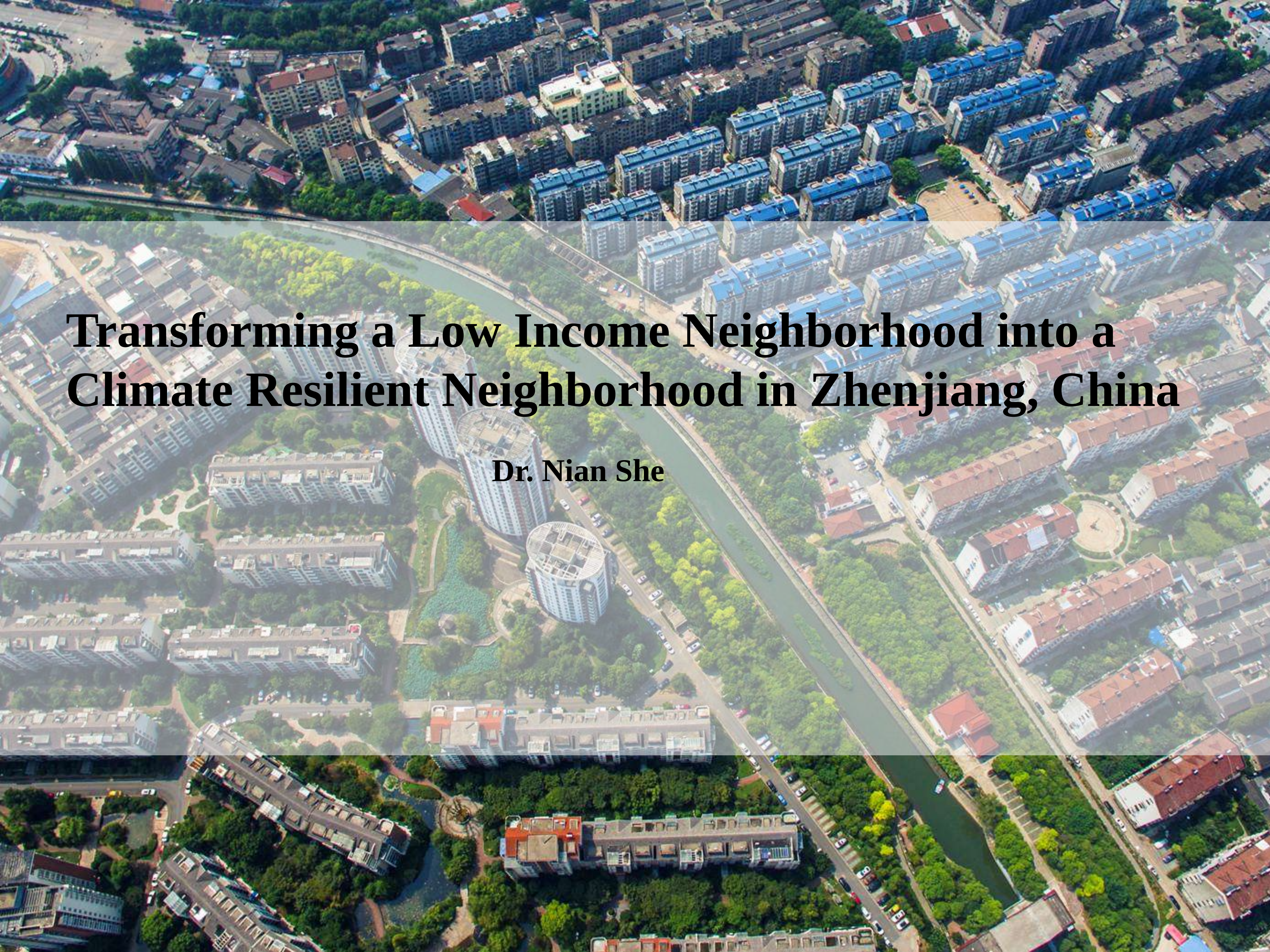


Transforming a Low Income Neighborhood into a Climate Resilient Neighborhood in Zhenjiang, China

Dr. Nian She

Location of the Project Area

This is a high density neighborhood built in 1970s. Most residents are low income retirees. Due to the lack of maintenance, this neighborhood had endured annual flooding, deterioration of aging infrastructure, lack of appropriate sanitary conditions and no parking lot . Young people moved out

Problem 1 - Flooding

Flooding Event in 2015 before the retrofit

Problem 2 – Pavement Damage

For decades there was no maintenance. The pavements in the neighborhood were damaged. Many green spaces were destroyed

Problem 3 – Landscape Sites Became Garbage Dumping Ground

The garbage were dumped into landscape sites

Problem 4 – Lack of Parking Space

Due to lack of parking space some green space became “illegal parking lots”

Problem 5 – Building Surface Deterioration and Lack of Appropriate Infrastructures

“Sponge City” Targets

- Control 1” rainfall
- Remove 40% TSS

However,

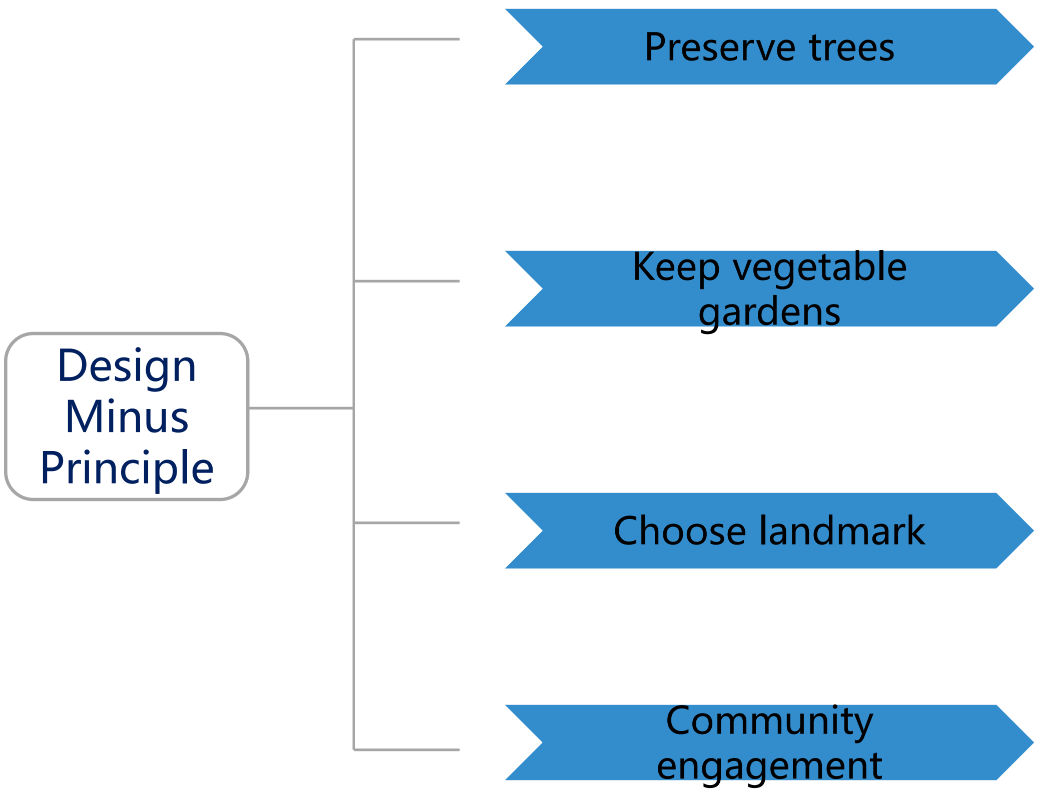
- Is this really what the residents want?
- Does this really make the residents happier?
- Can these problems identified be solved by following above targets?
- What should we do as a designer?

Our Approach

Landscape +N

- **Improve Livability**
  - ●Increase recreational spaces
  - ●Preserve big trees
  - ●Landscape reclamation
- **Flood Mitigation**
  - ●Route impervious surface into rain gardens and green spaces
  - ●Change sidewalk into permeable pavement
- **Better Property Management**
  - ●Re-organize property management
  - ●Setup maintenance guidance
- **Retrofit Gaslines**
  - ●Switch from coal gas to natural gas
- **Upgrade Water Supply Infrastructure**
  - ●Repair leaking pipes and meters
  - ●Replace eroded pipes
- **Increase Parking Space**
  - ●Increase parking spaces
  - ●Install porous parking lots
- **Energy Conservation**
  - ●Utilize thermal insulation materials
  - ●Install window shading
  - ●Upgrade electrical system and lighting
- **Sewer Separation**
  - ●Disconnect illegal connections
  - ●Separate sewer from storm drains

Design Principle



Design minus principle is minimizing the landscape intervention because this neighborhood has about 40 years of history. Residents spent most of their life in the neighborhood. Keep their memory is so important in the design work. After the retrofit it is desirable to minimize the maintenance cost, and encourage the residents to maintain their vegetable gardens and fruit trees.

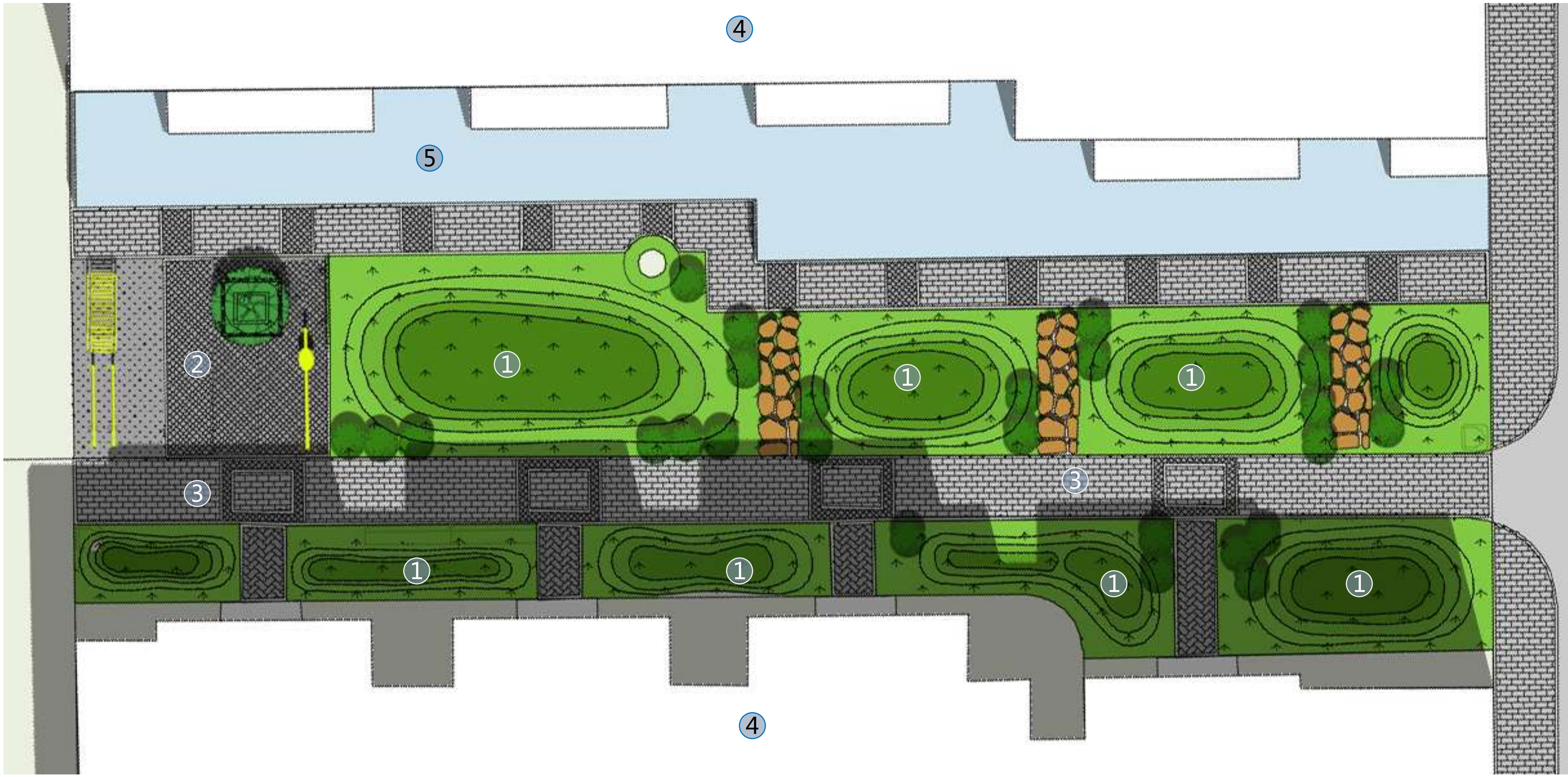
LID design process：

1. Site Investigation
2. Survey drainage network
3. Subcatchment delineation
4. Communication with residents
5. Soil infiltration testing
6. LID layout and modeling
7. Separation
8. Monitoring

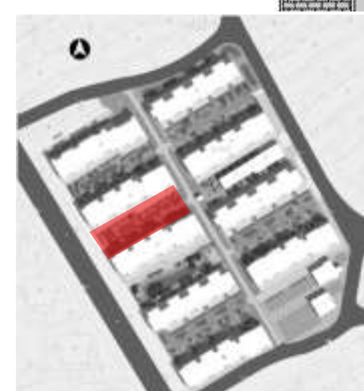
Layout

1
2
3
4
5
6
7
8
9
LEGEND
PRESERVE EXISTING FRUIT TREE
PRESERVE EXISTING VEGETABLE PATCH
RAIN GARDEN
VEHICEL ENTRANCE
PEDESTRIAN ENTRANCE
1 PERMEABLE PARKING LOT
2 RAIN GARDEN
3 PERMEABLE SIDEWALK
4 PERMEABLE SIDEWALK
5 OPEN SPACE
6 PLAYGROUND
7 ORCHARD
8 PUBLIC SQUARE/OPEN SPACE
9 VEHICLE ROAD
0 500 1000 2000m

Section Design



1. Bioretention
2. Recreation space
3. Porous pavement
4. Building
5. Yard



How Green Stormwater Infrastructure Works

Experiments before the construction

Growing Media Test

Plants Selections

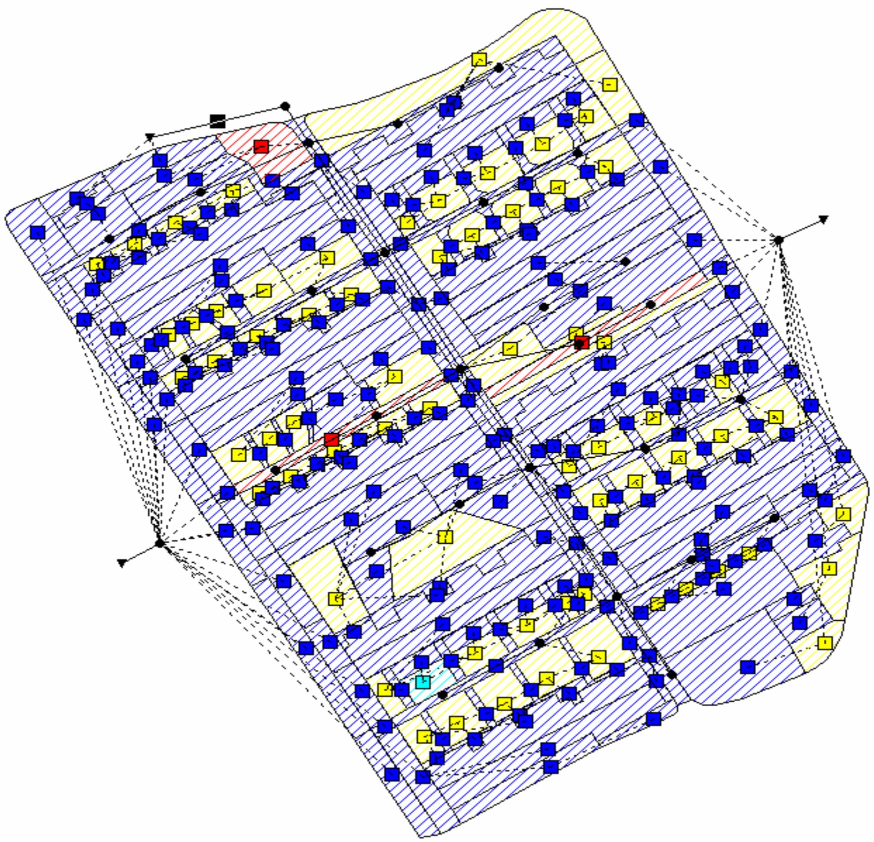
Infiltration Test

Observation of Plant Growth

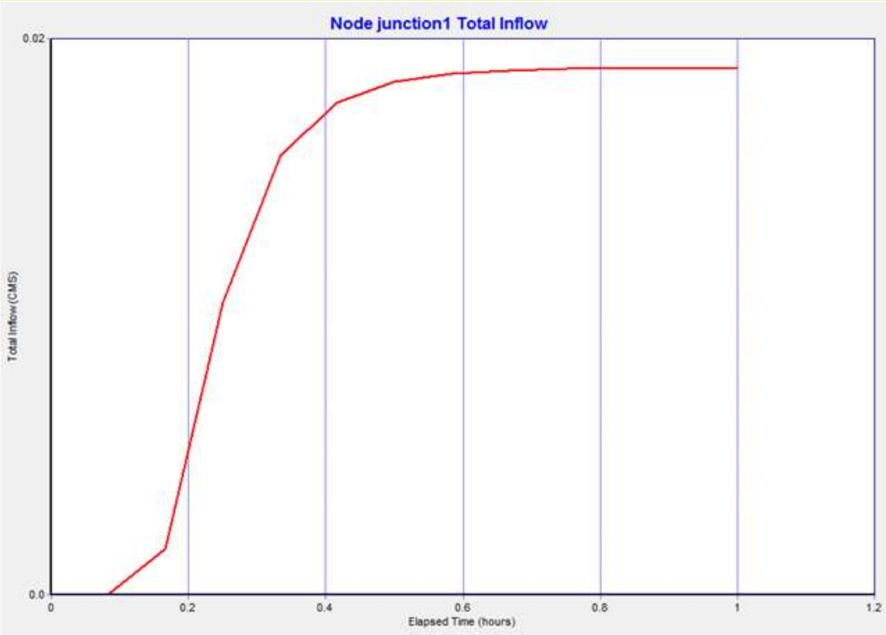
Site Delineation and Modeling：

Delineation: Rooftop, Road, Green Space and “Yard”

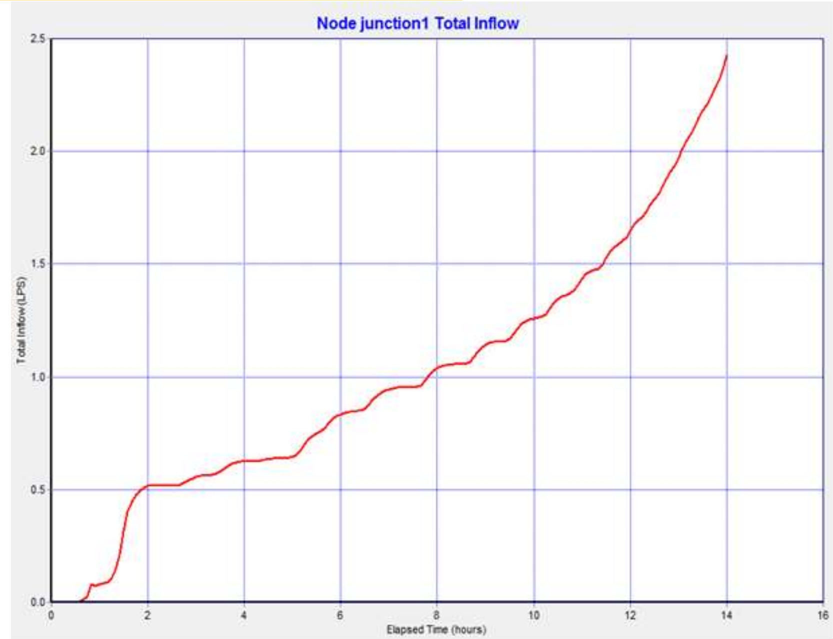
Model: SWMM



Runoff Quantity Continuity	Volume hectare-m	Depth mm
Initial LID Storage	0.022	11.521
Total Precipitation	0.413	219.979
Evaporation Loss	0.000	0.000
Infiltration Loss	0.052	27.927
Surface Runoff	0.189	100.574
Final Surface Storage	0.193	102.629
Continuity Error (%)	0.160	



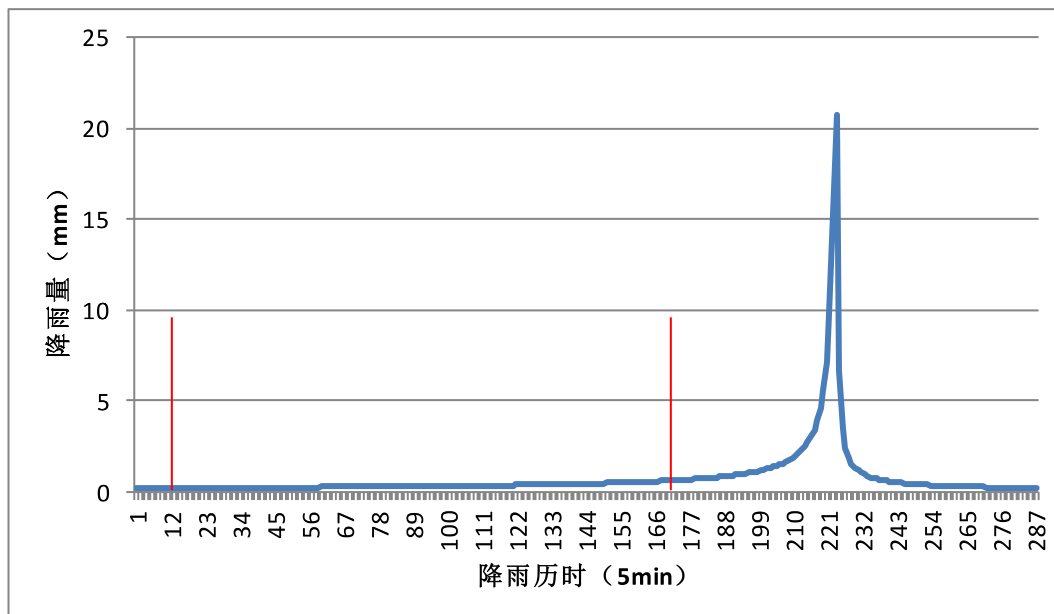
NO-LID （Before）6.2mm rainfall detention

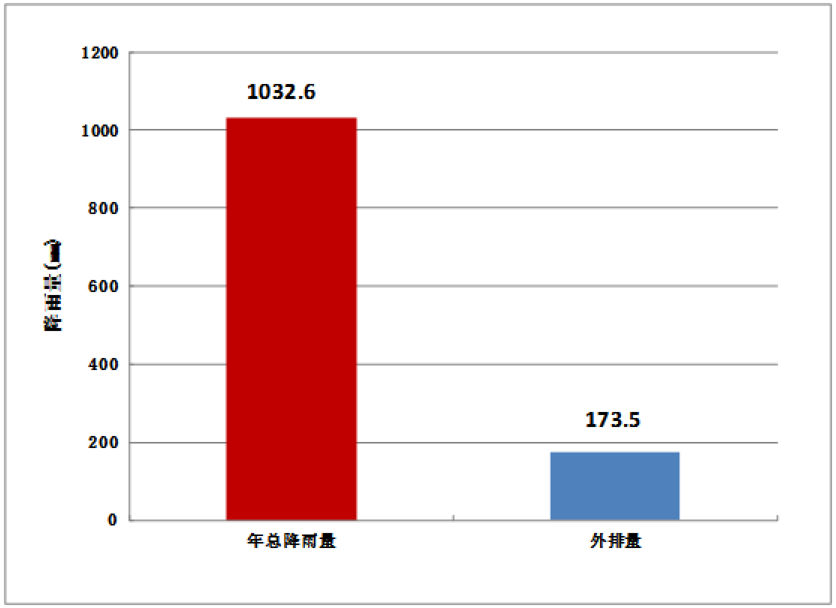


LID （After） 34.6mm rainfall detention

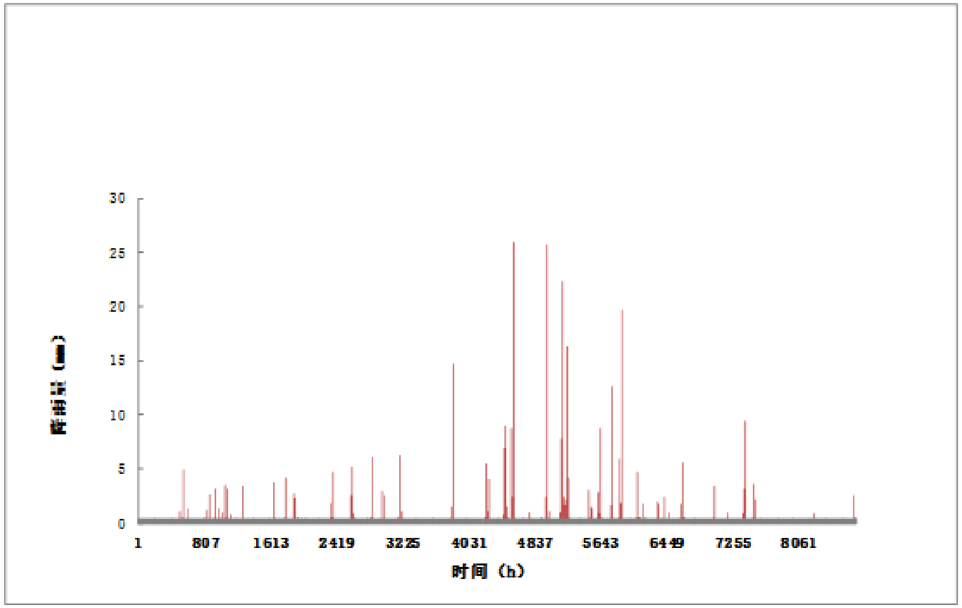
Concluding :

LID can delay 13 hours of discharge at the outfall. (Without LID it is just 1 hour)





Annual rainfall vs discharge



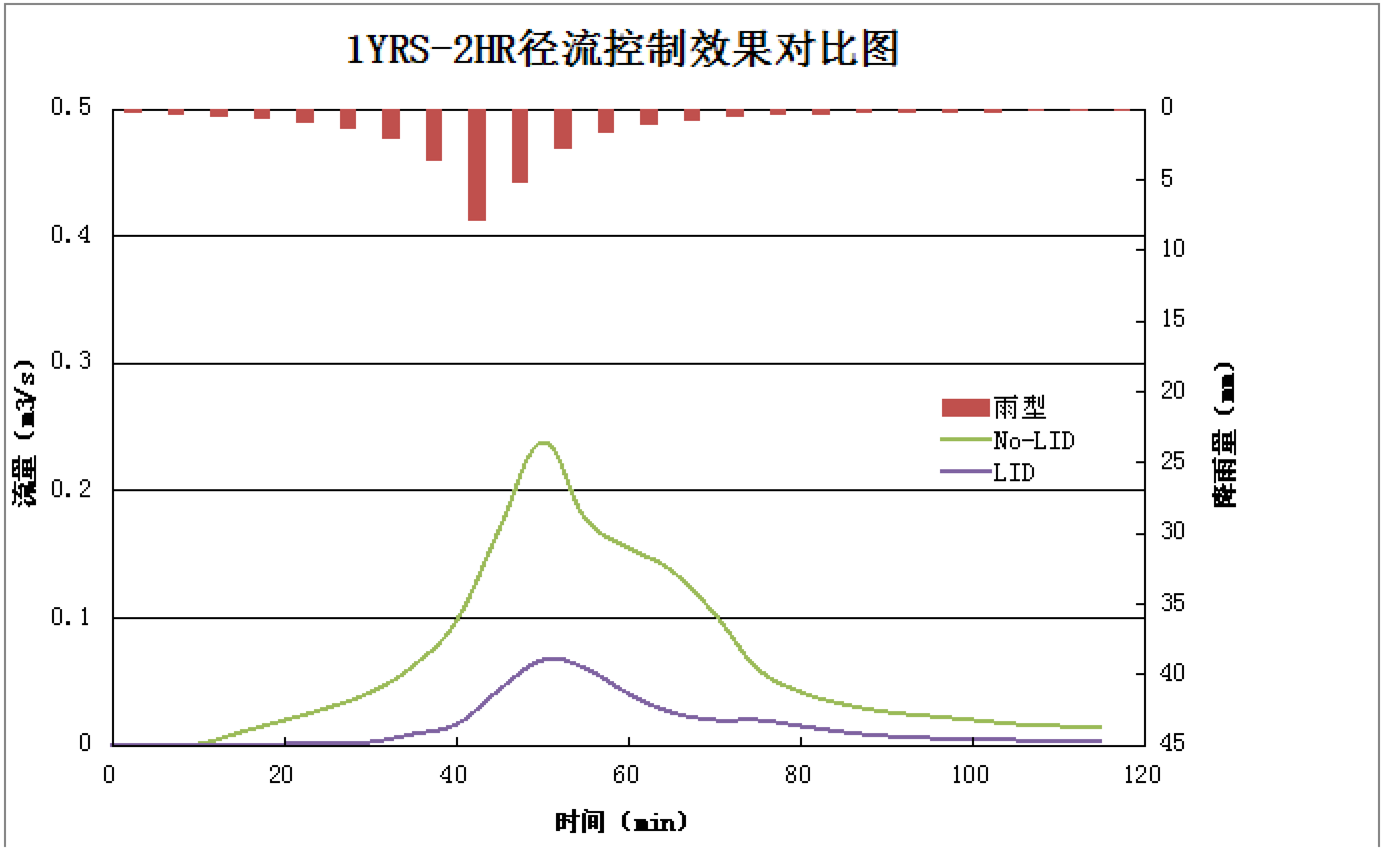
2005 rainfall data (5-min)

Data Analysis : 113 events , 7 events exceed 34.6mm , 6.2%。

Annual rainfall 1032.6mm , Discharged runoff 173.5mm , 16.8%。

注：以上年总降雨量及实测降雨量均参考2005年南京实测数据。

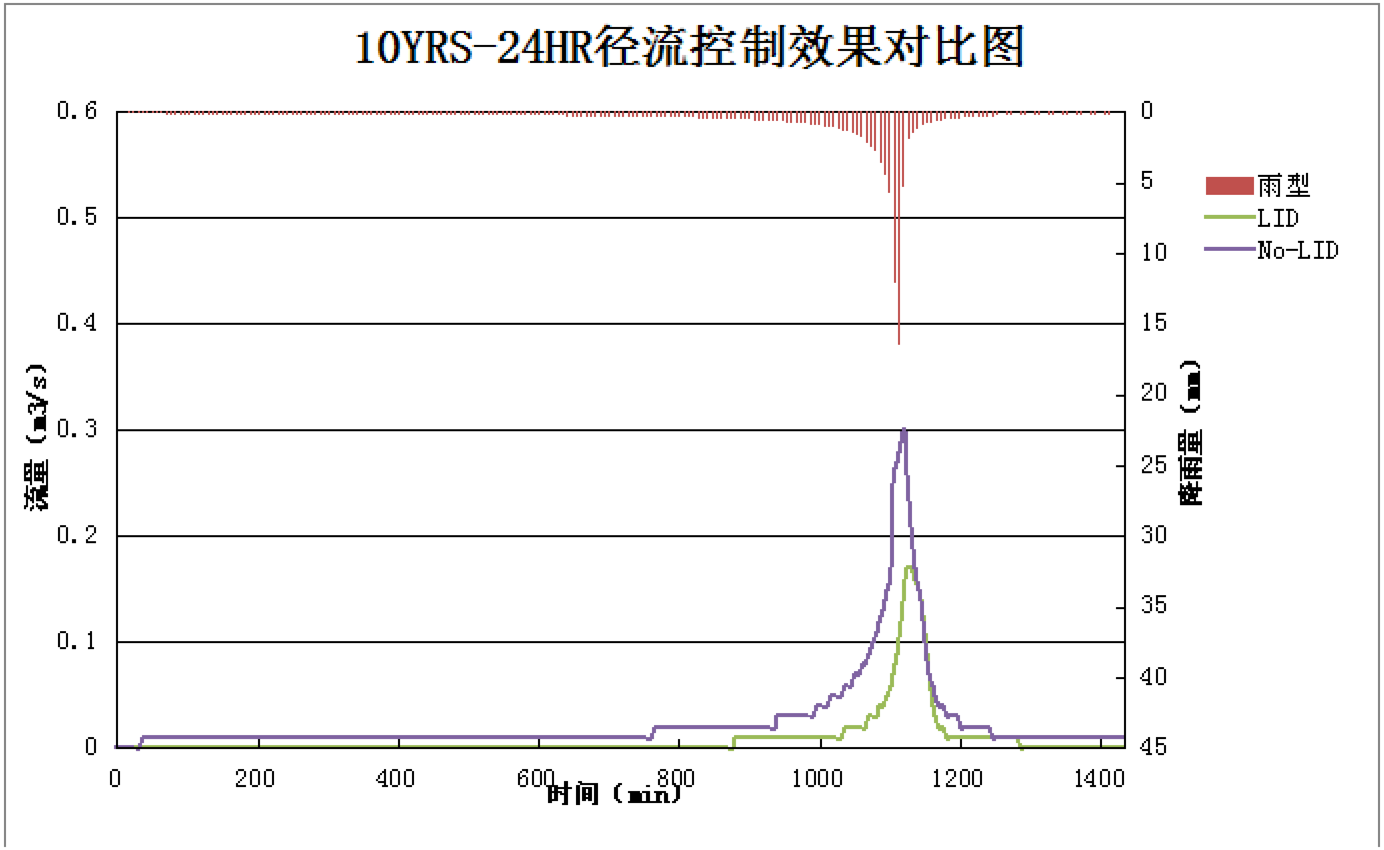
1yr-2h：



	Rainfall （mm）	Peak rainfall （min）	Peak runoff （min）	Runoff Volume （m³）	Peak runoff （m³ /s）	Runoff Coefficient
Before	37. 5	40	50	598	0.24	0.85
After	37. 5	40	50	198	0.07	0.28

72% runoff volume reduction

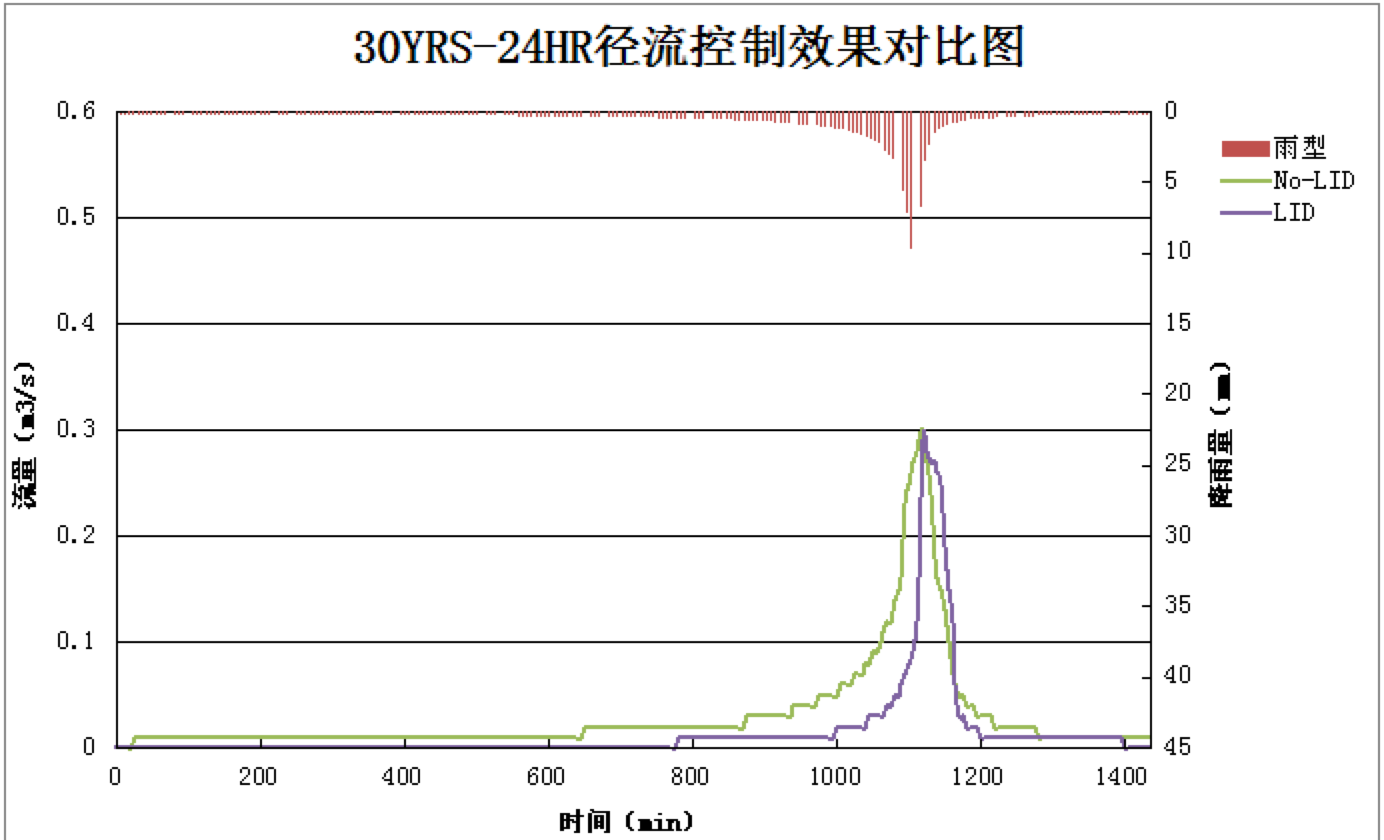
10yr-24h：



	Rainfall（mm）	Rainfall peak（min）	Runoff peak（min）	Runoff Volume（m³）	Runoff peak（m³ /s）	Runoff Coefficient
Before	175. 0	1115	1120	2810	0.30	0.85
After	175. 0	1115	1125	1290	0.17	0.40

Volume Reduction 54%，Peak Reduction 43%，Peak shifting

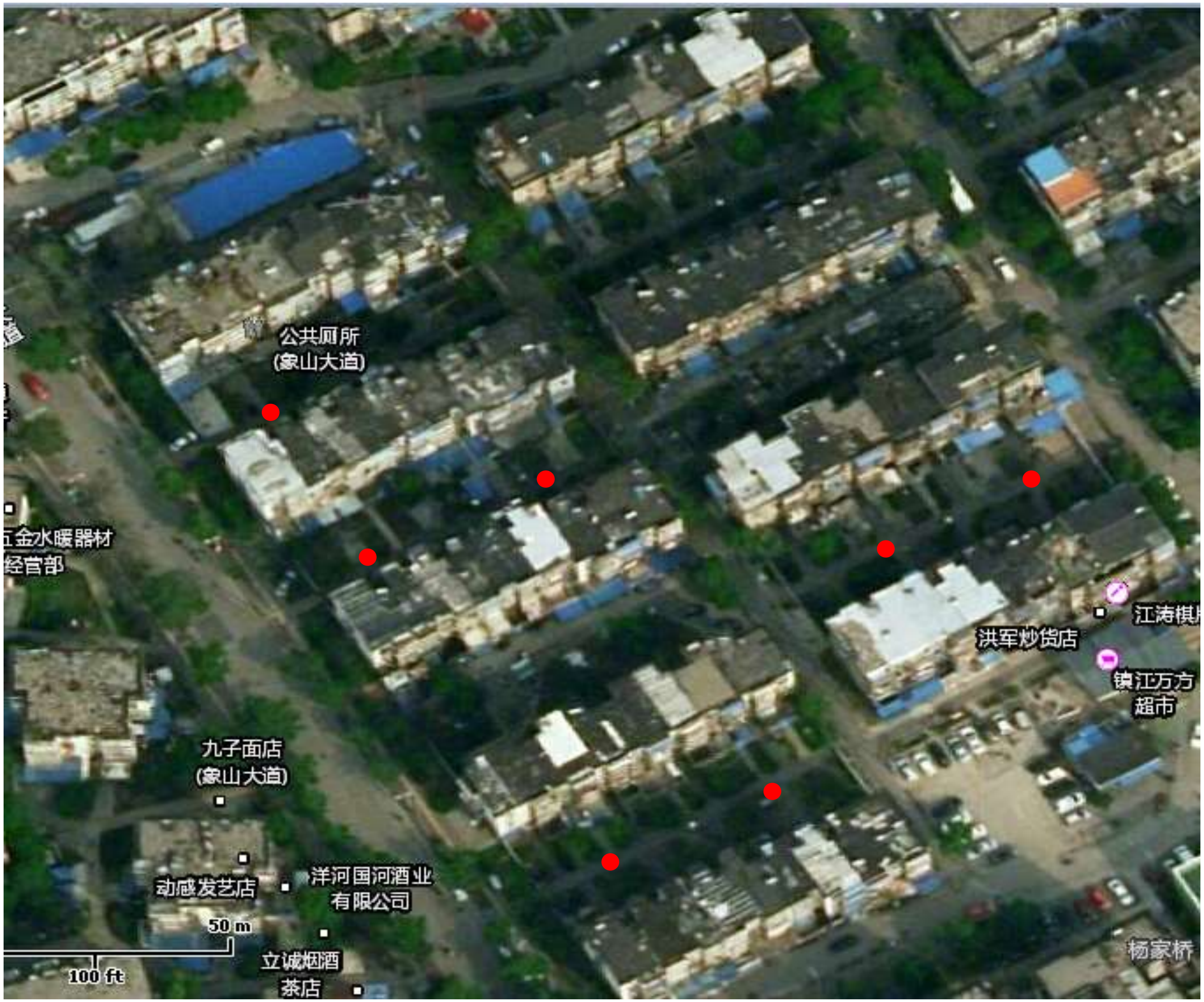
30yr-24h：



	Rainfall（mm）	Rainfall peak（min）	Runoff peak（min）	Runoff volume（m³）	Runoff peak（m³ /s）	Runoff Coefficient
Before	220. 0	1115	1120	3600	0.30	0.87
After	220. 0	1115	1125	1890	0.29	0.46

Runoff volume reduction 47.5%，No significant reduction of peak

30yr – 24hr



There are 24 hot spots before. Flood volume 512m3，14 spots exceed 15cm in depth。

Only 7 hot spots left after. Flood volume 62m3, Only 1 spot exceeds 15cm in depth. Flood time 30min。

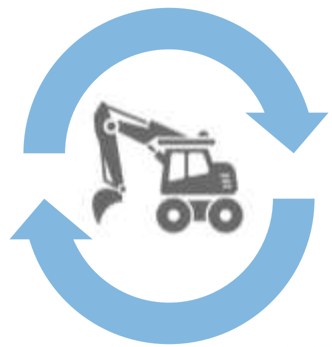
Design Process

Design Discussion

Outreach

Public Comments

Construction



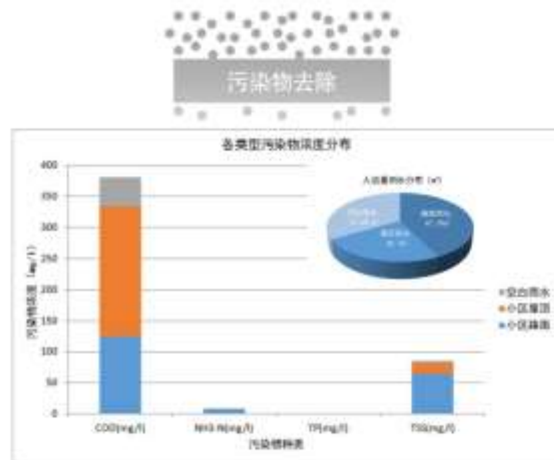
Completion

Post Construction

During Heavy Storm

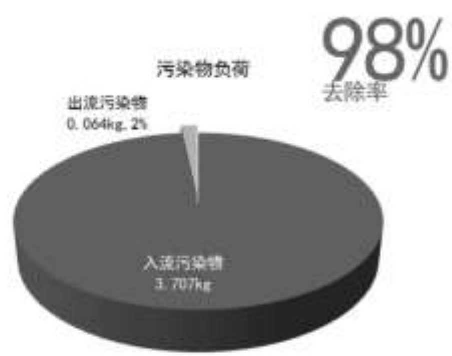
After completion of the project the neighborhood experience two heavy storm events. One is 138 mm rainfall in 2016 and another is 125mm rainfall in 2017.

Monitoring Results



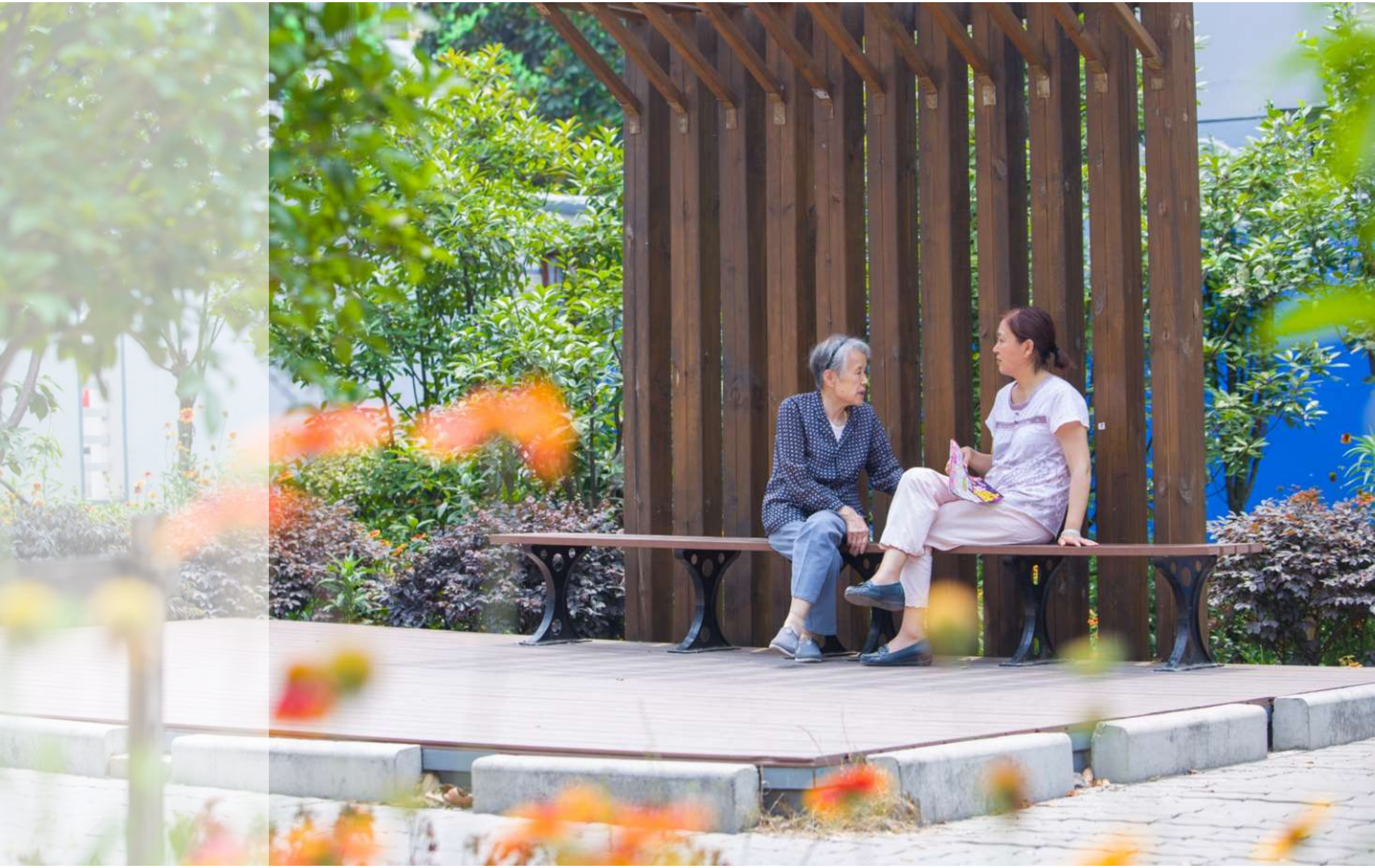
下垫面类型	COD(mg/l)	NH3-N(mg/l)	TP(mg/l)	TSS(mg/l)	入流总水量(m³)
小区屋面	125.09	7.57	0.21	64.73	47.79
小区道路	209.48	0.38	0.07	16.38	26.7
空白雨水	46.27	0.25	0	4.73	37.48
综合污染浓度	110.82	3.37	0.11	33.11	111.97

		总污染负荷(kg)	污染去除率(%)
综合污染浓度(mg/l)	33.11		
总入流量(m³)	111.97	3.7073	0.9831
出水水质浓度(mg/l)	11.36		
总出流量(m³)	5.63	0.064	

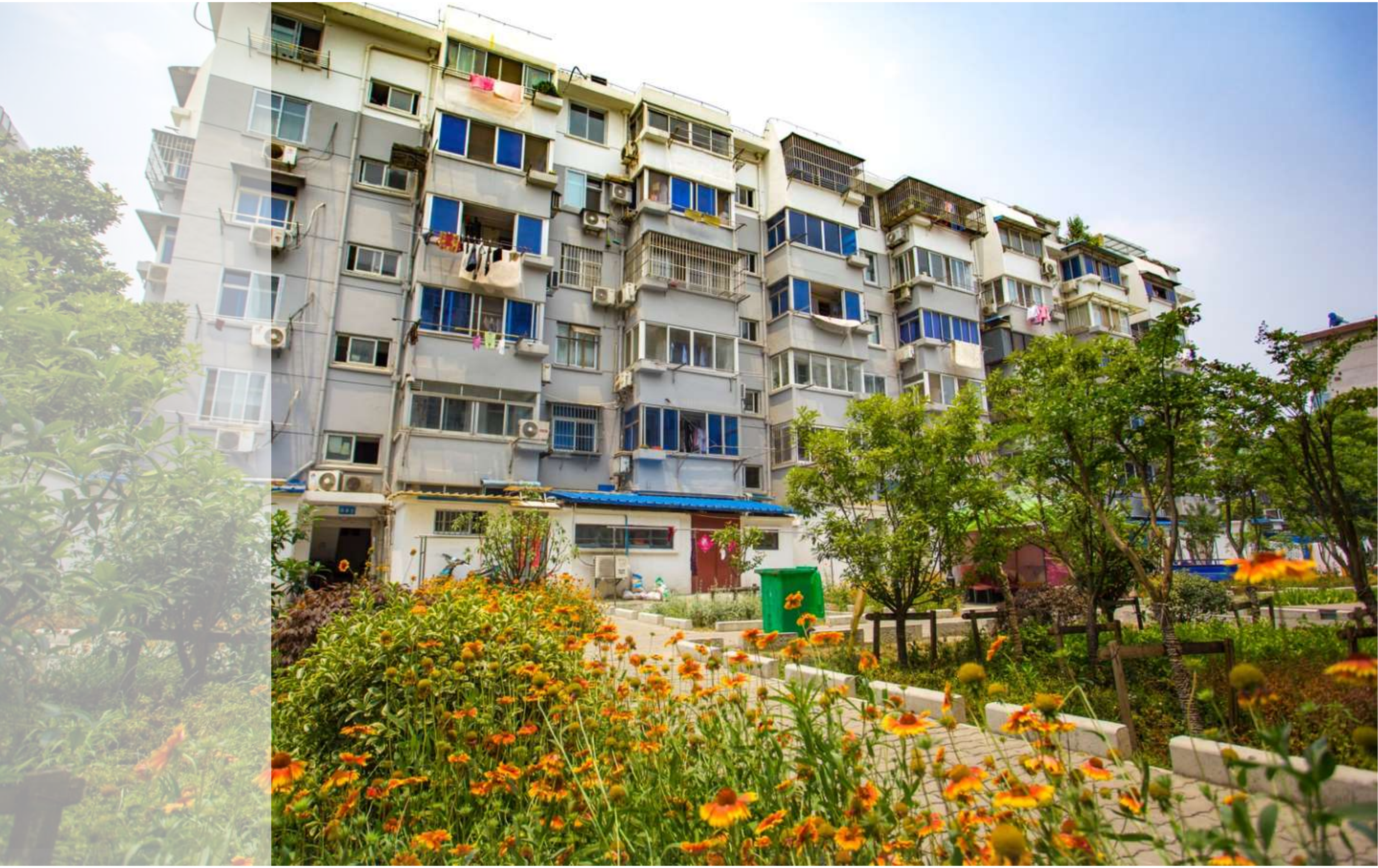


95% Flow Reduction, and 98% TSS Removal

An Ideal Place for Social Interactions of the Residents



Beautiful Landscape – Reduced Symptoms of Depression and Anxiety



Rain Garden + Porous Access = Improved Personal Safety

Happiness – Yong People bring their Children back


Take the green home
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