

Experience of JAPAN in IWRM

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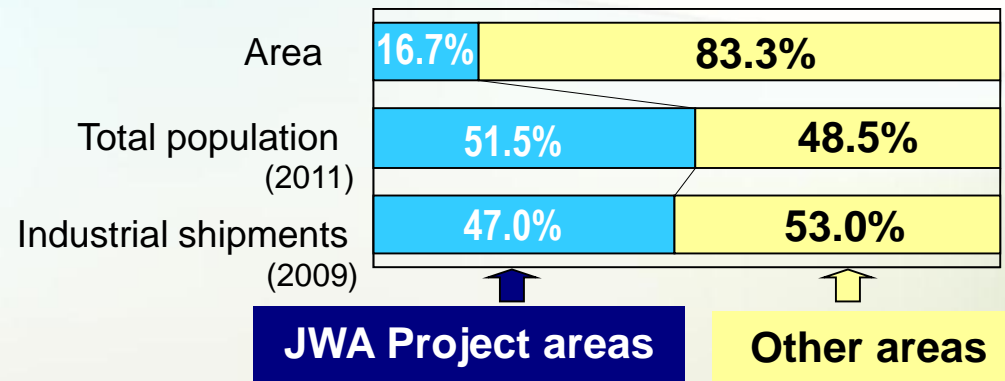
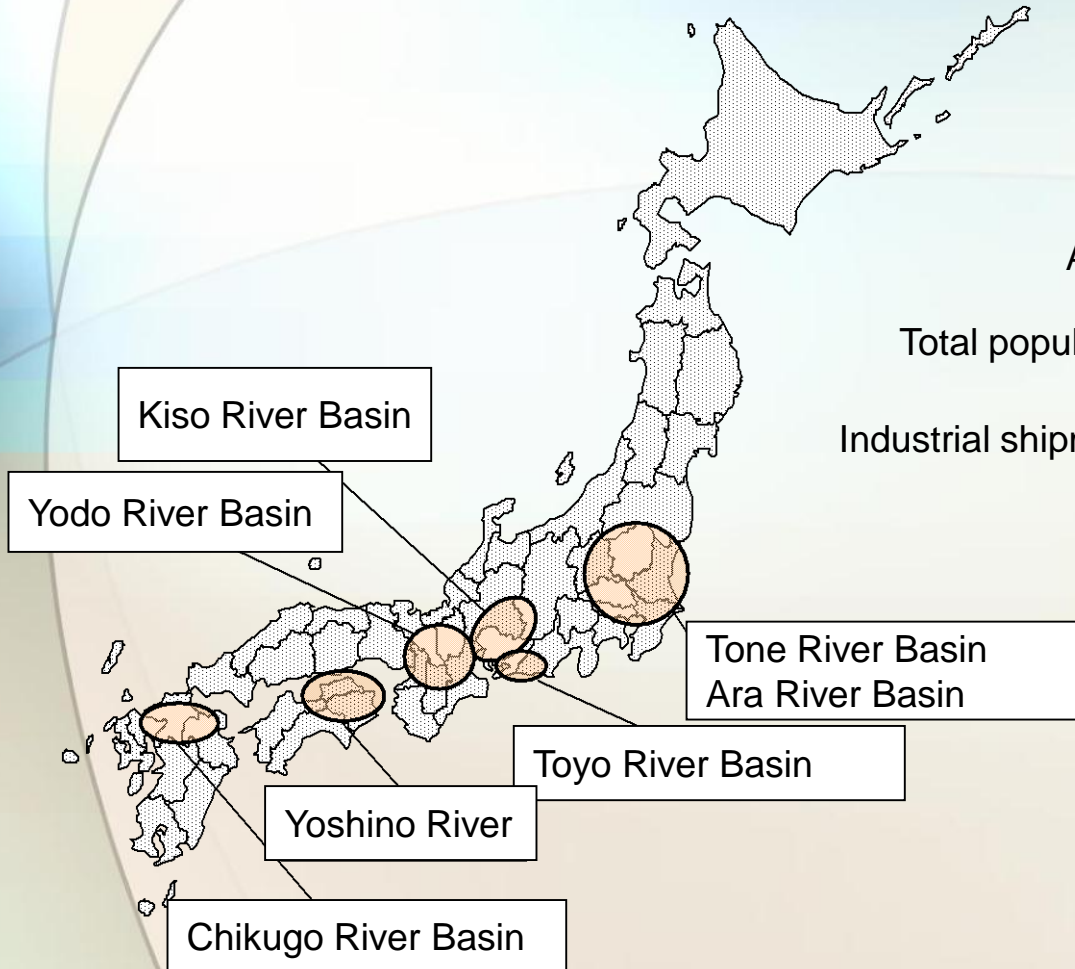
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Japan Water Agency[JWA]

Contents

- 1. Outline of JWA**
- 2. Rainfall in Japan**
- 3. IWRM in Yodo river basin**
- 4. Conclusions**

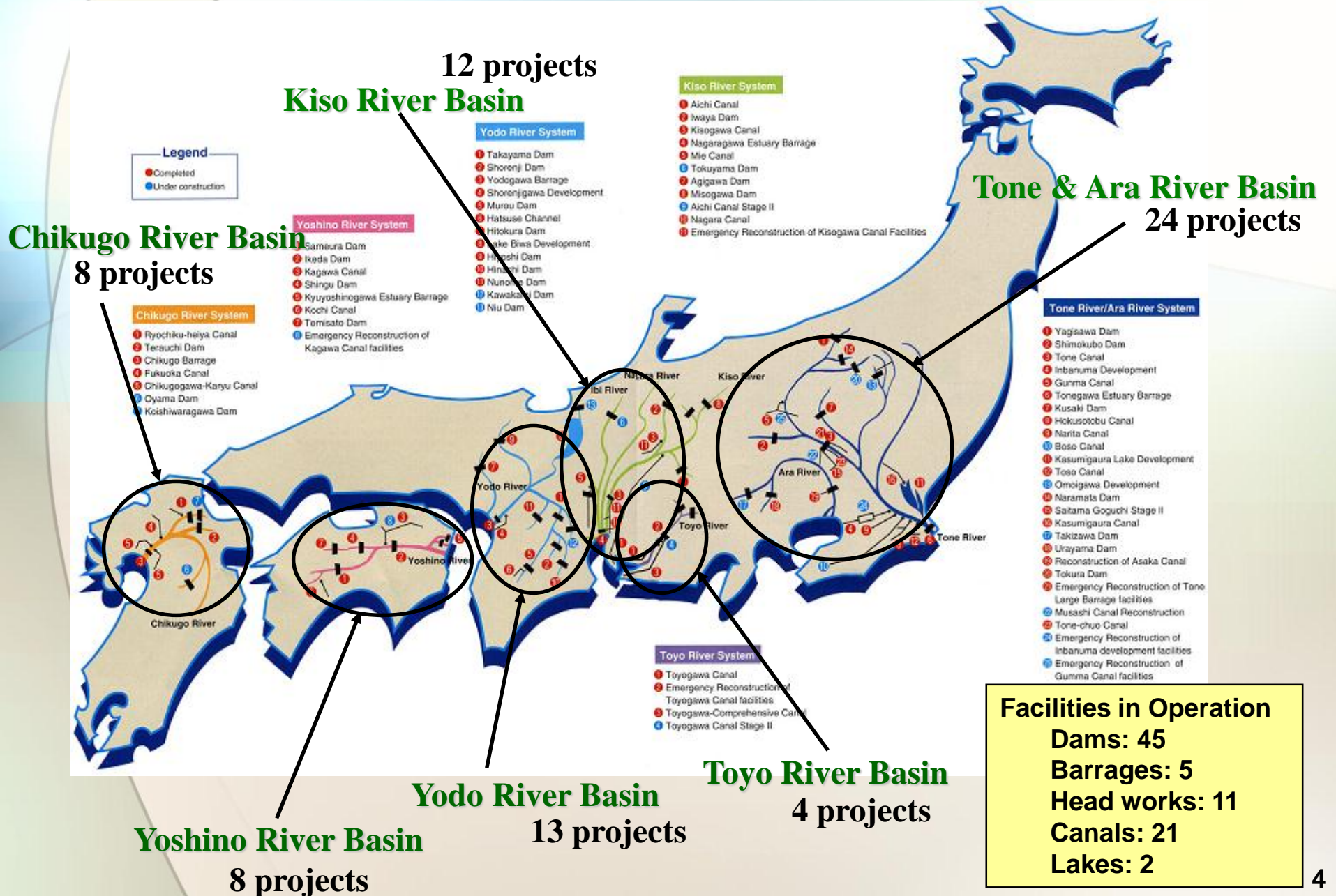
Hiyoshi Dam

Outline of JWA



The total area served water by JWA is only 17% of the national land. However, about 50% of the population and industrial output are concentrated there.

Projects under JWA's management



Various experiences of JWA



Yagisawa Dam (Arch Concrete Dam)



Tone Chuo Canal

Various tasks



Construction



Tone Barrage



Lake Biwa Development



Facility Inspection



Operation



**Water quality
management**

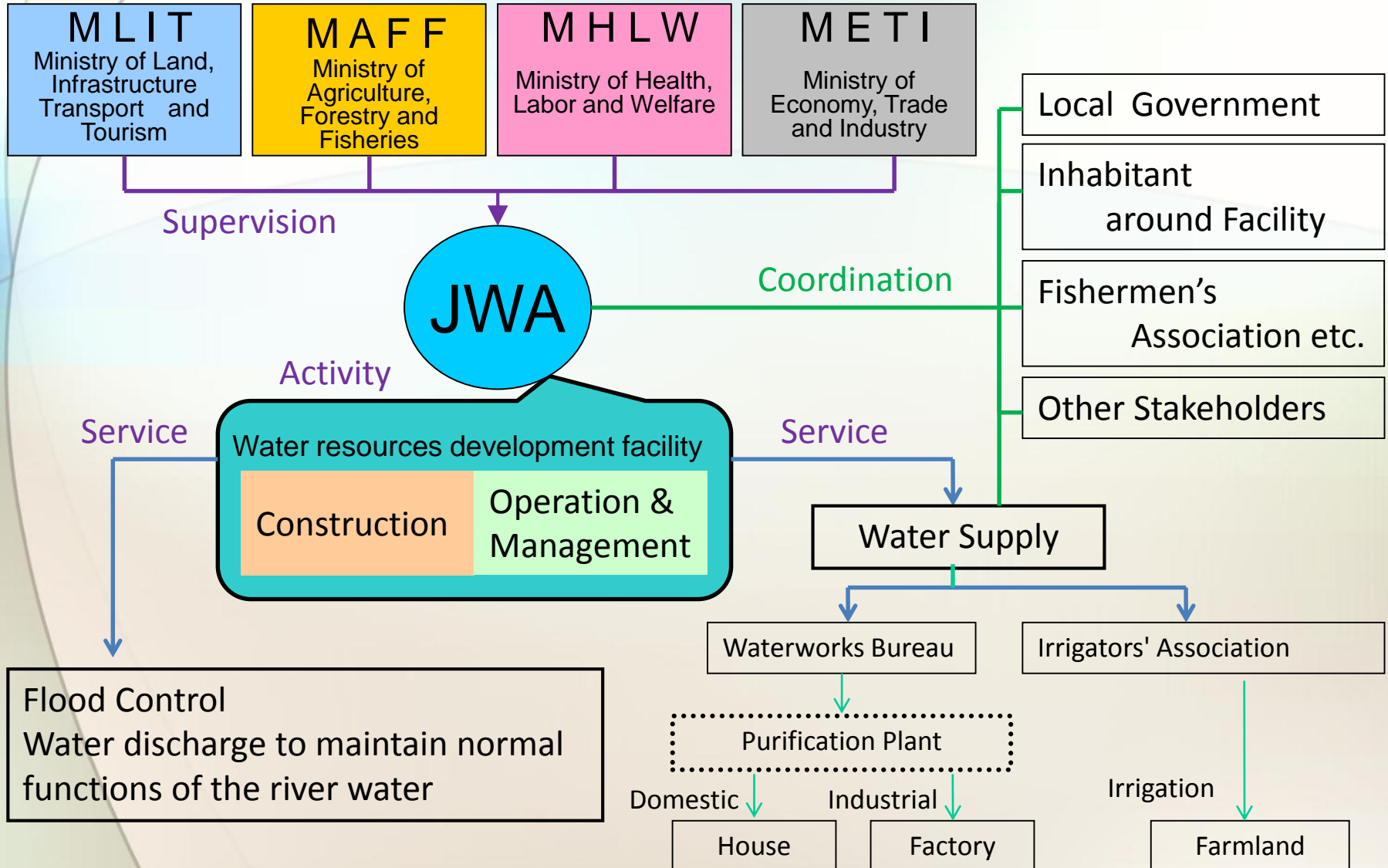


technical tests

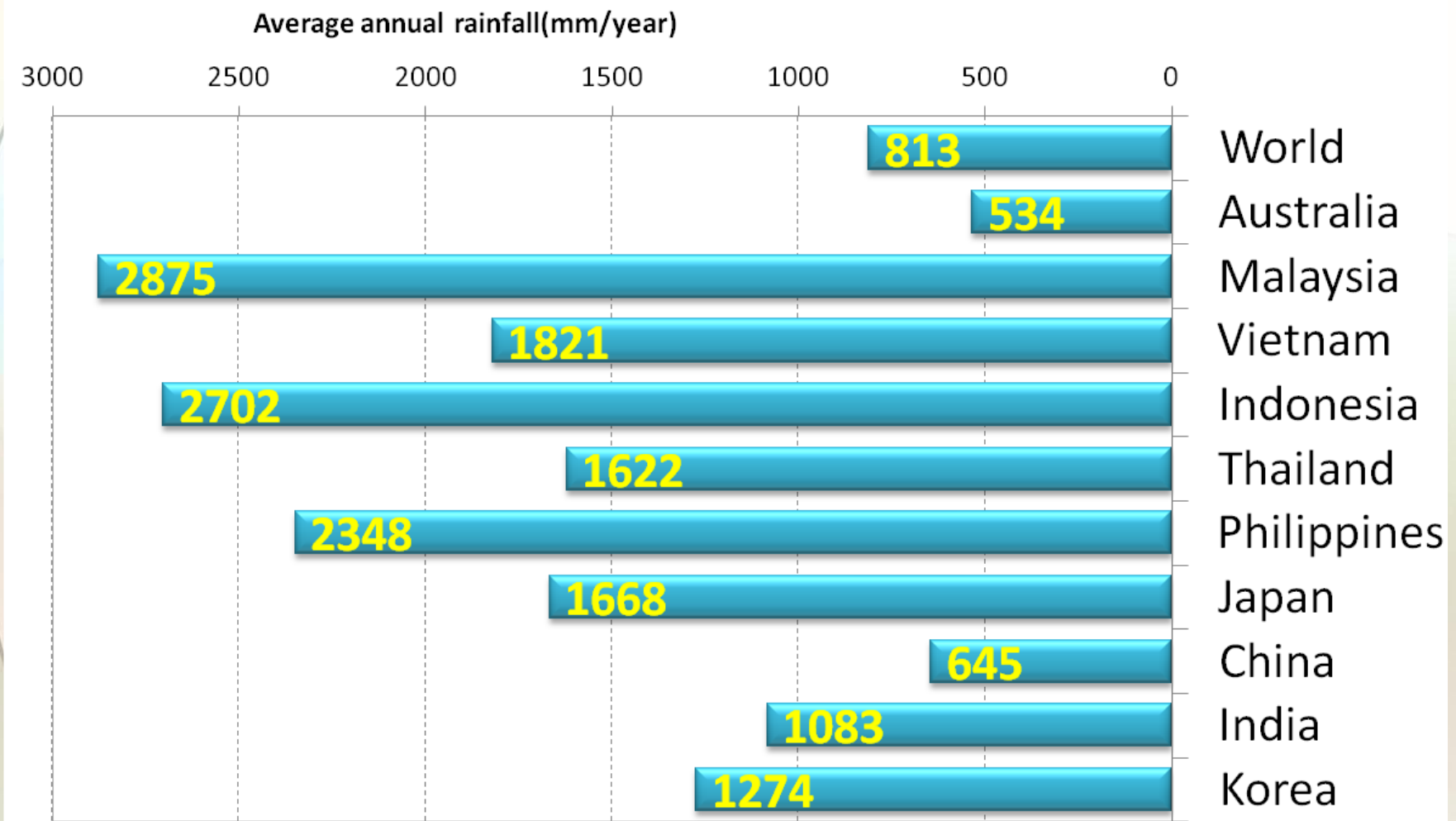
Various facilities

The role of JWA

Competent Authorities

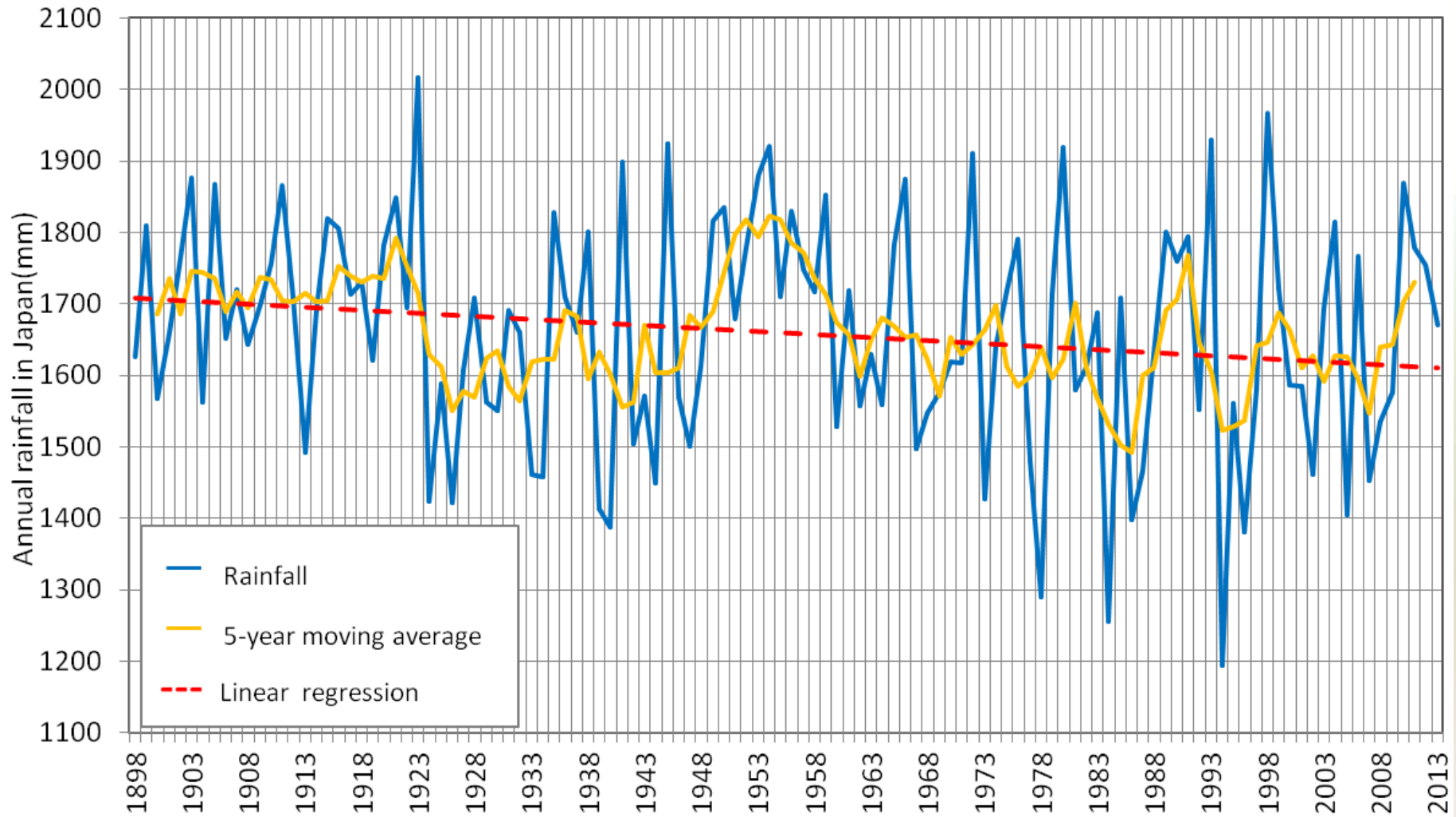


Rainfall in Japan



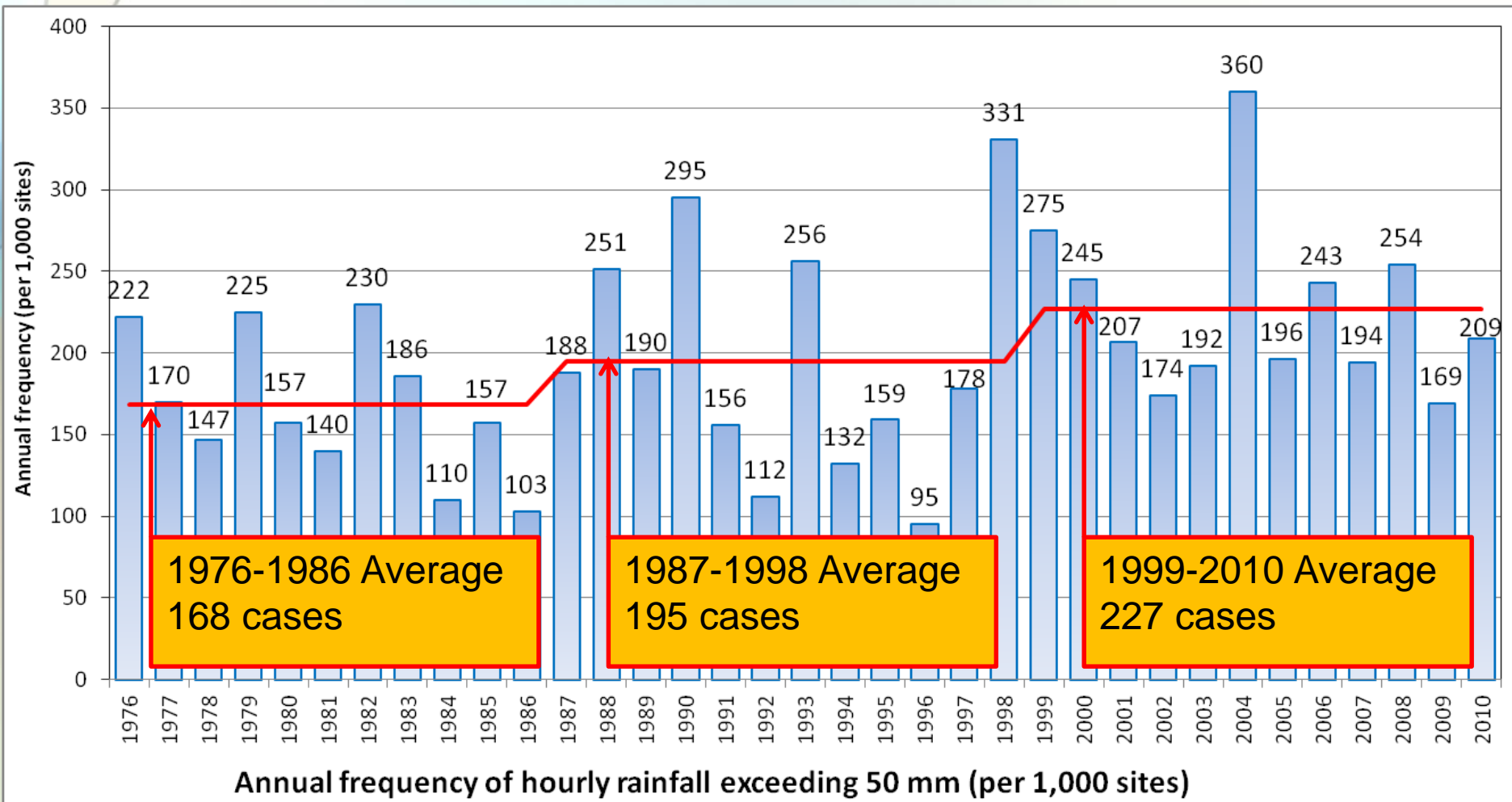
Source: Water resources in Japan 2013 by Ministry of Land, Infrastructure and Transport (MLIT)

Secular variation of annual rainfall in Japan(1898-2013)

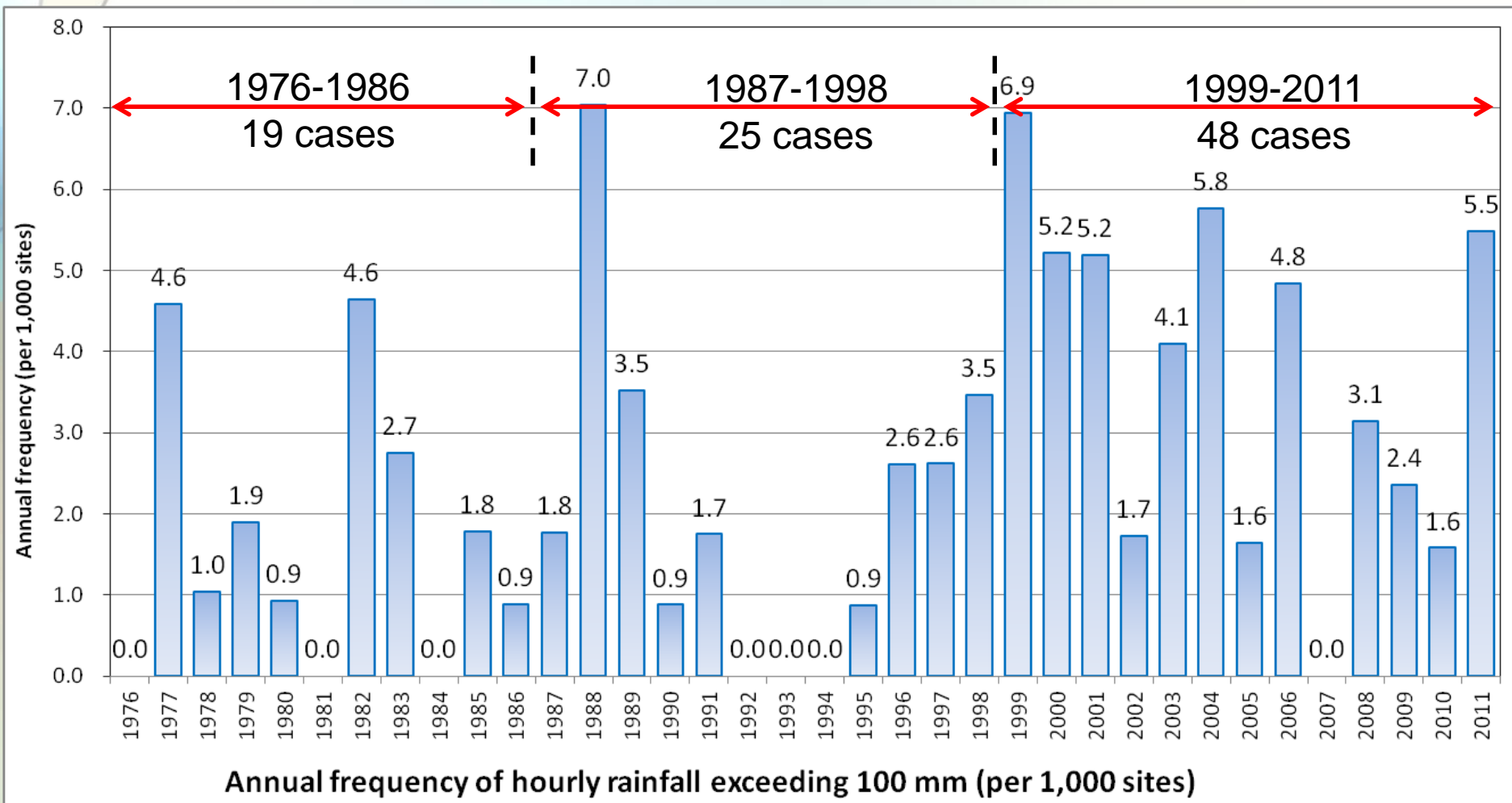


Source: Japan Meteorological Agency website

Annual frequency of hourly rainfall exceeding 50mm in Japan(1976-2010)

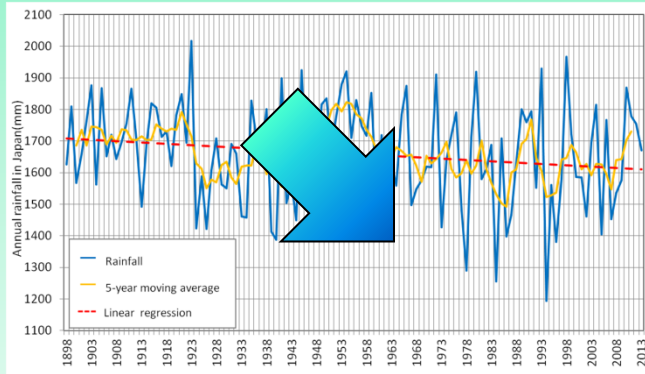


Annual frequency of hourly rainfall exceeding 100mm in Japan(1976-2011)

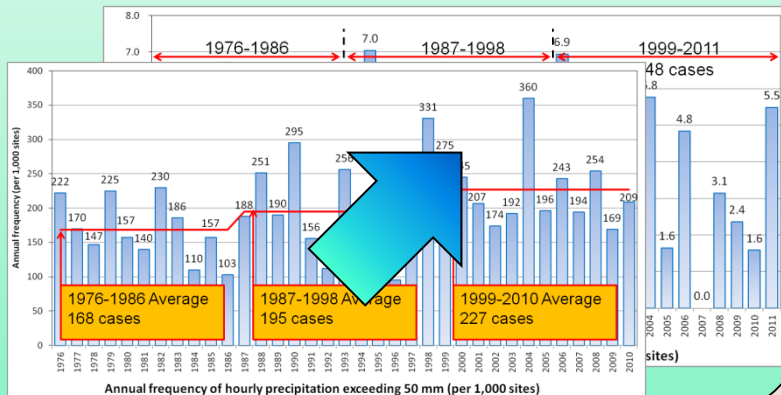


Necessity of dam operation that adapted to the extreme weather events

Annual rainfall : **decrease**



Hourly rainfall more than 50mm : **increase**

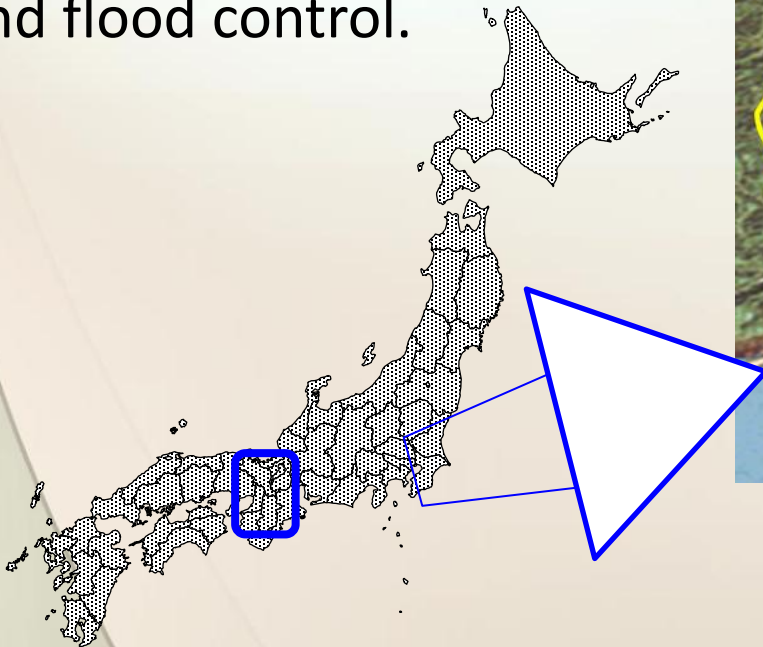


Increasing
“Extremes of
weather events”

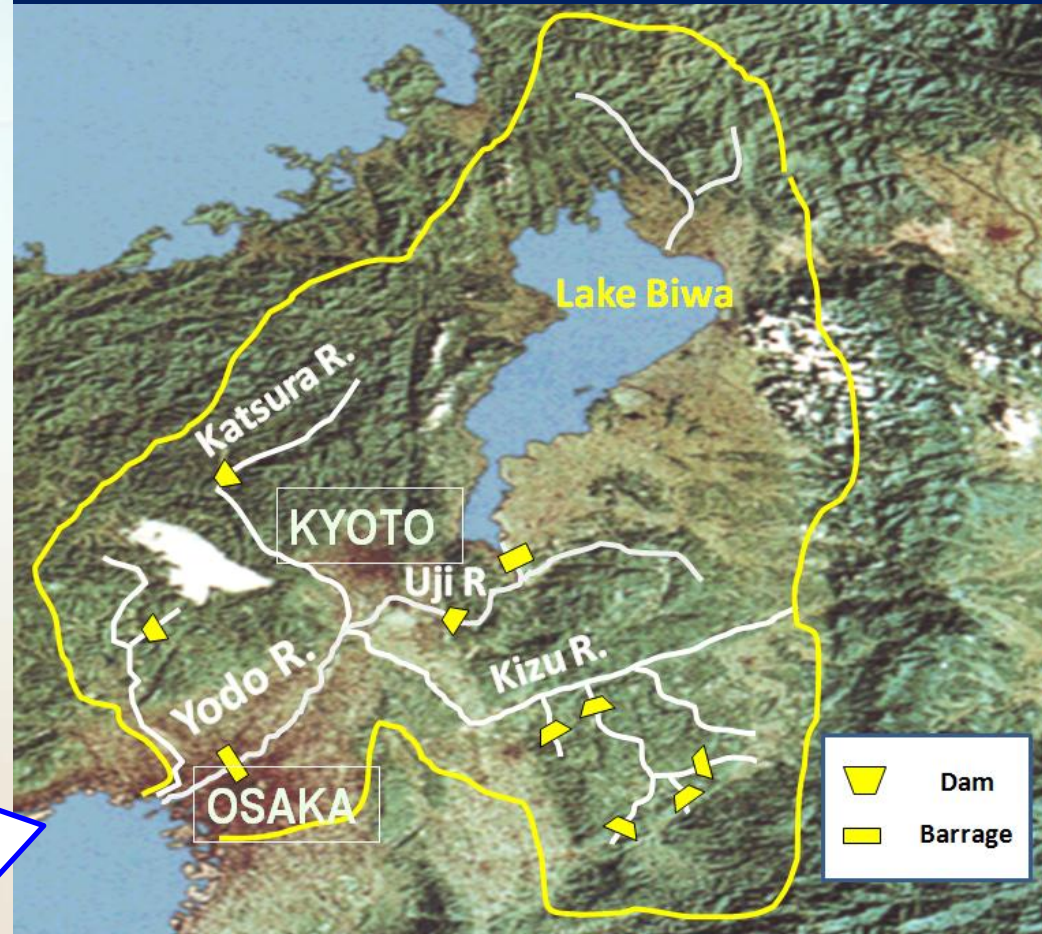
Expectations for more
appropriate dam operation

IWRM in Yodo river basin

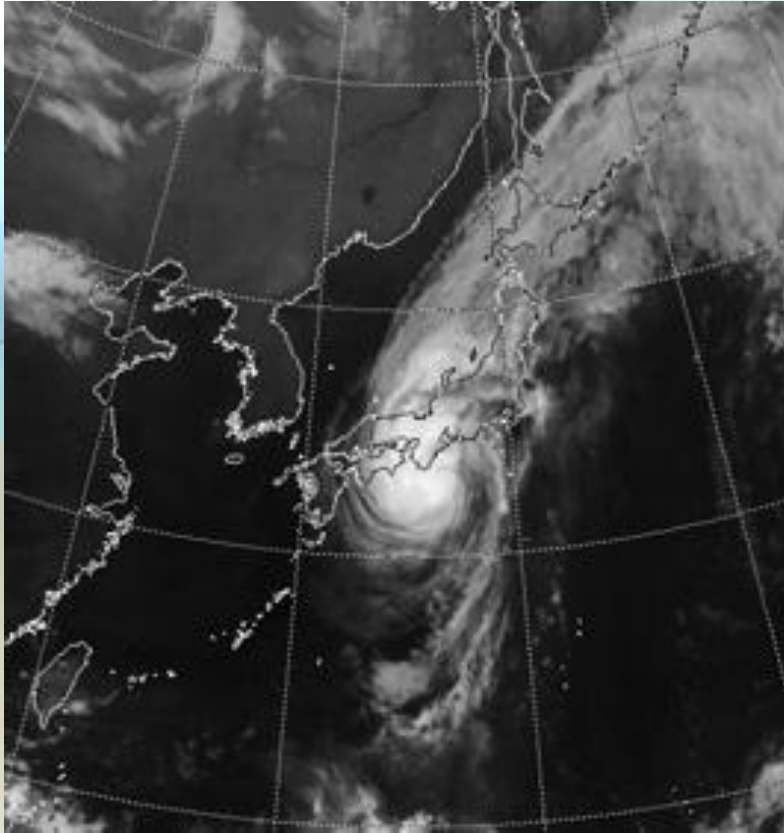
- JWA manages and operates water related facilities from upstream to downstream.
- Therefore, JWA always considers total management of the facilities in a river basin to contribute in water supply and flood control.



Dams / Barrages in Yodo River Basin



Flood management in basin level against flood in September, 2013 in Japan



Typhoon No.18, 2013 (Man-yi)

as of 3:00 on Sep. 16, 2013

- Lowest pressure 960hpa
- Highest winds 35m/s (162KPH)

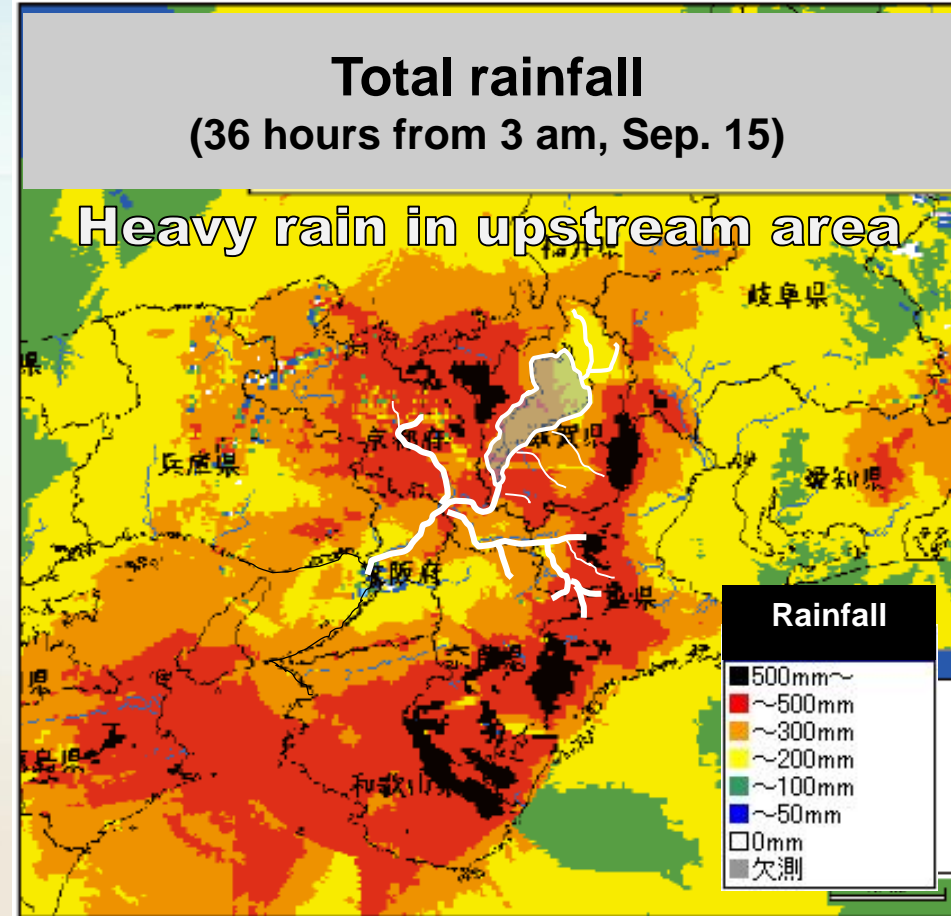


Outline of Typhoon No. 18 (Man-yi) & flood management

- Emergency warning of heavy rain! - *Return period: several decades*
- Massive flood in Yodo River basin
- Largest record of inflow at 2 dams
- More than planned flood inflow to Hiyoshi Dam

Threat of huge flood damage at urban area along the river such as Kyoto, Osaka

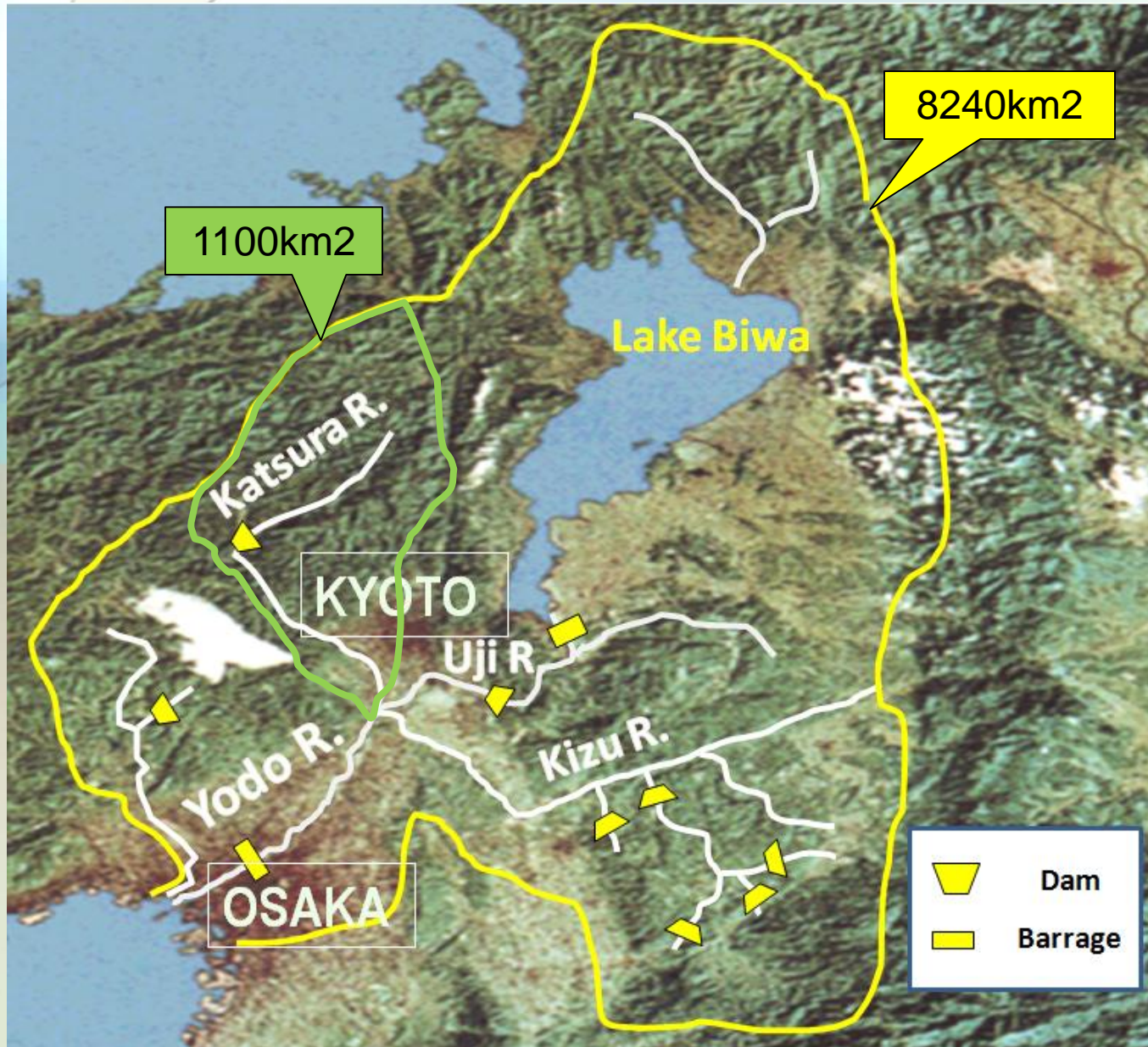
Integrated operation of dams and barrages in the river basin!



Source: MLIT

Achieved reduction of flood damage

Operation of Hiyoshi Dam



Hiyoshi Dam

Objective:

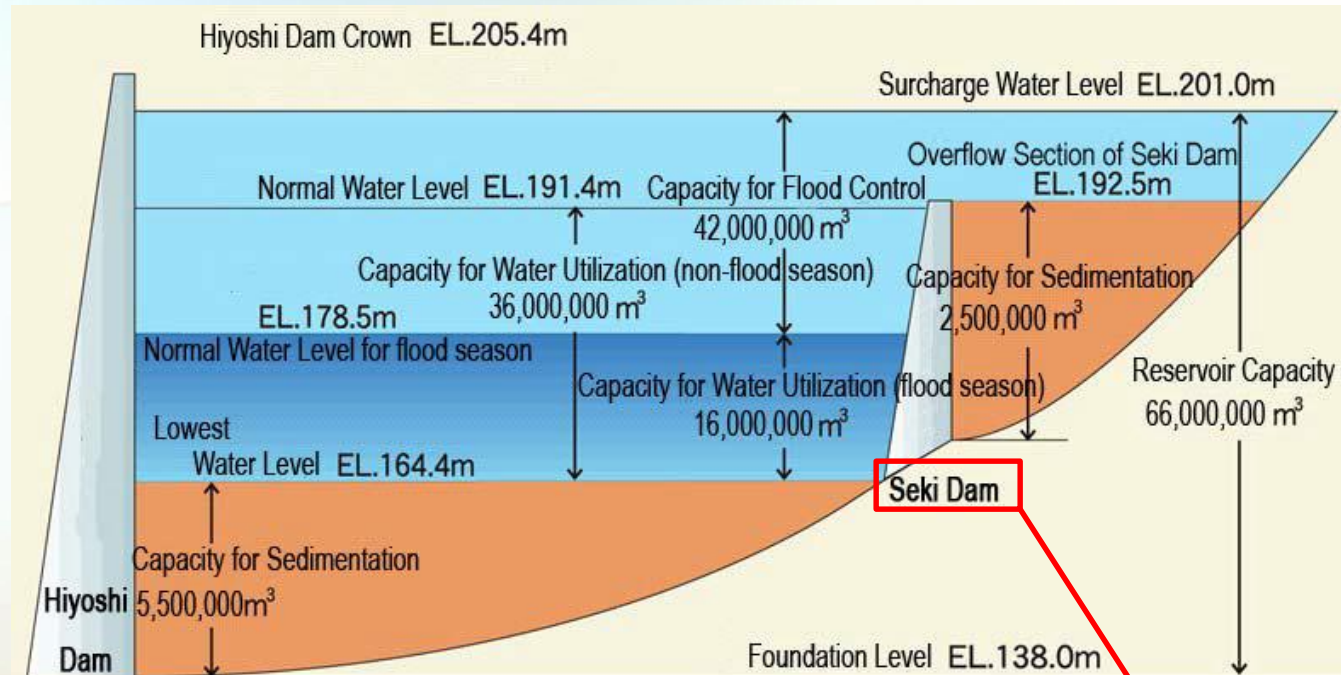
- Flood control
- Water supply
- Power generation
- Maintenance of normal function of river

Operation and management started 1998 Apr.

Specification of Hiyoshi Dam

Specification

Item	Contents
Dam Type	Gravity Dam
Dam Height	67.4m
Dam Crest Length	438m
Dam Volume	670,000m ³
Catchment Area	290km ²
Reservoir Area	2.74km ²
Owner	JWA

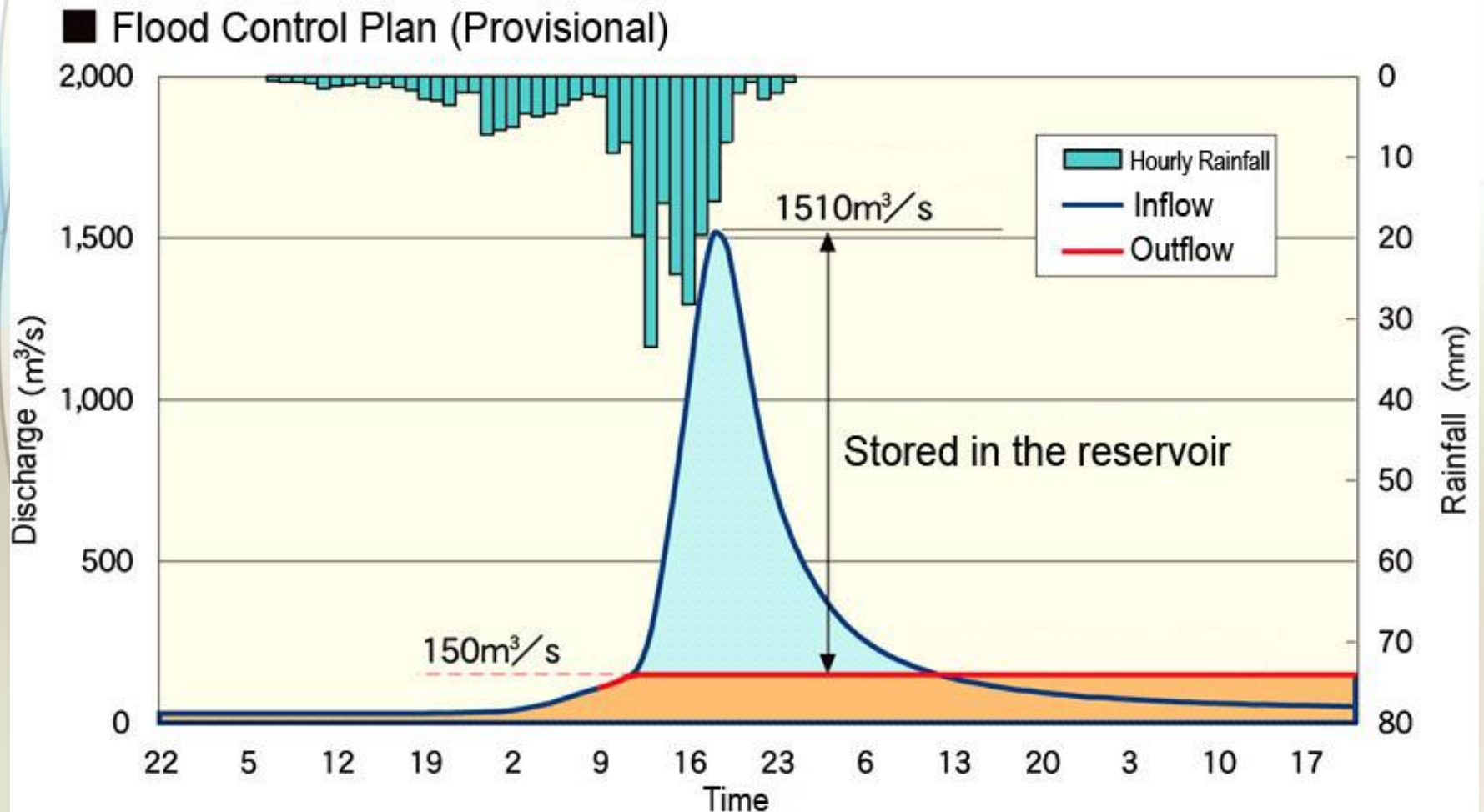


Seki dam's gate had been removed all.
The dam has used as a check dam.

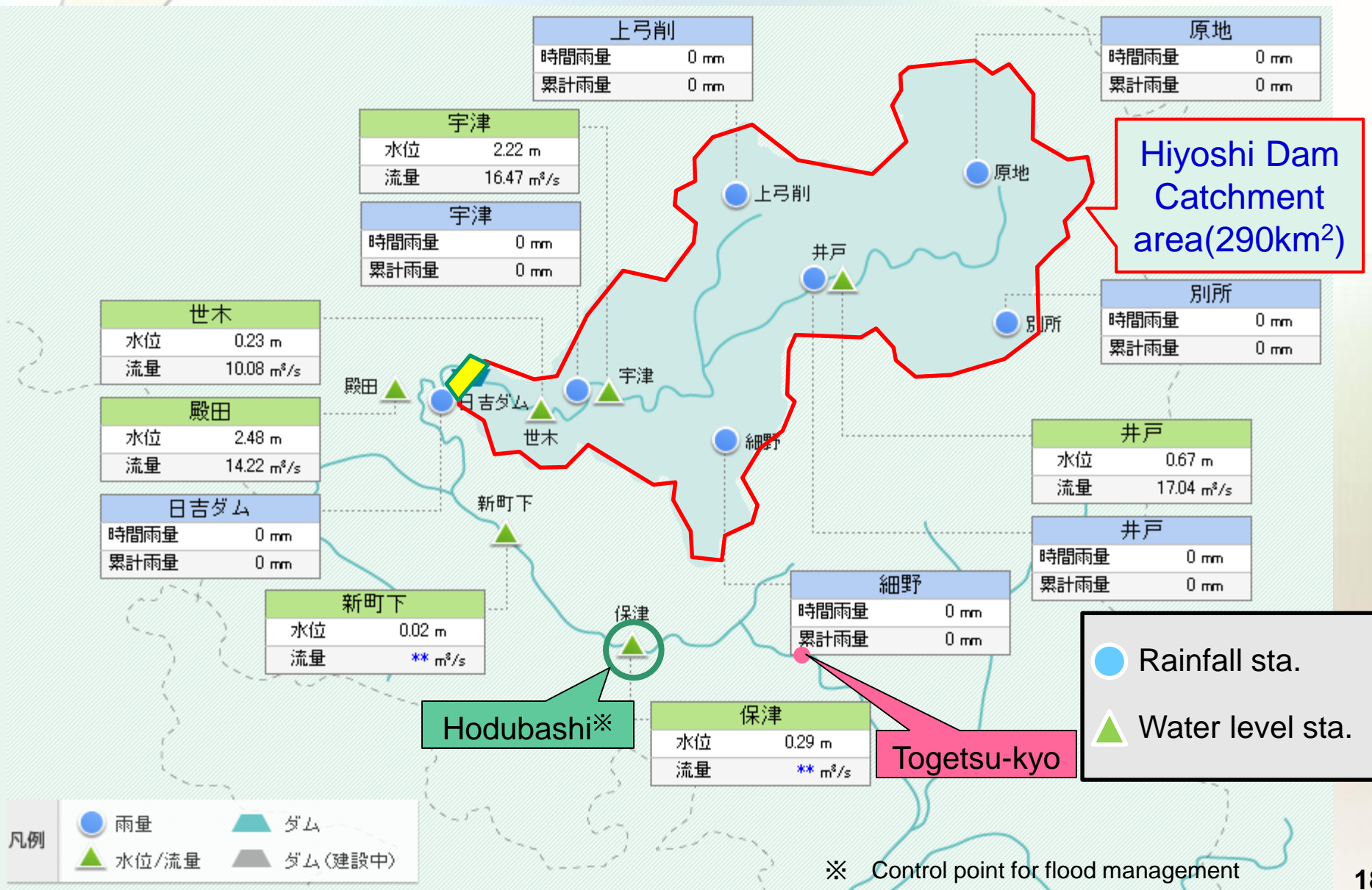


- **Surcharge Water Level:**
Water can be stored up to this level temporarily during floods.
- **Normal Water Level:**
Water is normally stored up to this level from Oct 16 to Jun 15 the following year.
- **Normal Water Level for flood season:**
Water level is restricted up to this level from Jun 16 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.

Flood control plan of Hiyoshi Dam



Hiyoshi Dam catchment area & its downstream



Operation of Hiyoshi Dam

■ Rainfall in the watershed (average)

34mm/hour (maximum)

345mm (total)

(Average: 201mm in Sep.)

■ $Q_{in} \text{ (max)} = 1,690 \text{ m}^3/\text{s}$

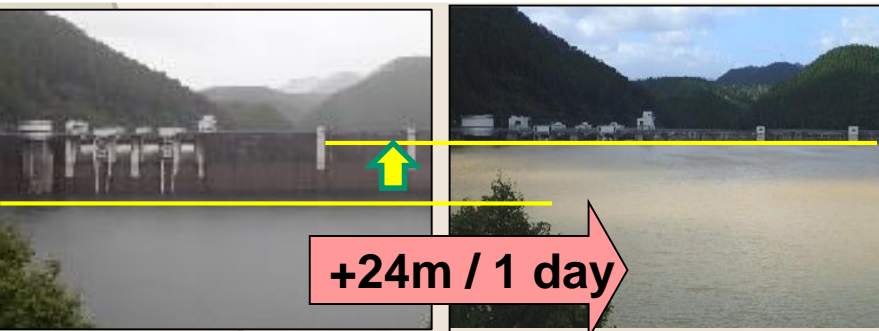


Reduced 90%

$Q_{out} = 150 \text{ m}^3/\text{s}$

■ Lowering 1.5m of water level in downstream

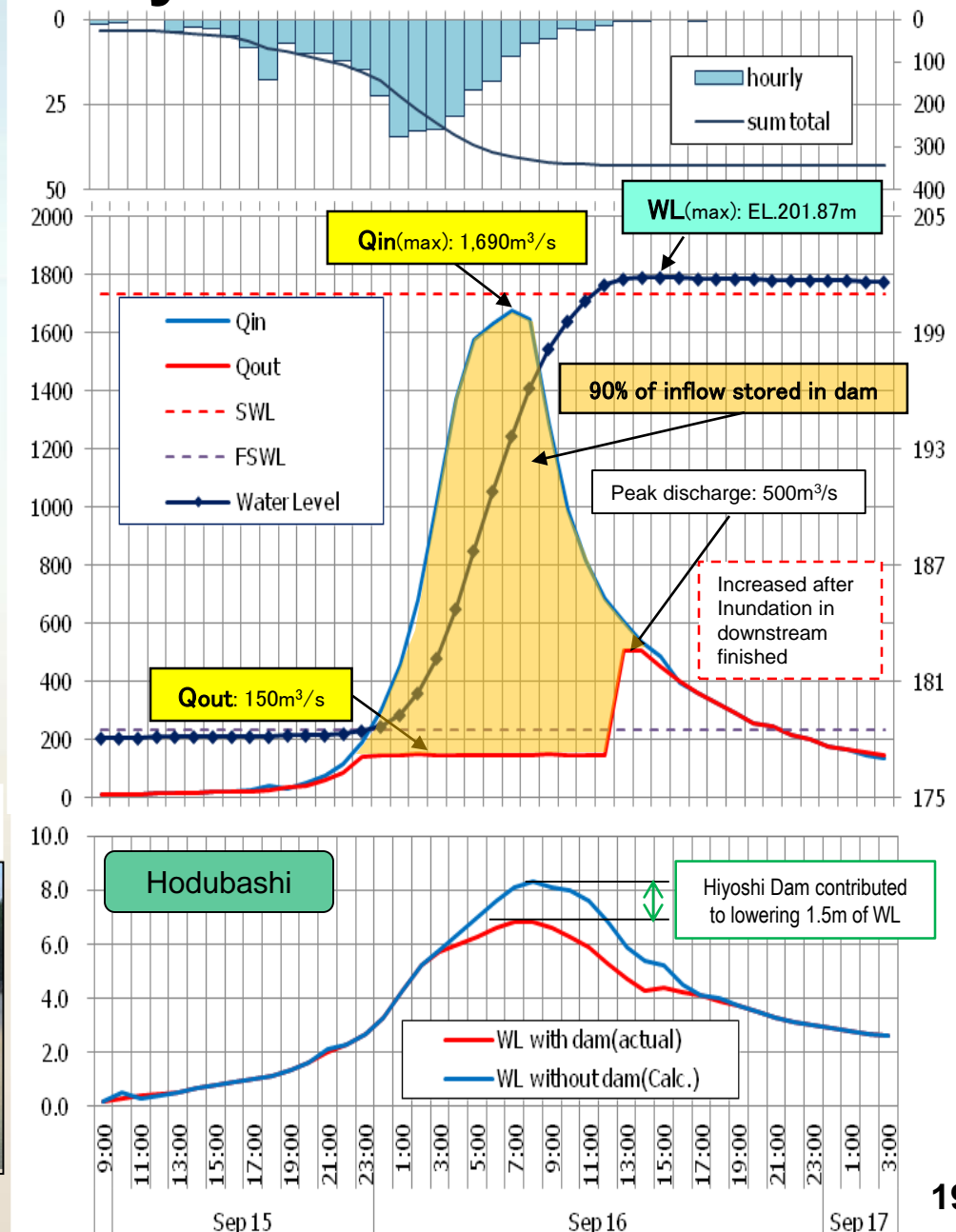
Water level of Hiyoshi Dam



+24m / 1 day

Sep. 15

Sep. 16



Operation of Hiyoshi Dam Contribution at Arashiyama



Togetsu-kyo Bridge: Landmark of Arashiyama

Water Level without dam (Calc.)

Water Level with
dam (actual)

0.5m

Togetsu-kyo

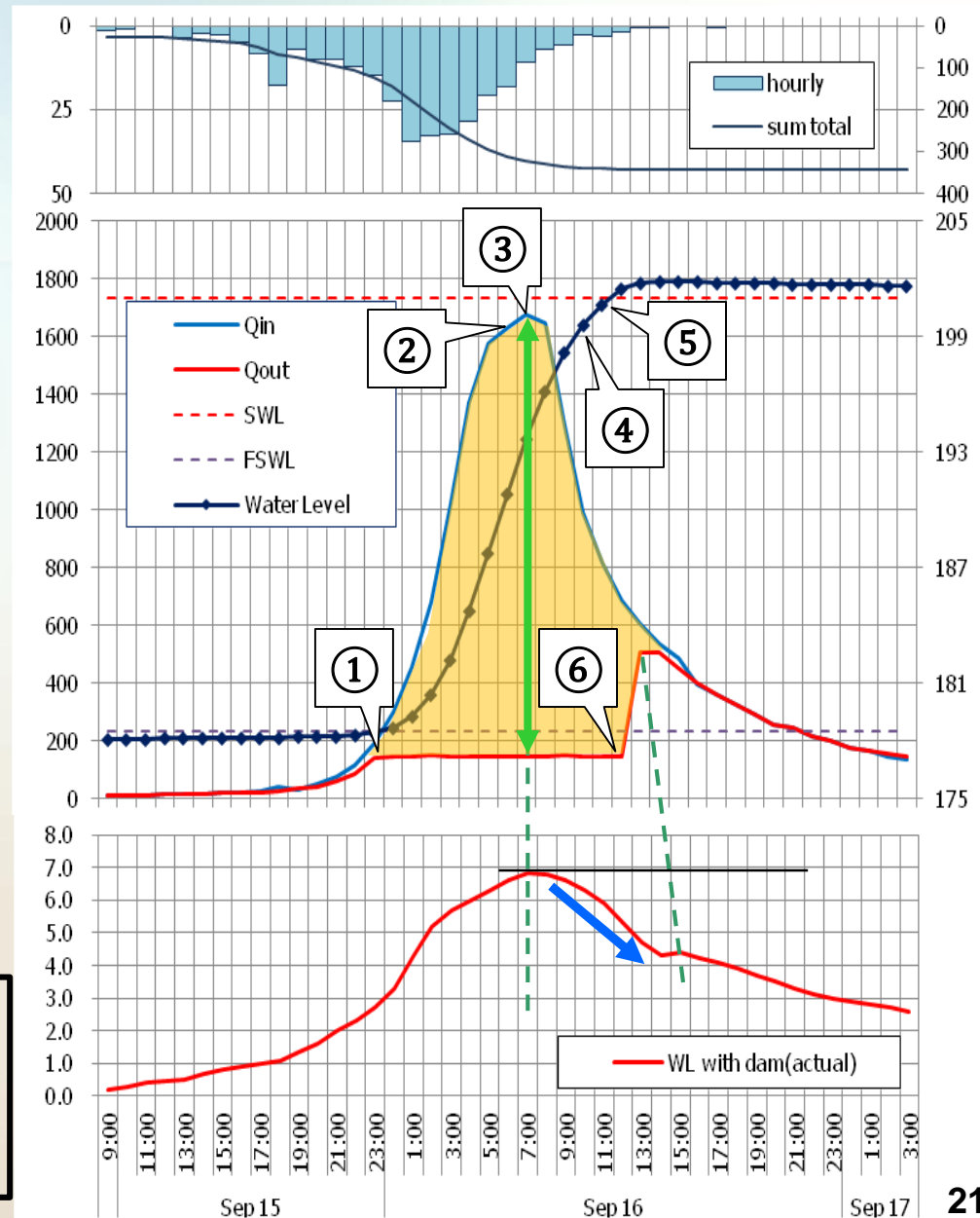
Some areas along the river
are inundated.

However,
**Hiyoshi Dam contributed
to lower water level 0.5m
at Arashiyama area, and
halved inundation area.**

Actually, the dam operation was difficult.

- ① Started flood regulation according to Standard Operation Procedure. ($Q_{in} \geq 150 \text{ m}^3/\text{s}$)
- ② Predicted reservoir water level exceeds Surcharge Water Level, and decided to start special operation 3 hours later.
- ③ Inflow peak. 90% stored in reservoir.
- ④ Time to start “special operation”. However, considering inundation situation & risk in downstream area, the dam continued same operation.
- ⑤ Exceeded Surcharge Water Level, but still continued same operation.
- ⑥ Started special operation after confirming river water level in downstream became enough lower.

◆④⑤⑥ are not described in Standard Operation Procedure
 ◆Special decision was made to reduce flood damage in downstream area.



What is the difficulty?

- If it was predicted that the inflow into the dam will exceed planned scale flood, the dam should start special operation to secure safety of dam itself in the Standard Operation Procedure.
- On the other hand, some of downstream areas are already started to be inundated, and if the dam start special operation, it means discharge volume increases, flood disaster damage might be increased.
- Is it OK to continue normal operation even though the time to start special operation comes?

What supported decision making to solve the conflict above?

Preparation & Technology

1) Enough preparation for emergency (by public sectors)

- Preparation in advance for operation procedure and facility against flood
- Good information sharing & communication among stakeholders (Central Gov., Local Gov., Citizens, etc)
- Flexible decision making scheme based on the consideration of appropriate data / information in order to secure happy citizens.

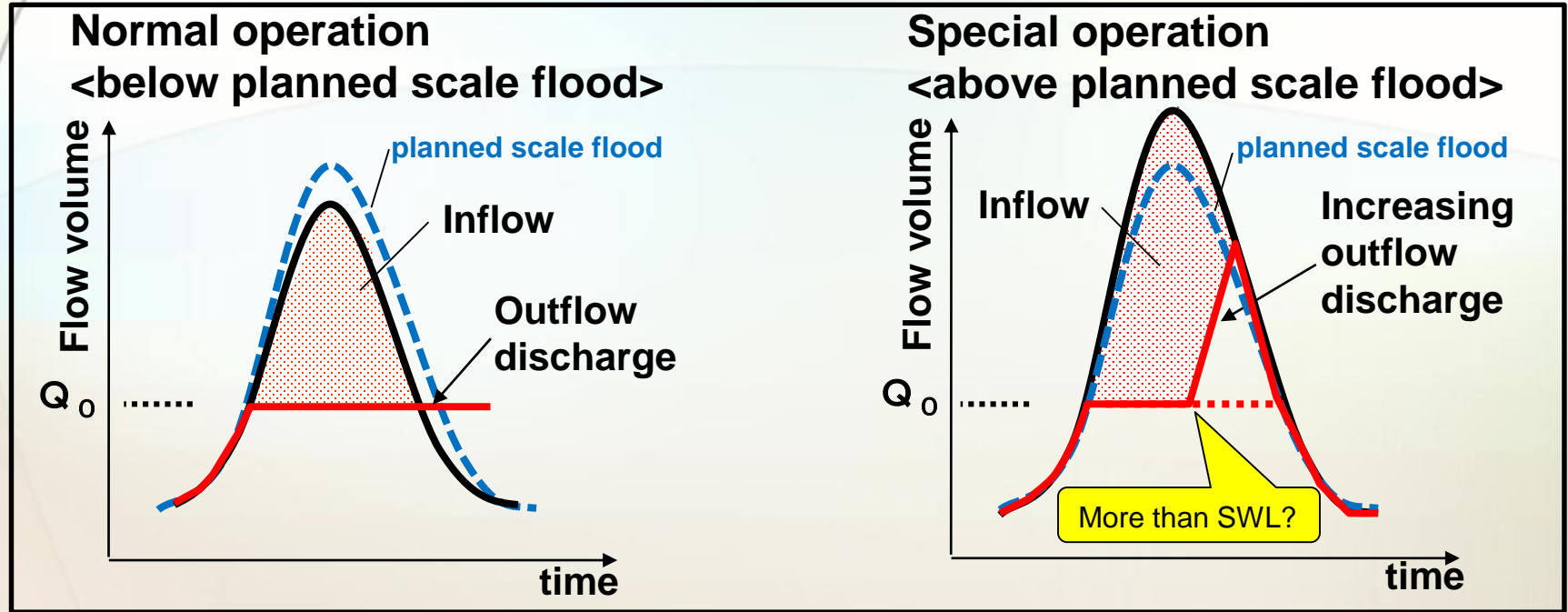
2) Appropriate technologies to achieve “disaster risk reduction”(supported by private sectors)

- Real time data / information monitoring and delivery for decision making.
- Frequent data analysis for future prediction with updated latest data etc.

Plan & facilities for flood reduction

- ◆ flood regulation plan is prepared in advance.
- ◆ Facilities for over planned scale flood are provided.

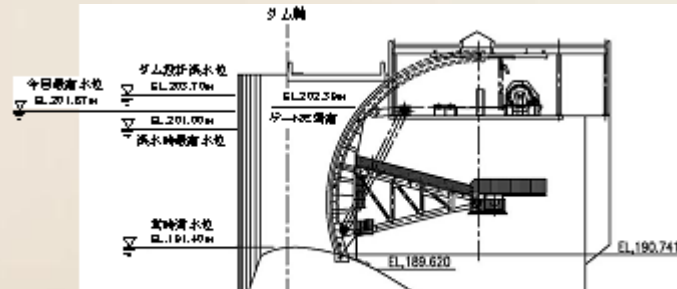
<Flood regulation plan of Hiyoshi Dam>



<Emergency gates of Hiyoshi Dam>



Front view(upstream)

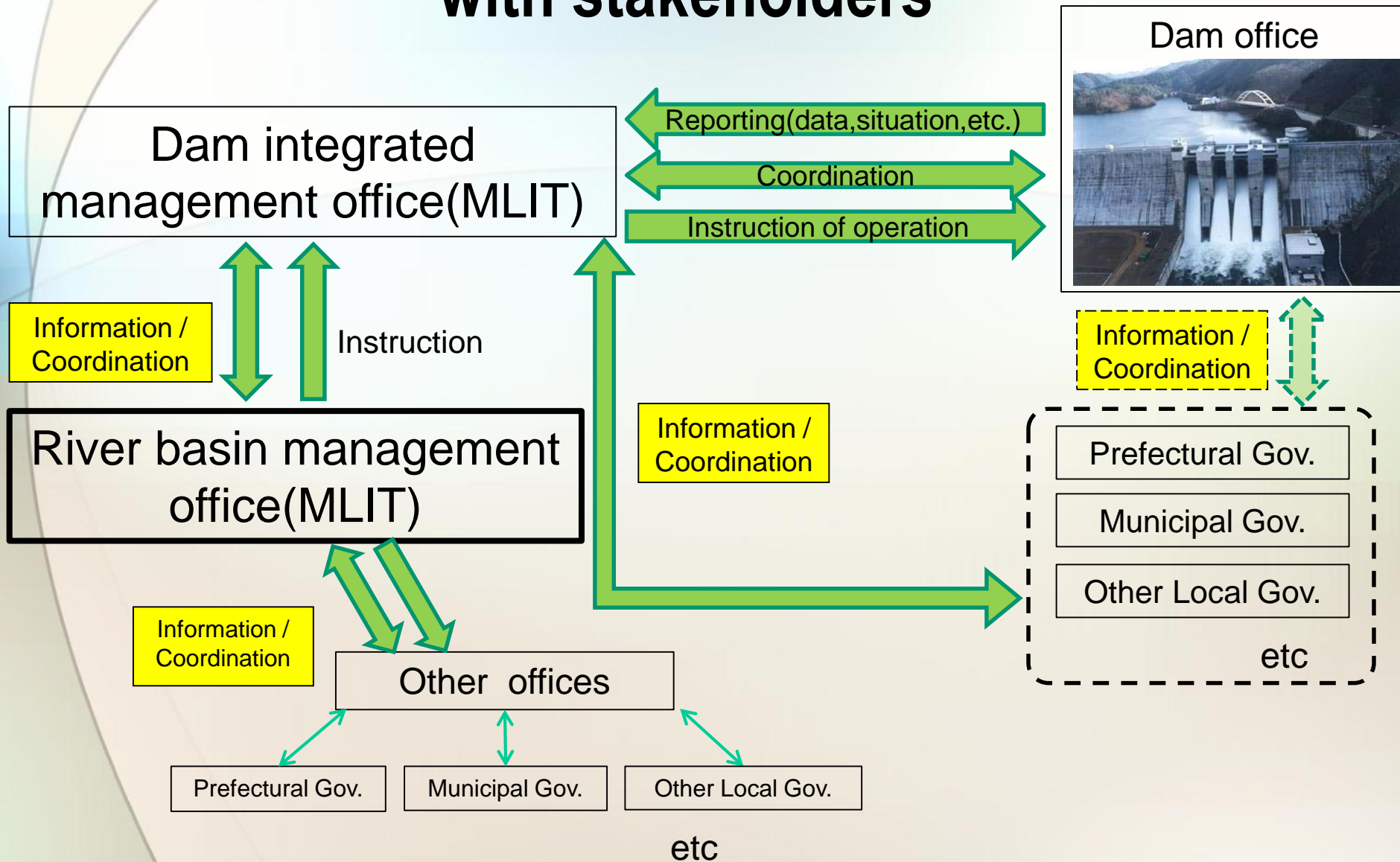


Longitudinal view



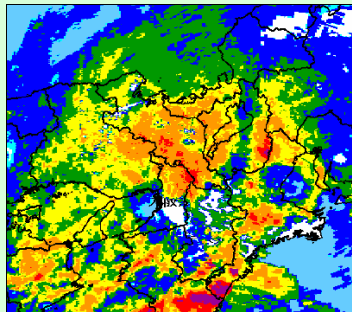
Front view(downstream)

Information sharing & coordination with stakeholders



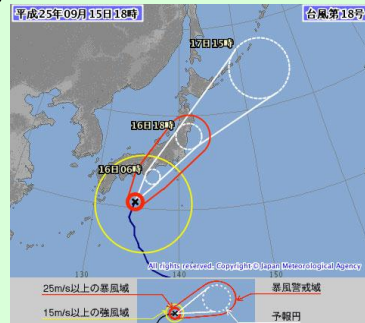
Information for decision making

MLIT

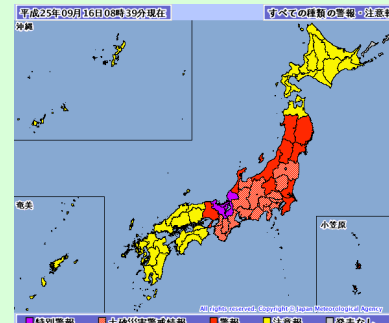


C-band radar

Japan Meteorological Agency

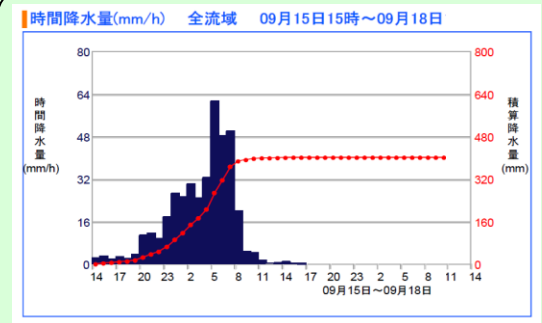


typhoon prediction



Disaster information

Japan Weather Association

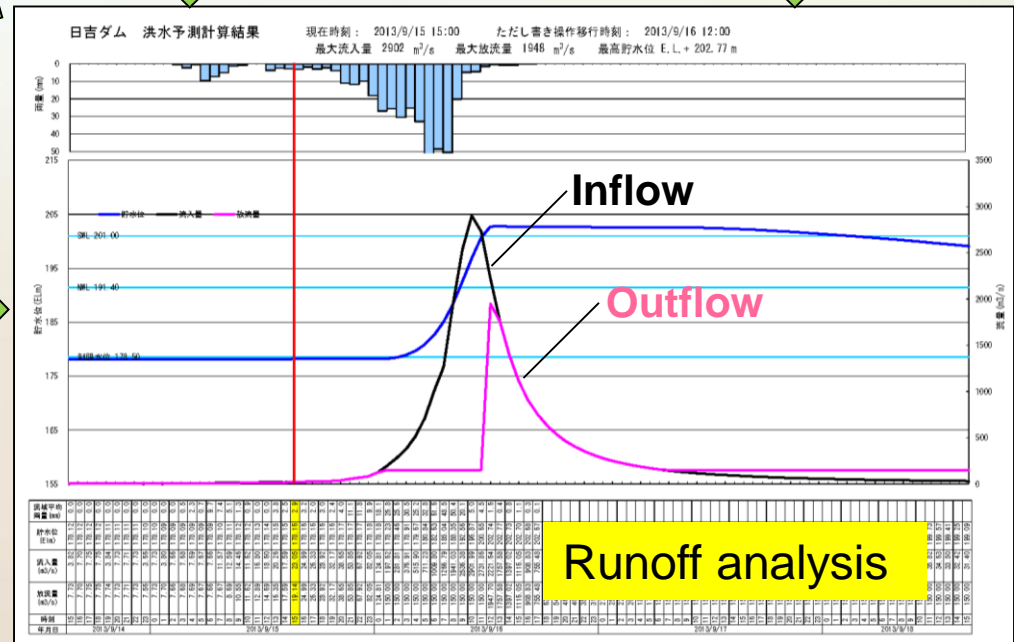


Rainfall prediction

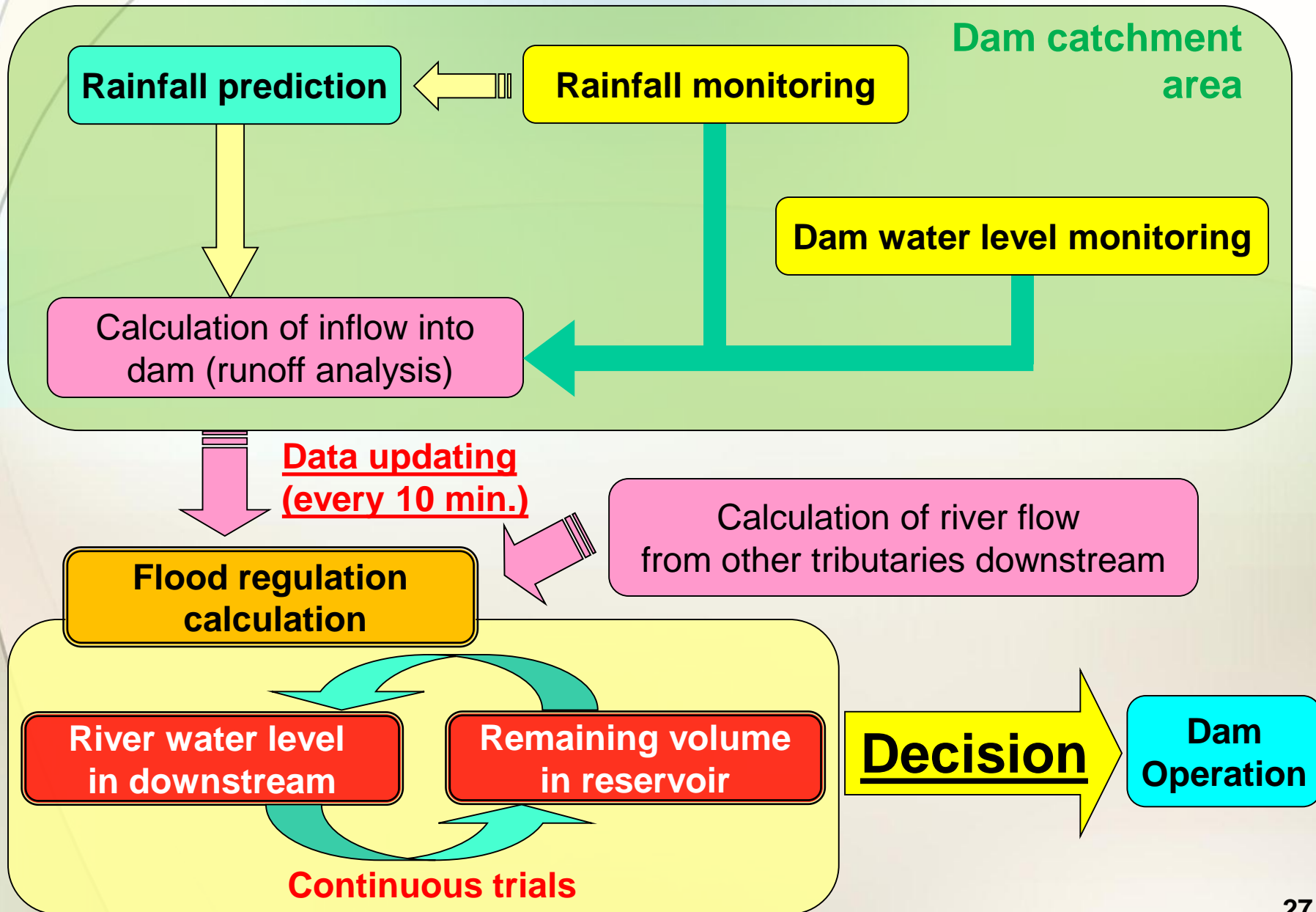
JWA (Dam management office)



Telemetry system
(rain gauge, water-level)



Information / data analysis for decision making



Monitoring facilities

Water level monitoring station



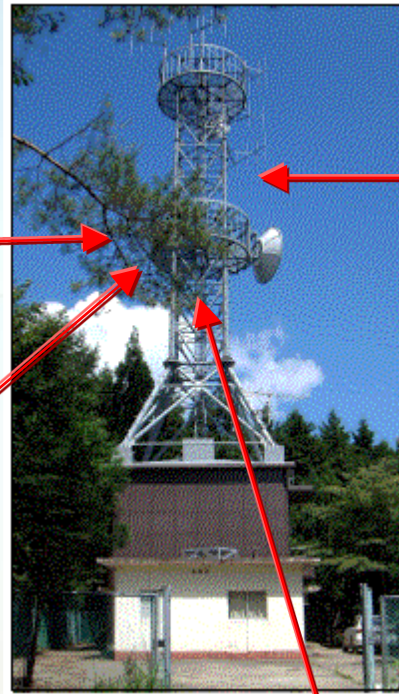
Rainfall gauging station



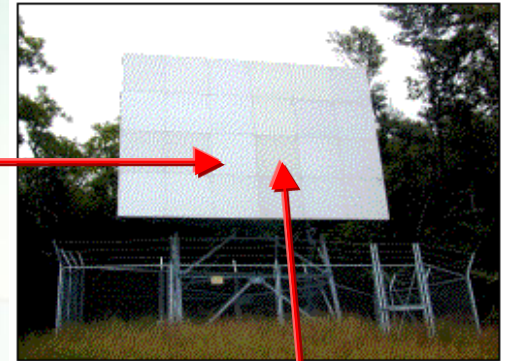
Data collection – Micro wave network



Rain gauge



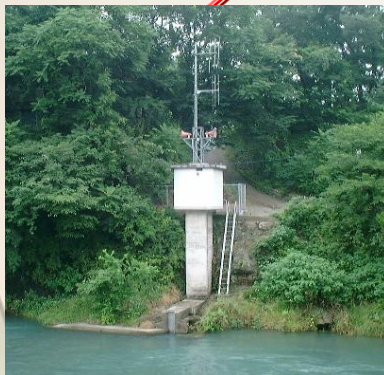
**Relay station on
top of mountain**



Reflex panel



**Integrated operation
and maintenance
office (MLIT & JWA)**



W.L. station



Dam office

Other facilities for flood management

CCTV (ITV) installation

Camera in field



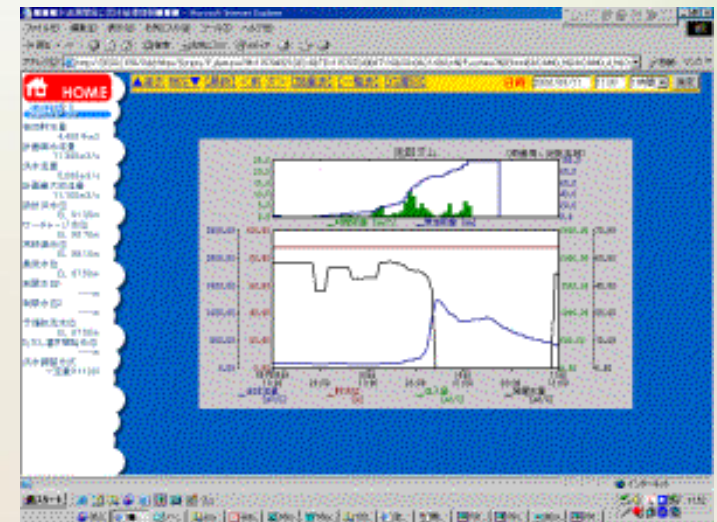
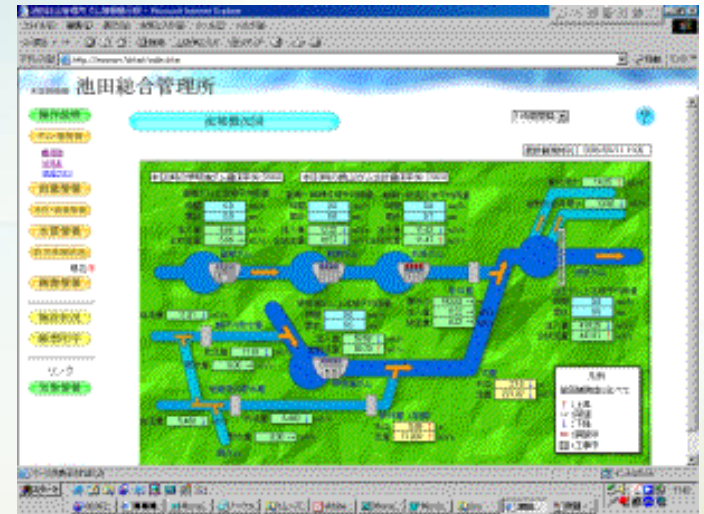
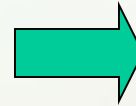
Supervision console



Information release for public



Online network



<http://www.ikesou.jp/>

Information release for public

Discharge warning signboard

Discharge warning siren & speaker

Information display board

独立行政法人水資源機構草木ダム管理所
電話(〇二七セ)九セー二二三

サイレン音	スピーカー音
五〇秒 五〇秒 五〇秒	サイレン吹鳴機能障害の場合 五〇秒 五〇秒 五〇秒

記

危険!!

《ダムのみずをながしかわのみずがふえることがあるからきをつけよ》

ダムの放流による増水に注意

この川の上流二五キロメートルのところに、草木ダムがあり、ときどきダムに貯った水を流し、この川の水が急に増えることがありますから注意して下さい。またダムに貯った水を流すときは、左記のとおりサイレンやスピーカーなどでお知らせします。そのときには危険です。河原に降りないで下さい。



Please be careful when dam in upstream increase water discharge.

Dam in upstream is discharging now!

Activities for Flood management by “human”

River patrol before increasing water discharge from dam



Flood management drills



preparation of Emergency operation plan, etc

Conclusions

The operation of Hiyoshi dam could realize by various Information/data & preparation for emergency.

Therefore, its operation can't be always implement.

However, extreme weather events may occur at a higher level.

We need to prepare for...

Conclusions

We need

by public sectors

- ❑ Coordination and building a good relationship with the stakeholders**
- ❑ constant monitoring / understanding of runoff characteristic in dam catchment area**

supported by private sectors

- ❑ introduction of appropriate technology for decision making**

An aerial photograph of the Hiyoshi dam reservoir. The water is a turbid, yellowish-brown color, indicating high sediment levels. The reservoir is surrounded by dense green forested hills. In the lower right, the dam structure is visible, along with some buildings and a parking area. The text "Thank you for your attention." is overlaid in large yellow font in the upper center.

Thank you for your attention.

This photo shows the situation of Hiyoshi dam reservoir when the water level of the Hiyoshi dam was EL.201.85m (2013, September 16, 13:45) .