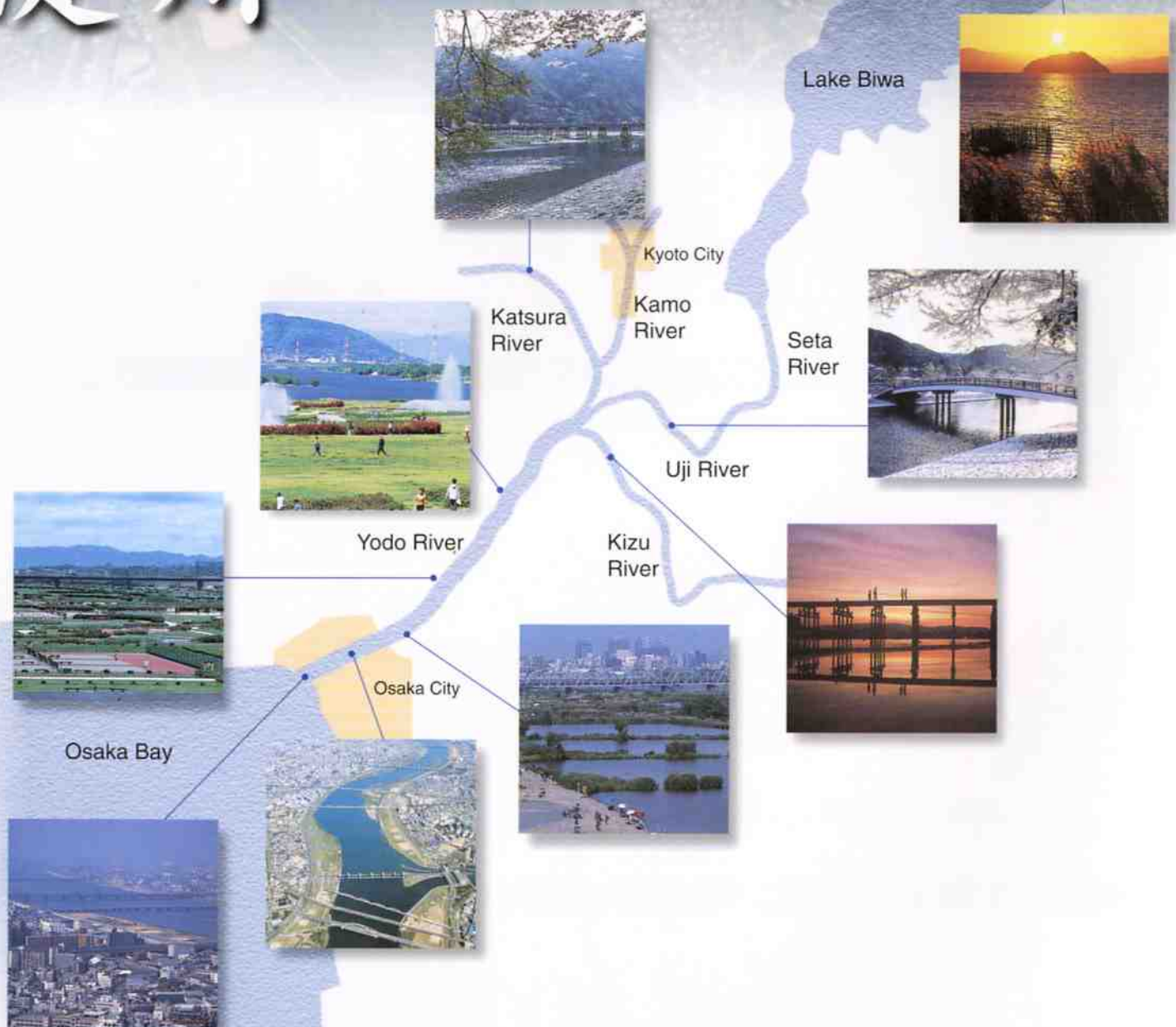


Working Towards Fostering Confidence and Culture

THE YODO RIVER

淀川



Ministry of Land, Infrastructure and Transport
Kinki Regional Development Bureau

Yodo River Office



Characteristics of rivers in Japan and the Yodo River

Since almost 70% of the Japanese archipelago is covered by sloping land and mountainous regions, the river slope tends to be steep and consequently, the length of rivers in Japan are significantly shorter than that of rivers in other countries. **fig.1**

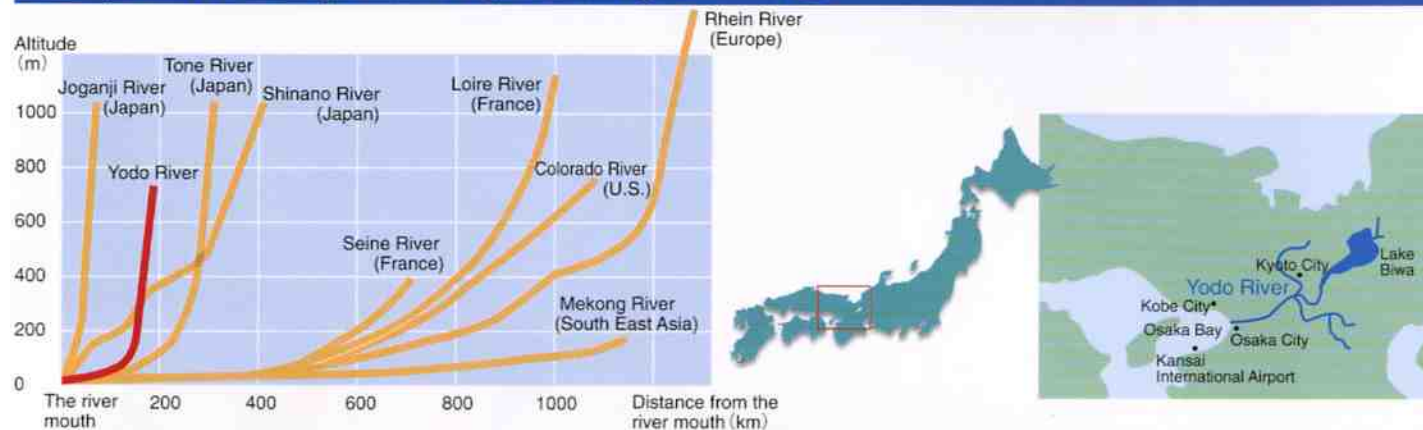
In addition, heavy rainfall causes sudden increases in water volume, during which water flows all at once to the plains before the sea. These plains, with a large number of inhabitants, lie mostly below river-water level.

In the Kinki region of Japan, where the Yodo and the Yamato Rivers are located, most of the heavily populated urban developments are located in areas lower than the river-water level. Therefore in worse case scenarios, where an embankment collapse might occur, these areas run a high risk of great damage. **fig.2**

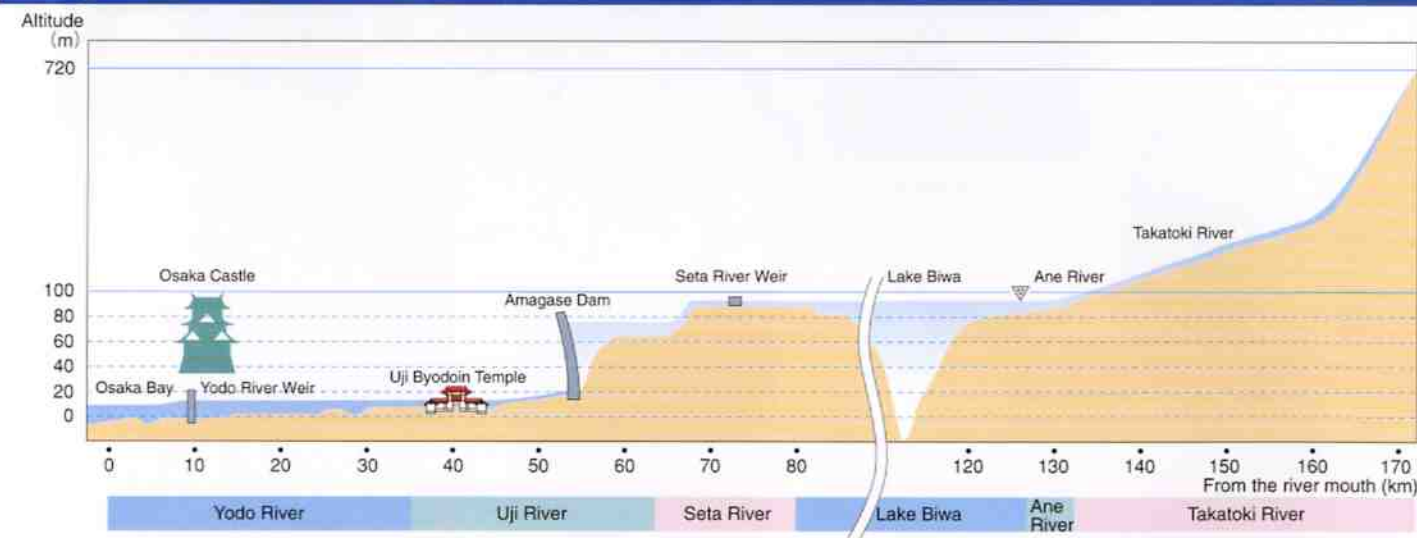
In Osaka City's case, it is estimated that 94.9% of the total metropolitan area is located within the flood-prone area.



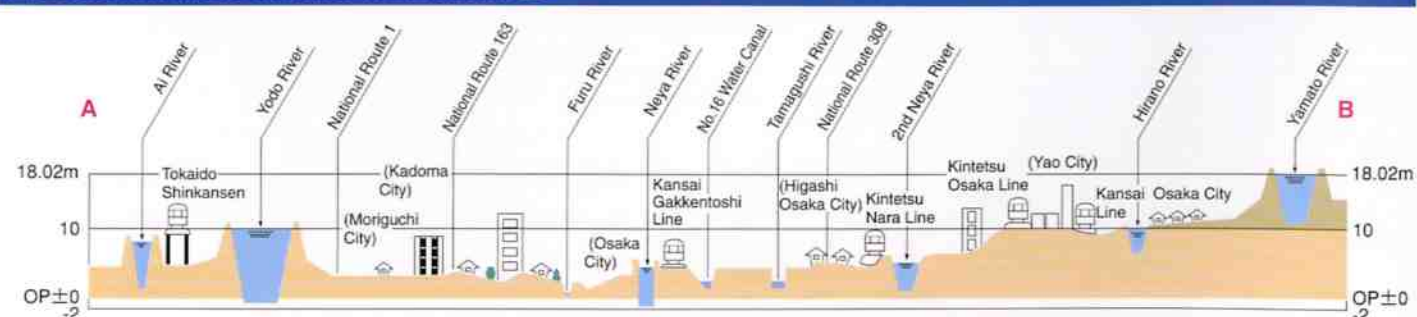
Comparison of river slope between Japan and foreign countries **fig.1**



Longitudinal section of Yodo River



Cross section of Yodo River downstream **fig.2**



Risk of flooding

Even the Yodo River, considered a bountiful blessing bestowed upon the people of the area, could turn in to a river fraught with the risk of flooding when heavy rainfall occurs. This is quite crucial for a nation that lies directly on the seasonal typhoon course, and is constantly hit by a large number each year causing considerable damage. **fig.1**

Ever since the typhoon No.13 hit the area in 1953, and caused an unprecedented flooding of the Yodo river system, heavy floods have been registered a record ten times within thirty years since 1953. This makes the risk of floods always a looming threat. **fig.2**



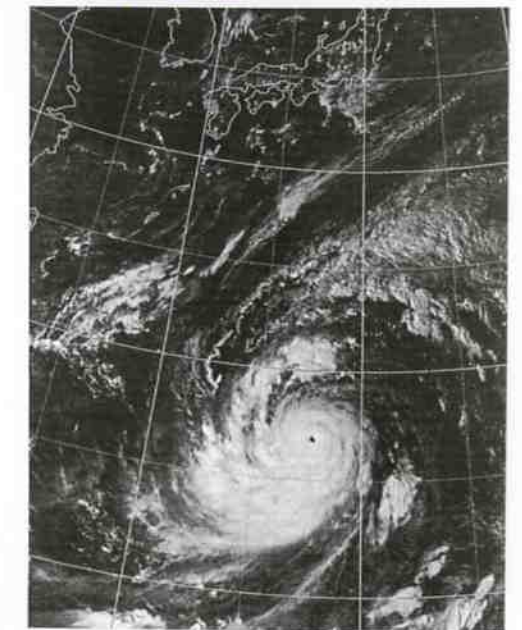
Broken embankment in 1953

Recent floods in Yodo River **fig.2** (at Hirakata)

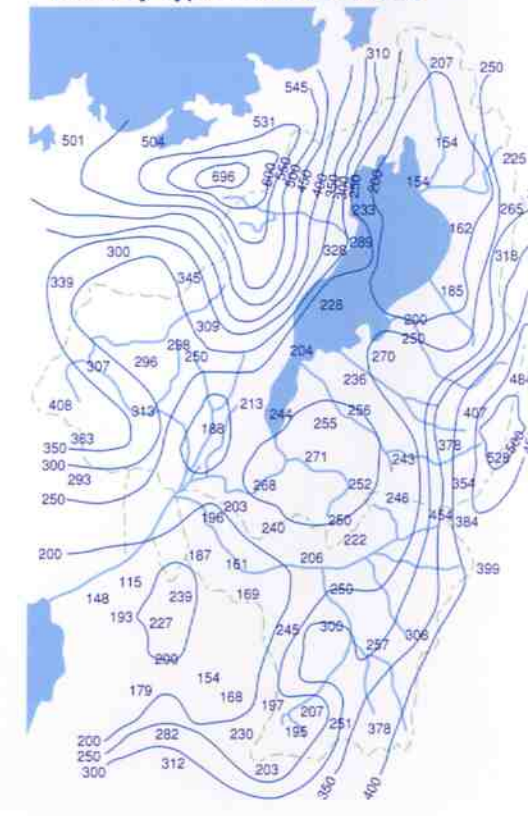
Occurrence date	Metrological cause	Basin's average total rainfall (mm)	Max discharge (m³/s)
1953. 9.25	Typhoon (5313)	249	7,800
1956. 9.21	Typhoon (5615)	176	5,025
1958. 8.27	Typhoon (5817)	171	3,990
1959. 8.14	Front/typhoon (5907)	272	6,800
1959. 9.27	Typhoon (5915)	215	7,970
1960. 8.30	Typhoon (6016)	179	3,775
1961.10.28	Depression, front, typhoon	251	7,206
1965. 9.17	Typhoon (6524)	203	6,868
1972. 9.17	Typhoon (7220)	200	5,228
1982. 8. 2	Typhoon (8210)	231	6,271

○ Flood above design high water level
○ Flood above design flood discharge

Typhoon approaching to the Japanese Archipelago **fig.1**



Distribution of rainfall at Yodo River basin by Typhoon No.13 in 1953





Utilization of water

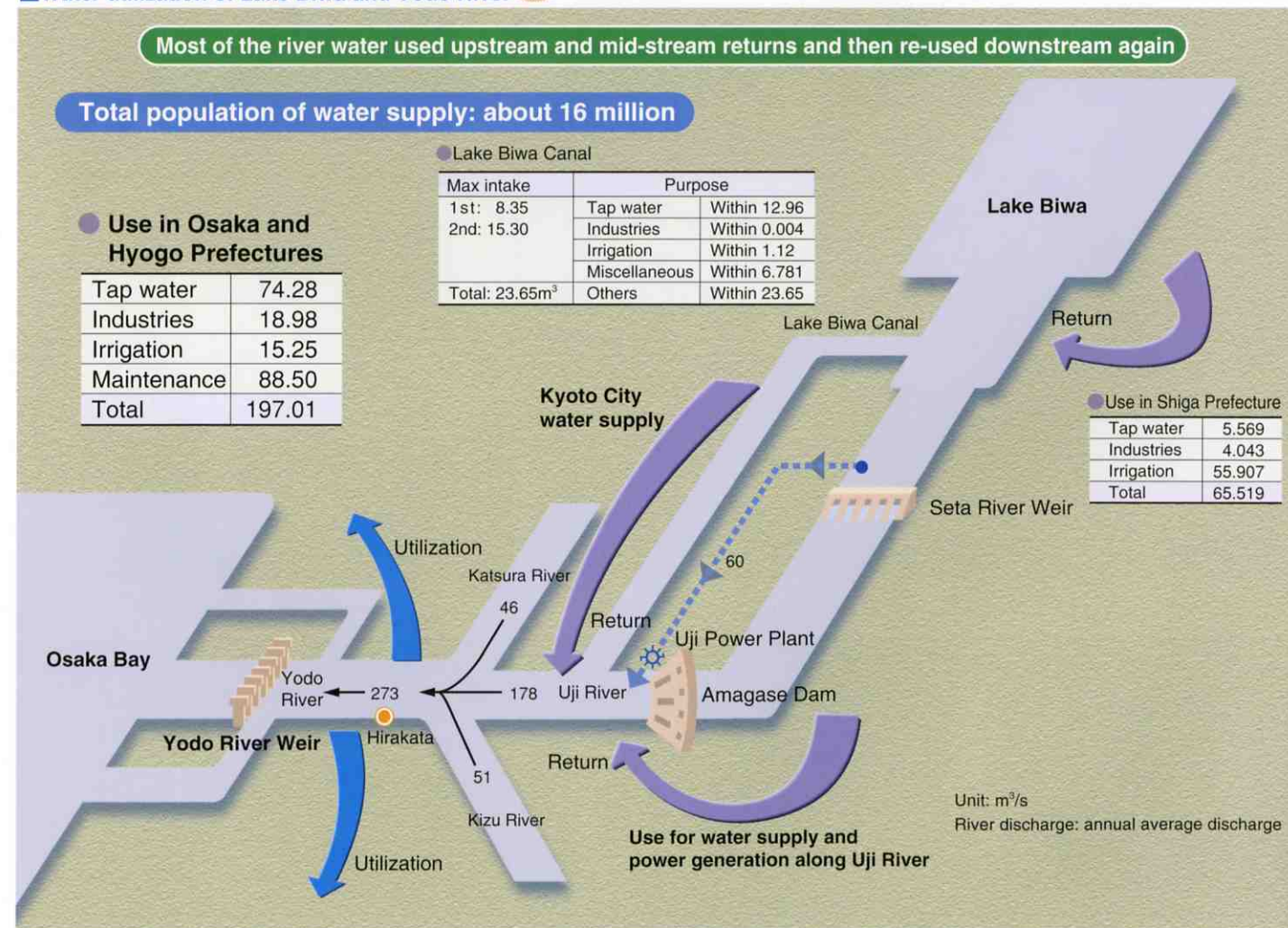
Springing out of Lake Biwa, Japan's largest lake, the Yodo River is considered one of the rivers with a steady water flow in Japan. The discharge of this river basin is complemented by additional discharge during different annual seasons, such as the snow melting season, the rainy season, and the Typhoon season. Therefore, this important water source has been providing water since old times for a wide range of uses, and presently it is utilized in various ways to provide vital resources for human life and industry such as tap water, irrigation and industries. **fig.1** But in recent years there has been several cases of water supply shortages. Together with this and the water demand for regional development in the background, the development of water resource and the careful management of existing ones become necessary.



Yodo River Weir (10km from the river mouth)

The Yodo River weir, prevents saline water from flowing upstream, stabilizes water intake at the river, and diverges the river water towards the city of Osaka.

Water utilization of Lake Biwa and Yodo River **fig.1**



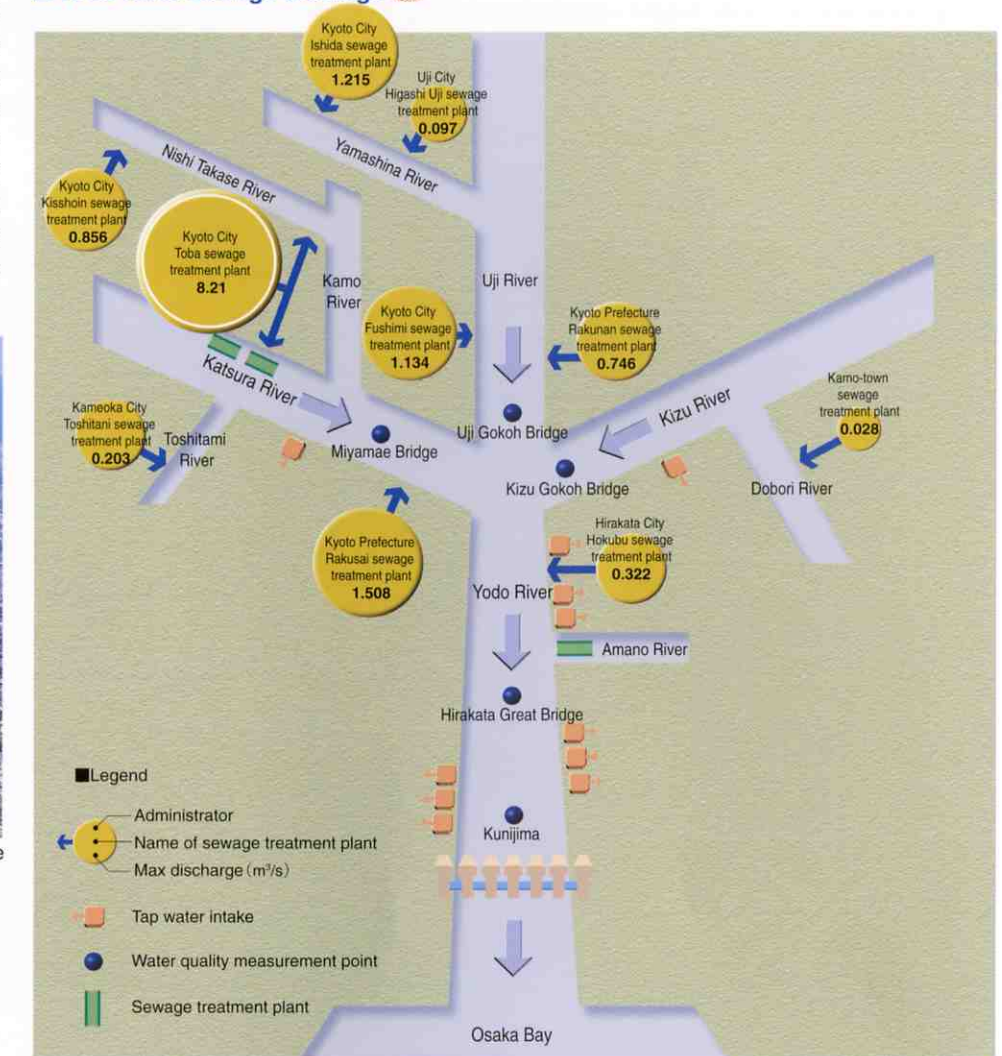
Promotion of proper water utilization at the Yodo River

A lot of domestic drainage flows into the Yodo River. **fig.1** But recently, due to the improvement of sewage networks and the enhancement of public awareness, the water quality of rivers has been significantly upgraded. **fig.2** River water treatment facilities with charcoal and gravel contact oxidation are set up in order to sustain a steady supply of fresh water with safety. **fig.3**

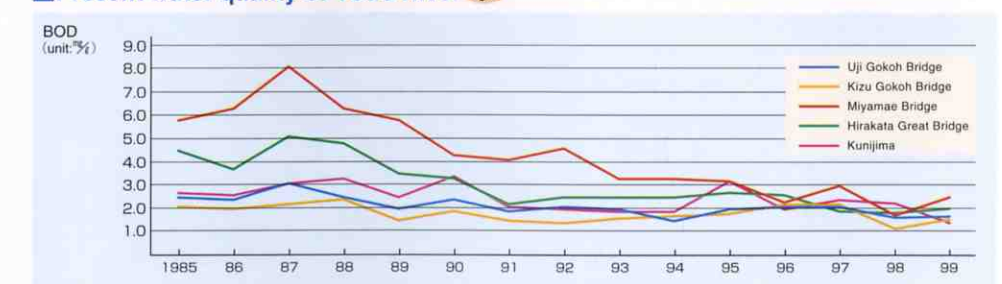


Bird eye view of Kyoto's streetscape

Yodo River sewage drainage **fig.1**

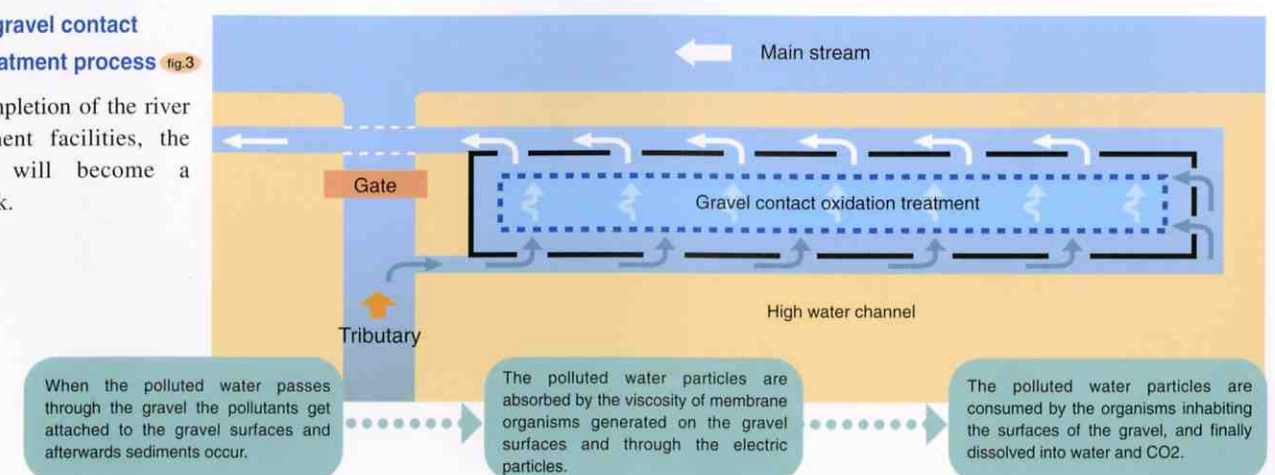


Present water quality of Yodo River **fig.2**



River water gravel contact oxidation treatment process **fig.3**

After the completion of the river water treatment facilities, the upper part will become a riverfront park.



In order to heighten the safety measure for flood control in addition to maintaining safe living conditions, flood control schemes were established based on data from previous disasters and their frequency in the past. Here, basic flood discharge and estimated flood discharge data were reviewed, and accordingly, comprehensive flood control plans were introduced around dams and different projects have been promoted and carried out. **fig.2-3** These include, widening the low water

channels, renovation and reconstruction of water gates and locks, construction of new river weirs, **fig.4** and enlarging discharge capacity by setting back river embankments. In addition, several disaster prevention measures have been promoted. These include, earthquake proofing embankments, **fig.5** the river front roads for earthquake disaster, and the water traffic routes; improving and upgrading super embankment structures that minimize dangers **fig.6**; preventing river embankment destruction during floods; in addition to implementing a comprehensive information network.

Flood Control Measures

Chronological Table of Yodo River Flood Control

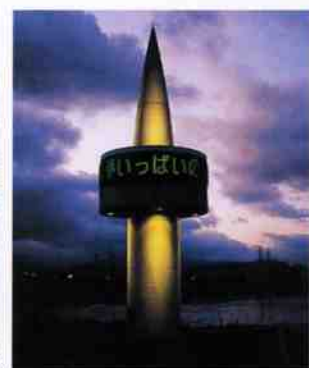
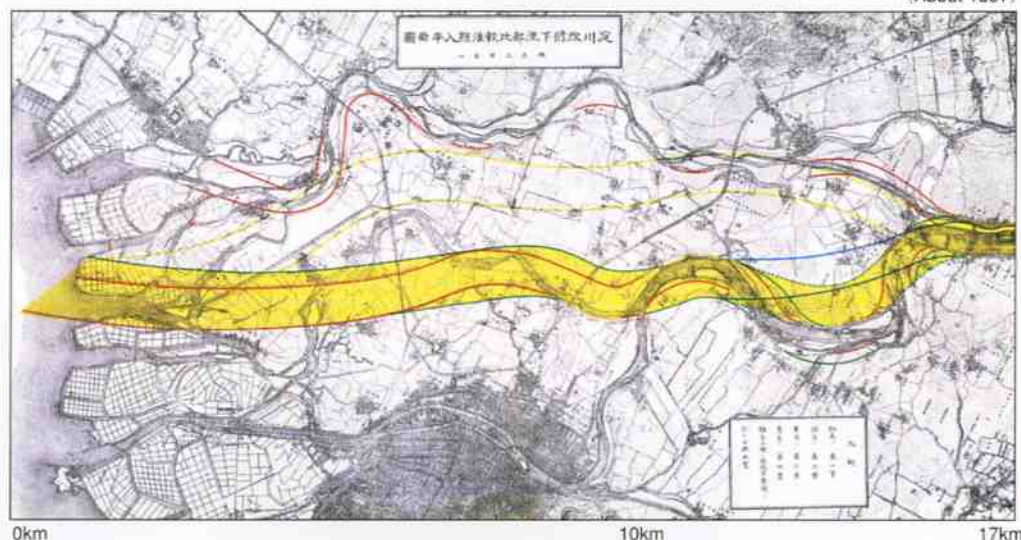
- 786 Wake no Kiyomaro, Courtier, separated Kanzaki River from Yodo River.
- 1596 Toyotomi Hideyoshi, Lord, built the embankment.
- 1874 A modern repair and construction work of Yodo River was initiated by Dutch civil engineers.
- 1885 Deluge of Yodo River due to typhoon and downpour
- 1896 Excavated a new Yodo River diversion channel **fig.1**
- 1905 Completed the (old) Seta River Weir outlet of Lake Biwa
- 1917 Deluge of Yodo River due to Typhoon
- 1953 Deluge of Yodo River by Typhoon No.13
- 1954 Decided the Yodo River System renovation basic plan
- 1972 Initiated Yodo River park project
- 1974 Centenary of Yodo river modern improvement works
- 1983 Completed the Yodo River Weir **fig.4**
- 1988 Completed the super embankment first in the nation

Completion year of multi-purpose dams at the Yodo River system

- 1963 Completed a new Seta River Weir outlet of Lake Biwa
- 1965 Amagase Dam **fig.2**
- 1969 Takayama Dam
- 1969 Initiated the integrated management of dams in the Yodo River system
- 1970 Shorenji Dam
- 1974 Muro Dam
- 1992 Nunome Dam
- 1997 Completed the comprehensive development of Lake Biwa.
- 1998 Hiyoshi Dam **fig.3**
- 1999 Hinachi Dam
- (Under construction: Daido-gawa Dam)
- (Under construction: Kawakami Dam)

The new Yodo River diversion plan **fig.1**

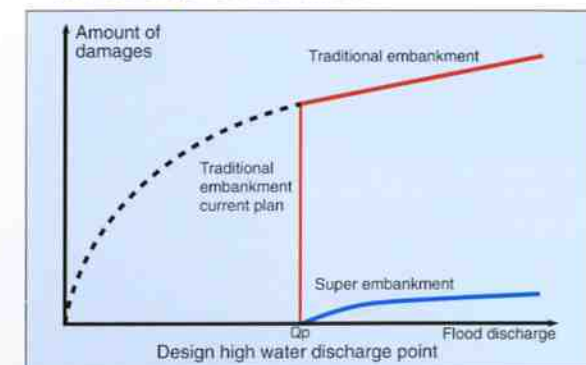
One of the earliest river construction works in modern times took place at the Yodo River. After a series of comparative studies and analysis of different substitute plans at the downstream part, the decision was made to excavate a new diversion channel 10 km from the river mouth. This new diversion channel was later proved significantly effective in controlling floods in the downstream area including Osaka City. (About 1897)



Super embankment (imaged figure) **fig.6**



Comparison between traditional embankments and the super embankment



Advantages of the super embankment

- Strong resistance against floods. Eliminating heavy damages due to floods more than the estimated scale.
- Strong resistance against earthquakes.
- Provides base for sensible environmentally friendly urban greening plan.

Inundation simulation

In an attempt to raise public awareness, and to provide in advance for risk management procedures/preparations, a disaster simulation exercise was conducted and publicized in order to demonstrate the kind of dangers that would result if ever an embankment collapse would occur.

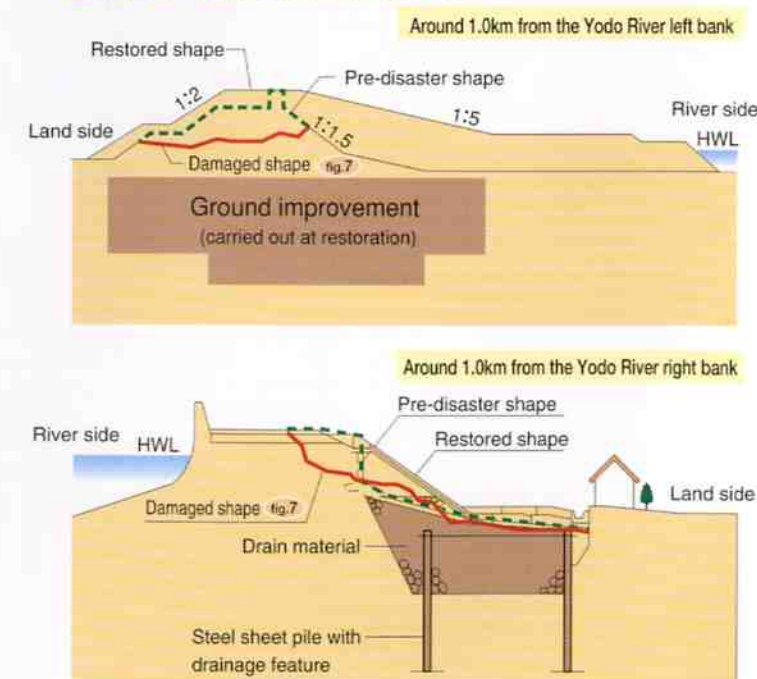


Anti-earthquake measures

In order to protect urban areas from earthquake related secondary disasters, several anti-earthquake features for river embankments have been promoted. **fig.5**



Anti-earthquake embankment **fig.5**



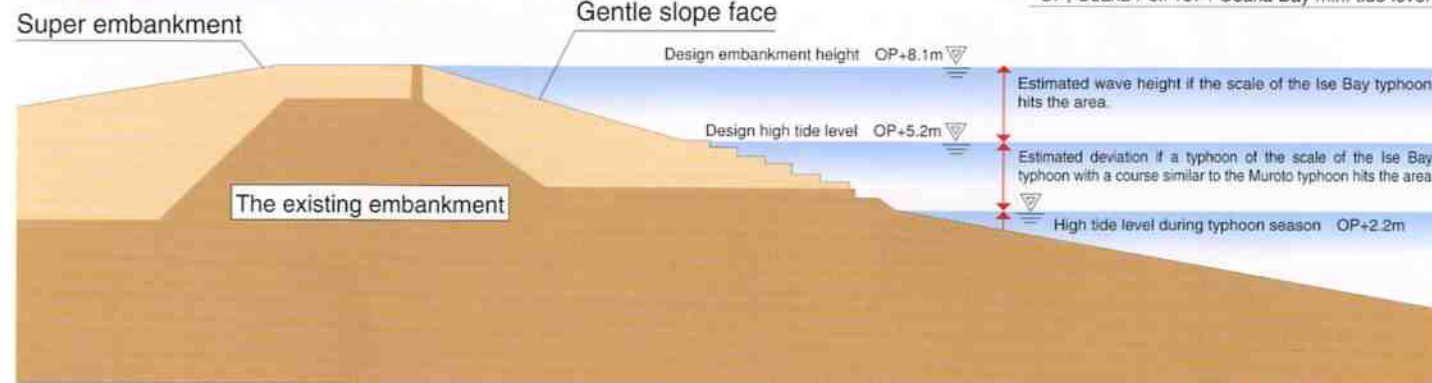
High tide counter measures

The area around the mouth of the Yodo River is very much prone to damage caused by high tide occurring during typhoons. Therefore, several measures are being implemented around these areas to counter this effect.

Reviews have been conducted on damage occurrence patterns resulting

from large scale typhoons that have hit in the past, such as the Ise Bay typhoon, and the No. 2 Muroto typhoon...etc. Accordingly, the improvement of the super embankment, that would also integrate earthquake proof measures, will be continuously carried out.

High tide embankment structure



Environmental consideration during works



Revetment with respect to the scenery
(Uji River Tonoshima area, 51km from the river mouth) fig.8

During the construction of facilities to counter the effects of high tide, earthquakes or floods, a number of aspects were taken into consideration. These include, preserving scenic areas, developing new ones, fig.8 and creating riverfronts that are nature friendly fig.9.



Revetment containing nesting cavities that are river creature friendly fig.9



Imaged figure



Steps taken to create riverfront environments

Continuous efforts are being done to create satisfactory river environments, while at the same time trying to harmonize between improvement works to the Yodo River system, and creating a pleasant river that will hold fresh water in abundance. For example, improving water quality using river water treatment facilities and water stream conservation canals,...etc., which is essential to create and protect river environments, and creating environments satisfactory for the breeding and living habitats of species that are unique to the area, such as the Itasempara species of fish(natural treasure) fig.1. In addition, we are also promoting the creation of leisure areas and waterfronts fig.4 that are rich in beautiful scenery, while at the same time harmonizing the historical, social, and natural features of each area fig.2-3.



Canoes in Kizu River fig.4



Fireflies (Akuta River)



Itasempara fig.1

Marshland (Wand) preservation fig.2

A rich variety of aquatic life inhabits the waters of the Yodo River. This is one of the main reasons for the creation of marshland areas. Several measures have been implemented to protect the future of river environments, which are indispensable for all sorts of living beings. Moreover, with the purpose of analyzing and understanding the marshland's environmental characteristics, we have conducted several surveys on the aquatic life of the river. In this regard, a new marshland area is being created in the Shirokita area for experimental purposes to investigate fish, shellfish, plants, etc.



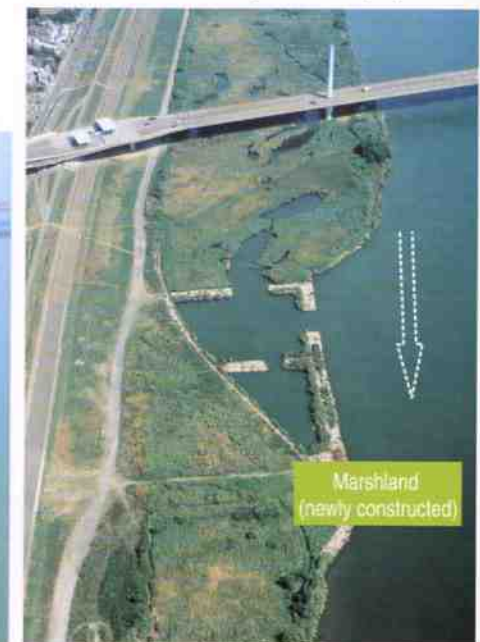
Byodoin temple (94's world cultural heritage) fig.3



Yodo River Park (Yodo River left bank Hirakata area, 26km from river mouth) fig.4



(Yodo River left bank, 1km from river mouth)



(Yodo River right bank, 1km from river mouth)

Although the marshland is a remainder of the groynes (spur dike) set up over 100 years ago to stabilize the low water channels, nowadays, it serves to protect and maintain a delicate eco-system.



Steps to promote the use of river front areas at the Yodo River

A number of experimental operations and efforts are being undertaken at the Yodo River to deepen the relations between people, living beings, the community and the river itself. These include plans to create appropriate waterfront areas, what is called "naturally diversified riverfront making", that will provide an adequate habitat for the living species indigenous to the rivers of the area, and at the same time maintains and creates scenic natural environments. All these attempts serve to establish the Yodo riverfront national Park as a riverside leisure area. **fig.1** In addition, after reviewing the history of water traffic on the Yodo River in the past, we carry out the project to bring back water transport up to date that is gentle to the environment.

Riverfront parks are classified into four types. **fig.1**

1

Facilities park areas

These areas are equipped with baseball grounds, tennis courts, large-scale leisure pools (land side), ice-skating rinks (land side), etc., to provide a joyful playground.



Beautiful flower belt

●Yodo River Park (as of March, 2000)	Design area	962.1ha	Number of users :427millions (1999)
	Service area	218.4ha	
	Completed area	23%	

2

Wild grassland areas

These areas contain belts of blossoming flowers and stroll gardens of all sorts of wild vegetation that reflect the four seasons of Japan. They provide the grounds that are close to nature.



3

Nature preserve areas

These are important places with natural eco-systems, in which the future of the Yodo River's natural environments are maintained and preserved.



4

Scenic preservation areas

These are areas that foster the preservation of special scenic river spots.



Major policies related to water transport in the Yodo River

In order to guarantee connection between the cities of Osaka and Kyoto with the main roads during times of earthquakes, riverfront roads are implemented. **fig.2** Moreover, wharf construction projects are being set up along these riverfront roads to deal with water transport during the times of an earthquake. **fig.3**



Completed riverfront road **fig.3**

History of shipping in Yodo River



Shipping in Edo period (1603 - 1867)



Steam liner traveling as passenger boat in stead of traditional river ship at Yodo River (1870-1940)



Aqua Liner, modern sightseeing passenger boat



The Yodo River distance marker

Distance markers have been placed at every 1km beginning from the river mouth, along the left and right banks of the Yodo River. Each one of them has been engraved with the river's name using different inscriptions gathered from public participation.



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