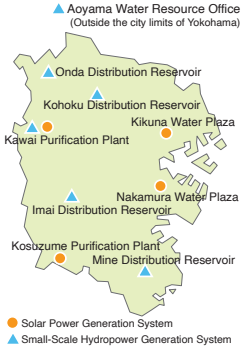
Eco-friendly Water Supply System

Renewable Energy

As about 98% of greenhouse gases emitted in Yokohama consists of carbon dioxide from energy use, we must limit the use of such energy to reduce greenhouse gases – therefore, we need to move away from fossil fuels and instead raise the ratio of renewable energy usage. At the Waterworks Bureau, we are enthusiastically introducing solar power and small-scale hydropower systems to build up an environmentally-friendly water supply system.



Renewable Energy Status (as of the end of FY2022)

Facility type	Generation capacity (kW)	Actual power generation (kWh)	CO_2 reduction (t-CO_2)
Solar power generation system	1,390	1,142,945	522
Small-scale hydropower generation system	728	4,051,098	1,851

*For small-scale hydropower generation system, efficacy maintained by Kohoku Distribution Reservoir's installer (The Tokyo Electric Generation Company) is included.

Environmental Measures for Dam Lakes (Reservoirs)

An aerator in action (Lake Sagami)

We circulate lake water and aerate it with aeration equipment to prevent proliferation of algae (Lake Sagami: 8 aerators, Lake Tsukui: 9 aerators).

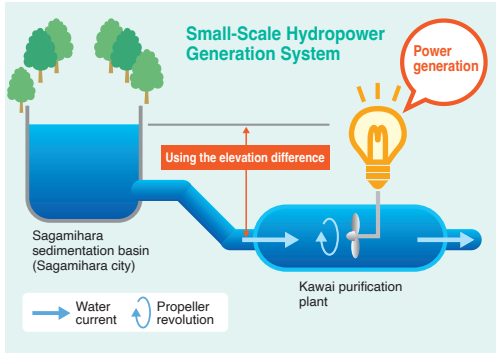
Solar Power Generation Facilities

Since installing a movable solar power generation system above a filtration basin at Kosuzume Purification Plant in FY2000 (the first in Japan), we have installed solar power facilities providing 1,390 kW in an ongoing effort to use renewable energy.

A movable solar power generation system above a filtration basin (Kosuzume Purification Plant)

Small-Scale Hydropower Facilities

We are promoting the introduction of renewable energy by installing small-scale hydropower units in water supply pipes to harness the power of flowing water. As of the end of FY2022, we have installed such units at six locations, such as Distribution Reservoirs and Purification Plants.



Yokohama Waterworks promotional video for overseas

Growth Depends on Water

The History of Yokohama's modern waterworks

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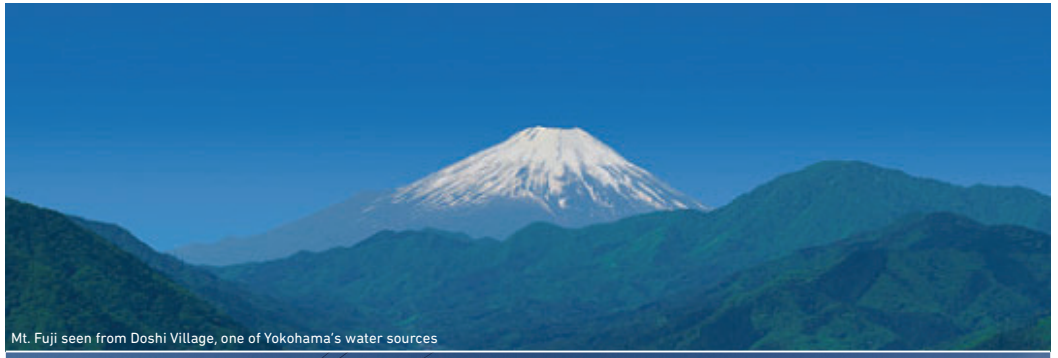
International Cooperation
Since 1973
50th Anniversary in 2023

国際貢献 開始50年 横浜市水道局

Waterworks of Yokohama



Mt. Fuji seen from Doshi Village, one of Yokohama's water sources

Minato Mirai district, which faces the Port of Yokohama ©Hideo Mori

Minato Mirai district, which faces the Port of Yokohama ©Hideo Mori

When the Port of Yokohama opened in 1859, it was difficult to secure sanitary water and the city was plagued by infectious diseases. Therefore, the governor brought in British engineers who introduced the latest European technology, and in 1887 Yokohama's waterworks began supplying water as Japan's first modern water supply (a water supply that filters water taken from a river and supplies it under pressure using iron pipes). This has greatly improved the sanitary environment.
Since then, over a long history, the City of Yokohama has developed advanced water technology, and through these technologies and efforts, we have succeeded in reducing non-revenue water and water leakage. For 50 years, we have been contributing to improving the water situation in emerging countries in Asia and Africa by leveraging the technology and know-how we have cultivated over the years, dispatching staff and accepting trainees. In recent years, we have been collaborating with Yokohama Water Co., Ltd., which was established with 100% investment from the Yokohama Waterworks Bureau, to work on solving issues in water supply businesses both domestically and internationally.

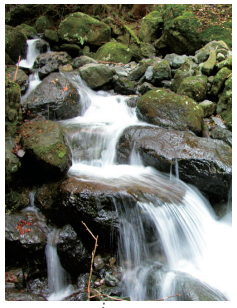
Yokohama Waterworks Bureau

6 CLEAN WATER AND SANITATION

Water Sources of Yokohama

Yokohama has five water source systems with a total capacity of **1,955,700 m³** a day.

1 Doshi river system	2 Sagami reservoir system	3 Banyu river system	4 K.W.S.A. Sakawa river system	5 K.W.S.A. Sagami river system
172,800m³/day	394,000m³/day	284,700m³/day	605,200m³/day	499,000m³/day
Orange line on the map	Red line on the map	Purple line on the map	Green line on the map	Pink line on the map

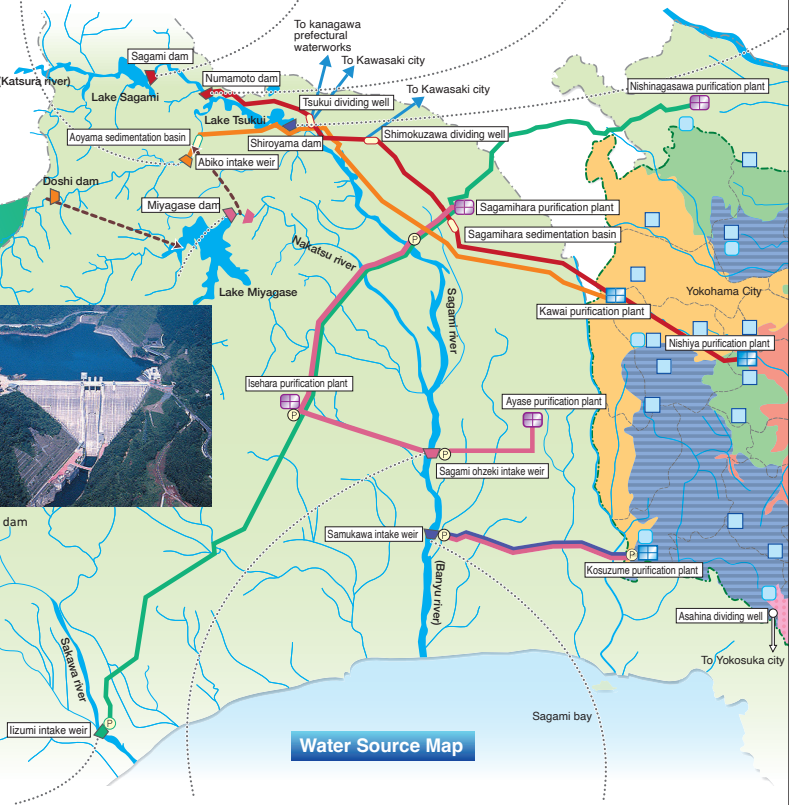

Doshi river


Abiko intake weir


Sagami dam


Numamoto dam


Shiroyama dam




Miho dam

Miyagase dam


Iizumi intake weir


Sagami Ohzeki intake weir


Samukawa intake weir

Main areas serviced by each water source

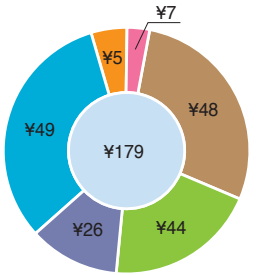
- No. 1 system water
- No. 2 system water
- No. 3 system water
- No. 4 system water
- No. 5 system water
- Yokohama Waterworks Bureau purification plant
- K.W.S.A.* purification plant
- Distribution reservoir
- K.W.S.A equalization reservoir
- Dam/intake facility
- Pumping station

*K.W.S.A: The Kanagawa Water Supply Authority, established in 1969 by Kanagawa Prefecture and the cities of Yokohama, Kawasaki and Yokosuka to avoid overlapping investment and enable efficient location and management of water facilities. It owns purification plants in Isehara, Sagamihara, Nishinagasawa and Ayase and the water from these plants is supplied to the four water utilities.

Water Supply (FY2022)

Total Population	3,768,664
Population Served	3,768,622
Number of Households Served	1,939,135
Service Rate	100.0%
Total Length of Pipeline	9,346 km
Annual Water Supply	403,234,300 m³
Average Daily Water Supply	1,104,752 m³
Average Daily Water Supply per Person	293 L
Maximum Daily Water Supply	1,179,400 m³ (June 30, 2022)
Past Maximum Daily Water Supply	1,607,000 m³ (September 4, 1992)

Cost to supply 1 m³* of drinking water (FY2022)

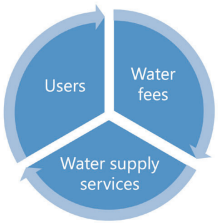


*Two thousand 500 ml bottles

- Cost to send water from water sources to water purification plants
- Cost to purify water at purification plants
- Cost to supply water from purification plants to customers
- Cost to repair water facilities
- Cost to prepare for future replacement
- Loan repayment interest

Sustainable Water Business

We provide water services by receiving fees from users as compensation and investing a portion of the proceeds in things necessary for water supply, such as updating and maintaining facilities.
In order to make the water supply business sustainable in the future, there are two important things.
First, it is necessary to set a rate that can recover the costs necessary for operation, maintenance, and planned renewal of the facilities.
Second, it is necessary to ensure that users pay the fees for the water they used.



International Cooperation

We engage in international cooperation by dispatching staff members and accepting trainees to share Yokohama's waterworks technology to water utilities around the world.

Staff member dispatch
approx. 460 persons to 34 countries (FY1973-2022)

Trainee acceptance
approx. 4,300 persons from 137 countries (FY1987-2022)

Water Purification Plants in Yokohama

A purification plant is where tap water is produced. Yokohama has three purification plants: Kawai, Nishiya and Kosuzume.

Kawai Purification Plant

Constructed: 1901 (1st expansion)
Daily Purification Capacity: 172,800 m³
Water Source: Doshi river system

Nishiya Purification Plant

Constructed: 1915 (2nd expansion)
Daily Purification Capacity: 356,000 m³
Water Source: Sagami reservoir system

Kosuzume Purification Plant

Constructed: 1965 (6th expansion)
Daily Purification Capacity: 820,000 m³
Water Source: Banyu river system
* Water from the K.W.S.A. Sagami river system is also treated in this plant.

Redevelopment of Nishiya Purification Plant

Nishiya Purification Plant aims to provide safe, high-quality water and a disaster-resistant, eco-friendly water supply. Redevelopment has been underway since 2021.

Main maintenance contents and effects

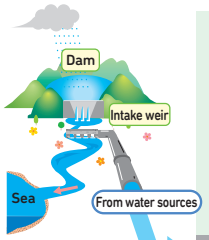
1 Earthquake resistance of facilities
By making the filtration basin and drainage basin earthquake resistant, water purification treatment can continue even in the event of a large-scale earthquake, making the water supply system more resistant to disasters.

2 Introduction of granular activated carbon treatment
We will introduce facilities that enable us to purify water continuously by filtering it through activated carbon in order to reliably remove musty odors* caused by algae growth.

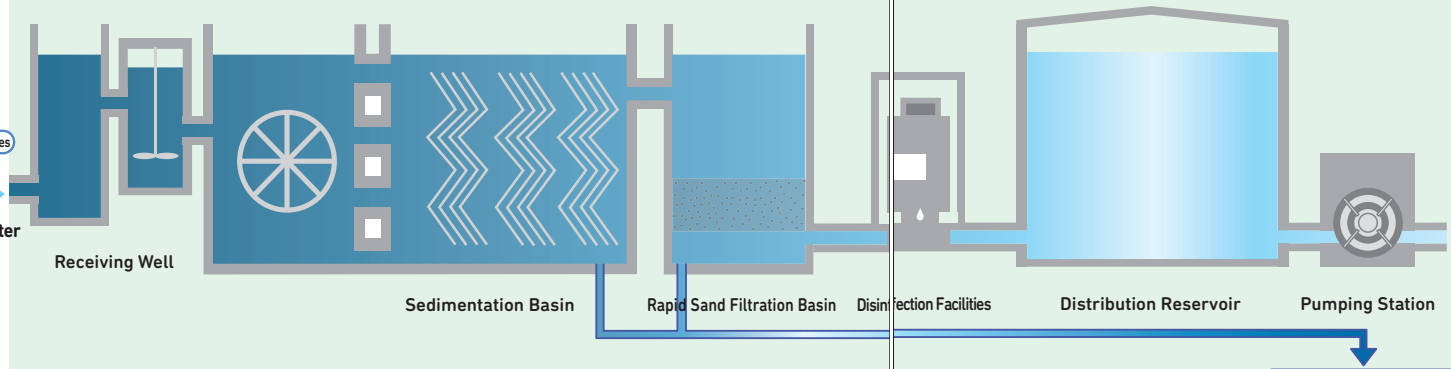
3 Increase processing capacity
We will increase the processing capacity from the current amount of approximately 356,000 ㎥/day to 394,000 ㎥/day, increasing the water supply area of the gravity flow water treatment plant.

* As the water temperature rises, algae can grow in the water source, giving the water a moldy odor.

Conceptual drawing of the completed Nishiya Purification Plant



Purification Plant System Rapid Filtration System



Receiving Well

This is where raw water drawn from rivers and lakes first arrives. The water level is adjusted here and water is sent to the sedimentation basin.

Sedimentation Basin

The coagulant (polyaluminum chloride) is injected into the raw water. Suspended solids coagulate into larger particles called floc and sink.

Rapid Sand Filtration Basin

Microscopic suspended solids that are not removed in the sedimentation basin are removed through a layer of sand and gravel.

Disinfection Facilities

Sodium hypochlorite is added to the filtered water to disinfect it.

Distribution Reservoir

This is where tap water is stored and volume is adjusted according to the quantity consumed. It also guarantees drinking water during emergencies, such as after an earthquake.

Pumping Station

This is where water is supplied by pumping at a specific pressure throughout the entire city, which is quite hilly.

Wastewater Treatment Facility

This is where floc removed in the sedimentation basin and filtration basin is condensed, dehydrated and then used as a construction material.

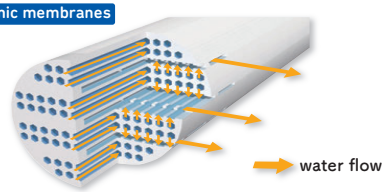
Purification Plant System

Kawai Purification Plant uses a membrane filtration system

Membrane filtration systems filter raw water through fine pores (approx.0.1 μm)* in ceramic membranes.

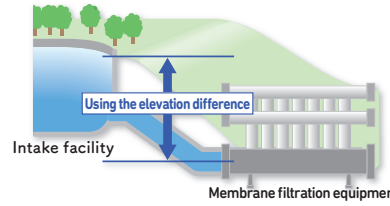
*1 μm=1/1000mm

ceramic membranes



The Kawai Purification Plant makes maximum use of the natural energy generated by the height difference from the water intake facility. This eco-friendly water purification plant filters water without using electricity.

How to utilize natural energy



Water is sent to the membrane filtration device using water pressure and filtered.

Safe and High Quality Water

Water Quality Testing Plan and Disclosure of Results

The national government's water supply quality standards were set to ensure that people can drink household tap water their entire lives without any ill effects and to prevent water being a hindrance in daily life in ways such as causing abnormal odors, discoloring laundry, etc. These rules apply in the same way to all water supply utilities nationwide, and, likewise, we are obligated to maintain water quality as well as conduct tests to check quality.

In order to ensure proper water quality tests and maintain transparency, we compile an annual water quality testing plan that clearly defines the items, locations, and frequency of water quality testing, and then implement inspections based on that plan. Moreover, we compile the results of inspections in a water quality test report. This report can be viewed on the City of Yokohama website, etc.

GLP certificate

Water Quality Testing

To ensure greater safety and reliability for our customers, we are certified under the GLP for Water Supply, the national standard for Tap Water Quality Testing Good Laboratory Practice, and strive to conduct accurate water quality inspection. We inspect about 120 items including 51 items defined in the national water quality standards.

● Bacteriological Examination

We examine standard plate count and *Escherichia coli* to ensure that pathogenic microorganisms are not polluting the water supply. The water supply is disinfected with chlorine, but microbiological testing is used to confirm its ultimate safety. Examinations are conducted in a clean room with all equipment sterilized in order to avoid polluting the sample during examination.


Bacteriological examination in clean room

● Testing Organic and Inorganic Substances

We test for incredibly minute amounts of organic and inorganic substances that can be found in raw water and supplied water. Among organic substances tested for are those derived from agrochemicals, substances that cause musty odors and trihalomethane generated by chlorine disinfecting. We test for these using a gas chromatograph mass spectrometer (GC-MS) or a liquid chromatograph mass spectrometer (LC-MS). Among the inorganic substances we test for are metals and ionized substances. We test for these using an induction-coupled plasma mass spectrometer (ICP-MS).


Organic substance examination using GC-MS

● Tap Water Quality Examination

When customers are concerned about the quality of tap water and request water quality testing, we conduct an examination to inspect five basic items (taste, odor, color, turbidity, and residual chlorine concentration). For customers who are still concerned after receiving the results or ask for a detailed examination, we conduct further examination for water safety confirmation (turbidity, color, pH, organic substances, etc.) and other examinations required. We issue a "water quality report" with the examination results for the customers.


Tap Water Quality Examination

Preservation of the Water Conservation Forest

Protecting and Fostering the Water Conservation Forest

The Doshi River, one of Yokohama's water sources, runs through Doshi village in Minami-tsuru-gun, Yamanashi Prefecture. The City of Yokohama has maintained the water conservation forest in this village since 1916. It is currently 2,873 hectares, accounting for about 36% of the total area of the village.
We established a Water Resource Forest Management Office and systematically carry out various activities such as thinning and weeding to protect and foster the water conservation forest.


Doshi river

Volunteer Activities for Doshi Water Conservation Forest

About 4,600 hectares of private forest which occupies 60% of the area of Doshi Village also plays the role of water conservation forest. However, due to a shortage of labor, some forests are not appropriately maintained. Such private forests have been maintained by civil volunteers since 2004. The maintenance is promoted in cooperation with the volunteer organization NPO Doshi Water Conservation Forest Volunteers' Association, which was founded by the participants in these volunteer activities. We also encourage maintenance activities carried out by NPO Doshi Water Conservation Forest Volunteers' Association or local volunteer groups.


Thinning by volunteers

Water Conservation Forest Eco project "W-eco・p"

The Waterworks Bureau cooperates with companies and organizations to promote the preservation of the the water conservation forest and pass it on to future generations. The project began in May 2009, with donations from partners to maintain the forest.

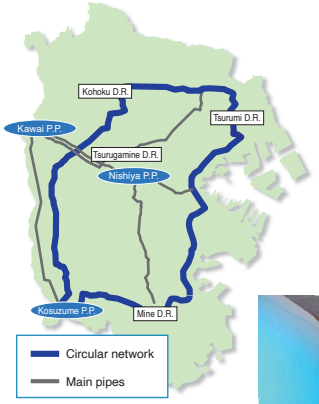
Doshi Forest Foundation

In order to support the volunteer activities in the Doshi water conservation forest and obtain cooperation from people who cannot participate in the activities, we established the Doshi Forest Foundation, a foundation to accept donations from individuals and businesses.

Disaster-Resistant Water Supply System

Circular Network

A circular network, which connects purification plants and distribution reservoirs with a total distance of approx. 70 km, was developed to enable emergency backup in case a purification plant is shut down by a massive earthquake, water quality accident or blackout. Even if a purification plant is shut down during a disaster, transmitting water from other purification plants through the circular network ensures stable water supply to residents.




1,350 mm-diameter water pipe inside the utility tunnel

Replacement of Aging Pipes with Earthquake Resistant Pipes

Aging pipes that may leak or burst are systematically replaced with earthquake-resistant water pipes.
The majority of water supply suspensions caused by large earthquakes occur when the joints between pipes become disconnected. Therefore, we replace aging pipes with new ones that are made of stronger materials and have joints that are more resistant to dislodging, thereby enhancing earthquake resistance.