melted off in the middle of the century the situation would go from bad to worse

for rivers fed by glaciers or snow fields (e.g. Rhine, Rhone; Po, Adige in the Alps, Syrdarja and Amurdarja in Central Asia, Maipo in South America). As one consequence purification of sewage should achieve a standard which makes further dilution dispensable. If the climate will change in Central Europe to circumstances comparable to the Mediterranean, it may be assumed that people desire to use rivers for bathing or swimming. SuSan therefore should enable high-quality-use of surface waters.
More frequent and heavier rainfall events will increase the probability of occurrence and the duration of combined sewage overflows with its negative effects described above. One essential element of sustainable sanitation systems therefore is the separate treatment of rainwater.

4.2 Separate treatment of different types of waste water

The separate treatment of different types of waste water is well known in large scale industrial sites. It is a precondition to optimise the treatment of different waste water flows according to their chemical or hygienic properties. By this the separate treatment of different types of waste water is a constitutive element in the process management of sustainable sanitation technologies. For municipal sewage three steps of separation are discussed:

Step 1: Separation of storm water (rainwater)

In arid or semi arid countries the storage and use of rainwater could be an important aspect to balance natural water offer and anthropogenic water use. Under the climatic conditions of Central Europe the main advantage of this step is to avoid dilution of municipal sewage. If the sewage is more concentrated and its volume fluctuates less, hydraulic dimensioning of purification plants can be optimised. The sewers can be constructed in smaller dimensions and combined sewage overflow can be reduced or avoided completely. This would be the first step to reach a more hygienic situation in streams and rivers.
In the meantime the technologies for a decentralised storm water management systems can be regarded as state of the art [Sieker et al. 2009]. Storm water can be seeped away if geological conditions are appropriate. If this is not possible rainwater can be lead to a run-off capability in open channels to improve the

Parameter	Separated sewerage system rainwater sewer	Combined sewerage system combined sewer
COD (mg/l)	47 – 120	176 – 720
NH_4-N (mg/l)	0,1 – 4,0	0,1 – 17
PO_4-P (mg/l)	0,3 – 1,7	3,0 – 4,3
Settleable Solid (mg/l)	7 – 446	327 – 758
Cadmium (Cd) (µg/l)	5 – 16	0,7 – 4,7
Copper (Cu) (µg/l)	10 – 235	27 – 136
Lead (Pb) (µg/l)	20 – 422	12 – 213
Zinc (Zn) (µg/l)	610 – 6100	411 – 1430

Table 3: Range of concentrations of important substances carried by waste water in separated sewerage systems and combined sewerage systems [Fuchs 2000]

urban environment or underground in a classical rain water sewer. Storm water infiltration can reinforce the problems of rising ground water tables resulting from increasing precipitation and / or from water saving strategies (as to be seen in the Berlin- and Rhine/Neckar-region in Germany). Due to its often higher concentration of some heavy metals (compare table 3) seepage of storm water bears the risk of groundwater pollution. The seepage should only be allowed if the materials for roofs and pipes the rainwater is exposed to are controlled or if a pre-cleaning is guaranteed before seepage.
In regions under water scarcity the main advantage of keeping storm water from the combined sewage is saving drinking water by use of storm water in households, hotels and industries. Typical uses are: irrigation, washing of clothes and flushing the toilets, washing cars and trucks. In the meanwhile the technology for rainwater use is well developed and designed [FBR 2006]. Cisterns for rainwater storage can be integrated in a pre-cleaning concept because heavy metals often are bound to suspended matter and thus can be retained in the sludge of the cistern.

Step 2: Separate treatment of grey water

Grey water from showers, bathtubs, and hand basins, or from washing machines and automatic dish-washers is relatively low polluted – compared to the sewage from toilets. A separate treatment in reed bed filters or immersed rotating disc plants is often sufficient for subsequent seepage into the soil or for direct input to surface waters. In a similar way to the separate treatment of storm water, separate grey water treatment is also a means to reduce hydraulic burden of treatment plants (compare table 4). Yet some questions are not answered completely. To give an example: The rising amount of water soluble paints will lead to an increasing amount of water soluble residues from paint-brushes and other equipment in the grey water after restoration of houses etc. At the moment it is not known, whether the above mentioned treatment technologies will be able to degrade or take out all the components of paints and other chemicals which can enter the grey water.
Recycling of grey water can contribute to the saving of drinking water. Typical use of recycled grey water is irrigation and flushing of water closets.

	Partial flows of domestic waste water (volume per person and year)		
Nutrient Mass flow	Grey water (GW) (25.000–100.000 l/P a)	Urine (~ 500 l/P a (=~1 % of GW))	Faeces (~ 50 l/P a (=~1‰ of GW))
Nitrogen (N) ~ 4 – 5 kg / P a	~ 3 %	~ 87 %	~ 10 %
Phosphorous (P) ~ 0,75 kg / P a	~ 10 %	~ 50 %	~ 40 %
Potassium (K) ~ 1,8 kg / P a	~ 34 %	~ 54 %	~ 12 %

Table 4: Distribution of nutrients in partial flows of domestic wastewater [Otterpohl 2004]

Step 3: Separate treatment of black water

After separating storm and grey water, so called black water from the toilets is the remaining fraction of a household. The data of table 4 show that the overwhelming percentage of the central agriculturally relevant nutrients – causing eutrophication in lakes and oceans – is concentrated in less than 1% of the household's waste water volume under the precondition that black water is not diluted by flushing water. Several techniques (low tech and high tech) exist for separate collection of concentrated black water. For urban situations in developed countries vacuum toilets – known from aeroplanes and modern trains – combined with a vacuum sewer system seem to be the most appropriate technical option.

Fig. 6: Different models of urine separating toilets [top: Roediger company – Hanau, Germany, bottom: EAWAG, Switzerland]

The separate collection and treatment of black water provides a set of advantages compared to the traditional waste water treatment:
1) Faecal bacteria and nutrients can be kept out of the water cycle.
2) The hygienic pollution of water bodies and eutrophication could be reduced.
3) Streams and rivers could be rediscovered for bathing.
4) Expensive public swimming baths could partly be abandoned.
5) Nutrients could be recycled.
6) The energy content of concentrated black water could be used via anaerobic production of biogas.
7) Organic waste from kitchen could be added directly to the vacuum system and be co-fermented together with black water. This makes the separate collection of organic kitchen waste dispensable.

Step 4: Urine separation

From the data in table 4 it can be seen that urine contains most of the nutrients. Separate collection and treatment of urine can be helpful if a cheap fertiliser should be produced or the expensive third stage in a purification plant should be avoided, for example in growing cities or at sites with fluctuating population like holiday resorts. For separate collection of urine various models of separating toilets (no-mix toilets) have been developed (figure 6). The urine is stored within the house in a tank which gets periodically emptied by a tank lorry. After a storage of six months for disinfection urine can be used as liquid fertiliser. Because of the limited acceptance for a liquid fertiliser by farmers, research is necessary about a conversion to a grainy fertiliser.

4.3 Membrane filtration instead of separation of partial sewage flows

Experience with separated collection of garbage shows that the quality of separation depends strongly on the social acceptance of the collecting system. There are some doubts whether a partial flow treatment can be installed under all housing conditions. Therefore actual research and trial concentrates on an improved purification of urban sewage with membrane bioreactors. Depending on the diameter of the pores of the membrane, microbes (0,1-1 µm – microfiltration), viruses (0,001-0,01 µm – nanofiltration), and even salts (<0,001 µm – reversed osmosis) can be detained [Lehn 2002]. Membrane bioreactors have been installed in traditional purification plants (e.g. in Germany: Leipzig, Rödingen, Monheim, et al.) and in semi centralised waste water systems (Heidelberg, Knittlingen) as well as in treatment units for only one house [Gutsch & Heidenreich 2001]. The quality of the effluent waste water complies with the guidelines of the European Union concerning bathing waters. A disadvantage of the system is the high energy demand – about 1 kWh/m^3– only to maintain the pressure across the membrane. The membranes are very sensitive against blockage. To avoid this, meshes with a width of 1-3 mm have to be installed at the inflow to the membranes. To reduce the energy demand it is useful to separate storm water before treating sewage by membrane filtration (volume reduction).

5. Conclusion

With the traditional method for collecting and treating municipal sewage, a system has been installed which may be called very suitable for spreading faecal bacteria, resistance against antibiotics, endocrine disruptors and medical residues into the surface waters of the urban environment. It has to be stated that – using this technology – comfort and hygiene in towns and cities is based on the hygienic pollution of the urban environment. A wide range of ecologic and socio-economic arguments is in favour of developing and testing new forms of urban water management, with the aim of integrating them in societies' infrastructures. The conclusions of the Johannesburg Conference 2002 show that an improvement of the hygienic situation of water bodies is urgent worldwide. Sustainable sanitation techniques could be a significant contribution to solve this problem and to cope with the impacts of global climate change on fresh water resources of urban hinterlands.

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River management in a changing world – flood risk modeling in the face of climate change

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From time immemorial, rivers provide the living conditions for human settlements. But the many different interests of using water and river basins (agriculture, settlement, navigation, industrial use, hydropower, drinking water, ecology, recreation) lead to conflicts that demand an interdisciplinary view on the future management of the water resources. These interests are not static but change with modified societal and natural conditions.
In particular the increase of extreme weather situations (heavy precipitation and droughts) due to climate change may alter water landscapes in a significant way and challenge the authorities and people to adapt their water management strategies in terms of preparedness, prevention, protection and increase of resilience. On base of hydrological, hydraulic and economic models in combination with land-use information the impacts of climate change can be quantified on local scale. This information is indispensable for a sustainable and future orientated river management.

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Introduction

Despite the fact that flood events are natural processes, which occurred in the past and will also occur in the future, the situation has worsen, especially in terms of financial losses. In the recent decades, the utilisation of floodplains for industries and urban settlements has increased, also causing an accumulation of values at risk and, as a consequence, increase of damage potential. The flood event of August 2002, as one of the severe flood disasters in Central Europe, caused economical loss of more than EUR 10 billion.

The flood risk is defined as the product of the flood hazard multiplied with the vulnerability. "Flood hazard" means the endangerment of an object or building by floods; "flood vulnerability" means the damage potential in endangered areas, e.g. of buildings and inventory. The information about flood risk in a river basin is indispensable for benefit-cost analyses of proposed hydraulic measures and civil protection actions.

To determine the hazards, first the relevant natural processes and parameters have to be analysed and quantified. For the assessment of flood potential, usually events with a defined maximum recurrence interval are taken into account. This information is available for most of the bigger rivers. But there is still a lack of knowledge for events greater than the design discharge. These Floods may be rare, but can cause severe damages and fatalities in case of overtopping or even destruction of protection structures. They can also cause extraordinary hydraulic situations like clogging of bridges due to debris, which need to be analysed separately. But even for floods below the design discharge, there is a residual risk due to factors such as soaked dikes in long duration flood events or delay in the operation of mobile protection elements. For an effective flood control planning, apart from the determination of flood hazard, the vulnerability in terms of potential economic losses must be estimated. On the basis of the accumulated values at risk in the areas and the functional relationship between the parameters of the flood events and the resulting damage, risk potentials can be identified, quantified and the expected damage can be estimated not only for single events but in the whole range of damaging flood events. It has to be ensured, that the used analytical tools enables the consideration of these factors in order to support the stakeholders.

1. Flood Risk Modelling

1.1 Hydrodynamic-numerical flood modelling

To quantify flood hazard and risk in urban areas or at single objects, statistical flood discharges (e.g., HQ100) have to be transformed into hydraulic parameters like water levels, inundation depths or flow velocities by means of hydrodynamic-numerical (HN) models. In many cases when the flow patterns in a given river section are characterised by compact and coherent streamlines, one-dimensional (1D) HN-models are considered as adequate for the estimation of flood-water levels and delineation of inundation zones (e.g. Baden-Württemberg 2005). In cases with more complex river geometries and flow patterns (e.g. at river confluences or other complex flow conditions), two-dimensional (2D) models are used for a spatially differentiated hydraulic analysis, especially when local parameters like flow direction, flow velocity, shear stress, etc. are requested. Depending on the intended purposes, both types of models (1D, 2D) may be applied for stationary flow conditions (e.g. hazard assessment for a certain HQT) or unsteady flow conditions (e.g. for impact analyses of dike failures).

At the Neckar River, a complex flood-information system was set up since the late 1990ies [Oberle et al. 2000], consisting of a series of 1D- and 2D-HN-models which are interactively connected with a geographical information system (GIS). This system enables the simulation of different flood scenarios in order to evaluate, for example, effects of river engi-

neering measures on flood waves. Using its GIS-interface, the hydraulic results can be superposed with a high resolution DTM (grid size: 1x1m) to determine inundation zones and respectively their boundaries. The DTM is based on elevation data from different data sources, i.e. terrestrial and airborne surveys. Apart from topographical information, flood-relevant spatial data like flood marks, flood impact area, retention zones and legally defined flood areas, are integrated in the GIS. Linkups to aerial photographs of recent flood events complete the volume of spatial data sets.

With respect to the main target parameters of flood-risk analysis and mapping (water levels, inundation zones/ depths) and to the flow characteristics along the Neckar River, a generally one-dimensional HN procedure was chosen. The choice of this procedure was supported by the fact that the handling of the system and the computing time should match with the size of the study area (approx. 220 river kilometres) and the goal, to install the system as operational tool for daily working practise in the water management authorities. Finally, the calculation of a flood event and the visualisation of inundation depths in the GIS only take minutes with this system, so that analyses can be realised also based on actual flood forecasts. Some river sections with more complex flow conditions (e.g., tributary mouths) could be assessed only insufficiently by means of a one-dimensional approach. Here, local 2D-HN-models were additionally applied. However, a stationary calculation on the base of a two-dimensional HN procedure requires several hours even using a powerful computer.

The model for the Neckar River served as basis for the generation of hazard maps with prototype character in a state-wide sense. Coordinated by the water management authorities in Baden-Württemberg, until 2010 flood hazard maps will be drawn up for all rivers with a catchment area > 10 km^2. For example, hazard maps for the lower Neckar River (fig. 1) are published on the mentioned internet platform: http://www.hochwasser.baden-wuerttemberg.de.

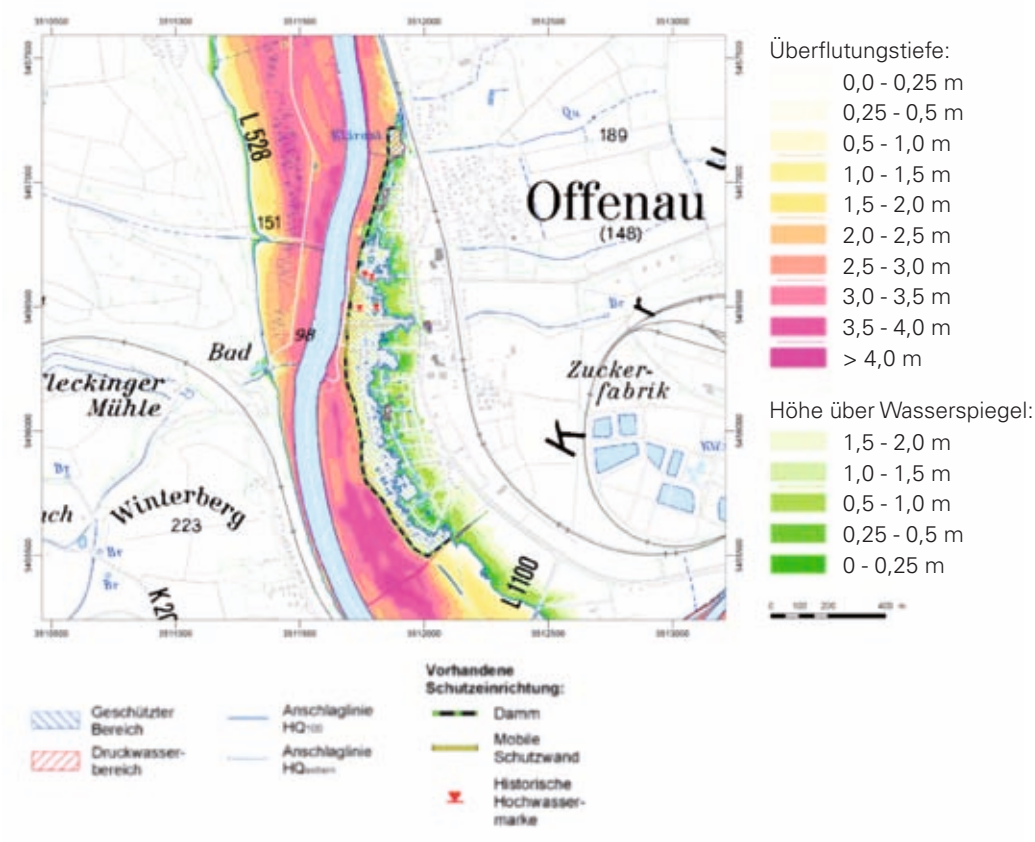

Fig. 1: Standard Map Design Type 1 – Depth of flood for a 100-year flood [Baden-Württemberg, 2005]

1.2 Flood Damage estimation

Apart from the determination of flood hazard, the vulnerability in terms of potential economic losses must be estimated. On the basis of the accumulated values in the areas at risk and the knowledge about the functional interrelation between the event parameters and the resulting damage, risk potentials can be identified and quantified and the damage expectancy values can be calculated. This information about flood risk for individual buildings, settlement areas and river basins is indispensable to inform the population and stakeholders about the local flood risk, for flood control planning measures and for benefit-cost analyses of projected hydraulic measures.

Recent flood events have shown that during slowly rising river floods the maximum water level during the flood event is responsible for the resulting damage. In these cases, the gradient of the flood wave is small and for this reason there are no damaging effects due to flow velocity impacts. Major damages are caused by wetting of inventory and building structure in the cellar and the ground floor. This does not apply for flash floods e.g. in mountainous areas where, due to high flow velocity, buildings may collapse partly or totally. Therefore, it is obvious that flood damage depends, in addition to building type and water depth, on many factors which are not considered using stage-damage functions. One factor is the flow velocity, but there are also others like the duration of inundation, sediment concentration, availability and information content of flood warning, and the quality of external response in a flood situation [Smith 1994; Penning-Rowsell et al. 1994; USACE 1996].

The flood-damage estimation can be undertaken on different levels of spatial differentiation:

On local scale, the damages can be estimated based on spatial data and stage-damage-functions for individual buildings or land parcels.

On a more aggregated level, the approach can be based on statistical information about population, added values, business statistics or capital assets for land-use units. These values are published yearly by responsible state authorities (statistical offices).

Large-scale analyses may be carried out for larger land-use units, like communities or ZIP-code areas, considering that they may be only partially flooded.

During the last years the computational power increased in a way that today flood damage analyses even for larger river courses can be undertaken with a high level of detail. In this context, the question of spatial scale of damage analysis is moving from limitations concerning the area size to limitations concerning the quality respectively the level of detail of available spatial data sets of hazard and vulnerability.

2. The effect of climate change on the flood risk – example of a section of the river Neckar

2.1 KLIWA Project

The question of a possible climatic change and the associated effects on human society is presently a major topic of public discussion. The observed weather phenomena of recent years, in particular precipitation events, make clear that also water management must adapt to changes occurring in the runoff behaviour. In order to investigate these implications, the states of Baden- Württemberg and Bavaria as well as the German weather service initiated the joint project KLIWA (climatic change and consequences for water management) in 1999, which was to examine the influence of climatic scenarios. In this joint project so-called climatic factors were determined, with which regionally dependent peak discharge quantities for different occurrence probabilities needed to be increased, in order to be able to consider the climatic changes. This contribution points out how climatic change affects, in view of further discharge processes of flood events, flood security as well as potential flood damages.

Return period [a]	2	5	10	20	50	100	200	500	>1000
climate-change factor $f_{T,K}$	1.5	1.45	1.4	1.33	1.23	1.15	1.08	1.03	1.0

Table 1: Climate-change factors fT,K for flood events of different return periods for the Neckar catchment area [Ihringer, 2004]

The design of flood protection installations and the evaluation and examination of the degree of flood protection is based on flood events with a certain probability of occurrence or exceedance. Within built-up areas the degree of protection is laid out for floods which statistically occur once in 100 or 200 years (HQ100 or HQ200, respectively). The return periods of corresponding peak discharges are derived from flood frequency analyses, which are based on time series of observed water levels recorded by gauges. The extreme weather events of recent years (2002 flooding of the Elbe and Danube and their tributaries, drought in the summer/autumn of 2003) raised the question as to whether these events are to due to changes in climatic conditions.

The fourth report of the joint project KLIWA has been published and includes the influence of the climatic scenarios for the catchment area of the Neckar River on the behaviour of mean annual peak discharges (derived from daily mean discharges). Using flood frequency analysis the effects on the discharge characteristics were determined. Based on the climate model the computations show clearly that an increase in the peak discharges is to be expected, especially for the discharge range corresponding to small to middle floods. For events with a lower probability of occurrence (large floods) the influence is less.

The introduction of a climate-change factor f is recommended, in which the return period T of a particular event K is selected. For design purposes the peak discharge HQ becomes:

$$HQ_{T,K} = f_{T,K} \cdot HQ_T$$

(Equation 1)

The computed climate-change factors for the Neckar catchment area are given in Table 1. The largest increases in peak discharges due to climate change occur for the more frequent flood events. For longer return periods the factor continuously diminishes and amounts to only 1.15 for a flood with a return period of 100 years. For events which statistically occur more than every 1.000 years no effect on peak discharges due to climate change is expected.

Return period [a]	Climate-change factor $f_{T,K}$	Peak discharge currently [m³/s]	Peak discharge with climate change [m³/s]	Δ Q [m³/s]
10	1.4	1680	2350	670
20	1.33	1960	2600	640
50	1.23	2330	2870	540
100	1.15	2610	3000	390
200	1.08	2885	3120	235
500	1.03	3200	3300	100
> 1000	1.0	3400	3400	0

Table 2: Influence of the climate-change factors fT,K on the peak discharges river section at the community of Offenau (Neckar-km 98.0) situated downstream from the confluences of the tributaries Jagst and Kocher.

2.2 Effect of climate change on flood security and damage potential

Within the context of a pilot study at the Institute for Water and Water Resources Management (IWG), the effects of the modified discharge characteristics were examined more closely for the barrage of Gundelsheim at the river Neckar. The section extends from the lock at Gundelsheim (Neckar km 93.8) to the weir at Neckarsulm (Neckar km 107.15).

The water levels were computed with the 1D computer model of the Neckar mentioned above. Table 2 shows the changes in the peak discharges for the investigated return periods; figure 2 shows the effects on the water levels and the potential damages.

Determining the potential flood damages was carried out exemplarily for the municipality of Offenau/Neckar using GIS-aided tools for flood damages analyses. The calculations were carried out for the small-scale based on the fine-resolution land-use map ALK. The calculations of monetary flood damages are based on the HOWAS damages database from which a square-root function of damages dependent on flood depth was derived. Since the study site is predominantly a residential area only damages to residential buildings were considered. In the pilot study the potential flood damages were determined, i.e. existing preventative measures were not considered.

The increase of the peak discharges leads, in particular for frequent flood events, to a significant increase in the water levels and thus to a substantial increase in potential flood damages. For an event with a return period of 20 years the climate-change factor increases water levels by more than 1 m, which leads to a 9-fold increase in flood damages. Even with a 100-year flood event with only a relatively small proportional change in the discharge volumes of 15%, an increase of 60 cm in flood depths is expected, which can potentially cause a doubling in flood damages.

The consequences of a possible change in climate conditions on the design of flood defence installations or the „re-valuation" of the degree of flood protection becomes significant when the changes in the peak discharges are calculated back to the associated return periods. In figure 3 the HQT values of both the current state and the state due to climate change are plotted with respect to return periods. It can be seen that the defences for a 100-year flood for the current condition will only be adequate to protect against a 20-year flood in the future. If the influence of climate change is incorporated into the planning of flood-protection measures, the design flood of the future return period of 100 years requires a degree of protection which corresponds to a 300-year event based on present climatic condition.

The investigations show that the climatic scenarios carried out in the KLIWA project can have substantial effects on flood security. In the investigated study area, a significant rise in water levels leading to an increase in potential flood damages, in particular for flood events of lower to medium extremity, can be expected. This means a reduction of flood security for existing protection facilities.

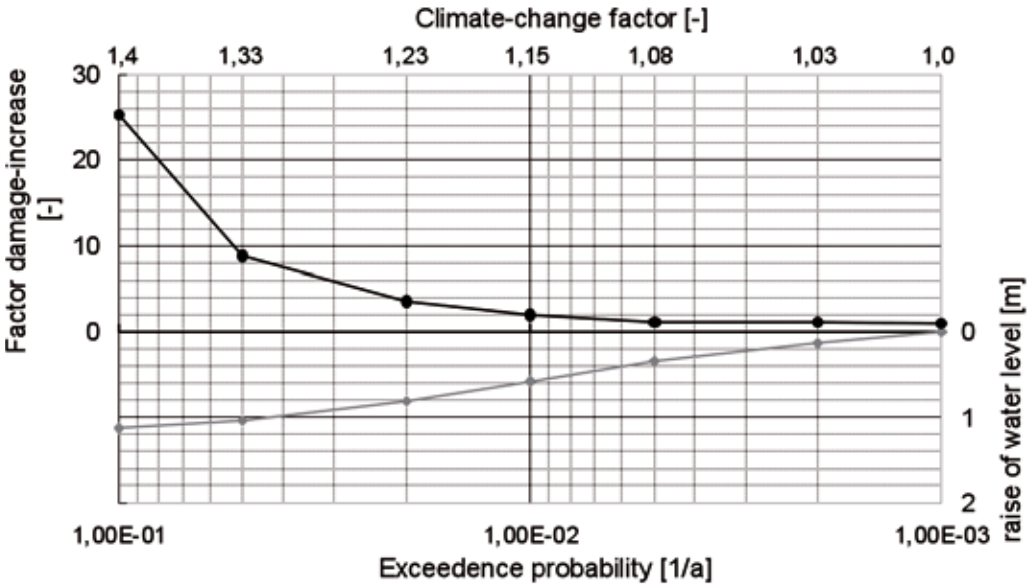

Fig. 2: Influence of the climate-change factor on water depths and potential flood damages in the municipality of Offenau (Neckar km 98.0).

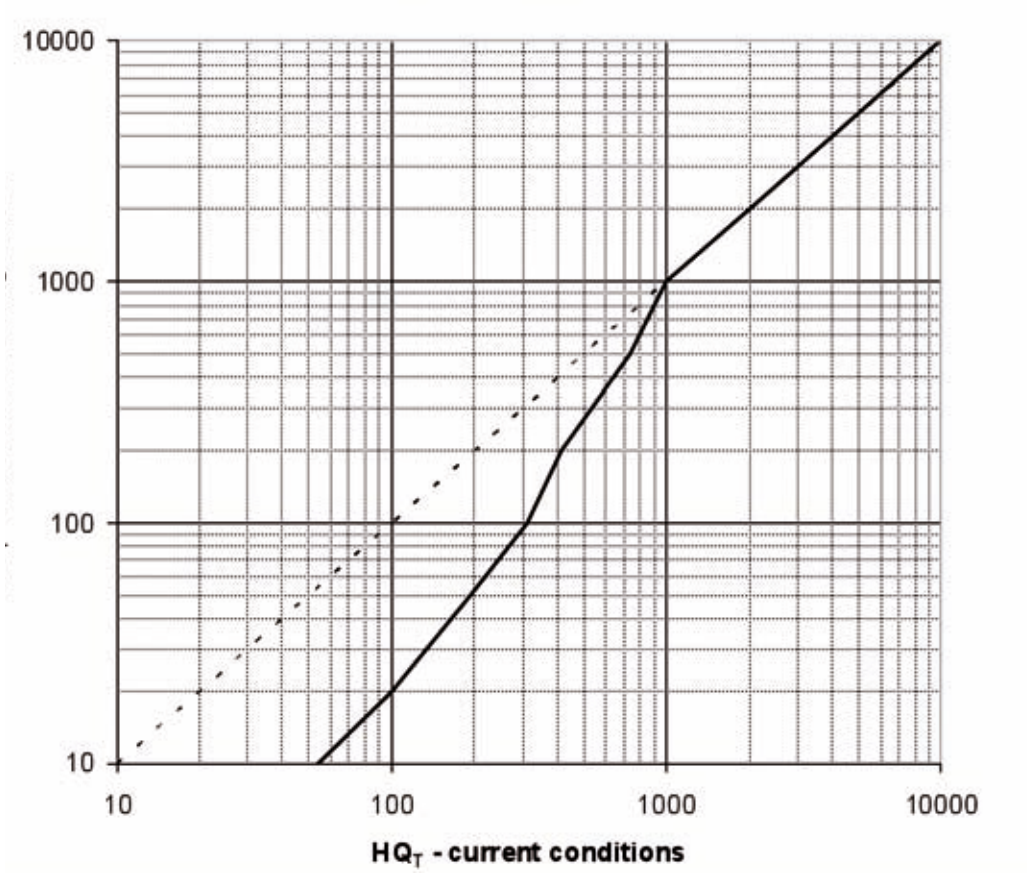

Fig. 3: Comparison of HQT values at Neckar-km 98 between the current and future climatic conditions.

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„Landscape of resistance" – the Fitzgerald Biosphere catchment

Ian Weir

If ‚landscape' is a cultural construction then how might we found landscapes capable of resisting the homogenising forces of development – forces exerted by often ubiquitous conditions such as landscape photography and architectural typology? This essay discusses the author's ten-year attempt to construct a ‚landscape of resistance' in the Fitzgerald Biosphere catchment – a remote, biodiverse region on Western Australia's south coast.

Dr. Ian Weir is a multidisciplinary practitioner and researcher with a keen interest in exploring the creative potential that lies within the space between biodiverse landscapes and their representation and inhabitation.
His mediums of exploration are high-end land survey, photography and architectural interventions. His research has lead to a number of exhibitions of photographic and cartographic artworks and the production of bushfire responsive houses on the south coast of Western Australia. Ian teaches design in the landscape architecture stream at Queensland University of Technology as well as running his architectural design and research practise ianweirarchitect.

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A resilient landscape is most often conceived of as being one which is resilient to biophysical conditions, such as water erosion or water scarcity. We forget too readily that 'landscape' is itself a cultural construction, not a physical condition, and as such 'it' can exhibit degrees of resilience to the forces of cultural change – forces (ideas, preconceptions, predetermined typologies etc) which are often quite subtle but are nevertheless intrinsically linked to the management (or mismanagement) practises we enact within the biophysical environment.

How then do we construct a landscape of resistance – one which is resistant to the imposition of unsustainable management practises and human inhabitation patterns?

A case study for such questioning is the Fitzgerald Biosphere catchment on the south east coast of Western Australia – an area of some 600 square kilometres which is recognised by UNESCO's 'Man and The Biosphere' for its biological richness and human habitation. The catchment falls within the greater bioregion of the South-west Botanical Province, which is the only bioregion within Australia to be recognised on Conservation International's register of 34 global 'Biodiversity Hotspots'. The primary criterion for achieving Hotspot status relates to the likelihood of significant biodiversity loss. Due to land clearing and associated soil salinity the Botanical Province retains only 11% of its indigenous vegetation yet still retains over 4.300 endemic plant species. A majority of the botanic diversity is found not within fertile soils and forests but rather in very nutrient-poor sand plain landscapes known as 'kwongan'.

While being host to such biological richness kwongan has a poor reputation amongst land owners and developers. It is derided for both its aesthetic and physical characteristics: being scrublike, bushfire prone and yielding to four wheel drive vehicles. Furthermore, it is also virtually ignored by artists (unless they are botanical illustrators) and architects and building designers who most often platform their sites with earthmoving equipment before commencing their designs. Evidence of the latter can be found at Point Henry subdivision in the Biosphere catchment, where the author spent eight years researching methods of achieving site-specific architecture for remote biodiverse landscapes.

Fig. 1: The Fitzgerald Biosphere catchment [All illustrations and photographs by the author except where noted]

Fig. 2: ***1*** Fitzgerald Biosphere Catchment
2 Fitzgerald River National Park
3 Point Henry Peninsula

Fig. 3: Kwongan heath – PhD study site on Point Henry

Fig. 4: Cleared sites on Point Henry – some are architecturally designed!

I came to the realisation that buildings are designed on representations of landscape (maps, contour plans etc) rather than the physical landscape itself and therefore in order to develop greater site-specificity I must first develop novel site and place specific representations of the landscape itself. In short – I must first construct the landscape 'idea' before I could spatiality intervene within the landscape. Of course design is not so causal – and we know from David Leatherbarrow and others that sites are constructed as much from spatial interventions (built form) as they are from any preceding representation. Nevertheless my overarching goal of encouraging greater engagement between people and the particularities of Point Henry was somewhat achieved through a diverse range of mediums which I employed in my study. These included: photographic artworks, motivational talks to artists, built works of architecture, site installations, botanical studies, membership of local development committees and even the purchase of four hectares of kwongan landscape (which I named 'Content Too' after our farm in the catchment: 'Content'). This creative research was presented to the catchment community via three public exhibitions, one of which toured Western Australia for two years as well as a local art symposium and workshops. Furthermore I coordinated three University of WA architectural and landscape architectural design studios within the catchment. These were aimed at developing an understanding of the relationships between perception and aesthetics within the context of both the biophysical and cultural landscape.

I borrow 'landscape of resistance' from James Corner who calls upon designers to rethink the means by which we might conceive of a landscape design practise which is more culturally and environmentally sustainable. Corner's concept builds on Kenneth Frampton's articulation of 'Critical Regionalism', which is useful for the key flaw in Frampton's argument is that it relies on the vernacular (read 'sustainable') to provide cues, keys and foils to a universal modernist aesthetic. Whereas the least resilient landscapes are arguably those that are without clearly identifiable histories of sustainable inhabitation – like my study at Point Henry which is being developed for permanent housing for the first time, and the greater Biosphere catchment which has only been farmed for two generations.

Fig. 5: Content – the author's home for his first 12 years (1963-1975) [Photographer unknown 1961]

Identity and resilience

Creating a landscape of resistance involves articulating an identity for a place. Without the articulation of a unique place-specific identity the 'local' gets consumed by the 'regional' and so on. Needless to say it is a massive task to create a culturally resilient landscape, but that, I argue is ultimately the context within which our discipline should work – defining the specific from within the general. Defining Point Henry, within the Biosphere catchment, within the Botanical province … has been a self fulfilling and propelling research project, one motivated by the urgency of loss, not so much loss of biodiversity but the potential for loss of the ability for this particular (extremely remote and biodiverse) landscape to generate new forms of representation, language and spatial intervention and thus contribute to and broaden understandings of landscape design practise.

Some examples of my creative research are as follows:

Earth as Light: using light based mediums to express the earth itself as light and animate. This work, which used stereo durational photography and light projections, was motivated by the propensity within architecture for forms which were derived from either a 'touch the earth lightly' ethos or digitally emergent animate forms (e.g. Greg Lynn). Both positions are problematic because they are based upon the preconception that the earth/site has an inert gravitas – landscape is thus cast as a convenient foil to these superficial form-making exercises. Motivated by John Rajchman's articulation of Lightness (in Rajchman, J. Constructions, Writing in Architecture Series) I sought to instead represent the earth itself as light and animate and in doing so develop an architecture which reveals rather than suppresses the dynamism of landscape to its inhabitant. Earth as Light was exhibited at the University of WA's Cullity Gallery in August 2000 (solo exhibition).

Eyes Wide Open: a more didactic series of works than Earth as Light. Here I developed large format digital prints incorporating from satellite imagery, botanical data bases, and botanist's anecdotes and my own landscape photography. The statement (by botanist K Newbey) "If you tried you could discover a new species everyday when some scientists are delighted to find one in a lifetime" overlays are list of the 3.500 or so plant species that scientists have found to date in the Fitzgerald Biosphere catchment. A similar sized panel (1.2 x 2.5 metres) lists the 25 (only) species that are grown by the broad acre farmers in the catchment. Eyes Wide Open was held at Gorepani Gallery, Albany in 2003 and featured three invited artists from the great southern region of Western Australia.

Terrestrial Laser Scanning: The texture of the 'point cloud' data from laser scanners bore a strange resemblance to the visual character of the kwongan heath of my study site. Using this technology for the first time to measure vegetation, the scanner has produced both an enigmatic representation and an empirical measurement in Cartesian coordinates. The result having both a poetic exhibition value and a factual record of the spatial structure of the landscape. The changeability of vegetated landscapes – in this case one which is regenerating from bushfire – is capitalised upon by repetitive measurement. For example, Before and after the fire incorporates two scans (literally one taken before a bushfire and one from the same position after the fire). In this way the dynamism of landscape is captured in a means which has direct relevance to

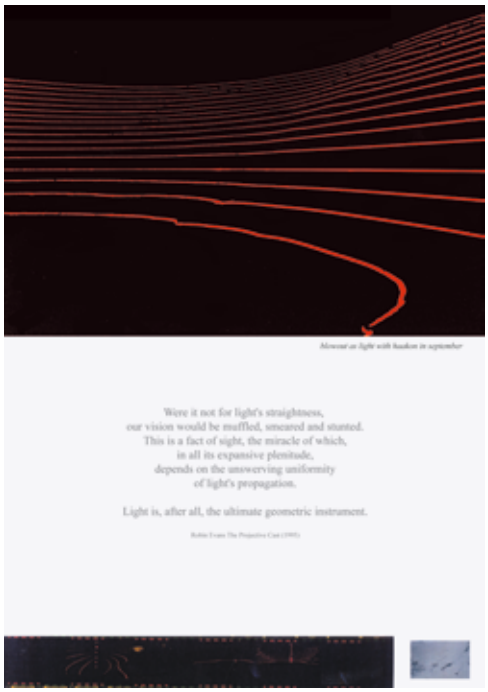

Fig. 6: Blowout as light with Haakon. Long exposure (three hours) of laser light projected in a dunescape in the Fitzgerald Biosphere Catchment, with text from Robin Evans, Architectural theorist. [Ian Weir 2000]

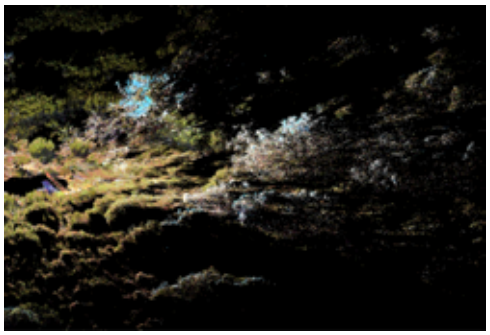

Fig. 8: Terrestrial Laser scan of kwongan landscape on Point Henry, Fitzgerald biosphere catchment. [Ian Weir 2004]

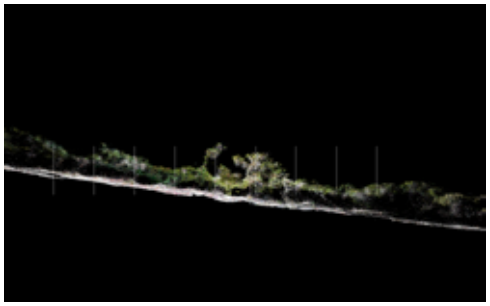

Fig. 9: Before and after the fire. Merged terrestrial laser scans taken before and after a fire on Point Henry. [Ian Weir 2004]

architectural design which always deals with the concrete and the finite. Form is generated and realised through the medium of measurement and here the previously un-measurable (the dynamic kwongan) has become a quantifiable factor in the design process. In short it has been concretised as a vegetative 'ground' in the same manner in which we normally attribute the mineralised one.

Lightsite: celebrating connectivity between people and their landscapes in the Fitzgerald Biosphere catchment. Here a room-sized demountable pinhole camera was transported for six months through a variety of landscapes in the catchment. Key people (farmers, fishermen, botanists) where placed inside the camera where the only light entering came through a small aperture in one

Fig. 7: One in a lifetime. 1.2 x 2.5 metre digital print of 3.500 species found to date in the Biosphere catchment, with quote from local botanist Ken Newbey (deceased). [Ian Weir 2003]

wall. Importantly the room-sized camera did not have a floor and was built directly over each person's landscape (a wheat field, sheep yard, fishing spot, kwongan heath). In doing so not only the person, but their physical landscape was revealed by the light coming though the aperture which itself was reflected off their landscape and projected inside.
The idea behind the work was to collapse, what has become in landscape theory, two opposing understandings of landscape: landskip, the graphic picture or framed landscape, and landschaft, which is the not graphic but rather encapsulates our idea or mental picture of landscape. The latter is usually attributed (by James Corner and others) to those that work the land and is cast as being more sustainable than scenic superficiality of landskip. Of course those that work the land and are embedded within it, value their home as much for its scenic attributes as their eidetic memories: they are nevertheless intertwined. Thus, lightsite seeks to incorporate the two by bring forth the relationship between eidetic memory and scenic landscape. It does so through the medium of light. Lightsite was commissioned by the Perth International Arts Festival though a Regional Arts Fund grant. It toured Western Australian regional galleries for two years (2006/2007) as part of the 'Hotspot' collection of artists from WA's great southern region.

Fig. 10: Barb on Content Too. Five minute long exposure of local botanist Barbara Miller-Hornsey. [Ian Weir 2006]

Fig. 11: Jack's Bay: the architecturalisation of memory. Five minute long exposure taken inside room-sized floorless camera obscura. [Ian Weir 2006]

The Hollingworth House: a bushfire responsive house on Point Henry. This house was not designed to be resilient to bushfire per se but to provide greater connectivity between the inhabitant and the multiplicities of conditions of their kwongan landscape. Physical proximity between the Hollingworth's and the kwongan heath is achieved through a variety of fire safety measures such as fire resistant glazing and shutters, a fire safety zone and the overall landscape design. Since Victoria's 'Black Saturday' tragedy the Hollingworth house (and its landscape) has achieved considerable attention in Australia as an example put forward (by the media) as a means of living sustainably with bushfire-prone landscapes. Rather than relying on once-in-a-lifetime measures (such as bunkers) the primary strategy here is to bring bushfire into the daily life of the inhabitant: the fire shutters, for example have to be used on a daily bases to control the sun. In doing so the two otherwise opposing goals of bushfire safety and biodiversity conservation are somewhat reconciled.

Fig. 12: Lightsite camera obscura sited in Content Too, the author's PhD study site.

Fig. 13: The Hollingworth House – Point Henry, WA (fire shutters down at dusk) [Photograph by Andrew Halsall 2008]

Fig. 14: The Hollingworth House – with the perforated fire shutters down at dusk. [Photograph by Andrew Halsall 2008]

Projects and implications for research

Reading constructed landscapes

Torben Dam

Complex problems hold more possibilities than any individual comprehends, and complexity evolves because disciplines interact arbitrarily with society, their own perception and the problem. Reading in a multidisciplinary group including interregional parties is new and will bring globalisation into a more resilient position, because the multidisciplinary groups read solutions of complex problems using landscape architectural projects defined in time and character of the place. The objective is to meet the challenge of complex problems by reading landscape architectural projects. The paper argues for using landscape architectural projects as cases. The aim is to show how and why landscape architecture can contribute to a multidisciplinary group solving complex problems in resilient water landscapes. The paper bridges the gap between science and design as well as their different cultures of research. The paper argues theoretically and by examples that multidisciplinary groups benefit from the reading of constructed landscapes. Complex problems can be discussed over and over again. With cases using landscape architectural projects somebody has prepared a very good background for a multidisciplinary group. The cooperation and reading of constructed landscapes can be varied in endless combinations and the themes can focus on bilateral comparisons, trilateral, regional perspectives or global ones.

Associate Professor, landscape architect mdl Torben Dam is appointed to landscape architectural study-programme at UC. R&D has under the years included several subjects. From 1998 – 2002 "Local storm water management in the suburb Tingbjerg". From 2000 – 2003 urban street design based on introduction of the sewage system in the second half of the 19th century. Over the years Torben Dam has organised or taken part in a number of standardisation works within design, constructing and maintenance. The present research is focusing on theory and methods enabling the planning process to handle hypercomplex relations. Torben Dam is the author of the Danish textbook "Befæstelser" on hard landscapes in landscape architecture.

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Complex problems hold more possibilities than any individual comprehends, and complexity evolves because disciplines interact arbitrarily with society, their own perception and the problem. Complex problems involving many disciplines challenge.

The challenge spreads in many directions; firstly the definition of a core problem challenges a multidisciplinary group. Many natural science disciplines seek to define the problem, and their interests depend on the inclusion of their subject. While planners and landscape architects sketch to investigate the matter taking scattered positions without explanation, the iterative process confuse scientists. Social science and economic however wants to involve people and future users before any problem is defined. The challenge is to find a common method to proceed.

Secondly the solution of complex problems eliminates and narrows possibilities and potentials while the process proceeds, often letting disciplines behind and combining issues never combined before in the particular case. The challenge is to decide on behalf of the site, space and time.

Thirdly all disciplines evaluate and comment on the solution, when it is found – visionary and holistic in a way that never occurred under the process. The challenge is to reach a solution early enough to utilise the energy of hindsight wisdom.

Fourthly, the international perspective shows that water links globally. Interest, terms, commitment and multidisciplinarity is global. Regional drivers' derivates make problems even more complex. In 20 years Australia has experienced a drought, the term "urban water sensitive design" tells about the solution adjusting plantings to avoid irrigation and adjusting pavings to harvest storm water. Australia has also a vernacular assimilation to the extreme climate e.g. flooding in the outback. River flooding over many years in Germany has made it evident to regulate storm water, so Regenwasserversickerung (Storm water management) incorporates the urban landscape for more than 15 years. Water management adapts already the demands in The European Water Directive. Denmark has a third regional perspective to storm water management. The main driver is water quality along the 7.000 km coastline. Bathing water quality is the main focus. The Danish government hesitates implementing the national plan due to the European Water Directive. The challenge is to link and balance the global and regional perspective.

Project presentations are regularly done, case studies often seen, closely reading of constructed landscape are seldom. Reading in a multidisciplinary group including interregional parties is new and will bring globalisation into a more resilient position, because the multidisciplinary groups read solutions of complex problems using landscape architectural projects defined in time and character of the place.

Fig. 1: Dip / flooding sign warning in Australia [Photo Torben Dam]

Fig. 2: Isar River flooding [Photo Torben Dam]

Fig. 3: Copenhagen Harbour Houses with swimming facilities [Photo Torben Dam]

1. Objective

The objective is to meet the challenge of complex problems by reading landscape architectural projects. The paper argues for using landscape architectural projects as cases. The aim is to show how and why landscape architecture can contribute to a multidisciplinary group solving complex problems in resilient water landscapes. Further the paper argues that cases facilitate multidisciplinary groups and single disciplines because they detect, exhibit and discover areas / fields of interest / absents of knowledge which need a specific focus. Documenting so on the basis of landscape architectural projects the multidisciplinary group balance individual interest in accordance with the core complex problem.

The paper bridges the gap between science and design as well as the deviating culture of research. The method involves case studies, theory of history of art, and theory of the reading of landscape architecture. The paper argues theoretically and by examples that multidisciplinary groups benefit from the reading of constructed landscapes. The examples are gathered from a range of readings illuminating approaches of interest to resilient water landscapes, also addressing the distinction of the global to the regional culture.

2. Theory

Theory about the design process illustrates the interchange between knowledge of all kinds and the design. This supports the reading of constructed landscapes and further supports the understanding of a multidisciplinary approach to solve complex problems in general. There is a massive amount of information that may be relevant, not only to all the possible solutions, but simply to any possible solution. And any possible solution in itself creates the unique circumstances in which the large bodies of information interact [Cross 2006, 57]. Designers moving freely between different levels of specific solutions and subject in their sketches often worry scientists. Constrains ruin the multidisciplinary approach to a complex problem, so confidence in the methods of science and design clarify multidisciplinary cooperation. The design method is the most promising and opens between different scientific cultures.

Can a multidisciplinary group proceed without having a clear definition of the problem and in which direction the process should go? If the answer is no, it favours the scientists. The risk is that definition of the problem takes all the time, and leaves no time finding a solution and discussing the result. All suggestions to a problem are tested by falsification, but as long as there is no idea of a solution all ideas can be falsified.

If the answer is yes, and the multidisciplinary group proceed, it favours the designerly way of thinking, and the risk is that the designer leaves other disciplines behind and time runs out before an iterative process has found a solution. All disciplines can rely to the solution, and maybe the solution is altered. Time becomes a problem in each case, so acknowledge of different cultures and agreement on one approach is necessary.

A place to merge natural science and design are the writings of Horst Rittel, who distinguish between the "tame" problem and the "wicked" problem [Rittel 1973]. The discussion between disciplines who want to define the problem and disciplines who wants to investigate the site,

the knowledge and possible solutions relate to different cultures. If all disciplines accept that complex problems are "wicked", all accept that a wicked problem is one we cannot understand without knowing about its context; one wicked problem we cannot meaningfully search for information about without orientation of a solution concept; one we cannot first understand then solve. [Rittel 1973] There is no definitive formulation of a wicked problem, all complex problems are wicked, but awareness of the character the multidisciplinary group don't lose valuable time. In design and planning the knowledge you need to know about the problem becomes apparent as you're trying to solve it [MacCormac in Cross 2006]. The advantage of reading constructed landscapes in landscape architectural projects is that we have a solution and therefore we also have a problem, the multidisciplinary group starts on a platform, even though they not necessarily agree in all parts of the case.

The term read or reading is well-established in the history of art. In humanities reading is a method, and we can adapt it if we are familiar with the method. "If we offer a statement about the causes of a picture, what is the nature and basis of the statement? More particularly, if we think or speak of a picture as, among other things, product of situated volition or intension, what is it that we are doing? So the question is, within limits, one about the historical explanation of pictures, though I more often speak of 'inferential criticism' of pictures." [Baxandall 1985]. Landscape Architecture is also a product of situated volition or intention, which we can read.

Malene Hauxner introduces the theory from humanities into landscape architecture. She calls it "Drawing and Reading" and even sees similarities in the design elements and the process of design compared to the process of reading as a kind of research. "Reading is to collect parts and put them together in a personally understood product, which build on empirical conditions. The basis of the method is thus the reading of the drawing. It is an analysis in the sense that the individual parts are unpicked. But it is also a synthesis since the parts are reassembled in an interpretation. Gardens are created in a particular time, on special cultural, political and economic premises, according to a particular programme, intended for a particular place by a particular person. In assuming this double nature, that the work besides being a work of art is a social product, the method requires both a critical reading of its context and a close reading of the language. Three conditions manifest themselves in a work: the intentions of the maker, statement of the work and the observations of the viewer, construction and interpretation." [Hauxner, 2003]

Complex problems can be discussed over and over again. With cases using landscape architectural projects somebody has prepared a very good background for a multidisciplinary group. All disciplines have similar information, and they have a constructed landscape, which can be seen as a solution. They can evaluate the problem; they can construe the specific knowledge within their subject used in the case. All combinations of detail, subject, problem and solution can be read and discussed. Disciplines can evaluate the knowledge used; they can question the problem and the solution. Evaluation of the solution can lead to reformulation of the problem; bringing new, not used knowledge into to solution, or conclude actual lack of knowledge. Each discipline is not alone and all parties rely to the same case, which gives the opportunity to acknowledge other disciplines findings and conclusions. Further everybody can test argumentation on a specific basis. "Starting with the case rather than the laws at least assures dialogue with the material." [Blundell-Jones 2002]

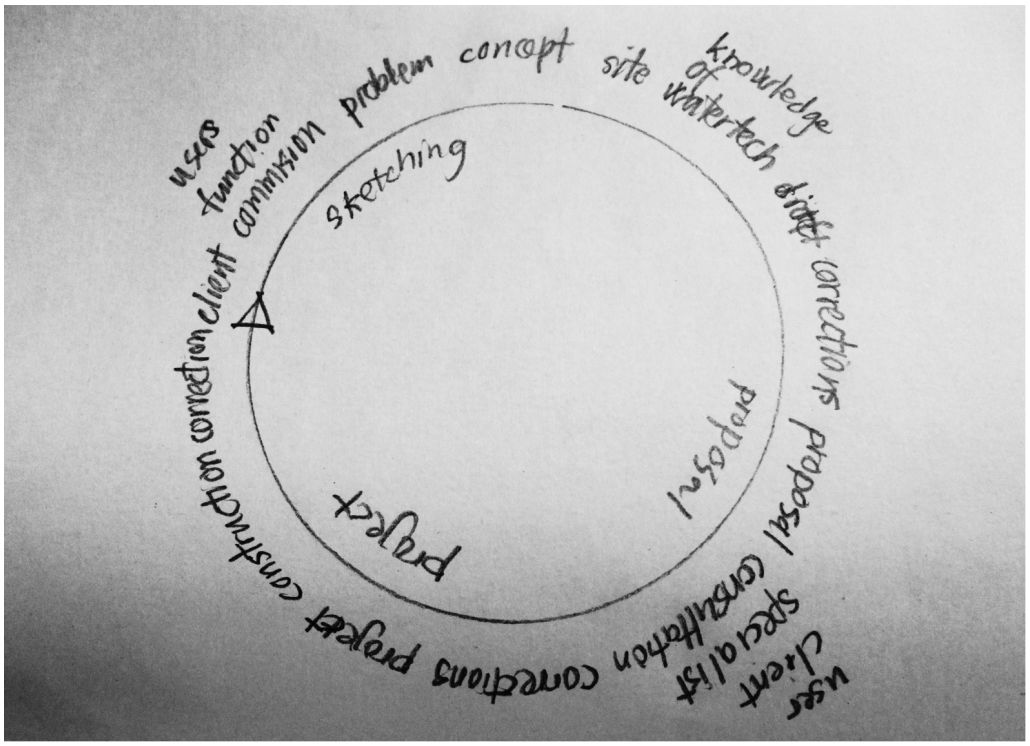

Fig. 4: The design process involves many positions and interacts with many disciplines. Study of the design process supports the reading of a constructed landscape. Models of the design process postulate interaction with disciplines and consultation. Knowledge is also featuring in all design models. Hauxner (2003) states that design and reading hold the same ingredients used in the opposite sequence. [Sketch by Torben Dam]

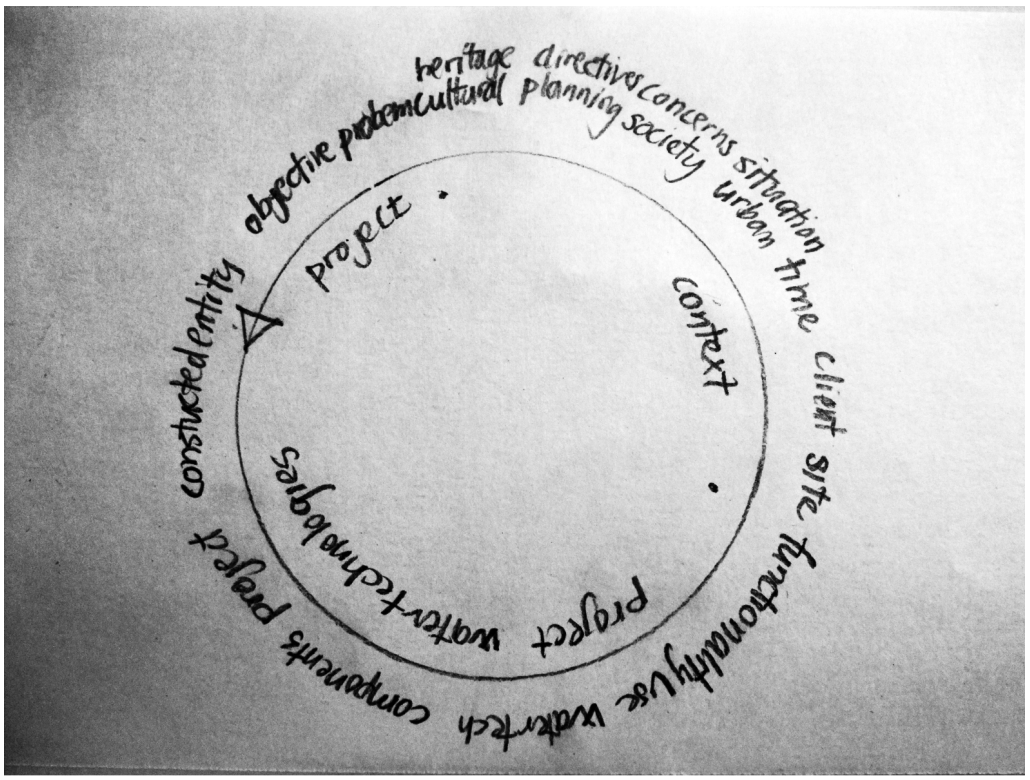

Fig. 5: Reading a constructed landscape. Description of the components, water technology, and the architectural language. Discussing the context as functionality, site, client, the urban context, society concerns, planning directives, cultural heritage. Comparing the constructed landscape with the objectives in the program and the commission. [Sketch by Torben Dam]

3. Reading six squares

The Danish professor Steen A. Høyer reads six contemporary squares in Copenhagen, Denmark and Malmö, Sweden [Høyer, 2002] using defining standpoints and tendencies. Høyer evaluates the cases by setting up two extremes and placing the six squares between the two. This allows an evaluation with professional subjects important to the case study and without "good and bad" or "like or dislike". The evaluation starts: "The opening of space as a public arena is a problem than has been addressed since the renaissance. From the closed and defined park and urban spaces, there has been a gradual dissolution of distinctions, from the baroque period to modernism, toward a total fusion of the urban-landscape space, where the dissolution of the concepts of culture and nature is a consequence of theory and practice." [Høyer, 2002]

Name	Landscape Architect	Place
Halmtorvet Square	Copenhagen municipality	Copenhagen, Denmark
Hillerød Library	SLA-architects	Hillerød, Denmark
Otte Krabbe's Square	Lundgaard og Tranberg	Copenhagen, Denmark
Glostrup Center	SLA-architects	Glostrup, Denmark
Sundspark	Jeppe Aagaard-Andersen	Malmö, Sweden
Ankapark	SLA-ARchitects	Malmö, Sweden

Fig. 6: Six contemporary squares in Copenhagen and Malmö read as cases in a discussion of urban space, nature and detailing [Høyer 2002]

One extreme	Subject discussed	Another extreme
Otto Krabbe's Square	The scope of these projects lies between Otto Krabbe's square as a fixed scheme and Ankapark as the fluid, furnished space	Ankapark
Halmtorv Square	The extremes are Halmtorv square design elements contra the integration of the existing terrain, paving and landscaping in Glostrup Center.	Glostrup Center
Hillerød Library	There is a great danger that the garden art drowns in a detail fetishism or haute-couture as is the case with Danish Architecture. The extremes here are Hillerød Library with its installation-like special gardens and Sundspark's robust bridge structures.	Sundspark
Otto Krabbe's Square	A focus on textural effects and sensualism's transitory presence can be seen as a reaction to the concrete and more stable architectural space and a result of the increasing abstraction in the IT-based space. The notion of matter, body, presence, meaning, and identity as articles in short supply at the moment is also parallel to the sculpture discussions about identity and the meaning of place in the public space. The extremes here are Otto Krabbe's square as the most collective and Hillerød library as the most intimate.	Hillerød Library

Fig. 7: The tension between selected subjects illustrates the matter of complex problems rather than summing up in one bottomline. Resilient water landscapes have the same stray subjects and the tension between extremes allows multidisciplinary groups to communicate.

4. Storm water source control – the effect on a proposal for the suburb Tingbjerg, Copenhagen

In a project financed by the Danish Environmental Agency a multidisciplinary group [Markussen et al. 2004] tested the effect of storm water management on a specific site in a suburb 12 km from central Copenhagen. The overall goal was to reduce combined sewer overflow from two outlets – in a canal and in a bog. The engineers asked the designers for a proposal and the landscape architects pleaded the engineers to give some first calculations of water and to point out where the problems were. Eventually a design was found, and if this design was used everywhere in the suburb combined sewer overflow could be reduced to 75 – 90 % of the precent overflow volume in the two outlets.

The iterative process running from 1999 to 2002 only managed one round, and the design ended up being a postulate. Storm water elements were either overloaded or not effectively used. Knowledge from the calculation models could have improved the efficiency and the design. Money ran out before a fruitful iterative process worked, luckily the intension never was to construct the proposal. The lessons learned were that the multidisciplinary group should know the different cultures. Not waiting, rather pushing preliminary solutions forward, and testing them in the calculations models, even though figures and numbers were approximate. All members of the multidisciplinary group had plenty of comment to the final report, but improvement was not possible.

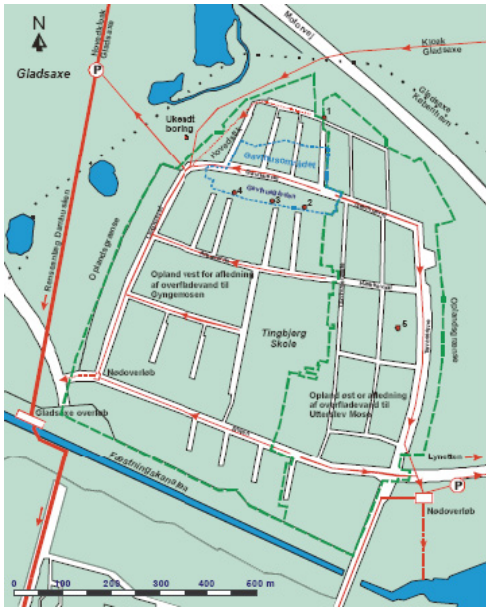

Fig.8: Design proposal with storm water elements. The wadi along the path infiltrate with a great variety, which could have been improved by a second turn in the iterative design process. [Markussen et al. 2004]

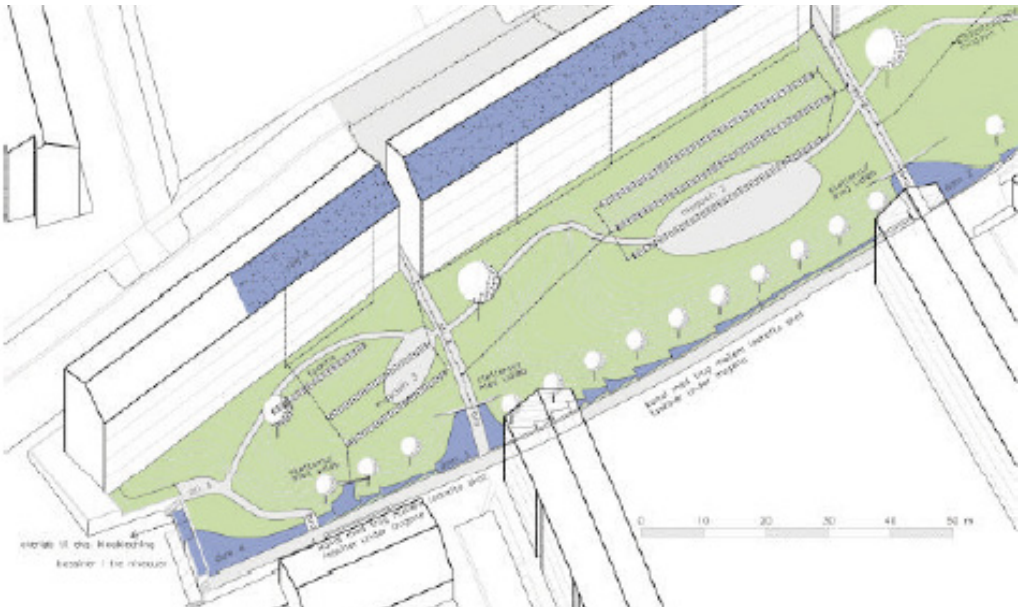

Fig. 9: Tingbjerg, a suburb 12 km from central Copenhagen [Markussen et al. 2004]

5. European landscape architecture

Reading constructed landscapes contribute with more information than regular project presentations in magazines. Presentations tend to have a linear storytelling, which seldom tells the true story of a complex problem. A multidisciplinary group is too informed to believe the simple storyline, and in a case study it is more interesting to unfold all the detailed choices, decisions and selections that normally characterise the iterative design process. This was also the intension in European Landscape Architecture from 2007 [Thompson et al, 2007]. Researchers and scholars from European countries studies one or two landscape architectural project from their home country. Drafts and sketches were collected and compared with competitions entries and the built result; telling the story of an iterative process, and illuminating arguments for particular choices among several options during the design period. The book aimed to examine the regional and European touch, and this was supported in the foreword: "Three crucial areas of work are detail durability, the preparation of a history of landscape technology and finally, regional case studies in landscape design detail" [Niall Kirkwood in Thompson et al. 2007]. The cases were coming from nine European countries: Ireland in the west, Hungary in the east, Sweden in the north, and Spain in the south. The motor-way rest by French office HYL is actually dealing with storm water.

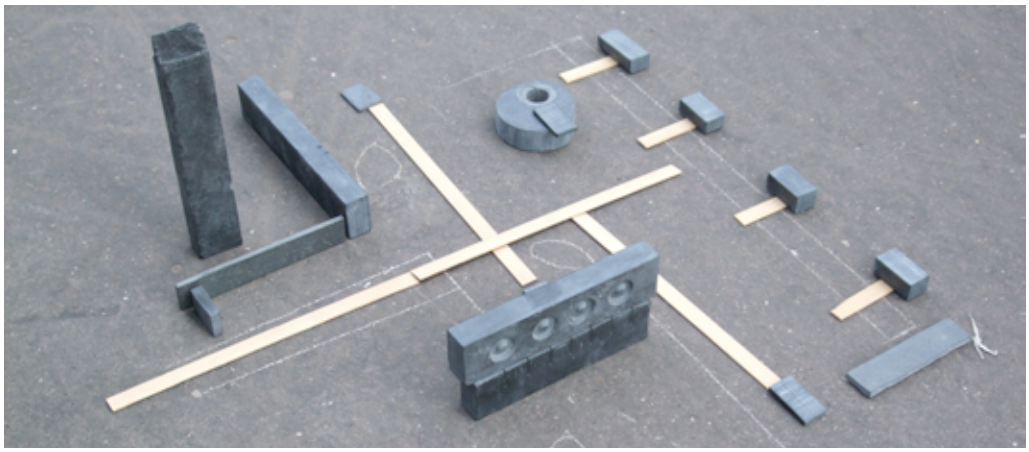

Fig. 10: Physical models built on the site as used on field trip at University of Copenhagen. They are a tool for multidisciplinary groups to determine the most important element on site. Here Parc Cormailles in Paris, Ivry, by Agence Ter. [Photo Torben Dam]

name	University / Faculty / Department / Unit	start	subject	Title of PhD-project
Jan Jeppesen	University of Aarhus Geology	01.01.2007	geohydrology	Quantification of the urban water cycle
Heidi Birch	Danish Technological University Environment	01.02.2008	Water-chemistry	Optimeret model-baseret monitering af vandkvalitet i dynamiske udledninger fra byer
Maria Bergman	Danish Technological University Environment	01.04.2008	Water - flowdynamics	Integrated modelling of sustainable urban drainage systems
Simon Toft Ingvertsen	University of Copenhagen Faculty of Life-sciences Soil science	01.02.2008	Water - chemistry	Technologies for storm and grey water treatment
Ole Fryd	University of Copenhagen Faculty of Life-sciences Forest & Landscape Parks and urban landscape	01.11.2007	Urban planning	Natural Process in the urban landscape – bridging the gap between planning, landscape architecture and hydrological technology
Antje Backhaus	University of Copenhagen Faculty of Life-sciences Forest & Landscape Parks and urban landscape	01.02.2008	Landscape design	Urban storm water landscapes – values and design
Toke Emil Panduro Petersen	University of Copenhagen Faculty of Life-sciences Forest & Landscape Forest economics	01. 12 2008	Environmental economy	Urban water management – towards greater economic rationality

Fig. 11: PhD-students analysing cases on the site

6. Field trip in master theme course at UC

Excursions are important. Being on the spot, experiencing the space, environment and context is crucial for the common understanding of a case. In the landscape program at University of Copenhagen physical models are introduced [life. 2009] to improve the value of the excursion and prevails exhaustion when visiting many places. The physical model is a tool where everybody can contribute, and simplification helps defining the key elements. In a multidisciplinary group the physical model can bridge the gap between scientists and designer, and even though the model is a designers tool, the language are known to all, and everybody can change or remove elements in the physical model advocating for their opinion.

Black, Blue and Green – integrated infrastructure planning as key to sustainable urban water systems [www.2bg.dk]. The 2bg-project is the largest Danish contribution to multidisciplinary research on storm water. Black is standing for the impervious surfaces, blue for water and green for the urban landscape where nearly all impervious surfaces are. Two examples are taken forward to illustrate the objective of this paper. One is a field trip to The Netherlands analysing eight cases, and the second is a common case done by eight PhD-students. The PhD-students cover a wide range of disciplines e.g. geo-hydrology, water chemistry, water dynamics, urban planning, landscape design, environmental economy, and participatory planning.

The excursion to the Netherlands looked at eight cases [Birch et al. 2008] and the PhD-students analysed the cases on site. They had two obligations: 1) to describe how their particular discipline was construed and if the case had a good common practise within their field, 2) When they saw the site they should detect what had been the main problem for the designers and discuss to which degree the design had succeeded.

A small stream – Harrestrup Å – at the west border of the municipality of Copenhagen has over 100 years developed to an open sewer. Up to a hundred times a year combined sewers overflow to Harrestrup Å. The PhD-students tested the title of the research program "integrating infrastructure planning as a key to sus-

Fig. 12: The study trip included visits to Leidsche Rijn (Utrecht), Eva-Lanxmeer (Culemborg), De Vliert ('s- Hertogenbosch), Monnikenhuizen (Arnhem), Haaksbergen (Twente), Ruwenbos (Enchede), Stad van de Zon (Heerhugowaard), and Westerpark (Amsterdam). [Birch et al. 2008]

tainable urban water systems" [Fryd et al. 2009]. Regarding the process as "wicked" they quickly started to make plans, which then were tested by the disciplines. The iterative process continued to the very end, and the PhD-students managed to turn problems into possibilities. The result is a heterogenic plan exploring different strategies in three areas and even leaving some areas out because of pollutants from traffic or contamination of the ground. The water company asked for one combined sewer overflow per year, and they estimate that local storm water management in combination with improvement in the sewer can meet climate change's 130 % storm water for a cost of five billion Danish krones (dkr) – ten billion dkr less than the cost of a new sewer system, which meets the same 130 % increase of annual storm water. The common case Harrestrup Å now creates the basis for each individual PhD study, and all eight PhD-students now have to proceed the research in the culture of their discipline. The results from Harrestrup Å are remarkable, but the main benefit is the change in perception of the core problem that each discipline experienced.

	Work analysis	Evaluation	Questions
hydrology			
Quality control			
Planning & design			

Fig. 13: Each of the eight case studies was evaluated in the matrix above. [Birch et al. 2008]

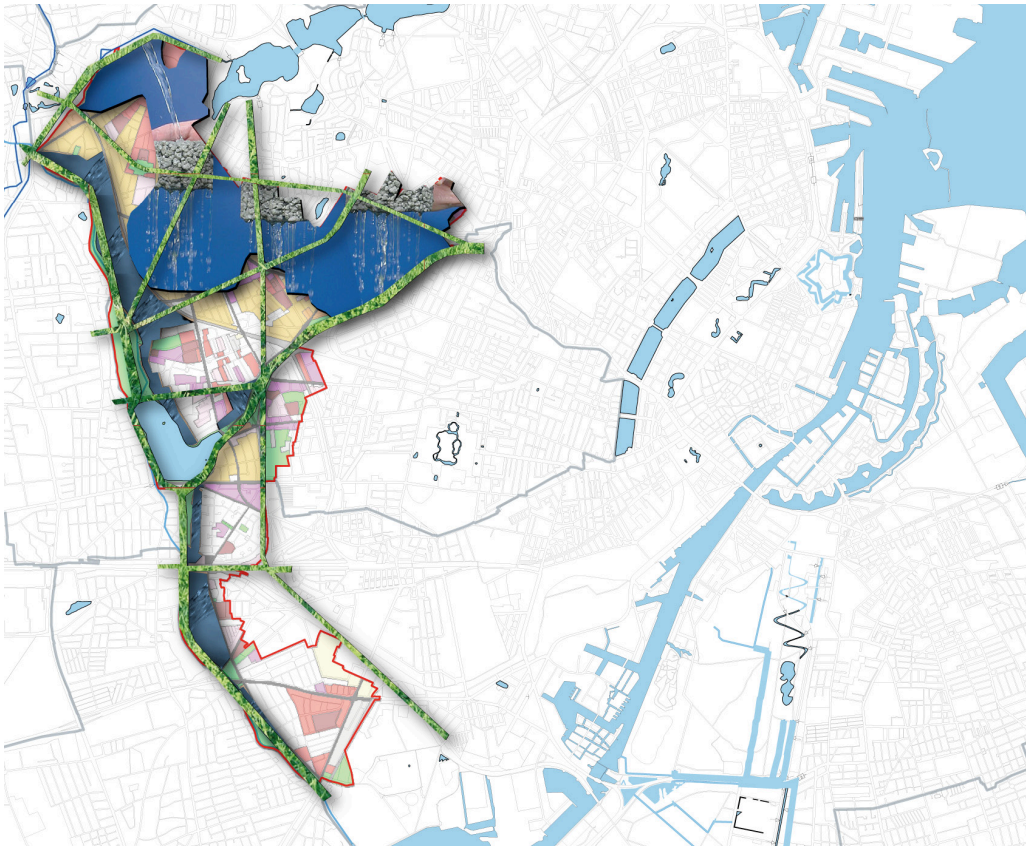

Fig. 14: The result is a heterogenic plan exploiting different strategies in three areas and even leaving some areas out because of pollutants from traffic or contamination of the ground [Fryd 2009]

7. Conclusion

Urban planning and design will always be complex, wicked problems. Cross, Hauxner and the cases from Tingbjerg and Harrestrup emphasise that. Storm water management is wicked too; the question is whether it will remain wicked or whether it will be "tame" as the traditional sewer system is today, Rittel, Markussen et al. propose that storm water management is wicked and support to get started. Cases studied by multidisciplinary groups embrace all cultures of the disciplines and accept a common method from humanities and design as described by Baxandall, Hauxner and Thompson et al. The group starts with physical models as mentioned from Life, picks extremes as Høyer does and allows reading of things not yet visible and documented as Hauxner suggests. The lessons learnt from multidisciplinary cases focus on quick preliminary conclusions, contextual conditions as shown by Birch et al., Fryd et al., Markussen et al., Thompson et al. The cooperation and reading of constructed landscapes can be varied in endless combinations and the themes can focus on bilateral comparisons, trilateral, regional perspectives or global ones. It has just to get started.

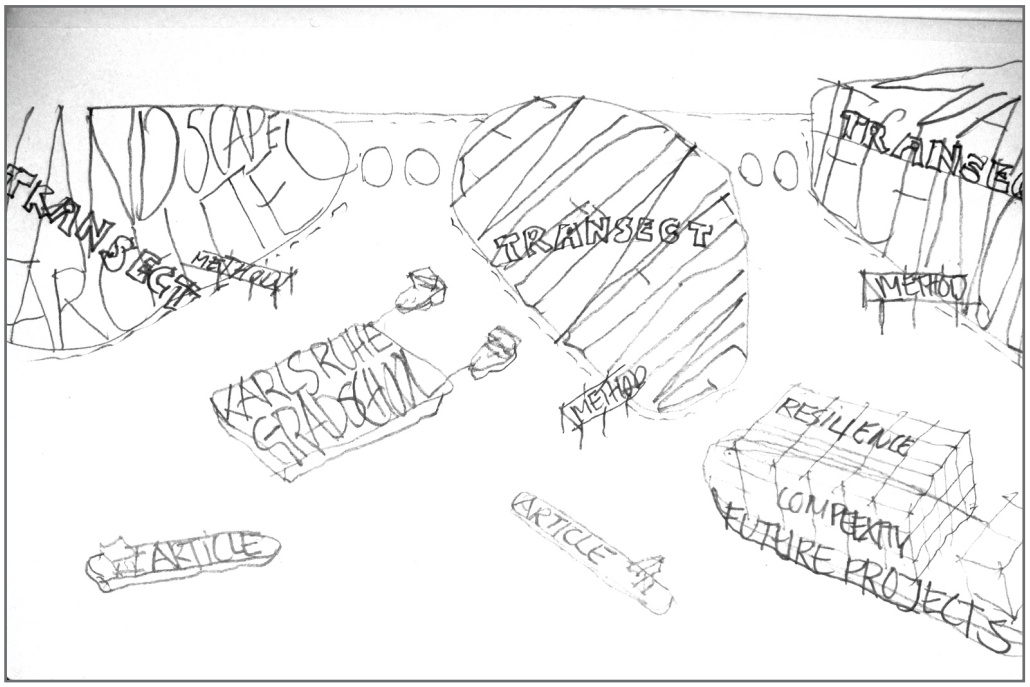

Fig. 15: The resilient water landscape. Three islands – water technology, quality assement and landscape architecture – are surrounded by the sea of possibilities. Vessels, barges, ships are navigating on the sea; some are ferries scheduled, and some contain sealed boxes. [Sketch by Torben Dam]

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WaterFieldWork: a working lexicon for critical refugia in arid landscapes

Gini Lee

Algebuckina Waterhole exists as a permanent waterhole near a north-south dirt road and an old trainline on the Oodnadatta Track – lines that once opened up the arid lands of central South Australia but are now bypassed. It also exists as the final and largest freshwater waterhole at the end of the Neales River system. It is a critical biodiversity site, a cultural place and a working environment. It is seen to need a resilient management plan that encompasses diverse interests and impacts. Its managers sense that the theories and practises emerging out of landscape disciplinary systems may be of help. Work-in-progress research towards a management methodology are presented through posing scenarios on how landscape thinking and design, informed by an emergent textual and visual lexicon for water landscapes, can intersect with scientific fieldwork to produce useful and transferable outcomes for Algebuckina.

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Algebuckina Waterhole exists as a permanent waterhole near the north-south dirt road of the Oodnadatta Track and the historic extant Ghan train line just to the west of Lake Eyre – the largest salt lake in Australia – into which all river systems in the centre eventually drain. Transport and communication lines that once opened up the arid lands of central South Australia are now largely bypassed by the main highway further west. The Track now services the movements of the pastoral communities of the large landholders and increasingly those tourists eager to immerse themselves in the authentic Australian desert outback. Algebuckina also exists as the final and largest freshwater waterhole in the lower reaches of the extensive Neales River system. It is a critical biodiversity site, a cultural place, a working environment and the site for a cross-disciplinary research project into resilient water landscapes as places of ecological and social refugia.

Work-in-progress fieldwork and research is currently underway to develop a management plan that encompasses the diverse interests of the researchers who are engaged in identifying and recording the impacts of water formed and water dynamic systems on this ancient landscape. Its government-based managers sense that the theories and practises emerging out of landscape architecture knowledge systems may be pertinent to ongoing scientific studies into the hydrology, geomorphology and aquatic ecologies of the catchment and the waterhole. Through working closely with communities and their knowledge and aspirations, a collaborative management methodology will propose how landscape thinking and design can intersect with scientific fieldwork towards eventual management regimes for the fragile landscapes of water bodies; with the ultimate aim to produce useful and transferable outcomes for the Algebuckina complex.

This expanded account of the WaterFieldWork presentation for the 2009 Sydney Resilient Water Landscapes Symposium establishes key landscape concepts for arid lands, and then presents a visual account of a light plane flight across country alongside a water lexicon of terms to assist in developing representational methods to communicate the landscape and the dynamics that shape it. The Algebuckina Waterhole Project is then described in relation to a developing research agenda for where landscape methodologies may contribute to affecting the long-term resilience of these arid places that are defined by ongoing negotiation between water absence and presence.

1. WaterFieldWork: water-shaping arid landscapes and their critical refugia

Despite an almost universal absence of permanent water in Australia's arid landscapes, the presence of water in shaping and modifying the rangelands of South Australia pervades the topography, morphology and ecologies of these remote lands. Such landscapes are simultaneously very ancient examples of geological shape-shifting over extreme timescales and continue to be subject to surface reorganisation by extreme climatic events such as floods, droughts and winds. No ground condition is ever static and the action of water and the structures that carry it across, under and over the land are essential drivers of today's dynamic water-formed landscapes.

John Wiens advocates the adoption of the term riverscapes to expand upon landscape based descriptions and concepts of the ecologies of places. Drawing upon landscape ecological methods, he researches relational spatial patterning effects on ecological processes; particularly where rivers and their associated systems define the connectivity of landscapes through 'multiple scales in time and space' [Wiens, J.A. 2002: 503]. Wiens supports approaches to landscape ecology that employ mappings that range across flow structures and uncontained pathways to enable the identification of landscape and riverscape character typologies beyond heterogeneous descriptions of typical features. These representational devices also reproduce

the ephemeral and often-indistinct relational intersections of human and water-based land-forming actions and are key to understanding the complexities of arid lands and their ecological and cultural landscapes.

Riverscapes in arid lands are spaces of exchange across indistinct boundaries and are not easily defined by typical river corridor concepts. Desert inundations may traverse kilometres of plains and entirely restructure the spatial relationships of high and low ground, of channels and dunes and of basins and islands. Because waterholes and the presence of water in dry landscapes are also magnets for indigenous and non-indigenous peoples alike, whether for life giving succor, for recreation and/or for spiritual well-being for travellers along the riverscapes of the outback.

Drought is the ever-present other in the arid water-formed rangelands of central Australia, and desertification is one consequence of a lack of knowledge on human and ecological interactions. Desertification spreads outwards from small points in vast landscapes – such as from a single stock watering point – which are further impacted by stock use, track making or compaction due to human occupation. Lack of water and nourishment causes intensive use at points where overgrazing or oversettlement can exacerbate degradation through poor management in both good times and bad [Dregne, H.E. 1986: 7].

The last point of resistance for all species in times of drought or unfavourable conditions is the existence of what are described as refugia or in extreme cases, critical refugia. Griffin and Pearce elaborate: „A refuge is a region in which certain types or suites of organisms are able to persist during a period in which most of the original geographic range becomes uninhabitable because of climatic change. The resulting refuge contains high frequencies of endemic species, because the species in it tend to respond to the contraction of range by evolving differences from their original, widespread stock." [Griffin, G.F. and Pearce, G. 1995]

In the Stony Plains region of the central South Australian rangelands, Algebuckina Waterhole has been designated a critical refugia; a place where its status as a permanent, if sometimes saline, pool within the Neales River system provides a habitat that supports aquatic fauna and flora. It has been noted, by researchers and managers at both the SA State and Federal government level, that if Algebuckina dries up or sustains damage beyond reasonable repair from external and potentially human generated forces, then the ecological diversity of the land and riverscapes west of Lake Eyre will also decline to critical and potentially terminal levels.

Waterlandscapes and their relational ecologies operate at the intersections of geographical, landform and environmental territories. Waterlandscapes are also researched, managed and occupied by expertise drawn from disciplines that operate at the intersections; between sciences, human ecology and designed landscapes. Cross-disciplinary and cross-territory projects are therefore necessary to devise management regimes that fundamentally recognize the diversity of required knowledge and approaches to support the ecological and cultural endurance of such critically important habitats.

2. Water-seeing: towards a water lexicon for the arid lands

One aspect that is immediately obvious in the development of cross-disciplinary studies in complex landscapes is the need to establish a common language of expressions and concepts that enables the fieldwork to be disseminated across a range of stakeholders. The Stony Plains rangelands may be remote but they are entirely modified by human use. The land is subject to constant negotiations between natural and cultural systems and the marks and traces left are clear evidence of such dynamic effects.

In order to find representational methods to communicate water scenarios across

disciplines a water lexicon of words, concepts and visual imagery is proposed towards developing a common language for arid landscapes.

The following visual essay seeks to establish the territory of the arid lands of central South Australia through the lenses of change that reimagine these arid landscapes as waterscapes. Through identifying the dynamic groundscapes recorded through the various scales of satellite imagery, of closer detail from the air and eventually through on-the-ground surveys, the nature and character of these landscapes can be described in layers of pattern and detail. Through also developing a time based chorography of sequences and associations for the journey, geomorphology and land use qualities are linked through reading or 'seeing' connectivity across landscapes at a particular moment in time.

Photographs taken from the air as the basis for the lexicon were the result of a morning's roundtrip; leaving from the Flinders Ranges 600 kilometers north of Adelaide and heading due north to the Algebuckina Waterhole near Oodnadatta some 400 kilometers away. I made this trip in July 2009 with my neighbour Ian Fargher as the pastoralist pilot – a man well versed in reading landscape through its formations and subtleties. Travelling by air – otherwise it takes a day to get there and a day to get back by road – we wanted to see what the lay of the land was like after some unusual winter rains – and the day was cloudy. It felt like the drought had broken but no one was sure as the land had been without really good rains for fourteen years previously and we'd been fooled by enticing storms before.

The images commence in the Flinders Ranges hill country of meandering and deeply cut river valleys and floodways, of weathered and upthrusting ancient hills and polished hillslopes, moving towards the flat and intensely patterned Stony Plains of the landscapes adjacent the lower and upper salt lakes of Lakes Eyre. We tracked north and west over the Neales and Peake River catchments that are the terminal water tracts from the Channel country that encompasses the vast rivers systems of western Queensland. Circling of the Algebuckina Waterhole, reveals the disused cast iron Ghan railway bridge, the Oodnadatta Track and the Waterhole's official and unofficial campgrounds before returning across the western regions of the Lake, taking in the fading outline of the inscribed Marree Man and the coal mined country of Leigh Creek, then finally coming in to land over the bare Flinders Ranges hills near home.

Sitting alongside Ian and hearing his descriptions of how he sees the landscapes, their formations, and water systems below confirms that every image is a water story in itself. Additionally, every sequence of images reveal water presence and absence in the multiplicity of conditions unfolding below us as expanded narratives of negotiation between the natural systems and human systems that occupy this country now, in this time and space. Beyond the immersive experience of being in the landscape and witnessing its characteristic aesthetics, dynamics and immensity lies the need to find the words and means to reproduce the immediate experience for others in other contexts; to enable the knowledge to be translated to others for useful as well as historical reasons. Concepts that underpin the visual appearance of the arid lands are also embedded in the language of science and aesthetics, and in the cartographies and lexicons drawn from various writings. This beginning lexicon is a list of both expressive and technical words and visual imagery to be read as clues to the conditions and qualities of this fragment of a larger landscape. It is a snapshot of the real, the worked and the conceptual qualities of a water-formed territory that is the basis for ongoing collaboration and research.

Fig.1: Flinders Ranges waterformed, weathered hills to plain

A conceptual arid water lexicon:

Alluvial plain, alluvial fan, aquifer, arid-zone, arroyo, artesian water, bajada, basin, bore, bore hole, braided river, brine pool, burst bank, carving erosion, cascade, catchment, channel, channel remnant, cistern, claypan, closed depression, cloud system, conductivity, confined aquifer, connectedness, connectivity, creek, current, custodians of springs, dam, degree of wetness, deposition, desert dunefield, desert pond, discharge, discontinuous ephemeral stream, distributary channel, divert, drainage line, drainage pattern, drillhole, drainage network, drought refugia, dryland river, dry landscape, dry saline crust, dry/wet model, dunefield, effluent stream, ephemeral feature, episodic rainfall, erosion, erosion cell, evaporation, fall & rise, flash-flood, flat, fluvial erosion, fluvial setting, flood, flood-out, floodplain, floodplain muds, flood pulse, flow, flow regime, flowing, fresh water, geomorphic classification, great artesian basin, groundwater, groundwater discharge, groundwater hydrological process, gully, hydroperiod, hyporheic zone, inferred channel, infiltration, inflow, influent stream, inland sea, inland wetland, intermittently inundated basin – playa, intermittently inundated channel – wadi, intermittently inundated flat – barlkarra, inundation, island, lacustrine, lake, landform setting, local groundwater flow, local runoff, lower confined aquifer, meander, mound spring, marine, mega-flood, mirage, moisture, mud, multi-aquifer system, non-marine, oasis, organic substance, over-bank flow, palustrine, permanently inundated basin – lake, permanently inundated channel – river, pluvial period of sustained flow, ponded-pastures, porous, post-flood flow, precipitation, pulse, pumped, quiet stratified water, rainfall event, rainwater recharge area, rapids, recharge, reflection, regional groundwater flow, regional runoff, regression, relative sea level, residual flow, riparian, river, riverine watertable, riverscape, running river, riverscape, run-off, run-on area, rush, saline, saline groundwater, saline playa, saline swamp, salt lake, sandplain, saturate, saturated hypersaline soil, seasonal waterlogging, seasonally inundated basin – sumpland, seasonally inundated channel – creek, seasonally inundated flat – floodplain, seasonally waterlogged basin – dampland, seasonally waterlogged channel – trough, seasonally waterlogged flat – palusplain, seasonally waterlogged slope – paluslope, sedimentation, sedge, seepage, sedimentary succession, shallow basin, shallow channel, sheet flow, single-thread arroyo, slack water deposit, soak, sporadic mega-floods, spring complex, spring wetland, subdued topography, submerge, subterranean, subtidal, surface flow, surface runoff pattern, swale, swamp, swathe, tectonic subsidence, temporary wetland, thirst, tidal influence, topographic low window, torrent, tract, transgression, transpiration, tributary, unchannelled floodplains, unconfined aquifer, upland creek, upper confined aquifer, upward vertical leakage, wash-out, water-born sediment, watercourse, waterfall, waterhole, watertable – zone of saturation, water barriers to movement, water feeding spring, water rights, water sculpture landscape, water table, wave, weathering, well, zero flow.

(Contributions to the lexicon are sourced from: Burmil, S., Daniel, T.C., Hetherington, J.D. 1999; Fensham, R. 2006; Semeniuk, V. & C.A. 1997: 145-158; and Wakelin-King, G.A. and Webb, J.A. 2007: 114-127)

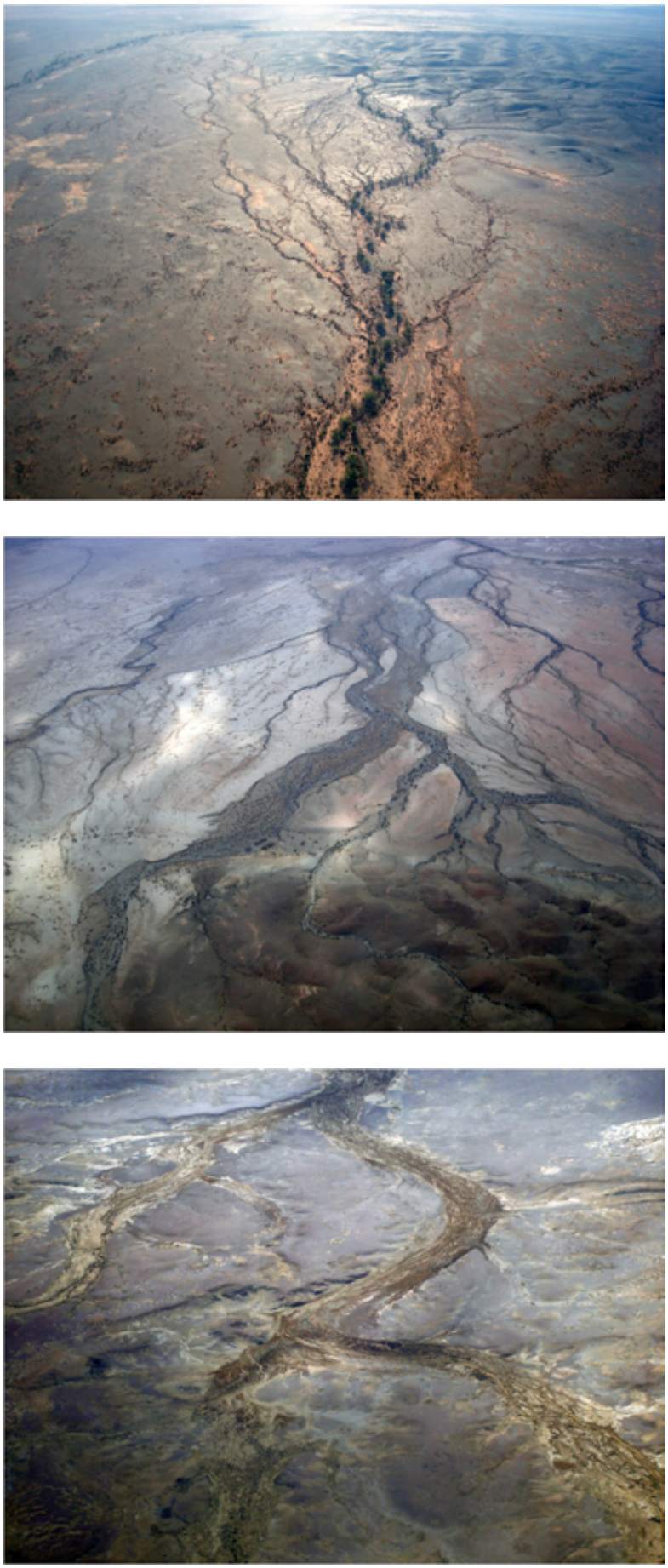


Fig. 2: Stony Plains: braided rivers incised, veined, weathered plains

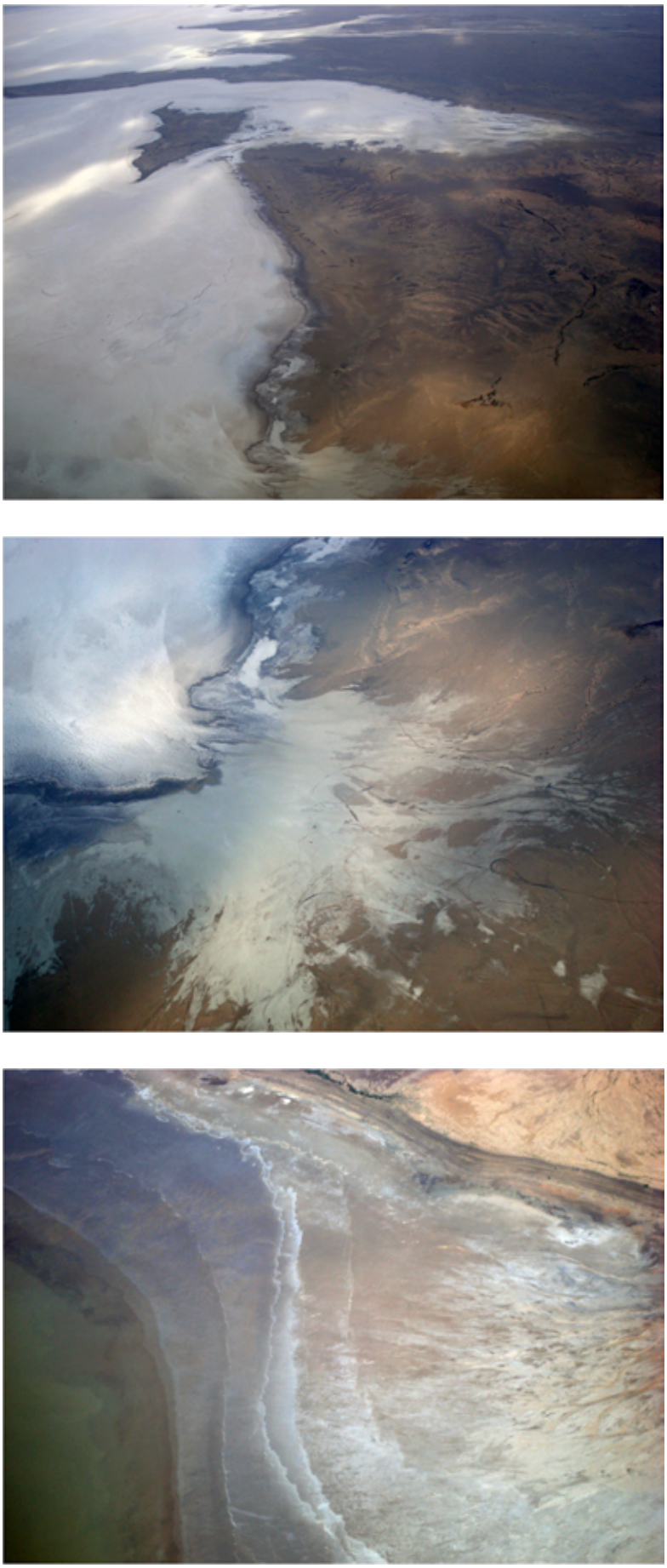


Fig. 3: Lake Eyre: salt fan margins between drylands and the inland sea

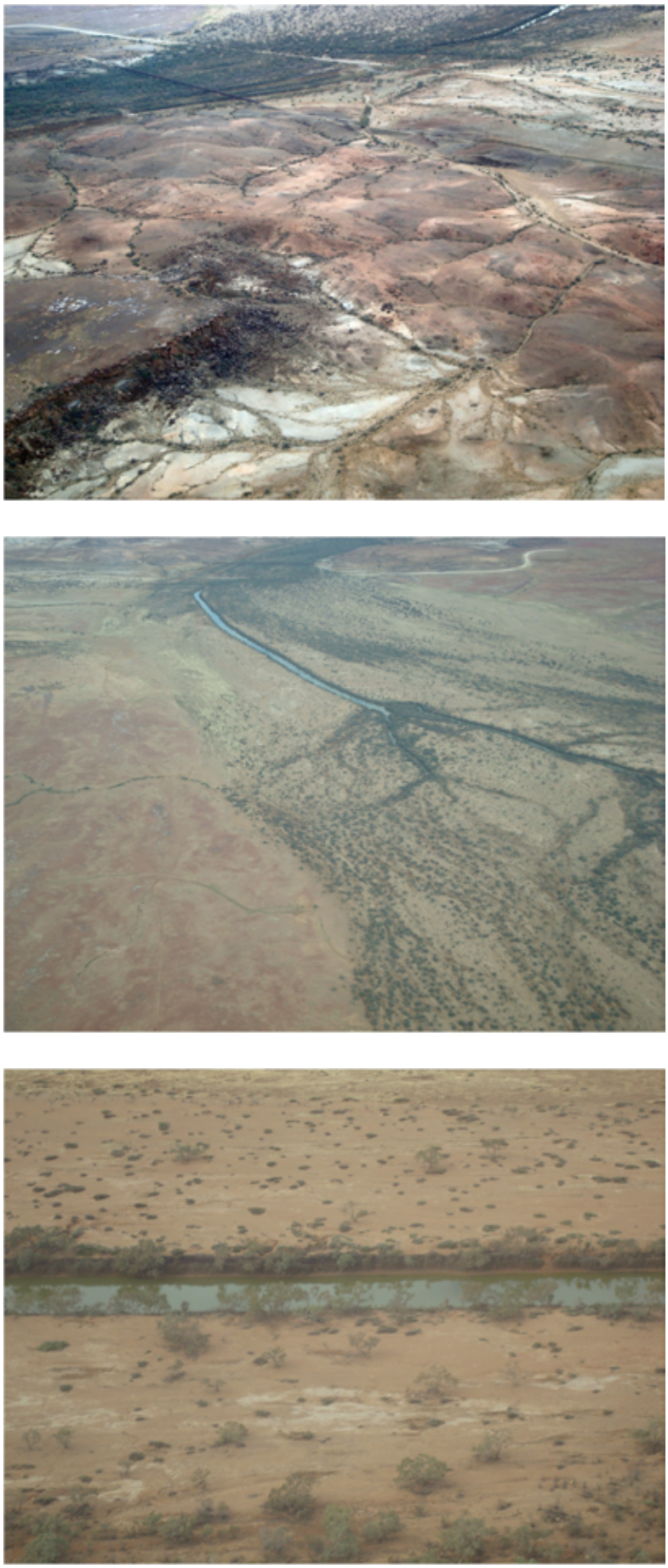
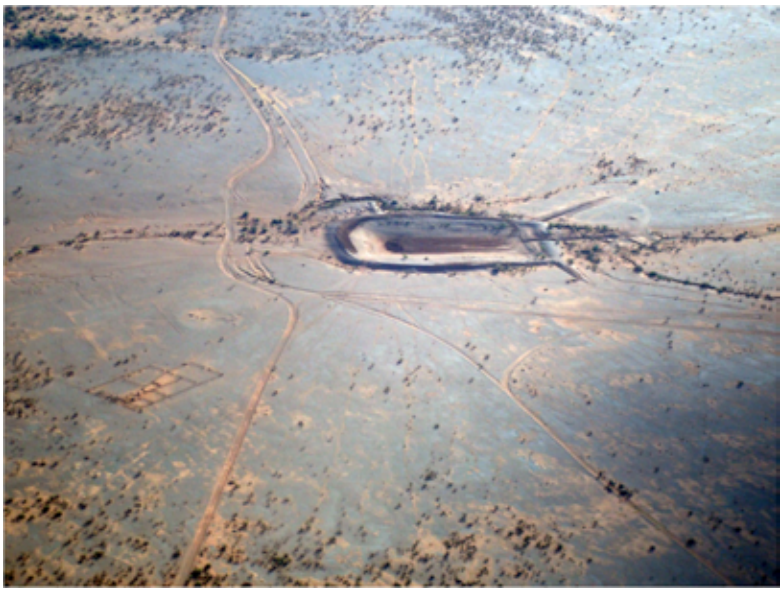


Fig. 4: Algebuckina: critical refugia waterhole and tourist magnet



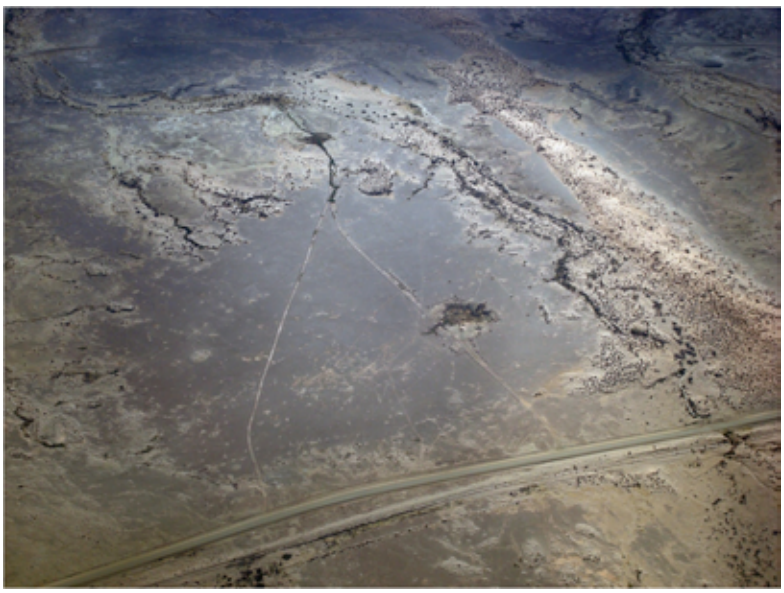
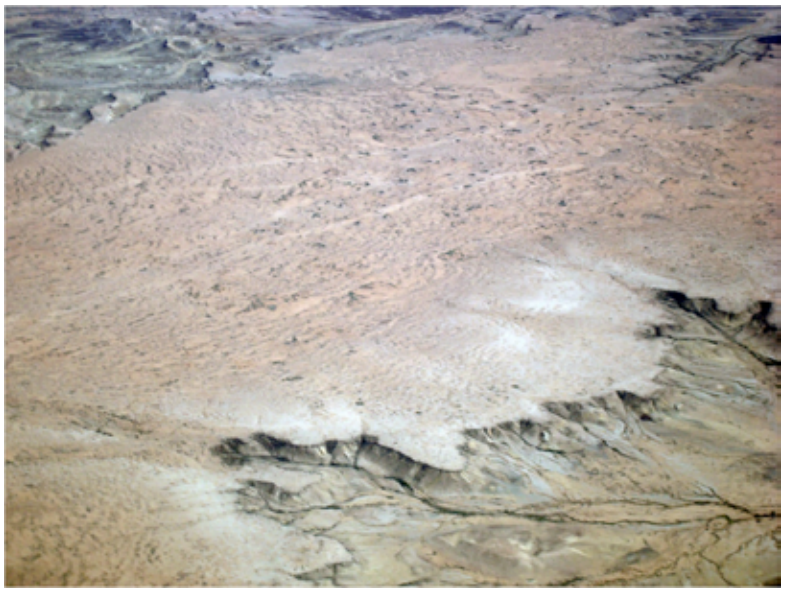


Fig. 5: Arid plains: human traces of water capture as marginal practise



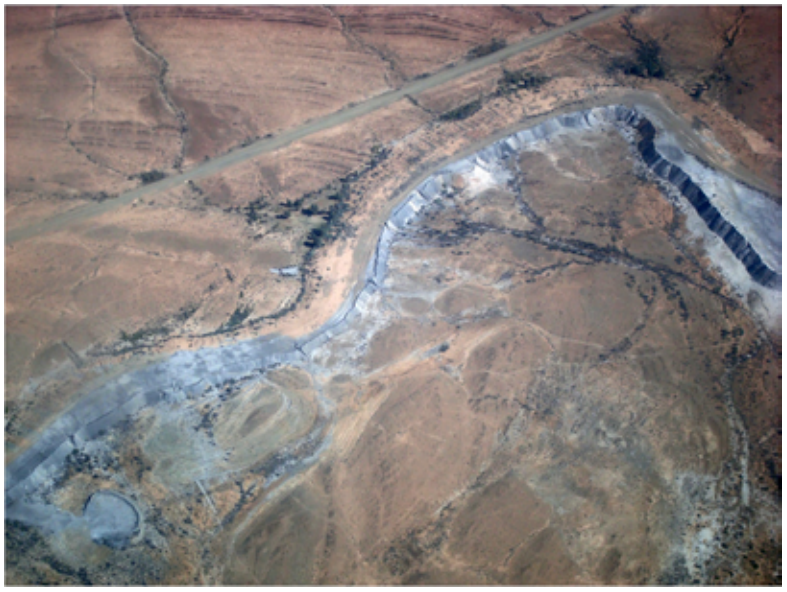


Fig. 6: Sculpted drylands: marked, scoured, inscribed and shadowed

3. Water-speaking: dreams for waterproofing

In her text Tracking Water, Jay Arthurs describes delving into the records of the National Library of Australia to uncover the often-contested conditions whereby post-invasion, settled Australia has sought ways to waterproof the country. Over the past two hundred years plans to provide permanent water inland - in country where water has always been an ephemeral presence - has caused a range of marks and scars and alterations to the ancient surface of the country; even including the remotest and driest places on the planet in the central Australian arid lands. Arthurs recounts that among the more curious but enduring suggestions from the mid 20th century on a grand engineering-scale is the now abandoned plan to flood the low-lying saline Lake Eyre in the centre of South Australia. The plan was to bring water south from Queensland or send it north from the southern Spencer Gulf through massive pipelines; the idea being that the desert climate could be altered into a moist water-bearing regime through a providing a large, permanent central water presence in order to support agricultural development in the drylands [Arthurs, J. 2007: 69].

Such ideas persist into the 21st century with notorious east coast, city based radio personality Alan Jones borrowing an earlier idea for a method for 'drought proofing Australia by turning the rivers inland to flood the desert in times of drought' [Potter, E. 2007: 247]. As Emily Potter and Jay Arthurs both point out, these dreamings of an altered centre are demonstrations of the 'ecological imaginary' where age-old geomorphological and climatic conditions can be altered by human intervention. Such 'solutions' for the 'problem' are based upon the premise that there is enough water in Australia for all but that it is located in the wrong places. Further, the notion that the water that is present is somehow going to waste as it is not being used - and that waterless or arid landscapes are therefore wastelands - pervades such dreams to 'fix' the problems of natural systems through constructed interventions.

The desire to see water in the desert following intermittent rains and occasional floods is engrained into the national psyche for many urban and edge dwelling Australians. Over the past year or so, from mid-2009 to the present, a number of major rain events have caused water to flow into the usually dry and salt encrusted surface of Lake Eyre. As a result there has been a tourism explosion of four wheel drive and light plane travellers in the Centre, all hoping to see the massive expanse of reflective water encroaching into the dry sand dunes, ephemeral water courses and red desert soils. They want to witness the rare occurrence of the desert blooming and the waterholes filling and to witness the birds and animals flock to the water, while it lasts.

Yet, as marvellous as these times are for the communities along the Oodnadatta Track, in that these are the years when big money is made to balance the dry and lean times, the impacts upon the waterholes and the fragile margins between roads and stony plains and creeks and their riparian edges are profound. Wash-outs, erosion, sedimentation and silting of watercourses is exacerbated by tourists with little or no idea of the fragility of the creek banks where they set up their tents or of the important structural integrity of the enduring Coolibah gum trees that are chopped down for endless campfires.

As laughable as these grand plans at national scale seem, they are pertinent to Algebuckina and its catchment in that the waterhole's fragile existence can be affected by dreams from other places; either in an instance of environmentally misplaced political will resulting in major infrastructural intervention such as in the burgeoning mining development, in the nearby environs to the west, and its endless need for water. Or in turn, a lack of money and care occurs through benign neglect in the face of external influences and onslaughts at the local scale.

4. On tracing/tracking water: plans for practical waterproofing

This final section in the account of the Algebuckina Waterhole work in progress water landscape driven project for central in South Australia has been made possible through funding from the South Australian Arid Lands Natural Resources Management Board. As already noted, Algebuckina Waterhole has permanent groundwater, which is sparse in this country. Accordingly the ongoing conservation and protection of the health of its natural systems is critical especially as it is used and impacted upon by invasive species such as fish, weeds, cattle and tourists. The waters that fill it are extracted for pastoralism and now increasingly for mining. It is too close to large uranium deposits and mining is greedy for water from the Great Artesian Basin deep below which is the other critical aspect of this system. The Oodnadatta Track delivers plenty of traffic in season and the Waterhole and its environs is increasingly accessed by eager and often ill-informed tourists eager to explore the great outback having undertaken their research through Google Earth and tourist blogs.

What can landscape architecture thinking contribute to this condition? The potential enormity of this situation often has me wondering as well. The project is a departure for the scientists who have been studying this place for many years. Everyone realises that measuring and recording the ecologies of the place are only one component in developing a program for managing – and the word should be used advisedly – this country and its systems. This landscape is both settled and worked driven by the complex relationships that exist between the sheer presence of the country, the people who manage the land for production and for conservation of essential systems, the people who pass through the land for recreation and the original people. The Arabunna and the Dunjiba have existed here for thousands of years, although now they live nearby in town settlements and pastoral stations.

The project is one of engagement of all the people and conditions impacting upon the place, collaboration across various disciplines and most importantly the making of a new framework where the various entities involved can co-ordinate how best to work with the critical issues that affect this place and its surrounding territories and catchments. And it is seen that the development of such a flexible framework can emerge from landscape methods and practises drawn from a fusion of McHargian landscape suitability, human ecology and landscape ecology thinking, and that a system based upon design thinking may well be the mechanism for collaboration across interests.

The project requires a pragmatic approach to resilient water landscapes through intensive fieldwork that requires working alongside hydrologists, aquatic ecologists, geomorphologists and a landscape architect. It positions landscape thinking and design practise in unfamiliar territory to everyday landscape architecture more concerned with site planning and design solutions and is an experiment across methodologies. The plan is to identify sites of importance within the broader river catchments and work outwards with the intent to gain understanding of and the impacts upon the local within a regional perspective. Links between scientific approaches and design-based strategies must be effected through systematic recording, coordinated mapping and the development of common or translatable languages and concepts.

To date we are engaged in fieldwork towards gathering information and towards developing languages and understandings of each other's aims and practises – I'm working with scientists, pastoralists, Aboriginal custodians, tourism operators, heritage people, state government managers and everyone else. Importantly, we researchers collaborate while travelling across country together through the various landscapes and situations that people, water and weather throw at us. We have already been rained out and overheated at Algebuckina, and expect it may happen again.

One of the critical aspects of the project is emerging and revolves around seeking a visual language that allows the sharing and coordination of information through mapping and interpretation drawn from landscape practise. The lexicon included here is a beginning experiment to demonstrate to the scientists as one way to represent the issues and wonders of these landscapes to others. Additionally, it is becoming clear that spatial design interventions will be useful, if not essential, to convey the spatial and material qualities of the place to the variety of users and to enable the health of the human occupied waterholes and springs to be improved and then maintained. It doesn't take much to pollute these water-formed places and permanently mark them for some time to come; even of a big flood comes along to wash away the ephemeral traces of human use and mis-use, the denuding of the old trees alongside compaction of the riparian zone and the gullying that often eventuates is complicit and even greater damage being caused by natural events. However, the use of landscape design assessments, strategies and visualisations is novel and untested out in these environments and may take some convincing to implement.

The research is not at all about making a landscape master plan for Algebuckina. Rather, the framework that appears to be emerging requires both surety – actions that people can follow – and simultaneously, flexibility –through acknowledgement and demonstration of processes and tactics that may be design-based – to enable sustainable response to changing conditions and to the tangibility and ephemerality of the arid lands and their inhabitation.

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all photos by Gini Lee

Urban water landscapes of resilience

Henri Bava

Landscape architecture is a discipline that can bring order to the chaos of contemporary urbanism. It can also give shape and structure to the dispersed city, offering solid answers wherever the debate over the city-territory and urban sprawl – with good reason – looks set to monopolise the attention of urbanists and architects for a long time to come. As yet, there are very few landscape architecture agencies in Europe that are both deeply involved in the territory and committed to a clear method of work. The international projects of Agence Ter in urban territories demonstrate the three fundamental postulates embodied in the work of partners Henri Bava, Michel Hoessler and Olivier Philippe. These postulates consist of comprehending the landscape's multiple horizons, developing plans for urban insertion within territories in motion, and creating open source systems. Henri Bava furthermore explores the particular aspects of the design of water landscapes in this respect.

Prof. DPLG Henri Bava (born 1957), landscape architect, studied plant biology at the University of Paris-Orsay and landscape architecture at the École Nationale Supérieure du Paysage at Versailles In 1986, he founded Agence Ter in Paris with Michel Hoessler and Olivier Philippe. In parallel with his work in landscape architecture, he functioned between 1987 and 1997 as a teacher and studio principal at the Versailles landscape architecture school, and was retained as government landscape advisor between 1993 and 1997. He was elected president of the Fédération Française du Paysage for the period 1996-1998. Since 1998, he has been titular professor at the University of Karlsruhe, where he heads the landscape institute of the architecture faculty, and where his work has been focused on exploring the role of landscape and urbanism confronted by climate change. In 2000, he started the German bureau of Agence Ter in Karlsruhe, from which he directed international urban projects. He was elected a member of the Berlin Arts Academy in 2006.

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Because landscape is by definition a complex unity of parts, transforming a site first implies considering all its components and the relationships between them before attempting to change anything. Creating continuity at the scale of our contemporary, multipolar city, building a network of parks from buffer zones to reconnect what was separated, articulating and connecting neighborhoods to one another again, creating genuine urban structure through landscape: these are the principal tasks and the expectations we have of landscape architects and urban planners. This is not a new strategy: it was developed by the landscape architect Frederic Law Olmsted between 1860 and 1900 in the United States. He preemptively intervened in natural or agricultural sites in the process of being swallowed up by urban development. These days, the city has dispersed, even if it could still spread out and grow even more: what we need, then, is to intervene at the heart of this dispersed city, working to repair, enrich and articulate using the components that are already there. Both environmental and hydrological factors, which have been rendered more urgent by climate change, must be taken into consideration in an attempt to meet the expectations of the urban landscape and create a coherent, inhabitable environment. The objective, then, is a combination of risk prevention, landscape enrichment and urban planning.

We will analyse several examples taken from different disciplines but that all take this approach: first, some urban elements that were created or altered so that they could be linked to their environment, their catchment area, with the aim of creating a coherent hydrological ensemble; secondly, some large-scale projects in which the hydrological solution played a major role in the urban plan itself; and thirdly, a post-industrial, cross-border project combining environmental, economic and infrastructural concerns.

1. The Urban Unit Connected to its Catchment Area

1.1 Floodable Gardens at a High School connected to Mountainous Hinterland (Philippe Lamour High School in Nîmes, France)

The city of Nîmes, determined to protect its inhabitants from floods like the catastrophic one in 1991, decided to modify its urban planning laws and require that in the highest-risk areas, construction had to begin 0.8 m above ground level. It was in this same preventative vein that the city decided to build a new school for 1.200 students on a 7-hectare parcel of land. This urban constraint forced the team of designers, landscape architects and architects to consider the entire site as a vast hydraulic unit, split into two layers: one for the movement of people, the other for (non-traversable) gardens and water. The landscape was therefore sculpted so that it could receive, stockpile and slowly evacuate water flow via a system of insular platforms, all raised 0.8 m above the ground, and upon which were built buildings separated by floodable gardens

Fig.1: Situation of buildings on raised platforms in the flooding zone

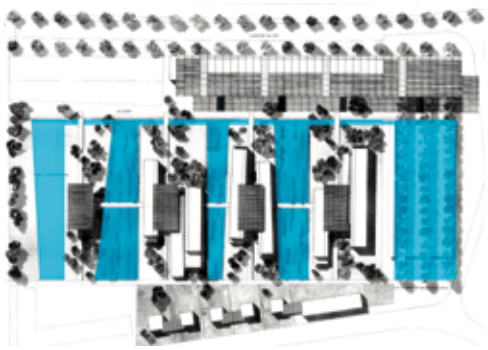

Fig.2: Flood zone of the Lycée Philippe Lamour

planted at ground level. The requirement to not bury any construction meant that every single intervention – water flow regulation devices, ditches, floodable areas, and retention basins – had to be part of the landscape. The need for pedestrian movement was met by a system of walkways and floating docks connecting platforms and quays, thus establishing continuity between the internal and external public spaces. In this way, city, architecture and outside space overlap to allow for the free movement of different publics within this floodable garden-school.

1.2 Peripheral Draining Border for a Public Garden and Commercial/ Residential Neighborhood (Square Eli Lotar in Aubervilliers, France)

The Eli Lotar public garden in Aubervilliers, a suburb north of Paris, is a hybrid space that serves both as a place of leisure for inhabitants of the surrounding neighborhood and as a retention basin for the area's rainwater. The garden's small size (1 hectare) led the designers to create a linear, peripheral retention basin instead of a concentrated one, which would have broken up the space.
Surrounding a large central lawn, the periphery of this square serves as security (barrier), scenery (planting) and technology (integrating water drainage and storage). It takes the form of a planted ditch that collects rainwater from the garden and the surrounding neighborhood (runoff from sidewalks and roofs) and stores it underground until it is removed by infiltration, absorbed by plant roots, evaporates, or, for excess amounts, overflows into the canal system.
The ditch's abundant vegetation consists of willows and grasses and integrates a barrier into the plant layer, functioning like the Ha-Ha of the English formal garden: a physical border, but not a visual one.
This draining border serves as a retention basin for a watershed that is limited to the rainwater coming from the roofs of nearby houses and the pedestrian areas around the garden.

Fig.3: Eli Lotar View of the draining borderline

1.3 Park and Public Spaces as the Hydraulic System for the Neighborhood (Parc du Trapèze, Boulogne-France)

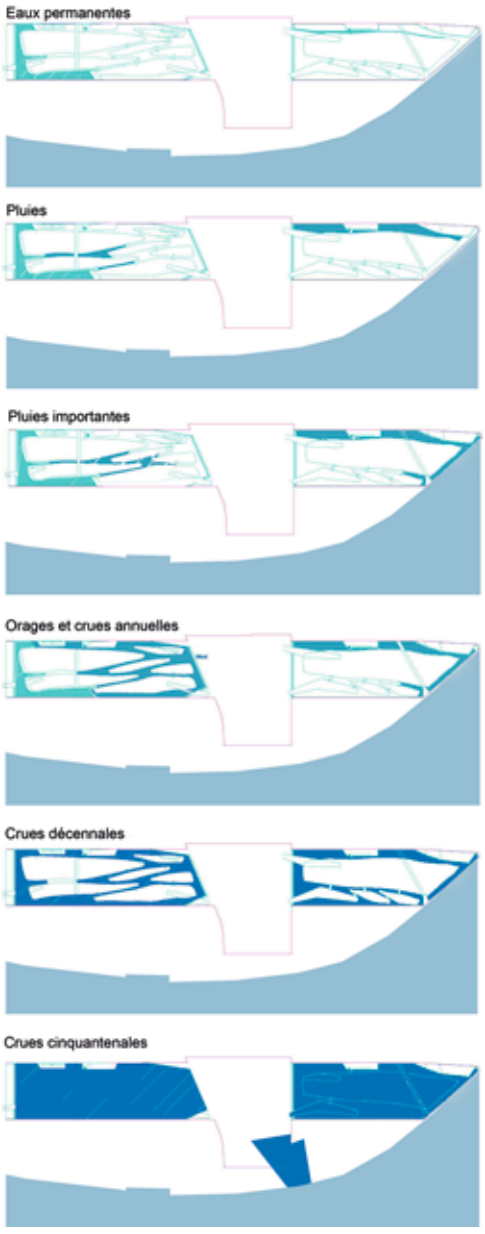

Fig.5: Diagram of the flooding process

This new neighborhood in the first-ring suburbs of Paris, built on the site of the former Renault factories in a meander of the Seine, is articulated around a large, linear 7-hectare park of about 700 m by 90 m. Concentrating and connecting future facilities, schools and shops, the space is a combination of performance, pastime and urban centrality. It also has an essential and experimental hydraulic function: all the rainwater from this 50-hectare neighborhood is collected in this submersible park. Three types of water have been differentiated according to their provenance: rainwater from the ground (green spaces, sidewalks) and roofs of privately owned plots, rainwater from public pedestrian areas, and rainwater from trafficked roads. The former two are channeled to the park via open-air drains, whereas the last is transported mainly via drainpipe, and is filtered prior to entering the submersible park.

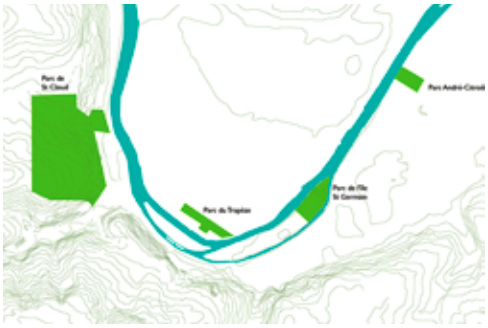

Fig.4: Site map of „Parc du Trapèze" along the Seine river

The implementation of this urban hydraulic system connecting private lots, infrastructure and park was the result of cooperation between the client (project owner) SAEM Val de Seine, the neighborhood urban planner (Patrick Chavannes), the road architect (Thierry Laverne) and the landscape architect for the park (Agence Ter: Henri Bava, Michel Hoessler, Olivier Philippe).

The floodable park is also a bi-level recreational park, like a dock: the city itself is built on the quays, like an urban façade, and the floodable park, where visitors can wander around and get lost in the abundant vegetation, is sunken 1.6 m below. The site of a constantly moving geography, it consists of long islands boasting the biodiversity of aquatic areas, separated by water meadows and branches of water. In the case of a storm, the water rises and floods the meadows, and at times of maximal flooding, the park becomes a harbor.

Fig.5: View of the flooded park

2. Hydrology as a Support to Site Planning

2.1 Bonn-Köln Land Management: the Arms of the Rhine (Germany)

The land between Cologne and Bonn is truly a landscape in movement: structured by the unknown qualities of the river, it has been profoundly modified since the river was channeled – due, mainly, to the set-up of large industrial metallurgical and petrochemical companies – in a way that no longer allowed meanders. Simulations of extreme flooding linked to climate change revealed that the landscape was fragile and that an inundation would create branches of water in tune with the physical geography of the landscape.

Two scenarios were envisaged based on these predictions: the first, which the designers called the Rhine Unchained, could also be called "wait and see" for its patient approach: it entails simply waiting, avoiding construction in the highest risk zones, which would have been clearly located and delineated beforehand. In the occurrence of heavy flooding breaking the dykes, there would be no system in place to obstruct the Rhine's waters.

The second scenario, called "The Branches of the Rhine," envisaged the creation of a network of grassy water meadows in the place of the areas identified on the simulated flood maps as most likely to flood. These water meadows would establish a hydrological system that could cope with both temporary variations in the water levels of the river and heavy flooding. It is made up of retention basins and integrates the existing gravel ones, joining them in a continuous ecological corridor that would encourage biodiversity. This network of water meadows would also structure new public spaces, and encourage non-polluting means of transportation between municipalities: the wetlands would be bordered by cycle paths and urban walkways that would link the disparate entities already in place: agricultural areas, industrial strongholds, and residential areas. This network would also demarcate the possibility of future areas of urban growth, spaced with existing construction, which could provide a façade of architecturally attractive housing along these new banks of the Rhine.

This integrated plan transforms a simple case of risk prevention on the scale of this section of the Rhine Valley into a dynamic of urban development that reinforces the idea that everyone is a part of the river and its valley.

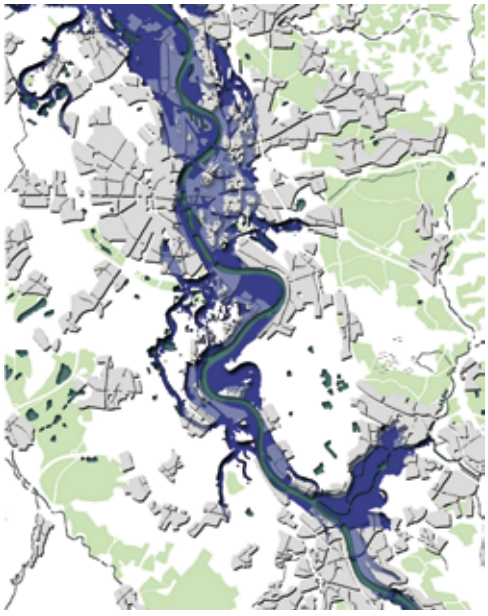

Fig.6: Simulation of the flooded Rhine between Cologne and Bonn

Fig.7: New channels as new landscape Scenario

2.2 The Swamp: Cooperation between Municipalities (Cayenne/ Remire-Monjoly/Matoury/French Guyana)

The peninsula is demarcated by the mouths of two major rivers, the Cayenne and the Mahury, and faces the ocean's horizon. The minor river that crosses it to the south has caused its inhabitants to call it an "island": the island of Cayenne. This territory is broken up into three municipalities: Cayenne, Rémire-Monjoly, and Matoury, and is traversed to the right of the border between them by a swamp that serves as a low stretch of relief, about 8 km long by 1 km wide, and surrounded to the north and south by hills destined for urbanisation.

The demographic explosion that has struck this region requires viable constructible land and a definition of an approach to urban development, in the absence of which a kind of wild urbanisation, such as the growth of shantytowns, will occur.

In order to overcome this deficiency, an association of social housing project managers asked the landscape architects at Agence Ter to come up with a master plan, the guidelines of which would be implemented by a public land management authority (EPAG).

Agence Ter's landscape architects proposed inscribing this future urbanisation in the logic of the landscape, determined by hydrography. An historical geological study showed that Cayenne previously consisted of islands located in front of the littoral, until sediment and erosion linked the islands to each other and then to the mainland.

Traditional urbanisation on a piedmont plain reveals a distrust of low-lying floodable areas. The swamp itself, now known as the swamp of the "crique fouillée" , or hollowed creek, is a former river branch that was traversed by a canal draining it into the sea in the 19th Century. Built by the Swiss engineer Guysan, this canal both began and ended in the seas, allowing the water to flow in both directions, depending on the wind.

Free of any construction, the swamp looks like a vast stretch of empty land that contains the rainwater in the wet season. It was, therefore, out of the question to build on it after extensive excavations, as some suggested; rather, it was a matter of conserving and protecting it for its essential hydrological function and ecological value. Its central location – which would soon be at the heart of the new urban landscape – made it a natural icon in the urban environment.

The master plan proposed, then, that the three municipalities extend their residential zones on the piedmont plain as far as the lowlands not likely to flood. Two new roads, primary infrastructure bordering the swamp's limits to the north and south, were called "dyke roads" for their role as dams for the valleys that flow into the swamp: in this way, retention basins would be created to slow down the rate of flow of rainwater in the tropical wet season. These retention basins would, in turn, become leisure spots in the residential zones, public green spaces with pontoon-style banks and wooden decks.

Lastly, the dyke roads would also create a demarcating frame to contrast with the swamp, like the long quays of an urban river: in this case, it would take the form of a green river at the heart of urban development, the center of a new hydrological system.

Fig.8: On both sides o the Swamp "crique fouillée": raised roadways dykes with retention basins + new residential quarters reaching out into the piedmont plain

Border Scale

Greenmetropolis – A Tri-National Regional Development Project

Concerning a vast swath of cross-border territory, the Greenmetropolis development project aims to bring together disparate and sometimes contradictory town-planning policies as well as the very different urban development cultures of three countries: Belgium, the Netherlands, and Germany, and fuse them in a holistic, coordinated global vision. The main objective is thus to turn this tri-national territory into an example of successful territorial cohesion. The project, named Greenmetropolis for its low density/area ration, is innovative in the way in which it has created a flexible framework for different local projects and ideas, thereby directly involving both citizens and private stakeholders. This project demonstrates practices of excellence in the redevelopment and regeneration of a large agglomeration and a post-industrial, formerly mining landscape; the methods tested here should be taken up by all or some of the numerous regions in Europe affected by these same economic and environmental problems.
The role of the urban planner / landscape architect, as the facilitator of this crossing of administrative and national borders, is primarily to research the continuities between – as well as the readability and the environmental accessibility of – metropolitan green space, axis that link new urban centers and the natural landscape. The approach in this project was to create an effective interface between the national and regional levels.
In order to find a solution to the complexity of this agglomeration's very heterogeneous landscape, which spreads over 200 km, the team of designers, consisting of Erik Behrens, Alex Wall, and Steven Craig, and led by Henri Bava from Agence Ter, decided to rely on a highway linking the city centers on the one hand, and a greenway connecting all the rivers and streams on the other. Each of these bodies of water, almost all of which had been channeled into canals for industrial transportation over the course of the last century, would be restored to its natural state.

A Participatory Development Process

In spring 2003, based on the initiative of the province of North-Rhine Westphalia, the EuRegionale2008 agency was commissioned to mobilise the individual stakeholders of the region for the idea of a tri-national development process. In an initial phase several local project plans and individual ideas were collected across national borders. At the beginning of 2004 Henri Bava-Agence Ter's team delivered with his competition entry called Greenmetropolis, a flexible framework tying together the various local project ideas and a convincing regional development concept. Avoiding long-term planning processes, the Greenmetropolis aimed right from the beginning for a speedy project realisation by directly involving the individual stakeholders with their ability and will for a fast implementation of their individual projects. In various workshops, their project ideas were refined and developed further as complementary building blocks set within the regional framework. The high level of communication associated with this planning process, thereby helped to overcome physical and mental borders enabling new initiatives and jump-starting new processes. In Autumn 2005, the Greenmetropolis successfully gained Interreg support by the European Union.

A Code of Regional Culture and Urban Identify

The area's identity can be read as a sequence of familiar alternating elements and characteristic spatial configurations: the city centers, the open spaces and parks, the abandoned collieries, historic mineworker settlements, the opencast mining pits, the mining dumps, are the

dominant topographical features in this area. In combination with new uses and future-oriented developments of the various communal initiatives, these elements could form new versatile centers of activity within the existing urban agglomeration and throw into relief the rich diversity of the region. Likewise, in the immediate vicinity of the cities, to make the mining dumps more attractive for the population, various design and accessibility measures will be implemented. Visitors will enjoy stunning panoramas from the viewing platforms on top of the mining dumps. The brown fields of the former mine sites provide unique development platforms for housing and employment spaces around the retained architectural monuments they contain. Providing legibility and accessibility a Green Route and a Metropole Route will connect the new centers of activity and natural landscapes. Both routes are intertwined like the strands of a double helix, and connect the elements into a code of regional culture and urban identity (urban DNA). The Metropole Route establishes a regional main street, which provides orientation and becomes the communication artery for residents and visitors alike. The Green Route acts as a pedestrian path/bikeway and follows the riverine structure that leads from the Eifel Mountains to the North Sea and provides the potential to establish a continuous ecological structure connecting the region's various parks.

A Continuing Platform for Regional Discussion

A regional management structure along with a communications and branding strategy will support the ongoing development process. A charter currently being developed will summarise the strategic goals. Thus the Greenmetropolis will be a way of combining existing initiatives and creating a new identity for the region. At the same time it will function as a platform for regional discussions across the borders of the three nations and a framework for additional projects centered on economic regeneration and tourism. It represents the start of a long-term process of negotiating its own future.

all figures by Agence Ter

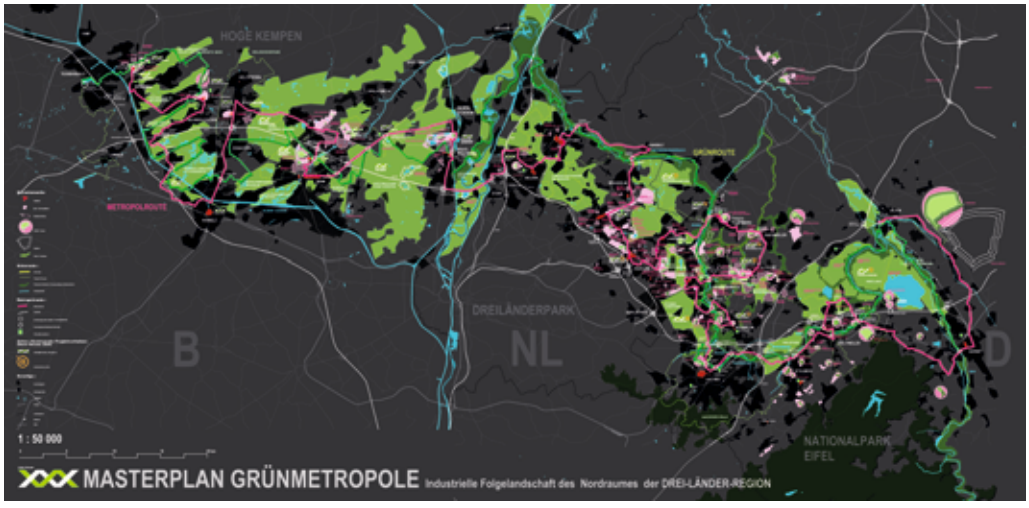

Fig.9: Master plan of the Green Metropolis as agreed

K. M. Simon (2009) Detail from Lausanne Series (Indigo). Ink on board, 400 x 400 x 50mm

The Lausanne Series explores the way in which the visual image of a city is often depicted through a standardised and uniform drawing of the street layout. Such drawings often sterilise or eliminate the unique and varied landscape qualities of a given urban environment, in favour of the regularised and self-contained road network. The drawings in this series manipulate the street pattern with layers of ink and wash which start to reinvigorate the drawing with suggestions of growth and decay; seepage and leakage. From the static road pattern a new set of landscape tendencies and possibilities starts to emerge.

Katrina Simon, Senior Lecturer in Landscape Architecture at the Faculty of the Built Environment, University of New South Wales, assisted with the organisation of the day-long symposium at UNSW. She also presented a paper, co-authored with Associate Professor Linda Corkery entitled 'Urban landscape atlas: representing urban form and transformations in relation to landscape conditions'. This paper presented the conceptual framework for the 'Urban Landscape Design Seminar' that is taught at UNSW to third year undergraduate landscape architecture students, introducing them to ways of reading and drawing the city itself as a form of landscape. This kind of understanding, which privileges the often overlooked landscape qualities, systems and processes of cities, is seen as essential to the fostering and development of urban resilience.

"Towards Resilient Water Landscapes" is the key focus of concern in these proceedings. Encapsulated in the approaches taken by the writers are clues into how researchers and designers – who must engage with the complexities of the landscapes, infrastructures and ecologies of cities and their communities – can contribute to growing design knowledge and critical debate in these times of rapid climate, environmental, spatial and cultural change. The realization that a multidisciplinary approach is essential to gain knowledge and to propose new solutions based upon design thinking underpins this collaboration between academics and designers from Karlsruhe Institute of Technology (KIT), Copenhagen University (UC) and Queensland University of Technology (QUT).

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