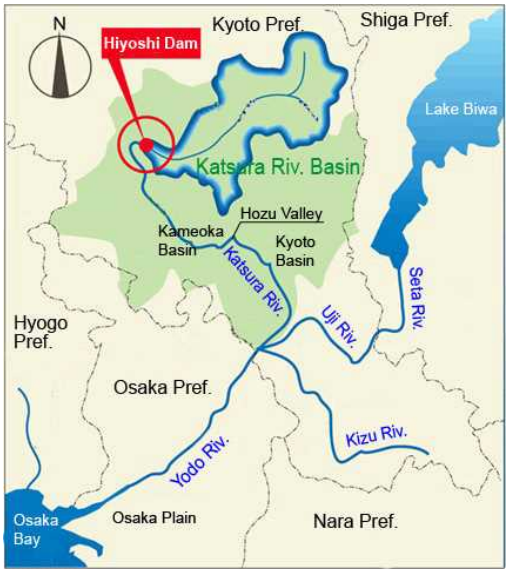
Hiyoshi Dam on Katsura River in the Yodo River System



The Katsura River begins near Sasari Pass, which is close to the boundaries of Kyoto, Shiga, and Fukui Prefectures. The river runs toward the west in the eastern part of Tamba Plateau, turns southeast just below Hiyoshi Dam, passes the Kameoka Basin, runs through Hozu Valley and Arashiyama, and reaches the Kyoto Basin. It becomes the Yodo River after joining the Uji River and Kizu River at the southwestern edge of the Kyoto Basin, and then discharges into Osaka Bay.

The Yodo River system is one of the largest river systems in Japan, with a basin area of 8,240 km^2. The basin area of the Katsura River is 1,100 km^2, which is equivalent to 13.3% of the basin area of the Yodo River. The length of the Katsura River is 114 km up to the confluence point.

Hiyoshi Dam is a multi-purpose dam constructed on the Katsura River as part of comprehensive development of the Yodo River. It is located at the middle of the Katsura River, 55 km upstream from the confluence point.

Course of Hiyoshi Dam

Floods due to rain fronts and typhoons have often damaged the Yodo River Basin including the Katsura River. Since the Katsura River has a narrowed part called the Hozu Valley, the Kameoka Basin located upstream of the valley had been often submerged (as shown in the photo: Typhoon No.10, 1982), causing much loss of life and damage to property. On the other hand, securing water resources in response to rapid population growth in the cities along the Yodo River had become a major social issue, and prompt measures were necessary to meet this water demand.

Under these circumstances, Hiyoshi Dam was planned (the name was originally “Miyamura Dam”). At that time, 201 households (216 houses) lived in the area that was to be submerged due to the dam construction. Thanks to their understanding of this project and their cooperation by relocation, etc., the dam was completed after 37 years after it was planned. Now, Hiyoshi Dam actively helps to control floods and to supply water along the Yodo River.

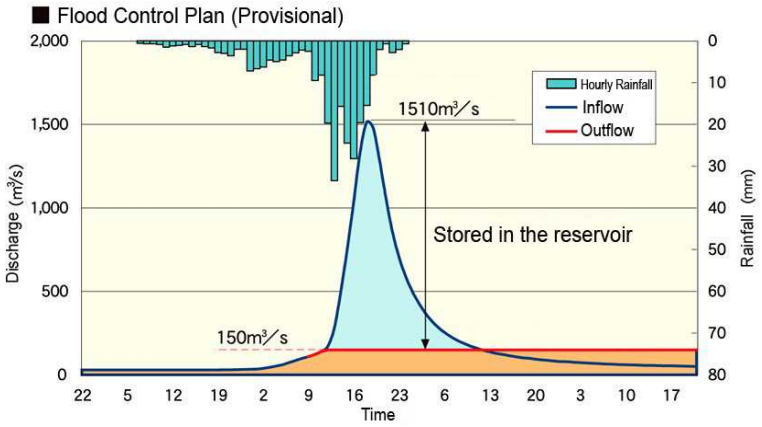
- Mar. 1961: Hiyoshi Dam (“Miyamura Dam” at that time) planned
- Sep. 1972: Hiyoshi Dam project incorporated into “Basic Plan for Water Resources Development in Yodo River System”
- Jun. 1981: Hiyoshi Dam designated under Act on Special Measures concerning Reservoir Areas Development
- Feb. 1992: Construction works on the diversion tunnel started
- Feb. 1993: Construction works on the dam body started
- Apr. 1993: Hiyoshi Dam designated as a Dam Opened to the Public
- Oct. 1994: Placement of dam concrete started
- Nov. 1996: Placement of dam concrete finished
- Mar. 1997: First filling of water started
- Dec. 1997: First filling of water finished
- Apr. 1998: Operation and maintenance started

- Sep. 2000: Due to discharge from the dam by drought, the lowest percentage of storage (4.4%) recorded▲
- Sep. 2013: Due to floods by typhoon No.18, the maximum flood control carried out (maximum inflow: 1,694 m^3/s)

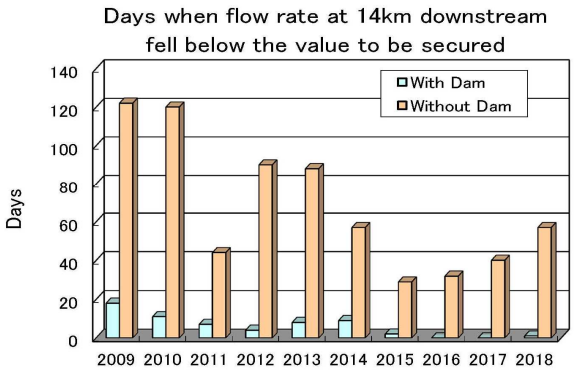
Purpose (1): Flood Control

By temporarily storing water in the dam reservoir during floods and by discharging water at a safe rate for the downstream areas, Hiyoshi Dam can reduce the damage caused by floods.

Hiyoshi Dam was constructed under a plan to control the 100-year floods. However, since river improvements in the lower reaches of the Katsura River are still in progress, flood-control operation with discharges of up to 150 m^3 has been provisionally carried out for controlling the 20-year floods. This operation is designed to maximize the effectiveness of flood control by the dam.



Purpose (2): Maintenance of Normal Function of River



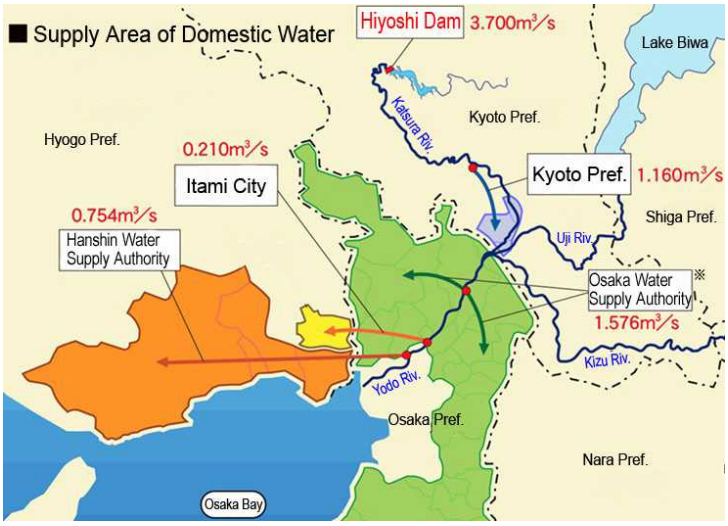
Hiyoshi Dam can discharge supplemental water for the vested water rights along the Katsura River and environmental preservation to maintain the normal functions of the river water. This supply has greatly reduced downstream water shortages.

However, the capacity of the dam is limited. If the dam were to continue discharging supplemental water for a long time without rainfall, the water level of the reservoir would decrease and the desirable flow rate downstream could not be secured. Therefore, the amount of supply is coordinated among the related members.

Purpose (3): Development of Water Use

Hiyoshi Dam has created additional water use of 3.7 m^3/s (sufficient for approx. 1 million people). It can supply domestic water to Kyoto Prefecture (Otokuni District: Muko City, Nagaokakyo City, and Oyamazaki Town), Osaka Prefecture (Osaka Water Supply Authority), and Hyogo Prefecture (Itami City; and Hanshin Water Supply Authority: Amagasaki City, Nishinomiya City, Ashiya City, and Kobe City).

*Osaka Water Supply Authority supplies domestic water to the whole of Osaka Prefecture except Osaka City.



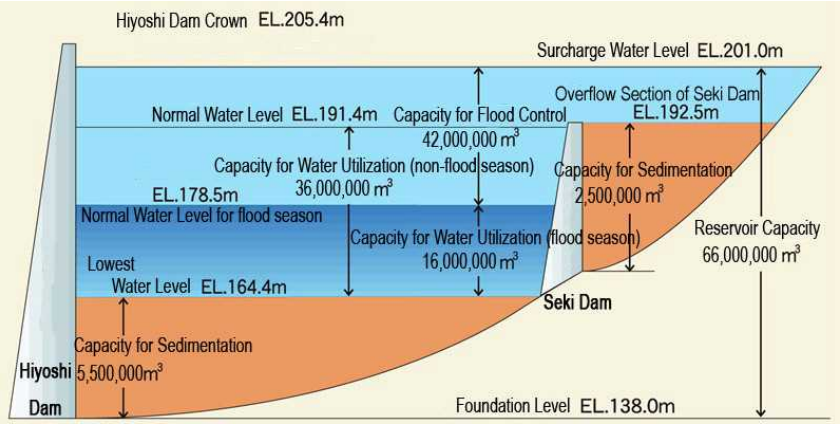
Power Generation for Dam Operation

The Hiyoshi Dam Hydropower Plant can generate electric power of up to 850 kW by using water taken through selective intake works (up to 3.0m^3/s) and turning a watermill. This clean electric power is effectively used for operation of the dam facilities, and the excess is sold to electric utility companies. This reduces the cost of dam operation.

Dam Body and Reservoir

Specification of Dam Body and Reservoir

Type of Dam	Concrete Gravity Dam
Height of Dam	67.4 m
Length of Dam Crest	438 m
Volume of Dam	670,000 m^3
Catchment Area	290 km^2
Reservoir Area	2.74 km^2
Reservoir Capacity	66,000,000 m^3



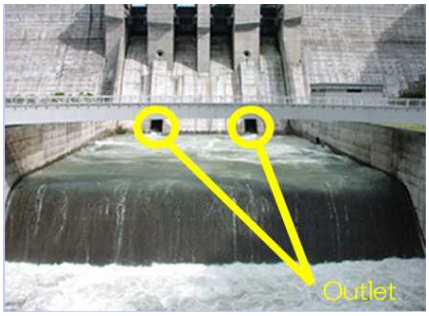
- **Surcharge Water Level**: Water can be stored up to this level temporarily during floods.
- **Normal Water Level:** Water is normally stored up to this level from Oct. 16 to Jun. 15 the following year.
- **Normal Water Level for flood season:** Water level is restricted up to this level from Jun. 16 to Oct. 15 in case of floods.
- **Lowest Water Level:** This level is operationally the lowest. The part below this level is the capacity for sediment.

Water Use Outlets

These facilities are used to discharge water taken from the selective intake works. The right photo shows the outlets into the stilling basin.

- **Branch Pipe** (right, 0-5 m^3/s): used for supplying water to downstream areas and during small floods
- **Main Pipe** (left, 0-50 m^3/s): used for discharging more than 5 m^3/s and while the valve of the branch pipe is being checked

Outlet Works for Flood Control



These conduit gates can be used during normal floods. One gate can discharge up to 250 m^3/s and two gates can discharge up to 500 m^3/s. The left photo shows water of 100 m^3/s through the two gates.

Before discharging from these gates, speaker broadcasts and siren warnings are made at 15 warning stations (as shown in the photo below) which are installed at the O&M Office and in downstream areas, and downstream areas are also patrolled by car to confirm safety.

Emergency Spillways

These crest gates could be used in conjunction with the conduit gates in case of bigger floods than the 100-year floods in the operating plan for this dam. One gate can discharge up to 775 m^3/s and four gates can discharge up to 3,100 m^3/s. The left photo shows some water discharged on a trial basis.

▲ Warning Station

Recycling of Driftwood

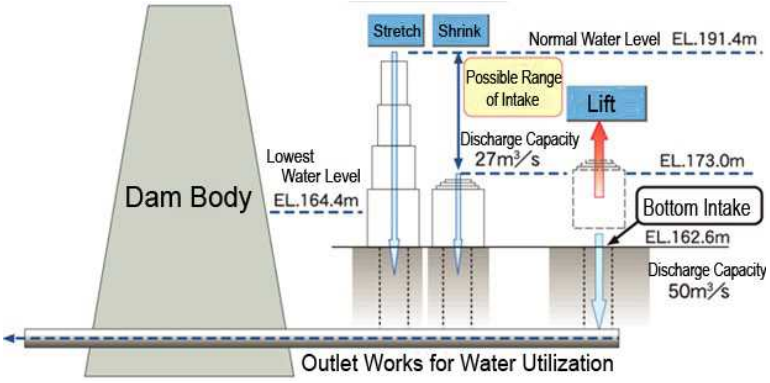
Driftwood and driftage that have flowed into the reservoir during floods are removed and treated. Withdrawn driftwood is effectively used by processing it into usable materials such as chips and compost.

Measures for Environmental Preservation

The following facilities have been installed in the reservoir to conserve the water quality of the reservoir and discharged water.

(1) Selective Intake Works

In order to prevent discharging cold and/or turbid water, water is always taken from the most appropriate depth through these facilities, taking into account the distribution of water temperature and turbidity in the reservoir. These measures reduce the impact on agricultural and domestic water taken downstream and aquatic organisms.



(2) Submersible combined aerator

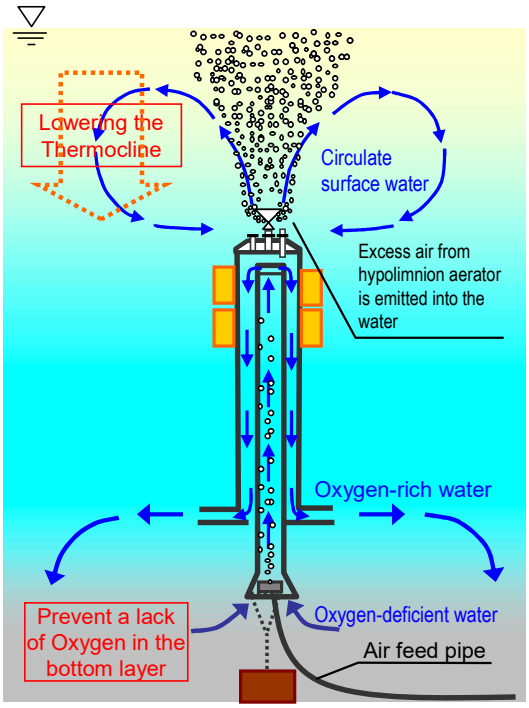
Hypolimnion aerator causes excess air with its operation. About 90% air is emitted into the atmosphere through discharger on the water surface. “Submersible combined aerator “ is aiming at the efficient use of this excess air. Development of automatic discharger allowed for stable emission of the excess air and realized combined aerator in deep / shallow water.

○ Aeration Device in Surface Layer

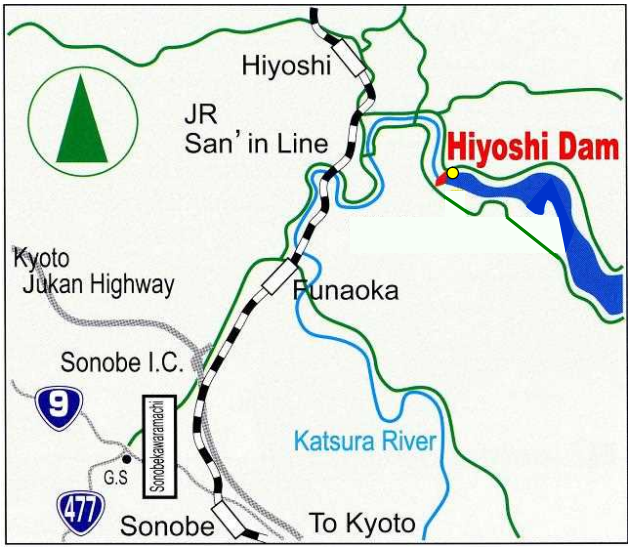
Since the surface layer of the reservoir warms from spring to summer, a thermocline gradually forms between the upper layer and the lower layer where the water is still cold. This thermocline prevents water from mixing easily. This device encourages the circulation of water between the layers by aeration from a pipe installed in the reservoir, thus lowering the thermocline. These measures reduce the impact of discharging cold water when the intake depth is lowered.

○ Aeration Device in Bottom Layer

Dissolved oxygen near the bottom layer of the reservoir tends to run short in summer. By taking water from near the bottom layer into the device, dissolving oxygen into the water, and then returning it to the bottom layer, generation of hydrogen sulfide and inorganic phosphorus is restricted. These measures help prevent the smell of hydrogen sulfide during discharging through conduit gates and blooms of phytoplankton.



Access to Hiyoshi Dam



■ By Train

- 30-minute walk from Hiyoshi Station along JR San’in Line. A public bus is available from the station.

■ By Car

- 7-km drive from Sonobe I.C. of Kyoto Jukan Highway.
- 9-km drive toward Nantan-Hiyoshi from Sonobe-Kawaramachi intersection in Nantan City along Route 9.

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Nov. 2022