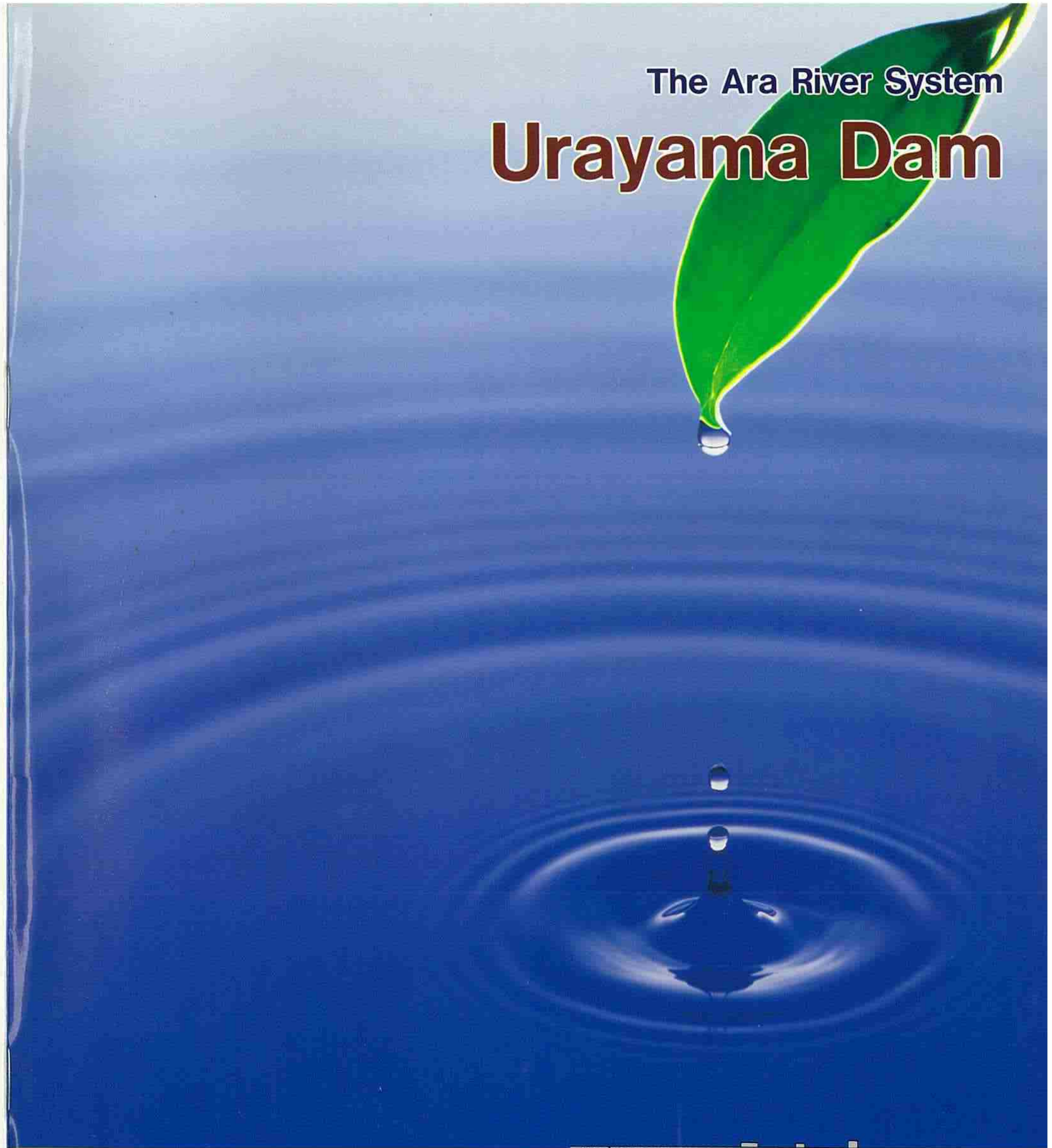
BC·RCD
156m
Develop
dam technology.

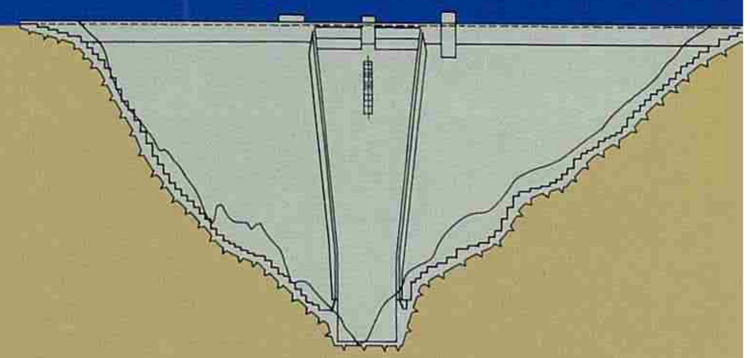
**Urayama Dam**

**Water Resources Development Public Corporation**
**Urayama Dam Construction Office**
130-1 Kami Kagemori, Chichibu-shi
Saitama Prefecture
Tel. 0494-24-6811～3

## The Ara River System

# Urayama Dam





**Water Resources Development Public Corporation**
**Urayama Dam Construction Office**

# Development of water resources in beautiful Chichibu mountains

## History of Urayama Dam Project

■1967 Ministry of Construction starts preliminary survey.

■1972 Ministry of Construction starts execution plan.

■1974 Ara River System is designated as one of water resources development river systems.

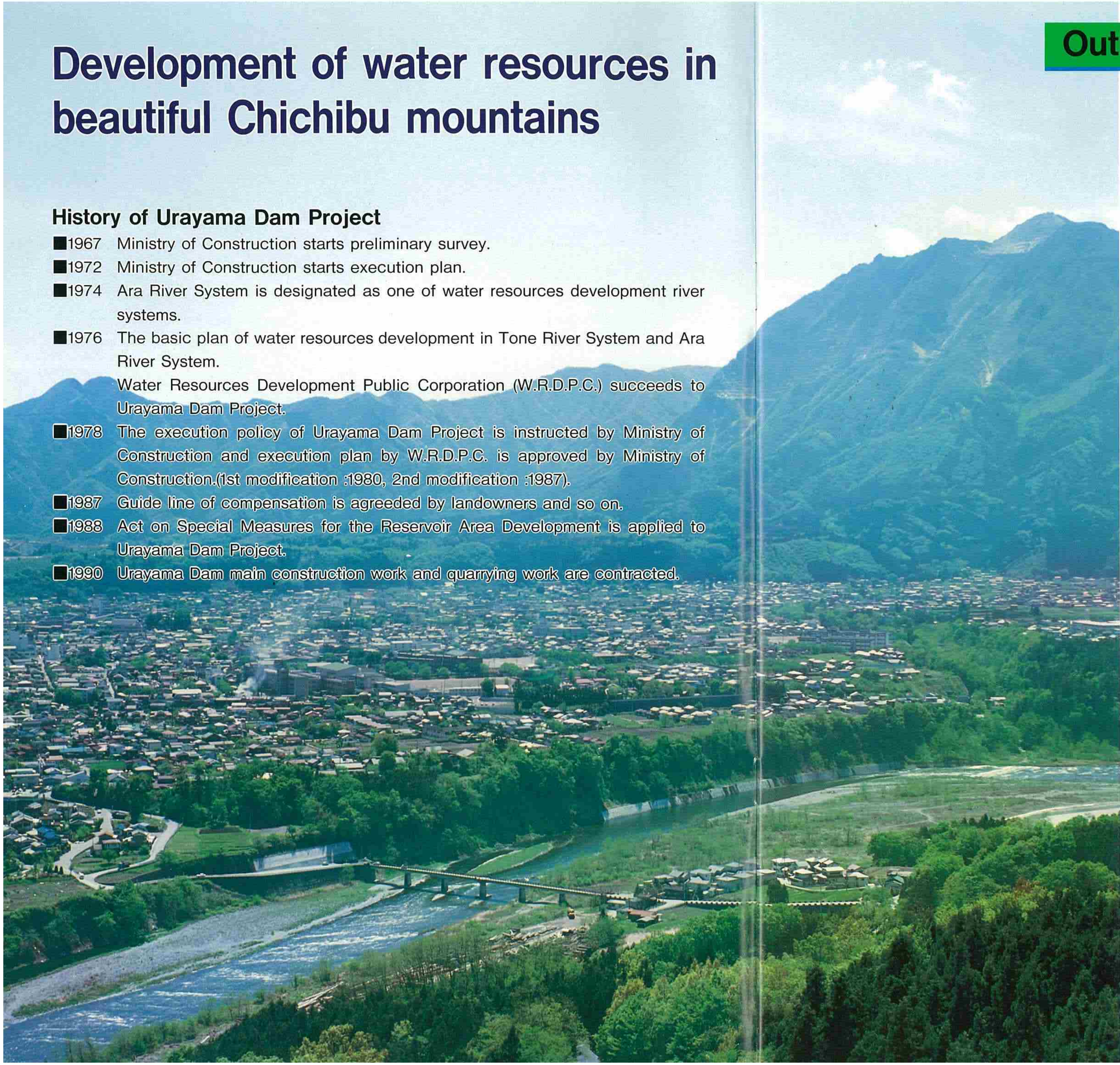
■1976 The basic plan of water resources development in Tone River System and Ara River System.
Water Resources Development Public Corporation (W.R.D.P.C.) succeeds to Urayama Dam Project.

■1978 The execution policy of Urayama Dam Project is instructed by Ministry of Construction and execution plan by W.R.D.P.C. is approved by Ministry of Construction.(1st modification :1980, 2nd modification :1987).

■1987 Guide line of compensation is agreeded by landowners and so on.

■1988 Act on Special Measures for the Reservoir Area Development is applied to Urayama Dam Project.

■1990 Urayama Dam main construction work and quarrying work are contracted.



◀Chichibu City

# Outline of Urayama Dam

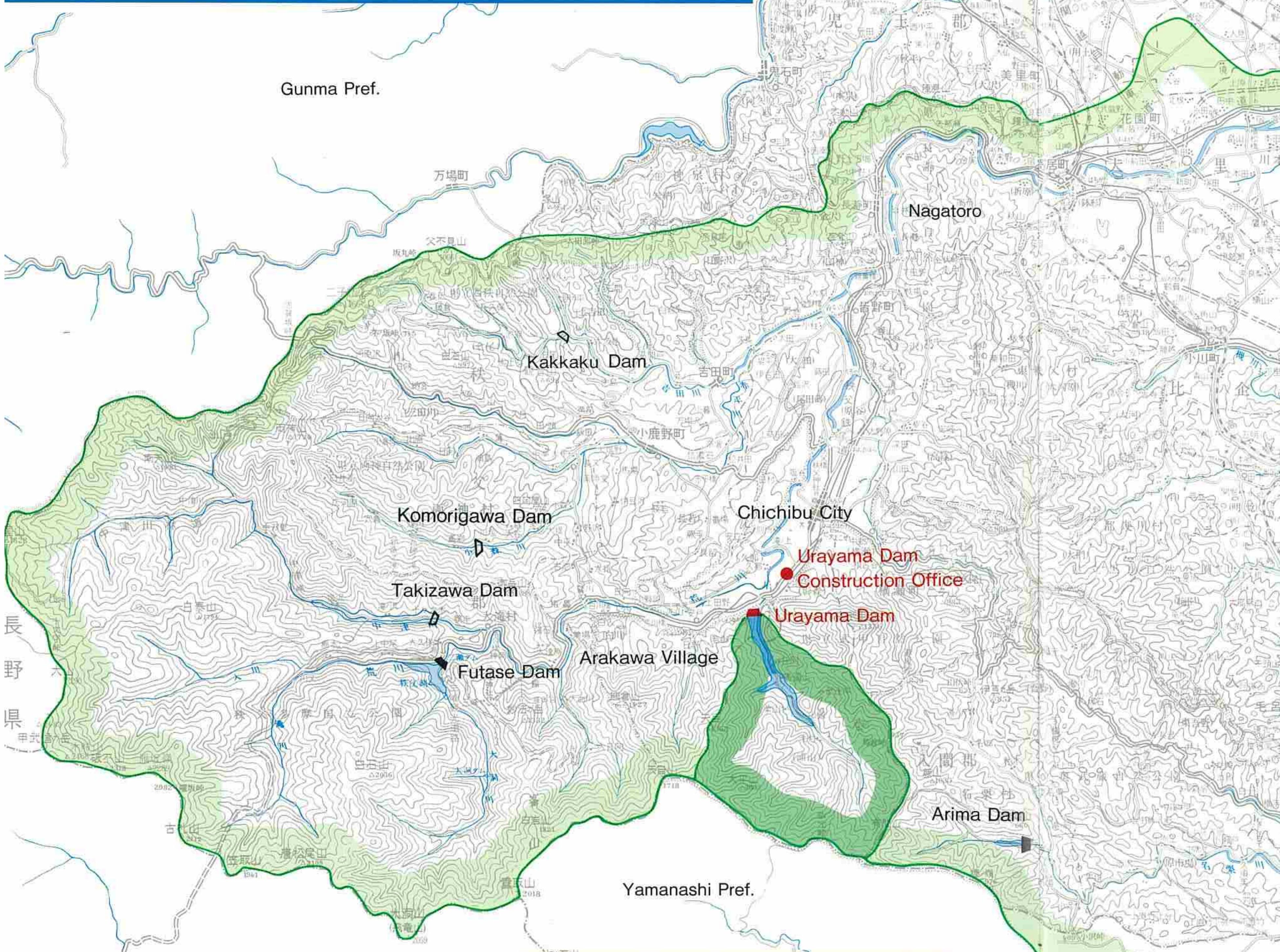
■Urayama Dam is a multi-purpose dam being constructed in Urayama River of the Ara River System, and it forms a part of the Ara River integrated development.

■Ara River has its origin in Mt. Kobushigadake(2,475m above sea level)of Chichibu Mountain Area. It is one of the Class A rivers flowing into Tokyo Bay. Combining many tributaries on its way, it flows to the north through Chichibu Basin, and through Nagatoro, it changes the flow to the southeast at the western part of Kumagaya City. From this point, it passes through the plain of the center part of Saitama pref., and flows into Tokyo Bay. The river separates Sumida River at Kita Ward, Tokyo Metropolis. The extension of its arterial flow is 169km, and the basin area is 2,940km$^2$.

■Thus, Ara River passes through the central part of Saitama Pref., which has been urbanized rapidly during recent years, and Tokyo Metropolis. The economic and social importance of its basin has been increasing year by year, so influence of an inundation if it occured would be a scale beyound our imagination.
Further more, the successive shortage of water in the metropolis sphere in recent years has been a serious social problem, because of rapid increase of demand for water by the rapid increase of population, improvement of the living standard, and the development of industries.

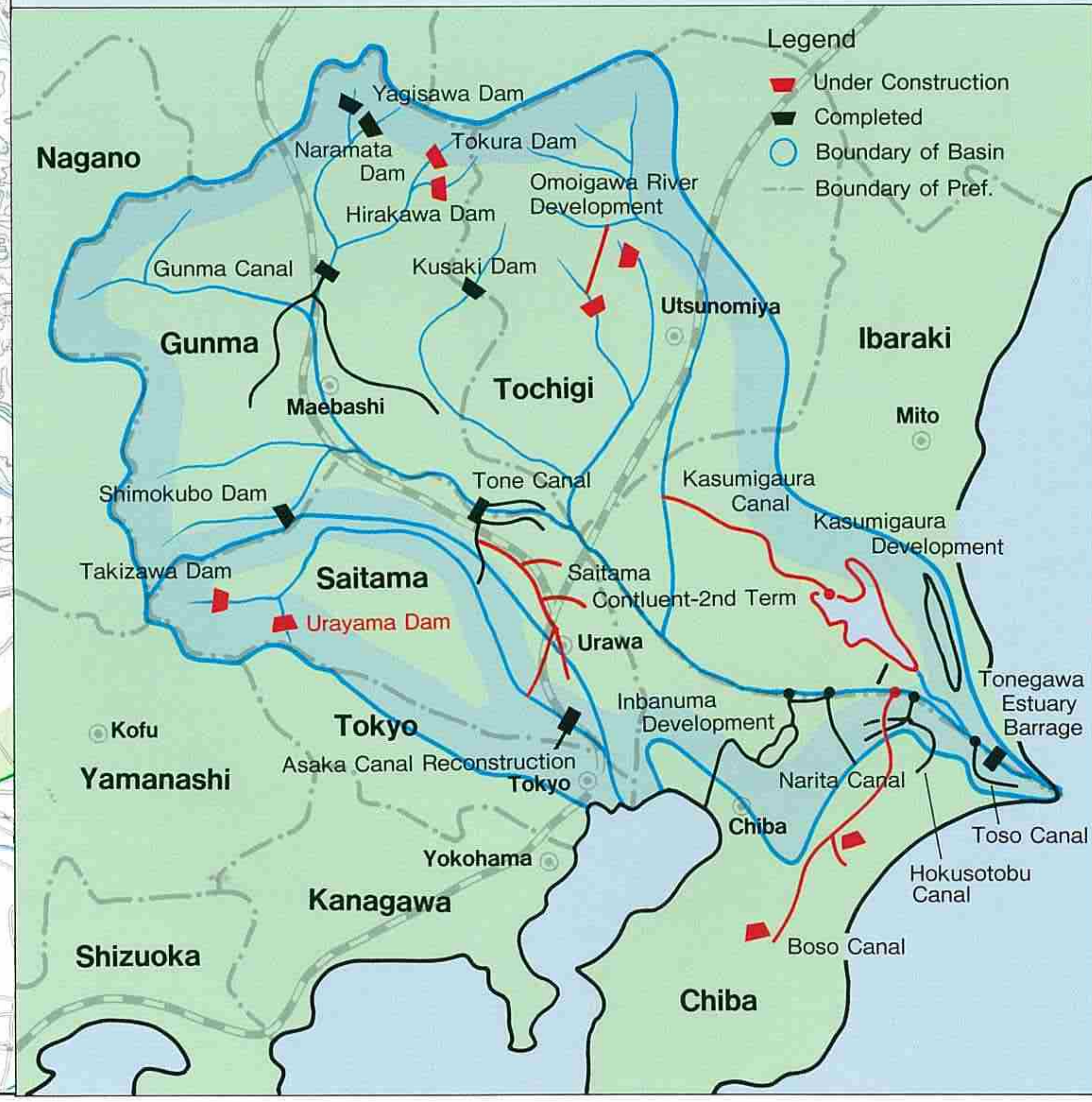
Contents

# Map of areas around the dam




Chichibu City▶

## General view of Tone River System & Ara River System water resources development plan



# Purposes of the Project

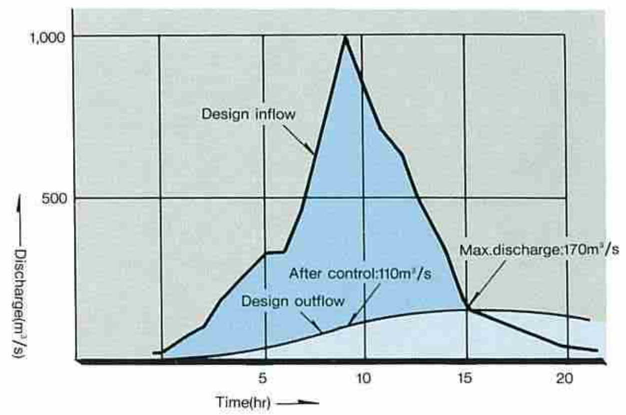
**1. Flood control**
To perform control of 890m³/sec out of the design discharge of 1,000m³/sec at the dam point.

**2. Maintenance of normal functions of river water**
To maintain and promote functions of river water including supply of water to existing facilities along Ara River.

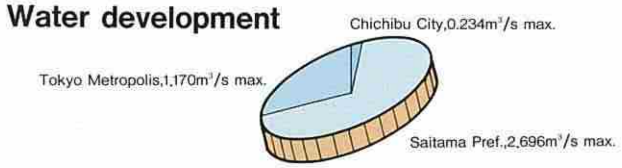
**3. Water Development**
To allow intake of4.1m³/sec of water, at most, as water for municipal use of Chichibu City, Saitama Pref. and Tokyo Metropolis.

Simultaneously with the construction of Urayama Dam, Urayama Power Station is constructed by Saitama Pref. to perform generation of electricity up to 5,000kw max.

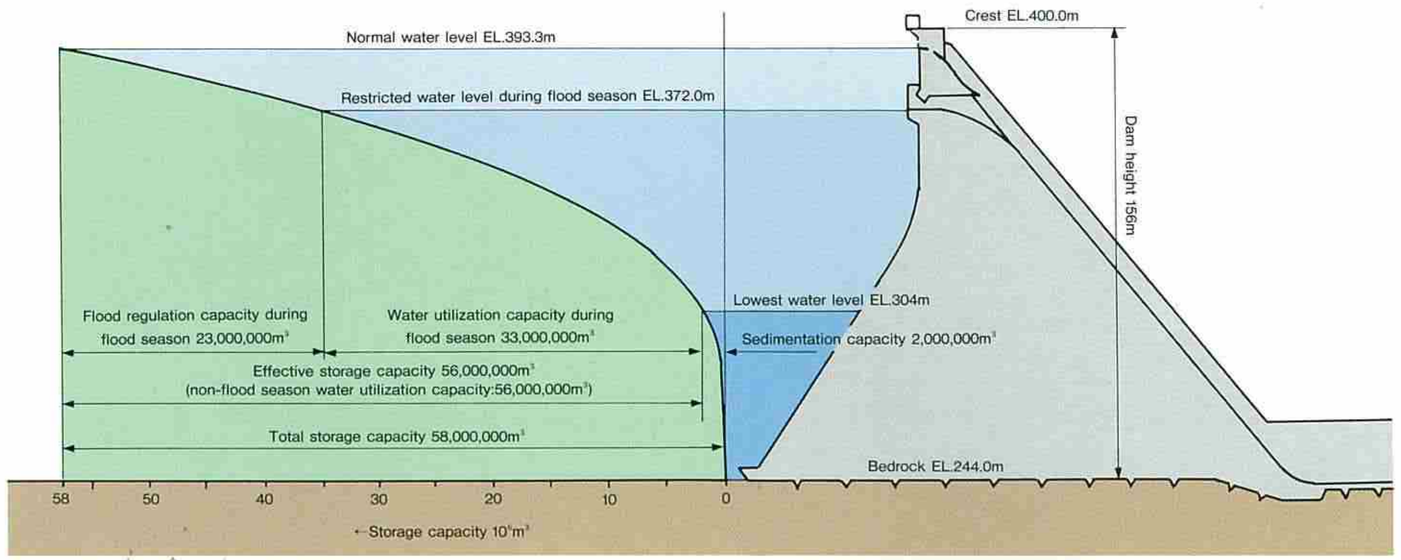
### Flood control scheme




### Water development



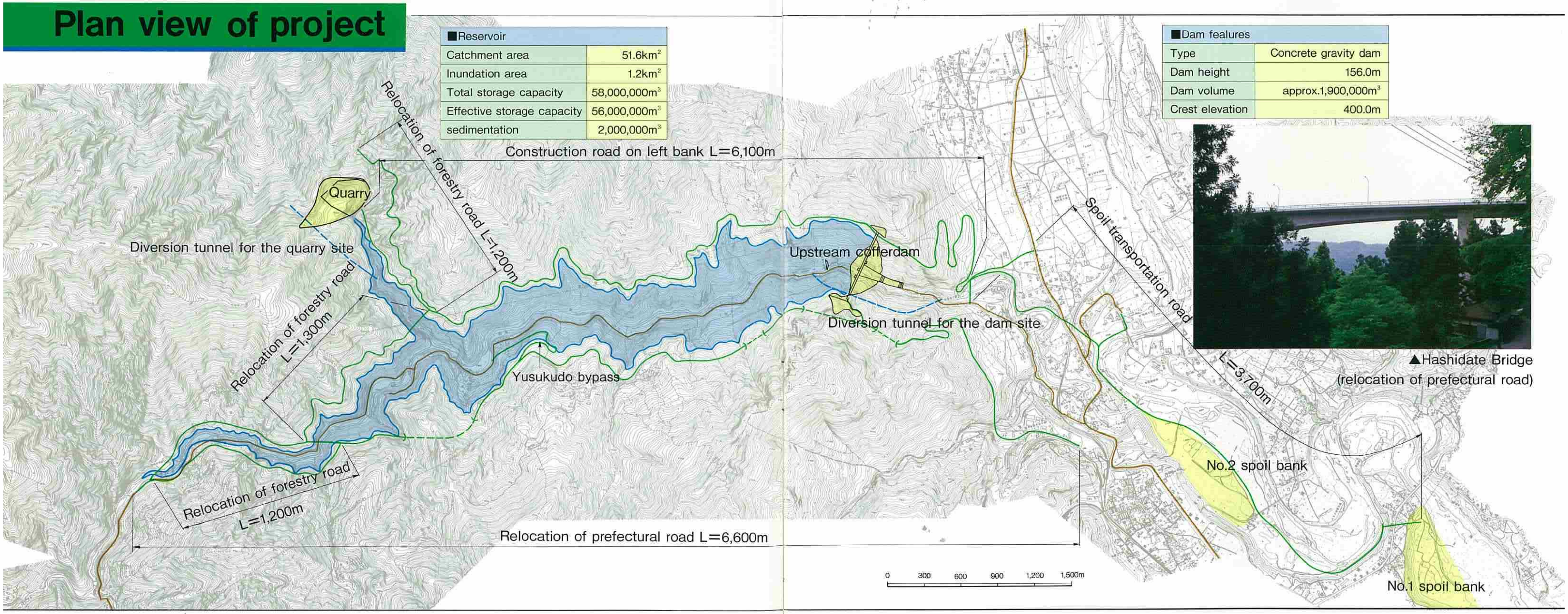

### Reservoir water level-storage capacity curve




# Plan view of project

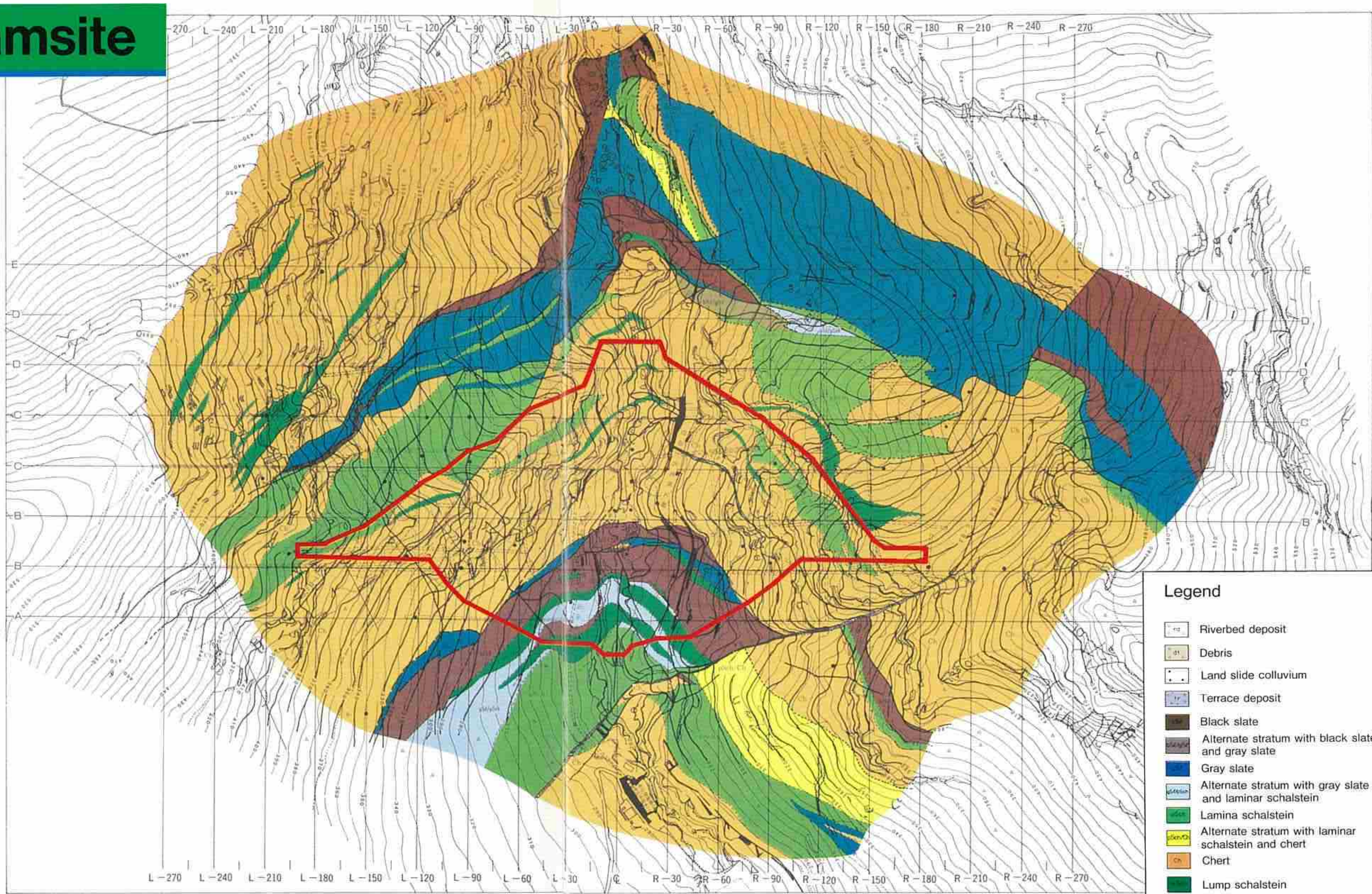
| ■Reservoir | |
|---|---|
| Catchment area | 51.6km² |
| Inundation area | 1.2km² |
| Total storage capacity | 58,000,000m³ |
| Effective storage capacity | 56,000,000m³ |
| sedimentation | 2,000,000m³ |

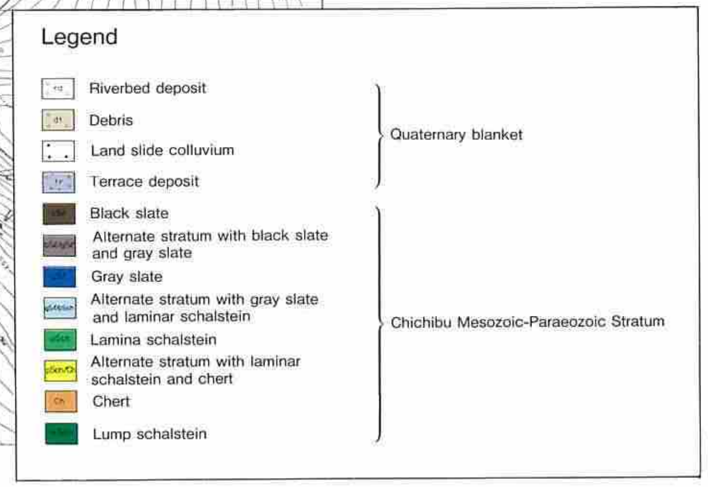
| ■Dam feaures | |
|---|---|
| Type | Concrete gravity dam |
| Dam height | 156.0m |
| Dam volume | approx.1,900,000m³ |
| Crest elevation | 400.0m |

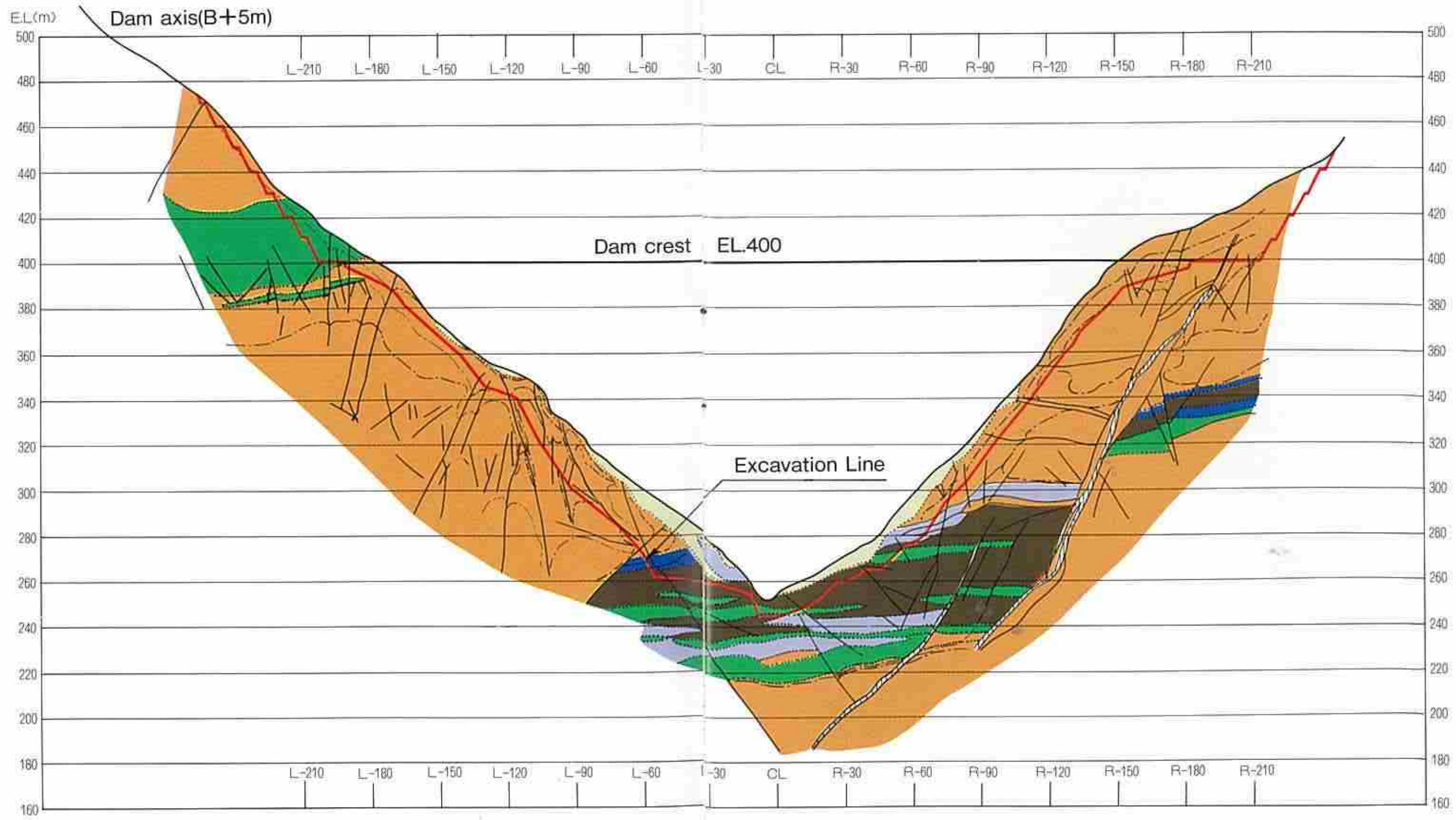



▲Hashidate Bridge
(relocation of prefectural road)

# Geological Plan of damsite






## Geological conditions

Geology around the dam and reservoir is composed of Hashidate Stratum and Urayama Stratum of Chichibu Mesozoic-Paraeozoic Stratum.

The bedrock of the dam site is composed of chert, slate and schalstein of Hasidate Stratums, and is a relatively fresh hard rock with a low degree of weathering. It is covered by unhardened sediments such as terrace deposit and colluvial deposit.

The geological structure around the dam site forms an anticlinal structure. The dam site is located at the north wing of the anticlinal axis, and the stratum is made of a homocline structure inclined by 30°-50°towards the downstream of the dam.

Bedrocks of both right and left banks are composed mainly of chert, and are very hard. However, due to distribution of cracks with low dip, they present high permeability. The dam bedrock is composed of rocks of CM-CH classes, but rocks of CL class are distributed in a limited range of riverbed on the upstream side.

▲In-situ shear test of cracks with low dip

# Design of the dam

## 1.Design of bedrock and dam section

Geology of the dam site is composed of chert, schalstein and slate of the Mesozoic-Paraeozoic stratum, and they are classified into B,CH,CM and CL classes by hardness of rock, crack interval and condition of cracks.

Chert belongs mainly to B and CH classes, and part of laminar schalstein and black slate belong to CL class. Therefore,the dam axis is allocated so the dam body can be placed on the chert, as possible.

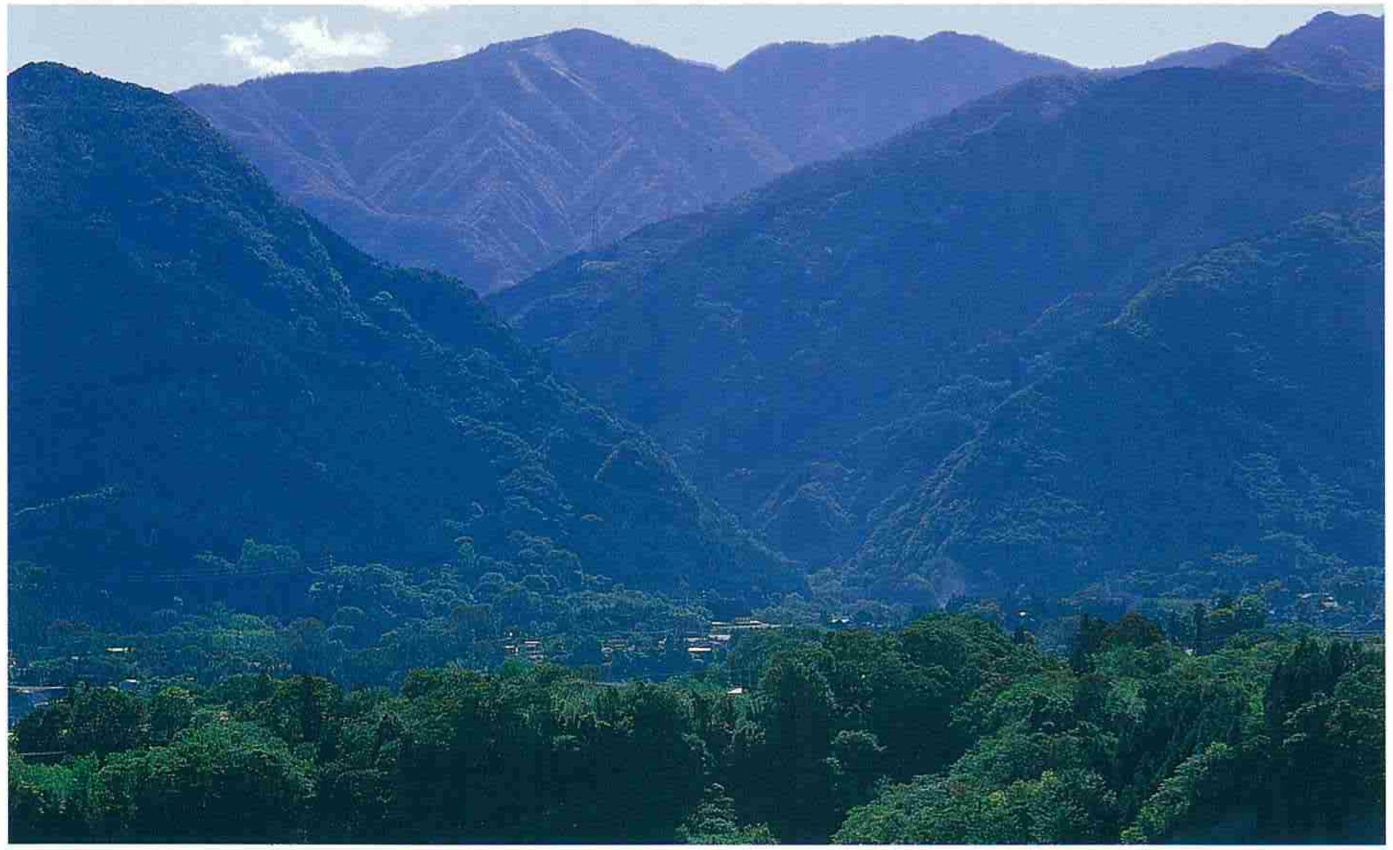
The body section of the dam is determined mainly by studies on sliding stability along the bedrock. The design value of shear strength of the bedrock is determined as average shear strengths by elevation by combining the design values of shear strength of each rock class, obtained by rock shear tests conducted on the typical rocks of rock classes B,CH,CM and CL, and the supposed geology of the face of excavation. After performing stability calculations along the bedrock, a large-scale fillet is decided to be installed on the upstream side in order to secure the shear-friction safety factor at the riverbed and mid-altitude parts.

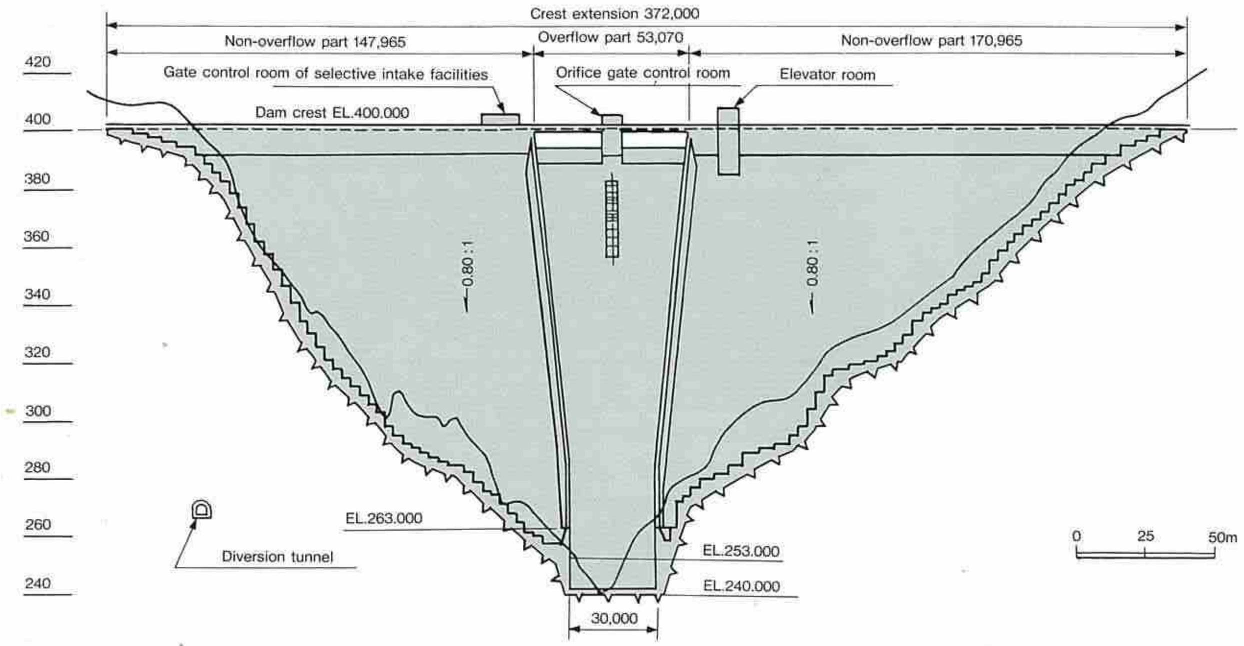
For high-dip and low-dip cracks distributed in chert of the left bank side, a possibility of improvement on impermeability is secured by cement milk grouting test. Regarding stability along the low-dip cracks, rock shear tests are conducted by cutting rock lumps containing cracks, and thereby the design strength is determined and check calculations are conducted.

## 2.Design of outlet works

Outlet works are composed of a spillway and outlet for water supply. As the catchment area is small as 51km$^2$ and the runoff time is short, the spillway is designed without gates because flood control by gate operation is difficult. So, the spillway is composed of an orifice for flood control, and a free overflow crest for flowing the designed flood discharge safely. The orifice of the section is designed so the discharge rate can be 110m$^3$/s when the design flood discharge of 1,000m$^3$s flows in. The free overflow crest is designed for the overflow width and overflow depth for discharging the designed flood discharge of 1,230m$^3$/s of the dam in cooperation with the orifice.

Outlet for water supply is composed of intake facilities having 12m$^3$/s max. of surface intake function not to release cold water to the downstream, and two controllable discharge valves, Large and small.

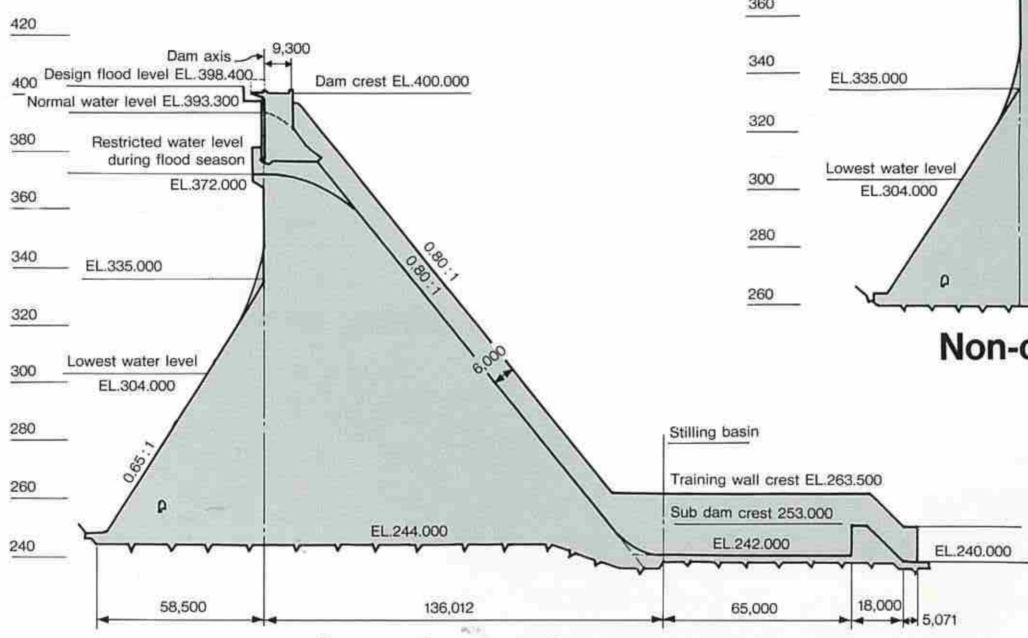




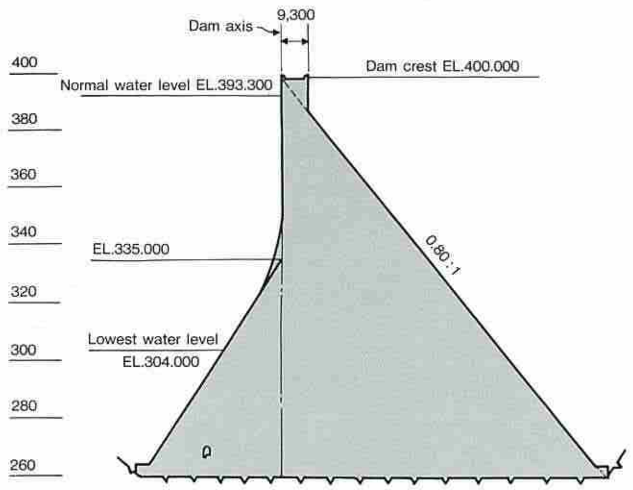

Downstream view of the dam

| | | |
|---|---|---|
| Designed shear strength | CL class $\tau o$=90tf/m$^2$, $\phi$=45° |
| | CM class $\tau o$=150tf/m$^2$, $\phi$=45° |
| | CH class and up $\tau o$=300tf/m$^2$, $\phi$=45° |
| Material property | Unit volume weight of concrete 2.35t/m$^3$ |

## Standard section of the dam




Over flow part




Non-over flow part

| | | |
|---|---|---|
| Design flood discharge of dam | | 1,230m$^3$/s |
| Discharge facilities | Normal spillway | Non-gate system B 4.07m × H 2.7m × 1 |
| | Emergency spillway | Free overflow system B23.0m×H5.1m×2 |
| | Other outlet works | Outlet for water supply,set of selective intake facilities |

# Rationalized construction work of the dam

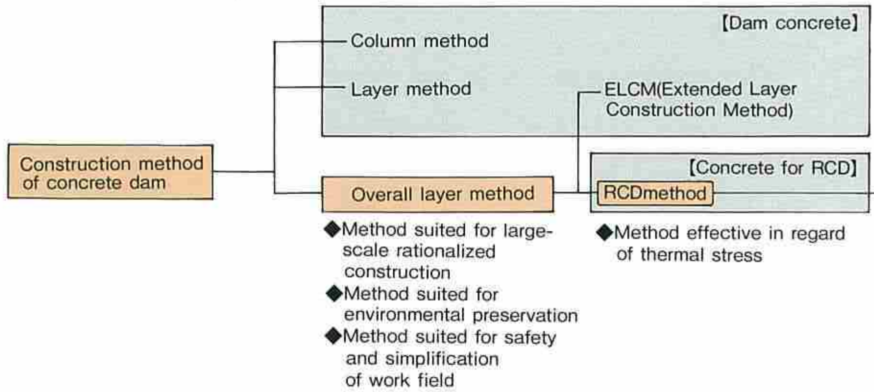

▲Execution of tests on RCD method (upstream cofferdam)

## Urayama Dam is constructed by RCD method and conveyer belt system:

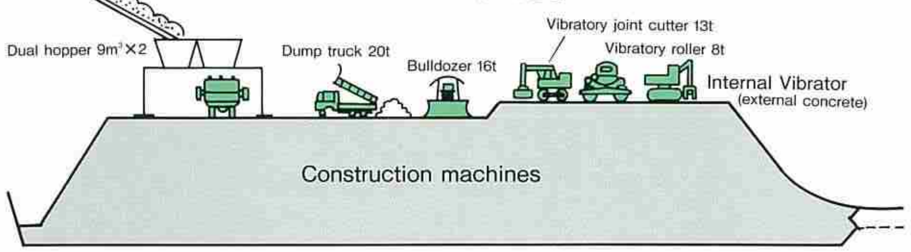
In executing a dam construction project, selection of the construction methods is an important point.
To construct Urayama Dam, we conducted studies and tests on the execution methods with the following mottoes:

- To develop world's new dam technologies and perform economical dam construction safely
- A dam construction harmonized with the beautiful mountains of Chichibu

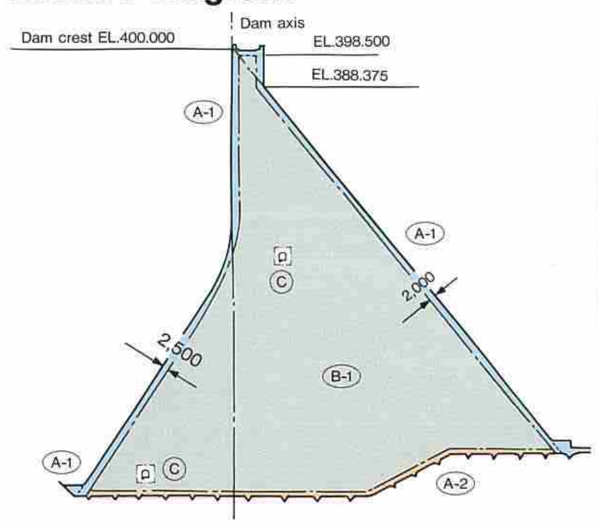
As a result, an exhaustive rationalized execution method, which consists of tlansporting system by using conveyer belt and RCD method, is adopted.



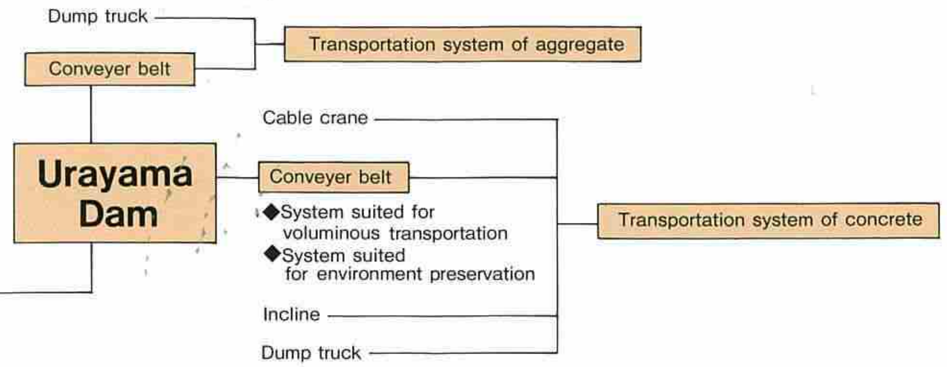

## RCD method




## Mixture diagram




▲Conveyer belt transportation test




## Conveyer belt transportation test and compaction test of concrete for RCD:

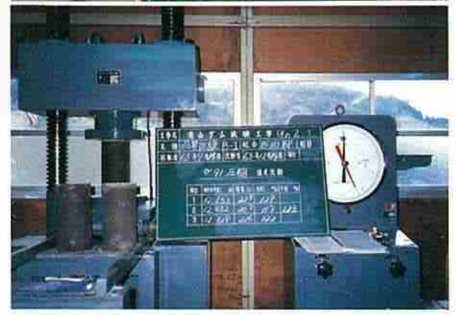
Transportation by conveyer belt is one of the rational execution ways, which affords a benefit of continuous and quantity transportation. In order to clarify the effect of conveyer belts as a concrete transporting facility, to concrete for RCD, conveyer belt transportation tests were performed utilizing construction fields including Nunome Dam. As a result, strength and other factors of concrete for RCD were proved to be comparable with concrete transported by dump trucks and free of any quality problems.
Also, performing compaction tests of concrete for RCD at the Urayama upstream cofferdam(lift thickness 1m), it was confirmed that quality of concrete was good.

## Mixture Table

| Mixture name | | | A−1 | A−2 | B−1 | B−2 | C | D | M |
|---|---|---|---|---|---|---|---|---|---|
| Maximum size of aggregate (mm) | | | 150 | 150 | 150 | 150 | 80 | 40 | 5 |
| Slump (cm) | | | 3±1 | 3±1 | 10〜20※ | 3±1 | 5±1 | 8±1 | − |
| Air (%) | | | 3±1 | 3±1 | 1.5±1 | 3±1 | 3.5±1 | 4±1 | − |
| Water-cement ratio W/C+F (%) | | | 49.5 | 58.9 | 65.4 | 66.3 | 54.6 | 55 | 60 |
| Fly ash mixing ratio F/C+F (%) | | | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Fine aggregate ratio S/G+S (%) | | | 26 | 27 | 30 | 27 | 36 | 46 | − |
| Unit quantity (kg/m³) | Cement C+F (kg) | | 210 | 180 | 130 | 160 | 240 | 280 | 500 |
| | Water W (kg) | | 104 | 106 | 85 | 106 | 131 | 154 | 300 |
| | Fine aggregate S (kg) | | 541 | 568 | 674 | 573 | 709 | 855 | 1,404 |
| | Coarse aggregate G (kg) | 150〜80mm | 308 | 307 | 314 | 310 | − | − | − |
| | | 80〜40 | 462 | 461 | 472 | 465 | 387 | − | − |
| | | 40〜20 | 385 | 384 | 393 | 388 | 504 | 502 | − |
| | | 20〜5 | 385 | 384 | 393 | 388 | 387 | 502 | − |
| | Admixture | Fly ash (kg) | 63 | 54 | 39 | 48 | 72 | 84 | 150 |
| | | Water-reducing agent (g) | 525 | 450 | 325 | 400 | 600 | 700 | − |
| Remarks | | | External: Upstream/donstream faces, apron | External: Bedding concrete | Internal: RCD concrete | Internal: Stop form | Around structures: Around reinforcement, training wall, end sill | Special mixture: Gate sill, railling, etc. | Base mortar |

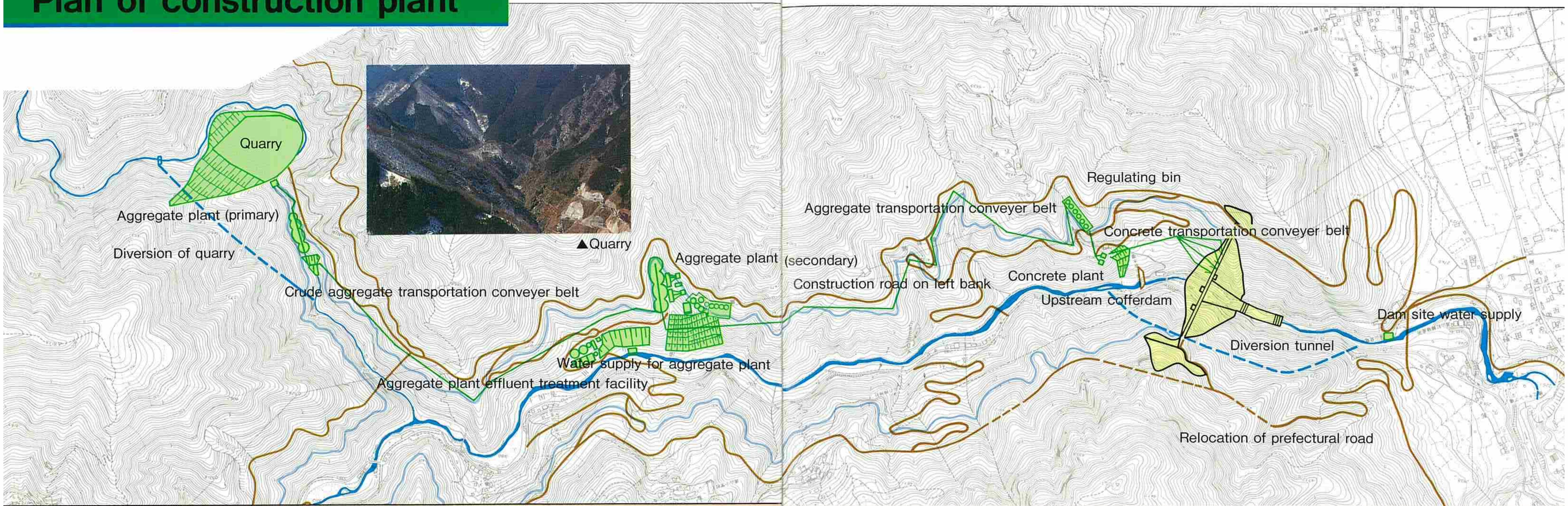
※VC value

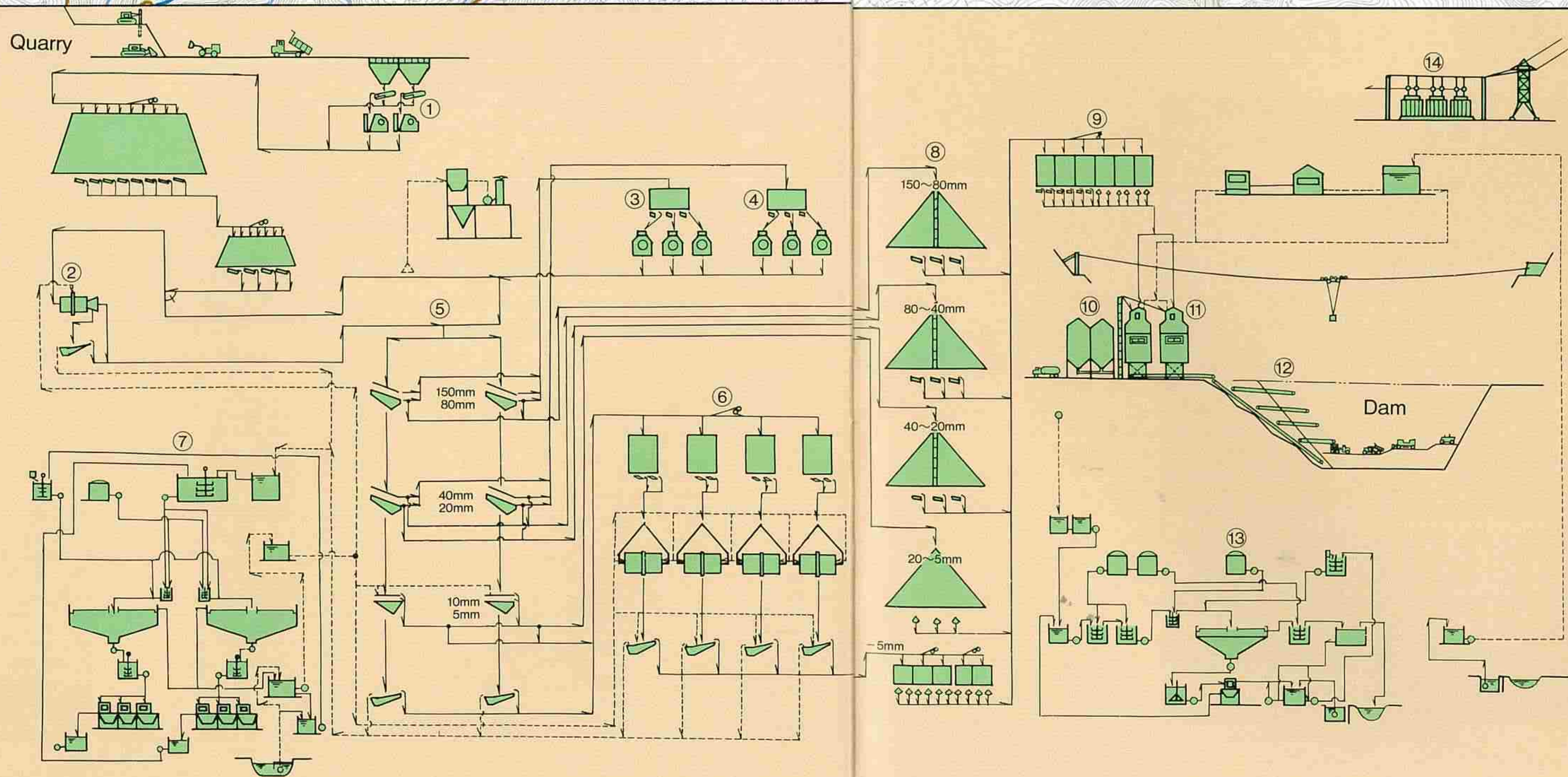




▲Conveyer belt transportation test

# Plan of construction plant

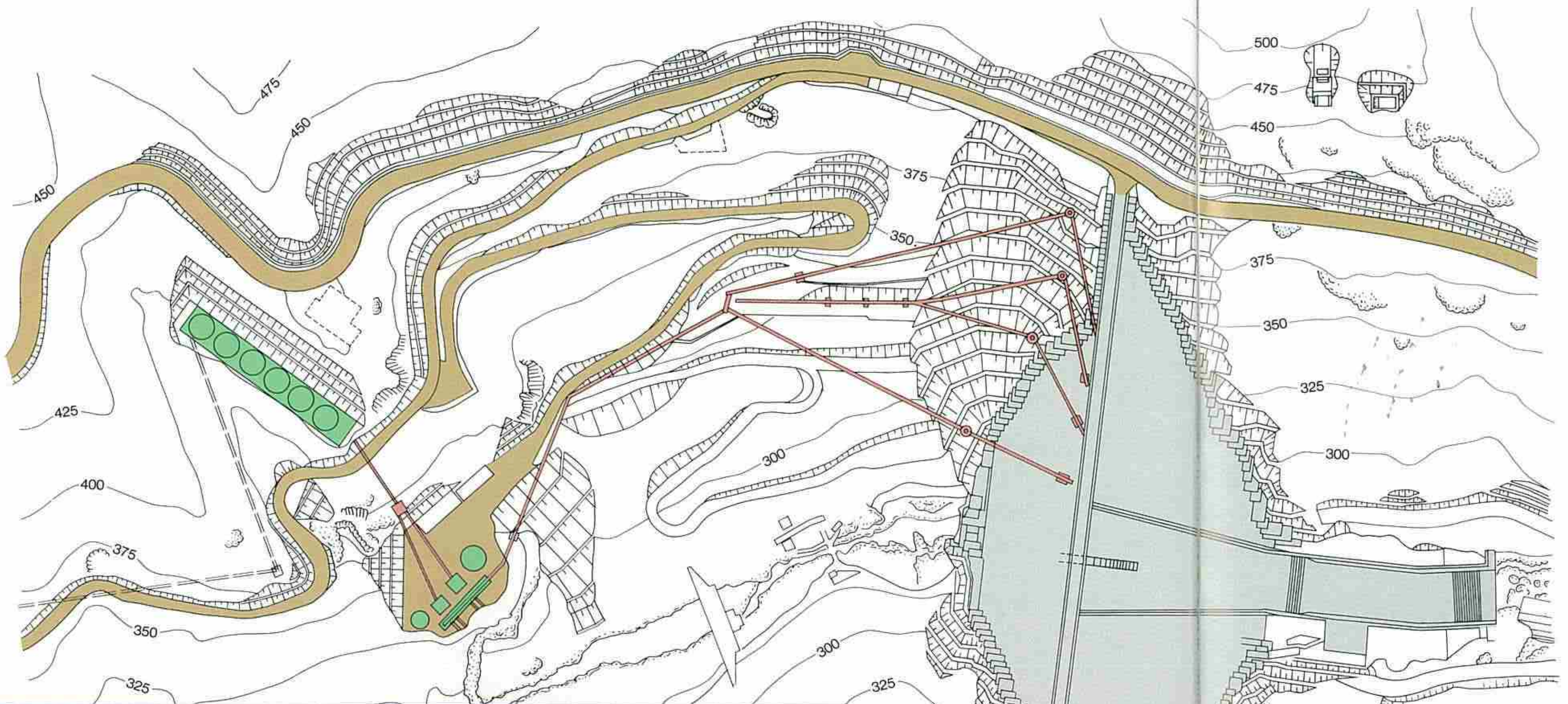


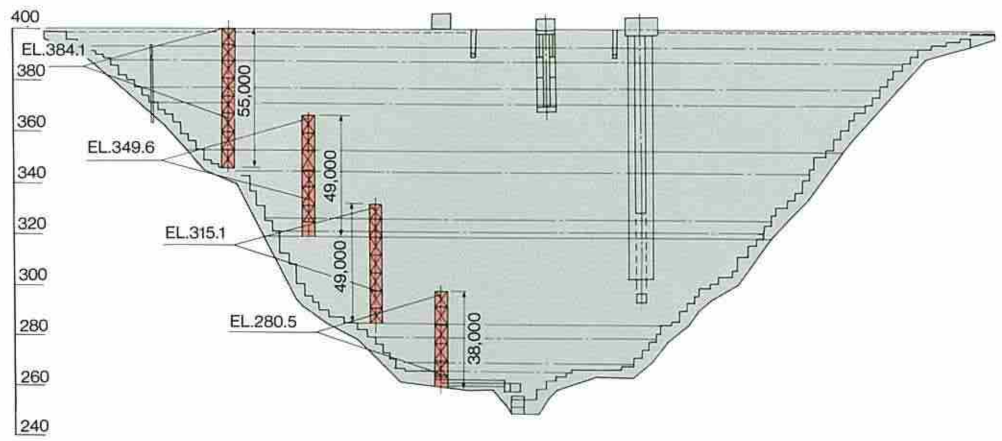

① Jaw crusher
② Scrubber
③ Cone crusher
④ Cone crusher
⑤ Screen
⑥ Rod mill
⑦ Turbid water Treatment for aggregates production facility
⑧ Stock pile
⑨ Regulating bin
⑩ Cement silo
⑪ Concrete production facility
⑫ Concrete carrying conveyer belt
⑬ Turbid water treatment for dam site
⑭ Transformer substation

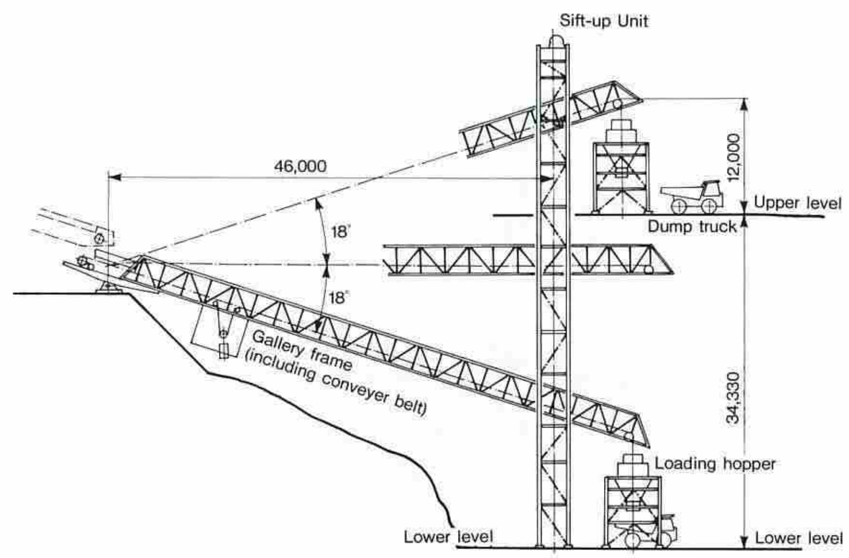
# Design of concrete transportation conveyer

Allocation and specification of conveyer belts used for concrete transportation of Urayama Dam are as shown below.



▲Excavation



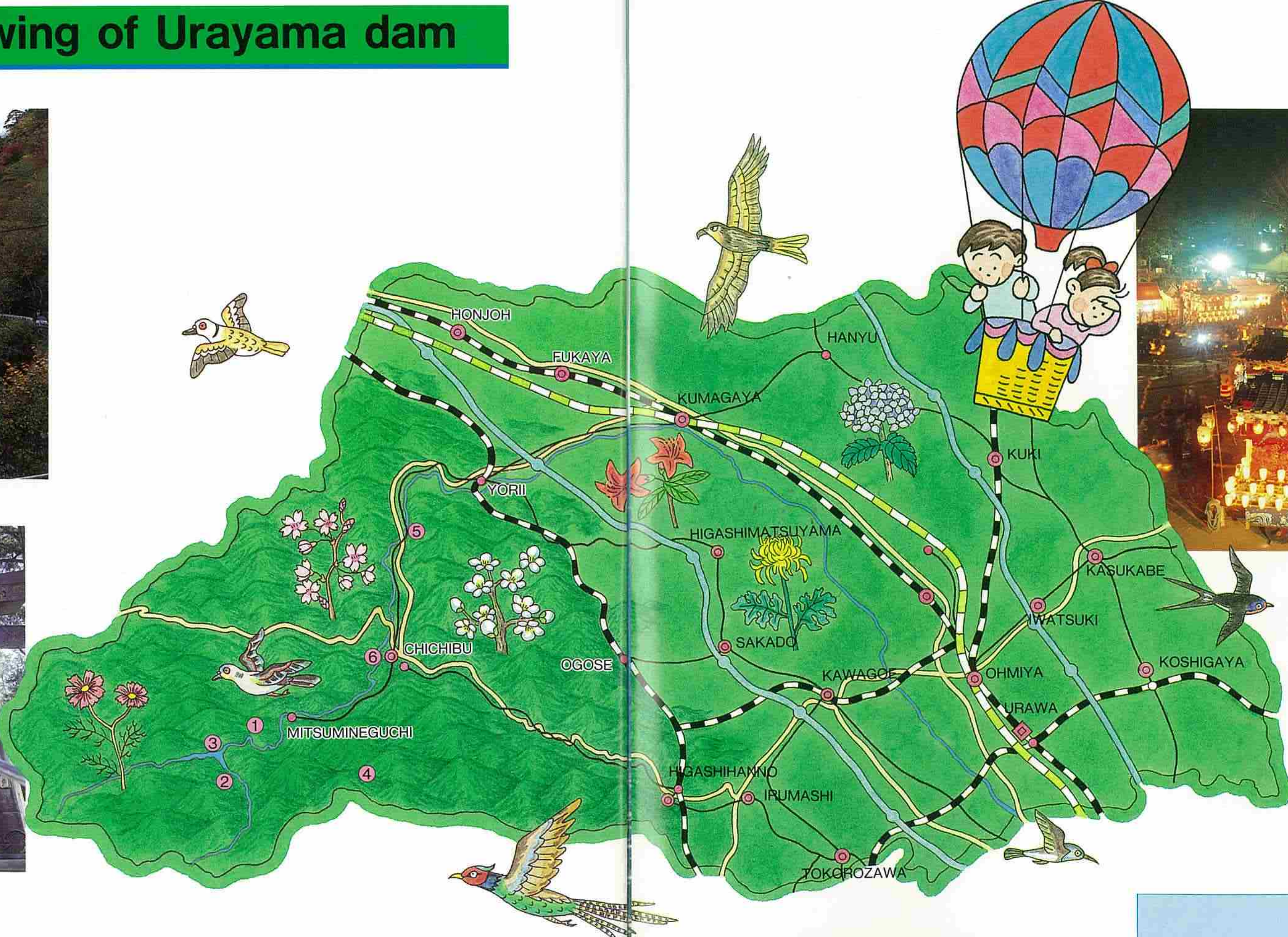

**Sift-up Conveyer Belt**

▲Concrete Batching Plant

# Peripheral drawing of Urayama dam

①Nakatsu glen

②The Mitsumine Shrine

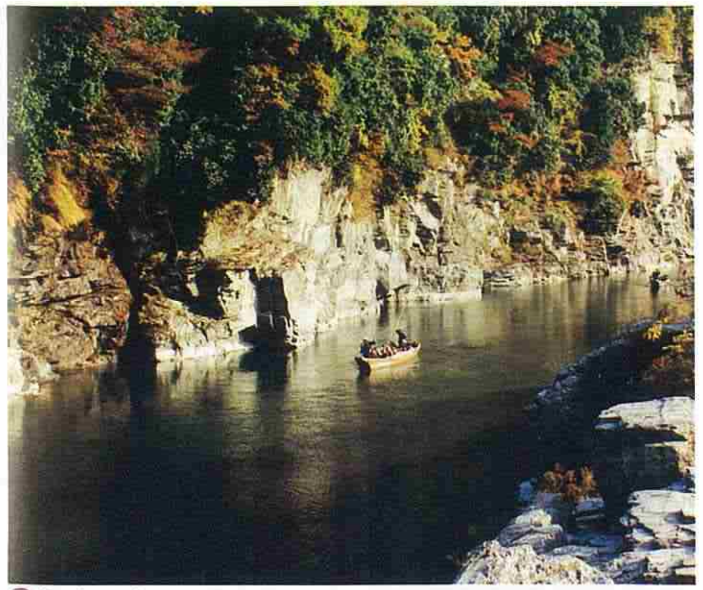




⑤Night Festival at Chichibu

③Futase dam

④Conceptual picture of Urayama dam at its completion



⑥Going down the Nagatoro river