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基于现实的生态建设

——杭州“西溪里”项目景观设计与思考

Building an Environmental Friendly Community

— Design and Review on Xixi Village in Hangzhou

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摘要 ……

本项目是一个在综合雨水管理指导下完成的景观设计作品，通过雨水工程师与景观设计师的合作，室外空间与生态雨水系统形成充分融合、相互依存的关系，使环境的生态可持续性和品质得以保证。同时，通过在项目实施中暴露出的矛盾，本文对景观设计行业发展中一些尚待解决的问题进行了讨论。

关键词 ……

综合雨水管理；可持续设计；政府规范；绿色基础设施；专业衔接；专业教育

Abstract ...

The design of Xixi Village is a project guided by the Low Impact Development principles. Through collaborations between landscape architects and engineers, an integrated stormwater system has been created within a community's outdoor space and water features, providing a showcase of environment-friendly development. Through the process of this project, issues of collaboration between architects, landscape architects and engineers were exposed and addressed. Longstanding practices of stormwater management must be challenged to assure sustainable development that would reduce flooding, improve water quality and enhance overall living quality.

Key words ...

Stormwater Management; Sustainable Design; Government Regulations; Green Infrastructure; Inter-disciplinary Collaboration; Professional Education

项目地址：杭州市西湖区
占地面积：13.1hm^2
项目委托：坤和建设集团
景观设计：美国ATA设计公司
项目总监：盛梅
首席设计师：Guy Walter、Austin Tao、Timothy Callahan
设计团队：余巧珏、徐文玉、康晓旭、牟丹丹、勾丽丽、高凌、王芳、石凯、夏青
雨水管理顾问：车伍（北京建筑大学）
设计时间：2007~2009年
施工时间：2008~2010年
建成时间：2010年

Location: Hangzhou, Zhejiang, China
Area (size): 13.1 hm^2
Client: Canhigh Real Estate Group
Landscape Architecture: ATA Lawrence Group
Principal: Mei Sheng
Chief Designers: Guy Walter, Austin Tao, Timothy Callahan
Project Team: Qiaojue Yu, Wenyu Xu, Xiaoxu Kang, Dandan Mou, Lili Gou, Ling Gao, Fang Wang, Kai Shi, Qing Xia
Stormwater Engineer: Wu Che (Beijing University of Civil Engineering and Architecture)
Design Period: 2007 ~ 2009
Construction Period: 2008 ~ 2010
Completion Time: 2010

1. 联排住宅的内部池塘
2. 场地条件
1. Internal pond in the townhouse area
2. Site conditions

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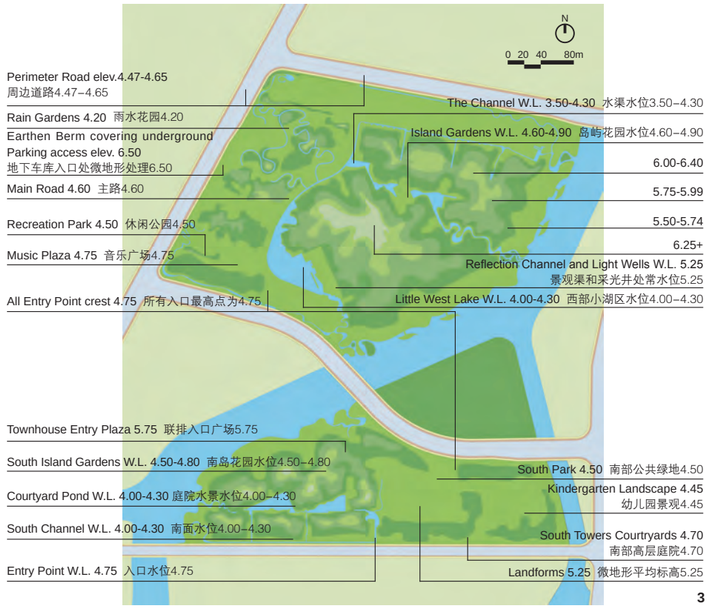
作为一个备受关注的话题，生态水环境建设如何在实施层面得以贯彻，而不仅仅作为一个观点和理论传播，是实践中面临的挑战之一。2007年，本项目团队获得一个难得的机会 —— 在杭州城郊建造一个以生态健康为目标的居住社区。委托方希望通过对场地的综合雨水管理和景观设计，为项目创造健康、积极的社会形象，并符合其成本控制要求。本着这一目标，设计师展开了一系列与现实的对话和碰撞。

1 项目挑战

西溪里项目位于杭州市西北部近郊，距离西溪国家湿地公园北侧边界仅1km。项目总占地面积13.1hm^2，是一个由联排住宅、高层住宅、社区商业和一个幼儿园组成的综合社区。一条河流（五常港河）从其间流淌而过，将场地一分为二。一方面，杭州悠久的历史为项目提供了丰厚的文化背景；另一方面，场地所处的城郊结合新区，其周边多为近20年内建造起来的社区，地方传统并未得到明显的体现。在这样的环境里，如何创造出既满足居民当代生活需求，又具有长期生态与人文价值的生活空间，是设计面临的首要挑战。

由于杭州降水丰沛（平均年降水量1 000~1 600mm，年降雨日130~160天），项目又增加了一重雨洪管理和雨水排放的压力。道路积水和洪水泛滥是杭州年年面临的问题，雨季集中而大量的雨水能够使很多区域在短时间内变为池塘。由于地方政府没有对新建项目的雨水排放提出严格规范，因此建造商计划将场地内的一部分雨水排入市政管道，另一部分排入相邻的五常港河内。这是当地通行的做法，如果开发面积小，对水环境的影响并不明显；可动辄十几甚至几十公顷的大规模开发建设将很容易改变场地原有的汇水模式，对现有市政排水系统与河道形成巨大冲击，如果不加约束，势必会加剧雨洪问题。因此，设计师希望在本项目中，通过设计提高场地自身的雨水控制与管理能力，缓解市政管网和附近河道的压力。

基于上述情况，本项目面临来自以下几个层面的要求与挑战：1）使用需求。即室外空间的尺度、位置、节奏和形式要满足各个部分的使用功能，并与建筑形态



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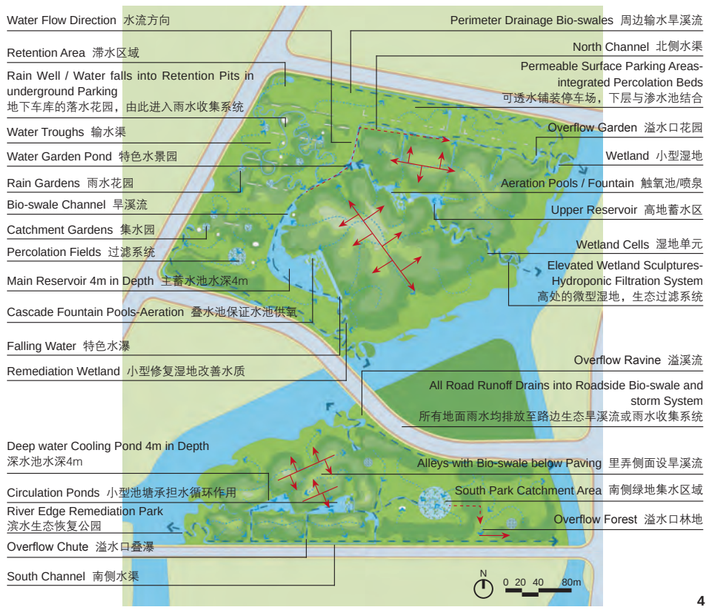

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和空间关系协调。2）文化需求。当地居民长期生活在西湖水畔，形成了颇高的审美判断和标准，不仅要求视觉上的赏心悦目，还要体现文化价值。3）生态需求。景观设计要实现低造价、易实施的雨洪管理目标，将开发建设对周边环境，尤其是自然水系统的影响最小化，并保证新建环境的可持续性。

2 设计方法：紧密结合雨洪管理的景观设计

本项目中，综合雨水管理是景观设计的一个核心内容，景观设计在场地设计和雨水管理两个层面平行展开。首先，景观设计根据各部分空间的需求确定室外交通、空间尺度、节奏和联系。雨水工程师同时根据场地规模、功能布局要求、气象数据，划分出适合的汇水区域，确定水系统的位置、规模、范围及竖向控制点与排水走向。之后，景观设计师以此为依据，深化场地设计，发展出景观方案，再将此成果提交给雨水工程师，进行各区域的详细计算和节点设计。整个设计过程中，对外部空间与功能的考虑和对场地雨水管理的设计同时进行，互为依据。

最终确定的方案，是对场地雨水进行全面收集，储存在不同大小的池塘和水池中，通过道路和建筑周边的种植明渠、覆盖植被的旱溪流和季节性的雨水花园的过滤，将雨水排放到两个市政排水点和河边湿地中。在这个经过延长的排放过程中，一部分雨水得到净化和再利用，一部分原地渗透补充地下水，剩余部分经过滞留后最终被缓慢地排放到城市排水系统中（排水干管与河道）。

满足使用功能和生态要求后，还要为场地赋予文化特性，以获得更好的认知度。经过对杭州本地文化的研究，设计确定了以一系列点状水景和具有象征意义的形象组合，塑造出用当代语汇构成的传统空间意向。这些水景同时也是蓄水区或排水点。宁静、舒缓是本设计力图创造的环境品质，以营造出一种如水墨画般简洁而有感染力的氛围。

3. 场地竖向概念
4. 场地雨水收集与利用设计概念
5. 整体种植概念
3. Site elevation design
4. Rainwater collecting and recycling design
5. Overall plan of planting design

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3 现实：从概念到实施的矛盾

本项目在实施阶段遇到了诸多挑战，其中，根据计算和精心排布而成的水系统，在项目深化过程中反而成为了一个难题。其难点不在于技术方法或建造材料，而是来自专业间的衔接。如前所述，场地设计是结合雨洪管理的要求完成的，其中细节的落实依赖建筑、工程等相关专业的配合——比如，建筑排水与场地排水标高的衔接、场地雨水系统和市政排水系统的结合——但由于建筑与市政排水采用的是传统思路，即雨水经由人工管道会被迅速排放到市政集中水管，场地无法收集到人工水体所需的预期雨量。虽然从委托方到各专业人员均对景观设计理念表示赞同，但受项目进度制约，其他专业没有机会按此标准对设计进行全面修改。于是不得不根据现有条件逐步缩小蓄水池的规模，并分期调整水循环方式。项目中一些核心部分的景观设计得到了保留，但一些具有争议性或未及完成专业间协调的部分，则以景观的放弃和牺牲作为结果。

最终，90%的景观设计（场地布局、空间形式、种植）实现了预期构想；雨水管理系统则在不同项目区块，分别实现了20%~90%不等。据综合统计，场地的整体雨水收集率约为30%，以地表径流为主，包括少量建筑落雨收集。大约50%的生态雨水系统得以最终实施，包括道路两侧和绿地周边的明渠与旱溪流、社区中心的生态池塘、沿河道的雨水花园和湿地区。社区入口和广场中的几处观赏性水景和喷泉，原计划用雨水来补给，但由于委托方担心无法确保水质而放弃。实施后的景观是一个妥协的结果，也是构想和现实之间经过碰撞、协调后的成果。

4 思考：专业发展中存在的问题

从本项目的设计和实施过程反映出，生态雨水管理在实际应用方面还有很长的路要走。究其原因，可以概括为以下几个主要问题：

4.1 应用规范与执行标准的缺失

设计的实施离不开行业规范与标准，目前各地对雨洪管理的要求尚未明确。在项目设计过程中，设计团队没有在地方法规中找到具体的规定和要求，换言之，法规规定得十分宽泛。以建筑和市政设计中对新建社区的排水量计算为例，有的按五年一遇计算，有的按两年一遇计算，更有甚者按一年一遇计算。以这样的标准设计，只要十年一遇的降雨就会造成场地积水泛滥，更不用说大规模城市建设本身所导致的日益恶劣的场地条件。如果能根据

发展建设强度，划分出不同层级的雨洪排放标准，以规范的形式固定下来，则可以对实施进行有效指导。

目前中国在这方面的发展呈现出一种有趣的现象：学术界看到生态建设领域的空白，将之作为一个有潜力的课题去研究；政府意识到环境问题的严峻性，将其作为政策去宣导。但从研究到实施、从中央政策到地方规范，则缺少详细、可执行的标准。而有意愿的建造方和设计师会根据手头的经验或直接参照欧美国家的标准去执行，颇有些民间自发的味道。这些零散的研究与自发的探索之间缺少衔接的渠道，无法形成有效的行业资源。虽然生态水环境的问题已经引起官方和全民的关注，但倘若实施环节中没有标准和规定，设计概念便容易停留在理论层面，难以得到实践的检验。

4.2 专业衔接的矛盾

因为缺少明确的标准，前文所述的专业衔接矛盾在所难免。在城市建设最需要应用雨水管理的城市化开发建设中，当前通行的做法是符合规范要求即可。当景观试图通过场地设计解决雨洪问题时，就出现了市政工程、建筑、景观等各专业标准不统一的现象。特别是在高密度的城市开发中，景观设计通常作为处理室外空间的手段，在程序安排上滞后于市政和建筑设计。这往往导致景观设计对场地的影响仅限于建筑之间的空白处，限制了雨水收集系统的范围和效果，使得场地的生态效益大打折扣。对此，需要景观设计师主动与委托方和项目团队中的各专业配合，提前说明设计意图和要求，在设计时间和影响决策方面争取更多主动权，为设计的成功实施增加机会。

在实施过程中，景观设计师要特别注意以下部分的衔接：1）建筑排水点与场地雨水收集系统的交接，即建筑落水口的标高、位置与地面收水点的对位。2）与施工方的沟通与配合，雨水收集系统虽不需按建筑实施的精度完成，但施工对竖向高点与低点的控制、渗透池、护岸、种植池等位置的做法也有规范性要求。施工方如果不能正确理解这些要求，就会出现按经验直接处理，保证视觉效果却牺牲了生态功能的结果，从而违背了设计初衷。

4.3 专业教育中的弱项

场地设计和雨水管理作为景观设计中的一个技术问题，在教学中有所涉及，但并不深入。作为工程类的应用学科，景观设计不仅需要对美学、空间有深入理解和把握，还需要具备工程技术知识和运用能力。以美国为例，景观设计师在获得专业学位和职业注册资格前，要完整地掌握场地设计和雨水管理的理论和应用方法，涵盖从基本概念到具体计算的方方面面。但国内相关专业的毕业生往往在此方面没有体现出应有的知识与训练，不能应对实践的要求。由于对概念和技能的掌握一知半解，很多设计师在项目实践中难以发掘并

芦园：联排里弄一，30%地面可进行雨水收集，并将雨水排放至河滨湿地。
Reed Garden: 30% surface of Alley No.1 in the townhouse area can collect rainwater and runoffs, and drains them into riverfront wetland.

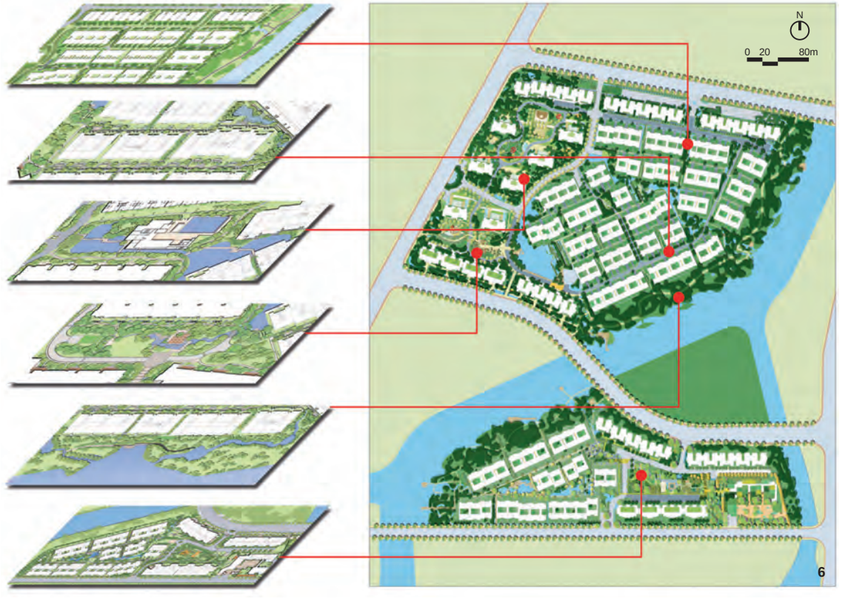
芦园：联排里弄二，80%地面可进行雨水收集，并将雨水排放至河滨湿地。
Reed Garden: 80% surface of Alley No.2 in the townhouse area can collect rainwater and runoffs, and drains them into riverfront wetland.

中心湿地池塘：80%地面可进行雨水收集，并经由小湿地对水质进行净化。
Central wetland pond: 80% surface can collect rainwater and runoffs which will be drained into small wetlands to purify water quality.

瑾园：高层住宅区景观：车库屋顶绿化；20%地面可进行雨水收集，并将雨水排放至内部溪流与雨水花园。
Gem Garden: landscape designed for high-rise residential area; the roof of underground parking area is covered with vegetation; 20% surface can collect rainwater and runoffs, and drains them into internal streams and rain gardens.

河滨生态公园：雨水花园和小型湿地可收集社区雨水，并经过滞留、过滤后排入河道。
Ecological waterfront park: rain gardens and small wetlands are designed to collect rainwater in this neighborhood, the harvested rainwater will be drained into river canals after detention and filtering.

随园（示范区）：车库屋顶绿化；60%地面可进行雨水收集，并经由内部明渠和雨水花园排入河滨湿地。
Side Garden (demonstration area): the roof of underground parking area is covered with vegetation; 60% surface can collect rainwater and runoffs which will be drained into riverfront wetlands through bio-swales and rain gardens.



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实现宏观概念以外的想法，加之由于自身的知识不扎实，与其他专业配合时不能利用事实和数据支持自身的观点，常常处于被动位置。LAF

6. 概念总平面与实施方案
7. 高层住宅花园的喷泉水景在实施中放弃采用雨水作为补给，绿化覆盖部分50%的雨水在被收集后进入生态排放系统。
8. 水池两侧覆盖卵石的明渠用来收集雨水，并将其排放到临近的渗水区（雨水花园）。
6. Conceptual master plan and construction programs
7. In the construction phase, rainwater is not utilized as supplies for the fountain features in the gardens of high-rise residential area, 50% collected runoffs drain into an ecological distribution system.
8. The bio-swale covered with pebbles on the both sides is designed to collect rainwater and drain it into adjacent infiltration areas (rain gardens).

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Environmental sustainability has been a popular topic and sensitive issue in China. When it is practiced, a major challenge is how to turn theory into practical implementable solutions that are functional and aesthetically pleasing. In 2007, the design team received an exciting commission — designing a low impact residential project in Hangzhou, China. The client intended to build an environmental friendly and cost efficient community. Stormwater management practices were applied to enhance water quality while reducing the quantity of water leaving the development site. Both would make a positive impact on the site and its surrounding urban context, and serve as a model for future development projects.

1 Project Challenges

Xixi Village is a mixed-use development in a northwest suburb of Hangzhou. It is one kilometer away from Xixi National Wetland Park. The total development area is 13.1 hectares. The site is divided in two lots by the Wuchanggang River, a branch for the city's main water supply. As a typical mixed-use development in China, Xixi Village consists of multiple high-rise condominiums, townhomes, two retail streets and a daycare center. The total building area is over 300,000 square meters, with more than 1,500 residential units. The City of Hangzhou provides a rich historic and cultural context for this development. In contrast, the suburb where this project is located in has been developed in the past 20 years. Little traditional and cultural influence can be found in these new developments. The biggest challenge the design team faced was how to create a living space that not only meets the needs of contemporary urban life, but also contribute to the environmental and cultural growth of the region.

Another challenge is the pressure caused by excessive stormwater runoff from the site. In Hangzhou the annual average precipitation is 1,000 ~ 1,600 mm, with 130 ~ 160 wet days each year. However, in the past twenty years, local regulations for stormwater management and environmental protection have not kept pace with the unprecedentedly rate of urban growth. Flooding has become a critical issue in the area. After heavy rains, streets and open spaces are filled with stormwater runoff, forming pools of water and that may last several days. This occurs mostly during wet days in the spring and summer, and causes heavy damage to property and public infrastructure, even resulting in the loss of human life. In surrounding areas of Hangzhou, more developments are planned over the next ten years. Minimizing the negative impact of developments on each other and the regional environment is a significant responsibility that cannot be avoided for either the developer or designers. Actions should be taken to control the overflow of stormwater in each new development and to reduce pressure on the city's overloaded and aging drainage infrastructure. A goal for this project is to fully collect and re-use rainwater captured on the site, and remove pollutants of stormwater runoff from the pavement and buildings through green infrastructure that minimize runoff into the river as much as possible.

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2 Approach: Stormwater Management Based Landscape Design

Stormwater management is the key aspect of this project. Since the beginning of the design, principles have been established to ensure environmental health and sustainability. Based on this guideline, the landscape design was generated in two layers: site planning and stormwater management. The outdoor spaces were first studied and defined by landscape architects to meet program requirements and residents' needs. At the same time, stormwater engineers developed a preliminary drainage plan, sketched out a catch-basin layout, water reuse strategies and earthwork grading of the site. After several meetings between collaborating landscape architects and engineers, the design team arrived at a plan that addressed issues of livability, aesthetics, and sustainability that integrated outdoor space with grading design. These alternative approaches to stormwater engineering were met with an expected amount of skepticism. Through extensive negotiations within the design team, the engineers performed their final hydrological calculations to assure the functionality of proposed approaches to stormwater management. The design of the outdoor spaces, buildings and stormwater system were inseparable through the entire process and provided a basis for each other.

The resulting plan will capture runoff from the whole site and rainfall from some of the buildings, moving it into constructed landscape areas, engineered ponds and water features throughout the site. Runoff from parking lots, streets and buildings will enter vegetated bio-swales, seasonal rain gardens and stone-lined waterways, while the overflows will be guided into the river. In this deliberately extended process, rainwater would be filtered and retained. A portion of the stormwater runoff will provide moisture for plants during the dry season. Some of the water will drain into the soil and recharge the groundwater. The rest would slowly flow towards the river, reducing flooding potential and improving water quality entering the river.

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3 Issues: from the Drawing Board to the Field

During construction, the carefully planned scheme was challenged by unexpected situations and longstanding views towards handling stormwater. Problems arose not from construction techniques or materials, but collaboration between professionals: architects, civil engineers and landscape architects. As an integrated

9. 内部溪流在局部形成人工湿地，对雨水进行收集与过滤。
10. 在地下车库顶板上进行覆土绿化，地表雨水汇集到路边的排水沟，集中排入雨水花园。

9. Internal streams create constructed wetlands at some specific areas to collect and filter rainwater.
10. The roof of underground parking area is covered with flourishing vegetation, runoff will be collected by the roadside bio-swales to recharge the rain gardens.

system, stormwater management relies on collaboration between architecture, landscape, and site engineering. However, project architects and drainage engineers followed a conventional method of rainwater treatment: distributing it through pipes and discharging it as fast as possible. The client's project team, without experience in this type of collaboration, realized the problem after urging by the landscape design team. However, this oversight was found too late, and the building design was unable to be changed and still meet the project deadline. As a result, the landscape architects and stormwater engineers were challenged to incorporate water management strategies into a development concept that had been largely predetermined by conventional and relatively unsustainable approaches. Catch basins and storm sewer piping were resized and the design was modified towards a greener approach. With construction underway the site design had to be modified piece by piece. The core methods of sustainable water management were saved by a strong defense from landscape architects and stormwater engineers, while some late modifications were not implemented.

Over time, 90% of the original open space plan, grading, hardscape, and planting designs were successfully constructed. However, implementation of a sustainable stormwater system varies from 20% to 90% at different phases of the project. Overall, 30% of rainwater is collected on site, including runoff from paved areas and buildings. Approximately 50% of the designed stormwater system was constructed, including roadside filtration trenches, bio-swales, a wetland pond located at the central space, rain gardens, and mini-wetlands by the river. Ornamental water features, such as plaza fountains, were designed to be supplied by filtered rainwater. However, this idea was dropped before construction because of client's concerns over the efficiency of water quality control and human interaction with the water features. The resulting built landscape is a compromised scheme from a landscape perspective, and the result of collaborative efforts and contests between theory and practice.

4 Review: Problems Remain in Professional Development

The problems described above are not unique to China. After reviewing the procedures of this project, several solutions can be found to establish regulations, professional development, and multi-discipline cooperation.

4.1 The Lack of Applicable Development Regulations

In the past 15 years, the concerns about environmental health in China have drawn the attention from the top government level to the general public. Topics in this field have been explored at colleges, universities, research institutions. Government has promoted public awareness of environmental health concerns. However, there is a big gap between theoretical research and implementable practice, a disconnection between central government policies and local and regulations. Due to the social structure of China, non-governmental organizations do not have easy access to research institutions or government support. Developers and designers — who are willing to contribute — need to look to sustainable practices borrowed from regions like Europe and the United States.

At the same time, there are not specific regulations to manage the impact of new urban developments like this Project. For example, in the case of Xixi, the design team did not find any specific requirements set by local authorities on stormwater control. Site engineers and architects often follow general rules that do not concern specific site or local conditions. This can lead to problems such as flooding. Regardless of development type or location, the designed drainage system is usually designed to handle a two-year flood frequency and occasionally a five-year flood. However, both of these regulations are often inadequate to protect property, public infrastructure and human life. There are few regulations issued by government or public authorities in China that guide developments to evaluate site planning and flood control. Criteria applied to each project may vary a great deal due to the lack of guidelines and regulations.

4.2 The Inconsistency of Design Standards

Consequently, professionals in different fields become acquainted with design standards that are often outdated or out of step with recent practices. As seen in this project, the architects, site engineers, and the landscape team (landscape architects and storm water engineer) followed different principles to generate specific design solutions. Due to the recent and fast-paced growth of projects of this type, clients are challenged to assemble teams that share a level of expertise and experience with sustainable design. Conflicts and misunderstanding between design professionals and the client project team will be minimized by widely implemented and accepted sustainable practices and regulations.

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However, given the fact that low impact design is an emerging practice in China, the setting of professional standards should not rely only on individual design firms or developers. A more proactive approach should be taken by the central and local governments to not only promote sustainable practices to assure flood protection and water quality, but also to direct the design and implementation of new development and redevelopment projects in order to meet overall health and quality of life concerns in a growing country.

4.3 The Information Gap in Professional Education

The education of stormwater management is widely offered in college-level teaching programs. However, limited time and efforts has been devoted to let students fully understand the concepts and skills required by best practices for stormwater management. As a consequence, landscape architecture graduates seem unprepared when they face similar problems in practice, few are capable of working and communicating effectively with engineers or architects. Without proper training and experience, landscape architects cannot communicate designs or manage projects efficiently. Landscape architects — regardless of where they practice — must be able to glean sources of inspiration from sustainable projects from around the globe. **LAF**

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11. 绿荫葱郁的高层住宅花园
12. 绿意浓浓的室外空间为居民营造出了放松宜人的氛围。
13. 消防回车场旁的人工池塘
14. 消防回车场地，经设计后成为具有观赏性的内部空间。
11. Luxuriant garden in high-rise residential area
12. The thriving green outdoor space creates a relaxed and comfortable atmosphere.
13. Internal pond in the turnaround loop
14. The turnaround loop for extinguishing and protection is designed as a ornamental internal space.

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