Water Environment Planning and Treatment Technology in Mountainous Watersheds: A Case Study of Zhongzui River in Chongqing

山地城市小流域水环境规划及治理技术：以重庆市中咀河为例

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1

山地城市水环境特点

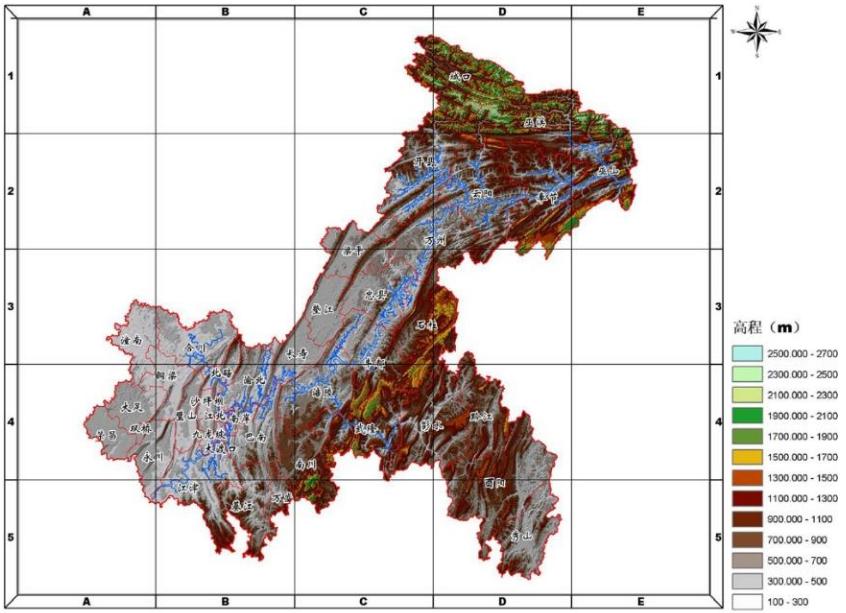
Water environment characteristics for mountainous city

（1）山地城市及河流的特点 Characteristics of mountainous city and river

“山地城市”:城市发展的地形环境内断面平均坡度>5%，垂直分割深度>25，其显著特点是山地城市用地地形地貌复杂，具有明显的起伏度和坡度，城市空间布局依山就势。

“Mountain City”: The urban terrain has an average slope of >5% and a vertical division depth of >25. The distinctive feature of the mountainous city is that the terrain is complex, with obvious undulations and slopes, and the urban spatial layout is on the mountain.

- 山地城市山地起伏，沟壑众多
- **Complex terrain, with numerous gullies.**
- 城市河流发源于山地区域，受山地山形影响，支流（叉）多（冲沟/冲塘）多
- **Rivers originate from mountainous commonly have more tributaries and rushing ponds than that in Plain area**
- 山地城市小流域流域面积小（**10-50 km²**），河流长度短
- **Limited watershed area (10-50 km²) and short river length.**
- 河流旱季流量小，暴雨期流量增量大
- **The river has a small flow during the dry season and a large increase in the flow during the rainstorm period.**



（2）城市发展和河流的冲突

Conflict between urban development and river

- 河流的盖板化——隐形的污染
- **Covered rivers - invisible pollution discharge**

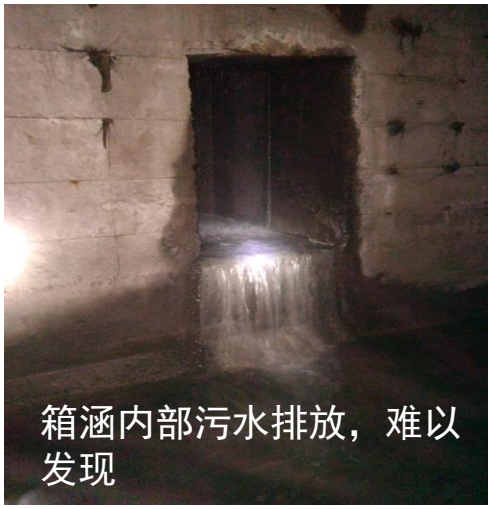
河流支叉多，旱季无来水，当城市发展需要用地时，河流被无情的盖板化（箱涵化）

Tributaries which is no water in the dry season are tend to be covered when the land was needs for development

- 冲沟、湖塘的填埋——河流生境的消失
- **Landfill of gullies and ponds - the disappearance of river habitats**

随着城市的发展，原有生态的径流通道被管道代替，河流分支比下降，河网密度和水面率下降，而干流相应被强化

With the development of the city, the natural runoff gullies was replaced by the pipeline, the branch ratio, density and the water surface rate of river decreased, the river network density and the water surface rate decreased, and the main stream was strengthened accordingly.



（3）城市发展和河流的冲突

Conflict between urban development and river

- 山系的开发——河流源头不再
- **Construction on mountain- the disappear of river source**
- 山系是河流的发源，山系的开发直接导致了来水的减少，来水水质变差
- **Mountain is the source of the river. The Construction on mountain leads to the decrease of river flow, and the water quality also get worse.**

- 河流的渠化——生态功能的丧失
- **Ecological capacity loss due to canalization**

旱季来水少，河床大范围干涸；

既要考虑安全，更要考虑生态

In the dry season, there is less water, and the riverbed widely dry up; We should consider both safety and ecology.

33年建设用地增长了500多km^2，导致硬化下垫面快速增加，河流湖库面积下降了22.1%

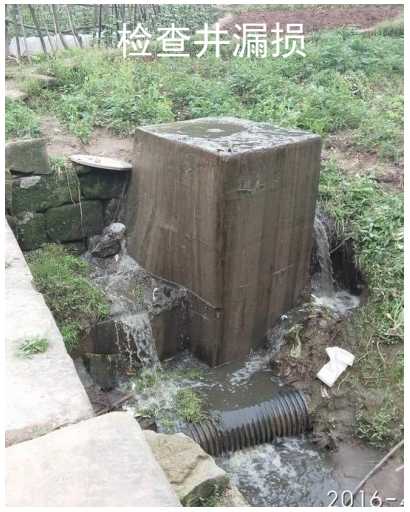
In past 33 years, the construction land has increased by more than 500 km^2, and the area of rivers and lakes decreased by 22.1%.

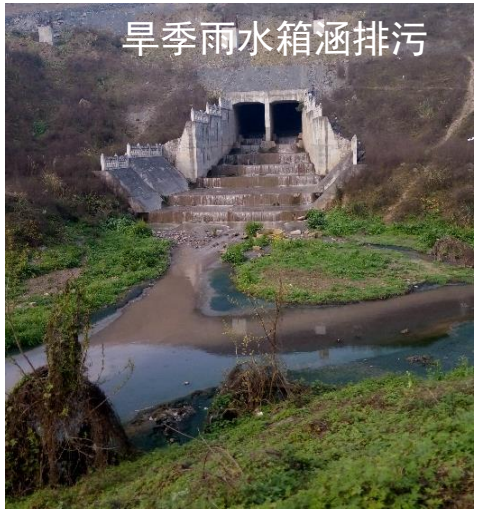
（3）山地城市小流域的污染特征 Pollution characteristics of small watersheds

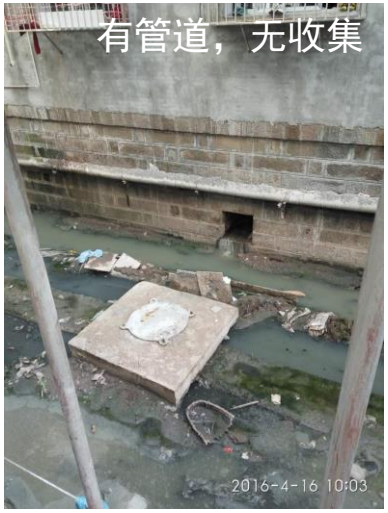
- 城市点源——地下设施应是重点
- **Urban point source pollution - underground facilities should be concerned**

  雨污错接管道排放、污水管道泄漏、污水散排、污水偷排、污水处理厂尾水的排放

  Misconnected rainwater and sewage pipes discharge, sewage pipeline leakage, sewage discharge, sewage smuggling and treated sewage water discharge.





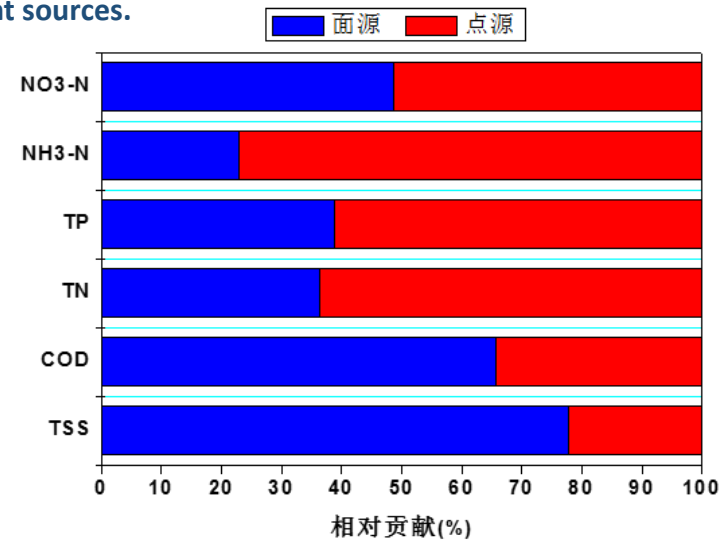


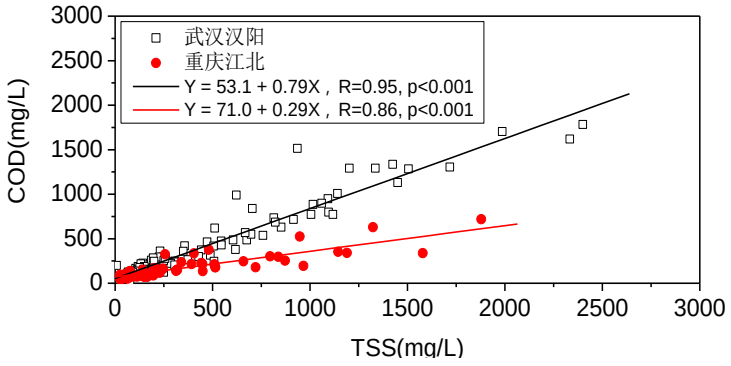
（3）山地城市小流域的污染特征

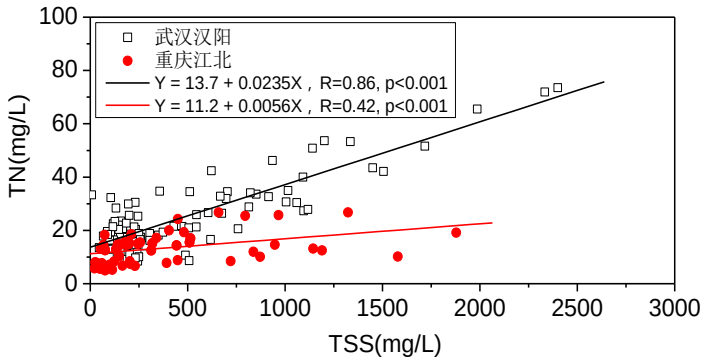
Pollution characteristics of small watersheds

- 城市面源——明确污染强度
- Urban non-point source pollution- clear about pollution intensity
  - 山地径流流速快，对地表冲刷严重，污染负荷高于平原城市
  - The mountain runoff has a fast flow rate, and the surface erosion is serious. The pollution load is higher than that of the plain city.
  - 散排城市面源与面源的点源形式化
  - Scattered urban non-point sources and point source formalization of non-point sources.
  - 考虑城市垃圾入河带来观感上的不悦
  - The uncomfortable feeling of urban garbage into the river

- 重庆降雨径流 中COD、TN、TP与TSS的比值都低于武汉
- The ratio of COD, TN, TP and TSS in rainfall and runoff in Chongqing is lower than that in Wuhan.
- 重庆地表径流污染具有高颗粒物效应
- Pollution of surface runoff in chongqing has high particle effect.
- 重庆山地城市水文过程源短流急、冲刷程度强烈
- Rainfall in Chongqing has short current,and scour degree is intense.







示范区内（盘溪河流域）面源污染TSS、COD占全年污染负荷总量的60~70%，TN、TP负荷占30~40%。

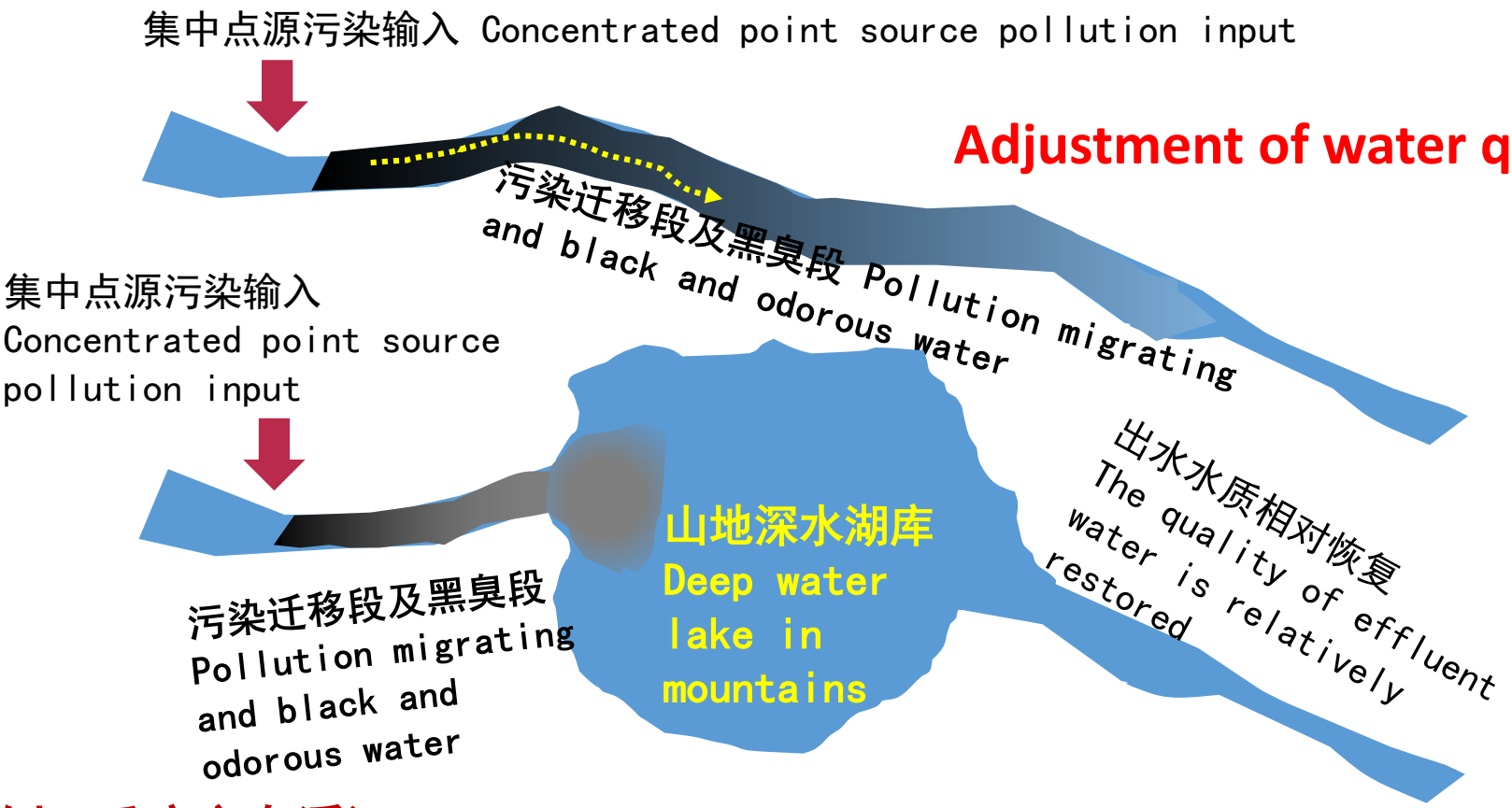
In Panxi rive, TSS and COD account for 60-70% of the annual total pollution load, and the loads of TN and TP account for 30-40%.

（4）山地城市小流域的自净能力 Self-purification ability of small watersheds

- 自净能力 Self-purification ability

- 流速相对较大，跌水、浅滩众多，无奈污染负荷过高
- **There are many water drops and shoals, as well as high flow velocity, but the pollution load is too high some places.**
- 山地河流复氧能力较强，溶解氧浓度高，氨氮低，总氮高。
- **Rivers in mountains have strong oxygen enrichment, high dissolved oxygen concentration, low ammonia nitrogen and high total nitrogen.**
- 山地流域中的深水湖泊，环境容量大，接纳、滞留了污染，下游水质会有一定好转，但湖泊修复的难度大
- **The deep-water lakes in the mountainous basins have large environmental capacity, which can accept and retain pollution, and improving the quality of downstream water, However, the lake repairing is difficult.**

（4）山地城市小流域的自净能力 Self-purification ability of small watersheds



案例：重庆市盘溪河 Case: Panxi River, Chongqing

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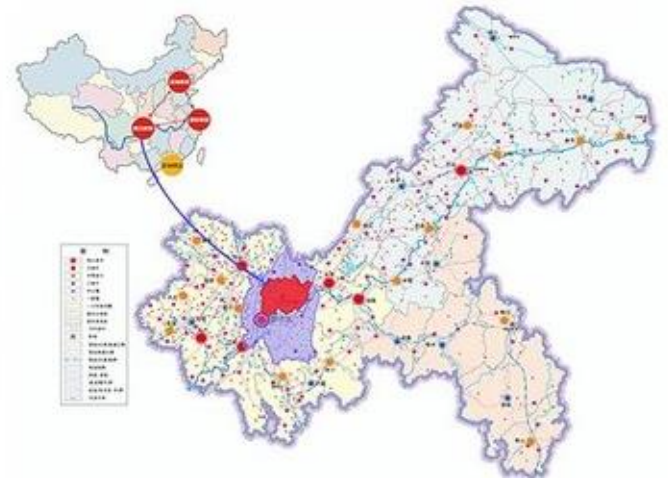
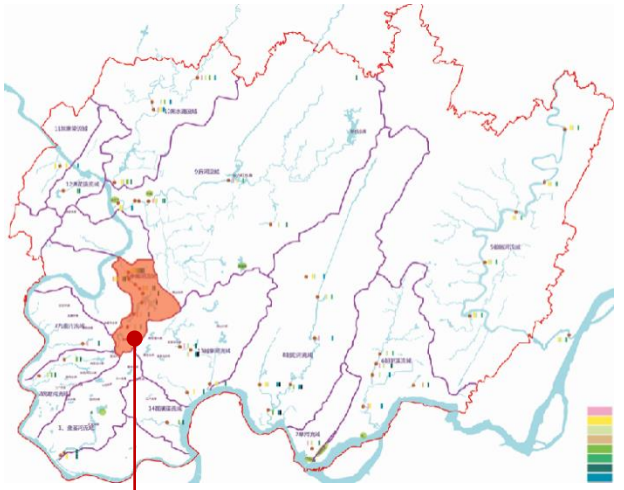
对象流域–中咀河流域概况

Overview of the Zhongzui River

Demonstration site of the National Grant Sci & Tech Project

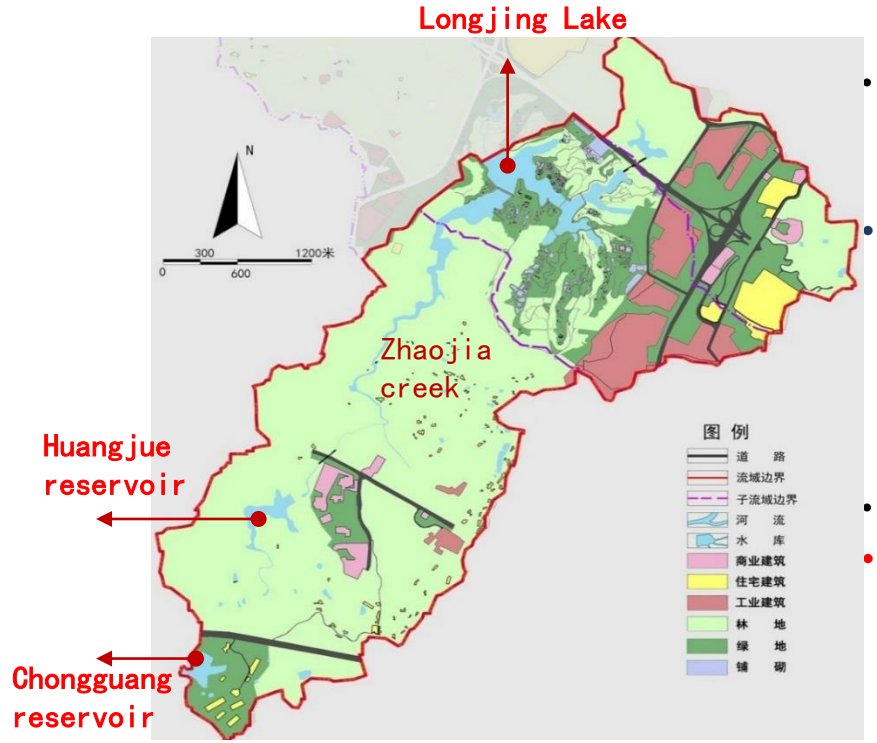
（1）流域位置 Location





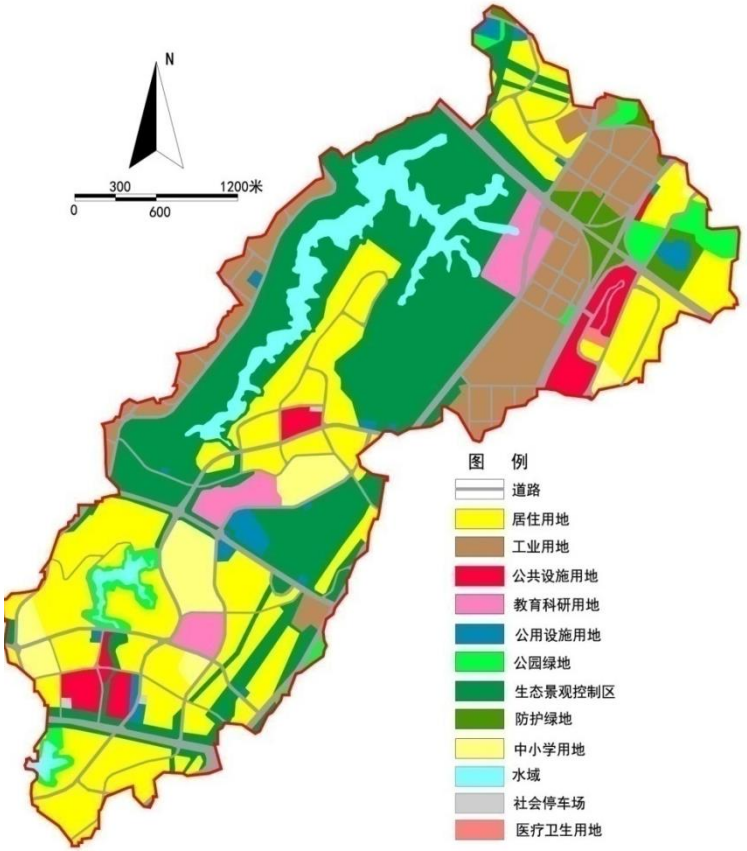
选取两江新区的典型流域——中嘴河流域作为技术示范流域

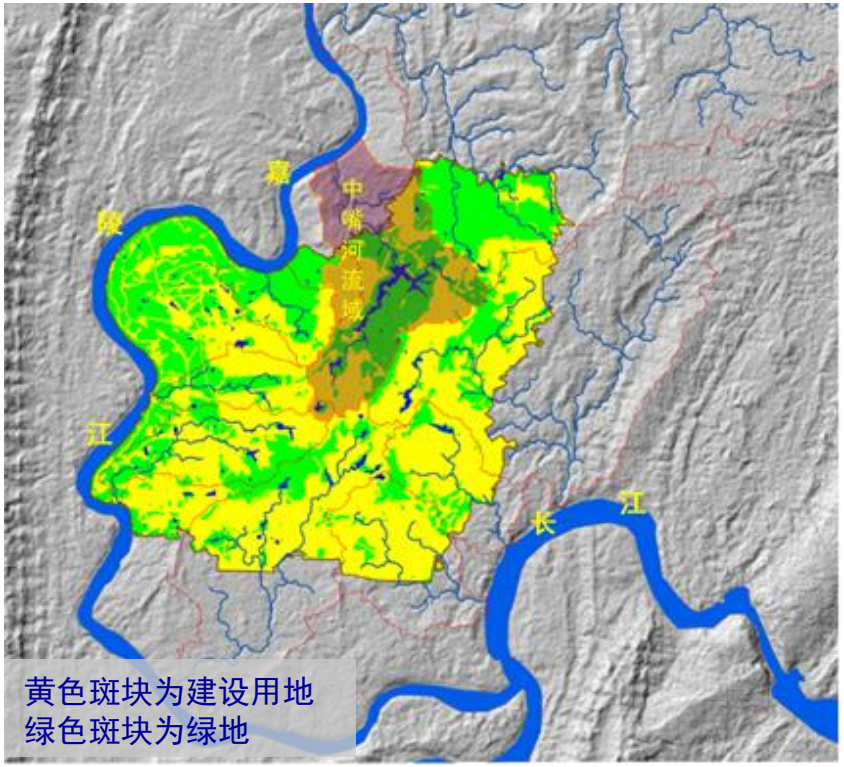
Zhongzui river watershed



- 中嘴河又名赵家溪，为嘉陵江水系左岸一级支流，流域发源于两江新区人和街道重光村四棱碑，河流经重光水库、黄桷水库、黄茅坪村、龙景湖水库和史家湾后，在渝北区悦来街道新春村河嘴处汇入嘉陵江
- **Zhongzui River, also known as Zhaojia creek, is a tributary Jialing River. The water originates from Liangjiang New District. The river passes through Chongguang reservoir, Huangjue Reservoir, Huangmaoping Village, Longjinghu Reservoir and Shijiawan, then goes into the Jialing River at the mouth of Xinchun Village in Yubei District.**
- 中嘴河流域总面积21.72 km^2，河道全长9.57km，河道平均比降 1.4 %
- **The total area of the Zhongzui River watershed is 21.72 km^2, and the length of the river channel is 9.57 km. the average slope is 1.4%.**

（2）流域用地布局 Watershed land layout



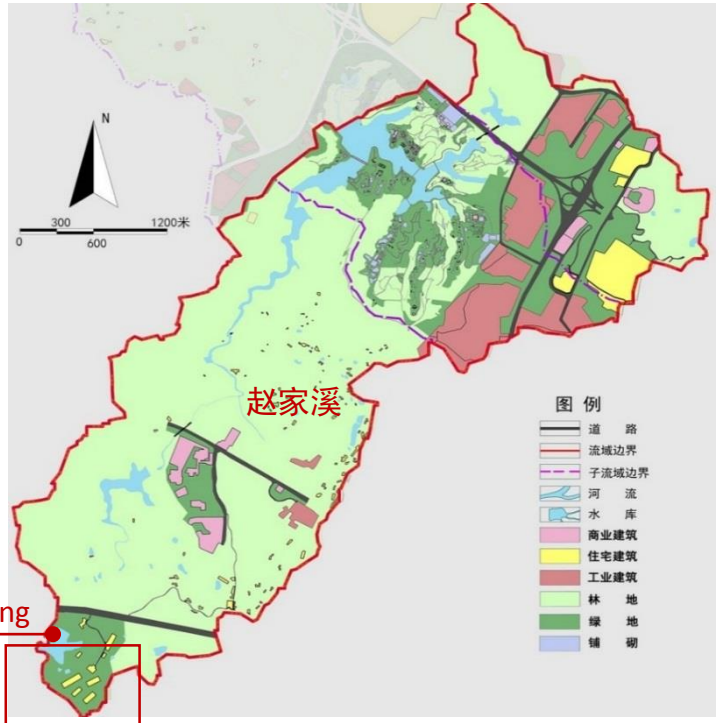


示范工程开展前，龙景湖上游及湖体区域以农林用地和绿地比例为80%，建设用地面积比例19.2%

Before the demonstration project was started, the proportion of agricultural and forestry land and green space was 80% in the upper reaches of the Longjing Lake and the lake area, and the proportion of construction land area was 19.2%.

- 2015年末，通过TM8卫星影像进行解译，明确了示范流域现状的用地格局
- **At the end of 2015, interpretation was carried out through TM8 satellite imagery, and the land use pattern of the current status of the demonstration basin was clarified.**
- 中嘴河流域的建设用地大幅度增加，建设用地比例上升至49.4%，绿地比例下降至46.2%
- **The construction land in the Zhongzui River Basin has increased significantly, and the proportion of construction land has increased to 49.4%, and the proportion of green land has dropped to 46.2%.**

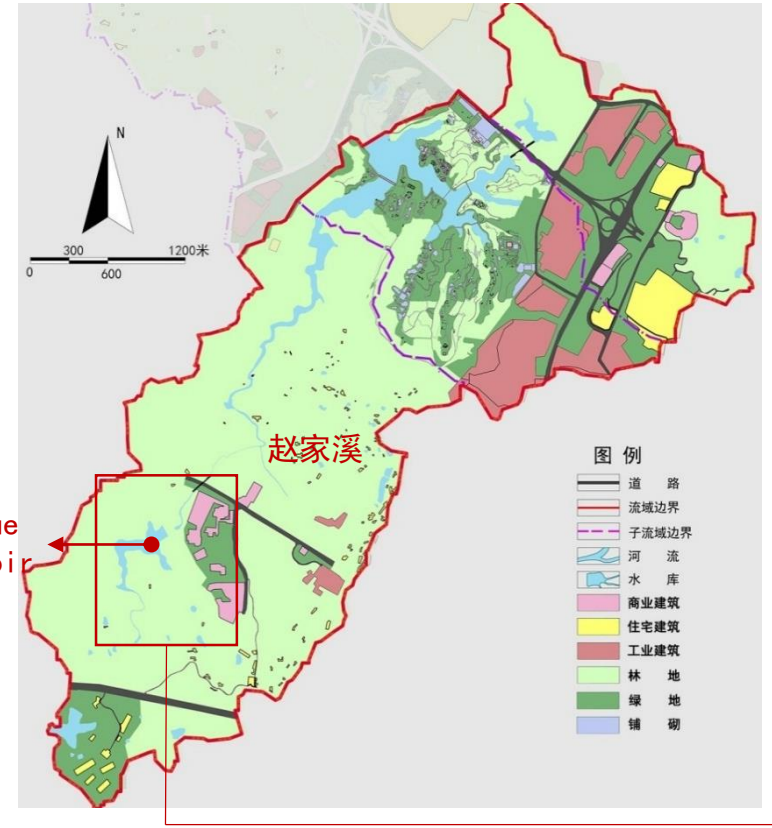
（3）流域重要节点——源头重光水库 Important sites- Chongguang reservoir



Chongguang reservoir

Relatively good water quality in Chongguang Reservoir

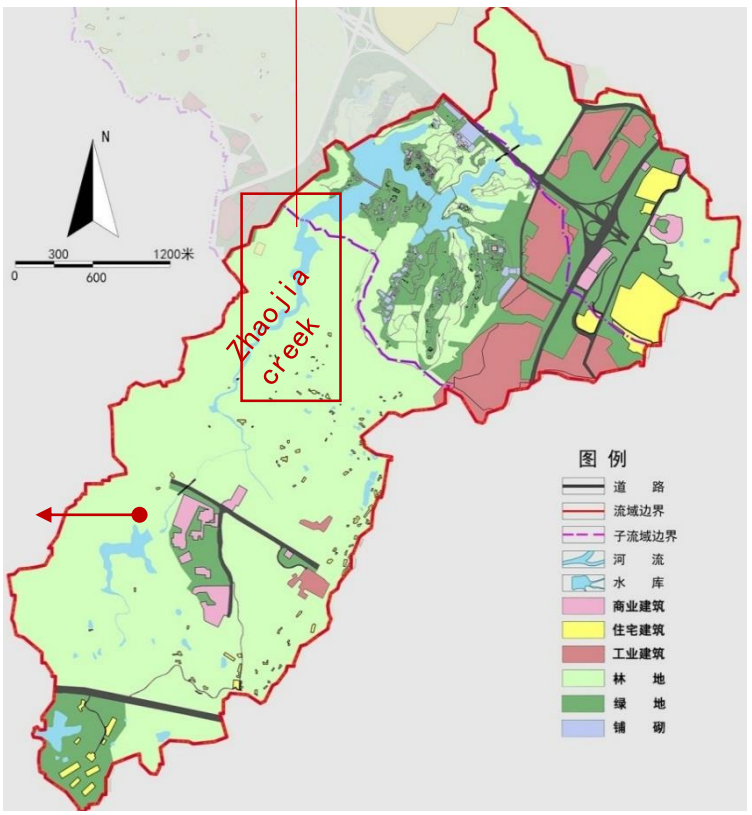
（3）流域重要节点——黄桷水库 Important sites- Huangjue reservoir



Huangjue reservoir

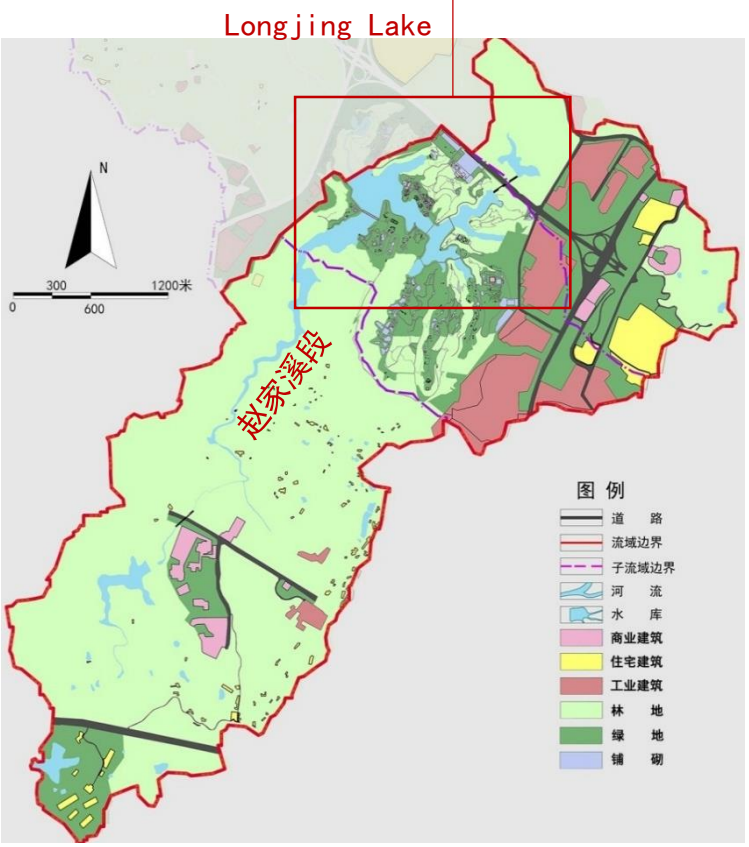
Relatively bad water quality in Huangjue Reservoir

（3）流域重要节点——赵家溪段 Important sites– Zhaojia creek



Some sections polluted due to residential area

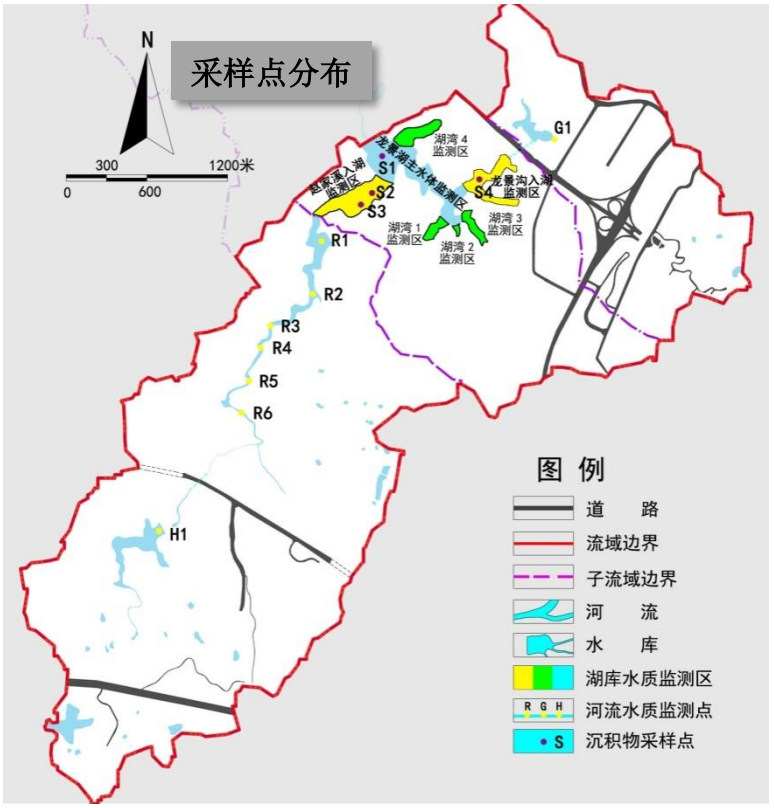
（3）流域重要节点——龙景湖 Important sits– Longjing Lake



The place where the EXPO garden (2011-2012) was located

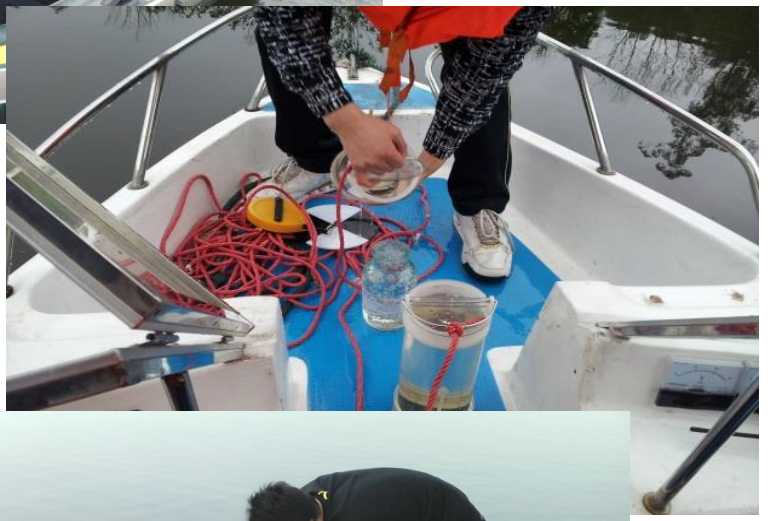
Water quality significantly improved after the implement of our project:
grade V (COD >50 mg/L, NH3-N>2 mg/L) to grade IV (COD <30 mg/L, NH3-N<1.5 mg/L)
(Chinese Standard, grade I is the best)

（3）流域水环境情况 Water environment



Sample collection on site

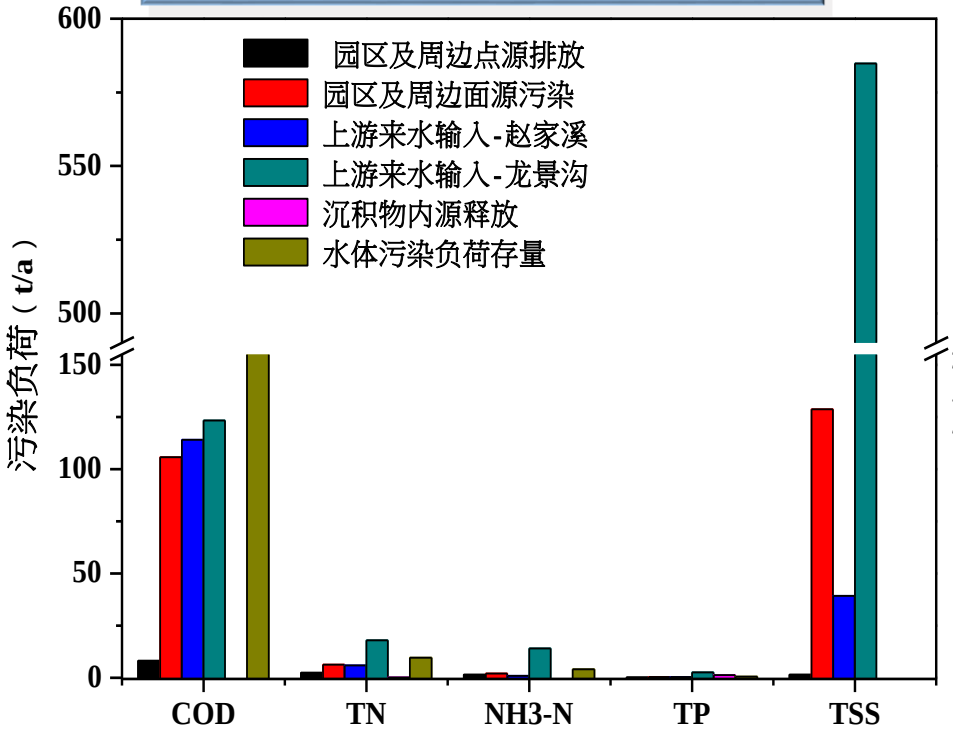
13 measured water quality index



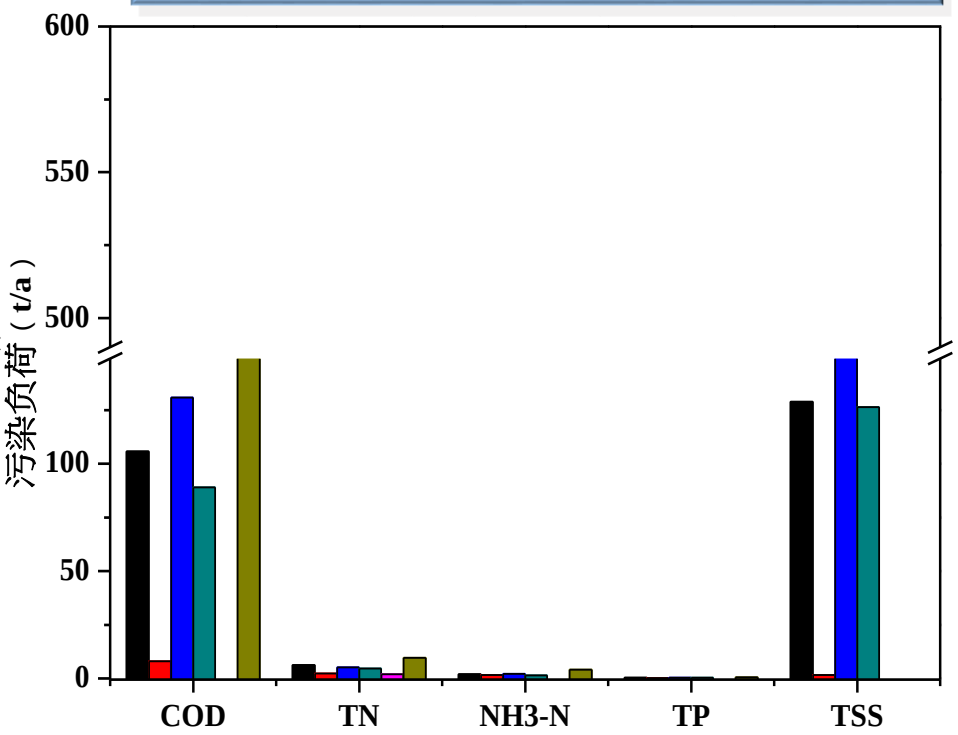
- 水样：T、DO、EC、COD、NH_3-N、TN、TP、NO_3-N、PO_4^{3-}-P；
- Water sample：T、DO、EC、COD、NH_3-N、TN、TP、NO_3-N、PO_4^{3-}-P；
- 沉积物：含水率、有机质、全碳、全氮、TP、重金属（Cd、Cr、Cu、Ni、Pb、Cu）、孔隙水NH_3-N，PO_4^{3-}P。
- Sediment: water content, organic matter, total carbon, total nitrogen, TP, heavy metals （Cd、Cr、Cu、Ni、Pb、Cu）, pore water NH_3-N，PO_4^{3-}P.

（3）流域污染负荷核算 Pollution load

现状年负荷 annual load before



规划后年负荷 Annual load after planning



- COD年负荷为351.3 t，以赵家溪、龙景沟上游来水输入贡献为主（33%、35%）；
- TN年负荷为34.8 t，主要来自龙景沟来水输入（52%）；
- NH_3-N年负荷为18.8 t，龙景沟来水输入贡献73%；
- TP年负荷为3.4 t，主要来源于上游龙景沟输入（77%）
- TSS年负荷为754.5 t，龙景沟来水输入（78%）和面源输入（17%）占到较大比例。

- **The annual COD load is 351.3 t，which is mainly due to the input of water from the upstream of Zhaojia Stream and Longjinggou（33%、35%）；**
- **The annual load of TN is 34.8 t, which is mainly from the input of Longjinggou (52%)；**
- **The annual load of NH_3-N is 18.8 t, and the input of Longjinggou is 73%；**
- **The annual load of TP is 3.4 t, mainly from the upstream Longjinggou (77%);**
- **The annual load of TSS is 754.5 t, and Longjinggou incoming water (78%) and non-point source (17%) account for a large proportion.**

（3）龙景湖污染负荷核算 Pollution load of Longjing Lake

现状污染物年负荷来源 Source analysis of pollutants

项目 item		园区及周边点源排放Point source from the park and surrounding areas	园区及周边面源污染Non-point source from the park and surrounding areas	上游来水输入Upstream water input		沉积物净释放量 Sediment release	水体污染负荷存量 Water pollution stock	合计 total
				赵家溪 Zhaojia Stream	龙景沟 Longjinggou			
COD	负荷 load	8.111	105.7	114.18	123.3	-	165	516.3
	比例 proportion	**2%**	**20%**	**22%**	**24%**	**-**	**32%**	**100%**
TN	负荷	2.43	6.3	6.05	18.03	0.259	9.68	42.7
	比例	**6%**	**15%**	**14%**	**42%**	**1%**	**23%**	**100%**
NH_3-N	负荷	1.62	2	0.98	14.17	-	4.11	22.9
	比例	**7%**	**9%**	**4%**	**62%**	**-**	**18%**	**100%**
TP	负荷	0.16	0.4	0.38	2.705	1.430	0.6	5.7
	比例	**3%**	**7%**	**7%**	**48%**	**25%**	**11%**	**100%**
TSS	负荷	1.62	128.8	39.33	584.77	-	165.75	920.3
	比例	**0.2%**	**14%**	**4%**	**64%**	**-**	**18%**	**100%**

（赵家溪和龙景沟）上游来水输入带来的各污染物负荷占所有来源污染负荷的比例均超过65%以上，其中以龙景沟来水对TSS、NH_3-N、TP输入贡献超过70%。

(Zhaojia Stream and Longjinggou) The proportion of pollutants from the upstream water accounted for more than 65% of the pollution load of all sources. Among them, Longjinggou water contributed more than 70% to TSS, NH_3-N and TP.

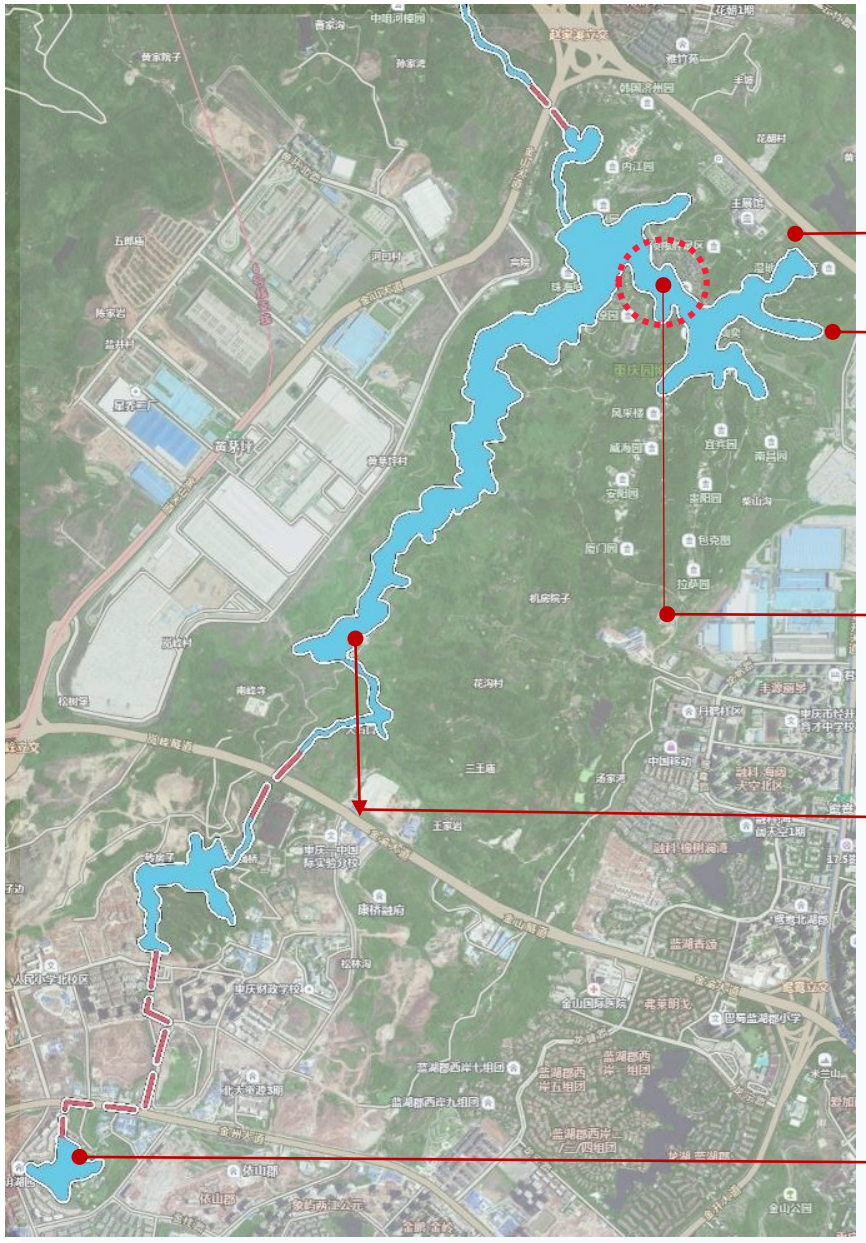
3

流域治理工程布局及技术

Engineering facility Layout and treatment technologies

Based on the analysis of pollution loads and the water quality requirement of demonstration River, engineering measures are necessary

（1）流域治理工程分布 Project Layout



面源污染源区段控制集成技术示范工程
Non-point source pollution control integration technology demonstration project

山地城市面源污染控制集成技术示范工程
Mountain City Non-point Source Pollution Control Integrated Technology Demonstration Project

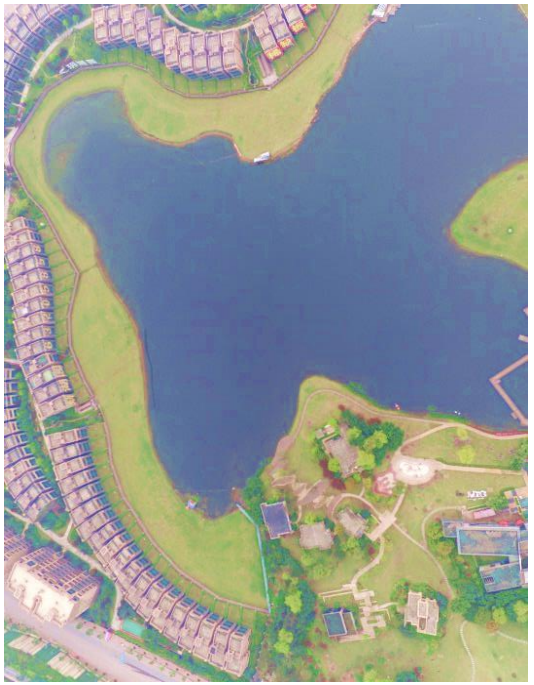
水体水质保障集成技术示范工程
Water quality assurance integrated technology demonstration project

入湖支流生态滤池深度处理示范工程
Demonstration project for deep treatment of ecological filter in the tributary of the lake

上游污染控制集成技术示范工程
Upstream pollution control integration technology demonstration project

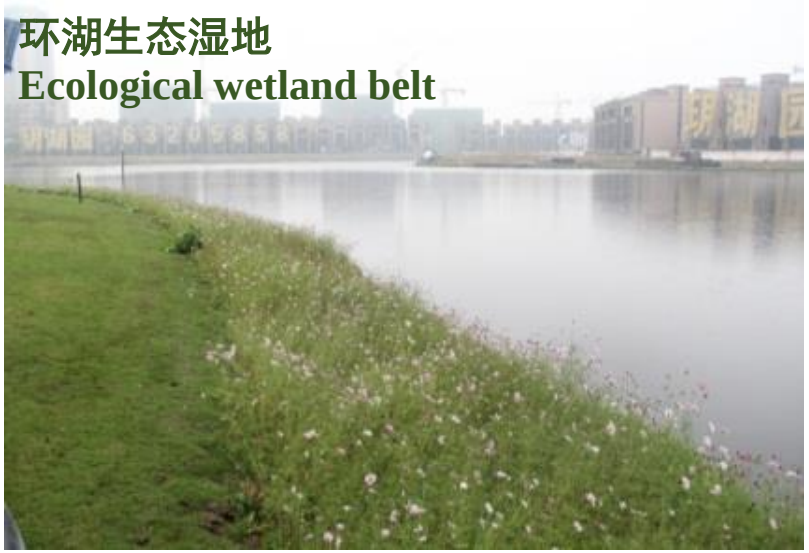
（2）上游治理工程措施 Facilities in Upstream

城市面源污染控制工程（重光水库治理点）
Urban non-point source pollution control project（Chongguang reservoir management point）



生态护岸 Ecological embankment

环湖生态湿地
Ecological wetland belt



道侧植草沟
Roadside grass gully

（2）上游治理工程措施 Facilities in Upstream

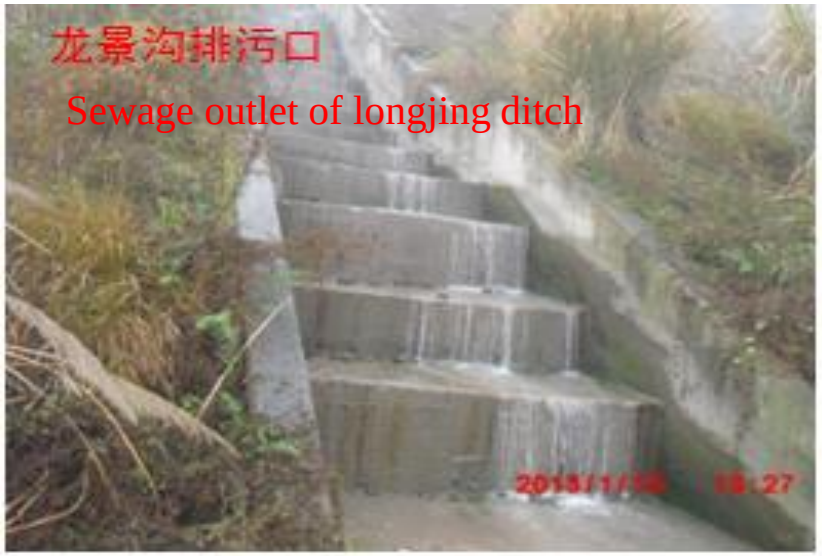
点源污染截流配套工程（龙景沟片区）

Point source pollution interception supporting project (Longjinggou Area)

- 龙景沟片区由于高程问题，污水无法自流进入，需修建泵站将污水有效提升
- 在此处建设污水提升泵站1处，提升污水，防止对龙景沟的进一步污染。该功能每年减少输入龙景湖的污染负荷COD 42.2 t、TN 17.1 t、TP 2.73 t、TSS 671.1 t

- **Due to the elevation problem in Longjinggou area, sewage can not enter by itself, and it is necessary to build a pumping station to effectively raise sewage.**
- **A sewage pumping station will be built here to raise sewage and prevent further pollution of Longjinggou.This function reduces the pollution load input to Longjing Lake every year,including COD 42.2 t, TN 17.1 t, TP 2.73 t and TSS 671.1 t.**

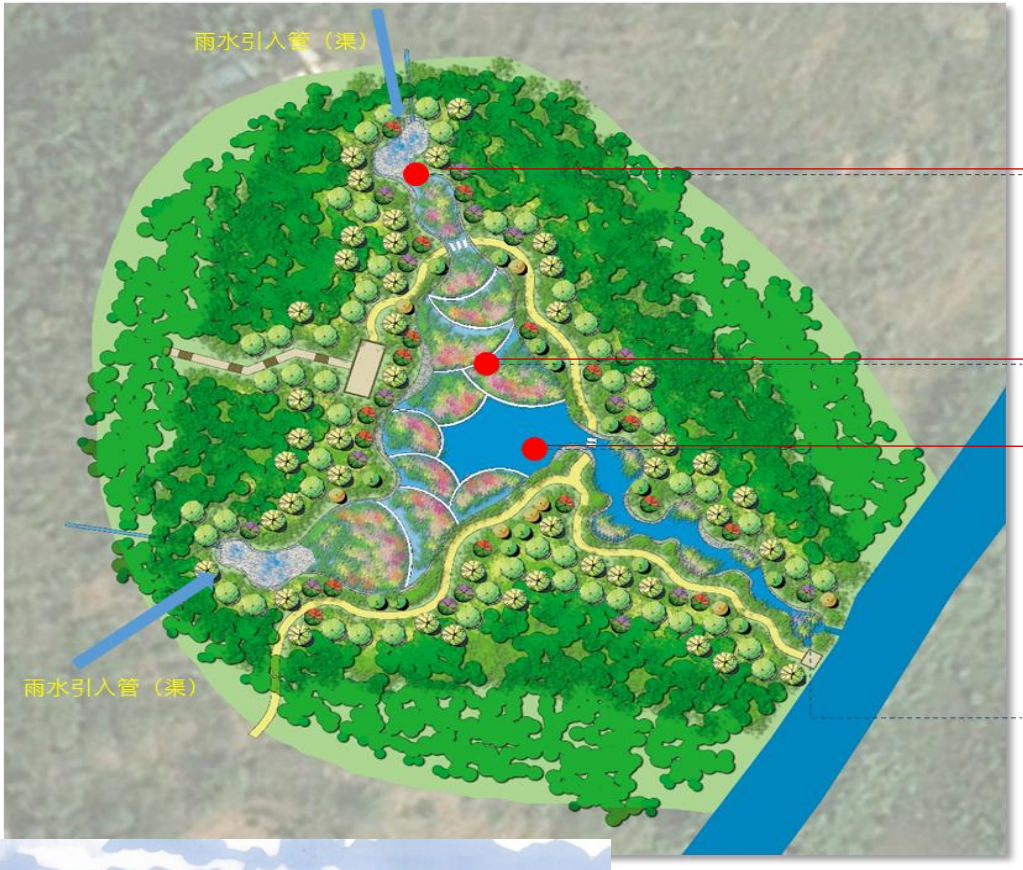
Pumping to intercepters



（2）上游治理工程措施 Facilities in Upstream

治理技术1——梯级滞水湿地

Technology 1——Cascade stagnant wetland



消能沉砂池

跌水景观

微型景观

- In the area where conditions permit, the construction of the gully pre-treatment wetland for the treatment of the initial rainwater
- The peak flow of rainwater in mountainous cities is large, and the sand content is high, and energy dissipation/sanding is essential.
- The rainwater passes through energy dissipation - grit sand - storage - percolation - stagnation and finally into the lake.
- Simulated construction of ecological runoff channels.

雨水管出水

↓

消能

↓

沉砂

↓

调蓄

↓

渗滤

↓

滞存

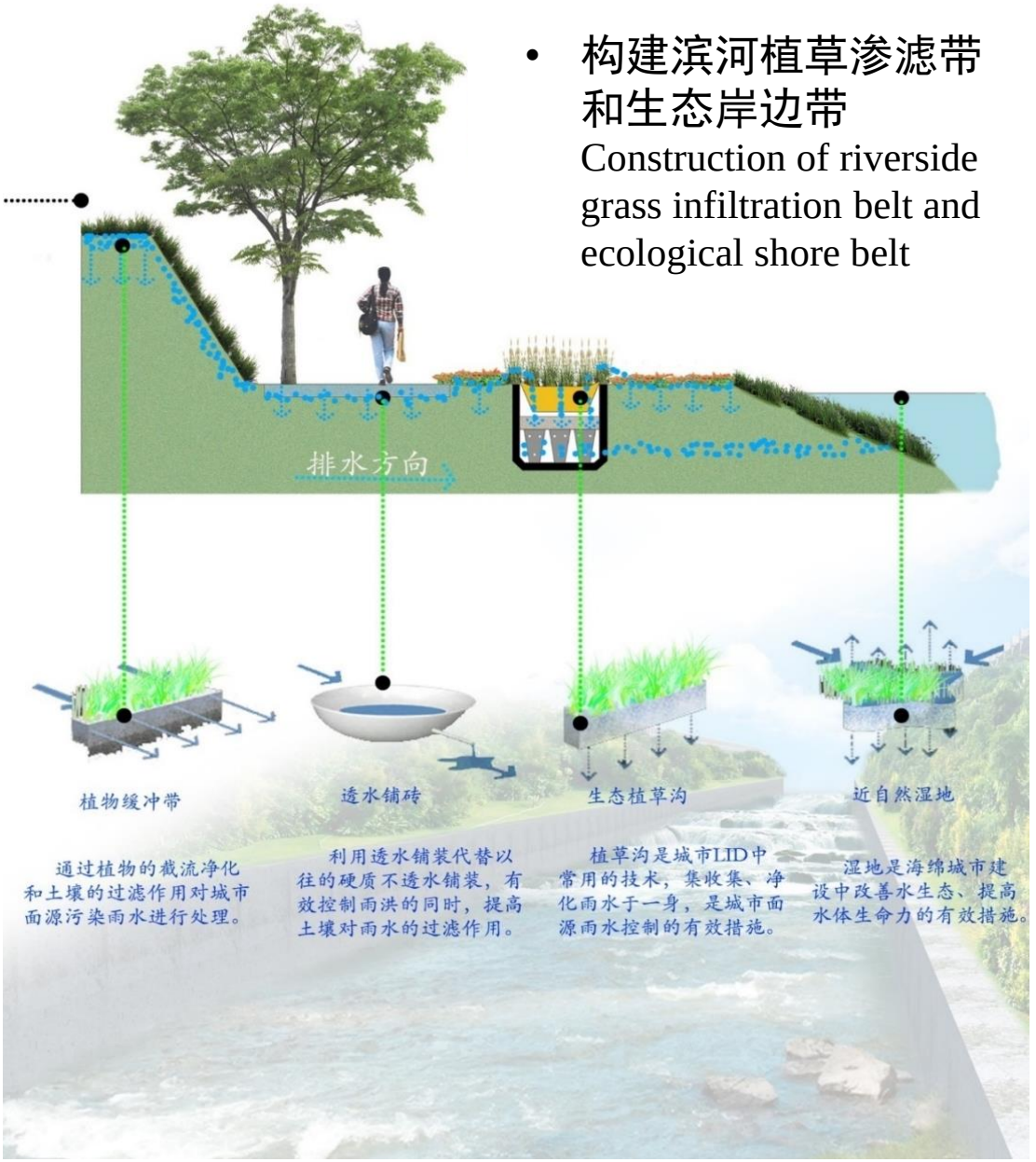
↓

出水

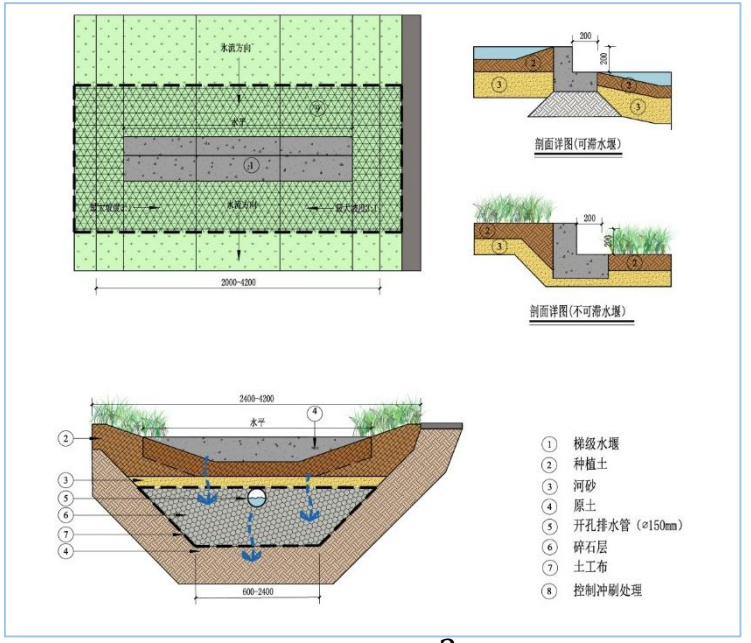
（2）上游治理工程措施 Facilities in Upstream

治理技术2——滨河植草渗滤带
Technology 2——Riverside grass infiltration belt

- 构建滨河植草渗滤带和生态岸边带
  Construction of riverside grass infiltration belt and ecological shore belt



- 山地城市梯级植草沟



$$Q = \varphi q F \times 10^{-3}$$

Q—设计地表径流流量（m^3/s）；
Ψ—汇水区综合径流系数（小于1）；
F—汇水区面积（10^4m^2）；
q—设计降雨强度（$L/s \cdot 10^4m^2$）

地表径流传输能力计算：

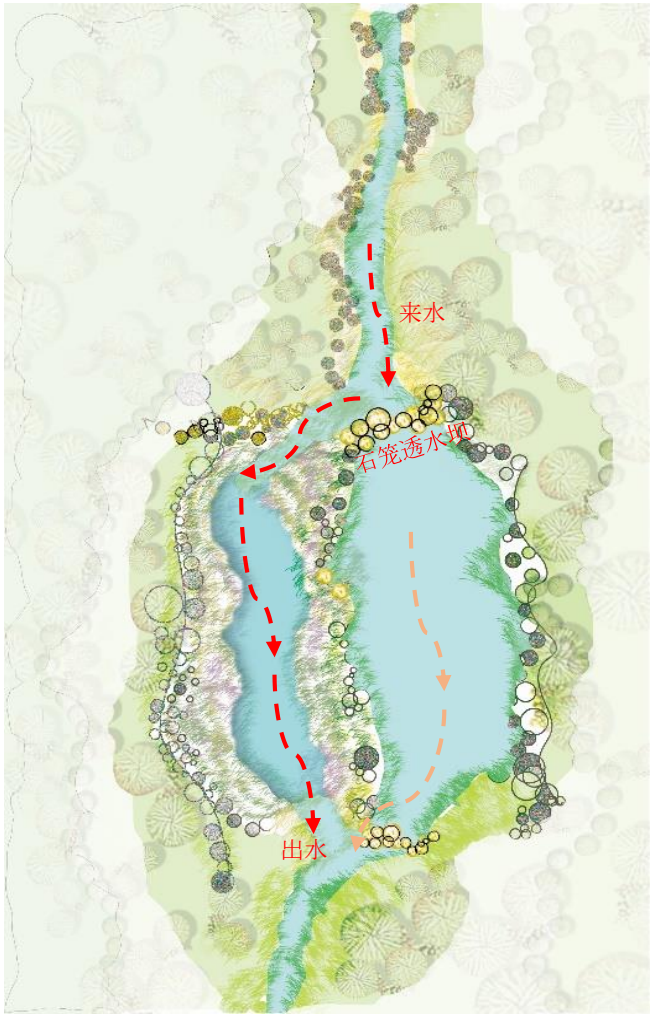
$$Q = V \times A = \frac{AR^{\frac{2}{3}}i^{\frac{1}{2}}}{n}$$

$$R = \frac{A}{P}$$

（2）上游治理工程措施 Facilities in Upstream

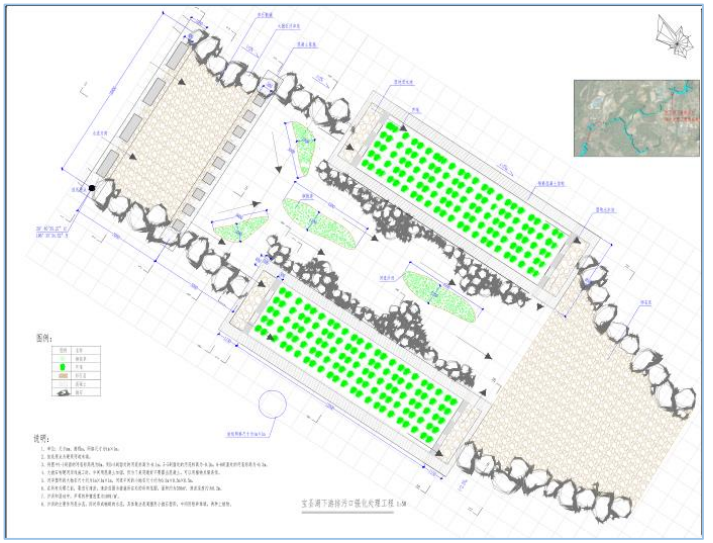
治理技术3——河道旁侧湿地技术

Technology 3——Riverside wetland technology



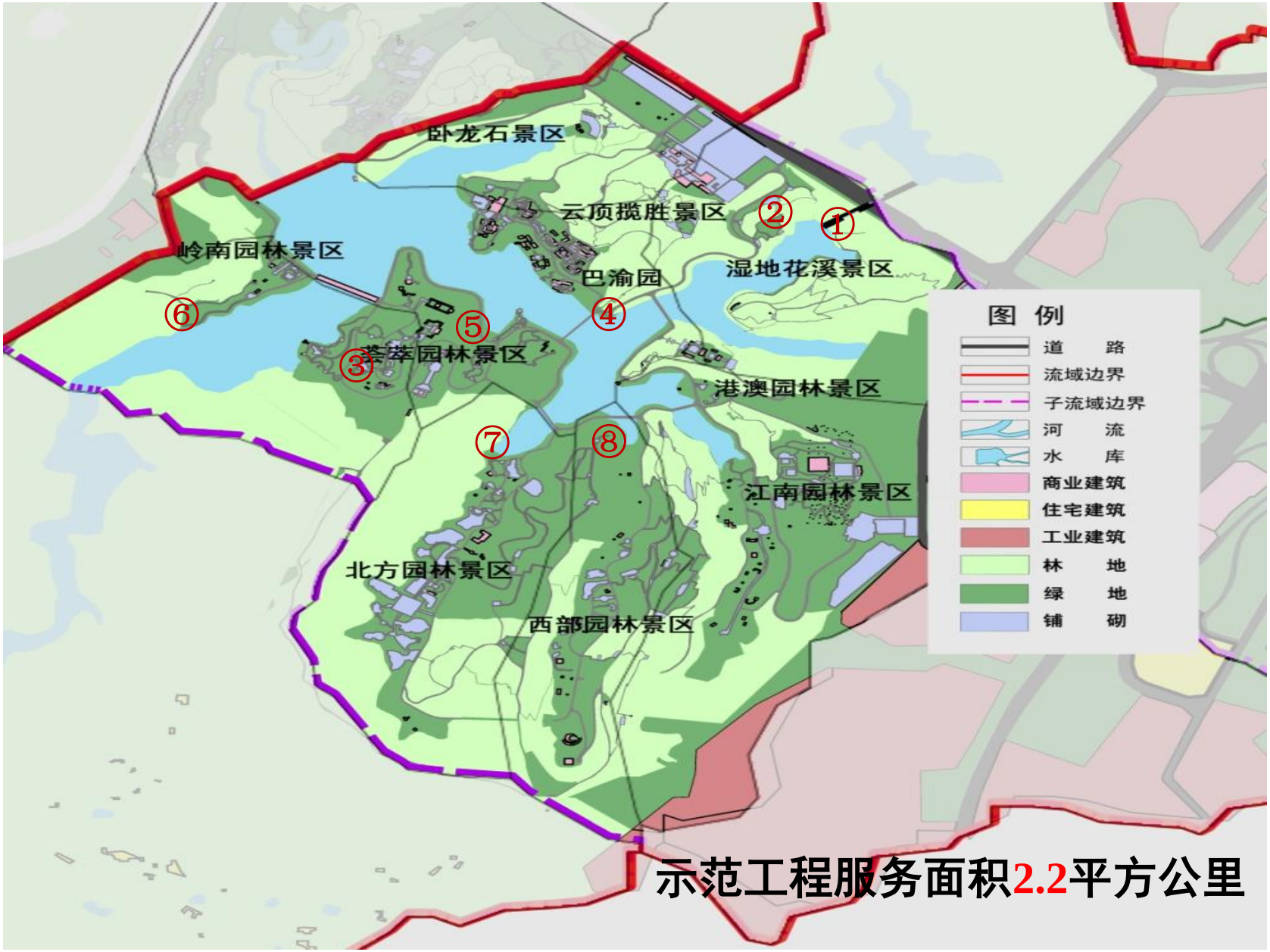
- 在有条件(用地充足)的情况下，建设滨河旁侧湿地，湿地与原有河道之间通过石笼坝隔离，湿地内种植有兼具净化和景观效果的植物
- 利用石笼构筑挡水坝和人造河道沙洲，将上游来水部分引入湿地进行处理
- 旁路湿地采用水平流人工湿地，水力负荷0.4~0.8$m^3/m^2 \cdot d$，水力停留时间1-3d，处理水量0.02m^3/s
- 洪水期大流量溢流，满足行洪要求

- **If the condition permits (sufficient land use), the wetland along the riverside will be constructed, and the wetland and the original river will be separated by the stone cage dam. The wetland will be planted with both purification and landscape effects.**
- **The stone cage is used to construct the retaining dam and the artificial river sandbar, and the upstream water part is introduced into the wetland for treatment.**
- **The bypass wetland adopts horizontal flow constructed wetland with hydraulic load of 0.4~0.8$m^3/m^2.d$, hydraulic retention time of 1-3d, and treated water volume of 0.02m^3/s.**
- **Large flow overflow during flood period to meet flooding requirements.**



（3）湖体周边面源污染治理工程措施

Engineering projects for non-point source pollution control around longjing lake



Demonstration engineering serves 2.2 square kilometers

（3）湖体周边面源污染治理工程措施

Engineering projects for non-point source pollution control around longjing lake

山地城市面源污染控制集成技术示范工程

Integrated technical engineering of non-point source pollution control in mountainous cities

Frequency:1/30 years, 83% rain water infiltrated

大坡度道路径流路肩带渗滤技术，410m²

道侧绿地滞控技术，100m²

径流入湖强化侧向流生物滤池净化技术，238m²

组合模块式大坡度径流控制滤池技术，238m²

径流沉淀消能池

径流沉淀消能池

径流沉淀消能池

微型水景滞存技术，875m²

复杂地质条件下源区促渗技术，630m²

微型水景滞存技术，205m²

（3）湖体周边面源污染治理工程措施

Engineering projects for non-point source pollution control around longjing lake

Infiltration technology in source area with complicated geological conditions

复杂地质条件下源区促渗技术示范

houlder slope filtration technology with large slope path

大坡度道路径流路肩带渗滤技术示范

（3）湖体周边面源污染治理工程措施

Engineering projects for non-point source pollution control around longjing lake

ainwater retention control technology on the side of the road

道侧绿地滞控技术示范

Composite modular large gradient runoff control filter technology

组合模块式大坡度径流控制滤池技术示范

（3）湖体周边面源污染治理工程措施

Engineering projects for non-point source pollution control around longjing lake

waterscape detention Technology

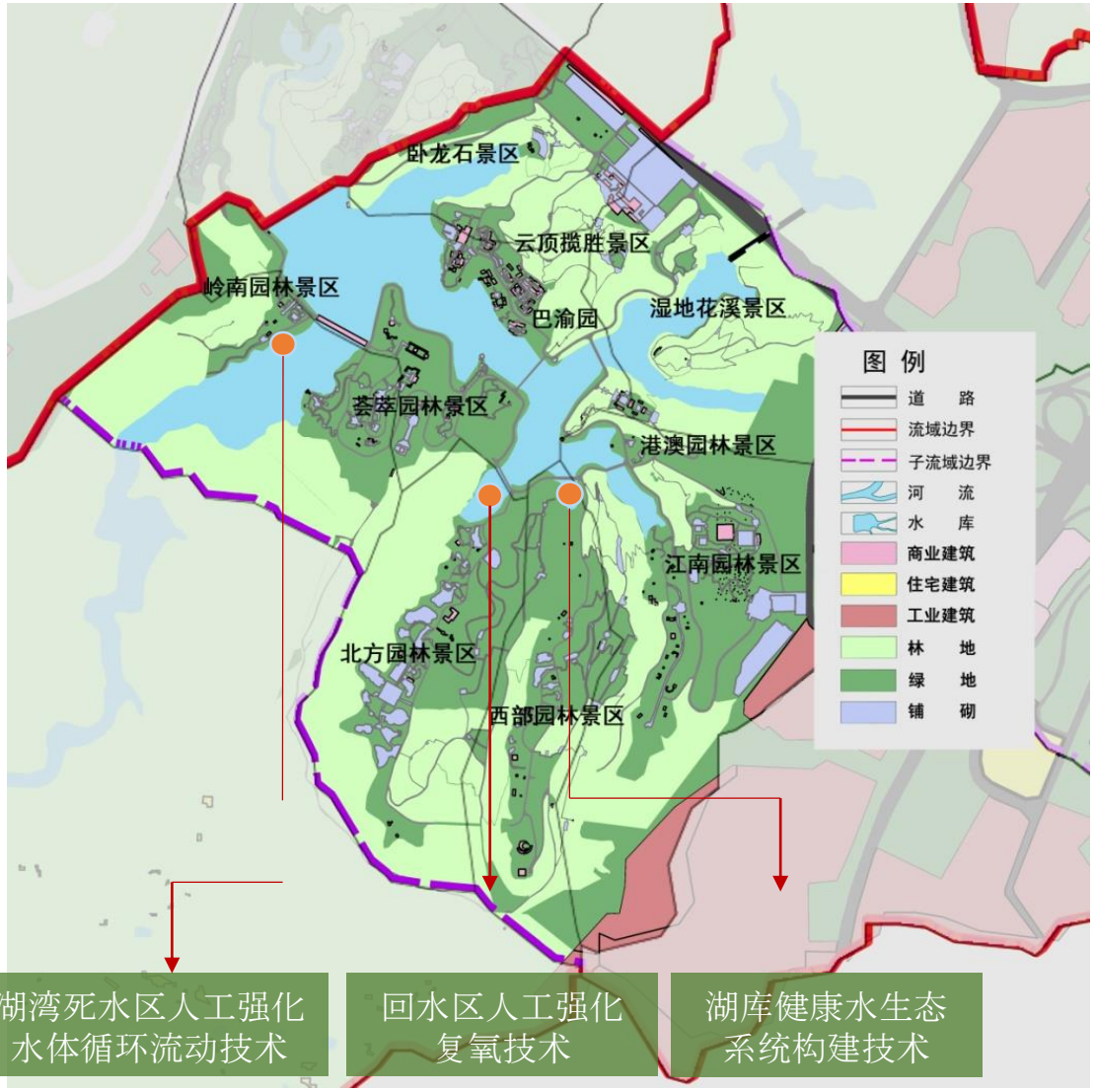
微型水景滞存技术示范

Biofilter purification technology for enhancing lateral flow into the lake

径流入湖强化侧向流生物滤池净化技术

（3）湖体水体自净能力提升工程措施

Technologies for improving the self-purification capacity of lake water



Artificially enhanced water circulation technology in the stagnant water area of the lake

Artificial enhanced oxygen enrichment technology in backwater area

Construction technology of lake water ecosystem

- 湖湾死水区人工强化水体循环流动技术示范工程位于园博园凌云桥湖湾；
- 回水区人工强化富氧技术示范工程位于园博园听雨桥湖湾；
- 湖库健康水生态系统构建技术示范工程位于园博园秋亭桥湖湾

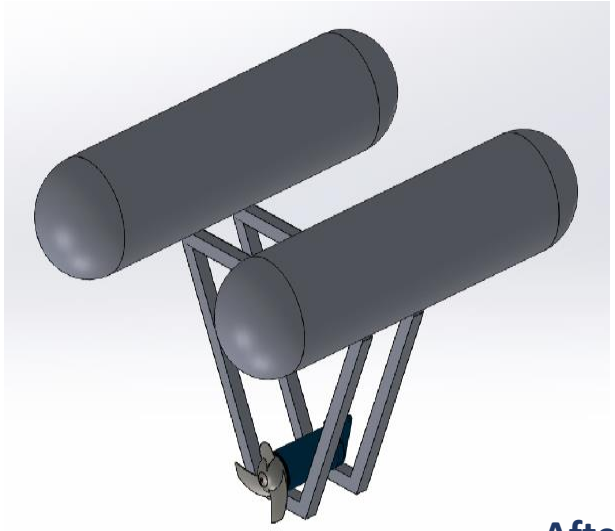
- The demonstration project of artificially enhanced water circulation flow technology in the stagnant water area is located in Lingwanqiao Lake, Yuanbo Bridge;
- The demonstration project of artificially strengthening oxygen enrichment technology in the backwater area is located in Yuboyuan Lake.
- The demonstration project of the lake ecosystem construction technology is located in the Qiuting Bridge in the Garden Expo Park.

（3）湖体水体自净能力提升工程措施

Technologies for improving the self-purification capacity of water in the lake

治理技术1——湖湾死水区人工强化水体循环流动技术

Technology 1—Artificially enhanced water circulation technology in the stagnant water area of the lake

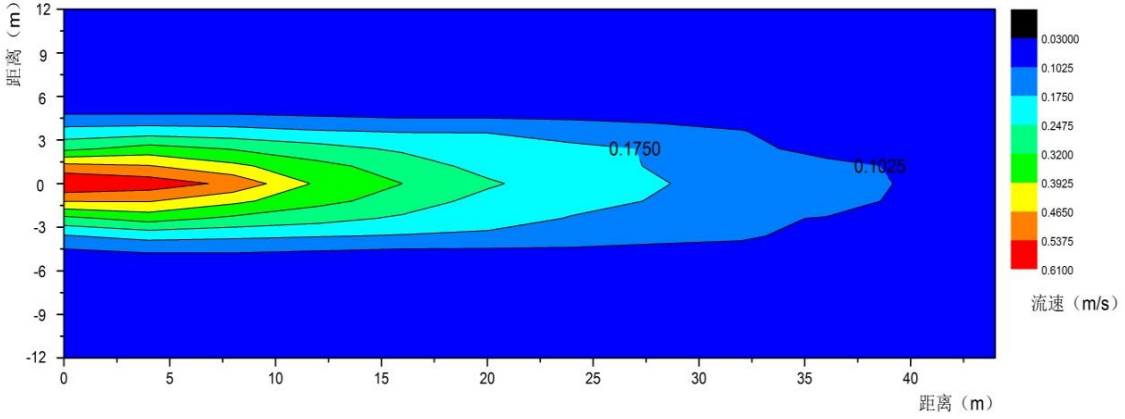


- 潜水推流器的型号为QJB5/12-615/3-480/S，叶轮直径620mm，功率5kw，额定电流12A，转速480r/min，轴向推力1300N，重量184Kg；
- 推流器安装深度为水下2.0 m。

- **The model of the submersible pusher is QJB5/12-615/3-480/S, the impeller diameter is 620mm, the power is 5kw, the rated current is 12A, the speed is 480r/min, the axial thrust is 1300N, and the weight is 184Kg;**
- **The installation depth of the flow ejector is 2.0 m under water.**

水体强化循环流动后，提高了水体的自净能力，水中的COD、TN和氨氮浓度有了一定的降低，同时大大减少了藻华爆发的风险。

After the water body strengthens the circulating flow, the self-purification ability of the water body is improved, the COD, TN and ammonia nitrogen concentration in the water are lowered, and the risk of algal bloom is greatly reduced.



（3）湖体水体自净能力提升工程措施

Technologies for improving the self-purification capacity of water in the lake

治理技术2——湖湾水体人工强化富氧(喷泉)技术

Technology 2——Artificial enhanced oxygen enrichment technology in backwater area

①喷泉设计形式采用直线狭长型配管方式，喷泉总长40m，主管道上装有DN25(1寸)万向直流喷头100个，喷头间距为40cm；
②喷泉共有潜水泵5台，漂浮式水箱10个，喷泉控制设备一套
③喷泉潜水泵功率5.5KW，流量100m^3/h，扬程12m
④夏季，考虑能耗，选择喷泉高度1 m;秋冬季最佳的喷水高度为5m(万向直流喷头)和1.5m(礼花喷头)；
⑤喷泉吸水口在水下7 m；

①fountain design adopts straight and narrow pipe type, the total length of the fountain is 40m, and 100 DN25 (1 inch) DC nozzles are installed on the main pipe, and the nozzle spacing is 40cm;

② fountains are equipped with 5 submersible pumps, 10 floating water tanks, and a set of fountain control equipment.

③ fountain submersible pump power is 5.5KW, flow rate is 100m3/h, head is 12m

④In summer, considering the energy consumption, choose a fountain height of 1 m; the best water spray height in autumn and winter is 5m (universal DC nozzle) and 1.5m (fireworks nozzle);

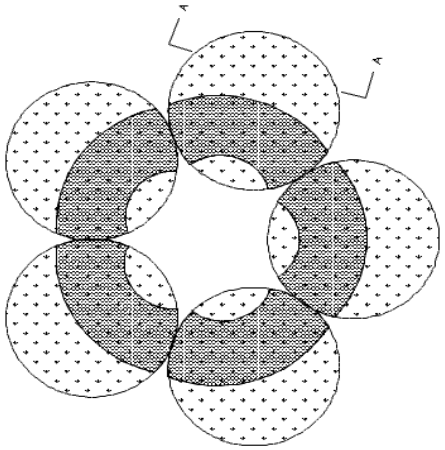
⑤fountain suction port under water 7 m;

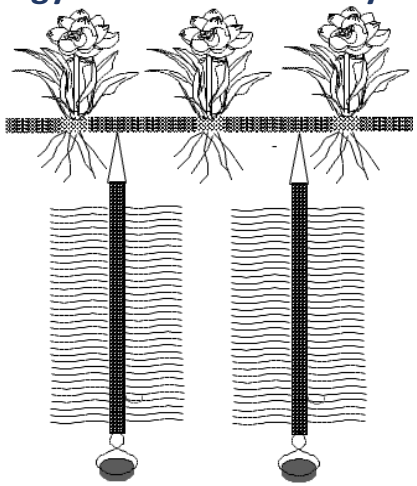
（3）湖体水体自净能力提升工程措施

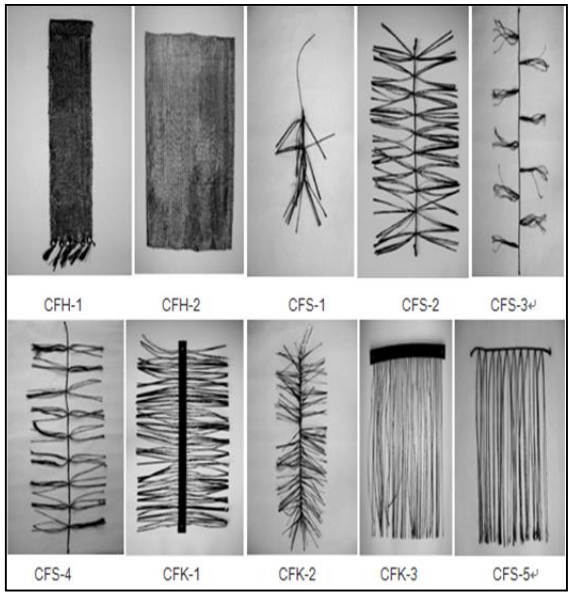
Technologies for improving the self-purification capacity of water in the lake

治理技术3——湖库健康水生态系统构建技术

Technology 3——**Construction technology of lake water ecosystem**







①浮床基质为亲水性好，耐腐蚀的椰棕，密度为0.78 kg/m^3

②浮床植物选择净化能力强、根系发达、景观品质高的当地品种，包括美人蕉、菖蒲、旱伞草，种植密度为16株/m^2，种植量为2400株

③生态草设置密度为1根/2 m^3，设计区域总设置量为800根

④考虑投放滤食性鱼类，以花白鲢为主，按3000尾/10000 m2投放鱼类，花鲢/白鲢比例为2:8，鱼苗投放规格为0.2-0.4 kg/尾，逐年回捕。利用滤食性的花鲢、白鲢控制湖体中蓝绿藻的生长

① **Floating bed** substrate is hydrophilic, corrosion-resistant coconut palm, density is 0.78 kg/m3

②Floating bed plants choose local varieties with strong purification ability, developed roots and high landscape quality, including canna, calamus, and sedge grass, with a planting density of 16 plants/m2 and a planting capacity of 2,400 plants.

③ The ecological grass has a density of 1 / 2 m3, and the total planting amount in the design area is 800.

④ Consider the introduction of filter-feeding fish, mainly white flowers, and put fish at 3000/10000 m2. The ratio of flower buds/white carp is 2:8, and the size of the fry is 0.2-0.4 kg/tail, which is collected every year. Controlling the growth of blue-green algae in lakes by using filter-feeding calyx and white peony

4

治理成效

Project efficacy

3 years operation of Engineering measures have improved the water quality in demonstration sites

五、治理成效

Results obtained after these projects

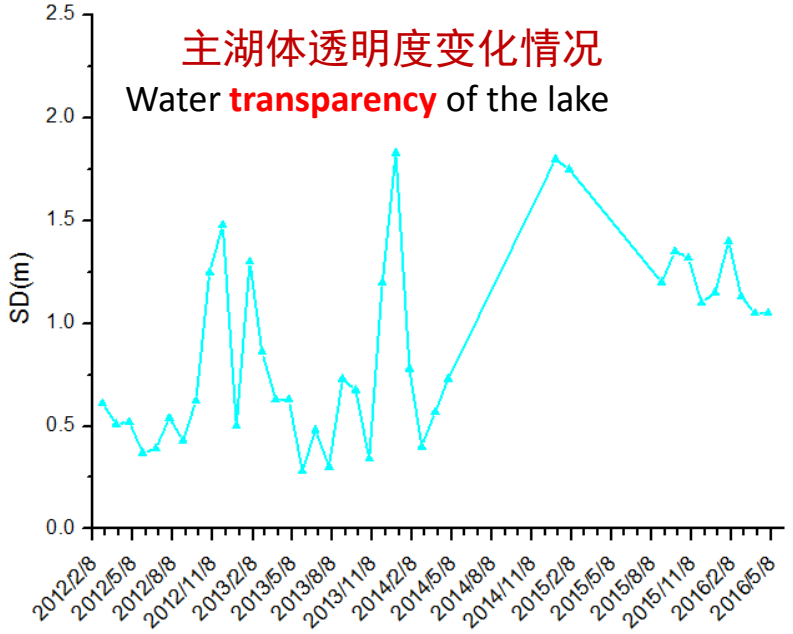
Loading reduction

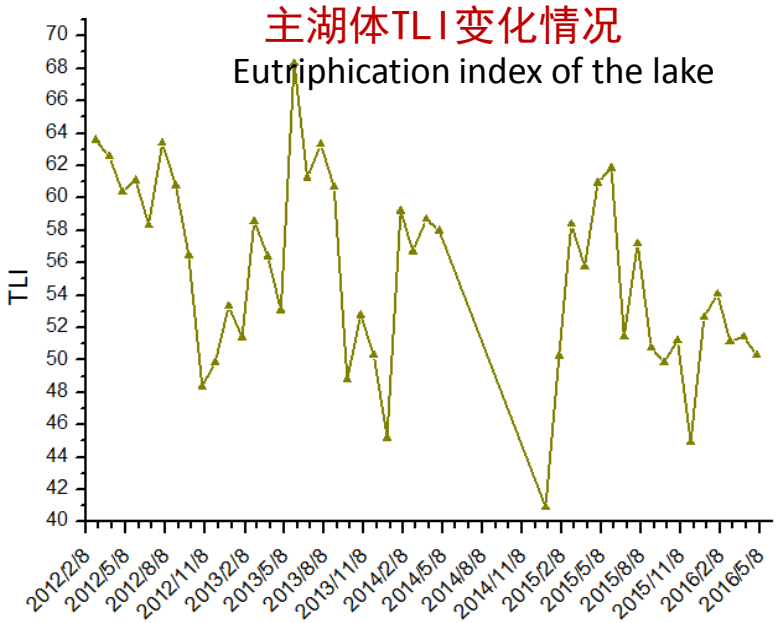
区 域 Area	污染负荷 Pollution load t/yr	工程措施 Engineering measures	污染负荷削减Pollution load reduction t/yr	削减率 Reduction rate
赵家溪来水段 The water section of Zhaojiaxi	COD 114.18 TN 6.05 TP0.38 TSS 39.33	重光湖滨公园面源污染控制工程 Non-point source pollution control project of chong guang Lakeside Park	COD 45.1、TN 1.28、TP 0.071、SS 4.32	COD 49.1% TN 31.7% TP 29.2% SS 63.9%
		赵家溪入湖支流生态滤池深度处理技术示范工程 Demonstration project of deep treatment technology of Zhaojiaxi tributary ecological filter in the lake	COD 10.95、TN 0.64、TP 0.05、TSS 20.8	
江南园湖湾汇水区 Lake catchment area in Jiangnan Park	COD 11.3 TN 3.1 TP 0.12 TSS 11.2	江南园山地城市面源污染控制集成技术示范工程 Demonstration project of integrated pollution control technology for mountainous cities in Jiangnan Park	COD 6.93 TN 1.43 TP 0.04 TSS 6.03	COD 61.3% TN 46.1% TP 33.3% TSS 53.8%
龙景沟 Longjinggou	COD 42.2 TN 17.1 TP 2.73 TSS 671.1	龙景沟截污工程 Longjinggou sewage interception project	COD 42.2 TN 17.1 TP 2.73 TSS 671.1	COD 100% TN 100% TP 100% TSS 100%
合计 total	COD 167.7 TN 26.25 TP 3.29 TSS 721.6		COD 105.2 TN 20.45 TP 2.881 SS 702.25	**COD 62.7%** **TN 77.9%** **TP 87.6%** **SS 97.3%**

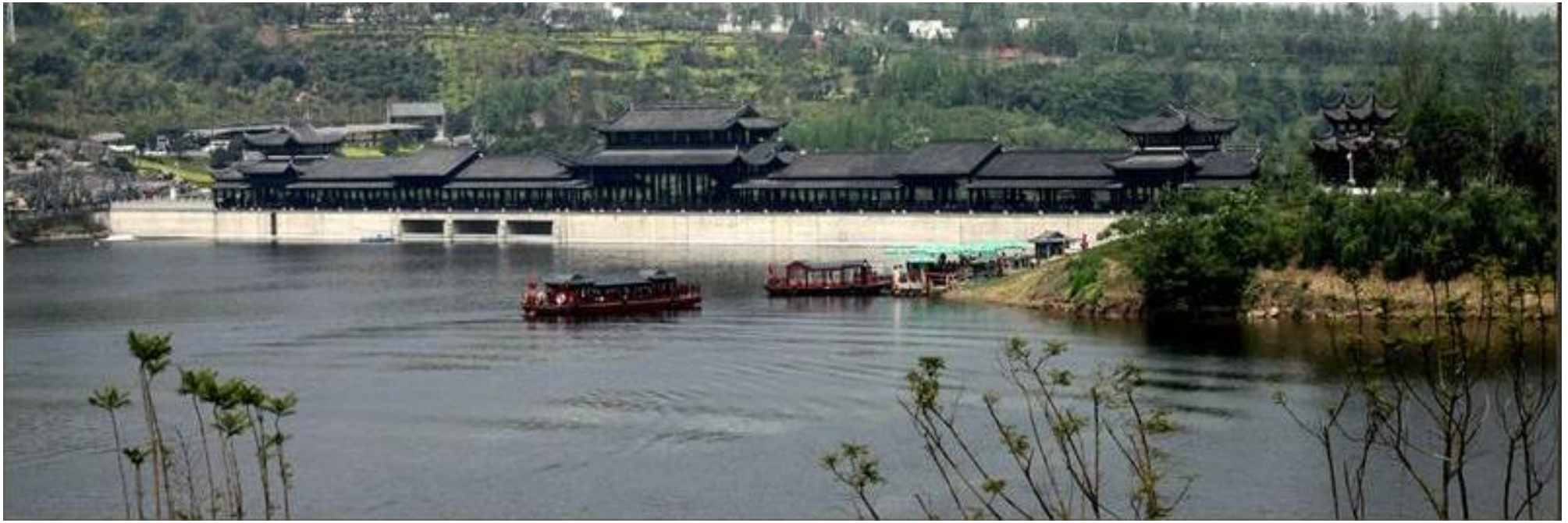
五、治理成效 Results obtained after these projects

Designed objective water quality (Grade IV) after 3 years' operation has been achieved!

指标 index	深水区平均 Average data for deep water	湖湾区平均 Average data for shallow water
高锰酸盐指数Permanganate index	3.89 mg/l	4 .03 mg/l
透明度 transparency	1.05m	1.01m
总磷 Total phosphorus	春冬季 0.12mg/l	春冬季 0.12mg/l
	夏秋季 0.09mg/l	夏秋季 0.09 mg/l
总氮 Total nitrogen	1.40 mg/l	1.36 mg/l
综合富营养化指数 Integrated eutrophication index	53.42	53.32








Thanks for your attention!