Water Supply in Xi'an

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Water Supply in Xi'an

- History of water supply
- Water supply capacity
- Quality of water resource
- Waterworks and water purification
- Water supply in the future

History of water supply

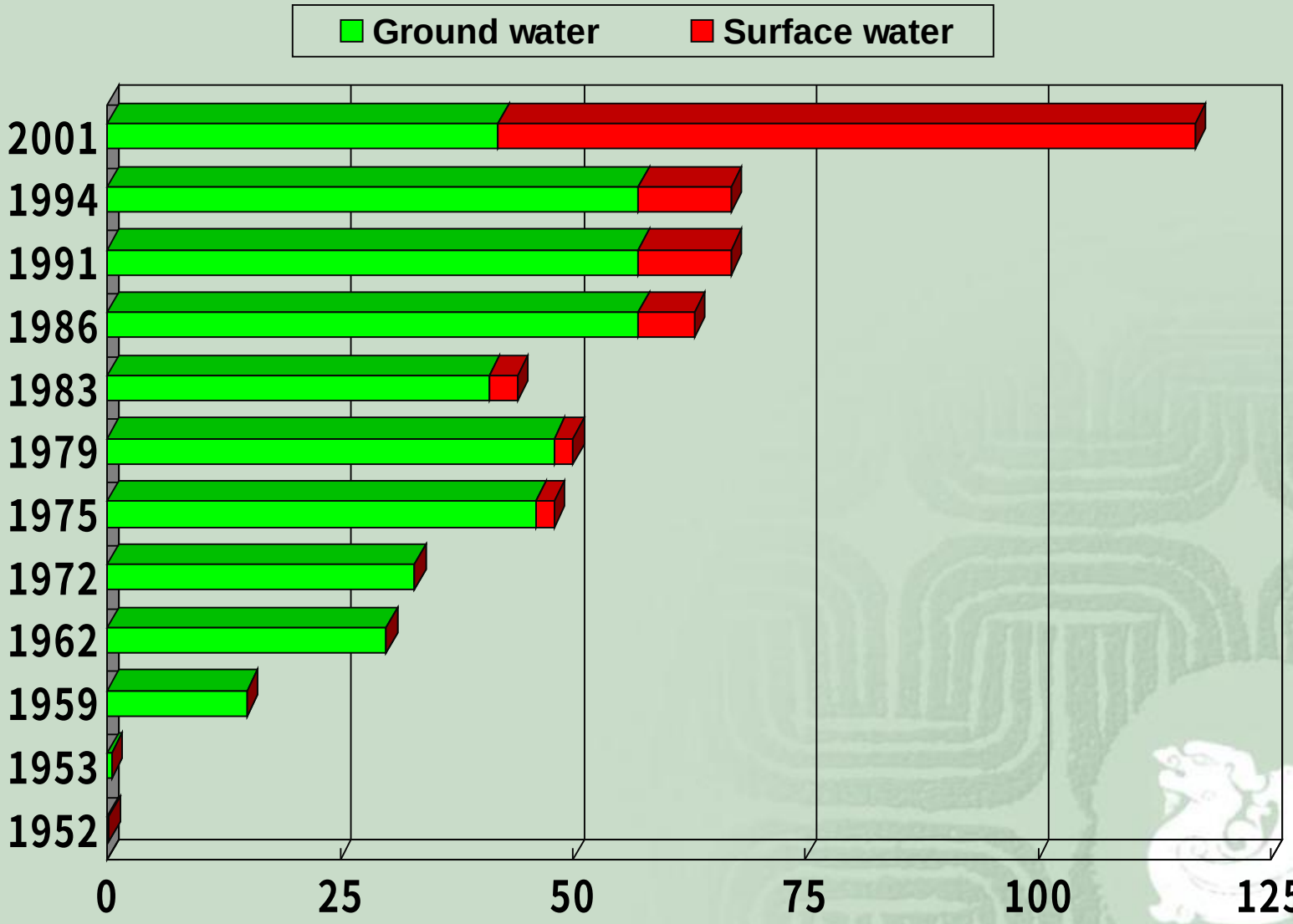
The first water treatment plant of Xi'an, taking ground water as its source, was established in Oct of 1952.

The plant supplied water for the city with a capacity of 3182.20 m^3/day.

History of water supply in Xian (1952~2001)

Year		1952	1953	1959	1962	1972	1975	1979	1983	1986	1991	1994	2001
Average daily water volume supplied ($\times 10^4 m^3/d$)	Surface water	---	---	---	---	---	2	2	3	6	10	10	74.8
	Ground water	0.20	0.50	15	30	33	46	48	41	57	57	57	42
	Total	0.20	0.50	15	30	33	48	50	44	63	67	67	116.8
Design water supply capacity ($\times 10^4 m^3/d$)	Surface water	---	---	---	---	---	3	3	6	12	72	72	122
	Ground water	0.32	0.50	23.5	41.5	41.5	41.5	51.5	51.5	66.5	68	68	50
	Total	0.32	0.50	23.5	41.5	41.5	44.5	54.5	57.5	78.5	140	140	172

Changes of supplied water volume(1952~2001)



Water supply capacity in 2002

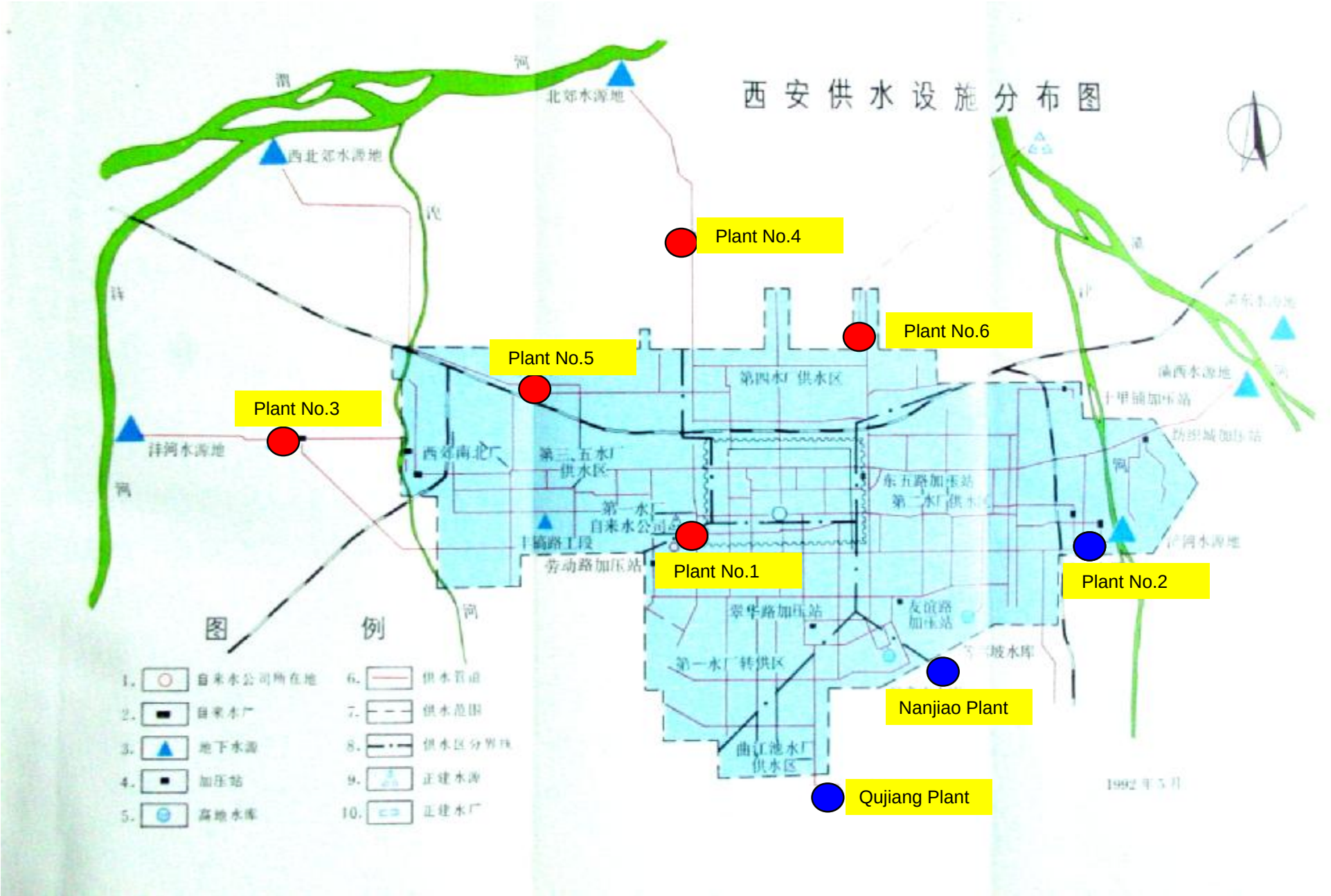
- There are 8 water plants in Xi'an, including : five Ground Water Plants and three Surface Water Plants.
- Total max. water supply capacity is about 172×10^4 m^3/day in 2002.

  Ground Water Plants supply 50×10^4 m^3/day

  Surface Water Plants supply 122×10^4 m^3/day
- Surface water volume transferred from Heihe River Valley amounts to 110×10^4 m^3/day

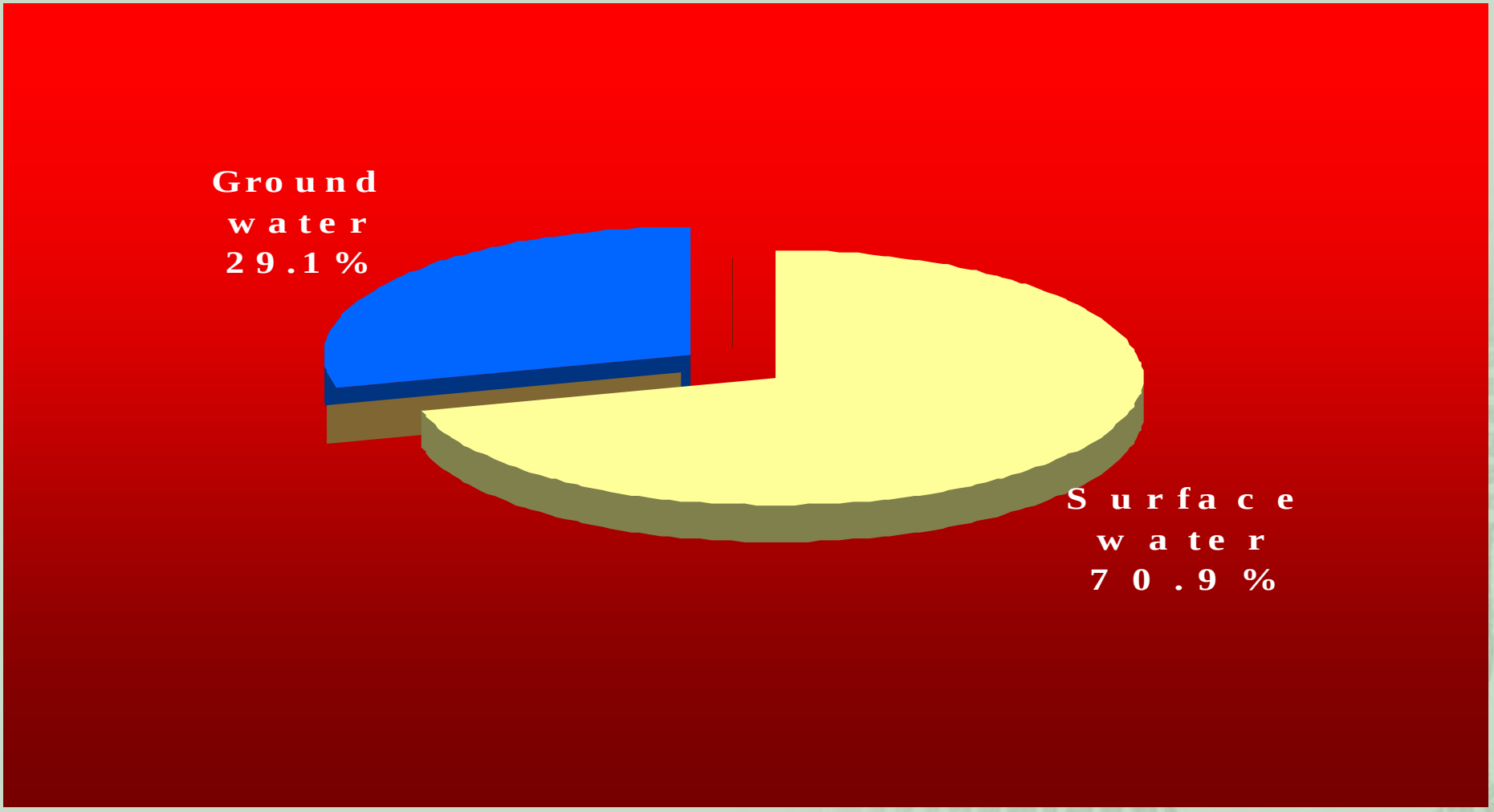
Waterworks of Xi'an (2001)

Water plant	Location	Water resource type	Well	Water supply capacity ($10^4m^3/d$)	Average Daily Supplied Water volume ($10^4m^3/d$)
Water Plant NO.1	In city area	Groundwater	12	1.4	0.67
Water Plant NO.2	East of the city	Groundwater near Bahe and Chanhe river	61	11	11
		Surface water from Chanhe river		12	3
Water Plant NO.3	West of the city	Groundwater of Zaohe river	22	4.9	9.9
		Groundwater near Fenghe river	34	10	
Water Plant NO.4	North of the city	Groundwater near Weihe river	36	10.7	8.8
Water Plant NO.5	Northwest of the city	Groundwater	46	12	10
Water Plant NO.6	Northeast of the city	Groundwater	8	(1.5)	(1.5)
Qujiang Water Plant	South suburb of the city	Surface water from Heihe river Shibianyu reservior and Tianyuhe river		60	46.81
Nanjiao Water Plant	South suburb of the city	Surface water from Heihe river		50	25



Sketch map of Water Plants of Xi'an

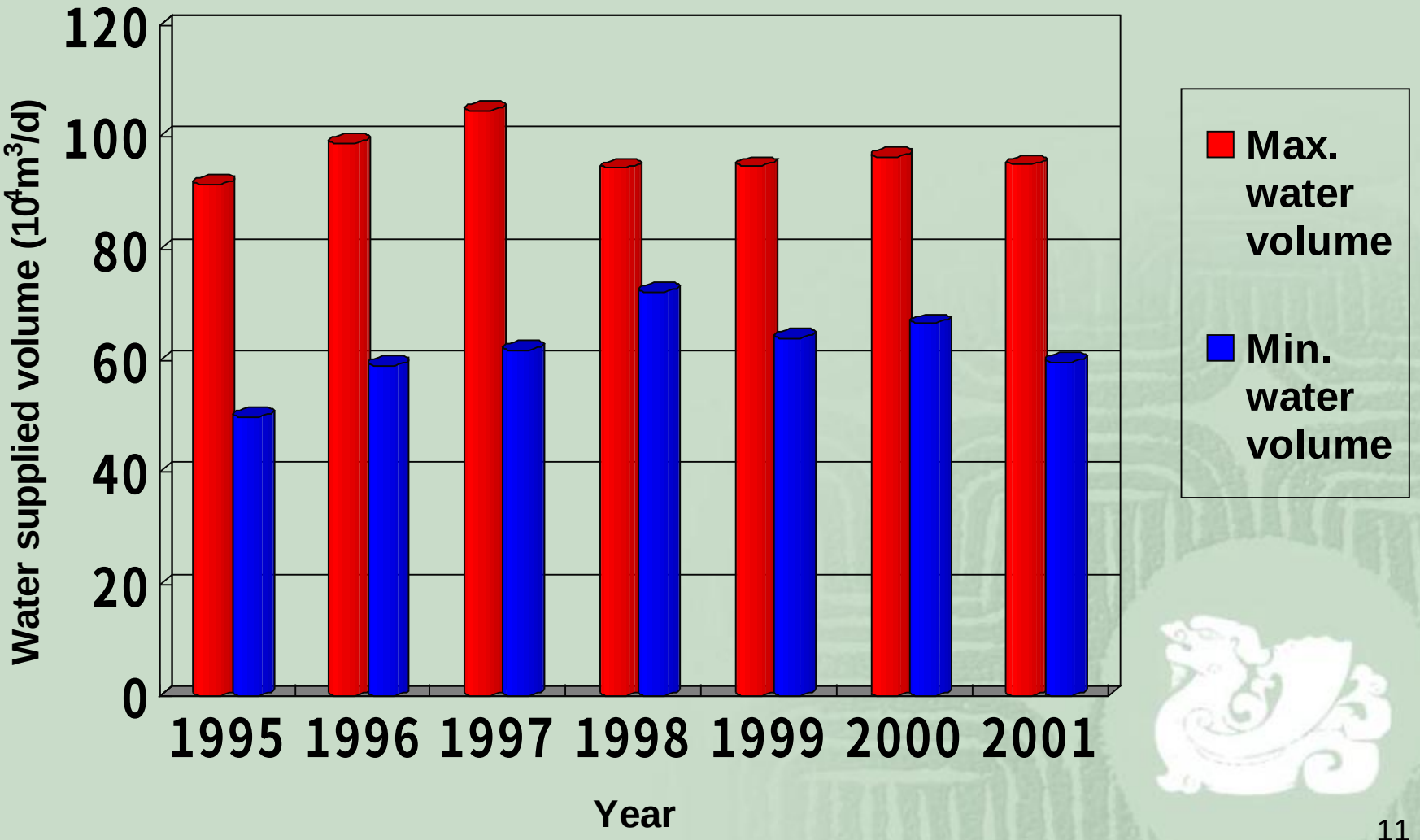
Water supply ratio of Xi'an



Water supply situation of Xi'an since 1995

(1)	(2)	(3)	(4)	(5)	(6)
Year	Max. daily supplied water volume ($10^4m^3/d$)	Pressure of Max. daily supplied water（MPa）	Min. daily supplied water volume ($10^4m^3/d$)	Pressure of min. daily supplied water（MPa）	(2)-(4) ($10^4m^3/d$)
1995	91.58	0.34	50.02	0.11	41.56
1996	98.77	0.37	59.13	0.17	39.64
1997	104.57	0.34	61.74	0.077	42.83
1998	94.39	0.30	72.23	0.169	22.16
1999	94.74	0.36	64.09	0.38	30.65
2000	96.51	0.32	66.59	0.33	29.92
2001	95.00	0.35	59.67	0.35	34.33

Supplied water volume in Xi'an since 1995



Quality of water resource

- **Heihe River:** According to the National drinking Water Quality Standards (GB5479-85), except the total colonies, coliform group, the turbidity of Shibianyu River and Fengyu River, the items accord with the Water Quality Standards (Class Ⅱ).The quality of the water transferred from Heihe River System is in good condition.
- **Chanhe River:** Except the item of volatile phenol, the items' values monitored and analyzed of the water are lower than that of the National Surface Water Quality Standards (GB5479-85).
- **Ground water:** The water quality is good in general. Very few wells are polluted.

Raw water quality of Qujiang Water Treatment Plant

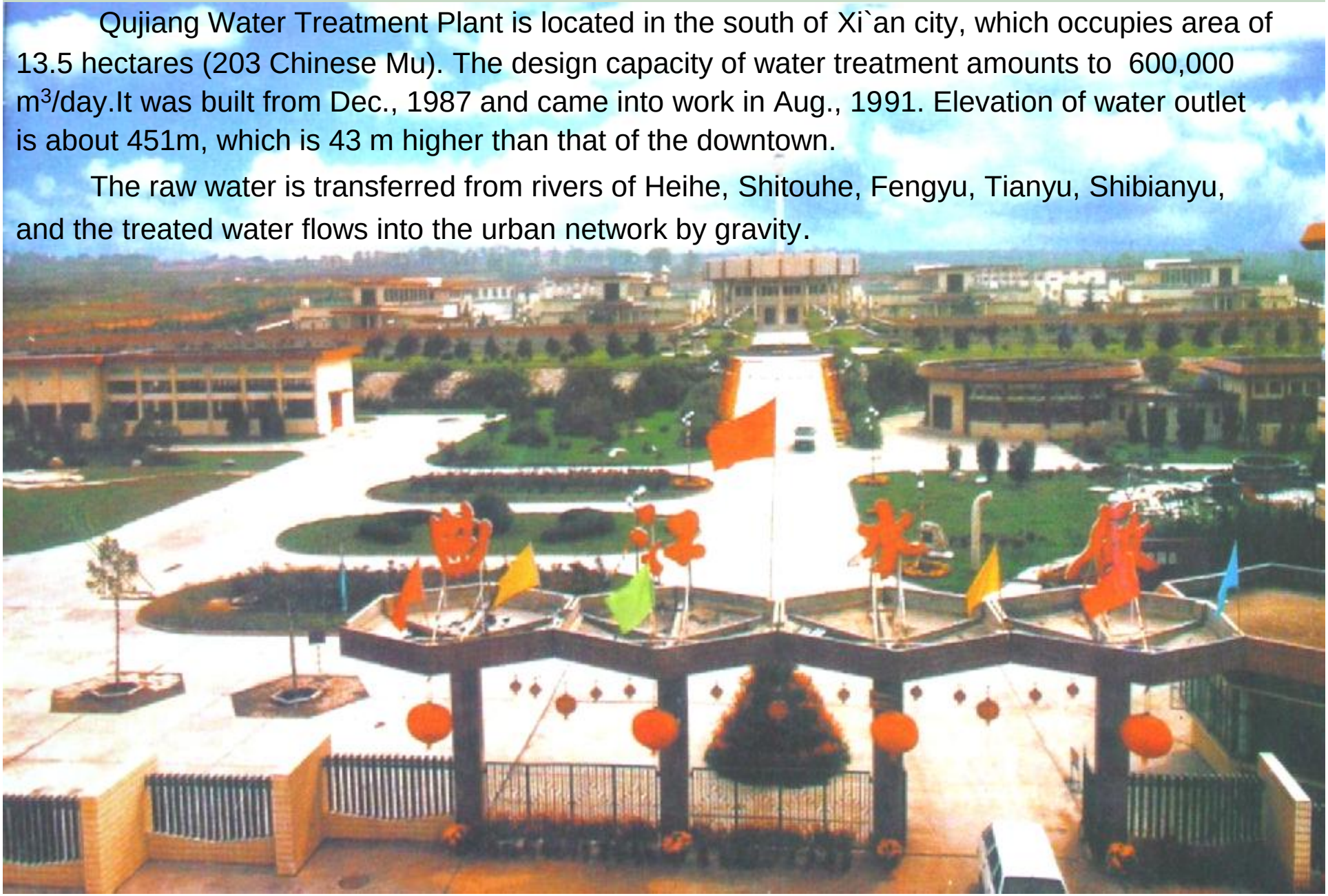
Items	Units	Results	Items	Units	Results
Temperature	◦ C	20	Cu	mg/l	<0.01
Color	Degree	15	Zn	mg/l	<0.01
Turbidity	Degree	20.5	Se	mg/l	<0.005
Odor	---	---	Hg	mg/l	<0.001
Macroscopic matter	---	---	Ag	mg/l	<0.05
pH value	---	7.60	Phenol	mg/l	<0.002
Hardness ($c_a co_3$)	mg/l	89.16	Resolvable solid	mg/l	115
Alkalinity	mg/l	66.98	Dissolved oxygen	mg/l	7.70
Chloride	mg/l	5.20	Oxygen consumption value	mg/l	2.73
Ammonia nitrogen	mg/l	<0.02	Anion wash	mg/l	<0.005
Nitrate (N)	mg/l	0.61	Sulfate	mg/l	9.60
Nitrite	mg/l	0.0428	Total bacterial count		90/ml
Hexavalent chrome	mg/l	<0.005	Coliform Group		230/l
Fluoride	mg/l	0.22	chloroform	μg/l	<10
As	mg/l	<0.005	tetrachloride	μg/l	<0.001
Fe	mg/l	0.01	DDT	μg/l	
Mn	mg/l	<0.05	hexachlorobenzene	μg/l	0.035
Pb	mg/l	<0.005	Benzo(a) pyrene	μg/l	<0.001
Cd	mg/l	<0.005			

Waterworks in Xi’an

A bird's eye view of Qujiang Water Treatment Plant

Qujiang Water Treatment Plant is located in the south of Xi`an city, which occupies area of 13.5 hectares (203 Chinese Mu). The design capacity of water treatment amounts to 600,000 m^3/day.It was built from Dec., 1987 and came into work in Aug., 1991. Elevation of water outlet is about 451m, which is 43 m higher than that of the downtown.

The raw water is transferred from rivers of Heihe, Shitouhe, Fengyu, Tianyu, Shibianyu, and the treated water flows into the urban network by gravity.



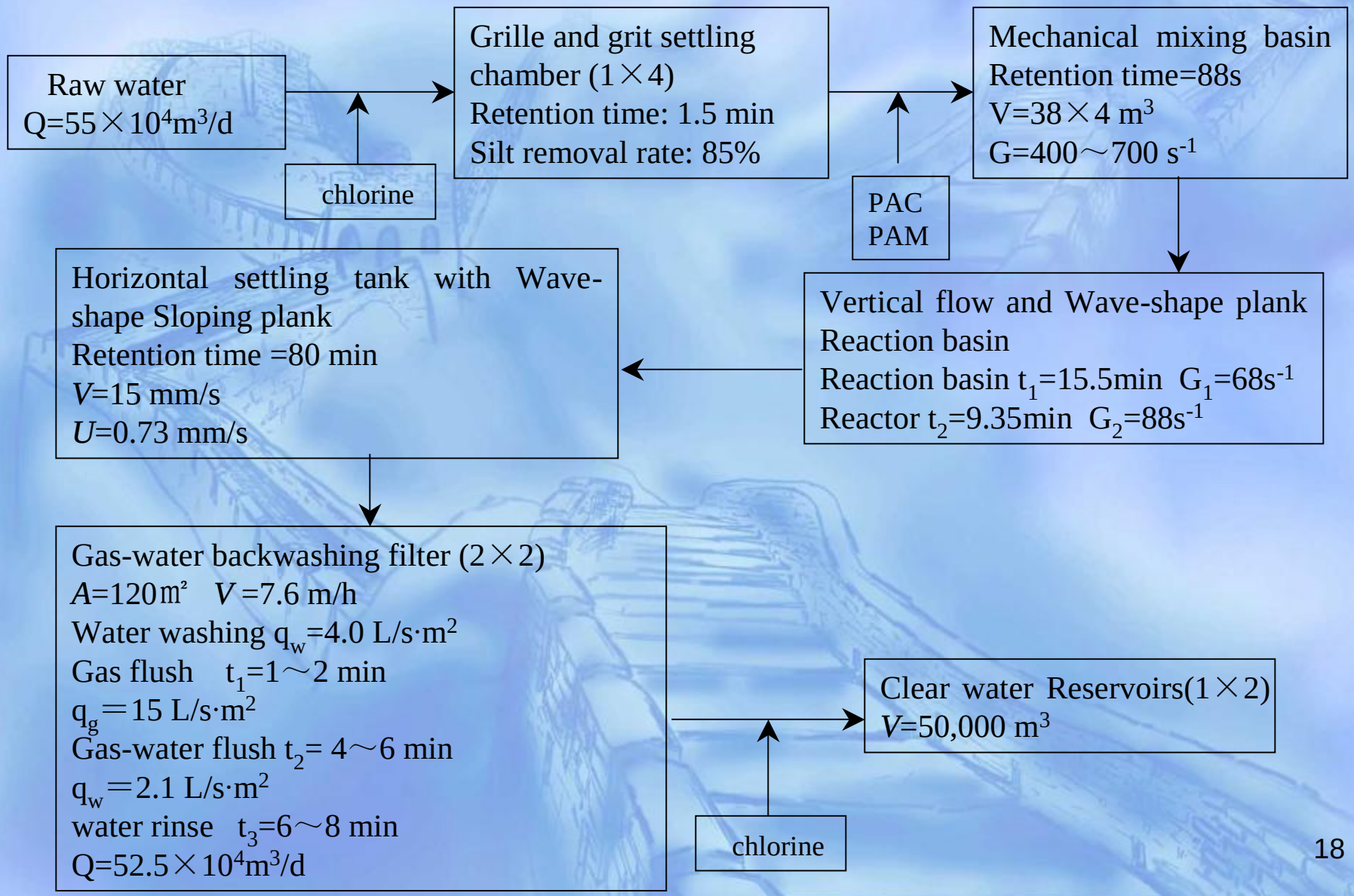
Water inlet of Qujiang Water Treatment Plant

A bird's eye view of Nanjiao Water Treatment Plant

Nanjiao (South Suburbs) Water Treatment Plant is located in the south of Xi`an city, which occupies area of 13.8 hectares (207 Chinese Mu). Its design capacity of water treatment amounts to 500,000 m^3/day.It was built from July, 1999 and came into work in December, 2001. Elevation of water outlet is about 40 m higher than that of the downtown. Total investment is about 272 million RMBY.

The raw water is transferred from rivers of Heihe, Shitouhe, Fengyu, Tianyu, Shibianyu, and the treated water enters into the urban network by gravity through 2 pipelines with diameter of 2000 mm.

Flow chart of Water Purification



Water purification facilities

Grilles and Grit Setting Chamber

- **Grilles and Grit Chamber are built together as one group. The group is divided into 4 cells**
- **Each cell can work and be overhauled independently.**
- **Horizontal Grit Setting Chamber:**

  Particle size $d_p \geqslant 0.26$mm.

  Horizontal velocity: 0.177m/s

  Effective residential time: 1.5 min

  Effective length: 16 m

  Each cell size: 3.6×16 × 2.5 (W×L×H) m

Grilles and Grit Setting Chamber of Nanjiao Water Treatment Plant

Water purification facilities

Mixing and Flocculating Tanks

- Mixing and flocculating tanks are built together.
- There are two groups, each group consists of two tanks.
- Mixing process: water passes 4 tubular static mixers and then enters 4 mechanical agitating tanks, each mixing tank is equipped with two agitators. Stage of mechanical agitating: 2 stages
  - Flocculant agent and flocculant aid: PAC and PAM
  - Agitating time: 24 seconds
  - Total retention time: 88 seconds
  - Velocity gradient: $G=400\sim700\ s^{-1}$
  - Volume of each tank: 38 m^3.
- Flocculating Tank is adopted the vertical-flow type tank filled with W- planks.
  - Average flow velocity: 0.10~0.04 m/s
  - Reaction time: t =15.5 min
  - Average velocity gradient: $G=68\ s^{-1}$ is 68s-1.

Water purification facilities

Setting Tanks

- There are 2 groups of setting tanks, each group consisting of 2 horizontal setting tanks (filled with lateral-flow W-shape sloping plank).
- The total retention time: t =80 min

  Horizontal velocity: v = 15 mm/s

  Overflow rate: U = 0.73 mm/s

  Effective depth: H = 3.6m.
- The lateral-flow W-shape sloping plank is installed at the end of the tank. The length of plank is 5 m.

Horizontal Settling Tanks of Nanjiao Water Plant

Water purification facilities

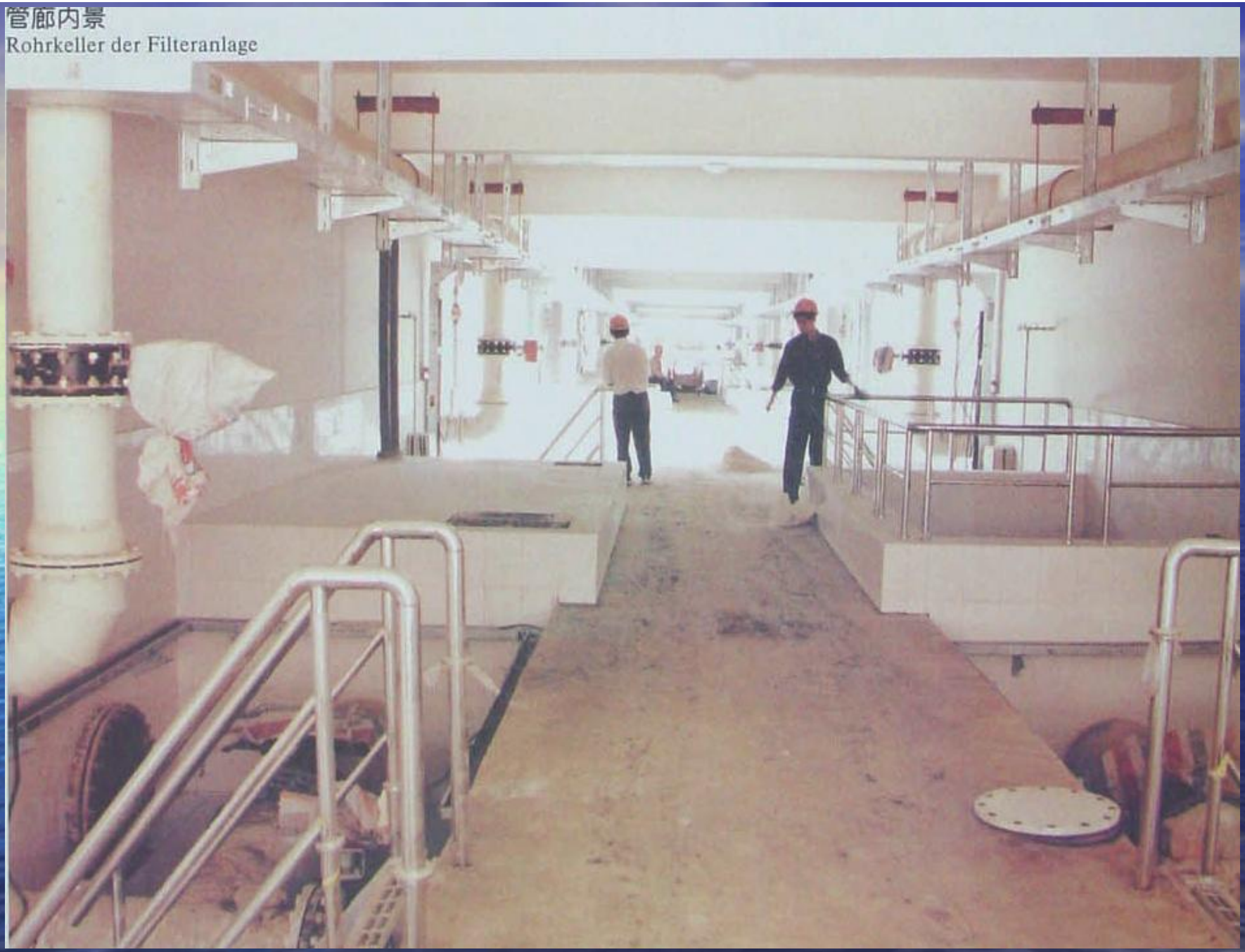
V-Filters

Filter type: V-shape silt filter
Filter number: two groups, 12 filters in each group
Backwashing of the filter: Gas –water backing
Filtration rate: 7.6m/h.
Total water filtration capacity: $52.5 \times 10^4 m^3/d$.
Filter size: $12 \times 11.3 (L \times W) m^2$
Effective filtration area: 120 m^2.

Backwashing Conditions

Index	Time (min)	Intensity ($L/s \cdot m^2$)
Gas washing	1~2	15
Gas-water washing	4~6	4.0(water)
Water rinse	6~8	2.1

V-Filters of Nanjiao Water Treatment Plant



pipes corridor

Water supply capacity in the near future of Xi'an (including wastewater reuse)

Year		2000	2005	2010
Surface water ($10^4m^3/d$)	Qujiang Water Treatment Plant	60	60	60
	Nanjiao Water Treatment Plant	0	50	50
	Water Treatment Plant of Chanhe River	12	12	12
	Total	72	122	122
Groundwater ($10^4m^3/day$)		50	50	61
Intermediate water ($10^4m^3/day$)		0	2	5
Wastewater reuse ($10^4m^3/day$)		0	2	5
Total water volume ($10^4m^3/day$)		122	176	193

Water supply capacity of Xi'an within 10 years