Dams on the Kinugawa River

Kinugawa Integrated Dam Control Office　Project Outline

Kinugawa River

The Kinugawa River originates at the Kinunuma Marsh on the boundary between Tochigi Prefecture and Gunma Prefecture.

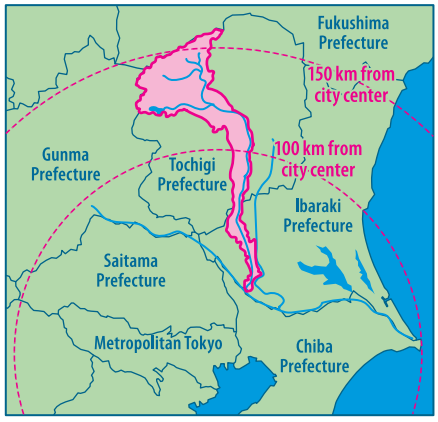
The Kinugawa River merges with tributaries including the Ojikagawa River, Daiyagawa River, and Tagawa River, flows across the Kanto Plain, and at Moriya City in Ibaraki Prefecture, it flows into the Tonegawa River which boasts the largest catchment area in Japan.

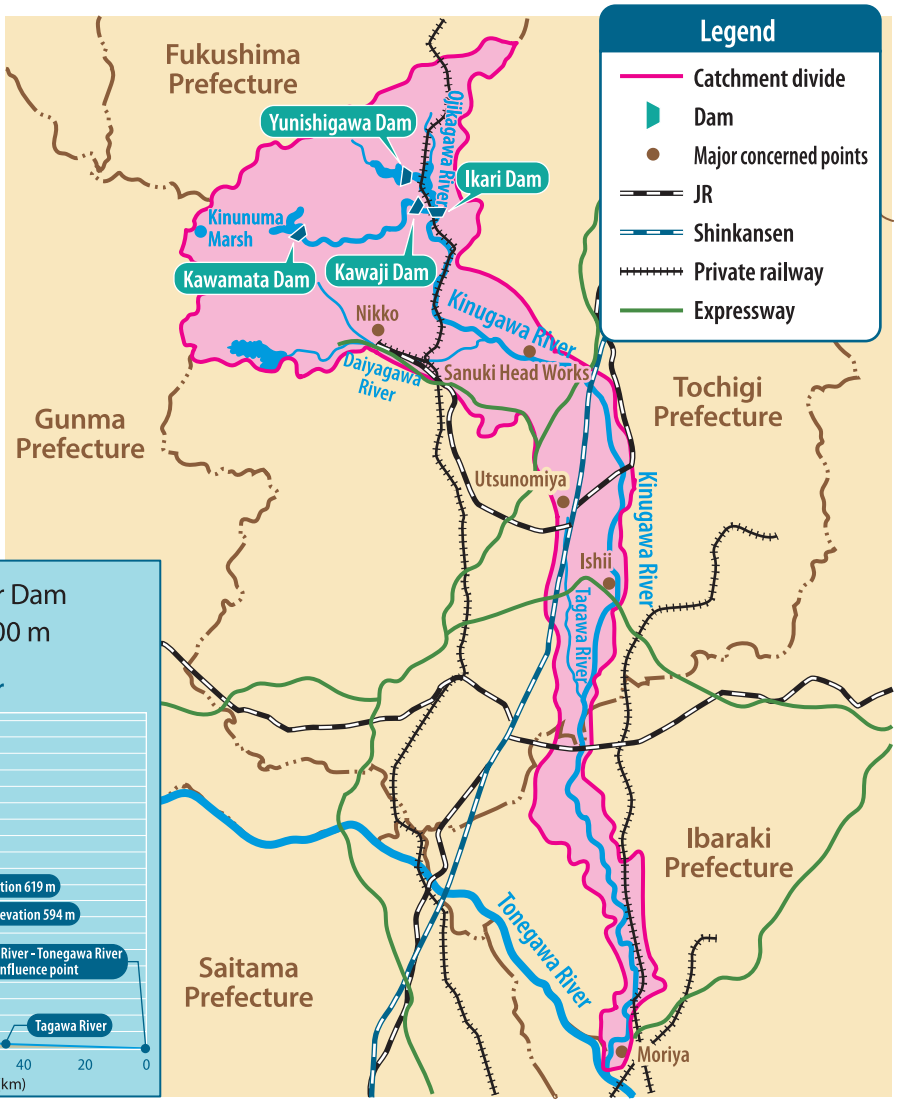
The name, "Kinugawa" is the name used in the area since ancient times. It came to be written using characters which mean "raging demon river because the river flows so violently it is likened to the raging of a demon.

Profile of the Kinugawa River

Length of main river channel	Catchment area	Mountainous area	Agricultural land area	Residential and other urban area	Basin population
177 km	1,761 km^2	1,398 km^2	314 km^2	48 km^2	About 550,000

Location of the Kinugawa Catchment Area map

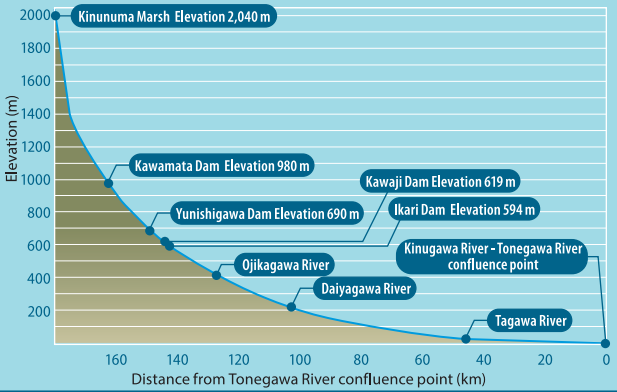




Elevation of Dam Top

Elevations of Upstream Kinugawa River Dam Group ranges from about 600 m to 1000 m

Longitudinal profile of Kinugawa River



History of the Upstream Kinugawa River Dam Group

1683	The Nikko Earthquake dammed up the Ojikagawa River, forming Lake Ikari.
1723	The dam formed by torrential rain blocking the river was breached, causing severe damage in downstream towns including Kawaji and Fujihara and extending as far as present day Utsunomiya City.
1926	In response to flooding around Tokyo in 1910 and 1914, the Government (now, MLITT) enacted the Kinugawa River Improvement Plan that called for the construction of dams on the upstream part of the Kinugawa River.
1934	A private electric power company planned to construct the Kawamata Dam.
1941	The Government planned to construct the Kawamata Dam as a multi-purpose dam with a flood control function.
	Dam construction projects were temporarily stopped as a result of the intensification of the war.
1947	Typhoon Kathleen breached the river embankment on the Kinugawa River.
1948	Typhoon Ione breached the river embankment on the Kinugawa River.
1949	Enactment of the Revised Tonegawa River Improvement Plan.
1950	An office to construct the Ikari Dam was established. The originally planned location was changed to a place about 2.5 km further downstream and work was started.
1956	**The Ikari Dam was completed.**
1957	An office to construct the Kawamata Dam was established.
1959	Work to construct the Kawamata Dam started.
1962	A preliminary survey was conducted by the Kawamata Dam Work Office to prepare for construction of the Kawaji Dam.
1965	Adoption of the Basic Work Plan for the Tonegawa River System.
1966	**The Kawamata Dam was completed.** An office to construct the Kawaji Dam was established.
1970	Work to construct the Kawaji Dam started.
1972	The Kinugawa Integrated Dam Control Office was established within the Ikari Dam Control Office in Fujihara Town (now Nikko City) to exercise integrated control of the two dams, the Ikari Dam and Kawamata Dam.
1980	Revision of Basic Work Plan for the Tonegawa River System. The Kinugawa Integrated Dam Control Office was relocated in Utsunomiya City in order to strengthen its functions.
1982	An office to construct the Yunishigawa Dam was established.
1983	**The Kawaji Dam was completed.**
2003	Conduit gate improvement work was completed at the Ikari Dam.
2006	**Completion of the Mutual Water Supply Facilities at Kinugawa Dam Network (Ikari Dam and Kawaji Dam headrace tunnel).**
2008	Dam body work started at the Yunishigawa Dam.
2012	**The Yunishigawa Dam was completed.**
2013	Amphibious buses began operating on Lake Yunishigawa (dam reservoir).
2015	Torrential rainfall struck the Kanto and Tohoku regions, breaching the river embankments on the Kinugawa River, flooding the surrounding land.
2016	Kawamata Dam reinforcement work started.
2020	Selective water withdrawal facility work was completed at the Ikari Dam.

Ikari Dam ground-breaking ceremony

(1950)

Work executed at the Ikari Dam with American support.

Work to construct the Kawamata Dam body

(1963)

Construction of the dam body of the Kawamata Dam is completed in December 1963.

Foundation fixing ceremony at the Kawaji Dam

(1978)

The foundation fixing ceremony was held in May 1978 followed by start of the work to construct the dam body.

Cruising RCD method at the Yunishigawa Dam

(2009-)

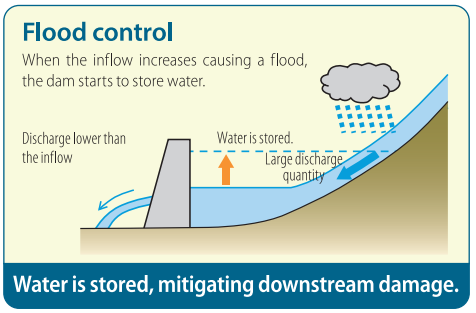
To shorten the work period, the cruising RCD method was adopted. As a result, dam body concrete work was done in 19 months.

Roles and types of dams

The four dams, the Ikari Dam, Kawamata Dam, Kawaji Dam, and Yunishigawa Dam and the Mutual Water Supply Facilities at Kinugawa Dam Network play roles in protecting the safety and security of the downstream regions of the Kinugawa River and Tonegawa River.

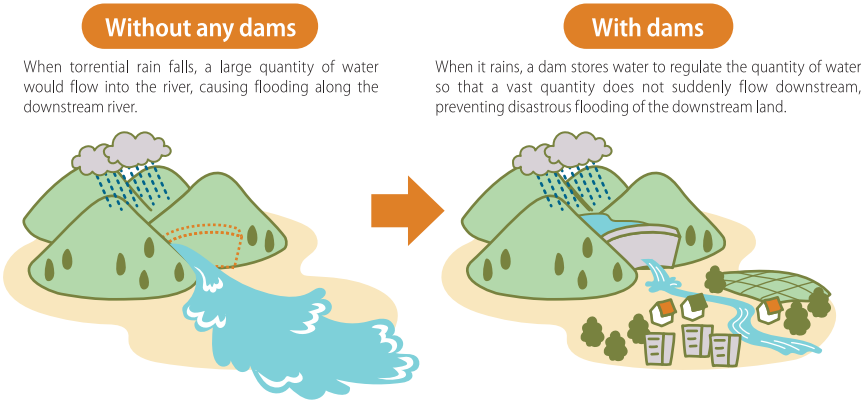
(1) Flood control to prevent flooding (F)

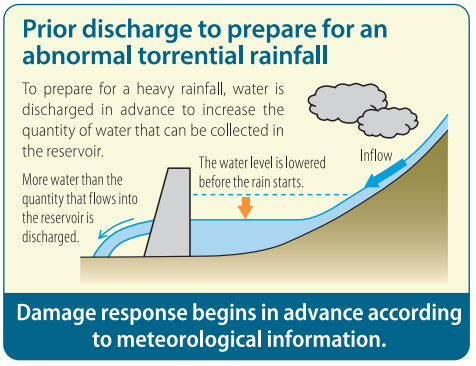
In order to protect the region downstream from the dams from flood damage, the dams perform "flood control": partly storing river water etc. (inflow quantity) flowing into each dam in its reservoir as it discharges the rest downstream. During the seasons when torrential rainfall is caused often by the seasonal rain front or typhoons (flood season) flood control capacities are ensured in advance so that the dams store flood waters.



And when, during the seasons when torrential rainfall does not occur (non-flood season), an unseasonal torrential rainfall has been predicted, preliminary discharge is executed to lower the reservoir water level and perform flood regulation just as it is done during the flood season.

And in a case where an abnormally heavy torrential rainfall which cannot be stored withing a dam's flood control capacity is predicted, water to be supplied for human use which is stored in this dam is discharged (prior discharge) to prepare for the flood.





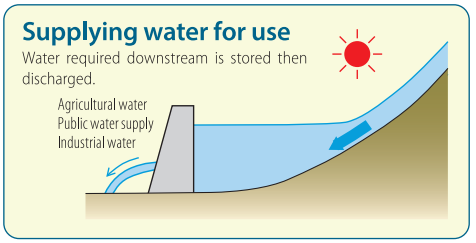
(2) Normal functions of the river water are maintained (N)

Even before people could build dams, they used rivers for fishing, agriculture and other purposes related to their daily lives. Rivers also formed natural environments which serve as habitats for the growth of diverse plants and animals. So, dams supply water in response to downstream conditions in order to maintain the normal functions of flowing water, by for example preserving the flow volume and water quality which each river originally provided.

View of a dry river bed caused by a falling flow rate

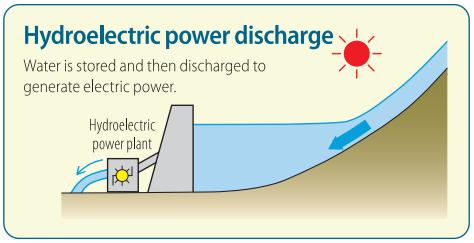
(3) Ensuring water for agricultural use, public water supply and industrial water supply (A W I)

Water used by humans must be stably supplied. So, dams play a role in stably discharging water from their reservoirs to their downstream rivers according to use of the water in each downstream region.



(4) Hydroelectric power generation (P)

Water stored in a dam reservoir generates power by rotating a hydraulic turbine using the force of the water generated by the level difference of the dam. Hydroelectric power generation is a method of generating electricity using the force of water so that it does not produce CO_2 (carbon dioxide).



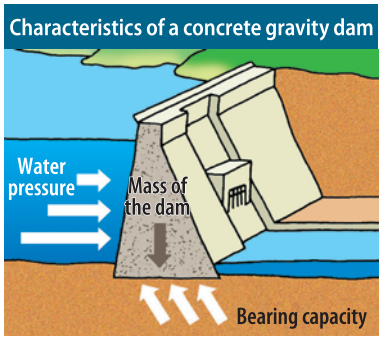
The letters of the alphabet, F, N, A, W, I, and P are used as codes indicating the roles (purposes) of a dam. Multiple letters are used to define the purposes of multi-purpose dams.

(F): Flood control, (N): Normal function of the flowing water, (A): Agriculture, (W): Water supply, (I): Industrial water, (P): Power generation.

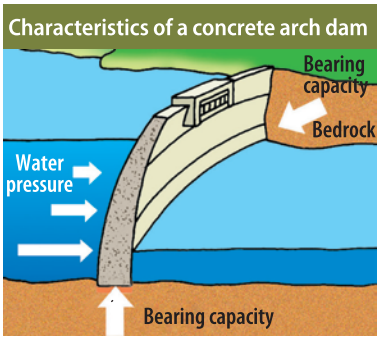
Concrete gravity dams and concrete arch dams

The Ikari Dam and Yunishigawa Dam are concrete gravity dams. The Kawamata Dam and the Kawaji Dam are concrete arch dams.

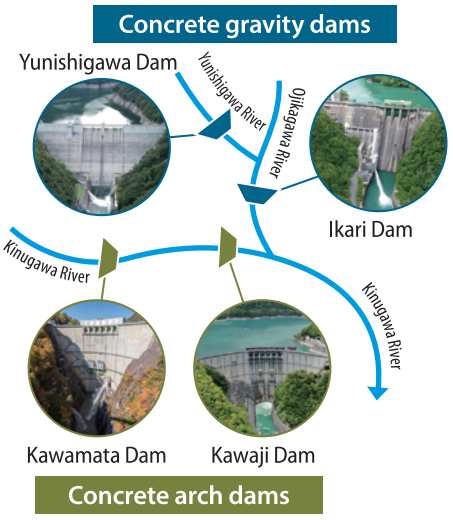
The forms of these dams were decided as the forms best suited to the location of each dam based on the results of investigations of the topography and geology at each site.

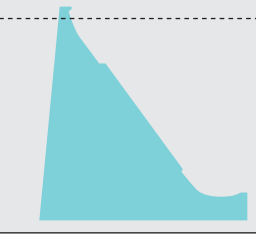
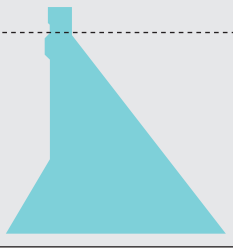


This dam is built with mass of concrete. The water pressure from the reservoir is borne by the dam's weight. It is the most common type of concrete dam.



This kind of dam can be constructed when the prospective site has a solid topography (bedrock). The water pressure on the arch surface is borne by the bedrock on both sides.



Type	Concrete gravity dams		Concrete arch dams	
Name	Ikari Dam	Yunishigawa Dam	Kawamata Dam	Kawaji Dam
Year completed	1956	2012	1966	1983
Dam height	112 m	119 m	117 m	140 m
Elevation of dam top	EL. 594 m	EL. 690 m	EL. 980 m	EL. 619 m
Dam shape (150 m / 100 m / 0 m)				

Ikari Dam

Completed after overcoming many difficulties such as the suspension of construction caused by World War II, it was the first dam higher than 100 m constructed in Japan.

The Ikari Dam is a concrete gravity dam completed on the Ojikagawa River on the Kinugawa River System in 1956 as the highest dam in Japan at that time.

The dam was constructed to control flooding, to maintain normal functions of the flowing water and to generate electric power.

The conduit gates of the Ikari Dam were improved in 2003 to complete the dam's functions. In 2020, a selective water withdrawal facility was installed to improve the environment of the water.

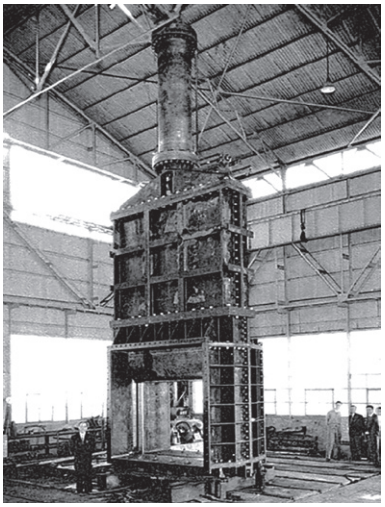
Dam specifications

Type	Concrete gravity dam
Geological feature	Granite
Height	112m
Length	267m
Volume	468,000m³

Reservoir specifications

Catchment area	271.2km² (Excluding Yunishigawa Dam's catchment area of 169.2km².)
Submerged area	3.1km²
Effective storage capacity	46,000,000m³

First high pressure slide gates manufactured in Japan

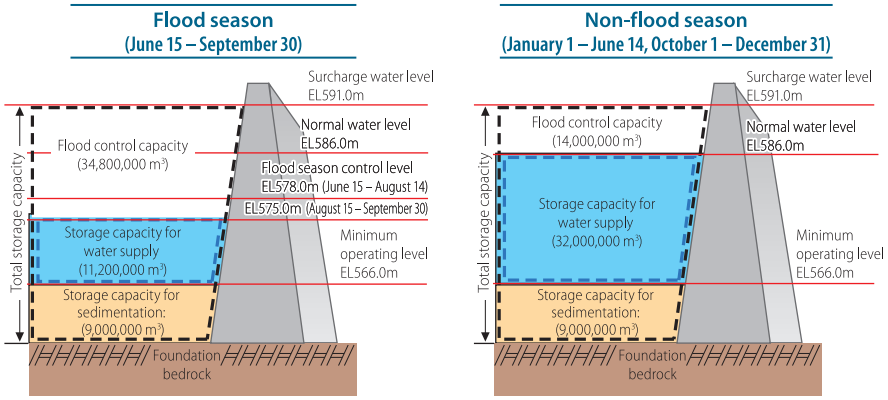


Full view of high pressure slide gate at time of construction

The high pressure slide gate used as the conduit gate which was made by Japanese technologists in order to construct the Ikari Dam was the first high pressure slide gate made in Japan.

Functions of Ikari Dam

Capacity allocation diagram



Flood control (F)

The Ikari Dam flood control plan sets the design flood discharge at the dam site at 1,500 m³/s. So, the flood control capacity which is the quantity that can be stored in the dam reservoir of 34,800,000 m³ is used, with 1,050 m³/s stored and a minimum of 450m³/s discharged downstream.

Water utilization (N)

The Ikari Dam, along with the Kawamata Dam, Kawaji Dam, and Yunishigawa Dam, supplies extra water to maintain the normal function of the river water.

Power generation (P)

Water discharged by the dam is used to generate electric power at the Tochigi Prefecture Kawaji Daiichi Power Plant.

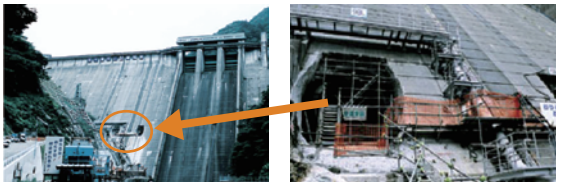
In 2020, the Tochigi Prefecture Ikari Power Plant that used the dam's maintenance flow volume etc. began to operate. Using part of the electric power as dam management power strengthened disaster prevention capacity by, for example, reducing maintenance costs and ensuring power for dam management.

Ikari Dam facility improvement

At the Ikari Dam which has operated for 60 years since its completion in 1956, a variety of facilities have been improved. This has transformed the shape of the dam body of the Ikari Dam. The Ikari Dam was improved by the 2003 installation of conduit gates which completed its functions. In 2020, a selective water withdrawal facility was constructed to improve the water environment.

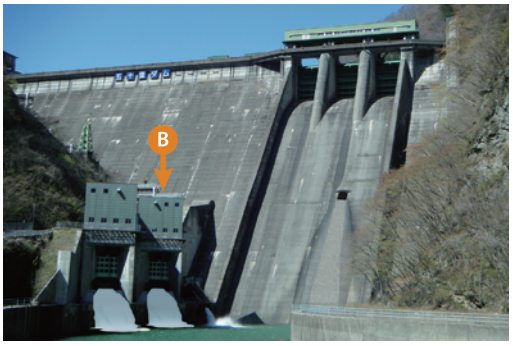
●Appearance when constructed

The conduit gates A at time of construction were hampered by low discharge capacity and an inability to regulate the quantity discharged. So, improvement work—installing new conduit gates B as an upgraded discharge facility with discharge capacity of 500m³/s—was done between 1999 and 2003.



The water level at the dam was lowered, two holes were bored in the dam body, and new conduit gates B were installed.

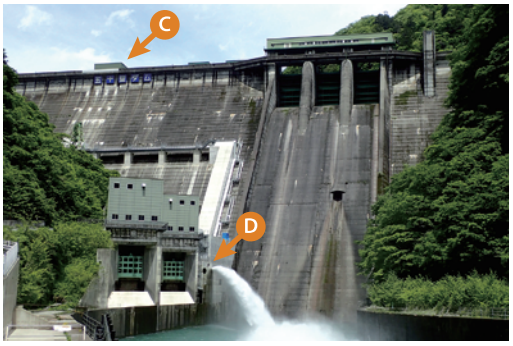
●Appearance after improvement in 2003

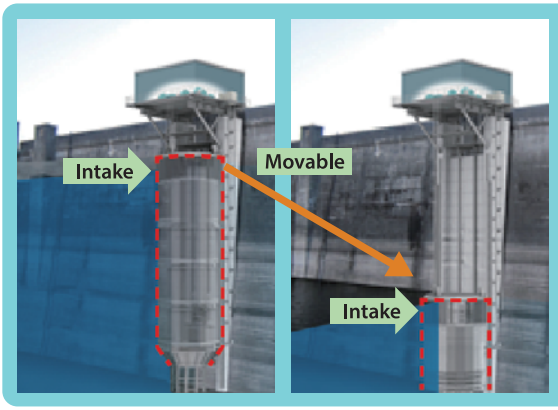


At the Ikari Dam, a selective water withdrawal facility C that can control the location where water is withdrawn from the dam reservoir to discharge clean water with an appropriate temperature downstream was newly installed in 2020 to protect the natural environment of the river downstream from the dam.

To install the selective water withdrawal facility C, a third hole was bored in the dam body to install a new outlet conduit D.

●Appearance after improvement in 2020

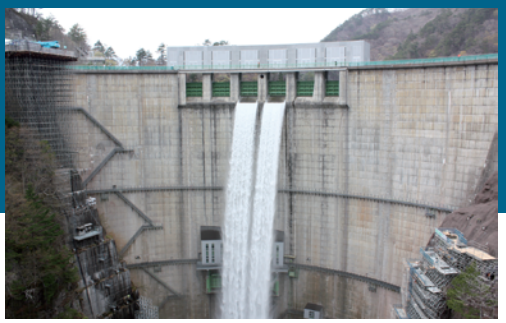




Selective water withdrawal facility C

The selective water withdrawal facility C is on the dam reservoir side where the inlet part is moved to permit turbidity-free water at appropriate temperature to be discharged downstream.

Kawamata Dam



Japan's longest concrete arch dam filled with the first drop from the Kinugawa River Source region.

The Kawamata Dam, which is located furthest upstream on the Kinugawa main course, was completed as a concrete arch dam in 1966.

The dam was constructed to control flooding, to maintain normal function of the river water, and to generate electric power.

The Kawamata Dam is 117 m high with a length of 131m for a height/width ratio of 0.89, and is the longest concrete arch dam in Japan. The dam is located in a tourist region called the Setoaikyo Canyon, attracting many sightseers.

Dam specifications

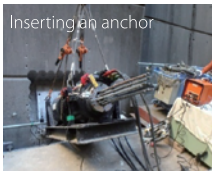
Type	Concrete arch dam
Geological feature	Liparite welded tuff
Height	117.0m
Length	131m
Volume	167,500m³

Reservoir specifications

Catchment area	179.4km²
Submerged area	2.59km²
Effective storage capacity	73,100,000m³

Bedrock improved to support the dam

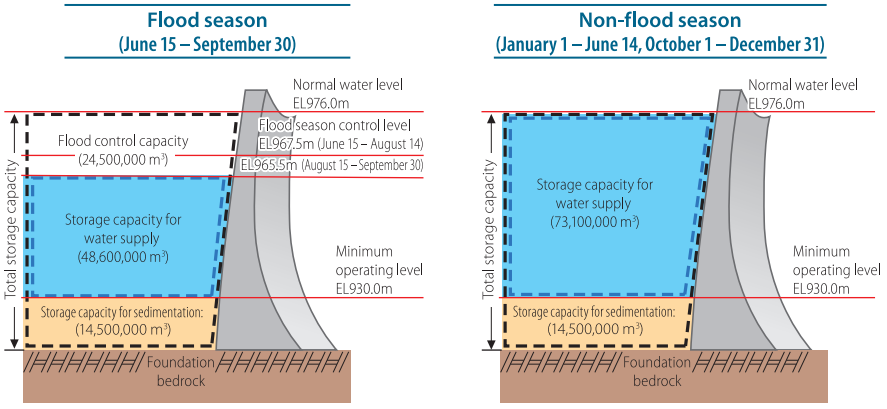
Bedrock improvement work was executed for the first time in Japan in order to strengthen the ground that supports the dam. Fifty years after its completion, anchor replacement work was done as preventive maintenance, ensuring the dam will remain in use for a long period of time.



The new anchors are the largest in use in Japan, with maximum length greater than 70 m.

Functions of the Kawamata Dam

Capacity allocation diagram



Flood control (F)

The Kawamata Dam flood control plan sets the design flood discharge at the dam site at 1,350 m³/s. So, the flood control capacity which is the quantity that can be stored in the dam reservoir of 24,500,000 m³ is used, with 1,000 m³/s stored and a minimum of 350m³/s discharged downstream.

Water utilization (N)

The Kawamata Dam, along with the Ikari Dam, Kawaji Dam, and Yunishigawa Dam, supplies extra water to maintain the normal function of the river water.

Power generation (P)

The construction of the dam was followed by the construction of the Kawamata Power Plant by a private company, and linking it to power plants etc. downstream increased the electric power supply.

Kawaji Dam

The last concrete arch dam constructed in the Kanto Region.

Kawaji Dam is a concrete arch dam completed in 1983 on the main course of the Kinugawa River following the Kawamata Dam.

This dam was constructed to control flooding, to maintain normal function of the river water, to supply agricultural water, and water for urban use.

The dam is a concrete arch dam which, at height of 140 m, is the fourth highest dam of this type in Japan. The Kawaji Onsen that is said to cure injuries, is located downstream from the dam.

Dam specifications

Type	Concrete arch dam
Geological feature	Diorite and tuff breccia
Height	140m
Length	320m
Volume	700,000m³

Reservoir specifications

Catchment area	323.6km² (Excluding Kawamata Dam's catchment area of 144.2km².)
Submerged area	2.2km²
Effective storage capacity	76,000,000m³

Dam with a beautiful three-dimensional shape

Dam body with a three-dimensional shape similar to a bowl
(Upstream side at time of construction)

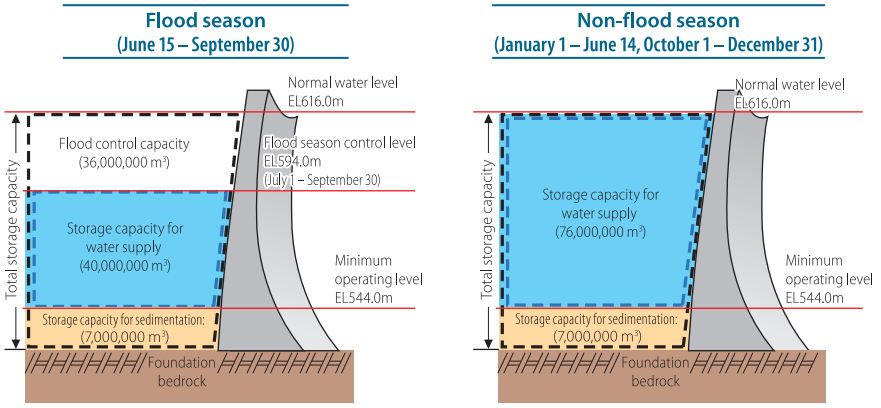
The top of the Kawaji Dam that is constructed in a steep-sided canyon, has an overhang shape that protrudes for about 16 m towards the downstream side.

Shape seen from the cat walk.

When you walk on the cat walk (inspection passage) on the downstream side of the dam, you can sense the three-dimensional shape of the dam

Functions of the Kawaji Dam

Capacity allocation diagram



Flood control (F)

The Kawaji Dam flood control plan sets the design flood discharge at the dam site at 1,800 m³/s. So, the flood control capacity which is the quantity that can be stored in the dam reservoir of 36,000,000 m³ is used, with 1,400 m³/s stored and a minimum of 400m³/s discharged downstream.

Water utilization (N A W I)

The Kawaji Dam, along with Ikari Dam, Kawamata Dam, and Yunishigawa Dam, supplies extra water to maintain the normal functions of the flowing water on the downstream river.

Agricultural use water supplied by the Kawaji Dam is provided to about 7,200 ha of farmland in Tochigi Prefecture and Chiba Prefecture. The dam also supplies about 7.2 m³/s of urban use water (public water supply and industrial water supply) to Tochigi Prefecture and Chiba Prefecture.

Management use electric power

In order to provide electric power for use in the Kawaji Dam, the maintenance flow is used to generate electric power. The surplus power is sold to an electric power company.

Yunishigawa Dam

Gravity concrete dam created by rationalized technology to adapt to the region and environment.

The Yunishigawa Dam is a concrete gravity dam completed on the Yunishigawa River in 2012.

This dam was constructed to control flooding, to maintain normal function of the river water, to supply agricultural water, and water for urban use.

The emergency spillway on the crest of the dam has no gates, so it is the only gateless dam in the Upstream Kinugawa River Dam Group with gaps on their crests.

Dam specifications

Type	Concrete gravity dam
Geological feature	Lapillituff
Height	119.0m
Length	320m
Volume	1,060,000m³

Reservoir specifications

Catchment area	102.0km²
Submerged area	1.98km²
Effective storage capacity	72,000,000m³

Introduction of Cruising RCD method

View in October 2009

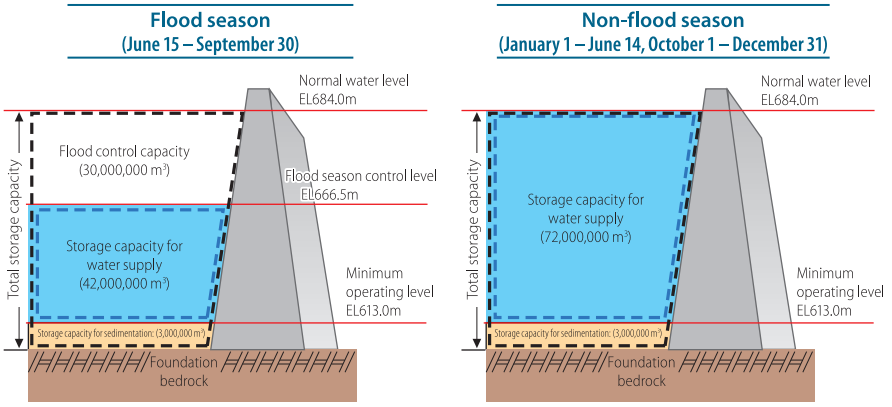
Shortening of dam body placing time by using the cruising RCD method

View in November 2011

To cut costs and preserve the surrounding environment, the placing of the concrete to build the dam body was executed in the shortened period of 19 months.

Functions of the Yunishigawa Dam

Capacity allocation diagram



Flood control (F)

The Yunishigawa Dam flood control plan sets the design flood discharge at the dam site at 850 m³/s. So, the flood control capacity which is the quantity that can be stored in the dam reservoir of 30,000,000 m³ is used, with 810 m³/s stored and a minimum of 40m³/s discharged downstream.

Water utilization (N A W I)

The Yunishigawa Dam, along with the Ikari Dam, Kawamata Dam, and Kawaji Dam, supplies extra water to maintain the normal functions of the flowing water on the downstream river. Agricultural use water supplied by the Yunishigawa Dam is provided to about 2.000 ha of farmland in Tochigi Prefecture . The dam also supplies about 2.2 m³/s of urban use water (public water supply and indusrial water supply) to Tochigi Prefecture, Ibaraki Prefecture, and Chiba Prefecture.

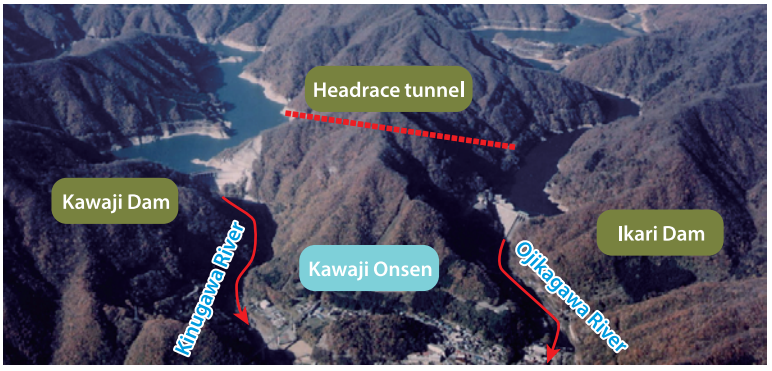
Management use electric power

In order to provide electric power for use in the Yunishigawa Dam , the maintenance flow is used to generate electric power and the surplus power is sold to an electric power company.

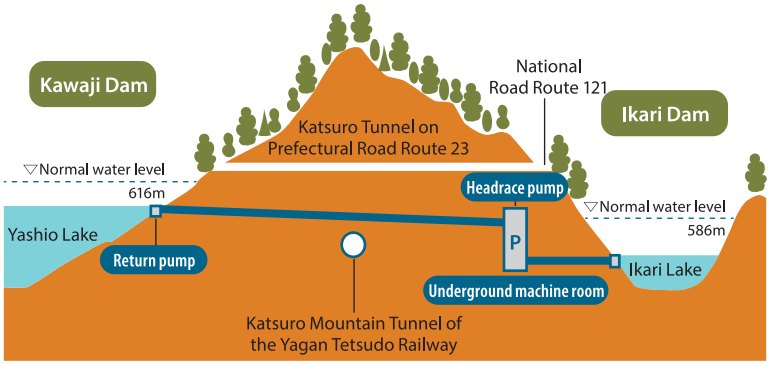
Mutual Water Supply Facilities at Kinugawa Dam Network

Mutual Water Supply Facilities

Headrace tunnels link the Ikari Dam and Kawaji Dam to form a two dam network in order to more effectively use the dam reservoirs, thereby improving the flow regime (seasonal fluctuation of flow volume etc.) in the Ojikagawa River downstream and the Kinugawa River downstream from the Ikari Dam.



Location of Mutual Water Supply Facilities at Kinugawa Dam Network

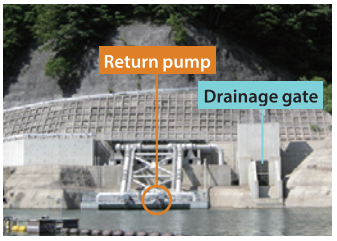


Cross section of Mutual Water Supply Facilities at Kinugawa Dam Network

Headrace pumps installed underground

The headrace pumps installed underground are two pumps with capacity to raise 10m³ of water per second by a height of 26.5 m.

Headrace pipe Headrace pipe carrying 20m³ per second (diameter 2.5 m)



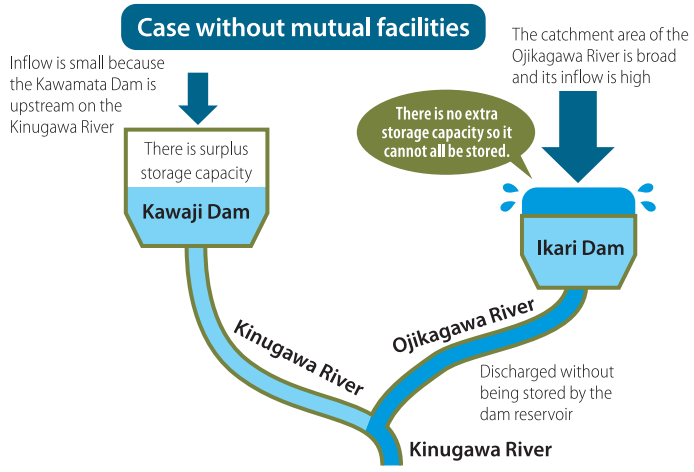
Return pump equipment

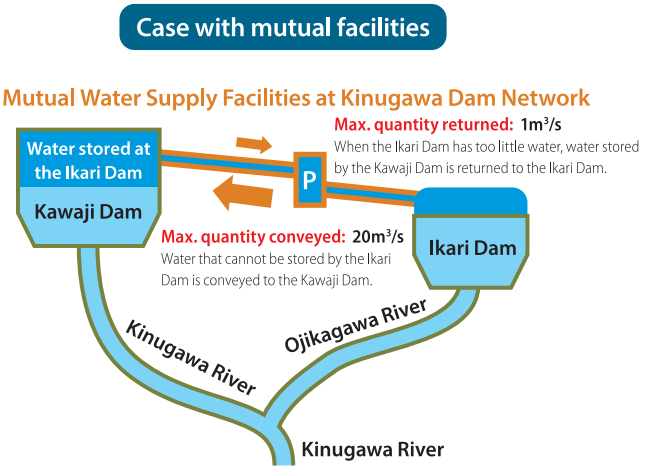
The return pump equipment on the Kawaji Dam side rises and lowers according to the changing water level in the dam reservoir

Characteristics of the Ikari Dam and Kawaji Dam and effective use of water

At the Ikari Dam, the reservoir is small and its storage capacity is low so water which it cannot store during seasons such as the snowmelt runoff and rainy season, is discharged downstream without being used.

At the Kawaji Dam on the other hand, the annual inflow is small compared with the large storage capacity of its reservoir, so even if the Ikari Dam is full, there is surplus storage capacity in the Kawaji Dam. Therefore, a network links the dams in order to effectively take advantage of the surplus storage capacity of the Kawaji Dam.





Roles played by the Upstream Kinugawa River Dam Group

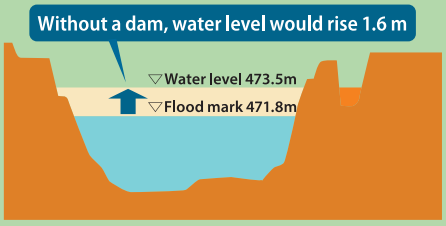
Flood control

In response to flood disasters in the surroundings of Tokyo in 1910 and 1914, a plan was made to construct the Ikari Dam in the upstream Kinugawa River in 1926. Approximately 90 years passed until the completion of the Yunishigawa Dam in 2012, and four dams, Ikari Dam, Kawamata Dam, Kawaji Dam, and Yunishigawa Dam have been constructed. These dams store rainwater that falls upstream during torrential rainfalls, holding down the rise of the water level in the downstream Kinugawa River and Tonegawa River, effectively preventing the rivers from flooding the surrounding land.

Change of the water level caused by the Upstream Kinugawa River Dam Group during the Kanto and Tohoku Torrential Rainfall (September 2015).

Upper reach

On the Ojikagawa River which flows through Kawaji Onsen, the water flowing into the dam holds down the rise of the water level to 1.6 m.



Lower reach

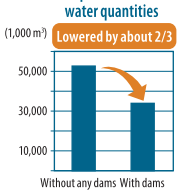
Near Joso City in Ibaraki Prefecture about 100 km downstream from the Upstream Kinugawa River Dam Group, the river embankment was breached. But the four dams stored the water to successfully reduce the flood damage by holding down the rise of the water level to between 25 and 56 cm.

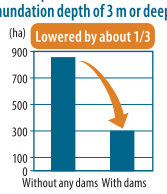
Fall of the water level at various points caused by the dams

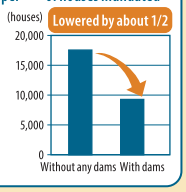
(cm)

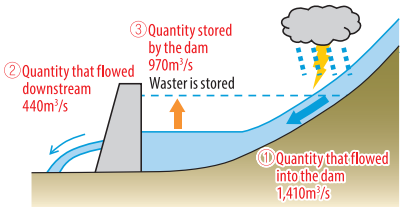
Location	Result
Hirakata Water Level Station	56
Breach location	25
Mitsukaido Water Level Station	25

This is based on a simulation









Case of Ikari Dam (at time of maximum inflow to the dam)

As rainwater flows in from upstream at a rate of 1,410 m³/s, the dam reservoir stores 970 m³/s which is 70% of the inflow and discharges 440m³/s downstream.

1,410m³/s(Quantity of inflow to dam) - 970m³/s(Quantity of water stored by dam)
= 440m³/s(Quantity discharged downstream)

State of water stored in the Upstream Kinugawa River Dam Group during the Kanto – Tohoku Torrential Rainfall of September 2015


Ikari Dam


Kawamata Dam

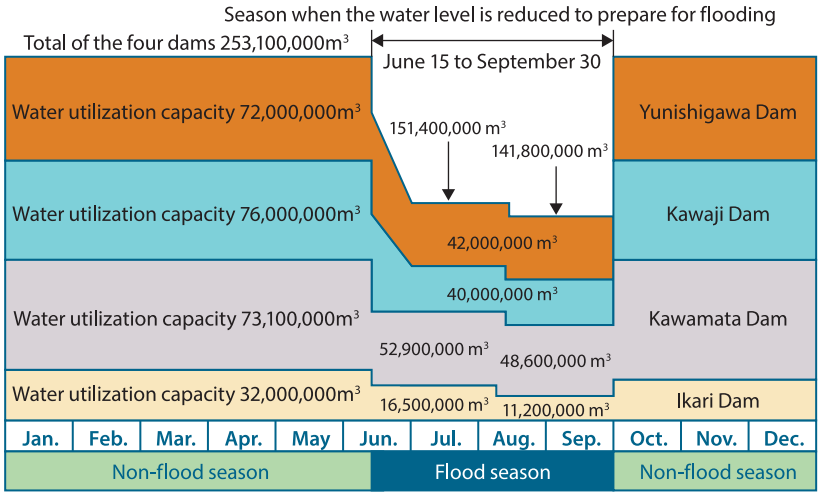

Kawaji Dam


Yunishigawa Dam

During the Kanto – Tohoku Torrential Rainfall of September 2015, the four dams stored about 100 million m³ of water, lowering the water level downstream, mitigating damage.

Concept of water supply

Each dam of the Upstream Kinugawa River Dam Group is equipped with capacity that stores water to be used in advance to facilitate water use in order that required water is stably supplied to the downstream region. This stored water and mutual facilities of the four dams used to be effectively operated so that when there was a shortage of rainwater in the downstream region as a result of a drought, the stored water would be discharged making up for the shortfall and preventing the downstream users from being unable to withdraw water.



Dams during flood season: Dam are provided with spare capacity so that during the rainy season and typhoon period when flooding is predicted, flood water flowing into dams is temporarily stored.

	Utilization water capacities of the four dams	Tokyo Dome	Remarks
Non-flood season	253,100,000 m³	About 204 times	Calculation assuming the Tokyo Dome holds 1,240,000 m³
Flood season	151,400,000 m³	About 122 times	
Flood season	141,800,000 m³	About 114 times	

State of water stored in the Kawamata Dam on the Kinugawa River

Kawamata Dam on July 25, 2018
(percentage of storage 18%)

Normal water level
(percentage of storage 100%)

State of water utilization

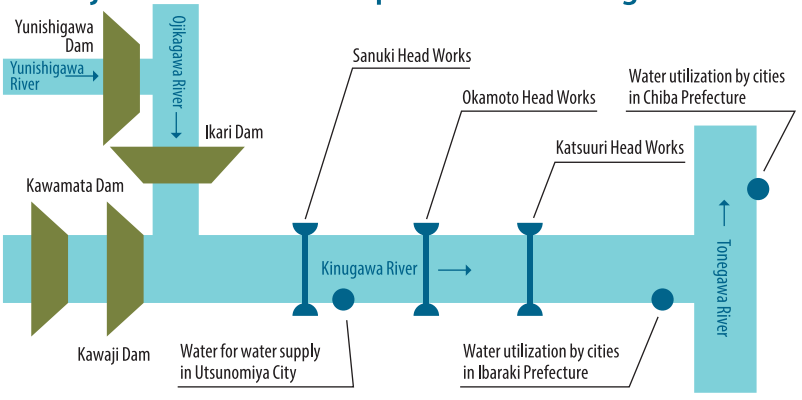
Water stored by the Upstream Kinugawa River Dam Group is used to supply agricultural water, urban water (public water, and industrial use water), to generate electric power and to maintain the normal functions of the flowing water in the river.

Also, to efficiently use limited water, the discharged water is used by multiple downstream power plants to generate electric power.

Sanuki Head Works

Sanuki Headworks completed in 1964 because the completion of the Ikari Dam, Kawamata Dam etc. improved flood control on the Kinugawa River and ensured a stable supply of agricultural use water.

Major water withdrawal points on the Kinugawa River



Equipment and facilities of dams

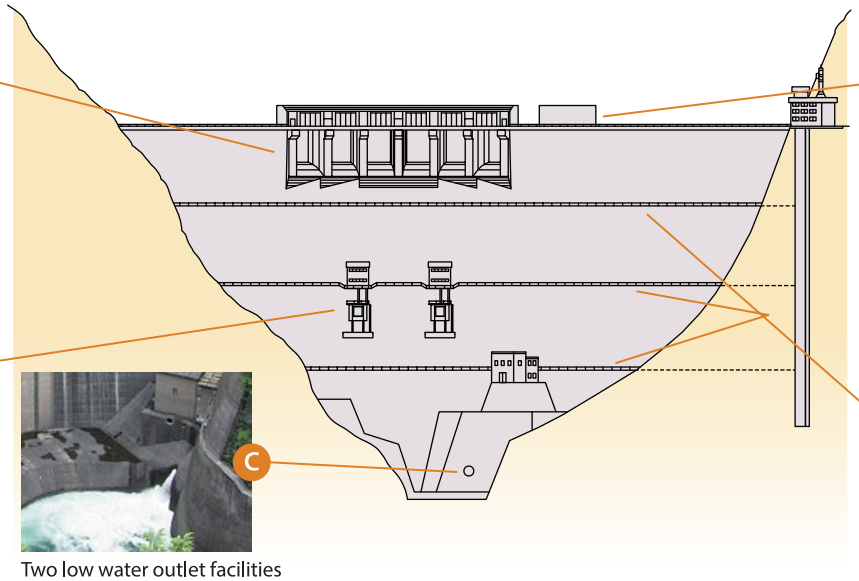
Names and functions of dam facilities

Dams are equipped with a number of types of discharge facilities used to safely and reliably discharge water downstream. A dam is also provided with various facilities used to appropriately manage it. Below various facilities are introduced taking the Kawaji Dam as an example.

Taking the Kawaji Dam as an example,

Six crest gates
Maximum per second discharge rate: 4.400m³

Two conduit gates
Maximum per second discharge rate: 400m³



Two low water outlet facilities
Primary maximum discharge capacity per second: 30m³
Secondary maximum discharge capacity per second: 5m³

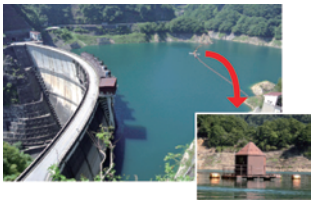
Selective water withdrawal facility

Cat walk
(Inspection passage)

	Names	Functions
A	Crest gate	Used when heavy rain falls and it cannot be handled by the conduit gates.
B	Conduit gate	Used for flood regulation
C	Low water outlet facility	This facility discharges water to agricultural water users, public water supply systems, and to industrial water users to maintain the normal functions of flowing water. According to the dam it is called a maintenance flow facility or a low water conduit pipe
D	Selective water withdrawal facility	Facility to discharge water with appropriate temperature and turbidity-free water downstream
E	Cat walk (Inspection passage)	Passage used by people to walk to perform inspections of the dam body, discharge facilities etc. Cat walks are installed at heights of 90 m, 60 m, and 30 m at the Kawaji Dam

Facilities installed inside dam reservoirs, around dams, and downstream from dams

A log boom
The boom prevents drifting wood from striking the dam body.



Automatic water quality monitoring equipment
Equipment that automatically monitors the water quality in the reservoir. Based on data it collects, water is withdrawn and discharged downstream at appropriate temperatures.

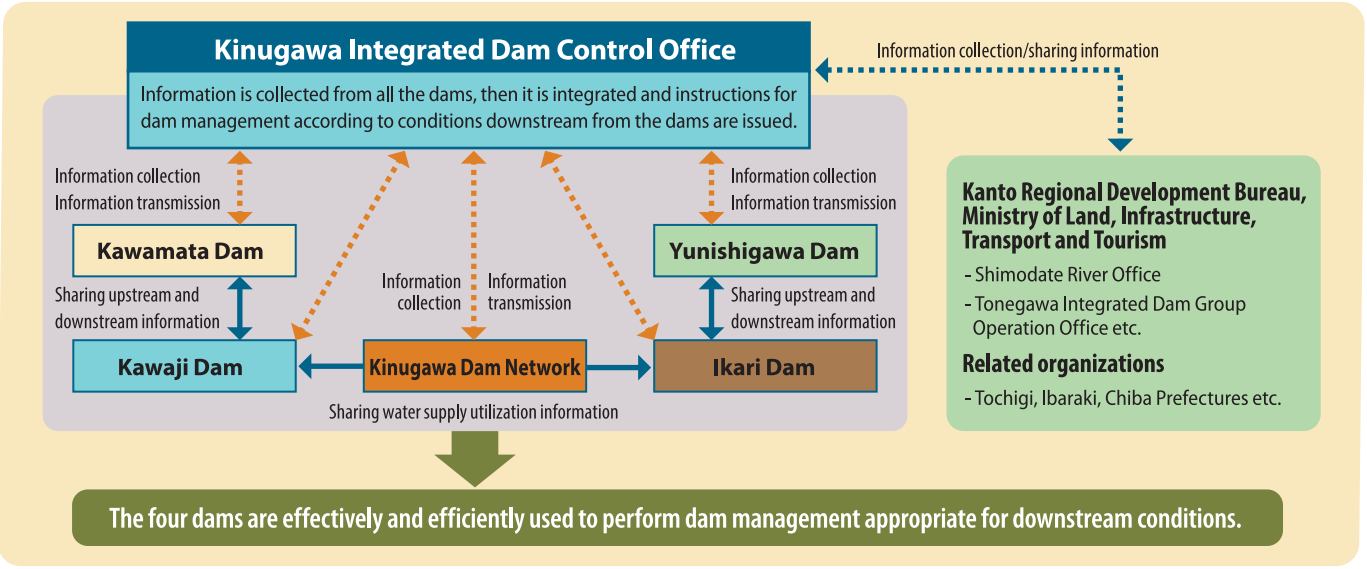
Reflective plate
One type of communication equipment that transmits dam information. It is equipped with a reflective plate that specifies the direction of the radio waves so they are transmitted in a straight line.

Dam discharge warning display panel
Display panel informing users of the river of a dam discharge.

Integrated management of the Upstream Kinugawa River Dam Group

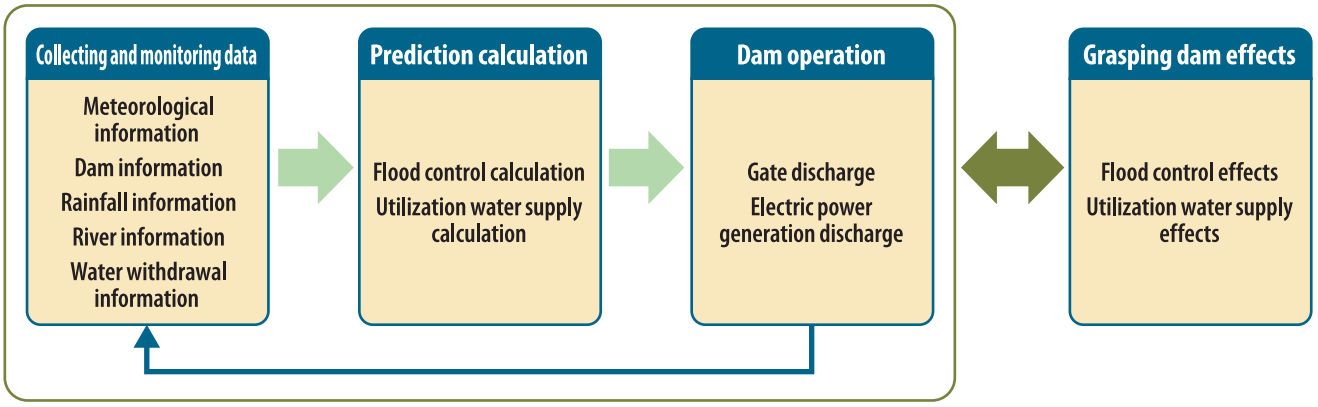
Integrated management

The upstream part of the Kinugawa River is the location of the Ikari Dam, Kawamata Dam, Kawaji Dam, Yunishigawa Dam, and Mutual Water Supply Facilities at Kinugawa Dam Network linking the Ikari Dam and Kawaji Dam. So to maximize the use of the functions of the four dams, the capability, layout, and positional relationship of each dam, topographical conditions and meteorological characteristics such as rainfall in each of their catchment areas, are grasped, and these various types of information are integrated to control flood response measures and water utilization measures on the Kinugawa River.



Flow of integrated operation

- Collecting and monitoring data
  - Collecting and monitoring data such as information about the dam and meteorological information.
- Prediction calculation
  - In order to effectively and efficiently operate the functions of the four dams, the various data which has been grasped are used to perform prediction calculations to control flooding and supply utilization water.
- Dam operation
  - Based on prediction calculation results, gates and valves etc. are operated to control flooding and supply utilization water.
- Grasping dam effects and modifying operation
  - The results of dam operation are watched to fully evaluate their effects, and "collecting and monitoring data", "prediction calculation", and "dam operation" are performed more effectively and efficiently.



Management of the dam

The Kinugawa Integrated Dam Control Office has many control facilities. In the Control Office, dam management is safely, steadily and promptly performed not only at normal times, but during flooding. Therefore, facilities are managed and weather and hydrology are predicted by controlling information, ensuring the safety of dam structures and their surroundings, and inspecting and improving all facilities in order to appropriately control the flow of water during floods and droughts.

Management at normal times

At normal times, management can be divided into management of the dam body and management done to appropriately operate the dam.

Management of the dam body

Behavior of dam body (deflection by water pressure for example) is observed and each facility is maintained and inspected, and data verified every day, permitting the dam to constantly play its roles in the best possible condition.


Behavior survey


Rainfall survey


Flow rate survey


Gate inspection


Equipment inspection

Management to appropriately operate the dam

Dams play their roles by appropriately storing water and reliably discharging water downstream. So, daily management is performed not only of the dam body, but of the dam reservoir and the surrounding environment.

Drifting wood countermeasures

Flooding produces large quantities of drifting wood. A dam reservoir collects this drifting wood so that it does not flow downstream. This drifting wood is either distributed to local residents or it is chipped and used.


Free distribution of drifting wood


Chipping drifting wood

Dam sedimentation prevention measures

Heavy rainfall carries large quantities of sediment from the mountains to dam reservoirs. Efforts are made to effectively utilize deposited sediment. For example, when the Yunishigawa Dam was constructed, sediment deposited at the Kawaji Dam was used as material to make concrete.


Excavation of sediment deposited at the Kawaji Dam

Water quality preservation measures

Large quantities of cloudy turbid water flow into the Kawaji Dam from upstream during flooding. As a result, the dam reservoir is filled with cloudy turbid water for long periods. So turbid water diffusion prevention fences are constructed as counter-measures to prevent the spread of turbid water throughout the dam reservoir. Also, selective water withdrawal facilities in the dam body are operated so that water discharged downstream is low-turbidity water in order to prevent turbid water from flowing in the downstream river.

Turbid water diffusion prevention fence at the Kawaji Dam

Preserving the downstream environment

To improve the environment of the river downstream from the dam, at the Ikari Dam, flushing discharge is performed regularly. Flushing discharge is done at the Ikari Dam by increasing the discharge flow rate to 100 m^3/s for a short time period to flush out invasive species using the power of the flow.

Flushing discharge is executed so the flowing water removes invasive species of diatoms

Discharge to improve the environment at the Ikari Dam

Monitoring the natural environment

The dam and dam reservoir are in the Nikko National Park which is blessed with a rich natural environment. So the dam surroundings are regularly surveyed to find out how they have changed: change of their living organisms for example.

Japanese deer walking on the frozen surface of the dam reservoir

Management during flooding

In order to prevent flood damage in the region along the downstream Kinugawa River, large quantities of inflowing water are temporarily stopped by the dams, then discharged within a safe range. The discharge is done by deciding to discharge water from dams after comprehensively collecting and analyzing the information such as weather and downstream river water level conditions. And warnings of discharges are given to downstream residents.

Patrol during discharge

Dam discharge procedure

Grasping meteorological conditions
Organizing information such as rainfall, flow rate, typhoon

↓

Predicting the inflow quantity at the dam location
Meteorological data analysis, inflow prediction calculations etc.

↓

Decision to discharge water from the dams

↓ Notification of concerned organizations

Warning the downstream region
Patrol sirens and speakers etc.

↓

Gate operation
Discharge from dam

Management during drought

When rainfall is so low that there is danger of a drought or water shortage, quantities of water required by public water supply and agricultural water users are systematically discharged into the downstream Kinugawa River.

Lake Kawamata when the water level has been lowered by drought countermeasures

Management in the event of an earthquake

When seismic intensity is 4 or higher or the seismograph at the dam records values higher than a preset level, an emergency inspection is conducted to find out if the dam body has been damaged. And as necessary, a drone is flown to confirm whether or not a landslide has occurred around the dam reservoir.

Seismograph in the base of the dam body

Confirmation of maximum acceleration by a seismograph

Visual confirmation of damage

Confirming the site by flying a drone

Roles of the dams in local development

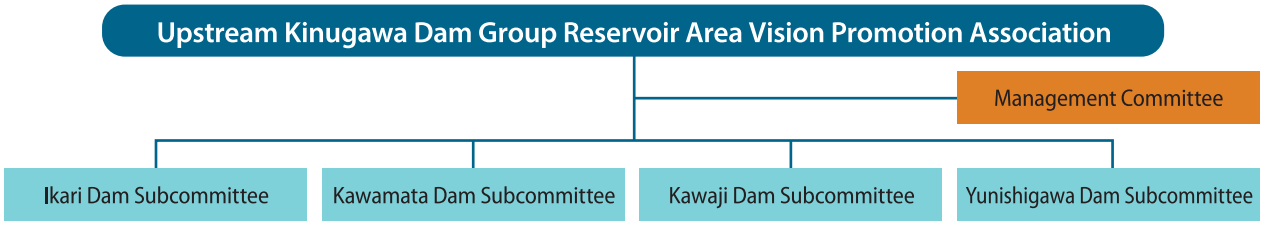
There is a thriving tourism industry featuring natural scenery and hot springs in the area upstream from the Upstream Kinugawa River Dam Group. So, the Kinugawa Integrated Dam Control Office is working to stimulate local development in this upstream area in cooperation with Nikko City in order for dams, dam reservoirs etc. to be used as a tourism resource. It also organizes tours of the dams and promotes relationships between the upstream and downstream areas in order that downstream residents understand the importance of the dams and the upstream area.

Promoting the Upstream Kinugawa Dam Group Reservoir Area Vision

In order for dams, dam reservoirs, etc. to play a role in the tourism industry which is a reservoir area industry, local residents, representatives of inn associations, fishing coops and other concerned organizations and of local government, dam managers and other dam officials and so on have enacted and are working to implement the Upstream Kinugawa Dam Group Reservoir Area Vision.

To encourage infrastructure-tourism through dam tours and the use of dam reservoirs, The Upstream Kinugawa Dam Group Reservoir Area Vision Promotion Association and its dam subcommittee are taking measures adapted to local conditions through consultations with local residents and representatives of other concerned organizations.

Reservoir Area Vision Promotion System



Infrastructure-tourism development

In the Upstream Kinugawa River Dam Group, the development of infrastructure tourism using dams and dam reservoirs has a long history. Particularly at the Yunishigawa Dam where the attractiveness of the region has been boosted by the first use in Japan of amphibious buses on a dam reservoir. Also, in cooperation with local residents and private companies, even dam facilities which have, until now, rarely been open to the public, have begun to play a role as a tourism resource.

Amphibious bus enters the reservoir

Tour of the Yunishigawa Dam

Amphibious bus tours let visitors look up at the dam from downstream which is an area that is normally inaccessible.

SUP tour of Lake Kawamata by a local travel company

Canoe tour on Lake Yunishigawa (social experiment)

At each dam, rules governing the use of the surface of the water are enforced to open the reservoir surface to users.

Cat walk tour of the Kawaji Dam

Tour inside the Ikari Dam

A local travel company commercializes the three national government and prefectural dams as a single dam tour

Tour held to show how discharge is done to improve the environment at the Ikari Dam

Tour of Mutual Water Supply Facilities at Kinugawa Dam Network

Dam equipment closed to the public until now is opened up with the cooperation of local people.

Lighting up the Kawamata Dam

At the Kawamata Dam, tours held so visitors can enjoy the sight of the lit-up dam and the star-filled night sky. Other dams are also used as nighttime tourism resources with the cooperation of local people.

The Yunishigawa River Mizu no Sato Tourism Center and Michinoeki (Roadside Station) Yunishigawa which are the bases of dam tourism. Amphibious buses depart from and return to both locations.

Michinoeki (Roadside Station) Yunishigawa

Yunishigawa Mizu no Sato Tourism Center

The Dam Museum and Library

Each of the four dams of the Upstream Kinugawa River Dam Group has a dam museum and library where visitors can learn about the dam and the region.

Ikari Dam Library

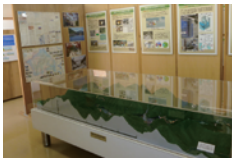
The Ikari Dam Management Branch Office is on the first floor. It was renovated in 2019.

Kawaji Dam Museum

It is located on the right side of the Kawaji Dam Crest. It was renovated in 2020.

Kawamata Dam Library

It is in front of and to the side of the Kawamata Dam Management Branch Office. It also provides complete information about local folklore.



Yunishigawa Dam Library

It is located on the Yunishigawa Dam outlook plaza. It was renovated in 2021.

Handing out dam cards and the stamp rally

At all four dams, dam cards are given out. Visitors who visit all four dams and collect four stamps are given a free specially made dam card holder. In this way, many people can enjoy local sightseeing including the dams when they visit the upstream area.

Dam cards are given out at the Ikari Dam, Kawamata Dam, Kawaji Dam and the Yunishigawa Dam.

The stamp rally forms are also sightseeing maps of the dam's surroundings.

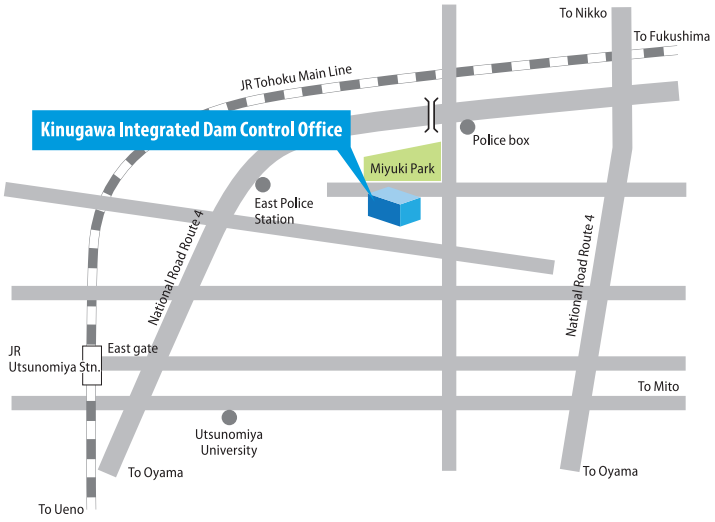
Events are held

●Upstream – downstream resident get-togethers

Children from cities downstream from the dams and children from Nikko City in the upstream region take part in Upstream – Downstream Resident Get-togethers . These events include dam tours and instruction in forest classrooms that deepen mutual understanding between water users in the downstream area and residents of the upstream area who send the water downstream.

●Dam tour

During the "Get to Know your Forests and Lakes Season" in July of each year, tours are held in usually inaccessible places such as the insides of the four dams and their mutual facilities on the upstream Kinugawa River region.



Kinugawa Integrated Dam Control Office

Kanto Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

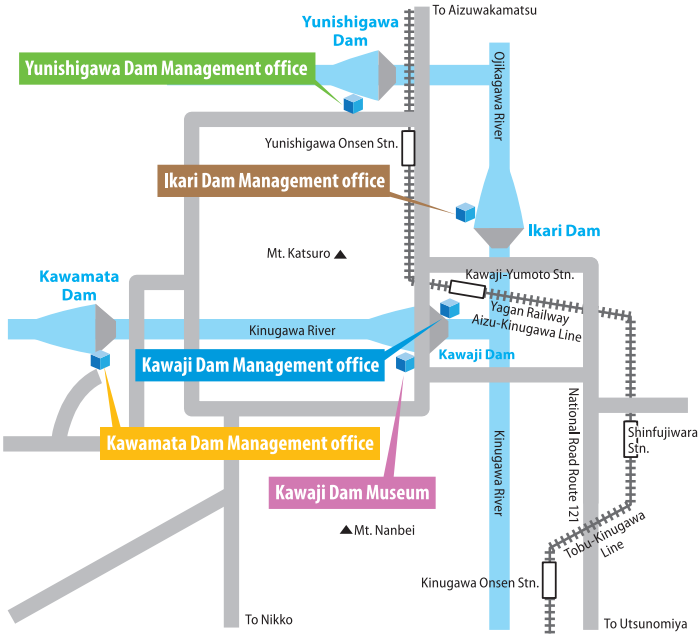
14-3 Hiraide Industrial Park, Utsunomiya City, Tochigi 321-0905

General Affairs Sec.	TEL 028-661-1341
Management Sec.	TEL 028-661-1342
Research Sec.	TEL 028-661-7764
Disaster Information Sec.	TEL 028-661-1059

Control office web site

●Web site URL http://www.ktr.mlit.go.jp/kinudamu/

●Disaster information for river http://www.river.go.jp/



Ikari Dam Management Branch Office

Official Twitter

Kawaji 295-1 Kawaji Onsen,
Nikko City, Tochigi 321-2611
TEL.0288-78-0071

About 50 minutes by car from the Imaichi IC on the Nikko-Utsunomiya Road

Kawamata Dam Management Branch Office

Official Twitter

Kawamata 646-1
Nikko City, Tochigi 321-2717
TEL.0288-96-0281

About 100 minutes by car from the Imaichi IC on the Nikko-Utsunomiya Road

Kawaji Dam Management Branch Office

Official Twitter

Kawaji 319-6 Kawaji Onsen,
Nikko City, Tochigi 321-2611
TEL.0288-78-0702

About 45 minutes by car from the Imaichi IC on the Nikko-Utsunomiya Road

Kawaji Dam Museum

Kawaji 293-3 Kawaji Onsen,
Nikko City, Tochigi 321-2611
TEL.0288-78-0702
(Kawaji Dam Management Branch Office)

About 45 minutes by car from the Imaichi IC on the Nikko-Utsunomiya Road

Yunishigawa Dam Management Branch Office

Official Twitter

Nishikawa 416
Nikko City, Tochigi 321-2603
TEL.0288-78-0184

About 60 minutes by car from the Imaichi IC on the Nikko-Utsunomiya Road

TEC-FORCE Technical Emergency Control Force

https://www.ktr.mlit.go.jp/bousai/index.html