

Water supply population and history of expansion projects

The Osaka Municipal Waterworks Bureau was born in November 1895 as the fourth largest modern waterworks following facilities in Yokohama, Hakodate, and Nagasaki, and the Bureau celebrated 120 years of water supply in 2015. The water supply population at the time the facility was established was 610,000, with a maximum water supply capacity of 51,240 m<sup>3</sup>/day. The water purification plant was located at Sakuranomiya on the left bank of the Yodo River, and this plant transmitted water purified by slow filtration to a water distribution reservoir at Osaka Castle, from where it was supplied to Osaka City by natural down-flow through water distribution pipes totaling 325 km in length. The total operational budget was 2.4 million yen (three times the city budget at the time).

Subsequently, as the city developed, a growing water demand made it impossible for the Sakuranomiya water resource to satisfy needs, and this resulted in the implementation of an expansion of operations nine times, including the construction of the Kunijima Water Purification Plant in 1914 during the second waterworks expansion project.

A huge water demand in Osaka City after the war, in particular, led to the construction of the Niwakubo Water Purification Plant in 1957 during the sixth waterworks expansion project and the Toyono Water Purification Plant in 1968 during the eighth waterworks expansion project.

In addition, to address problems in the deteriorating quality of the water in the Yodo River and a growing water demand volume, the ninth waterworks expansion project was undertaken in 1969. This resulted in acceleration of the slow filtration equipment at the Kunijima Water Purification Plant (601,000 m<sup>3</sup>/day), an increase of 198,000 m<sup>3</sup>/day and an increase of 50,000 m<sup>3</sup>/day at the Toyono Water Purification Plant system, giving Osaka City a water supply capacity of 2,430,000 m<sup>3</sup>/day in 1973.

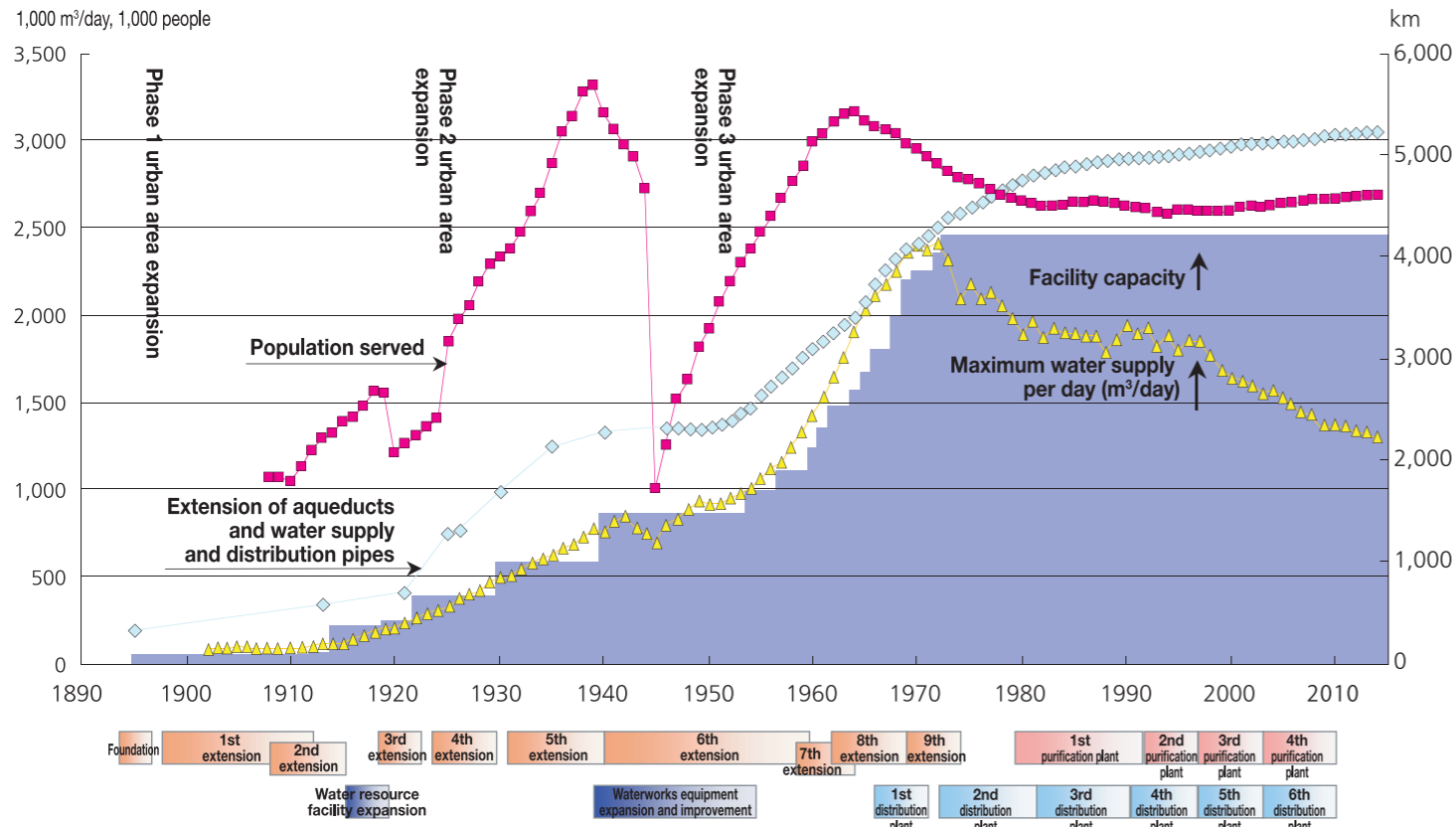
However, water demand peaked at a maximum daily volume of 2,417,700 m<sup>3</sup>/day in 1970, leveling out from the growth trend up to that point and beginning to decrease.

Against this background, construction for the additional 450,000 m<sup>3</sup>/day planned for the Toyono Water Purification Plant during the ninth waterworks expansion project was suspended in 1975, marking the transition from the period of facility expansion that had continued up to that point to an era of facility maintenance and management.

At present, with the aim of building an infrastructure to support a rich life for citizens and advanced urban activities in the 21st Century, there is a need for an even more stable and highly reliable waterworks system, marking the transition from the era of facility maintenance and management to the era of facility restructuring.

In particular, learning from the lessons of the Hanshin Awaji earthquake that struck in January 1995, the Osaka City Waterworks Bureau Earthquake Resistance Measures Reinforcement Plan 21 (Basic Concept) was formulated (March 1996) with regard to disaster prevention measures and with the aim of improving waterworks system functions capable of withstanding envisaged earthquakes, including near-field types. Then measures were systematically implemented from a comprehensive perspective, including both pre/post-measures, such as prevention planning, emergency recovery planning and enhancement of the reliability of emergency response systems. Furthermore, on the water quality front, while undertaking raw water quality maintenance activities, the Advanced Water Purification Facility Improvement Project was promoted from 1992. This resulted in the supply of water, which had undergone advanced purification, throughout the city in March 2000, and has helped achieve the City's initial objectives, such as the removal of mold-like and other odors and the reduction of trihalomethane. In addition, Osaka City has been reinforcing the measures to deal with contaminating organic chemical substances, such as agricultural chemicals and environmental hormones that have been becoming increasingly prominent in recent years as well as cryptosporidium and other infectious organisms, with a view to providing even safer, high-quality water.

Changes in the Osaka City water supply population, water supply volume, water supply capacity, and extension of aqueducts and water supply and distribution pipe s



Changes in matters related to water treatment

Year	Month	Matters	Remarks
1892	August	Beginning of project for establishment of waterworks	
1895	November	Completion of waterworks establishment project, birth of Sakuranomiya water resource	Water supply capacity: 51,240 m <sup>3</sup> /day (slow filtration equipment)
1925	August	Beginning of work on first rapid filtration equipment in Osaka City (Fourth Waterworks Expansion Project) (Completed in 1930)	Water supply capacity: 577,000 m <sup>3</sup> /day, including lime injection equipment (First rapid system)
1930	February	Start of work on chlorination	
	April	Start of first chlorine injection of 0.1 – 0.2 mg/L into slow and rapid filtration reservoirs	
1931	June	Pre-chlorination of rapid filtration system (Optional)	Water supply capacity: 862,000 m <sup>3</sup> /day (Second rapid system)
1933	November	Start of work on rapid filtration equipment expansion (Fifth waterworks expansion project) (Completed in 1940)	
1934	–	Installation of new slow filtration lime injection equipment	
1948	January	Post-chlorination raised to 0.7 mg/L (Set)	
1951	January	Post-chlorination raised to 1.5 mg/L (Set)	City terminal: 0.4 mg/L residue (target)
1952	June to August	Start of pre-chlorination of first and second rapid systems	
1953	June	Post-chlorination injection at Kunijima Purification Plant changed to 1.2 mg/L	
1955	August	Pre-chlorination injection of first and second rapid systems changed to 0.5 mg/L at Kunijima Purification Plant	
1958	June	Rapid system pre-chlorination injection increased (0.5–2.7 mg/L)	Black turbidity in raw water
	June	Start of slow system pre-chlorination injection (0.3 mg/L)	Excluding winter
1960	February	Start of chemical flocculation reservoir and pre-chlorination in the slow filtration system	
	February	Hand processing normally used for slow filtration, soda ash used for alkali agent (previously lime)	
	September	Slow filtration reservoir remodeled into chemical sedimentation reservoir	
1962	October	Kunijima first rapid system changed to discontinuous point chlorination	
	December	Kunijima second rapid system changed to discontinuous point chlorination	
1963	July	Start of pre-chlorination and discontinuous point chlorination at Niwakubo Purification Plant	
1964	April	Start of work on improvements to Kunijima Purification Plant purified water equipment as measure to deal with raw water quality contamination for the time being (3 years)	
	June	Due to increased chromaticity of filtered water from slow filtration, 5 mg/L of metaphosphoric acid soda was injected as countermeasure	
	June	Slow system intake stopped due to raw water quality contamination caused by water shortage	
	–	Completion of lime injection equipment and start of pH value adjustment	
1965	June	Aeration equipment installed at slow filtration reservoir at Kunijima Purification Plant	
1966	November	Testing of free chlorination started in slow system	
1967	December	Start of use of slaked lime as alkali agent (Niwakubo Water Purification Plant)	Use of soda ash discontinued

Year	Month	Matters	Remarks
1968	February	Start of test injection of polyaluminum chloride as flocculation agent (Kunijima Purification Plant)	
	May	Liquid aluminum sulfate used (Niwakubo Purification Plant)	Water storage concentration changed from 6% to 8%
1969	December	Start of testing red water prevention by pH value adjustment (Kunijima)	
1970	January	Chlorine injection of 42 mg/L recorded at Kunijima Purification Plant (38 mg/L at Niwakubo Water Purification Plant)	Black turbidity in raw water due to rainfall in abnormal turbid water
1971	May	Chlorine injection equipment capacity at Niwakubo Water Purification Plant changed (25–50 mg/L)	
	June	Powdered activated carbon injected (Kunijima, Niwakubo)	
	August	Start of pH adjustment processing as red water countermeasure (Niwakubo, Tatsumi systems)	pH target value: 7.5
	December	Polyaluminum chloride used at low water temperatures (Kunijima)	
1972	June	Use of liquid aluminum sulfate and caustic soda started (Kunijima)	
	June	Part of slow filtration equipment at Kunijima Purification Plant suspended	Complete suspension on September 24, 1974
	August	Ozone processing testing started (Kunijima)	
1973	February	Caustic soda injection equipment completed (Niwakubo)	
	June	Use of slaked lime high-concentration equipment started (Kunijima)	Approx. 15% concentration
1975	August	Ninth waterworks expansion project suspended	
1980	March	Emergency shutdown valve used on chlorination equipment (Kunijima)	
	March	Raw water toxic substance monitoring equipment completed at Kunijima Purification Plant (water quality test laboratory)	
1982	January	Advanced water purification test plant constructed (Kunijima)	Processing capacity: 60 m <sup>3</sup> /day
1986	–	Interim chlorine injection equipment installed (Kunijima third system, Niwakubo first and second systems)	
	–	Advanced water purification verification plant constructed (Kunijima)	Processing capacity: 2,000 m <sup>3</sup> /day
1988	–	Interim chlorine injection equipment installed (Kunijima fourth system)	
	–	Interim chlorine injection equipment installed (Kunijima second system, Niwakubo third system)	
1989	June	Powdered activated carbon injection equipment installed (Toyono)	
1990	–	Interim chlorine injection equipment installed (Kunijima first system, Toyono)	
1992	–	Advanced water purification equipment construction project started	
1998	March	Water transmission by the Kunijima Purification Plant lower system advanced water purification facility initiated	
1999	March	Water transmission by the Niwakubo Purification Plant advanced water purification facility initiated	
2000	–	Water transmission by the Kunijima Purification Plant upper system advanced water purification facility initiated	
	–	Water transmission by the Toyono Purification Plant advanced water purification facility initiated	
2010	September	Oxygen injection equipment installed (Kunijima)	
2010	November	Oxygen injection equipment installed (Toyono)	
2011	February	Oxygen injection equipment installed (Niwakubo first and second systems)	
2011	March	Oxygen injection equipment installed (Niwakubo third system)	