

## 赣江“S湾”活水岸公园： 自然驱动的河流景观生态修复实践

# THE S RIVER PARK ON THE LIVING SHORELINE OF THE GANJIANG RIVER: A NATURE-BASED SOLUTION TO ECOLOGICAL RESTORATION OF RIVERFRONT LANDSCAPE

### 1 项目背景

赣江是长江的主要支流之一，也是江西省最大的河流，在沿河区域的交通和经济发展中发挥着重要作用。本项目地处江西省赣江新区核心起步区内的儒乐湖新城江段。儒乐湖新城总体规划于2016年完成制定，在SWA集团设计团队的建议下，原本沿赣江水岸规划的城市快速路——金水大道的部分路段被改为地下隧道，避免了未来新城与水岸的割裂，从而为沿江公园的规划创造了良好条件。该公园长约6km，面积近14hm<sup>2</sup>，串联近20条规划街道，是新城未来重要的水岸空间。2018年，设计团队再次受当地政府委托，为沿江公园制定全面的生态修复和景观提升方案（图1）。

赣江流域显著的水位变化是河道演变的重要推动力之一（图2）。项目场地位于南昌市以北的赣江尾间主支中下游，受河道水沙运动、湖区三角洲沉积和人类活动影响，河道演变情况比一般河流更加复杂<sup>[1]</sup>。历史上，出于城市发展与抵御洪灾的需要，人们对河道进行了多种形式的改造和利用，如筑堤、造丁坝、堵流、采砂、航道管理等（图3）。这些工程直接或间接地影响了河流地貌的自然演变，使当地生态环境与生物多样性遭到破坏<sup>[2][3]</sup>。

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#### 摘要

河岸是一个地区抵御自然灾害的重要界面，具有显著的生态和景观价值，同时又极具动态性和敏感性。河岸空间规划设计只有遵循自然规律，才可实现人与自然和谐共处、最大限度减轻灾害的目标。

本文以江西省赣江新区儒乐湖新城“‘S湾’活水岸公园”规划为例，通过获取项目所在地不同历史时期的遥感地图与水位数据，分析河流水文特征的变化，并将其与历史上的主要河道整治与开发利用活动进行对应，结合水沙运动规律，初步厘清了场地河流形态的演变过程，进而提出基于自然的设计方案：通过适当的人工干预，利用河流的自然发育规律做功，复育被破坏的河流沙洲栖息地，同时根据场地自然条件划分公园功能区，营造引人入胜的滨水体验。设计方案旨在通过建立新城与赣江季相和水位变化之间的密切关联，使之更具活力与韧性。

#### 关键词

基于自然的解决方案；河流演变；河岸；生态修复；栖息地修复；城市韧性

#### ABSTRACT

Possessing significant ecological and landscape values, river shorelines are regarded as a region's most important interface to resist natural disasters while they are also extremely dynamic and sensitive. Therefore, it is critical to follow the laws of nature in design and planning of river shorelines to achieve the harmonious coexistence of human and nature free of flood catastrophes.

This article takes the S River Park on the Living Shoreline of the Rule Lake New Town, Ganjiang New District, Jiangxi Province as an example of nature-based design approach: First, by examining remote sensing maps and water level data in different historical periods of the site, the design team learnt the evolving hydrological characteristics of the river; Second, the relations between the river's evolution and major human interventions in history are clarified and sorted; Last but not the least, guided by the nature laws of water erosion and sedimentation, a nature-based design solution was approached—By catalyzing natural processes with appropriate human interventions, it aims at rehabilitating the damaged sandbar habitats through spontaneous remediation of the river, and creating fascinating riverfront experience out of a rational function zoning of the park based on various natural conditions, thus to make the new town more vibrant and resilient by connecting it with the seasonal waterfront landscape driven by the ebb and flow of the river.

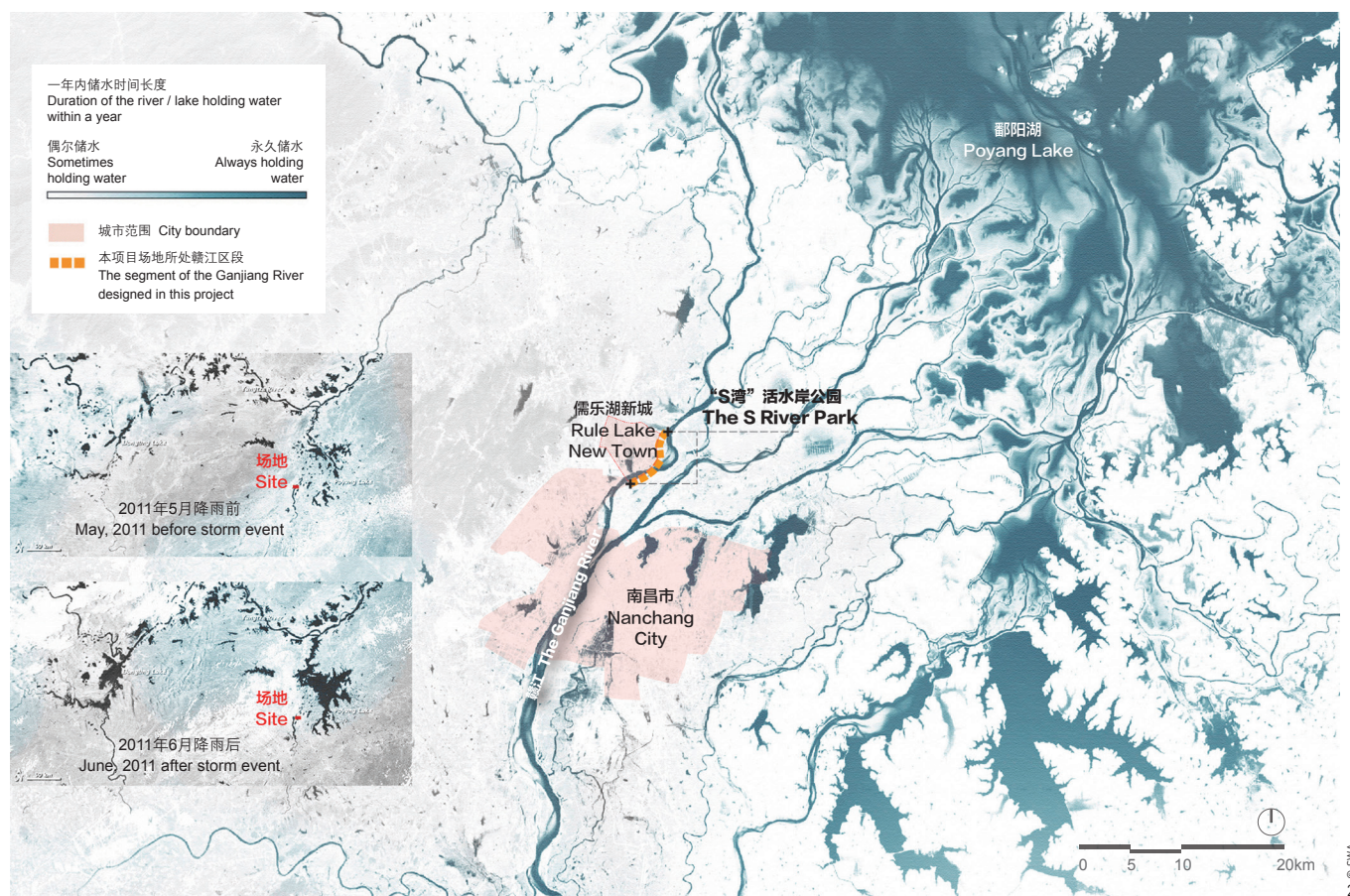
#### KEYWORDS

Nature-Based Solution; River Evolution; Shoreline; Ecological Restoration; Habitat Rehabilitation; Urban Resilience

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2. 区域水文格局  
2. Hydrological pattern in the region

态演变分析可知，随着场地附近的河流边滩逐步萎缩，赣江水位也在逐年下降。

## 2.2 人工干预河流事件梳理

随后，为了更深刻地理解上述演变的成因，找出场地内需要解决的关键问题，设计团队深入调研了过去20余年间主要的人工干预河流事件，并对其与河流水文特征演变的时间对应关系进行了梳理（图7）。

1989年之前，人工干预对河流影响较小；1990年万安水利枢纽截流后，赣江下游泥沙量减少，河水冲刷力增强，导致河床严重下切；到2000年，这一影响已扩大至南昌市附近<sup>[6]</sup>；2001年后，赣江河道盗采砂现象严重，特别是场地附近的乐化镇瓜洲村沿岸沙洲遭到滥采，沙洲最宽处由1990年的约990m缩减至2019年的约310m。萎缩的自然边滩不仅导致河流生态系统被破坏，也使河岸更易坍塌，防洪堤坝的稳固性亦受到威胁<sup>[9]</sup>。2011年后，大规模的盗采砂现象才得到一定遏制<sup>[6]</sup>。

2012年，由于原本的瓜洲联圩防洪堤坝（下文简称“瓜洲堤”）不能满足防洪需求，当地水利部门将其进行了加高和加固，以缓解江水对圩堤的冲击<sup>[10]</sup>。重修后的瓜洲堤顶宽24m，设计标高为24.0m，防洪等级由5~8年一遇提高至50年一遇，其安全性虽然得以提高，但景观

效果生硬、缺乏变化，更破坏了周边的生物栖息地：不透水的混凝土护岸切断了水陆生态之间的诸多互动，加快了水流下泄速度，使河道和流域的保水、滞水能力降低<sup>[11]</sup>。

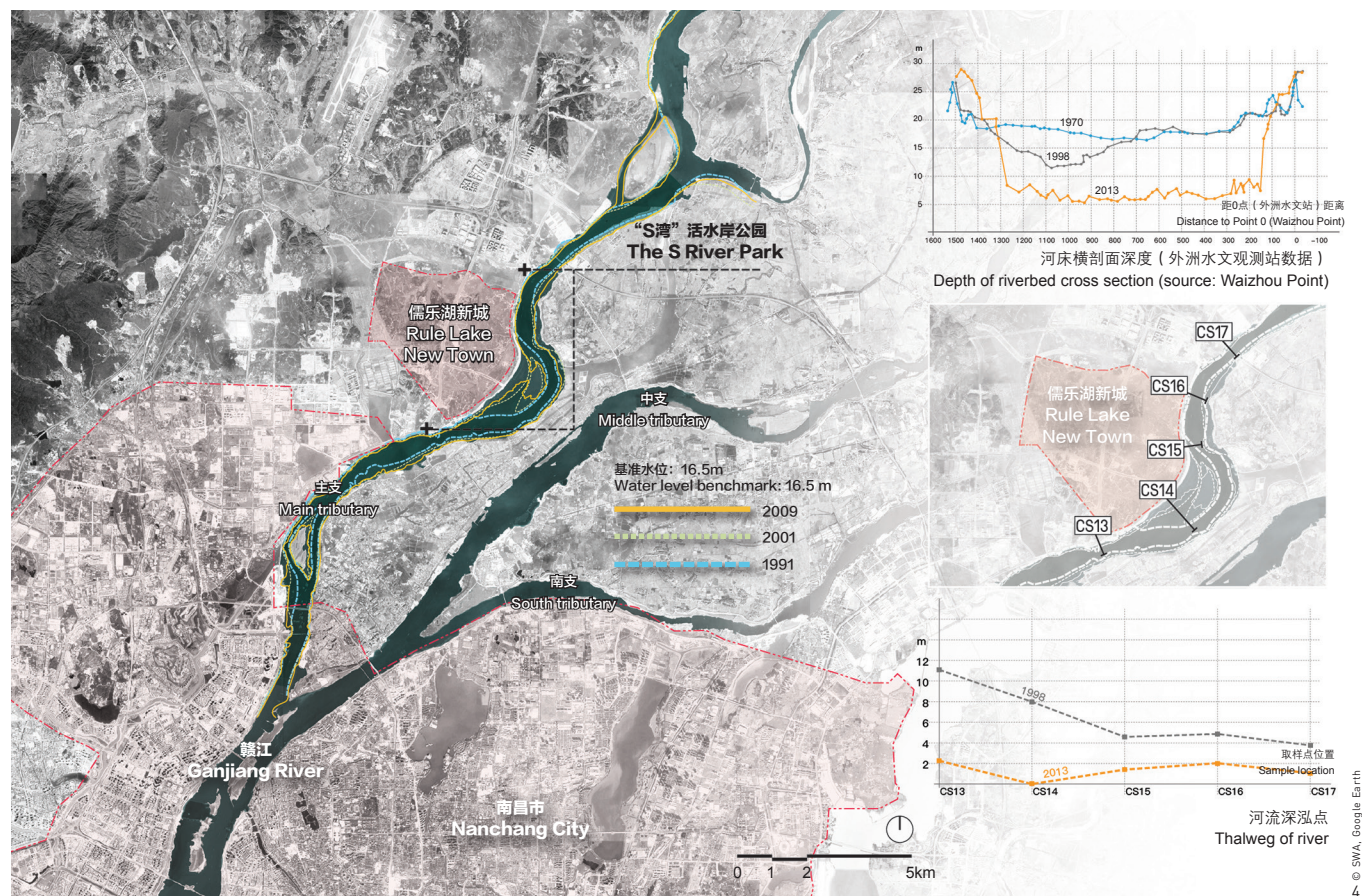
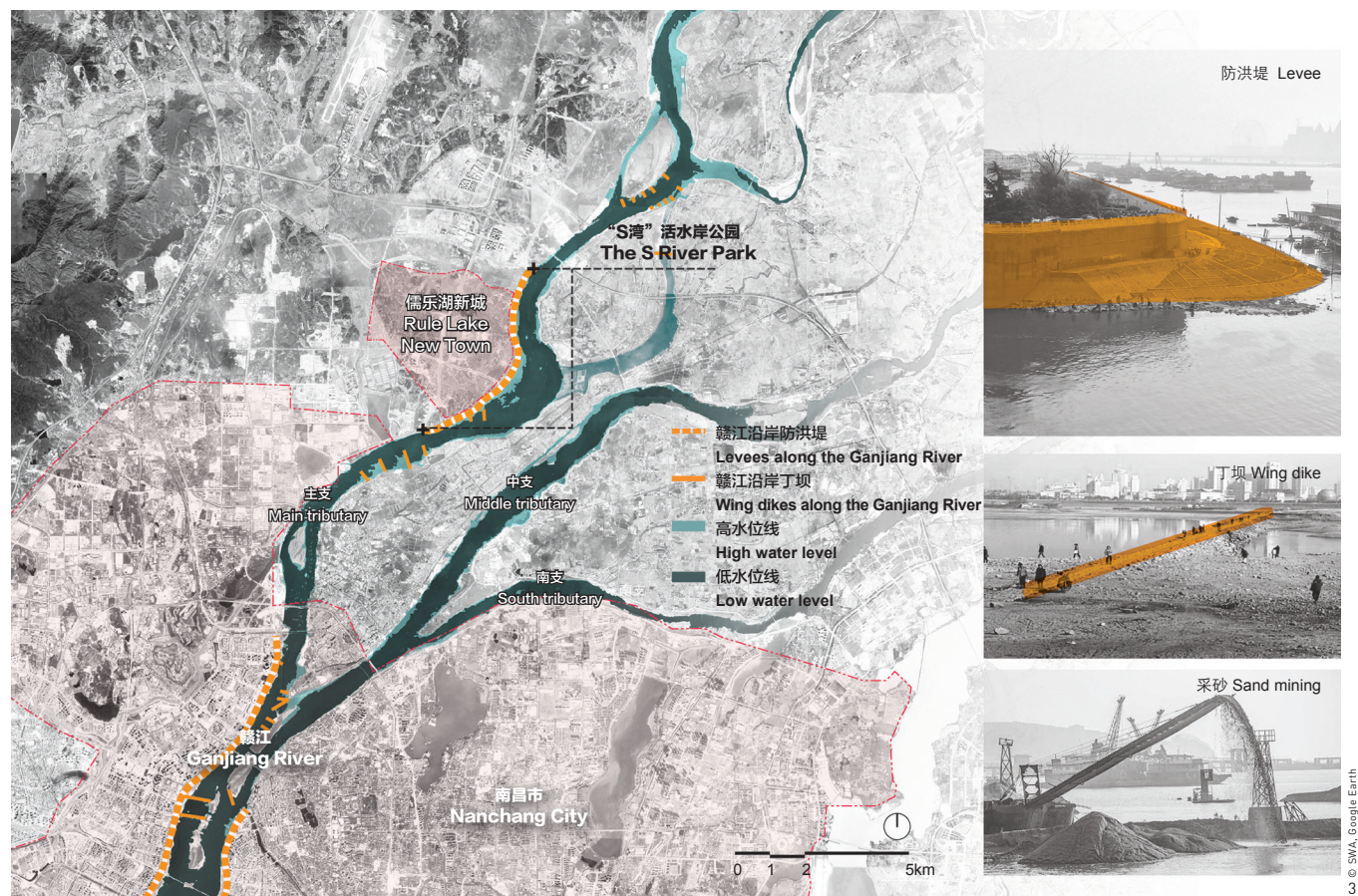
总体而言，在近30年来的一系列人工干预的影响下，场地内河段边滩的地表径流增加，与采砂坑连通为新的流槽，质地松散的河岸沉积物遭到侵蚀，原本稳定的S形凸岸逐渐破碎、瓦解，乃至消失。

值得一提的是，在瓜洲堤固坝工程同期，凸岸弯道处新建了一座长约300m的临时性丁坝，以保障水利工程顺利实施。丁坝主要被用于改变所在河段的流场分布和河床形态，以便进行航道管理，也可改变其周围水生生物分布格局，倘若布置得当，回流区可对主流区的生境损失进行一定程度的补偿<sup>[12]</sup>。卫星图显示，2012年丁坝筑成后，坝后回流区逐渐恢复河漫滩形态。这一发现也使设计师重新思考了丁坝的意义，并试图在沿江公园设计中使其发挥更大的生态和景观价值。

## 2.3 设计目标：恢复独特的“S”形河流地貌

综上，使河流恢复S形自然地貌成为此次设计的核心目标，其关键在于：1）通过生态技术和符合河流地貌自然发育规律的整地策略对新增的坑塘流槽进行管理，以减缓、遏制侵蚀过程；2）利用河水自然

3. 人们对赣江河道进行的整治工程与经济开发活动
  4. 研究河段水岸形态、河道横断面与深泓点的历史演变（来源：参考文献[5][6]）
3. Management projects and development activities along the Ganjiang River
  4. Historical evolution of the shoreline morphology, cross section, and thalweg of the Ganjiang River (Source: Ref. [5][6])



冲淤作用，恢复边滩和江心洲等S形河流地貌单元；3）打破原有防洪堤的平行线式断面设计，并在满足防洪需要的前提下提升河岸生态效益和景观品质。

### 3 基于自然的解决方案：赣江“S湾”活水岸公园

设计将沿江公园命名为“‘S湾’活水岸公园”，以突出标志性的S形河流地貌，并将自然的力量作为公园规划的核心驱动力，运用自然法则提高水岸和城市对抗自然灾害的韧性，使之与动态变化中的河流共生共存（图8）。

#### 3.1 顺应自然的整地策略

设计团队根据河流地形及其演变规律的分析结果，确定河岸和植被保护范围，进而结合场地自然条件和儒乐湖新城规划，分析公园不同区块的开发适宜度及强度，并得出公园的整地策略和实施步骤：

1）首先，根据历史河道地形图，模拟不同水位下的边滩边界，确定防洪堤外受损边滩的修复范围。并增设符合生态学原理的新型丁坝群，以利用河流自然发育规律整合现状破碎坑塘，建立弧形条状沙洲，稳固沙洲间不同高程的流路河槽，促进边滩自我修复，从而恢复河流自然蜿蜒的形态及生态群落，创造具有景观美学价值的水岸空间；

2）其次，在防洪堤内保留瓜洲村现状湿地水塘系统和周边植被，建立雨水花园等绿色生态基础设施，并塑造微地形，引导地表径流进入，实现雨水净化，并补给地下水；

3）最后，消化堤坝与滨江交界道路规划标高之间的高差，增加水

岸岸线形式的多样性，并对河岸景观及其空间功能随赣江水位变化而变化的情况进行模拟（图9）。

#### 3.2 从人工堤坝到“有生命的堤岸”

河流堤岸是重要的水陆过渡地带，其生态性对于河道生态系统非常重要。打破防洪堤单一的平行线式断面设计，软化人工坝基，重建有生命的堤岸是项目的设计目标之一，也是延缓流槽侵蚀、修复受损滩地的重要保障。

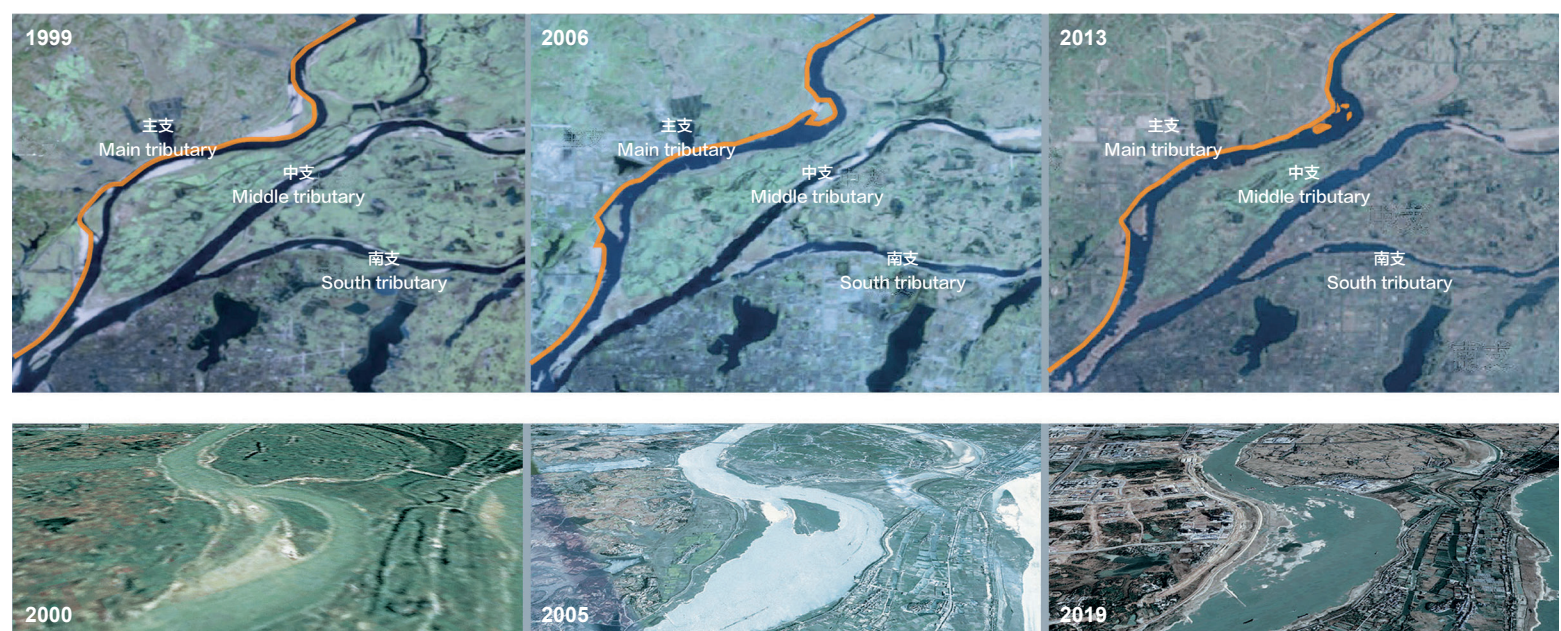
在岸线材料的选择上，设计团队运用多孔隙的自然材料创造可渗透的多样化水陆交界面，并根据不同区段河水冲刷力的强弱选择不同的固岸抗侵蚀材料，例如净水石笼砌块、椰棕纤维生态垫、柳条和沉水木桩、挺水植物种植笼等，以形成流速不同的水环境，保护滩体免遭侵蚀，并将不透水的硬质人工堤坝转变为可供生物栖息和繁衍的自然堤岸，以提高河流景观质量，满足亲水需求（图10）。

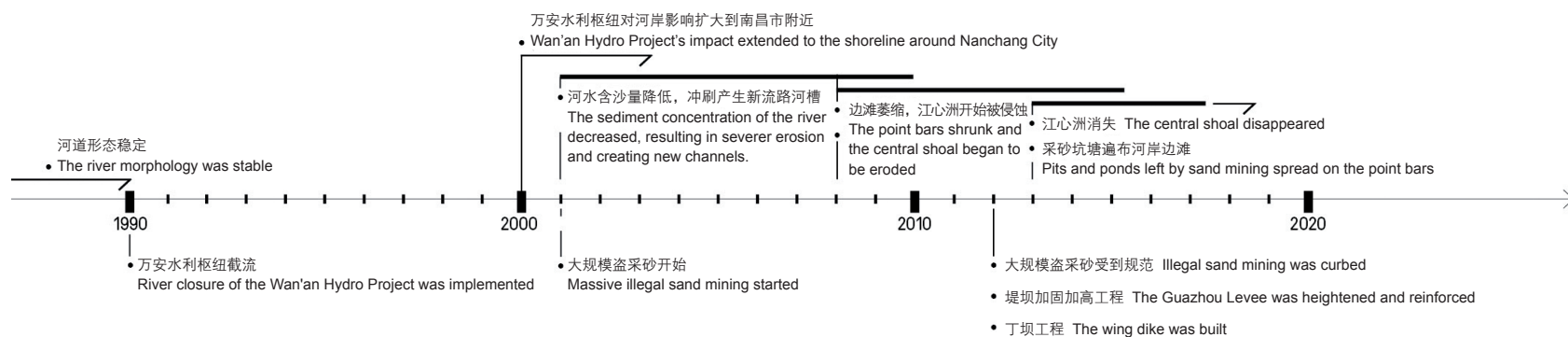
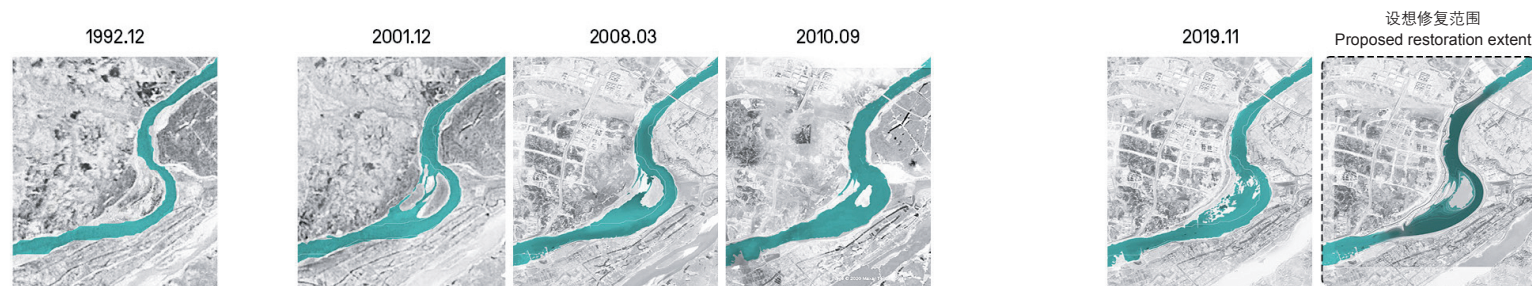
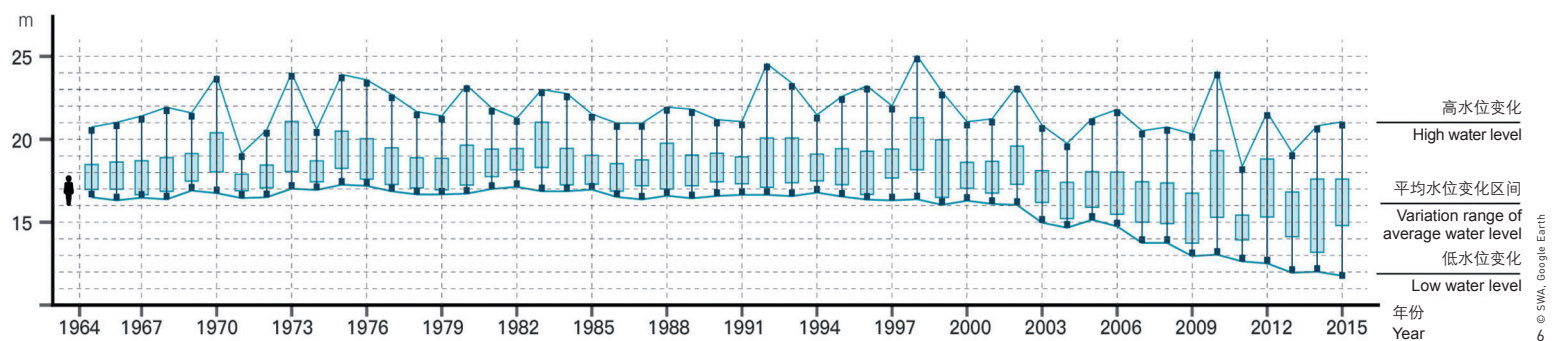
在岸线横剖面的设计上，根据堤坝与河流之间的不同高差，通过地形缓坡、植栽退台、石笼阶梯等形式打破防洪堤单一、生硬的边界，实现从城市建成区到水岸的自然过渡，同时保证满足50年一遇的防洪需求（图11）。

在防洪大堤的断面设计中，设计充分利用坝顶的高程优势，打造视野开阔的城市滨江慢行绿道：通过分层布置快行和慢行廊道，提供自行车骑行、慢跑和漫步等多种功能，廊道之间产生的高差可就地解决种植覆土缺乏的问题；同时在廊道之间种植森林绿带，既可以起到分隔空间的作用，亦能提供树荫，形成形式丰富的立体通行空间和舒适的微气候（图12）。

5. 场地内河段边滩与江心洲的形态演变（来源：参考文献[7]）

5. The evolution of the point bar and the central bar along the site [Source: Ref. [7]]





6. 1965-2015年间赣江水位变化情况

7. 人工干预河流事件与河流形态演变对照图谱

6. Water level variation of the Ganjiang River from 1965 to 2015

7. The evolution timeline of the river's morphology and the major human interventions on the river

### 3.3 基于河流自然形态的公园功能分区

在自然状态下, 场地北段凹岸不断被河流侵蚀, 岸线距离堤坝近、河岸陡峭; 河流沉积物在南段凸岸淤积, 形成平坦宽阔的扇形边滩。在这一规律的基础上, 设计团队结合儒乐湖新城规划对沿江开发强度和用地性质的规定, 将“S湾”活水岸公园从北到南划分为三个主要功能区: 腹地狭长的北段为湖江一线亲水区, 毗邻金水大道地下段与新城中央商务区的中段为中心河港区, 腹地宽阔的南段为沙洲湿地地区。

#### 3.3.1 湖江一线亲水区

S湾北段毗邻儒乐湖水坝, 现状岸线受其干扰较大, 自然环境退化严重; 且由于凹岸河水对河岸和堤底的冲刷作用较强, 堤坝与水面高差悬殊, 河岸极易塌方。因此, 设计团队提出尽可能保留现状河流浅

滩沙洲及岸上植被, 并利用新型生态丁坝促进河砂在丁坝之间沉积, 形成新的边滩栖息地, 以减小近岸的水流剪应力并降低流速, 既可缓解河岸侵蚀、稳固河岸, 又可消化堤坝与水面的高差; 城市街道则可通过丁坝延伸至水岸, 提高滨水可达性。

由于北段邻近新城规划中的文旅健康组团, 设计团队在该区段内新增了浮桥及游船码头, 并根据浮桥与丁坝的位置, 将河道冲淤后形成的边滩由北向南划分为游船河滩、亲水活动沙滩, 以及生态栖息地河滩。三个子分区分别使用与其功能定位相适应的不同的护岸材料, 并在空间上互不干扰。

#### 3.3.2 中心河港区

S湾中段紧邻规划中央商务区和一幢超过200m的超高层地标建筑, 是新城沿江开发强度最高的区段, 将主要承担公园的城市形象展



沙洲湿地地区  
Living Oasis Wetland Zone

中心河港区  
Central Harbor Zone

湖江一线亲水区  
River-Lake Waterfront Zone

- 1** 滨水生态混合林  
Waterfront ecological mixed forest
- 2** 群塘湖区  
Multi-pond zone
- 3** 湖畔活动草地  
Lakefront event lawn
- 4** 人行景观桥  
Pedestrian landscape bridge
- 5** 南码头  
South pier
- 6** 瓜洲溪  
The Guazhou Stream
- 7** 堤顶主绿道  
Levee-top primary greenway
- 8** 自然探索区  
Nature exploration zone
- 9** 绿连桥 / 功能建筑  
Bridge / service room
- 10** 隧道管理用房  
Tunnel management center

- 11** 地景艺术户外休闲区  
Land art zone
- 12** 排水设施用地  
Drainage facility
- 13** 16米标高水流通  
16-meter-elevation artificial channel
- 14** 15米标高水流通  
15-meter-elevation artificial channel
- 15** 14米标高水流通  
14-meter-elevation artificial channel
- 16** 江中岛  
River central shoal
- 17** 江底岛  
Submerged river shoal
- 18** 人行景观桥  
Pedestrian landscape bridge

- 海绵城市示范段**  
Sponge City Demonstration Area
- 1** 海绵城市体验馆  
Sponge City Academy
  - 2** 绿波儿童地景区  
Green Wave Playground
  - 3** 雨水花廊广场  
Rainwater garden square
  - 4** 运动+音乐多功能草地  
Multi-functional lawn for sports and performance
  - 5** 堤顶主绿道  
Levee-top primary greenway
  - 6** 净水草波台地  
Water filtration terrace
  - 7** 滨水主步道  
Waterfront path

- 亲水广场段**  
Waterfront Plaza
- 8** 儒乐S湾中心码头  
Central pier
  - 9** 游客中心  
Visitor center
  - 10** 梅岭轴线花廊  
The Meiling Axis Flower Corridor
  - 11** 特色S回廊  
Serpentine Corridor
  - 12** 江雾水镜广场  
Fog Mirror Plaza
  - 13** 乐活美食花海区  
Fun-food-flower zone
  - 14** 流水挑台  
Water terrace
  - 15** 都会水梯剧场  
Water amphitheater
  - 16** 城市溪流区  
City stream zone
  - 17** 季节溪流区  
Seasonal stream zone

- 一线廊**  
Water View Corridor
- 1** 两水观景台 / 水闸  
River-lake viewing deck / the dam of Rule Lake
  - 2** 湖江立体绿道  
River-lake 3D greenway
  - 3** 堤顶主绿道  
Levee-top primary greenway
  - 4** 赣江游船码头 / 游客中心  
The Ganjiang River ferry pier / visitor center
  - 5** 下沉连廊公园  
Sunken corridor park
  - 6** 儿童体验馆  
Children Exploratorium
  - 7** 湖滨码头  
Lakeside pier
  - 8** 生态净水绿地  
Ecological water purification lawn
  - 9** 滨江步道 / 栈道  
Riverfront path / boardwalk

- 活力沙滩**  
Urban Beach
- 10** 活动大沙滩  
Grand activity beach
  - 11** 泛舟沙滩  
Boating beach
  - 12** 生态河滩  
Ecological river beach
  - 13** 亲水坝  
Waterview wing dike
  - 14** 景观天桥  
Landscape sky bridge
  - 15** 沙滩平台  
Beach deck
  - 16** 向阳草坡  
Sunshine lawn
  - 17** 望江台  
River viewing deck
  - 18** 林荫花园  
Bower garden



## 4 总结与反思

基于自然的解决方案的核心价值在于运用科技手段重新了解自然系统的力量，引导自然力量做功。在本项目中，面对航道运输、防洪安全、公众教育、休闲游憩等诸多挑战和诉求，设计师不仅需要理解场地的自然属性，也需要掌握河流对人工干预的动态响应机制，才能最终提出以河流自然演变规律为核心的规划方案。

项目运用创新的设计方法回应了以下挑战：1) 将人造堤坝转化为“有生命”的生态堤岸，为形式单调、生硬的人造基础设施赋予更多富有活力的景观元素；2) 通过人工干预复育受损的沙洲边滩，提高滨江地带的可达性；3) 顺应自然，根据场地自然条件划分公园功能区，在不被洪水侵扰的堤内满足休闲游憩需求，并结合自然地形实现雨洪管理功能，同时对受季节和水位波动影响较大的堤外区域进行适度干预，借助河滩形态发育规律，推动河流的自我修复。该设计使儒乐湖新城在面对自然灾害时更具韧性，而场地极具特色的自然属性也将成为新城独一无二的名片（图16）。

由于设计周期较短，生态丁坝对研究河段对岸及场地周边行政区赣江河段的水文影响还有待进一步论证。此外，方案未来的落地实施还有赖于河流生态监测和评估系统的建立。设计团队希望未来有更多利益相关方能够参与到项目中，并与他们建立更长期的跨专业协作关系，以进一步检验设计方法、优化设计策略与实施步骤，从而使基于自然的解决方案这一规划理念真正落地。LAF

### 致谢

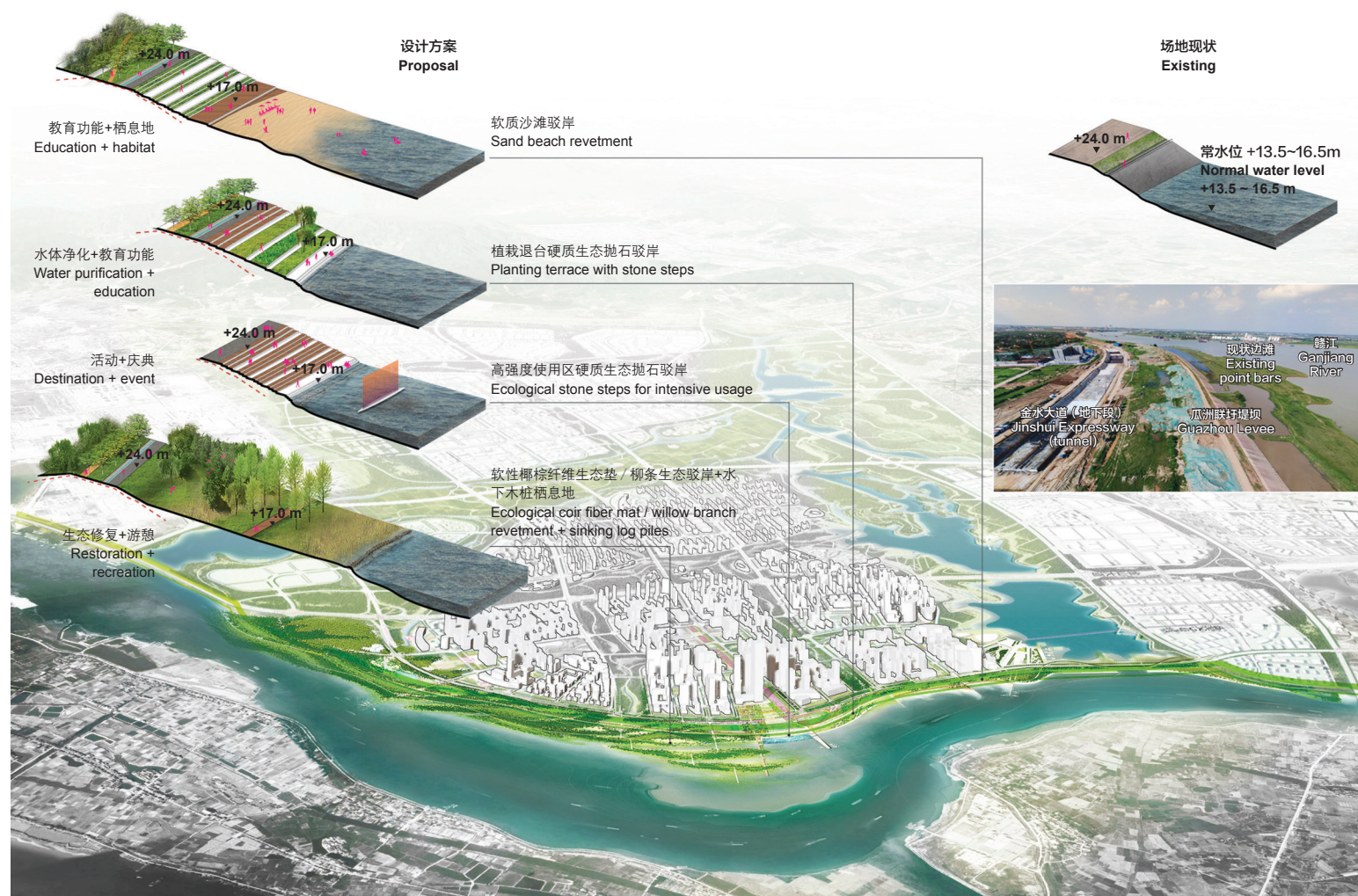
感谢南昌国家经济技术开发区管理委员会的胡远征、邹梦远为项目提供的帮助。

### 项目信息

项目地址：江西省南昌市儒乐湖新城  
项目面积：13.9hm<sup>2</sup>  
项目委托：南昌国家经济技术开发区管理委员会  
景观设计：SWA集团  
首席设计师：李慧琳  
设计团队：张楚晗，邵宇洲，马小萌，詹修贤  
设计时间：2018年8-12月  
所获奖项：2019ASLA北加州分会分析和规划类荣誉奖

10. 多样化的岸线类型

10. Diversified shoreline typologies



## 1 Background

As one of the main tributaries of the Yangtze River and the largest river in Jiangxi Province, China, the Ganjiang River plays a significant role in promoting transportation and economic development along the regions it passes through. Located in Rule Lake New Town that sits in the core launching area of Ganjiang New District, Jiangxi Province, this project envisions an about 6-kilometer-long riverfront park, covering nearly 14 hm<sup>2</sup>, as one of the most important waterfront spaces of the new town, which had been reserved thanks to the master planning of Rule Lake New Town completed in 2016: According to SWA Group's proposal, the planning proposal changed part of the originally planned Jinshui Expressway into an underground tunnel to conserve a piece of land connecting nearly 20 planned streets for potential linkage between the new town and the waterfront. In 2018, SWA Group was commissioned again by the local government to formulate a comprehensive masterplan for ecological restoration and landscape improvement of the riverfront park (Fig. 1).

Significant water level variation is one of the most important driving forces for the channel evolution of the Ganjiang River watershed (Fig. 2). Notably, this evolution is especially complex in the middle-lower reaches of the main tributary in the downstream of the Ganjiang River, north to Nanchang City, due to water-sediment movement, deltaic deposition of Poyang Lake, and human activities<sup>[1]</sup>. Historically, various measures have been taken on the river for urban development and flood control, including levee and wing dike building, tributary blocking, sand excavation, and waterway management (Fig. 3), directly or indirectly disturbing the natural evolution of river geomorphology and destroying local ecological environment and biodiversity<sup>[2][3]</sup>.

## 2 Current Problems and Design Goals

The current status of middle-lower reaches of the Ganjiang River is shaped by the water level variation, water-sediment movements, river management and development activities together, while its future relationship with the cities along and people living there could be found in the urban development vein. Therefore, the design team conducted a systematic analysis of the river morphology evolution, as well as the impacts of human governance and economic activities on the river, so as to reveal site's major problems and influence factors, and provide theoretical basis and strategic guidance for subsequent design.

### 2.1 Analysis of River Evolution Process

Through site surveys and regional geographic data review, the

design team found that the middle-lower reaches of the Ganjiang River was more influenced by the natural deposition process within the Poyang Lake delta instead of human intervention before 1989, when the water flow was gentle and the river bank was mainly composed of sandy soil. Generally, the water velocity is faster along the concave bank, resulting in severe erosion on the shoreline, while point bars gradually formed at the convex bank out of heavy sedimentation brought by much slower flows<sup>[4][5]</sup>, creating an S-shaped channel along the site, which is a very typical geomorphology in the middle-lower reaches of the Ganjiang River; however, such a meandering channel has been gradually straightened, even almost erased by human interventions in recent decades. In response, the design team analyzed the evolution of the riverbed based on remote sensing images throughout different historical periods, as well as the changes of the shoreline at different water levels, in order to rebuild the future relationship between the site and the river.

Taking 16.5 m (the average water level of the Nanchang Waizhou Hydrometric Station on the Ganjiang River) as the benchmark, it can be seen from the Landsat-5 TM satellite images that the shoreline did not evolve much between 1991 and 2001, and there was an arc-shaped natural point bar parallel to the convex bank; from 2001 to 2009, the shoreline moved downstream and a central shoal evolved out of the point bar<sup>[6]</sup> (Fig. 4).

Comparing Landsat-7 ETM+ and Landsat-8 satellite images of the dry seasons from 1996 to 2019, it can be seen that the shoreline has moved downstream greatly, while the point bars and the central shoal have gradually shrunk<sup>[7]</sup> since 2010. As shown in the satellite image of the dry season in 2019, the convex bank had been encroached by sand-mining pits and ponds and the upstream end of the central shoal had almost disappeared (Fig. 5).

According to data in literature, during 1965 to 2015, the annual maximum water level of the Ganjiang River ranged from 18.45 m to 25.60 m, while the annual minimum water level ranged between 11.50 m and 17.17 m; the average water level varied from 14.83 m to 19.63 m, and the maximum of interannual water level variation is 14.10 m (Fig. 6). The annual average water level shows a downward trend over the years, and the most significant decline happened in 1998 ~ 2011<sup>[8]</sup>. Combined with the evolution of the river morphology, it is concluded that the water level decline goes along with the shrinking of point bars along the site.

### 2.2 Review on Human Interventions

Afterwards, in order to find out the reasons of the evolution mentioned above and the key problems need to be addressed in this project, the design team reviewed the major human interventions on the river in the past two decades, and attempted

to reveal their relations with the evolution timeline of the river's hydrological characteristics (Fig. 7).

Before 1989, human interventions had minor influence on the river. However, due to the river closure of the Wan'an Hydro Project in 1990, the sediment discharge in the lower reaches of the Ganjiang River decreased, resulting in severer erosion and down-cutting of the riverbed and even impacting river channel along Nanchang City till 2000<sup>[6]</sup>. Since 2001, illegal sand excavation had spread along the Ganjiang River, causing extensive decline of natural sandbars across the watershed, especially around the Guazhou Village, Lehua Town near the site, where the widest sandbar had shrunk from about 990 meters to 310 meters from 1990 to 2019. As a result, river ecosystems were damaged, and shorelines and levees became more vulnerable during floods<sup>[9]</sup>. Such illegal exploitation has not been curbed until 2011<sup>[6]</sup>.

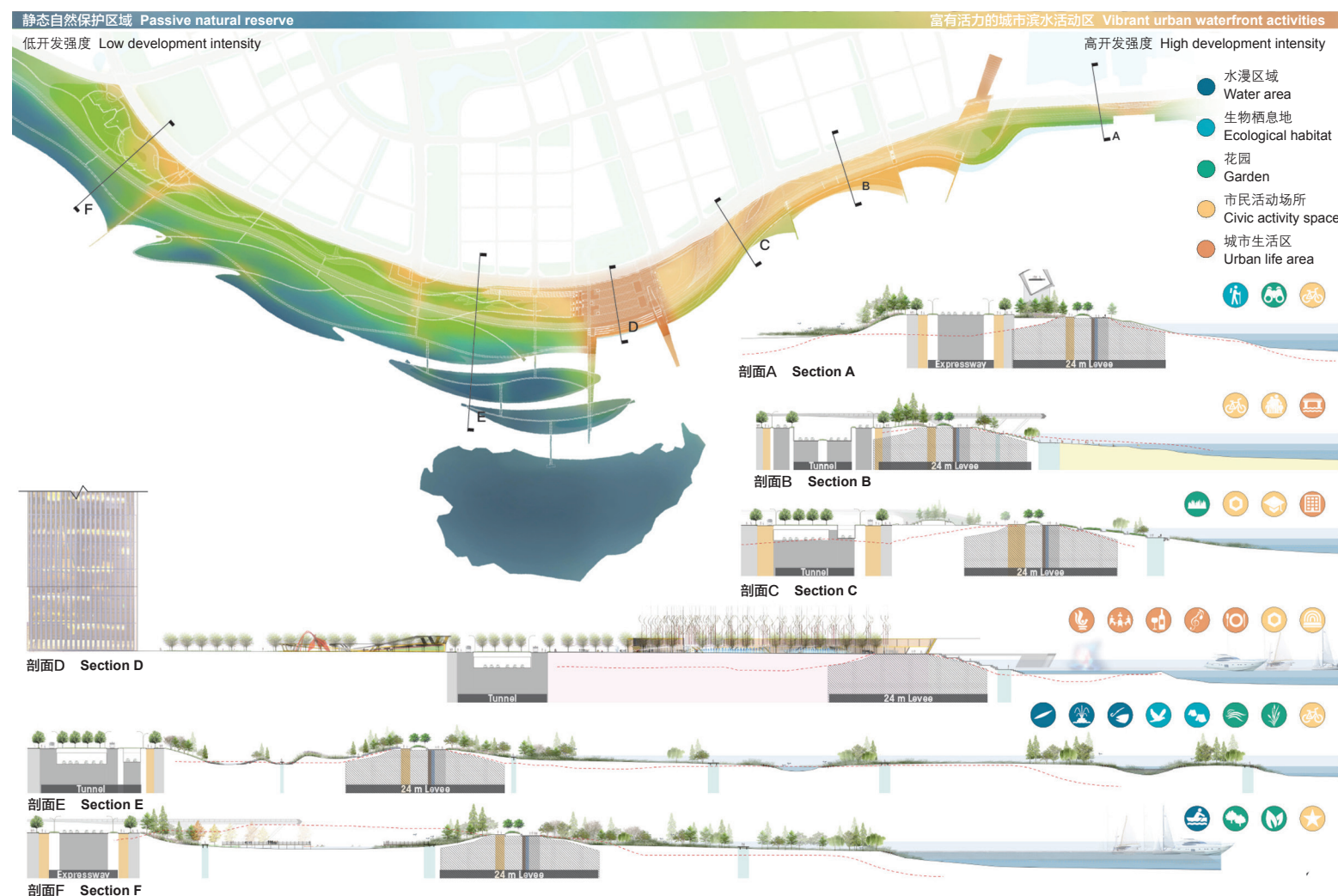
In 2012, the original Guazhou Levee was heightened and reinforced to meet a higher standard for flood prevention<sup>[10]</sup>.

Although it could resist a 50-year flood with a designed elevation of 24.0 meters, the new levee, 24-meter-wide on the top, failed to provide good landscape and caused habitat degeneration due to the application of concrete revetment, which not only cut off the interactions between the land and the river, but also lowered the water retention capacity with faster water discharge rate within the river watershed<sup>[11]</sup>.

To conclude, the river segment along the site has suffered from human interventions during the past 30 years. Influenced by human activities, surface runoff in point bars increased, washing away sediments from the bank through new channels between point bars and pits and ponds caused by sand excavation. As a result, the original convex bank of the S-shaped shoreline gradually became fragmented then disappeared.

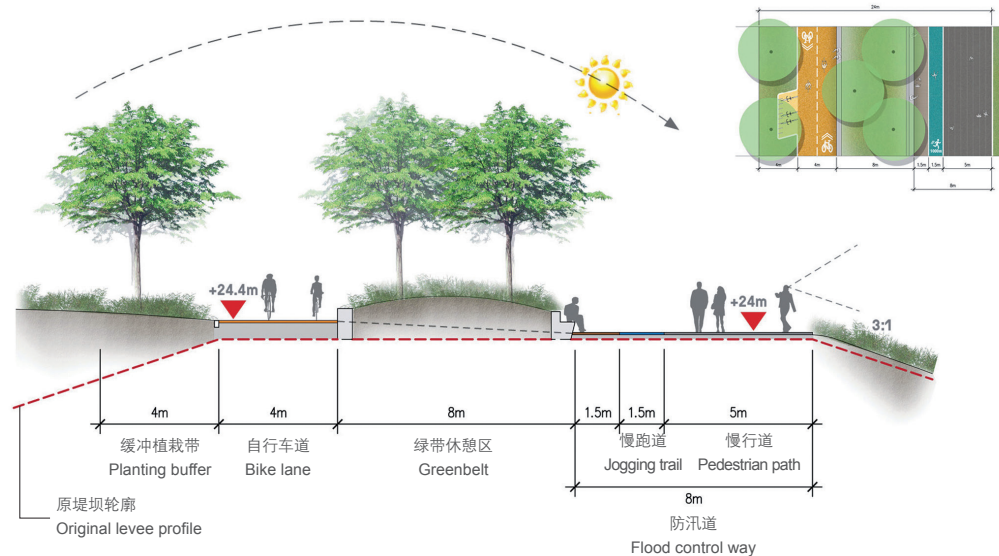
Besides, it is worth to note that there is a wing dike at the turning of the convex bank. It was built as a temporary assistant facility during the reinforcement of the Guazhou Levee. The wing

11. 不同形式岸线的横剖面设计与不同的滨河开发类型及强度相适应
11. Different shoreline cross sections along the river for a rich programmatic tapestry with varying development intensities





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12-1



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12-2

12. 防洪大堤转变为全景廊道

12. The redesigned levee providing panoramic view to the river

dike is usually used for optimizing the flow field distribution and riverbed forms for shipping; if being located suitably, it can also create a recirculation zone in the downstream, where the flow conditions are favorable for rehabilitating aquatic habitats to compensate the ecological damages in the upstream<sup>[12]</sup>. According to the satellite map, this 300-meter-long wing dike has helped re-establish the floodplain since its completion in 2012, showing great potential for ecological restoration and landscape improvement in this project.

### 2.3 Design Objective: To Rehabilitate the S-Shaped River Morphology

As above, this project aims to restore the natural S-shaped morphology of the river along the site. The critical approaches include 1) mitigate or curb the erosion caused by pits and ponds and new channels left by sand excavation through proper ecological technologies and land preparation strategies; 2) rehabilitate the typical features (like point bars and central shoals) of the original S-shaped river by taking advantage of the natural scour-and-fill process; and 3) improve the ecological performance and landscape quality of the levee with diverse landscape design strategies while meeting flood control needs.

### 3 A Nature-Based Solution: The S River Park on the Living Shoreline of the Gangjiang River

Featured with the typical S-shaped river channel, the project is named as S River Park in the expectation for a resilient coexistence of the new town and the river through a nature-based planning approach (Fig. 8).

#### 3.1 Nature-Based Land Preparation Strategies

Based on the analyses on the evolvement of river landform above, the scope of riverbank and vegetation protection was determined. Then, combined with the site's natural conditions and the new town's master planning, the design team proposed the park's program zones according to development suitability and intensity, and further developed following land preparation strategies and implementation steps:

1) First, simulate boundaries of the point bars under different water levels according to historical images, and identify the restoration extent of point bars at the convex bank. Then, establish new wing dikes at the suitable locations to repair the shoreline from existing pits and ponds, restoring scroll bars and reinforcing channels between them at different elevations, thus allowing for spontaneous revival of the points bars. As a result, the meandering river with diverse shoreline habitats would be restored, providing



13. 海绵城市示范区

13. The demonstration area of the sponge city construction

attractive riverfront for the new town;

2) Second, for areas inside the levee, preserve the existing wetlands, ponds and vegetation around in the Guazhou Village, transforming them into rain gardens as part of a new green infrastructure for stormwater management, and create gentle landforms through which the surface runoff could flow into the green infrastructure, then get filtered and recharge groundwater;

3) Finally, mitigate the gap created by the elevation difference between the levee top and the roads nearby and increase the diversity of shoreline topologies, providing different and resilient shoreline landscapes adaptive to varying water level scenarios of the Ganjiang River (Fig. 9).

### 3.2 From the Artificial Levee to the Living Shoreline

The levee is an important transitional zone between territorial and aquatic environments, critically influencing the ecological performance of a river ecosystem. Therefore, this project attempts to convert the monotonous concrete levee into a vibrant and permeable shoreline, which can restore riparian ecological habitats by helping mitigate the erosion and remediate the disappearing sandbars.

Porous natural materials are used to establish diverse shoreline typologies, and different materials are applied at different river segments according to water velocity and force, e.g., gabions, ecological coir fiber mats, willow branches and sinking log piles, and planters of emerging aquatic plants—These help make the shorelines more adaptive to various erosion intensities by creating dynamic environment in the river, and convert the impervious riverbank into a natural shoreline, providing habitats for living creatures and quality recreational space for local residents (Fig. 10).

Then, different forms of shoreline are proposed based on the elevation difference between the levee and the river, such as gentle landforms, planting terraces, and gabion steps. A vibrant interface is created, not only connecting urban built area to the river but also providing protection against 50-year floods (Fig. 11).

The design team proposed to build a double-layer greenway system on the 24-meter-high levee to make full use of the spectacular view to the river on its top: the greenway system, consisting of different corridors for cyclists, joggers, and pedestrians, would create various experience from quick passing through to promenade; the elevation differences between them can provide space for greenbelt with tree groves, not only solving the

problem of soil depth shortage on the levee top but also creating more shadows and enriching visitors' spatial experience in a pleasant micro-climate (Fig. 12).

### 3.3 Program Zoning of the Park based on the River's Natural Morphology

In the natural circumstance without much human intervention, intensive river erosion in the north of the site creates a steep concave bank, shortening the distance between the shoreline and the levee, while large amounts of sediments accumulate at the convex bank in the south, forming flat and broad fan-shaped point bars. Combining this natural law with the regulations on the development intensity and land use in the master planning of Rule Lake New Town, the S River Park is divided into 3 program zones from north to south: the River-Lake Waterfront Zone, the Central River Harbor Zone, and the Living Oasis Wetland Zone.

#### 3.3.1 The River-Lake Waterfront Zone

Influenced by the dam of Rule Lake nearby, the existing shoreline at northern stretch of the park has gone through gradual ecological deterioration; besides, severe erosion on the concave bank has resulted in dramatic drop between top of the levee and water level, making the bank extremely prone to collapse. In response, the design team proposed to preserve the existing

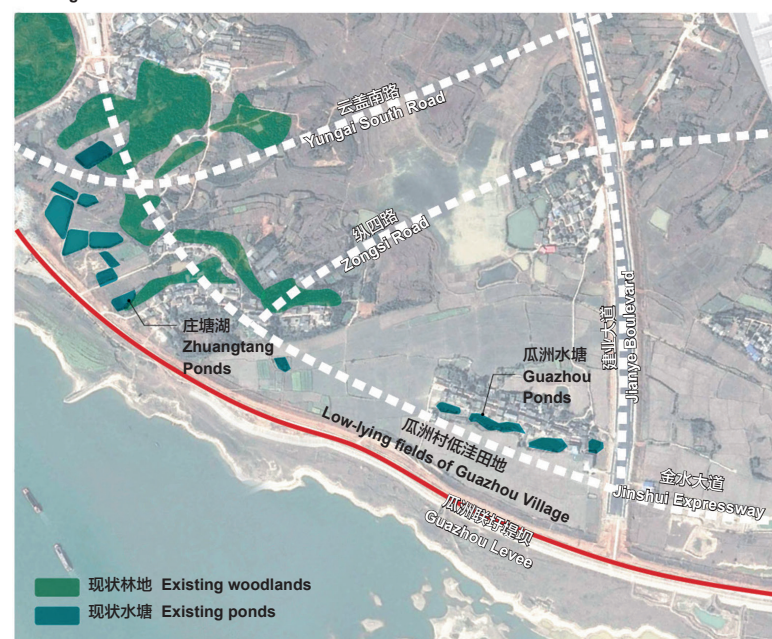
vegetation and riverbank, and establish ecological wing dikes to promote sand deposits in between. In this way, new point bars will emerge as soft shoreline, and bank erosion will be mitigated while the elevation drop can be reduced. Aligned with urban street grid, the wing dikes will also increase access to waterfront for citizens.

To better serve the adjacent planned Culture and Health Zone, a new floating bridge with boating pier is proposed at the north end of the zone. The wing dikes and the bridge help divide the emerging point bars into 3 relatively independent subzones from north to south, serving boating, waterfront recreation, and ecological habitat restoration, and the revetments are made of different materials to fit various program functions.

#### 3.3.2 The Central River Harbor Zone

Sitting beside the planned central business district and an over 200-meter-high landmark building, the middle segment of the S River Park is positioned as a major icon and an important venue for education, civic activities and events to serve the intensive development along the riverfront of the new town. Thanks to the proposal of transforming the Jinshui Expressway into an underground tunnel, convenient pedestrian access to the riverfront has been reserved, and recreational and ecological amenities such as tour bus lanes, greenway corridors, and grove

现状图  
Existing



设计平面  
Proposal



buffers will be provided as well: inside the levee, a demonstration area for sponge city vision would be established to convey the “sponge” concept through a series of educational units, showing the collection, purification, retention, and infiltration process of stormwater management; outside the levee, to mitigate the impacts of the existing water conservancy facilities (a pump station and a sluice for flood discharge) on the end of two planned streets, the design team proposed to combine them into two ecological trestles—one leads to the largest cruise pier of the park, and the other one serves as a fishing corridor to the restored central shoal in the river. In the future, citizens would enjoy the harbor as a landscape base for the skyline of the central business district, as well as a place for various festival events. Processes of how water get purified through the underwater biofilm grilles beneath the trestles can be showcased at the same time (Fig. 13).

### 3.3.3 The Living Oasis Wetland Zone

The south part of the park used to see intensive sand excavation and suffered from serious loss of natural point bar habitats, the recovery of which then becomes the core design goal for this zone and requires wing dikes building, scroll sandbars restoration, soil ecological remediation, and plant community re-establishment. Based on the analyses of the historical river landform and simulations of the shoreline boundary at different water levels in natural state, the design team determined the extent of point bar restoration, then proposed to create artificial channels with elevations of 16 m, 15 m, and 14 m through wing dikes and ecological revetments, thus re-introducing the natural process of flooding and deposition to help restore 3 groups of sandbars including the existing central shoal. The periodical nutrients convey onto the sandbars can prepare a fertile base for aquatic plant communities that can reinforce the sandbars in turn. Besides, a varying recreation program intensity from active to passive is proposed from city to river, in response to water level change of the Ganjiang River and the dynamic waterfront accessibility.

There are abundant woodlands, ponds, and wetlands in the broad hinterland within this zone, the elevation of which, however, is much lower than those of the adjacent planned streets. In response, the design team proposed to reshape the landform into a series of landscape terraces to connect this well-preserved native green with the area beyond the levee, and planned an ecological stream valley to connect the existing fragmented water bodies such as the Zhuangtang Ponds and the Guazhou Ponds (Fig. 14) as a stormwater retention system, thus to make this zone a green hub in the south gateway of the new town (Fig. 15).

## 4 Reviews and Reflections

The core value of the nature-based solutions lies in that they take advantage of science and technologies to re-discover the power of natural systems and direct it to fully function. In this project, it is the designer’s deep understanding of the site’s natural conditions and the river’s dynamic responsive mechanism to human interventions that leads to the final planning proposal based on natural river evolution, which meets needs of water transportation, flood control, public education, and leisure and recreation at the same time.

With innovative design approaches, this project mainly attempts to 1) transform an artificial concrete levee into an ecological shoreline with vibrant landscape; 2) restore the deteriorated sandbars and enhance the accessibility of the riverfront park by reasonable human interventions; and 3) apply rational zoning to the park according to various natural conditions on the site, realizing recreation and stormwater management in the city side the levee while catalyzing the self-healing process of the shoreline based on natural laws in the river side. By retrieving the typical river morphology, the Rule Lake New Town is expected to be more resilient to natural disasters, and the S River Park will be able to exemplify itself through the nature-based design solutions (Fig. 16).

However, more assessments are needed to demonstrate how the wing dikes would impact the hydrological conditions of the opposite riverbank of the site and other surrounding regions along

15. 丁坝景观桥

15. A wing dike extension serving as the landscape bridge



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16. “S湾”活水公园缝合了城市与水岸。

16. The “S River Park on the Living Shoreline” stitches the city and the riverfront.



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the Ganjiang River. The implementation of the proposal also requires a complete monitoring and evaluating system for the river ecology. The design team hopes to engage more stakeholders in the future stages of this project for transdisciplinary collaboration in a long term, so as to further examine the design methods, optimize the design strategies and implementation agenda, and truly realize this nature-based solution. **LAF**

#### ACKNOWLEDGMENTS

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#### PROJECT INFORMATION

**LOCATION:** Rule Lake New Town, Nanchang City, Jiangxi Province, China

**AREA (SIZE):** 13.9 hm<sup>2</sup>

**CLIENT:** Administrative Committee of the Nanchang National Economic and Technological Development District

**LANDSCAPE DESIGN:** SWA Group

**CHIEF DESIGNER:** Hui-Li Lee

**PROJECT TEAM:** Zhang Chuhan, Shao Yuzhou, Ma Xiaomeng, Zhan Xiuxian

**DESIGN PERIOD:** August – December, 2018

**AWARD:** 2019 ASLA North California Chapter Honor Award of Planning and Analysis Category

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