BIRKHÄUSER

WATER AS CATALYST

Int | AR

Interventions | Adaptive Reuse

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Department of Interior Architecture, Rhode Island School of Design

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Interventions | **Adaptive Reuse**

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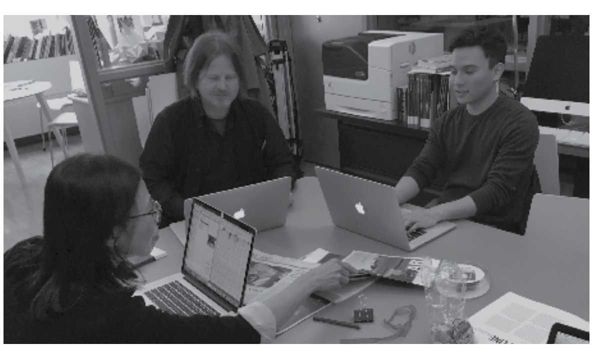

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BACK TO THE FUTURE

THE SPATIAL DIMENSION OF WATER MANAGEMENT

by KEES LOKMAN

"From the inception of our species, coping with the availability — or unavailability — of water resources has been an essential element of human beings' strategies for survival and well-being. Throughout history human ingenuity was manifest in the means by which water was procured, transported and allocated to various uses. The quality, distribution, seasonality and amount of water have been key determinants of subsistence, health and settlement potentials."
(Hassan 2011: 14)

Water management is essential to human development. Throughout history, reciprocal relationships between water management, human settlement, food production, climatic conditions, and social organization—on both local and regional levels—have produced a range of physical landscapes with a myriad of social-ecological and spatial dynamics. More recently, technological advancements coupled with accelerated processes of urbanization and agricultural production have created new demands for water, as well as new approaches to wastewater management and flood control. As such, today, we are confronted with multiple dimensions of water management—operating across various spatial and temporal scales.

In this context, the twentieth century was primarily characterized by a command-and-control attitude towards water management. Often sponsored by state governments through large-scale infrastructure developments (i.e. irrigation works, hydroelectric dams, and so on), these projects have favored the notion of

The Big U is one of the winning projects of Rebuild by Design. It combines a continuous 10-mile long flood protection infrastructure along Lower Manhattan with new open sapces and public programs to benefit surrounding communities

hydraulics (engineering) over hydrology (ecological processes). Not surprisingly, the cumulative effects of these interventions have triggered drastic changes to (river and coastal) ecologies, built environments, people's livelihoods and geopolitical relationships (Lokman 2016a). With the realities of climate change, ongoing urbanization and environmental degradation, there is an urgent need to develop adaptive planning approaches, policies and spatial strategies to manage water.

In recent decades, several of such new water management concepts have been proposed, including: *integrated water resources management, adaptive management,* and, more recently, the *water–energy–food nexus* (Giupponi and Gain 2016). And while these frameworks certainly help to elevate the debates on water management, they primarily focus on the use of planning tools and policy mechanisms to enact change. The role of design and the inherent spatial dimensions of water, however, remain largely overlooked. Roggema (2009: 59), in discussing climate change and its consequences for water management and energy developments, states: "The adaptation to climate change is well represented in strategies, policies and the media…but integrated designs for adapted spatial plans are hardly available. This is curious, because adaptation to climate change needs to be implemented and realized mainly through spatial patterns and layout." In other words, there should be more emphasis on the translation of policies into spatial design strategies in order to shift people's ways of thinking, and to make visible how the world can look by offering new ideas and formulating physical solutions to complex issues.

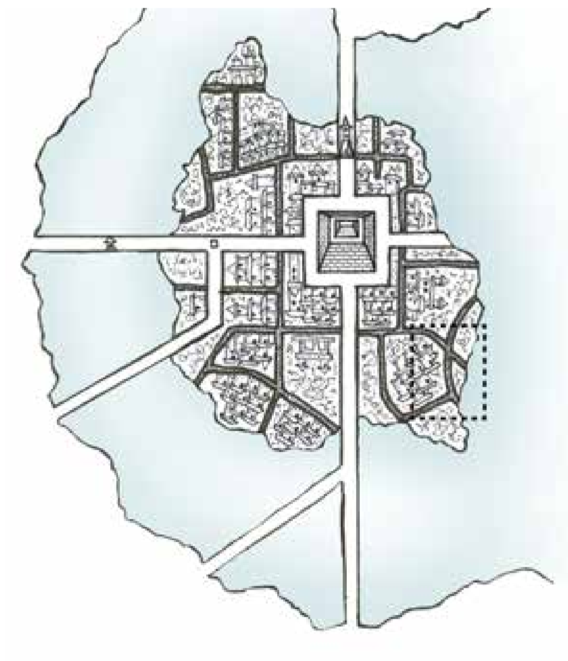
Along these lines, Priscoli (1998: 623) argues: "The spatial and functional characteristics of the river basins influenced human settlement and interaction long before the idea of the river basin started to be formalized into legal and administrative terms." Priscoli emphasizes water management has an inherent socio-spatial character which has evolved over time and space. We can learn from history in order to study how spatial, technical, and managerial solutions in the past can inform approaches to contemporary challenges such as sanitation, flood control and irrigation farming. As such, this article will focus on the interdependencies of people, water and space by discussing how we can manage water by actively co-designing with natural processes. How has water management historically informed the spatial configuration of landscapes? In which ways are these approaches incorporated in contemporary water management? Ultimately, how can we combine hard and soft-engineered water management practices to cultivate productive and dynamic social-ecological relationships?

The article begins by exploring three historical examples of water management, including: (1) the *chinampas* in Mexico City (a type of Mesoamerican agriculture which uses small, rectangular plots to grow crops); (2) Major John Wesley Powell's *drainage districts* (a proposal for an alternative hydro-political organization and water democracy for the American West); (3) the Dutch p*older model* (a mixed model of top-down and bottom up approaches to develop and maintain flood control infrastructure). Each example illustrates an approach to water management that fundamentally responds to local conditions, while embracing dynamic relationships between human agency and natural processes. Finally, the article discusses how these site-specific and culturally informed approaches are influencing contemporary water management projects.

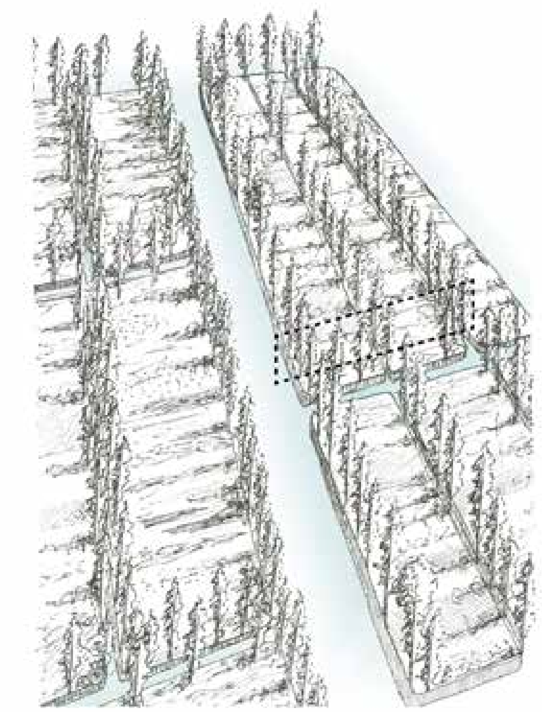
Chinampas: A co-evolution of social and ecological processes

One of the most sophisticated ways of manipulating landscapes to manage water and grow food was developed in Mesoamerica, in an area now known as Mexico City. Founded by the Aztecs in 1325, Mexico City (then known as *Tenochtitlán*) is situated in the Basin of Mexico, a highland plateau with no natural drainage outlet. Until the late nineteenth century the Basin contained a network of shallow lakes, which fluctuated between 0.8 and 3.0m during dry and wet seasons (Sanders 1979). In order to control flooding, and to provide access to fresh water and food, the Aztecs developed an ambitious system of dikes, aqueducts, and *chinampas*: rectangular farming plots filled with fertile dredged sediments. This half-natural, half-artificial landscape was based on a dynamic stability between ecological processes, agricultural productivity, economic vitality and specific forms of social organization (Torres-Lima et al. 1994; Nichols at al. 2006, Lokman 2016b).

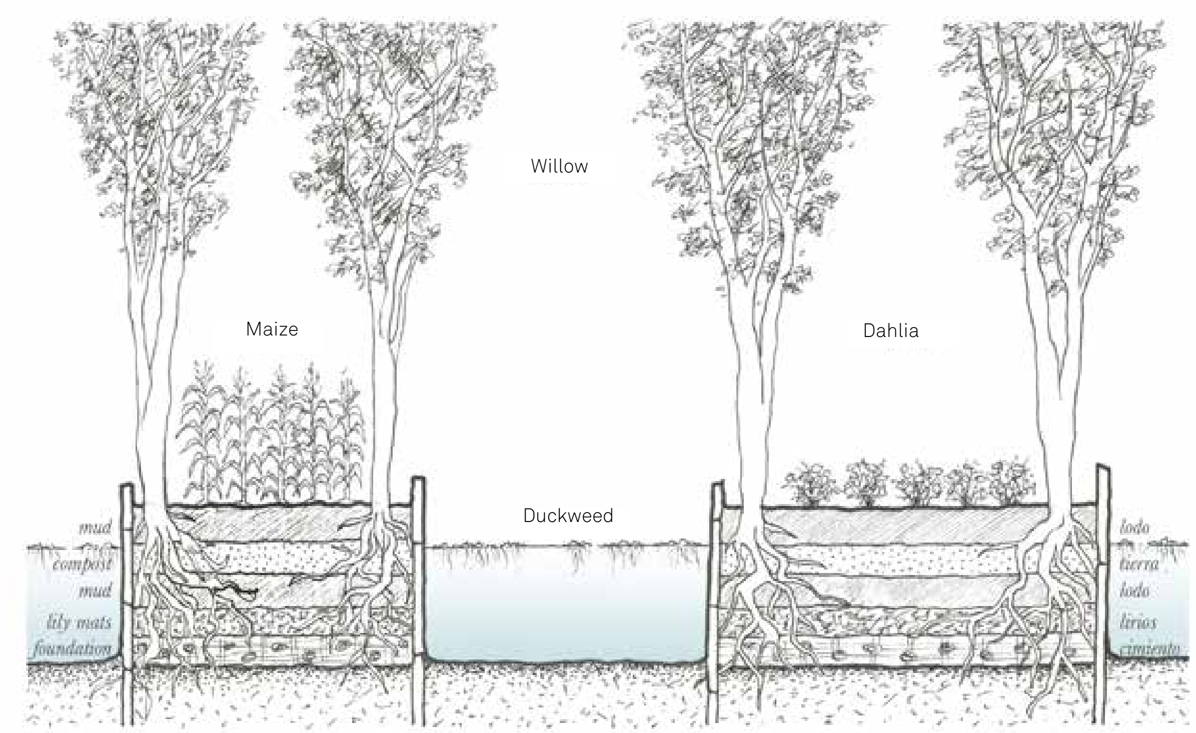
Chinampas provided the backbone of the Aztec Empire. When the Spanish invaded the region in the sixteenth century, *chinampas* covered an area over 1000 sq. km (Hassan 2011)—nearly a third of Rhode Island. Originally ranging from 6.0 to 9.0m wide and lengths of up to 100m, *chinampas* were constructed by alternating layers of dredged sediments and "thick mats of decaying vegetation" (Torres-Lima 1994: 38). A wattle fence and a planted row of native willows (Salix Bomplandiana L.) helped to retain soil and stabilize the edges. Once matured, the trees helped to block wind and trap warm air, permitting year-round cultivation and providing additional crop protection. The continuous application of animal manure, mud, and water from the drainage and transportation canals enhanced soil fertility and soil humidity, improving the overall growing conditions (Parsons 1991). This recycling of nutrients and waste not only reduced environmental impacts, but increased biological interdependence between crops and pest, and improved crop productivity, creating a highly complex and sustainable agro-ecosystem (Torres-Lima et al. 1994).



Tenochtitlan & Logo de Texcoco
1500 CE

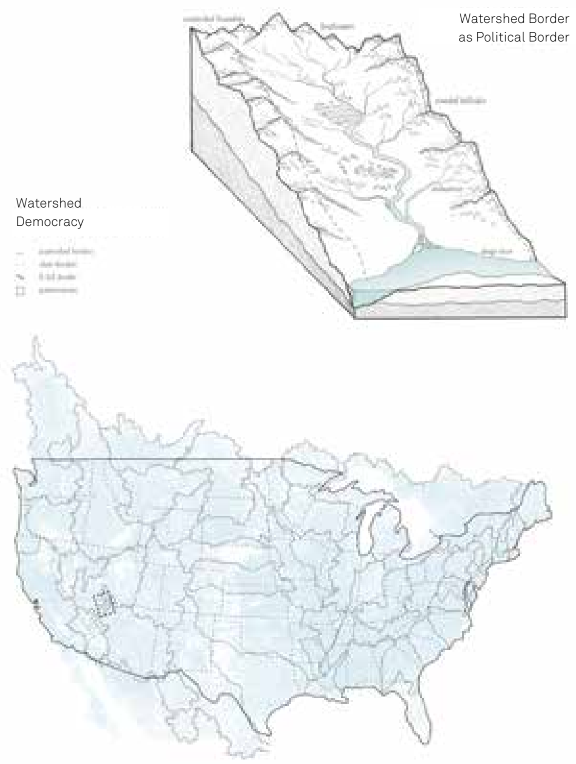


Chinampa Aerial



Chinampa Section

Illustrations of the chinampas system



Inherently shaped by the co-evolution of social and ecological processes, the distinct spatial configuration and sectional qualities of *chinampas*, in combination with centuries-long human stewardship, cultivated a heterogeneous landscape with numerous ecosystem services, including food provisioning, aquifer recharge, flood control, carbon storage, climate regulation, as well as providing critical habitat for numerous endemic and migratory species (Merlin-Uribe et al. 2013). Due to their spatial and functional complexity, *chinampas* were able to adjust to many different environmental and socio-economic pressures over time (Torres-Lima et al. 1994). In contrast to contemporary farming practices, which are mechanized and require large inputs of water and fertilizers, *chinampas* represent a low-tech and scalable form of agriculture based on closed-loop systems attuned to local ecological conditions. Moreover, they provided a diverse set of uses —from agriculture to housing, livestock keeping and recreation. And while only a few pockets of this pre-colonial agro-ecosystem remain today, the *chinampas* remain an inspiration in terms of developing sustainable methods of water management centered on the co-evolution of human systems and ecological processes.

Watershed Democracy: A communal way of water management

The next example focuses on John Wesley Powell's proposal for establishing *hydrographic basins*—political units defined by climate, topography and the natural flow of water. This idea not only promoted a communal way of managing water on a regional scale but also introduced a radically different way of organizing the territory of the American West—both spatially and politically.

Powell (1834 –1901) was a geologist, explorer and conservationist. Through his many expeditions of the West, which is characterized by limited rainfall, high temperatures and poor soils, he understood that the political and jurisdictional systems governing water rights and natural resources in this part of the continent could not follow the conventional logic at the time. In 1878, he published the "Report on the Arid Lands of the United States," which recommended that none of the water should be privatized; it belonged to everyone within a specific "hydrographic basin," or what we now call a *watershed*. According to Powell, water rights should be tied to the land, and not be sold except along with deeds to the land.

Counter to the 19th century frontier mentality, Powell opposed common practices that allocated parcel, county and state boundaries based on Euclidean geometry. Instead, he suggested dividing the land based on topographic features, thereby establishing "irrigation districts"; small tracts of irrigable lands in the lower lying areas, and "pasture districts"; larger livestock ranches for grazing nearby springs and small streams (Powell 1878). From the forests on the upper slopes, the grazing lands at mid elevations, and the arable bottomlands, residents were to work together across the basin to establish regulations for the use of water for irrigation and subdividing the land. Privileges to mineral rights (and the use of water and timber for mining) would be managed by the United States in order to prevent powerful individuals to obtain single control over these resources. Beyond this, government had no role: communities should be left to control their own water resources and production.

Moreover, as second director of the US Geologic Survey (1881–1894), Powell also developed important new knowledge and spatial information. His team created an extensive inventory of maps in order to visualize America's geography — its watersheds and the inherent relationships between climate, physiography, soils and hydrology (Worster 2009). Using these scientific assessments, along with detailed studies of indigenous and Mormon irrigation systems (Lewis and Torbenson 1990), Powell estimated that only a fraction of the West could ever be effectively irrigated. He predicted that misalignment of socio-political boundaries and hydrographic regions would result in geopolitical conflict and unsustainable water management. Powell said: "I tell you, gentlemen, you are piling up a heritage of conflict and litigation over water rights, for there is not sufficient water to supply these lands."

Illustrations of political border following the regional watershed boundaries

In an era that encouraged expansionism and individualism, Powell advocated for cooperative stewardship, conservation and environmental planning. The *watershed* would serve as the foundation for a resilient sociopolitical and place-based organization of the West by instilling uniquely democratic principles and Jeffersonian ideals. Unfortunately Powell's recommendations were never adopted, and today, his words could not be more true. California, after witnessing the worst drought in its history, is currently facing extreme rainfall and flooding. The recent failure of Oroville Dam highlights the challenges of America's ageing flood control infrastructure. At the same time, the West is facing increased tension and disputes among municipalities, governments, farmers, environmental groups, industries and Native Americans over water allocation and management. With the implications of climate change, ongoing urbanization and environmental decline, now more than ever, it is important to revisit Powell's ideas, and envision new socio-spatial frameworks for managing water.

The Dutch Polder Model: Designing with water

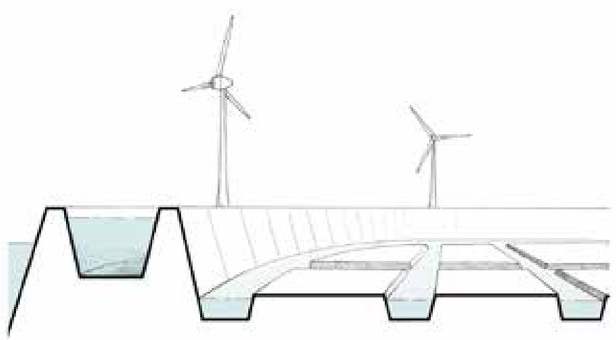
The final precedent concerns the Netherlands, where a long-standing relationship with water has informed innovative adaptation strategies and a distinct socio-political attitude characterized by consultation, compromise and consensus, also known as the Dutch '*polder model*' (de Vries 2014).

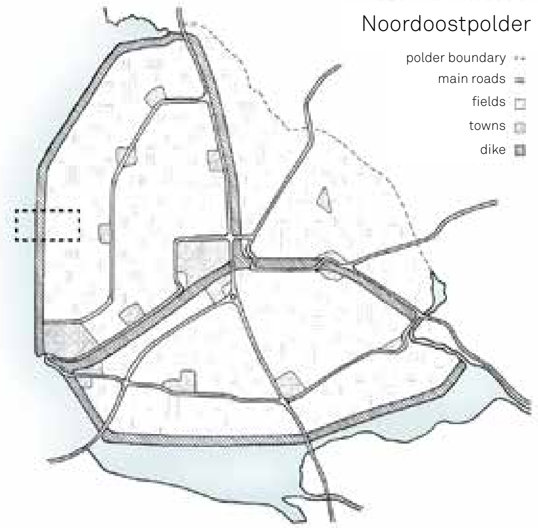
With nearly a third of the country situated below sea level, integrated solutions to water management have always been important to the Netherlands (Lokman 2016c). Dating back as far as the 9th century, the Dutch began building dams, dikes and other flood control measures to protect settlements, agricultural areas, and reclaimed areas of land. While initially a primarily local matter, with the growth of cities and their hinterlands it became increasingly important to coordinate flood control among various stakeholders (de Mul and van den Berg 2011). This meant people and social classes living in the same '*polder*' (a reclaimed area of land protected by dikes) had to work together to fund, build and manage appropriate flood control infrastructures (van Tielhof 2015). Over time, they established '*water boards*' (regional water authorities) to coordinate flood protection, preserve water quality, and to manage the general water economy of their respective regions. These water boards are one of the first forms of public administration, and the oldest form of democratic government in the Netherlands (Dutch Water Authorities 2015).

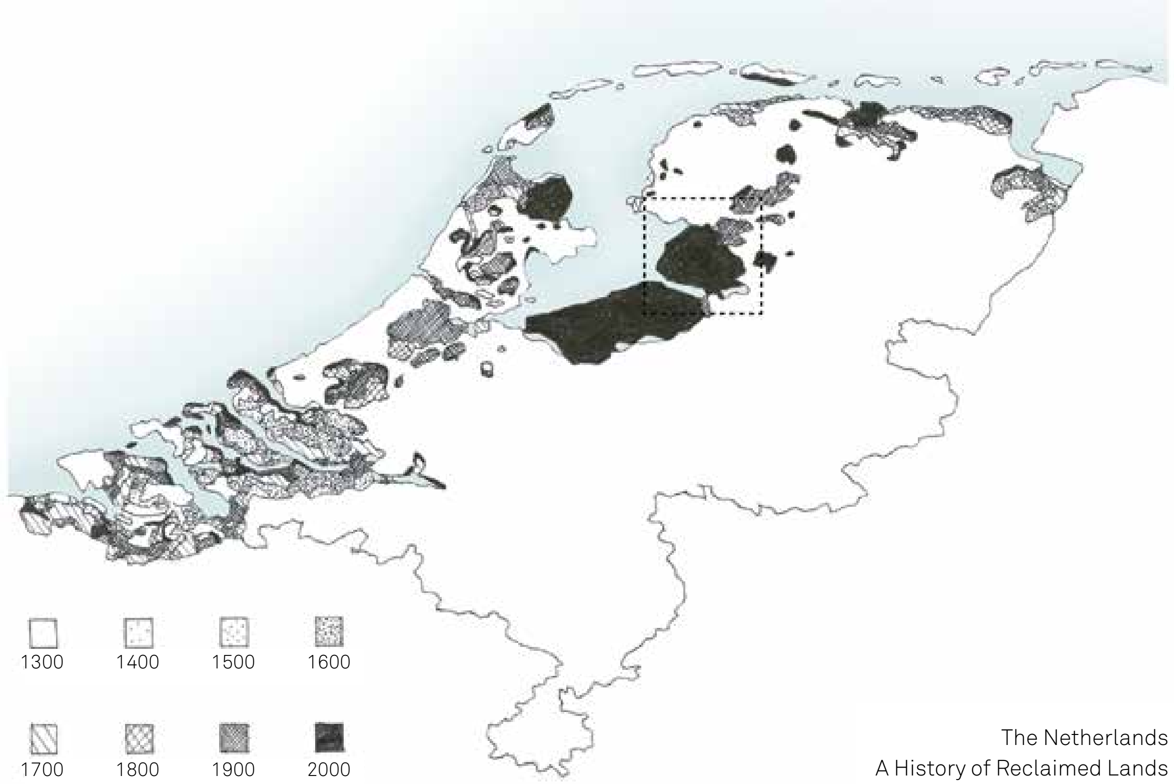
Since water-related tasks are of existential importance to the Netherlands, the organizational structure of water boards is decoupled from the political structure—they have their own administration, governing body and financial structure. As such, the budget for water management is not balanced against that of health care, education, defense spending, and so on (Dutch Water Authorities 2015). Water boards also maintain an *interest-say-pay* principle: the higher the interest of a stakeholder, the more tax is raised. In return, these stakeholders will have more influence on decision-making. As such, taxes differ substantially across the country.

In line with the emergence of a new ecological paradigm, including notions of complexity and resilience, the Dutch have recently changed their water management approach from focusing primarily on protection *against* flooding to working together with water. After major floods in 1993 and 1995, the government initiated the *Room for the River* program (2006-2015). The project focuses on increased flood storage and enhancement of the spatial quality. It consists of 39 distinct but interconnected local projects, which deploy numerous

Ruimte voor de wall
Rendering of the new bypass channel at Nijmegen and Lent







The Netherlands
A History of Reclaimed Lands

Illustrations of the contemporary Dutch Polder landscape

adaptation strategies and approaches, including depoldering (allowing water back into a polder), flood bypasses, dike setbacks and relocation of buildings to higher grounds. In addition to establishing extensive public participation platforms, the government also worked with various water institutes to develop a digital hydrologic model to calculate, coordinate and assess the overall effectiveness of all 39 projects.

Among the more visible projects is *Ruimte voor de Waal*, where a new bypass channel not only increased flood storage and provided habitat for fish and wildlife, it also created a new island with unique opportunities for recreation and urban development. Climate change and flooding are no longer seen as a risk but rather as a possibility to unlock new social, ecological and economic opportunities. As suggested by Veerman (2008: 7), “Changing the way our country is managed creates new options; working with water may improve the quality of the environment and offers excellent opportunities for innovative ideas and applications. Where there is water, new forms of nature can arise. Water can be used to produce food and generate energy. Flood defenses can be used for roads.”

Moreover, these complex and multi-scalar spatial planning projects call for planning approaches that combine top-down policies with bottom-up participation. According to Jeroen Rijke et al., it is exactly “through application of a mixed centralized–decentralized governance approach, [*Room for the River*] has tackled governance pitfalls related to centralized planning approaches that previously impeded integrated water management” (Rijke et al. 2012: 379). Thus, while climate change is a serious challenge it is also provides preconditions for testing new planning frameworks, and for the design of dynamic, multifunctional landscapes.

Back to the Future

The examples discussed above illustrate sustainable water management that involve adopting practices capable of dealing with dynamic and ever-changing social-ecological conditions. They are based on notions of *co-designing* and *co-evolving* social and biophysical systems. As pointed out by Priscoli (1998: 623): “Increased interdependence through water sharing plans and infrastructure networks can be seen as increases of our flexibility and capacity to respond to exigencies of nature and reduce our vulnerability to events such as droughts and floods and thereby increase security.” This also means, rather than holding on to a single approach to water management, we should develop a multiplicity of strategies and frameworks to solve issues of water scarcity, flood control, water governance and water ethics (Schmidt and Shrubsole 2013). This requires collaborative efforts and concerted action by all stakeholders in order to integrate knowledge and coordinate cross-boundary planning approaches.

Looking to the future, there are some reasons to be optimistic. The practice of landscape architects SCAPE, for instance, provides a good example of how mutualistic interactions between people, animals and plants (such were inherent to the *chinampas*) can be designed to create productive and resilient urban environments. In particular, SCAPE’s *Oyster-tecture* project, which was commissioned by the Museum of Modern Art in 2009 for the Rising Currents exhibition, shows how humans, natural processes and marine animals can work together to create an ecological infrastructure that provides flood protection, habitat restoration, food, and recreation.

Located in Brooklyn, New York, the proposal harnesses the various qualities of oysters and other shellfish to construct new cultural and environmental relationships. Using a low-tech FLUPSY system (floating upwelling system), the oysters are nurtured in post-industrial Gowanus Bay, where they help filter and clean the water. Once matured, they are transferred to the intertidal zone of the Bay Ridge Flats. Here, the artificially seeded shellfish species are attached to an armature of fuzzy rope and old wharf piles to create a reef for aquatic species, birds and people. Over time, as sediment, plants and shellfish inhabit this constructed landscape, the reef becomes a living breakwater that simultaneously acts as a unique ecosystem and wave-attenuating armature to protect against storm surges and rising sea levels. The design-research for Oyster-tecture has informed multiple ongoing projects, including the proposal ‘Living Breakwaters’, which envisions a series of ecological infrastructures along the shores of Staten Island. The project recently received $60M from the U.S. Department of Housing and Urban Development (HUD) and is currently being implemented by the NY Governor’s Office of Storm Recovery.

With respect to communal water management, the *acequias* in New Mexico present an alternative to current water-intensive and highly mechanized forms of agriculture in arid regions. While not a new invention (*acequias* have been around for centuries), both the social and spatial practices of the *acequia* culture can inspire novel ways of water management. Originally introduced by the Moors (North Africa), and further developed in Spain and former Spanish colonies, the term ‘*acequias*’ refers not only to the physical irrigation channels but also to the social and organizational structure of a water-sharing network (Santistevan 2016). Construction and maintenance of the acequia system (canals, ditches, reservoirs) is done collectively (Lewis and Torbenson 1990). Engineered to use gravity and natural contours of the land, acequias divert snow runoff from a main river into an artificial network of channels to irrigate farming plots. The mother ditch (*acequia madre*) distributes water to lateral ditches

(*linderos*) and secondary laterals (sangrias) to irrigate specific fields. These ditches also help to restore aquifers and enhance habitats along riparian areas.

Acequia members (*parciantes*) elect a 'ditch boss' (*mayordomo*) who is in charge of managing the water and settling disputes. Together with the *acequia* community, the mayordomo is responsible for making sure all members meet their water needs for agricultural production throughout the season. As a non-capitalist form of farming and social relations, the *acequias* "call attention to alternatives in how societies can reproduce themselves materially, from households to the broader economy" (Gunn 2016: 91). The emphasis is on cooperation and sharing in order for each *acequia* member to leverage a certain level of material independence. Instead of seeking to generate profit, the motivation is to maintain a regenerative way of life between people and the land. The fact that water is still flowing through the *acequias* speaks to their socio-economic and spatial resiliency. With economic uncertainties and the implications of climate change (variation in available water supplies and crop yields), *acequias* provide an adaptive, resilient and democratic model to support small-scale agricultural practices in semi-arid and arid regions.

The area of water management which is perhaps most rapidly evolving concerns regional flood risk mapping as well as the development of new spatial planning and design strategies for sea level rise adaptation. After Hurricane 'Sandy' hit the New York Region in 2012, HUD launched the *Rebuild by Design* initiative to facilitate collaborations between transdisciplinary design teams and local communities in order to develop strategies that promote socio-economic opportunities within a framework of ecological resilience. With a focus on using a research-based and design-driven approach to problem solving, *Rebuild by Design* provided funding for ten teams to develop innovative approaches for those areas in the region most vulnerable to flooding. These teams, then, worked several months with experts, community and local government stakeholders to develop strategies that were both realistic and replicable. In 2014, HUD announced six winners—SCAPE's *Living Breakwater* being one of the winning proposals—which have received additional funding to further develop and implement their projects.

Rebuild by Design has been a big success, both in terms of raising public awareness and in developing cutting-edge spatial strategies to combat climate change. At the same time, it has inspired similar initiatives across the United States, including *Changing Course* (2013), which challenged interdisciplinary design teams to develop strategies for the future of the Lower Mississippi River Delta, and ongoing projects in Miami and the San Francisco Bay Area. In each of these initiatives, adaptation to climate change is approached first and foremost as a *spatial* opportunity: by focusing on hybrid approaches that combine hard and soft engineering strategies, we can design landscapes that are dynamic and productive while cultivating new nature-culture relationships (Rojas et al 2015: 188).

The 1799 dike breach at Bemmel in the Netherlands by Christian Josi

Alongside developing new approaches to water management, there is a need to preserve cultural landscapes of traditional water management. As illustrated in this article, these landscapes have evolved over extended periods of time. They are key sources of knowledge concerning appropriate governance structures, social relations, spatial strategies and economic incentives essential to developing long-term sustainable water management. As pointed out by Kate Orff (2017): "Looking back reminds us that dramatic change in place, environment, and ecosystem is part of understanding current urban ecology, and critical in projecting forward newly modified cohabitats and communities." In the same way a site's history can inform future landscape proposals, historical water management approaches and techniques can guide us in developing new mechanisms moving forward. To do so we must develop solutions that neither over-romanticize the past nor simply revert to a 'technological fix' (Priscoli 1998). Instead, we should embrace the myriad of interactions among the human, non-human, and abiotic components of (urban) landscapes to develop a diversity of spatial models of water management.

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Project Name_Projecting Change

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BREATHE, LOOK, STAND UP

Project Name 01_ DC ExchangeProject_Site_ McMillan Slow Sand Filtration site_ Location_ Washington DC_ New use 01_ Community center, marketplace, performance_ Project Name 02_ People's Liberation Army No. 1102_ Location_ Shenyang China_ Original architect_ Communist Party China_ Rehabilitation architect_ META-Project_ New use 02_ Exhibition space, mini theatre

Image Credits_ Figure 01,02, 08_ McMillan slow sand filtration site, Washington, DC, Lewis Francis; Figure 03 –07_ Public Folly, Shenyang, China, META-Project; Figure 09_ Courtesy of Lindsay Winstead

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THE TEARS OF THE U.S.S. ARIZONA

Project Name_ A tomb that lives; Location_ Pearl Harbor, Hawaii

Image Credits_ Figure 01_ View of USS ARIZONA taken from Manhattan Bridge on the East River in New York City on its way back from sea trials. December 25, 1916, Library of Congress Prints and Photographs Division Washington, D.C. 20540 USA http://hdl.loc.gov/loc.pnp/pp.print; photographer_Enrique Muller, Jr. / E. Muller; 1916; Wikimedia; Figure 02_ A TOMB THAT LIVES Monument proposal, illustration by author; Figure 03_An aerial view of the USS Arizona Memorial, U.S. Navy photo by Photographer's Mate 3rd Class Jayme Pastoric, Wikimedia

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THE EDGE OF CONDITION

Project Name 01_ Three Mills_ Bromley-by-Bow_ River Lee_ London, England_ Project Name 02_ The White Building_ Lee Navigation Canal_ Hackney Wick_ Stratford, England,_Project Name 03_ The Marine Engine House_ Wlathamstow Reservoirs

Image Credits_ All images courtesy of the authors; Figure 01, 02_Three Mills Island, London_ Figure 03_ White Building_ Hackney Centre Wick_ Stratford_ Figure 04_ The Sinking Future Post Apocalyptic Flood Survival Centre.

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BACK TO THE FUTURE

Image Credits_ Figure 01_ The Big U, Courtesy of Bjarke Ingels Group; Figure 02, 03, 05) by Julia Casol; Figure 04_ Courtesy of H+N+S Landscape Architects; Figure 06_ Dijkdoorbraak bij Bemmel, 1799, Christiaan Josi, naar Jacob Cats (1741 – 1799), 1802, source: Rijksmuseum, Amsterdam

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THE OYSTER BLOCKS PROJECT

Project Name_ The Oyster Blocks Project

Image Credits_ Figure 01 – 07_ courtesy of the author

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THE HAMMAM OF ERBIL CITADEL

Project Name_ Hammam of Erbil; Location_ Erbil, Iraq

Image Credits_ Figure 01 – 04_ courtesy of the authors

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(re)MADE BY WATER

Project Name_ New World Mall, Bangkok, Thailand

Image Credits_ All images courtesy of the author; Figure 01_ Mall; central court, Photograph by Perfect Lazybones; Figure 02_ Floating market in Bangkok, Photograph by Georgie Pauwels: Figure 03_ Mall, escalators, Photograph by Olga Saliy: Figure 04_ Mall, koi, Photograph by Olga Saliy; Figure 05_ Mall, escalators, Photograph by Olga Saliy.

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T-HOUSE

Project Name_ T-HOUSE, theoretical project; Location_ Hains Point, Washington, D.C.

Image Credits_ Figure 01 – 08_ courtesy of the authors

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THE BLUE LINE

Project Name_ blue developments; Location_ Battir, Palestine; Qeparo, Albania

Image Credits_ Figure 01- illustration by author

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ENVIRONMENTAL IDENTITY

Project Name 01_ Caiaques kayaks; Location_ Pinheiros River, São Paulo, Brazil; Artist_ Eduardo Srur; Project Name 02_Pets; Location_ Tietê River in São Paulo, Brazil; Artist_ Eduardo Srur

Image Credits_ All photos courtesy of Eduardo Srur; Figure 01_ Caiaques, kayaks, Pinheiros River, photo_ Eduardo Nicolau; Figure 02_ Caiaques, kayaks, Pinheiros River, photo_Alexandre Schneider; Figure 03_ Pets, Tietê River, photo_Eduardo Srur; Figure 04_ Pets, Tietê River, photo_ Almeida Rocha

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A METROPOLITAN PARK OF WATER

Project Name_ Metropolitan Water Park project, Location_ Saragossa, Spain

Image Credits_ Figure 01_ Bridge Pavilion & Third Millennium Bridge, Río Ebro, Zaragoza, España, Source_Pabellón Puente y Puente del Tercer Milenio, Author_ Juan E De Cristofaro from Zaragoza, España, CC-BY-SA-2.0; Figure 02_Google Earth aerial view of Zaragoza, Spain; Figure 03_ Plano topográfico de la ciudad de Zaragoza del siglo XVIII, Wikimedia;

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BETWEEN RESILIENCY AND ADAPTATION

Image Credits_ All images courtesy of the author; Figure 01_ by author, background_ by Aleks Dahlberg at www.unsplash.com; Figure 02_ by author; Figure 03, 04_ graphic by author, background_ by Frantzou Fleurine; www.unsplash.com

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WATER AS MEDIUM

Project Name 01_ Water tower in Delft, Architect_ Rocha Tombal; Location_ Delft, NL; Project name 02_ Water tower in Brasschaat, Architect_ Crepain-Binst Architects; Location_ Brasschaat, Belgium; Project name 3_ Water tower Sint-Jans convent, Overijssel; Architect_ Zecc Architects; Location_ Overijssel, NL

Image Credits_All images courtesy of the authors_ Figure 01_ typological evolution of the water tower, Source: Inge Donné; Figure 02_ Water tower in Delft (NL), photo by Christiaan Richters; Figure 03, 04, 05_ Water tower in Brasschaat (BE), Crepain-Binst Architects, photo_ Crepain Binst; Figure 06, 07_ Water tower Sint-Jans convent, Overijssel (NL), Zecc Architects, photo_ Stijn Poelstra, http://www.stijnstijl.nl/;

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Ahmed Abbas holds a Bachelor Degree in Architecture from the Technical University of Avans and a Master in Interior Architecture from Hasselt University in Belgium. He has six years of experience as an architect in leading his own company. He has been a lecturer at the University of Newroz (Iraq) since 2014, where he teaches Modern Design and coordinates Working / Drawing and Building Construction. Since 2015 he has been working on his Ph.D. entitled "A Proposed Methodology for the Adaptive Reuse of Traditional Buildings in the Buffer Zone of Erbil Citadel".

Brian Ambroziak is an Associate Professor of Architecture at the University of Tennessee, Knoxville. His publications include *Michael Graves: Images of a Grand Tour* (2005) and *Infinite Perspectives: Two Thousand Years of Three Dimensional Mapmaking* (1999) with Princeton Architectural Press. In 2008, Brian Ambroziak founded time[scape]lab with Andrew McLellan and Katherine Ambroziak.

Katherine Bambrick Ambroziak is an Associate Professor of Architecture at the University of Tennessee, Knoxville. Her publications include *DeadSpace Arlington*, *Material Scribe: Memoirs of the Collective Individual*, *Surrogate Stones*, *Odd Fellows: Constructing the Positive Place|Self*, and *Codification of Ritual in Design*. Since 2009, she has served as the primary designer and coordinator of the Odd Fellows Cemetery Reclamation Project, a conservation and rehabilitation initiative that aims to educate and support the minority communities of East Knoxville through the design and implementation of a responsive memorial landscape.

Michael Leighton Beaman is the founding principal of Beta-field, a design/research office run with Landscape Architect and educator Zaneta Hong. Michael is also a co-founding member of the design nonprofit GA Collaborative. Michael currently teaches at the University of Virginia where he is an Assistant Professor in Architecture and at the Rhode Island School of Design, where he is a critic in the Interior Architecture Dept. In addition to teaching and practice, Michael is a writer for *Architectural Record* focusing on design technologies and techno-centric design practices.

Inge Donné completed her bachelor's degree in Interior Architecture at Lucca School of Arts, Brussels, and her master's degree on the topic of adaptive reuse at Hasselt University. After internships at Baccarne and Lens°ass architects, she researched the reuse of water towers and created a masterproject for the water tower of Hoeilaart (BE) as co-working space.

Dr Graeme Evans is Professor of Urban Design at Middlesex University, Department of Design and Director of the Art & Design Research Institute. He has been leading a research project in the Lee Valley as part of a 3 year Arts & Humanities Research Council-funded project: Towards Hydrocitizenship, exploring the changing relationships between people, ecosystems and urban water landscapes, and the legacy of waterside architecture and heritage. In June 2015 he curated the Hackney Wick & Fish Island Connecting Communities Festival including an exhibition of site-based design schemes including BA Interior Architecture student work, as part of the London Festival of Architecture. Graeme is also Professor of Culture & Urban Development at Maastricht University, The Netherlands where he has been working on several industrial heritage re-use schemes.

Alexander Ford earned a B.S. in Architecture from the University of Arizona in 2014, and an M.S. in Historic Preservation from Columbia University in 2016. Ford currently works for Daniel Libeskind in New York. His architectural work has been published internationally.

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