灰水利用的契机

——对境外水域的探寻与思考

WHEN THE ONLY WATER LEFT IS GRAY

— THE GROWING QUEST FOR FOREIGN WATERSHEDS

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摘要

干旱地区约占陆地总面积的41%，承载着全球三分之一的人口，更有多个特大城市坐落其中，以丰富的矿产和肥沃的土壤创造了每年数十亿美元的经济收入。然而，持续的人口增长与不断变化的降水量造成了水资源的严重短缺。为在维持当地经济稳定发展的同时有效进行人口增长的预测，世界各地的政府纷纷将水-能网络扩展到境外流域中。作为由哈佛大学查尔斯·艾略特旅行奖学金资助的比较设计研究项目的一部分，本文探讨了全球范围内的水资源短缺问题。项目研究了旱灾对干旱地区的影响，记录了不同区域水系统的特征，概述了大型水利工程对社会经济与社会生态的影响。通过呈现这些过程，本文从景观设计学的角度探讨了当前的水资源议题，通过强调灰水的重要性而将视野从“水之稀缺”向“水之充沛”转变。为印证这一具有社会和经济复杂性的构想，该项目通过国际案例研究探讨了中央集控下跨境调水的缺陷以及地方分控下灰水收集及利用的潜力。为应对水资源短缺的问题，跨尺度且多样化的干预措施不可或缺；以景观过程为框架的混合系统的建立，成为了跨学科规划与设计的关键。

关键词

水资源短缺；干旱；资源充沛模式；非中心化；基于景观的方法

ABSTRACT

Arid regions around the world comprise approximately 41 percent of the global surface area. These drylands are inhabited by 1/3 of the global population, are home to several mega-cities and nurture a multimillion dollar economy annually. However, continuous population growth and changing precipitation patterns created the phenomenon of water scarcity. To stabilize the local economy and facilitate population growth projections, governments around the world extend their water-energy-network to access foreign watersheds. As part of a comparative design research project under the Harvard based Charles Eliot Fellowship, this article addresses the global issues of water scarcity. It studies the effects of drought in arid regions, documents territorial water systems and outlines the socio-economic and socio-ecological effects of megaprojects. By revealing these processes, the article discusses the current water discourse from the perspective of landscape architecture and endorses a paradigm of abundance. To illustrate this complex social and economic proposition, a survey of international case studies provides the understanding of the territorial gap and demonstrates decentralized action on a local scale. Ultimately, to challenge water scarcity, a plurality of interventions at multiple scales are inevitable. The key for interdisciplinary planning and design lays in the hybridity of systems, which are framed by a landscape-based approach.

KEY WORDS

Water Scarcity; Drought; Paradigm of Abundance; Decentralization; Landscape-Based Approach

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1 关于干旱影响的国际调查

2017年11月12日，南非《时报》报道了有关开普敦市水资源紧缺的新闻，同时表明该市在替代水源的寻找上亦未取得实质性进展^[1]。仅一个月后，美国生命科学网发表了一篇题为《零水日：开普敦或成为首个水资源耗尽的大城市》的文章^[2]。极端气候所带来的旱灾和缺水问题正侵袭着全球各地的干旱地区，其中包括2010年发生在中国的旱灾和沙尘暴、2011~2017年严重影响加利福尼亚的前所未有的旱灾等。在经济迅猛增长的背景下，不断变化的环境与人口状况之间相互作用，使国家或地区对可用水资源的需求发生相应转变。干旱地区约占陆地总面积的41%^[3]，承载着全球三分之一的人口，更有多个特大城市坐落其中，以丰富的矿产和肥沃的土壤创造了每年数十亿美元的经济收入^[3]。更大范围内气候系统的变化影响着地区降水周期，二者又共同决定着水文周期及水体情况，补给着地区的淡水资源。众所周知，厄尔尼诺现象和拉尼娜现象^[4]均会带来全球范围内的气温和降水的反常变化。近年来因气候变化加剧所造成的降雨推迟或转移^[4]，影响了淡水的供应，对自然和人类发展造成了威胁。

“灰水利用的契机”是由哈佛大学查尔斯·艾略特旅行奖学金资助的设计研究项目。项目基于6个国际案例，对旱灾在干旱地区的影响进行了调查（图1）。通过记录这些区域的水系统情况（图2），并结合对相应流域所开展的大型项目的社会经济和社会生态效应的分析，该项调查揭示了全球普遍存在的水资源短缺问题。下文将首先简要介绍该项目中涉及的案例概况，然后从景观设计学层面探讨当前的水资源发展议题。该项目意在透过设计研究的途径展示探究全球

问题的层面，将基于景观的规划和设计方法视为构建多样化的地方干预措施的基础。

2 超级工程和自然危机

2.1 罗斯福新政时期的“资源稀缺”模式

迫于19世纪与20世纪之交的城市快速发展，洛杉矶市不得不从欧文斯流域引水^[5]。颇具远见的洛杉矶水电管理局总工程师威廉·穆赫兰提议建造首个洛杉矶引水渠^[6]。为使项目获批，穆赫兰以洛杉矶连年的干旱问题为切入点（持续的干旱已造成了市民的恐慌）^[7]。他还预见到洛杉矶将迅速发展为一个大都市，因而将目光投向了科罗拉多河。1922年，《科罗拉多河契约》签订，明确了沿河7个相邻州的供水分配^[8]——该协定的出现恰逢其时，因为美国彼时即将再次经历一场严重危机——20世纪30年代，一系列沙尘暴事件侵袭了美国中西部，加之经济大萧条的影响，胡佛大坝即在此背景下启动^[9]。这项超级工程开辟了同类项目的新标准，并为加州引入了新的水源。此后，利用自然危机谋求经济发展成为了政府的一种应对策略。在科罗拉多河被人为分为上下两段进行管理后不久，加州成为首个提出水资源供应诉求的州^[10]。为响应其诉求，389km长的科罗拉多河引水渠、130km长的全美运河及362km长的圣地亚哥引水渠等多个超级工程开始建造。图3~7展现了科罗拉多河流域水系统的景象，大量水利工程的建设使位于亚利桑那州葛兰峡谷大坝与毗邻墨西哥边境的莫雷洛斯大坝之间的自然景观被不断边缘化。

2.2 全球水资源的商品化

随着经济与人口的持续增长，水资源短缺地区亟需找到替代水源。为在维持当地

Ground Water Table and Aquifer
蓄水层

Los Angeles currently gets 12-17% of drinking water from ground water resources. They are considered to be the best storage tanks as the underground surface is either very deep or very shallow and constant pumping just a high level of water. The water is then pumped and energy infrastructure.

Water Reservoir
水库

Reservoirs main purpose is to store large amounts of water. The idea of storage works across scale starting with the single household. As the scale increases, the construction of reservoir will have an impact on the environment and in the case of Hoover Dam, retain and slow abundant water, displacing the Colorado River Delta. Their integration and connection to the larger network is crucial.

Settlement Basin
沉降池

They are temporary installation of construction, agricultural, water culture and mining sites. They are built to separate and remove settle matter and turbidity from wastewater and effluent that contain pollutants runoff. They separate the waste particles before discharging to adjacent streams or water bodies.

Swale and Bio-swale
草沟与生态草沟

A swale is a low tract of land, and is of natural or man-made origin. They are often designed to manage water runoff along major roads, filter pollutants, and increase groundwater infiltration.

Detention Basin
蓄洪池

Their task is to store and hold water during storm surges to prevent flooding of streams, lakes and seas. They are artificial structures and constructed as either ponds or basins. In addition to the main purpose of water retention, they can also filter chemical before they are released into the natural system.

Infiltration Basin
渗透池

The main implementation is meant to manage polluted storm water runoff, prevent flooding and downstream erosion, improve water quality through filtration. They are also considered recharge basins, but are distinguished from detention basins, as it is designed to discharge to a downstream water body.

Recharge Basin
补给池

The Coachella Valley Basin is the central link of the basin connected to the aquifer. Recharge generally happens through the percolation of surface water, drainage of intermittent streams and through runoff from rainfall water. The Coachella Aquifer is the main source of potable water for the region and depends on recharge.

Parking Planter
停车场种植槽

Planting infrastructure to increase infiltration of a vast impermeable surface that drains water directly to a point drain to avoid local flooding. Water then discharges untreated into neighboring creeks, and increase the amount of phosphorus that is harmful for stream wildlife habitat and the estuarine ecosystems. The enhancement of vegetation manages polluted runoff, increases the microclimate and green shopping experience of customers through the visual appeal.

Flood Plain or Wetland
泛洪平原或湿地

They are categorized as swamps, marshes and bogs and appear anywhere from the inland, to riparian areas. Flood plains are the coastal areas. Wetlands are the water retention, aquifer recharge and effective infrastructure for wildlife habitat. The performance of constructed riparian wetlands is the highest (USFWS, 1998).

Forebay (Reservoir)
缓冲渠 (水库)

It is classified as an artificial pond of water in front of a larger body of water and has either natural or constructed. They function as infrastructure to control flooding, act as buffer during floods, and control the release of impounding water to larger water bodies. They are also used upstream of reservoirs to trap sediments and debris. Sediment Forebay in order to keep reservoirs clean.

Flood Basin
洪泛区

They are also considered as infiltration basins and range across scales. Each watershed typically has a designated area where water accumulates and slowly seeps into the aquifer. At the urban scale, the infrastructure manage storm water runoff, prevent flooding and improve water quality. Recreational uses might be one of the important signs during dry seasons.

Rain Garden
雨水花园

They are implemented at the human scale and serve as natural sponges in storm and heavy rain events. Their implementation along streets has the potential to manage polluted storm water runoff. Furthermore, the increase in vegetation enhances the microclimate and visual experience, providing identity.

Effluent Treatment Wetland
水质净化湿地

Treatment Wetlands are common systems that capitalize on the wetlands filtering function. Constructed wetlands have the highest performance for nitrogen and phosphorus removal. The landscape created is used by the public and can be used for recreation. Release of water may be allocated for downstream systems, such as the Colorado River Delta.

Waste Water Treatment Plant
污水处理厂

Processes and converts sewage and urban effluent water, that is no longer suitable. The clarification process turns waste water into an effluent, suitable to be returned into the water cycle or with more energy production for drinking water. Most treatment plants reduce the major pollutants and chemicals before discharging it far out into our oceans. A lot of water gets lost in the process. Alternatives may consider the recharging and storage of water in aquifers.

Aquifer Injection Well
蓄水层注水井

Injecting treated water back into the aquifer is a direct physical method, based on physical processes. Recharge is generally calculated from the base of flow levels of water and ground surface water. The injection well is the direct flow. Electric water depth underground into porous rock formations, such as sandstone. Techniques differ depending on depth of the injection.

Hydro-dam
水电站

Hydro-electric dams were implemented to gain "clean" energy. Hoover Dam was constructed during the Great Depression with the intention to prevent flooding irrigation and the production of water. Sediments that are important for the Colorado River Delta are trapped behind the dam and take up water storage space.

Levee
堤坝

They protect home owner in the event of a 100-year flood event and prevent storm surges. Many levees today are outdated and need repairs and eventually replacement. They are often not tested, as their insurance companies and contractors to reconsider their use.

Gray Water Collection Tank
灰水收集箱

The collection of greywater with not local contamination in combination to a natural or mechanical filtration system, allows home owners to recycle water in place and with more energy production for drinking water. This is one of the techniques that should be considered for the planning of new regions.

Effluent Integrated Wetland
水质净化湿地

This combination of river and wetland works well as a natural cleaning and filtering mechanism for polluted water. The wetlands lay on higher ground and are fed by rain runoff. Sedimentation and filtration clean the water as it moves through the natural layer and returns into the river. The stream of the wetlands may be used in combination to energy production.

Canal
运河

The LA river is a prime example of a man-made, single-use infrastructure that has a major environmental and ecological effect of a city's water cycle to other purposes is to transport water from the point of collection far out into the ocean. Impervious sediments, get transported far out where it settles on the ocean floor. Canals per se are vulnerable for cracks and need a lot of maintenance. The loss of water is another negative side effect that might also become a point-source that pollutes the aquifer.

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2. 洛杉矶市用于水资源储存与运输的基础设施一览
2. Los Angeles water infrastructure catalogue between storage and conveyance

经济稳定发展的同时有效进行人口增长的预测，世界各地的政府开始借鉴加州的蓄水和输水方法，将水资源网络扩展到非本地流域中。这种将水资源视作储备物资的意识^[11]，使得资源利用超越管辖界限和国家边界。这意味着来源于某个特定地域的水资源将被一个或多个经济子系统加以利用^[11]。利用过的或受污染的水体（即灰水）不再被视作“资源”，而是作为废水和污染物被排入污水池^[12]。下面的三个案例将呈现这一城市化进程所带来的多方面影响。

2.2.1 中国华北平原——南水北调工程

北京地处中国华北平原，曾拥有丰富的河流和淡水资源^[13]。华北平原是中国第二大

平原，主要由黄河、淮河和海河冲积而成^[14]。不断变化的降水周期、显著减少的降雨量、严重的干旱、频发的洪水，以及迅速的经济增长与城市扩张，已严重超越了北京当地资源的承受能力。地下水的过度汲取导致蓄水层几近枯竭，工业排污管理不善造成水质下降，肥沃土地面临严重的沙漠化威胁^[13]。1952年，毛泽东主席提出通过向水资源丰沛的南方借水，以解决北方水资源短缺的问题^[15]，由此形成了建造超级水利基础设施——包括2 400km的运河及渠道网络的南水北调工程的构想。该工程主要包括东线、中线、西线三条调水线路。其通过连接长江、淮河、海河和黄河，形成了“四横三纵”的总体布局，以调取长江流域的水资源

（图8~10）^[13]。尽管面临环境短板，华北平原仍在持续发展。近期，中国中央计划在北京和天津的南部建设百万级人口城市——雄安新区^[16]。尽管其建立可以缓解北京的城市扩张所带来的影响^[16]，但同时也增加了北方地区整体用水需求。在这种背景下，对诸如南水北调这样“以工程手段解决生态难题”^[17]的超级工程的构想应运而生。

2.2.2 南非——零水日

当前，南非城市开普敦的水资源现状不容乐观。曾有预测，2018年4月22日，开普敦将面临“零水日”危机^[18]——导致这场水资源浩劫的因素包括立法的不完善、机制的不健全、议会中政治角色与技术角色的失

调^[19]。气候变化的加剧引发了年降雨量的变化，而高温则造成水库水面蒸发量加大，人口向城市的不断聚集亦使问题更加严峻（图11，12）。1998年，《南非共和国水法》颁布，这是其后种族隔离时代所颁布的多项法律的其中一部，旨在保障公民的水资源供给^[20]。该项法案对中央及地方的相关水资源职责进行了划分：中央政府需要履行其对水资源的保护、开发、储存、管理和控制职责^[18]；省级和市级政府则负责当地水源的管理、维护和运输^[19]。因此，开普敦市级政府事实上无权对该城市水供应基础设施进行投资。此外，与1998年新水法并行运作的1968年《国家水资源指南》在诸多方面已经过时，其所列出的各项标准（例如水质规范）不再适用于应对当前前所未有的水危机。这一情况使当地的水管理更加复杂，并不可避免地阻碍了变革的进程。

2.2.3 新加坡——唯一且巨大的水资源挑战

新加坡位于东南亚的热带岛屿之上，于1963年脱离英国统治获得独立^[21]，且自1965年从马来西亚分离出来后，依然维持着其与马方原先签订的供水协议^[22]。但自马来西亚经历了多次旱灾后，从其南部城市柔佛进口的水资源水质与水量开始下降^[22]。由于新加坡与马来西亚两国的政治角力，再加上新马供水协议将在2061年终止，新加坡不得不改变其在水资源方面的政策方向^[23]。为实现水资源独立，新加坡第一任总理李光耀将水资源相关事务列为政府政策和城市发展的重中之重^[22]。

3 景观，获取丰沛水源的途径？

无论是对于社会发展还是包括农业与工业在内的经济增长过程而言，水资源都至关重要。由于可用水资源的约束与限制对产品的生产以及新工作岗位类型的出现有直接影响，因而成为了制约城市发展的重要因素。前文提出，罗斯福新政时期“水之稀缺”的论断伴随着水的商品化而产生。该供水方案通过不断从境外流域获取水资源，将水－能

网络从生产地扩展到消费地。由此，中央集控的供水系统不可避免地造成资源分配的地域差异^[24]，形成影响自然环境及其再生能力的社会过程断层。尽管大型跨境引水项目能够通过缓解水资源稀缺的情况维持经济子系统的运行，我们亦应提出如下问题：倘若这种中央集控的供水系统不断扩张，一旦严重干旱或其他重大灾难造成系统崩溃，我们将采取何种替代方案？在这一背景下，强调水之可用量、质量以及对淡水资源的获取具有增长极限的“水峰值”的概念^[25]，或许能够让我们重新审视通常被视作“废水”的灰水的重要性。对“灰水”的关注能够将我们的视野从“水之稀缺”向“水之充沛”转变，即从有赖于中央集控的跨流域调水策略，转向地方分控下依托于混合系统的灰水收集及利用策略。

在中国，为了应对华北平原地区的不断发展，亟需跨越辖区界限的规划和决策新思维。如果能够发展出一套以景观过程为框架的精明土地利用规范，将能够更为充分地利用城市和乡村的天然水体和湿地。例如，“海绵城市建设”策略意在增强洪水期间的城市弹性，保护并提高溪流、湖泊和储水层的水质，增强市民与环境之间的社会－生态联系。因此，快速发展的中国城郊可被视为一个净水收集及供给的巨大“社区”。通过回收和循环利用灰水，该“社区”使水循环网络再度贯通，充分发挥水作为“可再生资源”的优势。在南非，西开普省的伯格河修

复工程通过废弃物和废水管理来解决水质问题^[26]。沿伯格河而居的低收入群体能够从开展的试点工程中获取更多有关水资源的知识^[26]。这种互动形式也使得这一群体成为了工程的主要受益者，大大提升了人们自给自足的能力和主人翁意识。新加坡在其淡水资源极度匮乏的大背景下提出的四大“国家水喉”计划^[27]，使该国摇身变为水资源净产出国。“国家水喉”计划的主要目的是在从马来西亚进口淡水资源的基础上，通过扩大蓄水能力来集水。此外，该计划通过与景观设计项目紧密结合，将市民和游客重新吸引至自然景观之中。滨海堤坝（图13）以及碧山宏茂桥公园便是该策略的典型案列。

上述案例及概念，均是从本地出发应对水资源短缺问题的尝试。这些基于景观的规划和设计方法可以同时促进社会经济和社会生态的发展。由此，景观成为了一种超越其自身学科价值的媒介，为应对从大尺度地区到小尺度社区所面临的关键性挑战提供了新的范式与方法。如果这一观点能够得到充分认识，其将对城市发展产生积极影响。“灰水利用的契机”项目指出，应对水资源短缺问题不应局限于远程调水方案，而应基于重塑市民与环境的关系，采取更为自主的能够满足当地用水需求的水策略。**LAF**

注释

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3.

位于美国亚利桑那州佩吉市的葛兰峡谷大坝和水库
4.

在位于亚利桑那州马布尔峡谷的科罗拉多河进行考察
5.

位于亚利桑那州莫哈维流域的农业用水分配泵
6.

位于加利福尼亚州穿圣贝纳迪诺县而过的科罗拉多河引水渠
7.

位于加利福尼亚州洛杉矶市的恩西诺水库
3.

View of Glen Canyon Dam and reservoir at Page, Arizona.
4.

A Colorado River expedition at Marble Canyon, Arizona.
5.

Agricultural water distribution pump in the Mohave Valley, Arizona.
6.

Colorado River Aqueduct crossing the San Bernardino County, California.
7.

View of the Encino Water Reservoir, Los Angeles, California.

1 Effects of Drought — An International Survey

On November 12th, 2017, the South African newspaper *The Times* reported about Cape Town’s dwindling water resources and their daunting quest for alternative water supply^[1]. Just one month later, Live Science publishes an article titled “Day Zero: Cape Town Could Become 1st Major City to Run out of Water”^[2]. Issues of drought and water shortages during extreme events, such as the 2010 China drought and dust storms, or the 2011 ~ 2017 historic droughts in California, effect arid regions globally. It is the interplay of changing environmental and demographic processes in a rapidly growing economy, altering the demand over available water resources. Arid regions around the world comprise approximately 41 percent of the global surface area^[3]. These drylands are inhabited by 1/3 of the global population, are home to several megacities and nurture a multibillion-dollar economy^[3] from their mineral rich grounds and fertile soils. In these geographies, precipitation cycles depend on an exchange of climatic systems. They define the hydrological cycle, shape the water bodies, and replenish the local fresh water resources. Well known, the El Niño and la Niña cycles^[4] influence both temperatures and rainfalls on a global scale. In recent years, shifting patterns delayed

or relocated these rainfalls^[4], effecting the availability of fresh water, which pose a challenge for both nature and human kind.

“When the only water left is gray,” is the title to a design research project under the Harvard based Charles Eliot Traveling Fellowship. This survey studies the effects of drought in arid regions on six international case studies (Fig. 1). By documenting their territorial water system (Fig. 2), in connection to the socio-economic and socio-ecological effects of megaprojects, the survey reveals issues of water scarcity. This article introduces the study project and discusses the current water discourse from the perspective of landscape architecture. Hereby, the emphasis lays on revealing the perspectives of a global issue through the means of design research. It frames a plurality of local interventions under a landscape-based planning and design approach.

2 Megaprojects and the Crisis of Nature

2.1 The New Deal Era — A Paradigm of Scarcity

Rapid urban growth at the turn of the 20th century, forced Los Angeles to extend their water supply system into the Owens Valley^[5]. Chief Engineer and visionary William Mulholland of the Los

Angeles Department of Water and Power proposed the construction of the first L.A. Aqueduct^[6]. To get the project approved, Mulholland capitalized on the ongoing drought, which had already manifested in the fear of citizens^[7]. Anticipating a rapidly growing metropolis, Mulholland laid eyes on the Colorado. The 1922 Colorado River Compact regulated the allocation of the river's water between the seven bordering states^[8]. This agreement came just in time, as the U.S. was about to experience another severe crisis. During the 1930s, the Dust Bowl in the Mid-West and the Great Depression, resulted in the commission of Hoover Dam^[9]. This engineered masterpiece set a new standard and established California as a water frontier. Thereafter, using the crisis of nature as an economic trajectory depicted a reactionary behavior. After the institutionalization and division of the Colorado River into an Upper and Lower basin, California was the first state to put in a request for water^[10]. Several

megaprojects, including the Colorado River Aqueduct (389 km), the All-American Canal (130 km), or the San Diego Aqueduct (362 km), had to be built to convey this water. Following the Colorado River, Figures 3 ~ 7 provide an impression of the territorial water system, marginalizing the native landscape between the Glen Canyon Dam in Arizona, and the Morelos Dam near Mexican border.

2.2 Water Commodification at a Global Scale

Continuous economic and population growth, in areas with limited water resources, come in desperate need for alternative water supply. To stabilize the local economy and facilitate continuous population growth, governments around the world adopted California's practices to store and convey water by extending their water-energy-network into foreign watersheds. This understanding of water as a stock^[11] created a systematic dependency on resources far beyond the jurisdictional- and national borders, which means that water

flows from a specific resource into one or multiple economic subsystems, where it is consumed^[11]. After its consumption and qualitative appropriation, the water is released into our sinks as effluents and pollutants^[12]. The consequences of this urbanization process are manifold and shall be explored on three case studies.

2.2.1 North China Plain — The South-North-Water-Transfer

Beijing, located in the North China Plain, was featured with abundant streams and fresh water resources^[13]. This second largest plain was formed by deposits of the Yellow River, the Huai and the Hai River^[14]. Shifting and declining precipitation cycles, severe droughts, reoccurring floods, as well as a rapidly growing economy and urban expansion, outgrew the local resources. The results were depleting aquifers from over-extraction, declining water quality due to poorly regulated industries, and an encroaching desertification on fertile land^[13].

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In 1952, Chairman Zedong Mao addressed the water shortages with the idea to borrow water from the abundant South^[15]. His vision took form in the largest water infrastructure, the South-North-Water-Transfer (SNWT) project with 2,400 km network of canals and tunnels. The aqueduct consists of the three main routes: East, Central and West. They divert water from the Yangtze River Basin by linking the Yangtze, Huai, Hai and Yellow Rivers (si-heng san-zong) (Fig. 8 ~ 10)^[13]. Despite environmental inequalities, the North China Plain continues to grow. Recently, the Central Government plans the construction of Xiong-An New Area, a multimillion city at the southern periphery of Beijing and Tianjin^[16]. The new special economic zone is supposed to offset Beijing's urban expansion^[16] yet increases the overall water demand. In this context, megaprojects such as the SNWT appear to be "an engineering solution to an ecological discrepancy"^[17].

2.2.2 South Africa — Day Zero

Cape Town faces the most profound water crisis in history. Severe water shortages with a projected Day Zero on April 22, 2018^[18] are the results of legislative

entitlements, a lack of institutional responsibilities, and a misfit between political and technical actors within the council^[19]. Climatic changes responsible for decreasing annual rainfalls, evaporation of reservoirs due to high temperatures, and a continuous influx of people further add to the equation (Fig. 11, 12). The Water Act of 1998, as part of the post-apartheid legislation, entitles citizens with sufficient water supply^[20]. Hereby, the National Government is accountable to protect, develop, conserve, manage and control water resources^[18]. Whereas the provincial- and municipal government are responsible for the local management, maintenance and delivery of water^[19]. The city of Cape Town, however, is not entitled to invest in infrastructures producing water for their overall supply. Furthermore, the 1969 National Water Guidelines is outdated and contradicting the current crisis in terms of water quality standards, which complicates local water management and discourages change.

2.2.3 Singapore — Water to Become the Nation's Single Most Threat

Located on tropical islands in South-East Asia, Singapore gained its independence

from the UK in 1963^[21] and managed to uphold a former water agreement after splitting off from Malaysia in 1965^[22]. However, imported water from Johor started to decline in quality and quantity, as Malaysia experienced several droughts^[22]. Political pressure and the termination of this long-term water supply agreement by 2061 forced Singapore to change its course^[23]. To become water independent, Singapore's first Prime Minister, Kuan Yew Lee, declared water as the top priority in government policies and urban development^[22].

3 Landscape, an Approach towards Abundance?

Water is a crucial requirement for both social and economic (agriculture and industries) growth processes. Restrictions and limitations of water availability confines the production of products and creation of jobs, which is connected to urban growth. The previous chapters argue that water scarcity was produced with the commodification of water under the New Deal Era. This water scheme requires continuous access to foreign

8. 为“南水北调中线工程”而开凿的运河（位于河南省郑州市）
9. 位于河南省的中央运河和黄河隧道抽水泵
10. 一艘货船正行驶于位于江苏省扬州市的京杭大运河上
8. View of the Central Route canal of the SNWT project in the City of Zhengzhou, Henan.
9. View of the Central Canal and Yellow River Tunnel Pump, Henan.
10. A barge traversing south along the Grand Canal in Yangzhou, Jiangsu.

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watersheds, extending the water-energy-network from the place of production to the place of consumption. Hereby, centralized water systems produce a territorial gap^[24], a social disconnect that affects the natural environment and its ability to regenerate. While inter-basin-water-transfer projects can bridge the water shortage and sustain the economic subsystem, how far can this

water system be extended before the risk of systems' failure becomes a major threat? Within such context, the notion of "peak water"^[25], which underlines the growing constraints on the availability, quality, and use of freshwater resources, provides an opportunity to invest in local decentralized and hybrid systems that close the urban water cycle.

As the North China Plain continues to grow, it needs to adapt to a new mindset of planning and decision making across all jurisdictions. Hereby, developing smart land use regulations with a strong implied landscape framework could capitalize on the natural water bodies and wetlands in both urban and rural areas. For example, the "sponge city" strategy helps to increase the urban resilience during flood events, protect and enhance the water quality in streams, lakes and aquifers, and create a socio-ecological connection between citizens and their environment. Therefore, the rapidly growing "Chinese Suburb" can be organized as a larger community that becomes a net producer of fresh water. By recycling and recirculating their gray water, the community closes the hydrological cycle and acknowledges water as a renewable resource. The Berg River Restoration Project in the Western Cape addresses water quality by managing waste and wastewater flows^[26]. Communities of lower income along the river are being educated through the implementation of pilot projects^[26]. This interaction establishes the community as a main shareholder, creates an

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- 11. 位于南非西开普省的伯格河水坝泄洪区
 - 12. 低水位时期的希沃特思路夫水坝
 - 13. 位于新加坡的滨海堤坝将海水与淡水分隔开来
-
- 11. View of the Berg River Dam outflow, Western Cape.
 - 12. Low water levels at Theewaterskloof Dam
 - 13. The Marina Barrage disconnecting sea from fresh water, Singapore.

understanding of self-reliance and ownership. Singapore established a four-tap strategy^[27] to become a net producer of water. This approach capitalizes, besides imports from Malaysia, on the catchment of water through the extension of their storage capacity. In addition, each tap is tied to a landscape-based approach, reconnecting both citizens and visitors to their native landscape, as The Marina Barrage (Fig. 13) and Bishan-Ang Mo Kia Park demonstrate.

The discussed projects and notions, address issues of water scarcity locally. The landscape-based planning and design approach mentioned enhances the socio-economic and socio-ecological processes. Hereby, landscape is recognized as a medium beyond its disciplinary implications. It is understood as a paradigm and method, addressing critical challenges from the territory to the community. This proposition, if taken seriously, will have a changing effect on our cities. It addresses not only supply, but also the demand of water by reconnecting citizens to their environment. **LAF**

NOTE

For more information about the author's research, please visit www.thomasnideroest.com.

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