

协同设计与创新管理 ——温岭东部新区海绵城市建设经验谈

COLLABORATIVE DESIGN AND INNOVATIVE MANAGEMENT — THE EXPERIENCE OF SPONGE CITY DEVELOPMENT IN THE EASTERN NEW DISTRICT OF WENLING CITY



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摘要

如何因地制宜地落实国务院办公厅于2015年10月印发的《关于推进海绵城市建设的指导意见》，是现阶段海绵城市建设的热点问题。浙江省温岭市东部新区自2010年启动城市建设实践起，即率先形成了以“水”为核心的绿色基础设施雏形，搭建了完整的城市生态建设框架，系统地在全区域范围内进行了多维度的雨洪管理实践。本文采访并总结了开发方、城市管理机构、施工方、景观设计师等与该地海绵城市建设直接相关人群的实践经验与心路历程，得出优先规划绿色基础设施、敢为人先的突破性理念、系统化的解决方案，以及执行到位的精细化管理是项目实施效果较好的基本原因。

关键词

海绵城市建设；绿色基础设施；协同设计；管理

ABSTRACT

In current sponge city development, the question of how to implement plans according to local circumstances and the Guiding Opinions on Promoting Sponge City Development, issued in October 2015 by the State Council, has become a hot topic. Starting with urban development in 2010, the Eastern New District of Wenling City, Zhejiang Province has taken the lead in building an early phase of green infrastructure that centers on “water” to establish a complete framework of urban ecological development and carry out various practices of city-wide stormwater management systematically. This article summarizes the practical experiences and conceptual procedures of developers, urban administrative agencies, contractors, landscape architects, and other people who are directly related to the development of this sponge city. It is believed that the prioritized planning of green infrastructure, the boldness to be a pioneer, the systematic solutions, and the proper execution of tactful management are the fundamental reasons for the successful implementation results.

KEY WORDS

Sponge City Development; Green Infrastructure; Collaborative Design; Management

译

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2016年12月，浙江省温岭市东部新区成为国家新型城镇化标准化16个试点项目之一，根据试点方案，温岭东部新区将总结已建成的长达25km的海绵型道路、企业生态化排水与生物滞留设施、透水铺装、雨水花园等项目的相关经验；制订《生态化排水设计、施工及维护指南》《生态化排水规范》《绿色湿地建设规范》《海绵城市后期维护规定》等标准；构建包含“海绵道路”“海绵建筑”“绿色湿地”等子体系的“海绵城市”标准体系。温岭东部新区建设完成的湿地公园、住宅小区、产业园区、污水处理厂尾水湿地深度处理、中小学校园等相关项目将为全国海绵城市建设提供参考。

2016年冬，《景观设计学》编辑部走进温岭东部新区，考察并探究了其成果与经验。中共温岭市委常委、温岭东部新区党工委书记蒋招华、北京大学深圳研究院绿色基础设施研究所执行所长栾博和北京一方天地环境景观规划设计咨询有限公司（以下简称“一方国际”）总经理王鑫，将关于海绵城

市建设中协同设计和创新管理的心路历程与实践经验娓娓道来。

先见之明：绿色基础设施优先规划

温岭东部新区占地面积36.9km²，为浙江省省级经济开发区，属典型的滨海平原地貌，淤涨型滩涂。其年均降雨量1 423.9mm，历年最大单日雨量124mm，夏季受台风影响较大，新区内主要水系包括三条河流和两个湖泊。作为浙江东部沿海经济相对发达的地区，几十年的快速工业化和城镇化，积累了粗放式发展带来的一系列问题，如河道水质恶化、城区内涝等。在担任东部新区党工委书记之前，蒋招华曾在美国学习一年，对美国的生态环境保护感受颇深。为践行科学发展观，实现可持续发展，东部新区自2010年启动实质性建设起，即以构建低影响开发（LID）系统为核心，探索“海绵城市”建设路径，期望实现控制城市面源污染、治理黑臭水体、防治城市内涝、综合利用雨水资

源、保护鱼虾螺蚌栖息地等目标。新区管理委员会于2011年7月委托土人设计研究编制了《东部新区生态基础设施规划》，并以此为基础对已经编制完成的《东部新区城市总体规划》进行了调整优化。在生态优先的前提下，东部新区形成了以河湖、廊道、绿道等为基本绿色骨架的空间结构形态，其中可持续雨洪管理是生态基础设施规划中的重点内容。东部新区在城市开发前，就率先形成了以“水”为核心的绿色基础设施雏形，搭建了完整的城市生态建设框架，在国家提出海绵城市建设号召之前，系统地在全区范围内进行了多方面的雨洪管理实践。

2011年12月，东部新区按照LID要求对已设计完成的市政绿化工程进行重新设计，启动了第一条3.9km长的海绵型道路的建设，同时开展企业厂区的生态化排水试点项目。在总结问题和经验的基础上，制订了《温岭东部新区工业企业设计、建设和管理准则》，用以指导项目的设计、施工和管理。

2012年底，为保证LID设施更为有效地

1. 温岭市东部新区园区鸟瞰
1. Aerial view of the Eastern New District of Wenling City



落地，新区管理委员会委托镇江市规划设计院编制了《温岭市东部新区北区生态排水方案》，通过对北区自然水文条件、面源污染负荷、水环境容量等方面的分析研究，提出了“源头削减污染、过程控制径流、充分利用雨水资源”的生态化排水建设方案。同时制订《温岭市东部新区生态化排水设计、施工及维护指南》，对城市道路、居住用地、工业用地的植草沟、雨水花园、雨水塘、过滤带、下渗渠、透水铺装等工程提出具有针对性的设计目标、施工规范和维护要求，以此来指导生态化排水工程的设计、施工、管理和维护。

从生态基础设施规划到生态排水专项规划，再到设计施工维护指南、施工操作手册及企业准入管理要求，温岭东部新区制定的这一系列规划、技术指南和管理制度，为全面推进海绵城市建设奠定了坚实的基础。

勇于突破：最难改变的是观念

在海绵城市建设的推行过程中，开发方、城市管理机构、施工方、工程师、景观设计师、建筑师、城市规划师及城市公用设施维护团队都是重要的相关群体，如何保证设计与落地方向一致，蒋招华认为，“最难改变的是观念”。

“海绵城市建设成本很高”是第一个难以改变的既有观念。开发方中有不少人认为生态化做法的成本过高。据蒋招华估算，就达到各项生态化数据要求的市政项目而言，其建设成本反而比传统做法下降了7%。在依据生态排水方案实施建设的企业厂区，以金鸿机械有限公司为例，容积达1 625m³的雨水池及相应的雨水收集系统造价25万元，但每年可利用的雨水逾1万立方米，收集的雨水可用于喷淋厂房使其降温、冲洗场地、浇灌绿化、提供消防和厕所用水等。按照工业用水6.1元/m³的价格计算，5年左右就可以收回成本，更为重要的是，它从源头削减了地表径流、净化了水质。本着这样的思路，蒋招华带领设计师逐一拜访利欧集团、爱仕达集团等知名入区企业，讲解“海绵城市”相关理

念。如今，新区管理委员会在与入区企业签订土地出让合同时，均将雨水生态化利用系统建设纳入合同条款，明确规定所有企业都必须建设海绵型厂区，且设计方案、施工过程中都须在管理委员会的统一管理下完成。目前东部新区已有28家企业建成雨水生态化利用系统，雨水收集有效容积逾1万立方米，年可利用雨水逾6万吨，另有24家企业已完成方案设计并正在建设。当前，入区企业已达成建设雨水生态化利用系统的共识，屋顶虹吸集水、具有净化功能的储水池、生态化雨水花园、循环喷淋厂房降温系统等新技术在各工业企业中得到了广泛应用。

第二个难以改变的观念是“以排为先”的传统水利观念。蒋招华认为，目前水利等规划部门对海绵城市“渗、滞、蓄、净、用”的作用认识不足。他认为东部新区水环境面临的主要问题不是排涝，而是河湖湿地保护、城市面源污染控制、地表径流削减和雨水资源储用等。实施中的《温岭东部新区水环境综合规划》正是在解决这些问题的基础之上把防洪问题考虑在内而编制的，它不是单纯的水利规划，而是全面解决城市水问题的多解组合。2015年，在受9号台风“灿鸿”和13号台风“苏迪罗”影响期间，东部新区没有发生内涝，道路也不见积水。事实证明，通过源头治水，雨洪可以变废为宝。

系统设计：海绵城市建设的综合性途径

东部新区的海绵城市建设不是单目标工程，而是一个跨尺度、多目标的系统性实践。蒋招华表示，“在海绵城市建设过程中，径流总量和面源污染控制是核心目标，但并非全部。还应全面考虑其在生态、休闲、文化、社会与经济方面的功能与价值。”东部新区与来自北京大学、中国科学院、一方国际等的科研设计机构和相关规划单位合作，探索海绵城市建设的系统性落地实践。对此，《东部新区生态基础设施规划》项目负责人栾博补充道：“温岭东部新区的海绵城市建设与绿色基础设施实践中最难能可贵的是系统性和综合性。”系统

2. 金鸿食品机械有限公司的雨水花园

2. Rain garden of Jinhong Food Machinery Co., Ltd.

性是指东部新区不只停留在绿色基础设施的宏观规划层面，而是以宏观规划为指导，在中观、微观尺度系统性地开展了一系列落地实践工作。由此逐步形成了从企业园区、行政办公区、居住小区、中小校园等不同类型的场地中雨水的源头管理，到城市道路植草沟的过程控制，再到城市生态河道和湿地的末端调节，形成完整的雨水管理链条。综合性使得东部新区的海绵城市建设在一定程度上实现了综合价值，而不只是单目标绿色工程。当前国内大量施用植草沟、雨水滞留池等技术设施，但对人的参与体验通常缺乏考虑，改造后的场地也往往与城市功能衔接不足。东部新区在这方面做了很多探索。比如，在以太平小学东部校区和温岭市第三中学东部校区为代表的中小校园雨洪管理设计中，将雨水收集、净化、传输、下渗过程与环境教育、自然课堂、互动体验、校园文化活动相结合，使校园成为师生们可参与的“活”景观，而非被设计好的“死”空间。学生们可以了解雨水如何蓄集形成湿地水塘，可以亲用手收集的雨水浇灌菜园，可以看到蔬菜如何生长，更可以感知雨水花园的四季变化。这样的海绵校园除了具有降低面源污染、控制径流总量等基本功能外，还能让学生们在海绵校园中探索体验，在互动中学习成长。

精细管理：落地执行是对政府能力的最大考验

随着一系列规划及规范出台，理解和执行成为了关键的步骤。东部新区是以产业为基础的城市综合功能区，从6余年的实践来看，新区管理委员会先从主干道建设、污水处理厂尾水处理、湿地保留与恢复等公共项目着手，推广应用各类生态化工程措施；同时，尽可能多地保留原有海沟，与新开的河道形成河湖网络，使东部新区的水面率保持在12%以上。对非政府性投资项目，管理委员会对入驻和待入驻企业厂区的建设实施精细化管理，通过宣传发动、编制指南、合同约定、方案审批、先进奖励、示范推广等

措施引导设计方案落地。

海绵型设施建设的要求与传统的施工标准往往相对立，因而施工团队经常会表现出不理解、不知如何操作等问题。为此，管理委员会组织施工培训并培养了一批能够理解生态化排水设计的施工团队。方案落地需要方案切实可行，对此，长期与东部新区合作的一方国际总经理王鑫认为：“从2015年国家海绵城市建设开展以来，全国共有30个城市被选为国家海绵建设的试点城市。在这样的宏观政策背景下，为使温岭的海绵城市设计和建设既符合基本要求又能适应本地的地理环境条件，海绵城市建设的所有相关方需在诸如雨量分布不均、沿海风力大等问题的解决措施上达成共识。”另外，在植物物种的选择上，管理委员会要求在方案设计时选取能够抵抗强台风袭击的本土树种和乡土植被，比如狗牙根草等。为防止企业将污水排入雨水管，管理委员会要求所有企业的雨水管在接入市政管网之前实行明池排水，做到排水可视化，避免污水排入河道。

全方位建设的生态化排水系统，不仅解决了新区的水环境问题，更改善了新区的土壤状况。区域性的生态排水系统，淋洗了土壤中过量的盐分，使盐碱性土壤得到了一定

程度的改良。560hm²的龙门湖湿地的保留与恢复，使得湿地不仅成为雨洪的调蓄池，而且为40多种候鸟和野生鸟类提供了栖息地。2014年，龙门湖湿地入选浙江省首批重要湿地名录。

为了更准确地监测生态化排水方案与海绵城市建设的绩效，2016年，管理委员会协同中国科学院，开启了为期两年的定量监测，第一份监测报告将于2017年上半年完成，届时，海绵城市建设的具体成效将通过系统的数据分析得到呈现。

新区管理委员会对多年的努力即将获取的成效充满信心，他们经受过起步时的外部阻力，坚持独立探索，讲究实际效果，每个阶段都经过反复的方案求证与数据模拟。为推进东部新区的可持续发展，他们欢迎更多针对监测结果的开放性讨论与提升建议。**LAF**

注释

本文根据采访整理而成，并参考了由受访者提供并授权的相关政府报告、《温岭市东部新区北部工业区生态排水方案》《温岭市东部新区生态化排水设计、施工及维护指南》《温岭东部新区工业企业设计、建设和管理准则》，以及由一方国际提供的利欧集团海绵产业园、温岭三中海绵校园、生态河道修复、都市农园和城市尾水湿地公园案例等资料。



In December 2016, the Eastern New District of Wenling City (Wenling END), Zhejiang Province, became one of the 16 pilot cities for the standardization of national new urbanization. According to the plan, the new district would sum up its experience in construction of a 25-kilometer sponge road, ecological drainage and bio-retention facility for enterprises, permeable pavement, and rain gardens. It would also formulate the Guidelines for Design, Operation and Maintenance of Ecological Drainage, the Specifications of Ecological Drainage, the Specifications of Green Wetland Development, and the Regulation on Post-Maintenance of Sponge City, while establishing the standard system of “sponge city” for sub-systems on “sponge road,” “sponge building,” “green wetland” and so on. Projects such as wetland parks, residential housing, industrial parks, wetland treatment of tailwater from sewage treatment plants, as well as campuses for middle and

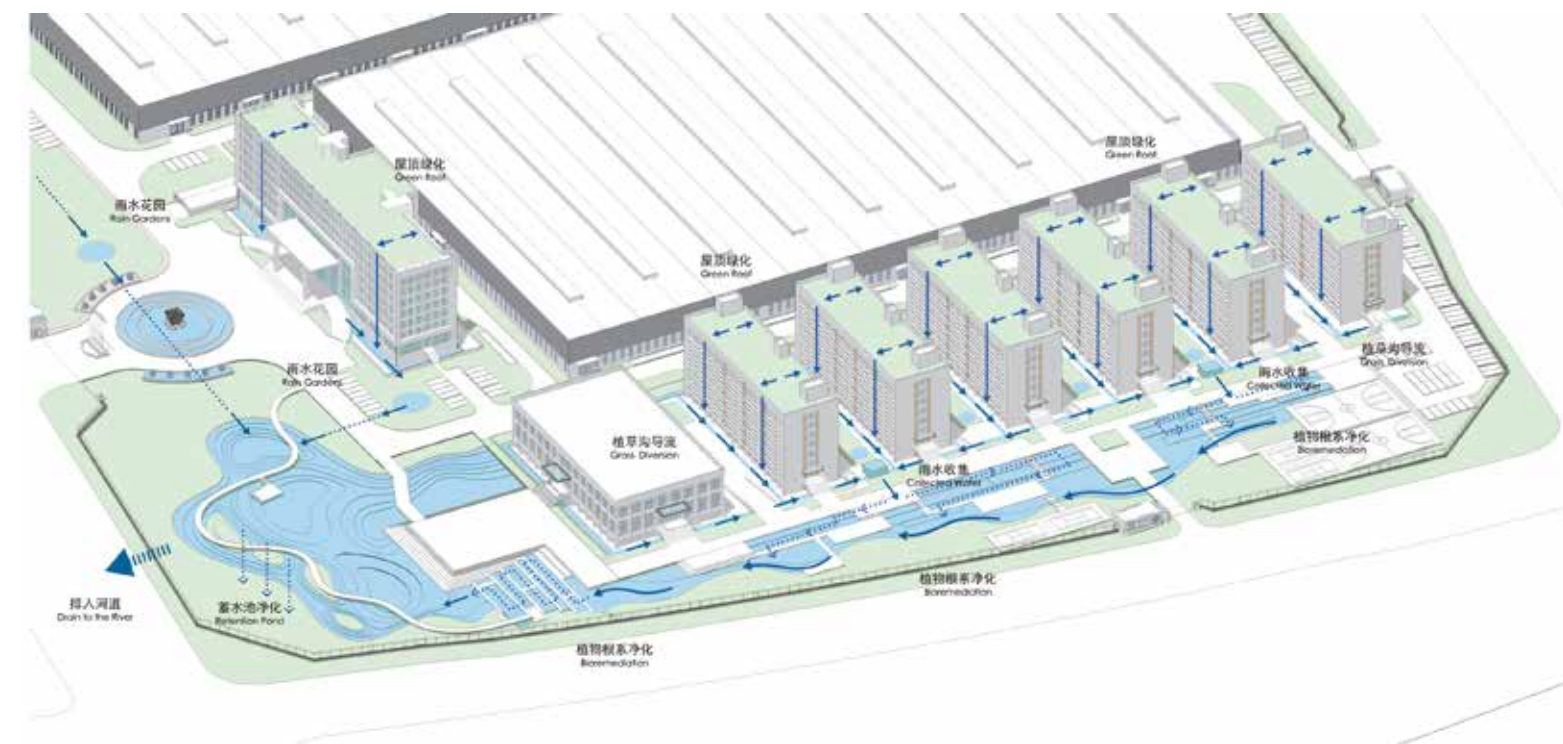
primary schools will serve as a reference for nationwide sponge city development.

In the winter of 2016, the editorial staff of *Landscape Architecture Frontiers* visited Wenling END to investigate its achievements and experience. We learned about the conceptual course and practical experience on collaborative design and innovative management of sponge city development from Zhaohua Jiang, member of the CPC Standing Committee of Wenling City as well as the secretary of the CPC Working Committee of the new district, Bo Luan, executive director of the Green Infrastructure Institute of Peking University Shenzhen Graduate School, and Xin Wang, general manager of Yifang-Vista.

Foresight: Prioritized Planning of Green Infrastructure

Wenling END, with an area of 36.9 km², is a provincial economic development zone in Zhejiang Province.

It has a typical landscape of coastal plain and tidal mud flats. The planned area has an average annual precipitation of 1,423.9 mm, and the historical maximum daily rainfall is 124 mm. In summer this area is frequently influenced by typhoons, and the key water system consists of three rivers and two lakes. Being the most economically developed area in eastern coastal Zhejiang Province, decades of rapid industrialization and urbanization have resulted in a series of issues caused by the extensive mode of development, such as deteriorating water quality in river courses and urban flooding. Before becoming the secretary of Wenling END's CPC Working Committee, Zhaohua Jiang had studied in the US for one year, where he was deeply impressed by the degree of environmental protection in the country. Substantial construction started in Wenling END in 2010, centered on the establishment of a low impact development (LID) system. To promote “scientific development”



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3. 温岭市利欧集团海绵产业园区
4. 融入自然教育和互动参与的海绵校园

3. Sponge Industry Park of the Leo Group in Wenling City
4. A sponge campus integrated with natural education and interactive engagement



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and realize sustainable development, Wenling END initiated exploration into constructing a “sponge city” in a bid to control urban non-point pollution, contaminated water bodies, and urban water-logging, as well as the integrated utilization of rainwater resources, and the protection of fish, shrimp, snail and mussel habitats. Appointed by the administrative committee of the new district, in July 2011, TURENSCAPE compiled the Ecological Infrastructure Planning for Eastern New District; based on their findings, the Master Plan for Eastern New District was adjusted and optimized. On the principle of prioritizing ecology, a spatial structure was formed that takes rivers and lakes, corridors and green belts as the basic green framework, and frames sustainable stormwater management as the key content of ecological infrastructure planning. Before urban development, the new district had already established the early form of green infrastructure that takes “water” as the core, and constructed a complete urban ecological development framework. Before the campaign of sponge city development was launched nationwide, various types

of stormwater management had already been conducted within the new district.

In December 2011, the municipal greening project of the new district was re-designed according to the requirements of LID. Construction of a 3.9-kilometer sponge road, as well as a pilot project for ecological drainage within factory areas, was launched. Based on a summary of problems and experiences, the Guidelines on Design, Construction and Management of Industrial Enterprises in Wenling Eastern New District was formulated to guide the design, construction and management of the projects.

In the end of 2012, to ensure effective implementation of LID facilities, Zhenjiang Planning and Design Institute was entrusted by the administrative committee of the new district to compile the Ecological Drainage Plan for the Northern Part of Wenling Eastern New District. Based on analysis and study of the natural hydrological conditions, non-point pollution load, water environmental capacity, and other features of this area, the research team proposed an ecological drainage development plan that featured

“pollution reduction from the source, runoff control in the process, and full utilization of rainwater resources.” At the same time, the Guidelines for Design, Construction and Maintenance of Ecological Drainage in Wenling Eastern New District was formulated to draw up related design objectives, construction standards, and maintenance requirements for projects of bio-swales, rain gardens, rainwater ponds, filter strips, infiltration ditches and permeable pavement in development of urban roads, residential areas and industrial lands. These measures were implemented for guiding the design, construction, management, and maintenance of ecological drainage projects.

From ecological infrastructure planning to special planning on ecological drainage, and further to guidelines for design, construction and maintenance, to a construction and operation handbook, and to enterprise admittance management requirement, Wenling END has set up a serial planning, technical guideline, and management system, laying a solid foundation for fully promoting sponge city development.

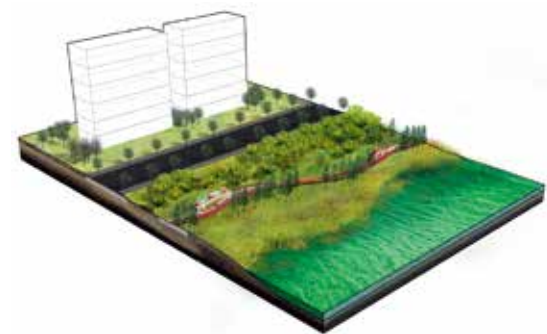
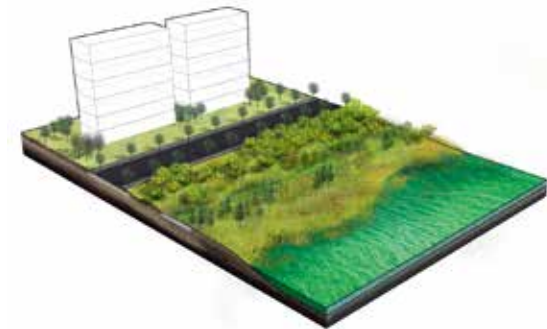
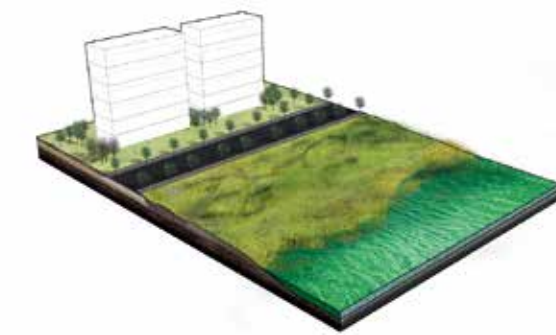
Dare to Make Breakthroughs: It Is the Most Difficult to Change Perceptions

In the process of promoting sponge city development, developers, municipal administrative agencies, constructors, engineers, landscape architects, architects, urban planners, and the maintenance team of urban public facilities are all important and relevant groups. Concerning how to ensure consistency in the process of implementation, Zhaohua Jiang said, “it is the most difficult to change perceptions.”

The first existing perception that is difficult to change is the presumption that “sponge city development is costly.” Among the developers are many people who believe the cost of ecological measures is too high. Zhaohua Jiang has conducted a calculation which found that municipal projects conforming to the requirements of all ecological indexes have a development cost 7% lower than those using traditional methods. Take for example Jinhong Machinery Co., Ltd., an enterprise that implemented an ecological drainage plan in its factory. Its rainwater pond and the collecting system were built at a cost of CNY 250,000 with a storage capacity of 1,625 m³. Every year, more than 10,000 m³ of rainwater is collected and utilized to cool down factory buildings, rinse the plant, irrigate the landscape, fight fires and flush toilets. Because the price for industrial water is about CNY 6.1 per cubic meter, it would take only 5 years to recover the cost. More importantly, the surface runoff is reduced, and the water quality is improved, from the source. Following this way of thinking, Zhaohua Jiang, together with designers, visited Leo Group, China ASD and other famous companies in the district to explain the concepts of “sponge city.” Currently,

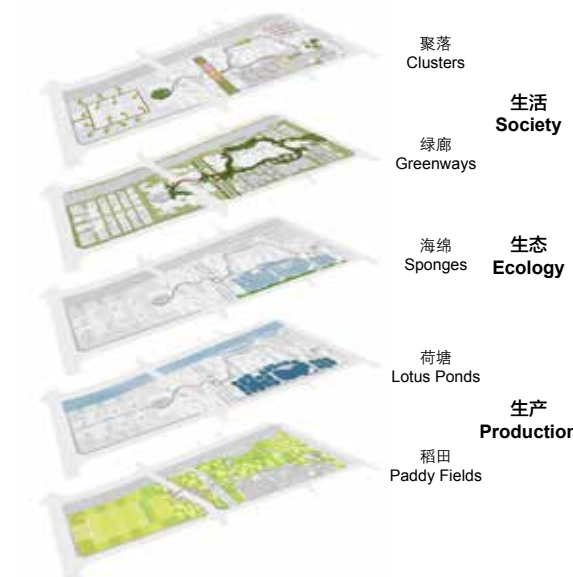
when the administrative committee signs land transfer contracts with new enterprises, the development of ecological rainwater utilization systems will be included in the agreements, in which it is clarified that all enterprises should construct their factories into the “sponge” type, and that the design proposal and construction process should be conducted under the standardized management of the administrative committee. So far 28 enterprises in Wenling END have built ecological rainwater utilization systems, with an effective storage capacity of more than 10,000 m³ and an annual rainwater utilization of over 60,000 tons. Another 24 enterprises have completed their conceptual designs and started construction. A consensus has been reached among the enterprises within the district to develop ecological rainwater utilization systems, and they have also widely employed new technologies such as rooftop siphoned water collection systems, water storage ponds with purification functions, ecological rain gardens, and factory house cooling systems with circulatory spraying.

The second hard-to-change concept is the traditional water management idea of “drainage first.” Zhaohua Jiang said the water resources planning agencies had an insufficient understanding of the “infiltration, retention, storage, purification, utilization” functions of sponge city. He believes the major problem facing the water environment of Wenling END is not flood drainage, but the protection of rivers, lakes and wetlands, urban non-point pollution control, surface runoff reduction, and storage and utilization of rainwater resources. The Integrated Water Environment Planning for Wenling Eastern New District, which has gone into effect, had been edited to tackle these problems together with the issue of



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5. 日升河改造策略
6. 融合城市海绵、城市公园、城市农业的都市农园
5. Regeneration strategies of the Risheng River
6. Urban Farm integrated with urban sponge, park and agriculture



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flood control. It is not a pure planning on water resources, but a portfolio of solutions to comprehensively address urban water-related issues. In 2015 when the No. 9 typhoon “Chan-Hom” and No. 13 typhoon “Soudelor” affected the new district, no water-logging could be seen on the roads or in the region. It is proven that, by managing water from the source, stormwater can be converted into a resource.

Systematic Design: A Comprehensive Approach for Sponge City Development

The sponge city development of Wenling END is not a single project, but a multi-scalar and multi-objective systematic practice. “The control of total surface runoff and non-point pollution is the core, but not the only, objective for sponge city development. The ecological, leisure, cultural, social and economic functions and values should also be considered,” said Zhaohua Jiang. Cooperation has been advanced with research and design institutions from Peking University, Chinese Academy

of Sciences, Yifang-Vista and other institutions of planning to jointly explore the systematic implementation of sponge city development. “The most valuable things in the development of sponge city and green infrastructure in Wenling END are systematicness and comprehensiveness,” added Bo Luan. Wenling END is not only conducting macro-planning of green infrastructure, but also developing a serial of systematic practices on meso- and micro-scales under the guidance of the macro-planning, creating a complete management chain that consists of source management (enterprise factories, administrative office area, residential communities, and middle and primary school campuses), process control (bio-swales on urban roads), and end control (urban ecological rivers and wetlands). The sponge city development of Wenling END is not a single-objective green project, but has, to a certain extent, realized comprehensive values. Currently technical facilities such as bio-swales and rainwater detention ponds have been widely constructed in China, but public participation is

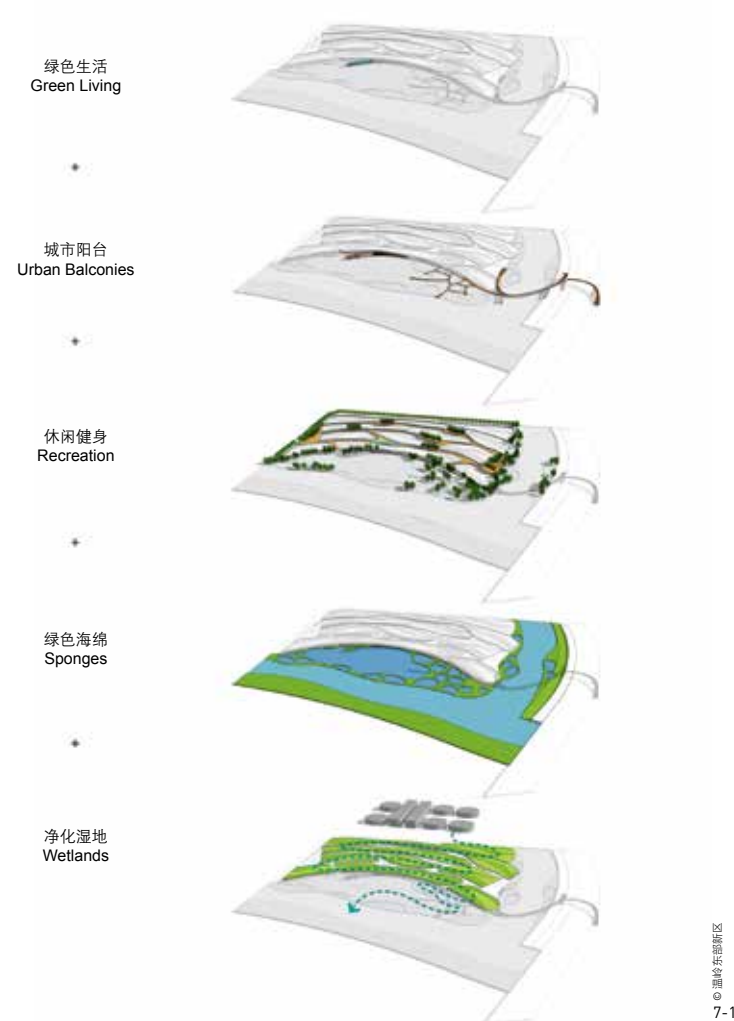
usually lacking, and there is a missing link between every renovated site and urban functions. A lot of exploration has been made in the new district. For example, in the rainwater management design for middle and primary school campuses (in particular the eastern campus of both Taiping Primary School and the No. 3 Middle School of Wenling City), the process of rainwater collection, purification, transfer and infiltration has been combined with environmental education, courses about nature, interactive experiences, and on-campus cultural activities, transforming the campus into a “living” landscape (in which teachers and students can participate), instead of designed “dead” space. Students can learn how rainwater is collected and stored to form wetlands and ponds, water the vegetable gardens with the collected rainwater, observe the growth of vegetables, and perceive the seasonal changes in the rain garden. This kind of sponge campus not only performs the fundamental functions of non-point pollution reduction and total runoff control, but also makes it possible for students to explore, experience, and grow up in an interactive way.

Tactful Management: Implementation Is the Biggest Challenge for Governmental Capability

After the plans and standards are published, understanding and implementation become the key steps. Wenling END is a comprehensive urban functional zone with an industrial basis. In over six years of practice, the administrative committee started with public projects, such as the construction of main roads, control of tailwater from sewage treatment plants, and wetland conservation and restoration,

to promote all types of ecological engineering measures. At the same time, efforts have been made to preserve as many rivers and streams as possible, and together with newly excavated rivers, to form a network of rivers and lakes that maintains the water surface ratio of the new district higher than 12%. For non-governmentally invested projects, the administrative committee has adopted tactful management strategies for the construction of factories planned or already established in the new district, ensuring the implementation of design schemes through measures such as publicity and mobilization, editing of handbooks, signing of contracts, examination and approval of schemes, rewarding of excellent practice, demonstrations, and promotions.

Quite often, sponge city development has opposite requirements compared to conventional construction standards. As a result, construction teams frequently found the requirements difficult to understand and execute. To address this problem, the administrative committee organized trainings for the construction teams to help them understand the design of ecological drainage. To get implemented, the plan needs to be feasible. Xin Wang, general manager of Yifang-Vista, who participated in many projects in the new district, said, “Since 2015 when the national sponge city development was launched, 30 cities have been selected as pilot cities. Against such a background of macroscopic policy, methods for aligning sponge city design and development in Wenling City with universal requirements while fitting into local geographic conditions, such as the imbalanced rain distribution and strong wind in coastal areas, is an issue on which consensus is needed among all participants in sponge



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7. 集废水净化和游憩科普于一体的城市尾水湿地公园
8. 龙门湖湿地目前状况

city development.” For example, the administrative committee required that local tree species and vegetation, such as *Cynodon dactylon*, be selected in the conceptual design so that they can resist the attack of strong typhoons. To prevent businesses from discharging wastewater into storm sewers, the administrative committee requested that they drain their rainwater pipes into open ponds before connecting to municipal pipes. Through transparent rainwater drainage, wastewater discharge into rivers can be prevented.

The comprehensive ecological drainage system not only addresses issues of the water environment in the new district, but also improves the soil conditions. The regional ecological drainage system has washed away the excessive salt content of the soil, to some degree ameliorating the saline and alkaline lands. The conservation and

restoration of the 560-hectare Longmen Lake Wetland creates not only a regulating basin for stormwater, but also a habitat for over 40 types of migratory and wild birds. In 2014, it was included on the first list of important wetlands of Zhejiang Province.

To monitor the performance of ecological drainage as well as sponge city development in a more precise manner, in 2016 the administrative committee initiated a two-year quantitative monitoring program with the Chinese Academy of Sciences. The first report is due in the first half of 2017, when the performance of sponge city development will be assessed by systematic and statistical analysis.

The administrative committee is confident with the output of years of efforts. They resisted external pressures in the beginning, insisted independent investigation, emphasized actual effects,

and conducted repeated verification and statistical simulation for each stage of development. In order to promote the sustainable development of the new district, they welcome more open discussions and suggestions on the monitoring results. **LAF**

NOTE

This article is based on interviews, and documents provided and authorized by the interviewees, including the related governmental reports of the Ecological Drainage Plan for Northern Industrial Park of Wenling Eastern New District, the Guidelines for Design, Operation and Maintenance of Ecological Drainage, and the Guidelines on Design, Construction and Management of Industrial Enterprises in Wenling Eastern New District, and projects of the sponge industry park of the Leo Group, the sponge campus of No. 3 Middle School of Wenling City, the ecological restoration of rivers, the Urban Farm and The Urban Tailwater Wetland Park, provided by Yifang-Vista, etc.



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