



Fig. 1 Aerial view of the completed campus.

A Landscape–Hydrology-Driven Strategy for Flood Management and Ecological Integration on a University Campus

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FEATURES

Sponge City; Flood; Mountainous Area; Landscape Hydrology; Stormwater Management; Resilient Landscape; Campus

PRACTICE REFLECTIONS

- The core challenge of such projects lies in balancing flood safety, ecological

performance, and everyday use under high-intensity development conditions

- By coordinating distributed LID systems with a central detention framework, the project addresses system stability under extreme rainfall events
- Prioritizing hydrological logic in spatial organization is a key strategy for enhancing campus resilience and long-term climate adaptability

1 Site Context

Against the intertwined backdrop of the global climate crisis and rapid urbanization, campus planning models dominated by grey infrastructure have been proven increasingly insufficient in addressing frequent extreme weather events and ecological fragmentation. Reframing hydrological systems—from singular tools

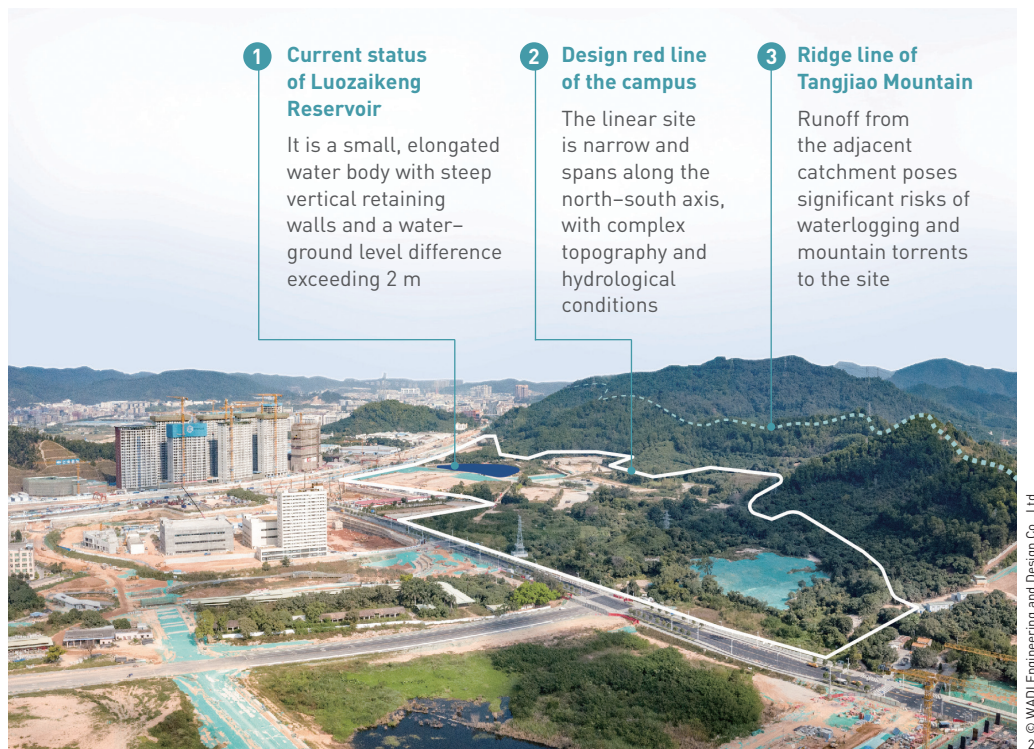


Fig. 2 Site conditions before development.

for flood control or drainage into drivers of ecological connectivity, spatial innovation, and campus culture—has become a frontier issue in sustainable university campus development.

The main campus of Shenzhen University of Advanced Technology is located in the upper reaches of the Maozhou River, at the boundary between Guangming District, Shenzhen City, and Dongguan City, covering approximately 56 hm². Bordered by Tangjiao Mountain to the east, the site is highly ecologically sensitive. The Luozaikeng Reservoir (1.8 hm²) constructed in 1966 is situated in the northern part of the site. Originally serving agricultural irrigation and flood control, the reservoir has functioned solely for flood control since 2019 following urban development.

Recognizing the reservoir as the core hydrological element, the design team adopted a “One Water” strategy to integrate the campus with surrounding natural and urban ecological systems. After two years of

iterative design development, the reservoir was transformed into a central detention water system aligned with the campus axis. Through ecological catchment corridors, it establishes seamless hydrological and ecological connections between the surrounding mountains and the campus, forming a continuous blue-green framework. Elements like ecological creeks, lakeside running trails, green roofs, and distributed low impact development (LID) facilities are interwoven throughout the campus, creating a multilayered landscape experience.

2 Overall Design Strategies

While largely preserving the original topographic runoff patterns of the mountainous terrain, the campus is organized into six compact, mixed-use block clusters. Each cluster features shallow, distributed LID systems. These are linked by inter-block corridors and a central

detention lake into a multi-tiered water system that can respond to extreme rainfall and mountain flood risks.

Located in the Pearl River Delta, the campus lies within a region characterized by frequent intense rainfall events. During the flood season (April to September), short-duration high-intensity storms are frequent, often resulting in rapid flood surges. Coordinated with the campus master plan, the original reservoir was expanded to 2.5 hm² at normal water level and 3.5 hm² at flood level, with the contributing catchment area increased to 48.3 hm² to accommodate additional on-campus runoff. Under extreme rainfall conditions, the available detention capacity was increased from 20,000 m³ to 42,500 m³, and the flood protection standard was upgraded from a 20-year to a 100-year return period. Overflow channels were installed on both the northern and southern sides of the lake, reducing downstream discharge rates compared with existing conditions and significantly alleviating downstream flood pressure.

3 Landscape-Based Hydrological System Construction

3.1 Distributed LID Systems

With the objectives of reducing downstream flood peaks and achieving zero surface flooding on site, a multi-level resilient hydrological system integrating grey and green infrastructure was established to balance hydrological regulation and landscape performance. The campus was divided into 17 independently drained sponge units, where most stormwater runoff is managed locally through rain gardens, permeable pavements, infiltration-drainage sunken green spaces, infiltration swales, and wet ponds. After attenuation and purification, runoff is conveyed into the central

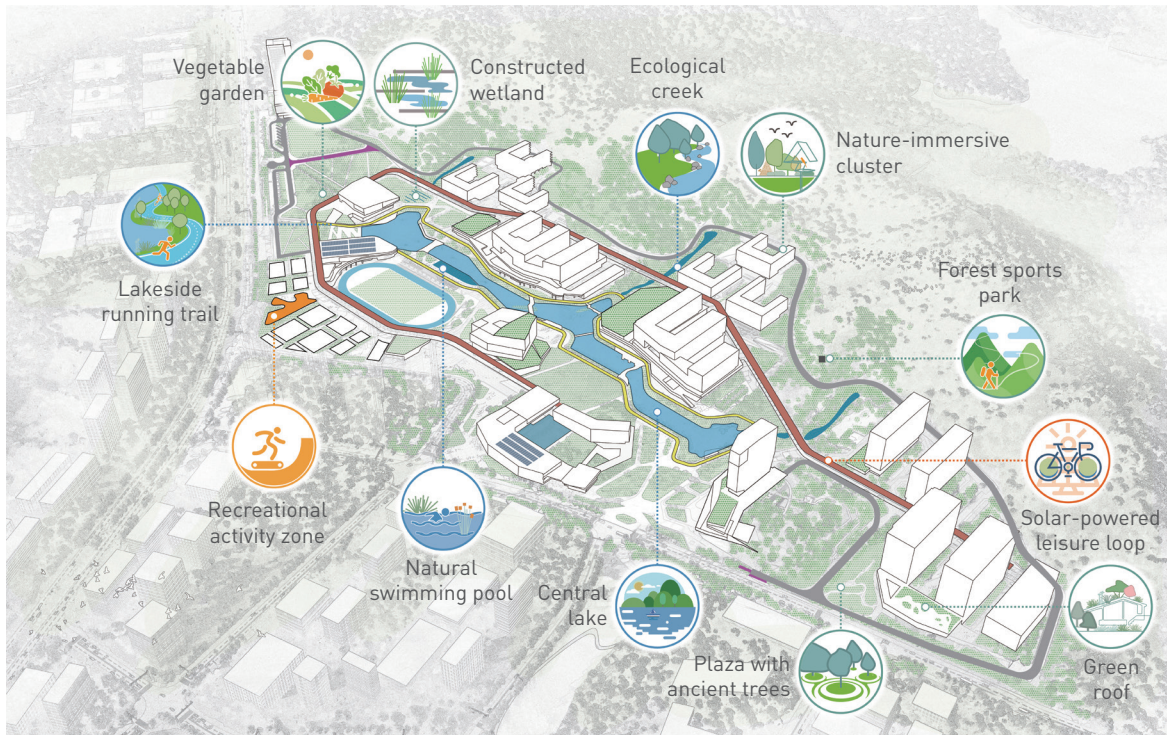


Fig. 3 Conceptual diagram of the site.

Fig. 4 Integrated water management strategies in the site.

detention lake via three dry creek corridors and eight lakeside stormwater outlets.

Based on the short-duration rainfall data of Shenzhen, existing drainage network information, and a digital elevation model, EPA-SWMM was used to simulate the performance of the LID measures and drainage systems in the site. The results indicate that the annual runoff volume control rate exceeds 73%, while the removal

rate of non-point source pollutants is greater than 45%, meeting local sponge city implementation requirements.

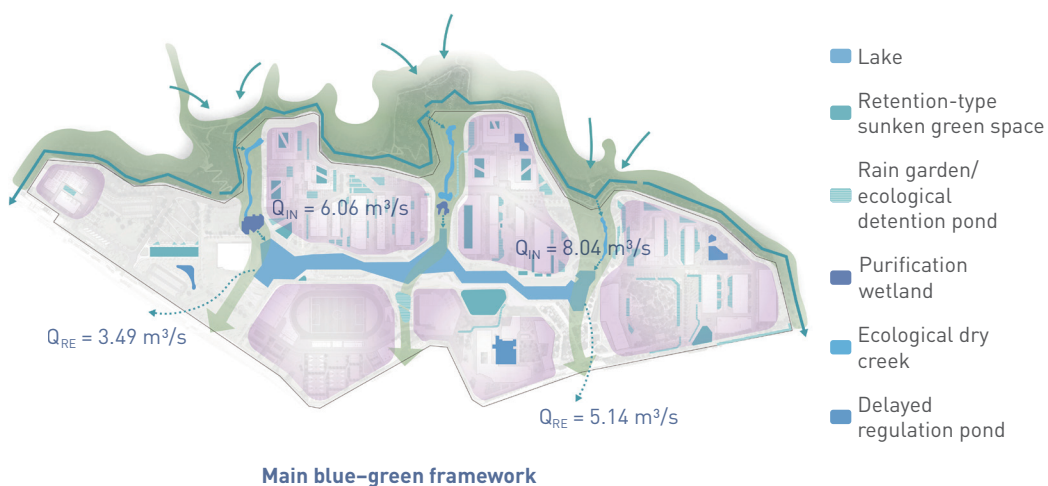
3.2 Mountain Flood Drainage Channels and Dry Creek Corridors

Mountain flood drainage channels with a total length of 2.73 km were constructed to a 100-year return period standard, with widths ranging from 1.0 m to 2.3 m,

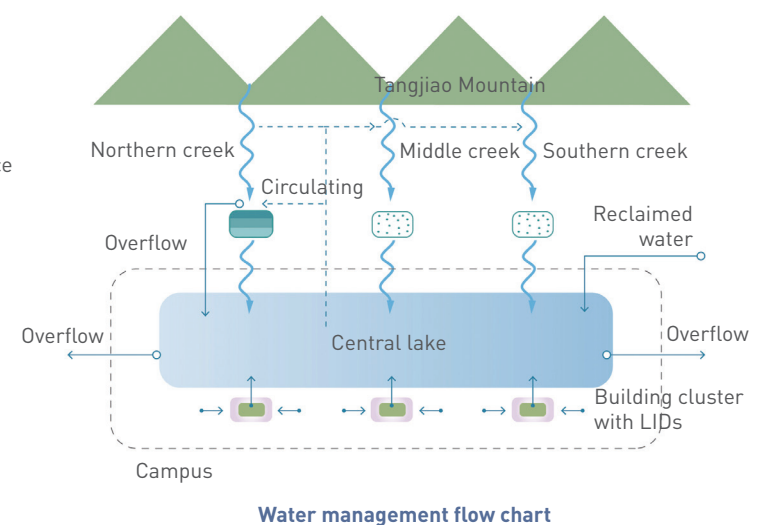
depths from 0.6 m to 1.2 m, and an average longitudinal slope of approximately 5‰. External mountain runoff is intercepted by hillside diversion channels and directed into dry creek corridors, where it passes through a sedimentation and surface-flow wetland system before entering the central lake. In addition to ensuring flood conveyance safety, the three dry creek corridors function as continuous open spaces and ecological corridors linking the surrounding forest parks with the campus ecological network, providing habitat and refuge for wildlife.

3.3 Central Lake System and Resilient Waterfronts

Based on catchment zoning and the elevation difference between the northern and southern campus areas, the central lake system is divided into a north lake and a south lake, connected by a flow-through weir. The storage volume between the normal water level and the overflow level is allocated for rainwater harvesting and reuse, while the volume between the overflow level and the 100-year flood level is designed for peak attenuation and controlled discharge, incorporating floodable waterfront platforms. Detention calculations were performed using the water level-storage curve and the water



Main blue-green framework



Water management flow chart

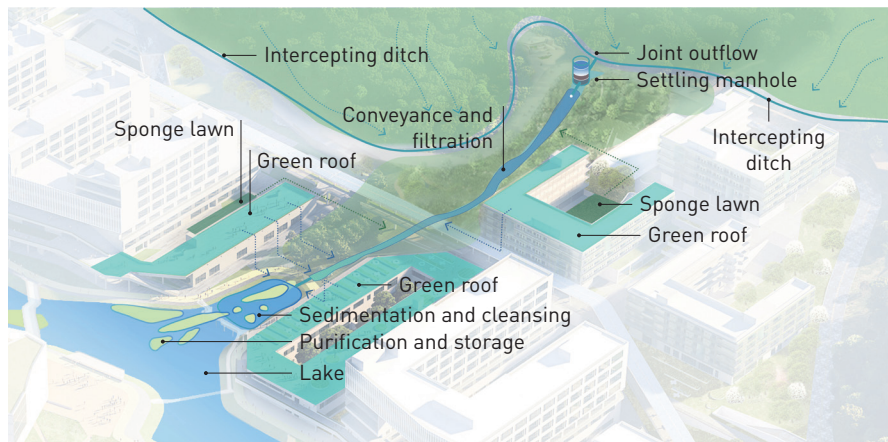


Fig. 5 Water management diagram of corridors in the central section.
Fig. 6 Completed dry creek landscape.

level-discharge relationship to ensure compatibility between water supply regulation and daily use. The north lake focuses on waterfront recreation and water sports, while the south lake prioritizes habitat creation and water accessibility, supported by 12 waterfront nodes offering diverse shoreline typologies and user experiences.

3.4 Water Quantity and Quality Management

Daily water balance calculations were conducted to assess rainwater harvesting and reuse efficiency. The results show that more than 90% of the lake's annual replenishment is derived from rainwater, with an average annual reuse volume of approximately 72,000 m³, substantially

reducing dependence on municipal water supply. To ensure long-term water quality stability, an underground integrated circulation pumping station was installed on the western side of the central lake, diverting lake water to a 1,680 m² constructed wetland for purification at a flow rate of approximately 200 m³/h. In addition, floating ecological islands (1,265 m²) and in-situ submerged-plant purification wetlands (9,985 m²) were implemented to collectively maintain surface water quality at the Class III standard.

3.5 Nature-Inclusive Habitat Creation

Existing native vegetation communities were preserved and enhanced, while diverse microhabitats were created through the incorporation of shoreline deadwood, bird

islands, and gravel shoals. Building upon this foundation, a "Nature-Inclusive" design approach was adopted by integrating habitat and nesting facilities within green corridors and building interfaces. These measures provide suitable refuges for birds, insects, and other species, supporting the long-term restoration of the campus ecological network.

4 Project Reflections

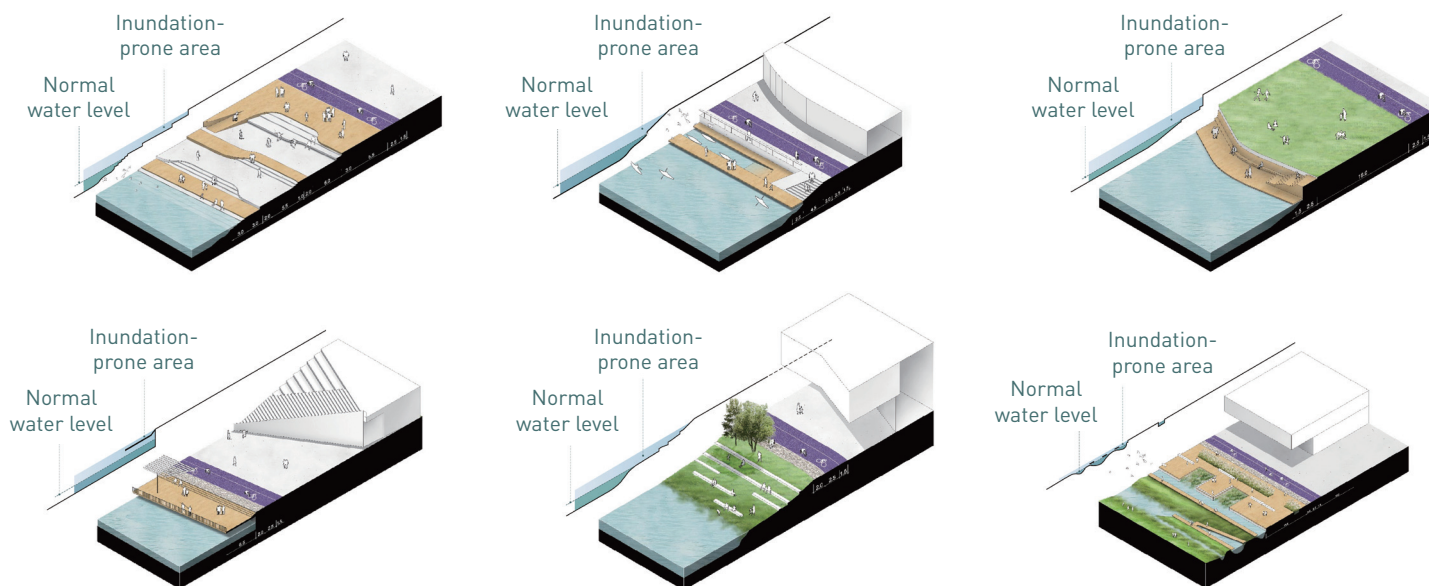
Supported by an innovative water management strategy, the green infrastructure system of the campus has evolved from a mono-functional spatial configuration into a multifunctional system that integrates public use with watershed-scale detention capacity, demonstrating a landscape-hydrology-driven approach to spatial organization.

University campuses in China have traditionally been characterized by enclosed management and functional self-containment, often exhibiting limited integration with urban water systems



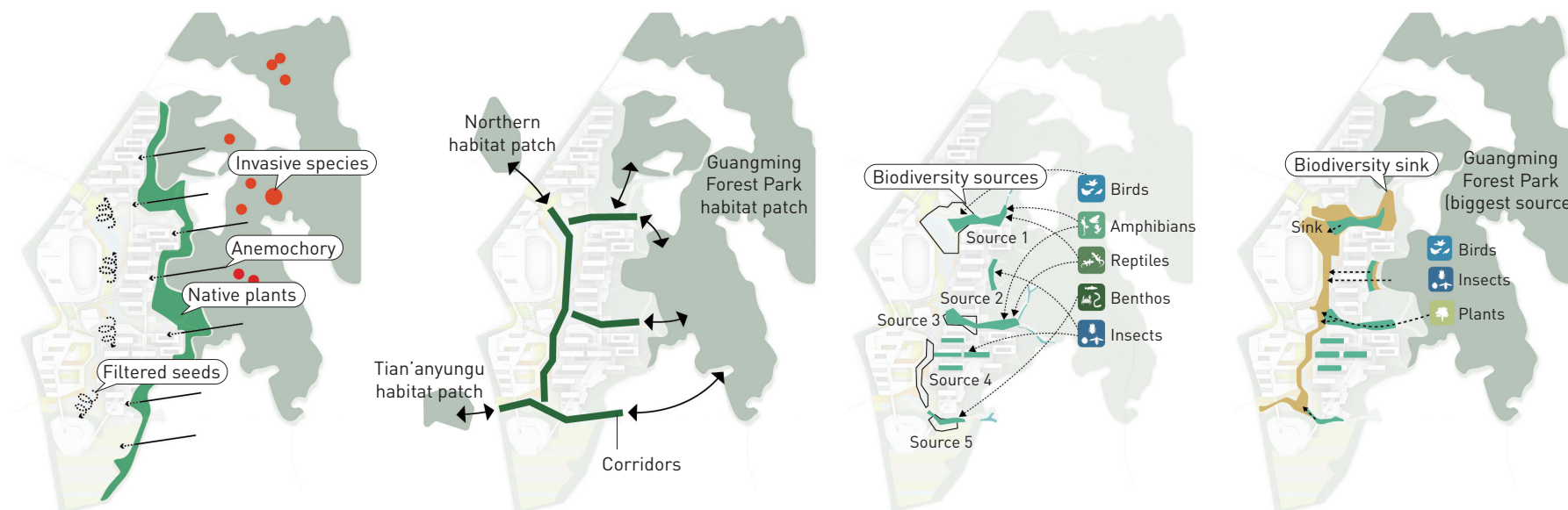
Fig. 7 Completed lake landscape.

Fig. 8 The flow-through weir regulates water exchange and maintains designated water levels between the north and south lakes, while also serving as an overflow structure to manage extreme flood events.



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Fig. 9 Resilient lake shoreline design.
Fig. 10 The Nature-Inclusive strategy restores and connects habitats through invasive species control, ecological corridors, and source-sink spatial design to support urban biodiversity.



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and public space networks. As the sharing of urban resources becomes increasingly emphasized, campuses with sufficient spatial scale and favorable landscape conditions have the potential to assume broader social and environmental functions. In the context of climate change and increasingly frequent extreme rainfall events, transforming flood risk into a manageable and reusable ecological resource is emerging as a critical challenge that campus planning and development must address.

Competing interests | The authors declare that they have no competing interests.

Project Name: Landscape and Ecological Water System Design of Shenzhen University of Advanced Technology
Location: Shenzhen, China
Size (area): 541,563 m²
Client: Bureau of Public Works of Shenzhen Municipality
Landscape Architecture: WADI Engineering and Design Co., Ltd.

Principal: Hao Wu

Project Team: Qi Guo, Zuobei Hu, Chen Li, Chao Du, Jun Zheng, Shuyue Guo, Peipeng Tang, Jingyi Song, Yixuan He, Jiankun Cui, Ying Dong (intern)

Collaborators: reMIX Studio, China Academy of Building Research, China Northeast Architectural Design & Research Institute Co., Ltd.

Design Time: 2020 ~ 2023

Completion Time: 2026 (estimated)