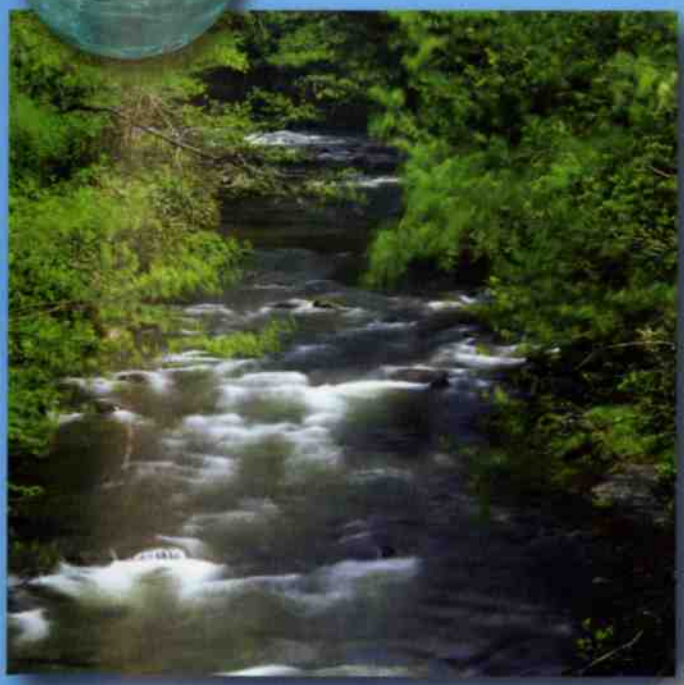
THE ISHIKARI RIVER



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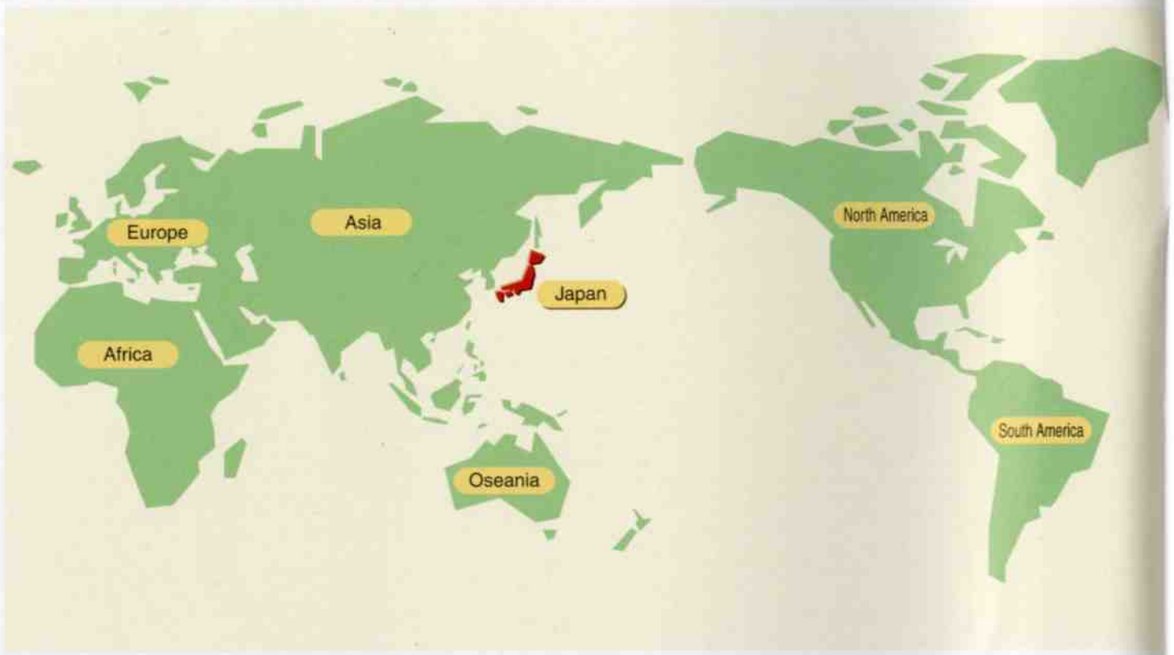


Figure 1 The world and Japan

1) Natural characteristics

Geographical features

Japan is an island nation located on the east side of the Eurasian Continent and the islands form an arc shape covering a distance of 3, 000 km from the north to south. The country is comprised of four main islands of Honshu, Shikoku Kyushu, and Hokkaido in addition to the 4,000 small islands that are scattered. Japan is surrounded by water including the Pacific Ocean, the Sea of Japan, etc. The land area of Japan is about 378,000 km² which is slightly larger than Malaysia, about 1/25 of China and U.S., about 1/23 of Brazil, about 1/5 of Indonesia, about 1/4 of Iran in the Middle East, and about 1/3 of South Africa.

The population is about 127 million and is the seventh largest in the world. There are eleven cities with population of 1 million or greater including Tokyo, which as a metropolitan area is the fourth most populated city in the world following New York, Mexico City, and Los Angeles.

Figure 2 Japanese map

Topography

The Japanese Island is on rare crust, that is collision point of four plates among the few tens plates covering earth. The Japanese Islands spans over two continental crusts of the North American plate and the Eurasian plate and is being compressed strongly from two directions due to sinking of the Pacific plate and the Philippine plate.

The Japanese Islands is located on one of world's prominent earthquake freguent occurrence zone known as "Pacific-rim earthguake zone" and is one of world's prominent volcanic country wherein about 10% of the active volcanoes in the world are located. Mountainous regions were developed due to the active fluctuation in the earth's crust caused by these volcanoes and together with a remarkable corrosion action caused by the meteorological condition of raining often as usually found in a temperate zone, a complex and unstable topography was formed.

About 70% of the country is mountainous and many mountain ranges extend along the length of the archipelago. The rivers are generally short and rapid, deep valleys are formed between the mountains, and the coastline is rugged.

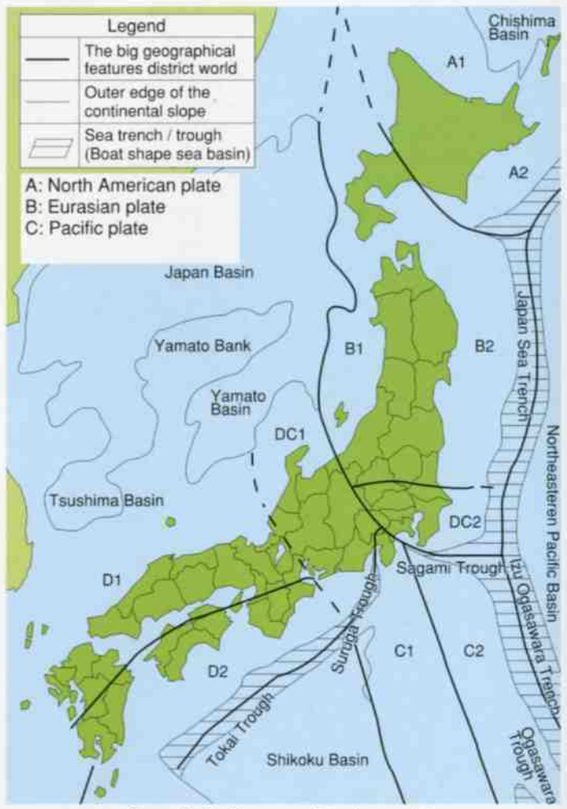


Figure 3 Position map of the Japan plate

The great Hanshin - Awaji earthquake (1995)

Eruption of Mt. Usu (2000)

Climate

The climate in Japan varies greatly between the north and the south from being a subtropical zone to a subarctic zone but most of the regions enjoy a mild marine climate and there are four distinct seasons. Also, the Japanese Islands is divided by the mountain ranges into the Sea of Japan side and the Pacific Ocean side and the climate on these two sides differs greatly.

On the Pacific Ocean side, the summers are hot and humid due to the southeasterly seasonal wind and in the winter, the weather is fair most of the time, the air is dry, and does not snow often.

On the Sea of Japan side, it snows often during the winter due to the northwesterly seasonal wind from the continent. Hokkaido and Northeastern section of Japan are located in one of world's prominent heavy snow zone.

Except for Hokkaido, there is a rainy season of high temperature high humidity called tsuyu from June to July. Also, damages from storms and floods occur from August to October due to being located in the path of typhoons. However, these rainfalls help to make the water resources in Japan rich together with the snowfalls in the winter.

The average annual precipitation is about 1,700 mm though there is a difference depending on the region.

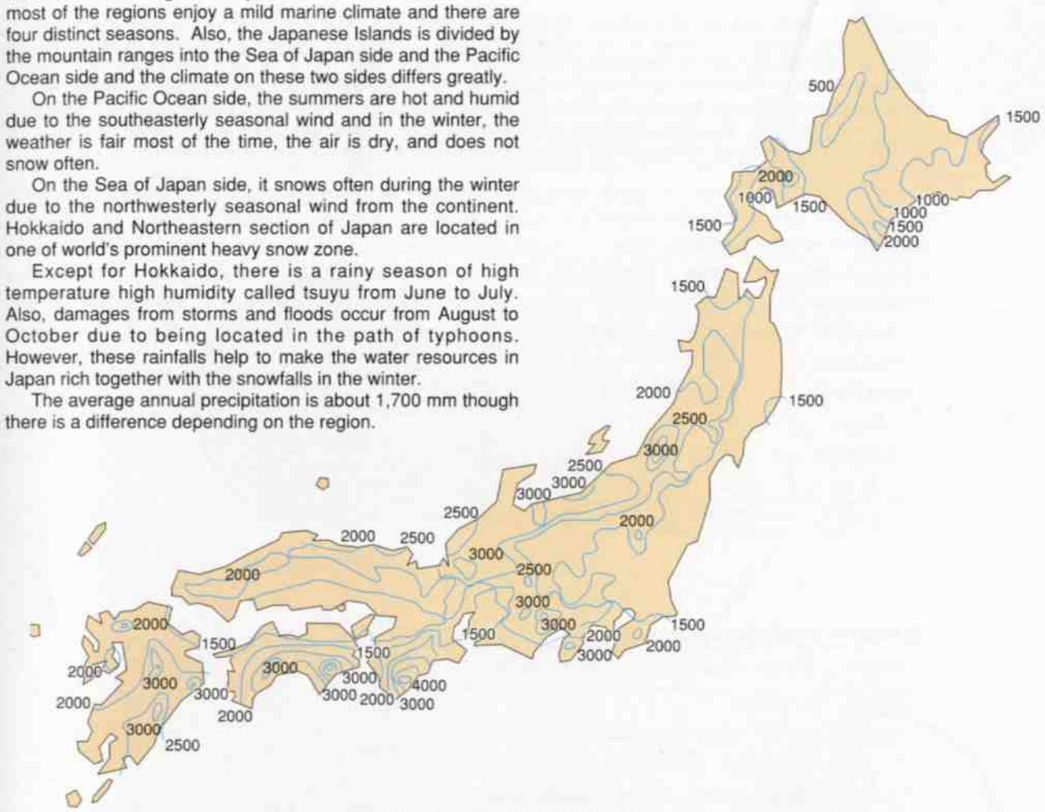


Figure 4 Average annual precipitation

Figure 5 Arrangement of atmospheric pressure

2) Social conditions

Japan is a long and narrow Island country that spans from the north to south, steep mountain ranges extend longitudinally through the center of the archipelago, about 70% of the country is occupied by mountainous regions, and the population is concentrated in the remaining flatlands. There are large urban communities such as Tokyo, Nagoya, Osaka, etc. on the Pacific Ocean side where the weather is mild and transportation · industry have developed, this zone from the South Kanto region on Honshu to North Kyushu is referred to as the "Pacific Ocean belt," and more than 70% of the population is concentrated in this area. As a consequence, there is a big difference in the social foundation and life style between the large urban communities and the provinces.

Table of national land use (1992)

Type of land use	Area (1,000km²)	Percentage (%)
Agriculture	52.6	13.9
Forested	252.1	66.7
Wilderness	2.6	0.7
Water Surface	13.2	3.5
Roads	11.7	3.1
Residential	16.5	4.4
Others	29.1	7.7
Total	377.8	100.0

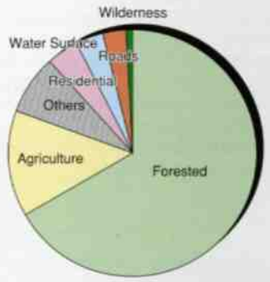


Figure 6 Land use

National population by region (2000)

Region	Names of the urban and rural prefectures	Area (km²)	Population (1,000 people)	Density of population (people)
Hokkaido	Hokkaido	83,453	5,683	68
Tohoku	Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima	66,886	9,817	147
Kanto	Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi	36,888	4,1321	1,120
Hokuriku	Niigata, Toyama, Ishikawa, Fukui, Nagano	38,787	7,821	202
Centra	Shizuoka, Aichi, Gifu, Mie	29,301	14,775	504
Kinki	Shiga, Kyoto, Nara, Osaka, Wakayama, Hyogo	27,332	20,855	763
Chugoku	Tottori, Shimane, Okayama, Hiroshima, Yamaguchi	31,913	7.732	242
Shikoku	Kochi, Tokushima, Kagawa, Ehime	18,801	4,154	221
Kyushu	Fukuoka, Saga, Oita, Nagasaki, Kumamoto, Miyazaki, Kagoshima	42,156	13,445	319
Okinawa	Okinawa	2,271	1,318	580
Total		377,788	126,921	336

*Area: "2001 National geographical survey on the area by prefecture and by city, ward, town, and village" and estimated area by the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts & Telecommunications
*Population: 2000 population census

In the last few years, the gross national product of Japan has been repeating a cycle of increasing slightly then decreasing slightly. According to the 2000 National Census Secondary Base Aggregate, the gross national product was about 513 trillion yen, which was minus 0.26 points in comparison to the previous year. According to the items of the respective industrial categories, the primary industries are responsible for about1.3% of the gross national product, the secondary industries about 28.4%, and the tertiary industries 70.2%. Compared with the numerical values in the 1995 National Census, the ratio for the primary industries decreased greatly, the secondary industries decresed less than 30%, and the ratio of tertiary industries increased even more. Even looking at the employment figures for 15 years and older, it is only 5.06% for the primary industries in comparison with more than 30% in 1960. The secondary industries kept the thirty-percentile mark at 30.7% and the tertiary industries, which were in the fifty- percentile mark till the 1990 National Census, grew to 63.65%. This shows a shift to an industrial structure that is different from a period when the economy was showing a continuous growth.

Number of laborers by industry (2000 population census)

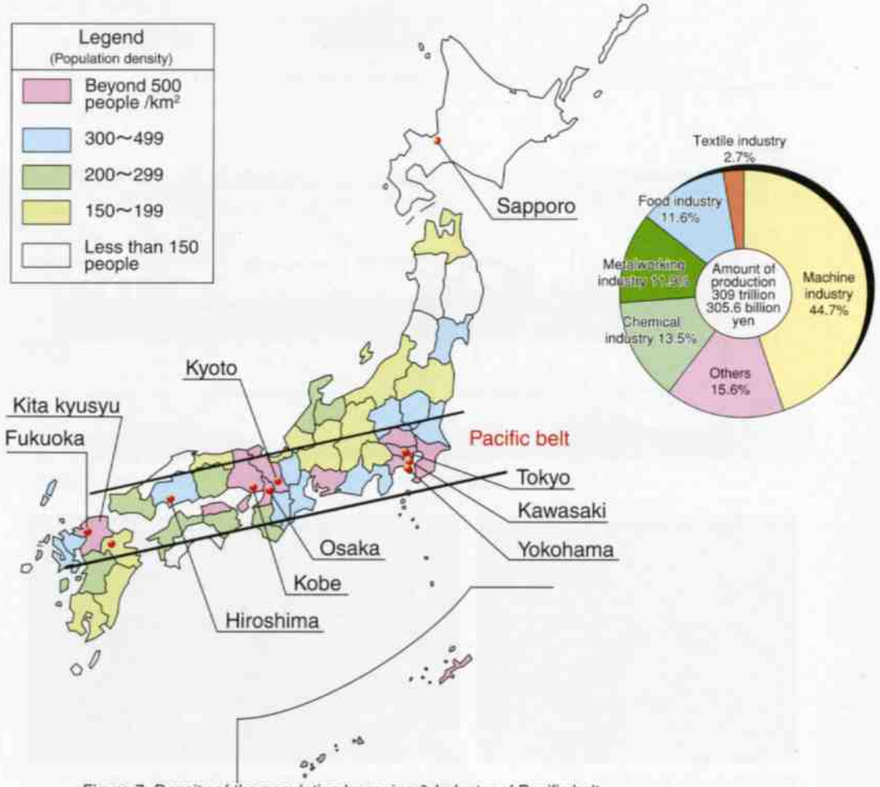


Figure 7 Density of the population by region & Industry of Pacific belt

2. Rivers in Japan

1) Brief summary of the rivers

Characteristics of the rivers

There are more than 35,000 rivers in Japan. Most run through narrow and steep terrains so the length of the rivers is short and the basins are small. Whereas there are many rivers of 5,000 km or greater in the world with 6,695 km for the Nile River, the longest river in Japan is the Shinano River at 367 km. As the basin area, the largest basin area in Japan of 16,840 km^2 for the Tone River is about 1/400 of the Amazon River (7,050,000 km^2).

The characteristics of the rivers in Japan are the steepness and the rapid flow. If it is a heavy rain, the rainwater flows down all at once, and discharges into the ocean rapidly. And the water carries a large volume of sand and dirt. As a consequence, beautiful valleys, deltas, alluvial fan, and river terraces are formed. On the other hand, the peak discharge is great during the rainy season and typhoons due to the large volume of rainfall. Therefore, the rivers in Japan are prone to flooding and are characterized by the fact that the difference in the water discharge is great between normal times and flooding.

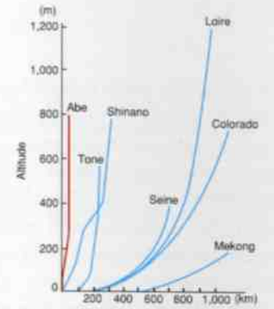


Figure 8 Comparison on the slope of the riverbeds with the other rivers of the world

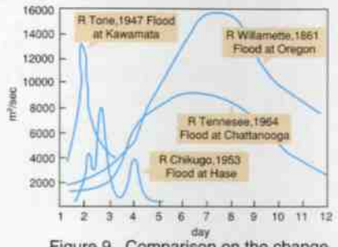


Figure 9 Comparison on the change in the maximum water discharge during a flooding

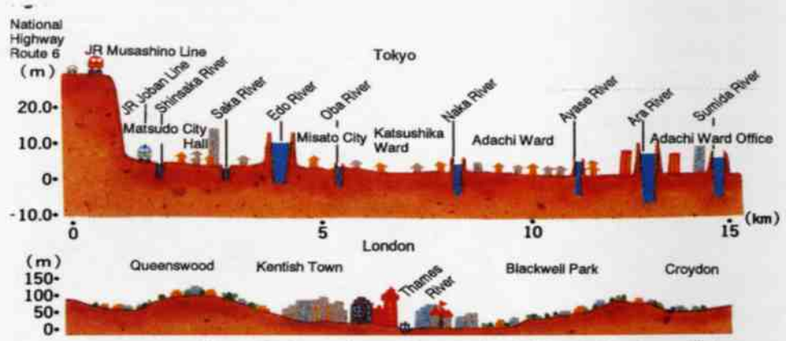


Figure 10 Comparison on the water level of rivers in London and Tokyo

Photograph- Yodo River (Osaka urban prefecture)

Photograph- Tsurumi River (Kanagawa prefecture)

Relationship between communities and rivers

Rivers have played a major role in the development of the life style and culture of man. This is the same even in Japan and the rivers are utilized widely for generating electricity, industrial use, and daily living in addition to agriculture.

On the other hand, there are many mountainous regions in Japan and the areas inhabited by its people are concentrated in the lowlands. Though the land that is lower then the water level of the rivers during floods is only about 10% of the national territory, 50% of the population and 70% of the properties are concentrated in these areas. Consequently, Japan is faced with a situation of being exposed to great damages when the rivers overflow.

Although the average annual precipitation in Japan is about double that of the world average, this is only about 1/5 of the world average when it is computed per capita. Therefore, Japan cannot be said to be rich in water resources and it is always exposed to danger over water shortage in the urbanized areas.

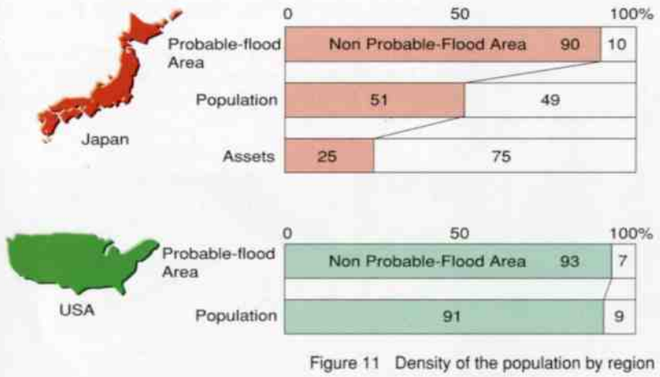


Figure 11 Density of the population by region

The city population of more than 1 million people

City	Population(1000)
Tokyo(ward area)	8,134
Yokohama	3,426
Osaka	2,598
Nagoya	2,171
Sapporo	1,822
Kobe	1,493
Kyoto	1,467
Fukuoka	1,341
Kawasaki	1,249
Hiroshima	1,126
Kitakyushu	1,011

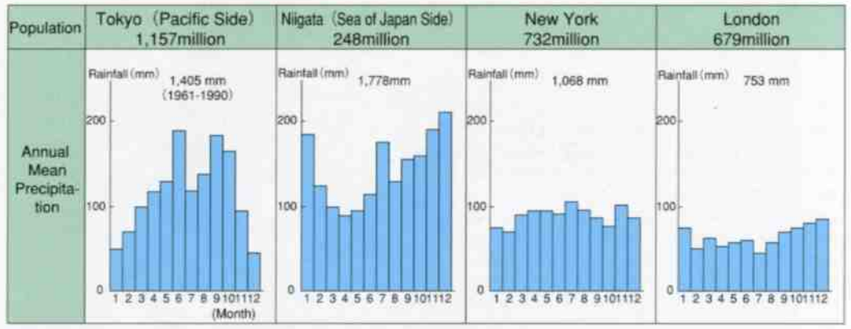


Figure 12 Average monthly precipitation in the major cities of the world

2) Flood control in Japan

History of flood control

It is said that in Japan, flood control had already started in the Stone Age. According to the records, the oldest flood control work wast done in about 320 A.D. at the lower reach of the Yodo River by Japanese emperor Nintoku. As the time progressed, various means were taken for flood control and for water use such as building levees to protect the villages from floods, creating ponds to better utilize the water, etc.

(Shingen levee, eastward diversion channel of the Tone River, Kiso River)

During the age of civil wars in the 16th century when Japan was divided into many dominions, works to control flood were carried out by the feudal lords of the respective dominion from a need to clear new farmlands to increase their economical strength and military power. For example, Hideyoshi Toyotomi, a feudal lord, separated the frequently flooded Uji River and the Ogura pond, constructed levees along the Yodo River, and made channel on the Kiso River.

Another feudal lord, Shingen Takeda took on major flood control works such as dividing the strong currents of the Midai River into two, weakening the flow of the Kamanashi River by striking against a cliff called "takaiwa (high rock)," and controlling the water with "piled stones." These are the Shingen levees that used the embankment methods referred to as "ganko levee" and "open levee".

Figure 13 Illustration of the Shingen levee (16th century)

In the 17th century, major flood control projects were started in various regions. The large scale river improvement project such as diverting the flow of the Tone River towards the east (the present Ara River), restoring the damages from the flooding of Kiso River, etc. are representative. In the 17th century, the flood control projects were concentrated on flood control measures that allowed flooding to occur. In addition, constructions for shipping service and water service were undertaken. In the 18th century, development of new rice fields progressed and in order to prevent flooding, work to strengthen and connect the levees was undertaken to stabilize the channels.

Figure 14 Tone River 1000 years ago and now

(Flood control in the Meiji Era and thereafter)

In the 19th century, excavation work was done mainly to improve navigation. At this time, a Dutch engineer Johannes D. Recke took on the work of river improvement, port planning, and Sabo project that incorporated the modern technologies of the West and he is considered as "a benefactor of flood control in Japan."

Thereafter, the River Law was drafted 1896 and the flood control projects were under taken based on a nationally consistent system.

Figure 15 Improvement on the Kiso River in the Meiji era

Figure 16 Plan view of river improvement on the Yodo River

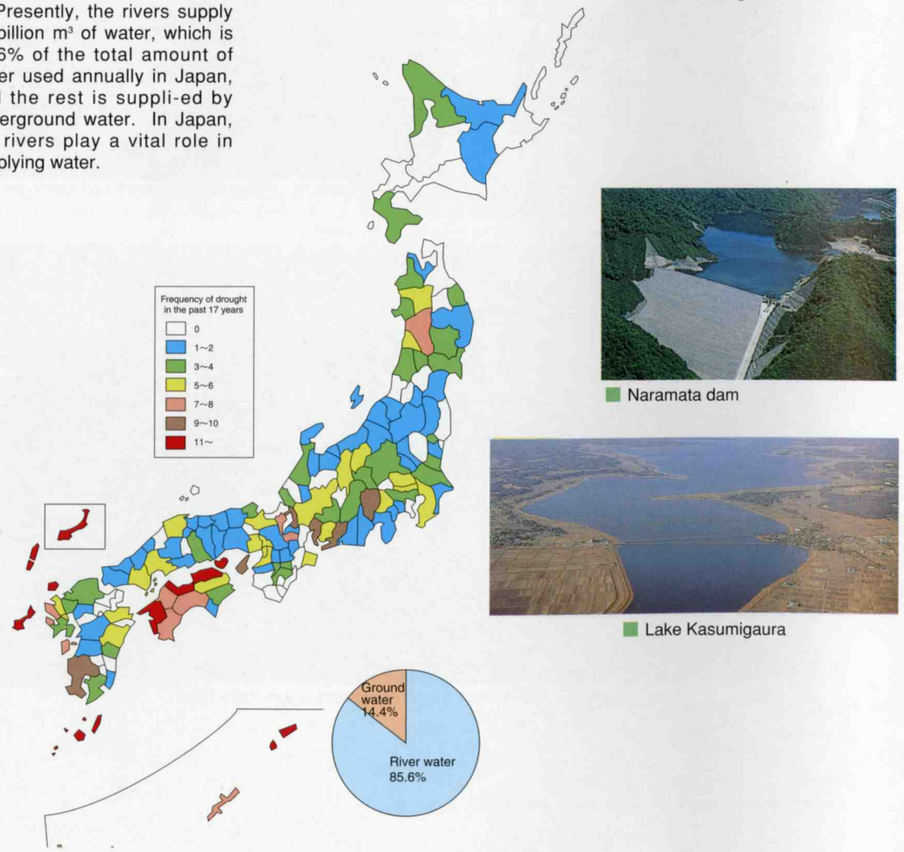
3) Water use in Japan

The rivers in Japan have a tendency to flood due to the rainfall flow out to the sea swiftly. Therefore, flood control was started from early times. At the same time, enabling stabilized farming and supplying water for everyday living were also considered as important problems. The history of water use in Japan coincides greatly with the history of farming, namely, growing rice. Therefore, a technology for submerging the rice paddies and dehydrating in relation to the season and a technology for a storage facility called "irrigation pond" in areas with small amount of rainfall were developed.

In the 20th century, water use was also given importance in Japan due to the urbanization and industrial development. Consequently, dams were created to supply water service throughout the year in event of a drought, etc. In this background, the River Law was revised in 1964 and a systematic system for flood control and water use was incorporated. The water use project became a main element in the river project along with the flood control project.

Water supply tank necessitated by water shortage

Presently, the rivers supply 78 billion m³ of water, which is 85.6% of the total amount of water used annually in Japan, and the rest is suppli-ed by underground water. In Japan, the rivers play a vital role in supplying water.



Naramata dam

Lake Kasumigaura

Figure 17 Ratio of drought and water supply in the past 17 years

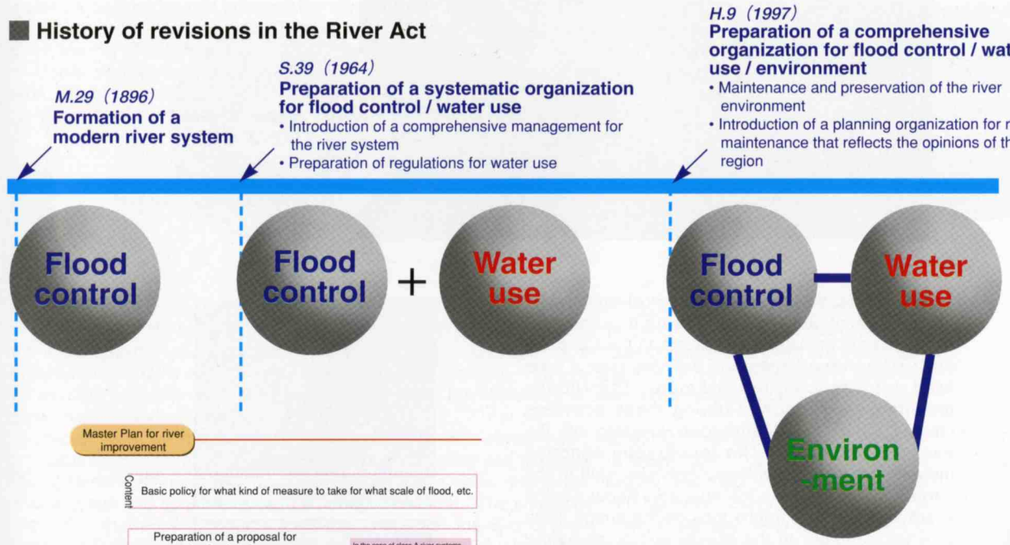
4) Laws related to rivers

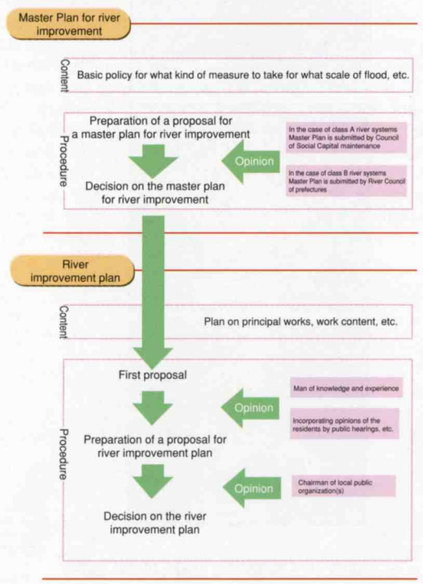
Until the initial River Law was drafted in 1896, there were no proper laws related to the rivers. This initial River Law initiated nationwide flood control projects that continue to the present time, but the purpose was for flood control measures and was not sufficient for water use.

After the war (1945), a basic re-evaluation of the systems and laws in Japan was made and even the River Law was revised in 1964. A systematic system for flood control and water use was prepared by this revision and changed from the conventional sectional river management to a comprehensive river management. The supervising authorities were clarified so that class A rivers are supervised by the nation, the class B rivers by the prefectures, and the quasi rivers by the municipalities and regulations were made in relation to disaster prevention with use of the dams.

In 1997, The River Law was revised again and the system was organized to newly incorporate "maintenance and preservation of the river environment" as an objective in relation to rivers in addition to flood control and water use, to give consideration to treatment of rivers not only unusual times such as floods and droughts but even usual times, and to reflect the opinions of the residents.

History of revisions in the River Act





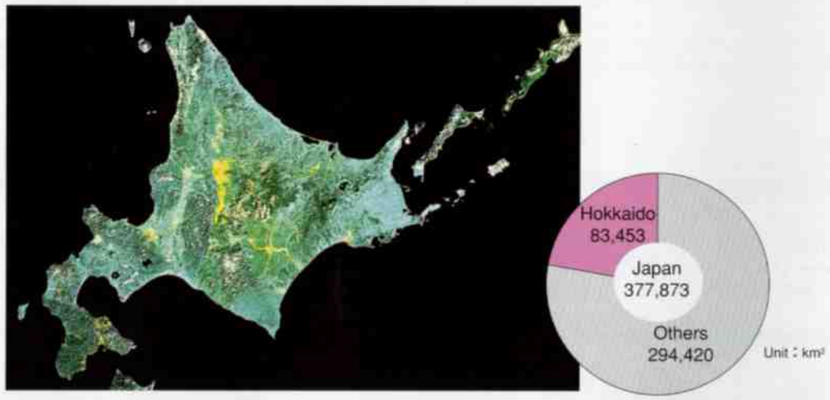
VOL.2. Brief summary of Hokkaido

1. Natural • social conditions

1) Geographical features

Geography

Hokkaido is composed from the main island of Hokkaido and more than 500 small islands. The total area is 83,453 km² and is about the same size as Austria. (To get an idea of this northern territory), this total area is the largest among the prefectures and occupies about 22% of the area of Japan.



What created the topography of Hokkaido are the orogenesis of the Hidaka mountain range that occurred from the late Mesozoic era to the Cenozoic era. These were large-scale activities over a wide area not restricted to Hokkaido. The Hidaka mountain range formed during these activities created a backbone that divides Hokkaido into the east and the west. The topography changed thereafter due to the volcanic activities, shift in the earth crust, end of the ice age, etc. About 10,000 years ago, the topography took on the shape close to what is today. In the alluvial epoch thereafter, sedimentation of sand and dirt occurred from decrease in the volcanic activities and corrosion by rain so the current topography of Hokkaido was formed.

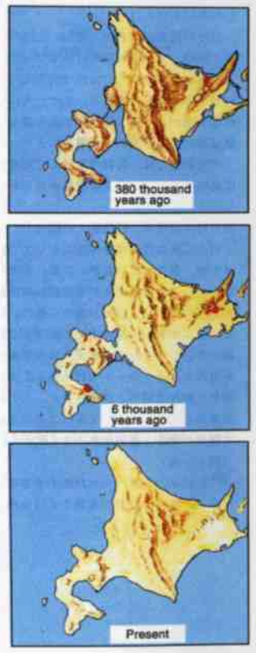


Figure 18 Lapse time model of Hokkaido

Topography


Taisetsuzan mountain range


Hidaka mountains range


Ishikari plains

Hokkaido is located at the northern end of the Japanese archipelago that extends from the north to south and has a characteristic shape similar to a manta ray. The ratio of the mountainous regions and the flatlands is about fifty-fifty, the mountainous regions and hilly regions are minimal in comparison with the rest of Japan, and the topography is characterized by flatlands.

Hokkaido is surrounded by three sea, which are the Pacific Ocean, the Sea of Japan, and the sea of Okhotsk. Also, it is located in an area where the ocean currents collide so that it is one of the world's foremost fishing ground.

The Taisetsu mountain range called the "rooftop of Hokkaido" is located at the center and the Hidaka mountain range and the Teshio mountainous region are connected from the north to south.

The Kamikawa basin, Nayoro basin, and Furano basin referred to as the central lowland areas are located between the mountains, and there are the flatlands such as the Ishikari plain, Yufutsu plain Tokachi plain, Kushiro marshland, Teshio plain, etc., which are the alluvial flatlands.

Moors, which are poor subsoil formed by very cold weather, expand in the Ishikari plain, Kushiro marshland, and Sarobetsu wasteland.

Also, crater lakes are scattered in various areas due to the many volcanoes.

Climate

The climate in Hokkaido has a peculiar characteristic that differs from Honshu due to being located at the northern edge of the temperate zone and the southern edge of the subarctic zone. It enjoys four distinct seasons and it is the coldest region in Japan. However, it has a cool climate with low humidity and there are hardly any effects from the rainy season or typhoons as it is on Honshu. The average annual temperature is 6 ~ 10°C and the average annual precipitation is about 800 ~ 1500 but this differs in each region according to the topography, ocean current, and seasonal wind.

The southwestern part on the Pacific Ocean side is relatively warm and though the rain falls quite frequently in the summer, there are many fair days during the winter and the does not snow often. The eastern part on the Pacific Ocean side rises in temperature in the inland areas during the summer, but there are often fogs at the coastal areas and continuous days of low temperature. The snow does not fall often during the winter but it is very cold. However, there are many fair days. On the Sea of Japan side, there are many fair days in the summer and the temperature is high but it snows a lot in the winter due to the seasonal wind from the continent.

The inland areas are very cold in the winter with the temperature reaching below 30°C on some days but the temperature in the summer reaches more than 30°C at times hence there is a temperature difference close to 60°C. On the Sea of Okhotsk side, the amount of precipitation is minimal throughout the year and prides in having one of the highest percentage of sunshine in Japan. Though it does not snow often, it is surrounded by glacier from February to March.

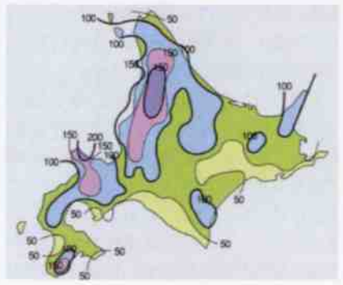


Figure 19 Distribution of the average maximum snow coverage

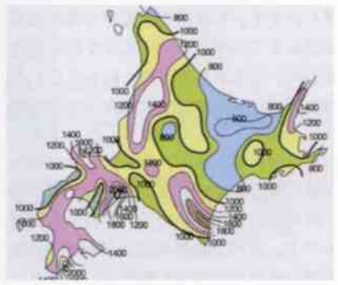


Figure 20 Distribution of the annual precipitation in a year

2) History of Hokkaido

Reclamation of Hokkaido

Hokkaido developed an original history and culture separate from Honshu due to its geographical location and weather conditions. However, records of its history can be surmised only from the ruins and folktales. Before the 19th century (Meiji era), Hokkaido had been known as "Ezo" and was inhabited mainly by the "Ainus" who were hunting people. It was in the 19th century (the latter part of the Edo era) that Hokkaido started to appear in the historical data and it was in the middle of the 19th century that the course of its modern history was included as a region.

Japan became a modern nation from the middle of the 19th century, a measure to enrich and strengthen the country was rapidly promoted modeling on the Western nations, and reclamation of Hokkaido was considered as one of the main objectives in this measure. In 1869, an envoy was dispatched to Sapporo to supervise the reclamation.

Progress in the reclamation

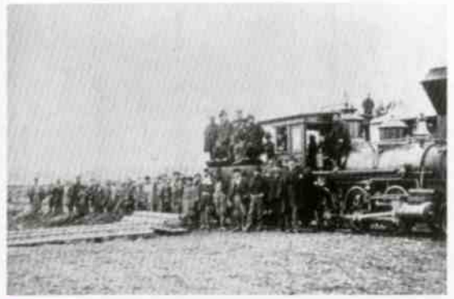
After establishing Bureau of colonization in Hokkaido, the reclamation was promoted in steps by introducing foreign engineers, introducing the Tondenhei system (a system wherein soldiers work as farmers and fight as soldiers in times of emergencies), etc. When the Hokkaido Agency was established in Meiji 19 (1886), reclamation of Hokkaido was at last promoted under a continuous organization. Development of the social foundation such as railroads, highways, etc. progressed rapidly and the population grew quickly as people moved to Hokkaido from Honshu to work on the reclamation (due to the selective settlement project). Furthermore, with Settlement Plan, reclamation spread over the entire territory of Hokkaido in the 20th century.

Ezo in the first map of Japan "Illustration of Shohookuni (1644)"

Bureau of colonization

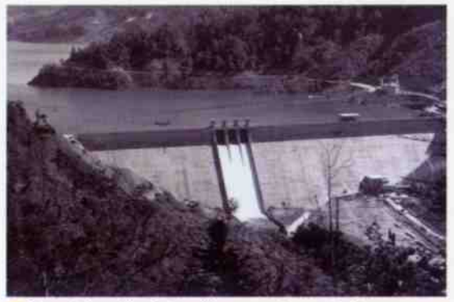
Survey of the settled parcel of land

Reclaimed land in the mid Meiji Era (Furano)



Foreign engineer Crawford, et al. and Benkeigo

An excavator that excavates new water channels



Completion of the first multi-purpose dam under the jurisdiction of Hokkaido / Katsurazawa Dam (1957)

Common use of the Tomakomai harbor as an industrial harbor (1963)

The reclamation spread even to the inland areas and the population also grew steadily. In 1922, Sapporo, Hakodate, Otaru, Asahikawa, Muroran, and Kushiro became the initial cities in Hokkaido and became self-governing organization capable of exerting the same self-governing rights as in Honshu. These cities are the principal cities economically in the present Hokkaido.

Establishment of a Comprehensive Hokkaido Development Plan and Hokkaido Development Bureau

By the beginning to the 20th century, there were results from the reclamation project but the social foundation could not catch up with the level on Honshu.

After the war, a basic reform was made in the constitution of Japan and in the various systems • organizations to comply with the new constitution. In this background, Hokkaido Development Agency and Hokkaido Development Bureau were established and the reclamation and the development of the social foundation in Hokkaido were promoted under a new organization. Also, a comprehensive development plan for Hokkaido was established and work is currently being carried out based on this plan in all fields such as roads, rivers, ports, airports, farming, etc.

3) Social conditions

Population

The population of Hokkaido is about 5.68 million, there are about 2.3 million families (2000 population census), the population is about 4.5% of the Japan's total population, and is about the same as Denmark or Switzerland. The population density is about 68 people per 1 km², this is the lowest in Japan, and is 1/5 of the mean in Japan. As the compositional ratio of the population by age, the youth population is decreasing whereas the ratio of the elderly of 65 years or older is upwards of 18% and is increasing rapidly.

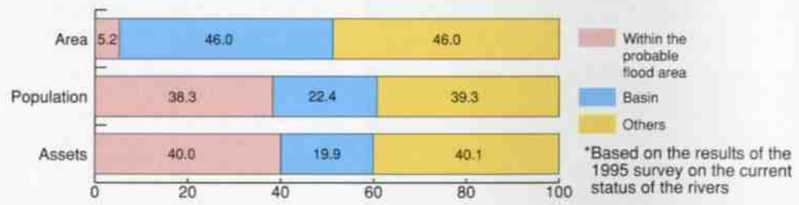
Also, there is a strong tendency for the population to be concentrated in the urban communities and more than half of the population is concentrated at the basins of the class A rivers systems flowing through the urban communities. In looking at the distribution of population in Hokkaido, almost 80% of the total population is concentrated in the urban communities with more than 40% in the Sapporo region in particular. This means that the population is concentrated in the probable flood areas.

Assets

The basin area of the class A river systems in Hokkaido is about 42,765 km² and occupies more than 50 percent of Hokkaido but when restricted to the probable flood area, the area is only 5% of Hokkaido. However, about 40 percent of the population and assets are concentrated in this small area.

The total production in Hokkaido is about 20 trillion yen. This is a scale comparable to one nation but most of the social assets responsible for the production are in a dangerous condition of being exposed to extensive damages when a flood occurs.

Population and assets within the class A river basins and probable flood area



*Based on the results of the 1995 survey on the current status of the rivers

Area and population of each class A river system (based on the results of the 2000 survey on the current status of the rivers)

Name of the river systems	Principal cities and towns	Basin area (km²)	Population within the basin (people)	Amount of assets within the basin (million yen)	Area within the probalbe flood region (km²)	Population within the probable flood region (people)	Amount of assets within the probable flood region (million yen)
Teshio River	Nayoro city, Shibetsu city	5,598.9	99,072	1,492,395	551.2	48,867	697,073
Shokotsu River	Monbetsu city	1,240.6	12,642	177,376	71.9	4,566	71,170
Yubetsu River	Engaru town	1,506.5	35,324	501,375	111.6	25,833	363,086
Tokoro River	Kitami city	1,926.8	140,265	1,863,724	192.8	68,638	925,320
Abashiri River	Abashiri city	1,389.3	53,492	791,904	112.9	21,198	319,257
Rumoi River	Rumoi city	275.7	18,639	247,307	21.3	11,694	170,458
Ishikari River	Sapporo city, Iwamizawa city, Takikawa-shi, Fukagawa city, Asahikawa city, Furano city	14,341.3	2,495,902	31,303,598	2,150.1	1,709,384	23,488,585
Kushiro River	Kushiro city	2,519.6	177,076	2,404,238	240.3	84,990	1,056,731
Tokachi River	Obihiro city	9,020.1	337,816	4,749,124	665.1	164,532	2,310,882
Mu River	Mukawa town	1,252.2	13,230	213,088	55.5	4,522	70,081
Saru River	Monbetsu town	1,339.0	15,439	236,856	61.1	7,229	104,019
Shiribetsu River	Kutchan town	1,635.3	38,806	605,085	83.8	17,921	272,498
Shibetsushibetsu River	Imakane town	719.8	12,520	189,871	59.2	7,152	106,971
Total		42,765.1	3,450,223	44,775,941	4,377.0	2,176,524	29,916,131

Industry

In Hokkaido, various industries are in operation with its vast land area and rich natural environment. As the laborer population ratio, it is 8% (national ratio is 5%) for the primary industries, 23% (30%) for the secondary industries, and 69% (65%) for the tertiary industries. The basic industries are agriculture and fishery. With the national share for agricultural raw products at 10% and the amount of fishes caught at 26%, it is fulfilling its role as a food base for Japan along with having a major influence on the prices of agricultural products.

With regards to the agricultural products in particular, beets is 100% of the national production, kidney beans 89.5%, azuki beans 85.9%, white potato 74.1%, wheat 54.9%, round onions 51.6%, corn 39.6%. Light weight horse produces 93% of the national total mainly in Iburi and Hidaka area and even the amount of milk production is 42.9% of the national total.

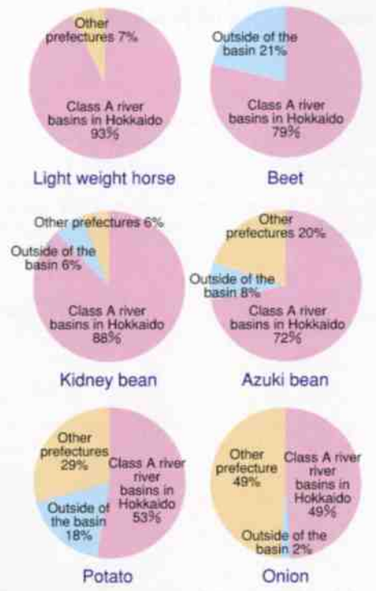


Figure 21 National share of the principal agricultural products

Tourism

Tourism is another major industry in Hokkaido due to its rich and magnificent natural environment as represented by the six national parks. Also, events that make the most of the snow such as the Sapporo Snow Festival are a held at various regions. Furthermore, "green tourism" that focuses on experiencing nature has been becoming popular in the recent years.

Onuma Park and Mt. Komagatake in Onuma National Park

Lake Mashuko in Akan National Park

Canoeing experience on the Shiribetsu River

Sapporo Snow Festival

2. Class A rivers of Hokkaido

Figure 22 Class A river system in Hokkaido

1) Brief summary of rivers

Brief summary

There are more than 400 rivers in Hokkaido and in the modern history of Hokkaido, rivers were mostly used as water transportation into the inlands. Thereafter, the rivers took on a role as a rich water resource that supports the industries and agriculture, etc. 13 rivers including the Ishikari River, which is one of the three major rivers of Japan, Tokachi River, Teshio River, etc. are specified as class A river systems. Just the basin area of these 13 river systems correspond to about 51% of the total area of Hokkaido and occupy about 18% of the total basin area of Japan's class A rivers systems. About 60% of the population in Hokkaido lives in these basins. Therefore, there is a good friendship and important role between the class A river systems and the residents.

Summary of class A rivers in Hokkaido (H7. (1995))

Name of the river systems	Name of river	Area of the basin	Length of the main river channels	Design flood discharge (reference point)						Population within the basin	Maximum population within the probable flood region
				Reference point	Discharge	City	Town	Village	Total		
(Class A rivers)		km²	m	Ishikari	m³/s					People	People
Ishikari River	Ishikari River	14,330	268	ohashi	14,000	16	30	2	48	2,495,902	1,709,384
	Toyohira River	898	73								
	Chitose River	1,244	108								
	Yubari River	1,463	136								
	Ikushunbetsu River	332	59								
	Sorachi River	2,622	195								
	Uryu River	1,713	177								
	Chubetsu River	345	59								
	Biei River	718	68								
Shiribetsu River	Shiribetsu River	1,640	126	Nakoma	3,000		6	3	9	38,806	17,921
Shiribetsutoshibetsu River	Shiribetsutoshibetsu River	720	80	Imagane	1,250		3		3	12,520	7,152
Mukawa River	Mukawa River	1,270	135	Mukawa	3,600		2	1	3	13,230	4,522
Saru River	Saru River	1,350	104	Biratori	3,900		3		3	15,439	7,229
Tokachi River	Tokachi River	9,010	156	Moiwa	13,700	1	14	2	17	337,816	164,532
	Toshibetsu River	2,855	150								
	Satsunai River	725	82								
	Otofuke River	740	94								
Kushiro River	Kushiro River	2,510	154	Shibecha	1,200	1	4	1	6	177,076	84,990
Abashiri River	Abashiri River	1,380	115	Bihoro	1,200	1	3		4	53,492	21,198
Tokoro River	Tokoro River	1,930	120	Kitami	1,600	1	5		6	140,265	68,636
Yubetsu River	Yubetsu River	1,480	87	Kaisei	1,800		5	1	6	35,324	25,833
Shokotsu River	Shokotsu River	1,240	84	Kamishokotsu	1,300	1	1		2	12,642	4,566
Teshio River	Teshio River	5,590	256	Ponpira	5,700	2	10	1	13	99,072	48,867
	Nayoro River	743	64								
Rumoi River (specified river)	Rumoi River	270	44	Ohwada	800	1			1	18,639	11,694
Shibetsu River	Shibetsu River	691	78	Estuary	910		2		2	25,640	11,694
Koitoi River	Koitoi River	300	42	Koitoibashi	270	1			1	2,251	14,155

Top 10 river lengths/basins in Japan

VOL. 3. Brief summary of the Ishikari River

1. Geographical · social conditions

Figure 23 Map of the Ishikari River Basin

1) Brief summary of the river

Brief summary

The Ishikari River originates in Mt. Ishikari (1,967m above sea level) in the Taisetsu mountain range, passes through Kamuikotan as it joins with Chubetsu River, Biei River, etc. in Asahikawa City, the second largest city in Hokkaido, and flows out to the Sea of Japan with confluence of Uryu River, Sorachi River, Ikushunbetsu River, Yubari River, Chitose River, and Toyohira River and passing through Sapporo City, the largest city in Hokkido. True to the name of "a very meandering river," there are still many traces of the meandering rivers at the middle and lower reaches of the Ishikari Plains.

Condition of the basins

The length of the Ishikari River is 268 km, which is the third longest river in Japan and before the short-cut works during the river improvement, it was the second longest following the Shinano River. Also, the basin area is the second largest in Japan following the Tone River at 14,330 km^2 and the size corresponds to 1/6 of the total area of Hokkaido.

Today, after 130 years since the reclamation, there are 48 cities, towns, and villages in the Ishikari River basin as the economical, industrial, and culture center of Hokkaido including Sapporo City, Asahikawa City, etc. and about 3 million people, which is more than half of the population of Hokkaido, live in this basin.

A project to straighten the meandering river was promoted by the full-scale flood control project that started in 1910 and varied use of the land is being achieved in the Ishikari lowlands.

River bed slope

Ishikari River is a river with gentle slopes when compared with the other principal rivers in Japan and is comparable to the Kitakami River. Even most of the tributaries have gentle slopes like the Ishikari River excepting for the Toyohira River. In particular, Chitose River, Uryu River, etc. have even gentler slopes than the Ishikari River.

After flowing from the source of the river and passing through Kamuikotan, which is the narrow section at the middle reach of the river, it flows through the gently-sloping Ishikari plains and out to the Sea of Japan. However, the river meanders repeatedly hence the flow changed with bank erosion in case of flood. Therefore, the transformation in the river course was extensive.

While showing a gentle flow, the amount of water discharge is great and the annual water discharge is about 1.6 billion m^3 hence it is referred to as a "mother river" due to its abundance of water.

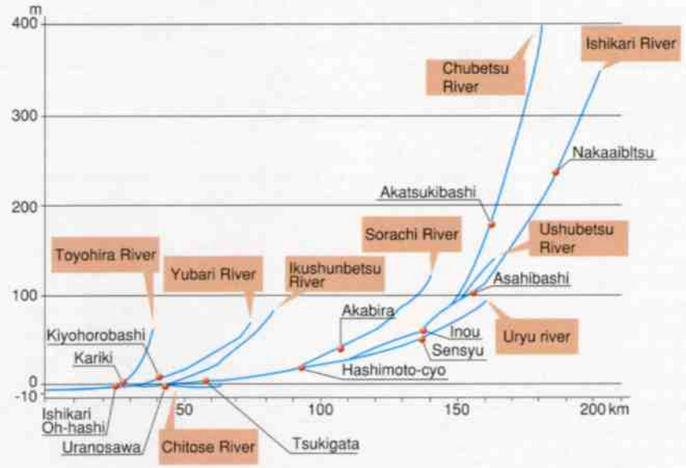


Figure 24 Slope of the riverbeds in the Ishikari River System

2. Flood control

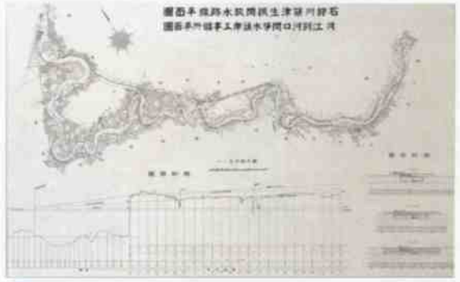
1) History of flood control projects

Flood control plan according to Bunkichi Okazaki

Engineer Bunkichi Okazaki is as the "forefather of the Ishikari River improvement." Bunkichi Okazaki studied the latest Western science and technology, at that time, and became an engineer for the Hokkaido Agency. After experiencing the big flood in 1898 that killed 112 people, he appealed on the importance of a study on flood control and became involved with research on water flow. "Okazaki style concrete mattress block" still remains in Ishikari River. This is one of the bank protection methods for recessed riverbanks. This attracted worldwide interest and is regarded as one of the world's three major bank protection method along with Frances's decauville style and U.S.'s Misoli style.

Also, "Ishikari River Flood Control Plan" was prepared as a master plan to control flooding of the Ishikari River. The design discharge for Ishikari River was set at 8,350 m^3/s (at the Tsuishikari point) and this stood until the 1965 master plan was drawn up. In his latter years, he was also involved with flood control of China's Liao River. He died in 1945.

Engineer Doctor Bunkichi Okazaki



Proposal for flood control and drainage of the Ishikari River by Bunkichi Okazaki

Assembling of the "Okazaki style concrete mattress block" (Ishikari River)

Flooded state

Date of flood	Amount of rainfall at representative point(s)(mm / 3 days)	Inundated area (km^2)	Deaths (people)	Homes destroyed (homes)	Damage (100 million yen)	Article
September 1898	Sapporo 158 / Asahikawa 163	1,500	112	18600	271	Creates an opportunity to start an examination on a flood control plan
July 1904	Sapporo 177 / Asahikawa 152	1,300	Unknown	16000	65	A study on the amount of inundation was conducted by Professor Bunkichi Okazaki.
August 1922	Sapporo 66 / Asahikawa 105	Unknown	7	9200	190	
August ~ September1932	Sapporo 78 / Asahikawa 103	1,400	9	18100	422	
July 1961	Sapporo 140 / Asahikawa 125 /Yubari 216	523	11	23300	391	
August 1962	Sapporo 203 / Asahikawa 125 / Furano 170	661	7	41200	554	Record flood in past
August 1975	Sapporo 175 / Asahikawa 193 / Yubari 164	292	9	20600	601	Amount of rainfall and water discharge are about the same scale as in the original plan established in 1965
August 1981	Sapporo 294 /Asahikawa 296 / Iwamizawa 406	614	2	22500	1,152	Huge flood of a scale measured as the highest amount of rainfall and water discharge in history
August 1981	Sapporo 229 Iwamizawa 124	57	1	12200	153	Heavy rain concentrated at the basins of the Toyohira River and Chitose River
August 1988	Sapporo 66 / Iwamizawa 159 / Ishikari Numata 425	65	-	2000	262	Heavy rain concentrated at the basin of the Uryu River
September 2001	Sapporo 153 /Asahikawa 169 / Iwamizawa 151	25	-	63		

Chronological table of flood control for the Ishikari River

Year	Flood control project
1868	Bureau of colonization was established, settlement at the shores of Ishikari River
1898	Professor Bunkichi Okazaki starts conducting a study on a flood control plan for the Ishikari River
1908	"Ishikari River Flood Control Plan" is submitted to the director-general of Hokkaido Agency
1909	Hokkaido First Settlement Plan (1910 ~ 1925) is established. In accordance with this plan, work on bank protection using concrete mattress block was executed at the recessed shores as one part of the flood control project.
1918-24	Cut-off channels such as Oyafuru, Tobetsu, Tsuishikari, etc. and work on the new floodway on Yubari river are started. Embankment on the left bank of Kuriyama is started. Work on the embankment for Takikawa city is started.
1931	The Oyafuru new floodway is completed.
1936	The new floodway of the Yubari River is completed.
1951	Hokkaido Development Bureau is established. Work on the Katsurazawa Dam is started (the first multipurpose dam in Hokkaido). Hokkaido first Comprehensive Development Plan (1952 ~ 1962) is established.
1954	The new floodway of the Toyohira River is completed.
1957	Katsurazawa Dam is completed.
1964	The River Law is revised.
1965	Ishikari River is specified as class A river.
1967	Work on the Hoheikyo Dam is started.
1968	Work on the Taisetsu Dam is started. Third Flood Control Project within five years Plan (1968 ~ 1972) is established.
1969	Cut-off channel of Sunagawa is completed.
1972	Hoheikyo Dam is completed. Work on the Ishikari new floodway is started.
1978	Barato River purification projected is started. Work on the Jozankei Dam is started.
1979	Project for comprehensive flood control measure on specified rivers (Fushiko River) is started.
1980	Work on the Izarigawa Dam is started.
1982	Sabo Project is started at the upper reach of the Toyohira River. Ishikari new floodway is completed.
1983	Work on the Takisato Dam is started.
1986	Work on reconstructing the Kiyohoro groundsill for the Yubari River is started.
1987	Work on Sunagawa retarding basin is started.
1989	Jozankei Dam is completed.
1990	Ikushunbetsu Dam is completed.
1992	Kiyohoro groundsill is completed.
1995	Work on the Yubari Shuparo Dam is started. Sunagawa retarding basin is completed.
1997	The River Law is revised. Ninth Flood Control Project within five years Plan (1997 ~ 2001) is established.
1999	Takisato Dam is completed.
2000	The new floodway of the Ohou River is completed.
2002	Cut-off channel of the Uryu River is completed.

Transition in the flood damage and flood control project

As the name of Ishikari means "a very meandering river," there are many meandering courses. Therefore, when there was a heavy rain, flooding occurred in various areas and caused great damages in the basins.

The flood that occurred in 1898 caused unheard of damages devouring homes, just cleared fields, and valuable lives. From this experience, the Ishikari River Improvement Office was established and a full-scale flood control project was started.

Almost 100 years have passed since the full-scale flood control project was started and today 3 million people live in the Ishikari River basin. However, huge floods that caused major damages occurred in 1975 and 1981. The flood of August 1981 inundated an area 614 km², immersed 22,648 homes, and caused damages totaling 100 billion yen.

[Flood of August 2 ~ 6, 1962]

- Amount of rainfall 235 mm (Sapporo City)
  215 mm (Iwamizawa City)
- Devastation 7 people dead or missing
  Building 41,200 houses Area 661 km²

Chitose River, a tributary of the Ishikari River (Eniwa City)

Sunagawa City on the left bank of the Ishikari River

[Flood of August 22 ~ 24, 1975]

- Total amount of rainfall 175 mm (Sapporo City)
- Devastation 9 people dead or missing
  Building 20,600 houses Area 292 km²
  Amount in money 60.1 billion yen

Akabira City, Moshiri on Sorachi River, a tributary of the Ishikari River

Tsukigata City on the right bank of the Ishikari River

[Flood of August 3 ~5, 1981]

- Total amount of rainfall 294 mm (Sapporo City)
- Devastation 2 people dead or missing
  Building 22,500 houses Area 614 km²
  Amount in money 115.2 billion yen

Toyohira River, a tributary of the Ishikari River (Sapporo City)

Confluence of the Horomui River and Yubari River, a tributary of the Ishikari River

[Flood of August 25, 1988]

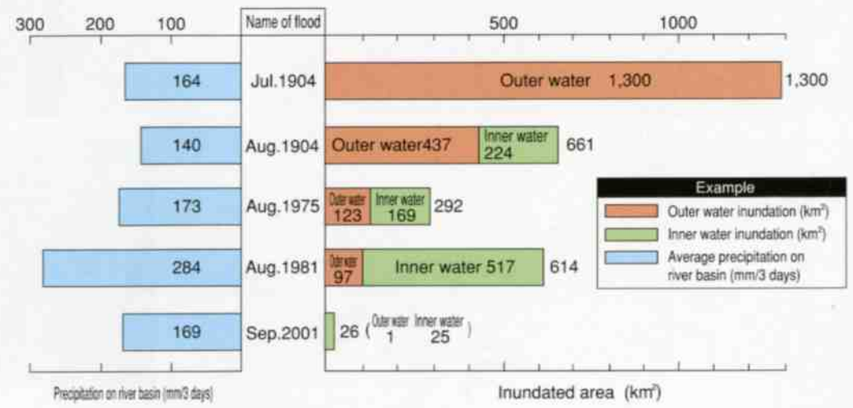
- Total amount of rainfall 243 mm (Uryu River Basin)
- Devastation 3 people dead or missing
  Building 6,037 houses Area 65 km²
  Amount in money 16.5 billion yen

Uryu River

Transition in the flood damages

Before the flood control project was started, flooding of the Ishikari River occurred repeatedly over a wide area due to its vast lowland. The flood control project was started after entering the 20th century and the inundation area gradually decreased even when a large amount of rain fell as work on the levees, cut-off channel, shore protection, drainage pumping stations, dams, etc. progressed. However, though big scale damages decreased due to the flood control project, construction of levees in particular, inland water damages have occurred and the form of damages is changing in recent year.

Transition in the cause of inundation from floods



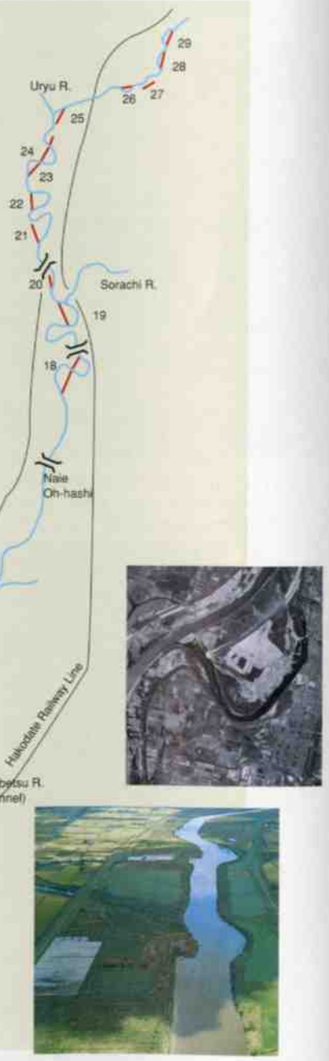
History of cut-off channel project

In the meandering river of the Ishikari River, natural shortcutting is one part of channel evolution. This is a straightening caused by the force of the river itself and shortcuts in the river channel are being created in the Ishikari River at 15 locations. In the flood control project at the start of the 20th century, cut-off channel work was commenced to straightening the meandering course and to discharge the flooding water quickly to the lower reach of the river. 29 shortcut channels have been completed since Oyafuru channel (completed in 1931) started in 1918. The length of the cut-off channels is 42 km and the decreased length is 75.8 km.

Straightening of the principal tributaries was commenced simultaneously with the cut-off channel work. The principal new channel projects, is that on the Yubari River (1922 ~ 1936), Toyohira River (1932 ~ 1941), and Ikushunbetsu River (1941 ~ 1961).

■ Table of cut-off channel work on the Ishikari River

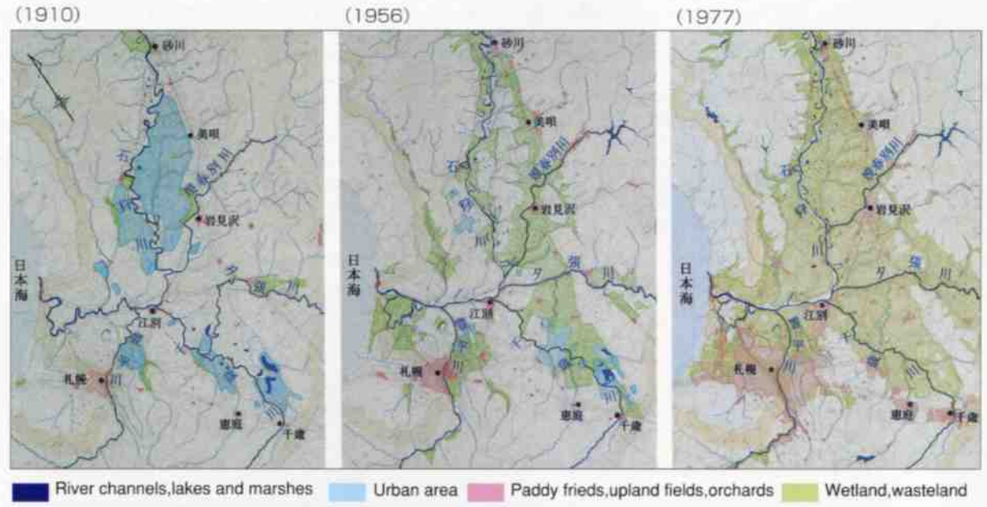
Name	Posi-tion	Length km	Old river length km	Shortened length km	When work was started	When water was passed through
Oyafuru	1	3.7	18.2	14.5	1918.10	1931. 5
Shinoro 2	3	0.9	2.1	1.2	1919. 6	1921. 9
Shinoro 1	4	1.6	3.0	1.4	1922. 4	1923.11
Tsuishikari	5	2.3	5.9	3.6	1923. 4	1933. 8
Tobetsu	2	2.8	4.2	1.4	1924. 7	1933. 5
Toyogaoka	11	1.9	2.8	0.9	1934. 4	1941. 7
Shimotappu	8	1.5	3.0	1.5	1934. 5	1939. 9
Sunahama	7	0.8	1.6	0.8	1934. 6	1938. 9
Tomoenojo	6	1.5	4.9	3.4	1935. 4	1938. 5
Horotappu	9	0.7	1.3	0.6	1937. 4	1942. 5
Anakuri	10	0.7	1.3	0.6	1937. 4	1942. 9
Kawakami	14	0.3	0.5	0.2	1937. 6	1949. 9
Takonokubi	22	0.6	4.0	3.4	1938.10	1939. 5
Kareki	15	2.1	4.6	2.5	1939. 4	1940.10
Satsupinai	17	0.8	2.5	1.7	1939. 4	1956.10
Ikenomae	21	2.5	6.0	3.5	1939. 5	1941. 9
Kamishinshinotsu	12	1.0	1.7	0.7	1940. 4	1943. 9
Kitsunemori	13	1.1	2.5	1.4	1940. 4	1949. 9
Omagari	16	1.2	3.7	2.5	1941. 5	1955.10
Ainuchi	19	1.2	2.5	1.3	1941. 5	1951.11
Kisui-cho	20	1.0	1.5	0.5	1942. 5	1947. 9
Memu	25	1.2	3.2	2.0	1946. 5	1953.10
Inada	26	0.5	1.0	0.5	1951. 8	1951. 9
Hirosato 3	29	2.3	3.3	1.0	1951.12	1953. 7
Nakajima	27	1.0	2.5	1.5	1953. 5	1955. 3
Hirosato 2	28	0.9	1.9	1.0	1954. 7	1955.11
Ebeotsu 2	23	2.9	3.8	0.9	1956.11	1960.11
Rokkojima	24				1960. 5	1961.11
Sunagawa	18	3.0	6.5	3.5	1964. 6	1969.11
		42.0	100.0	58.0		



Effect of the cut-off channel project

The cut-off channel project and the project for constructing new floodway of the Ishikari River effectively lowered the ground water level in addition to having an effect on flood control such as lowering the water level during floods, enhancing the capacity of flow, reducing the flood duration time, etc. The Ishikari plain, which was a marshland, was changed into a vast farmland, agricultural production was increased considerably, and there was a dramatic effect economically.

■ Transition in the land use of the Ishikari River Basin



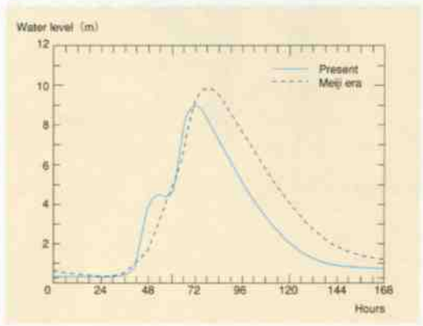


Figure 25 Water level during floods resulting from the cut-off of the Ishikari River

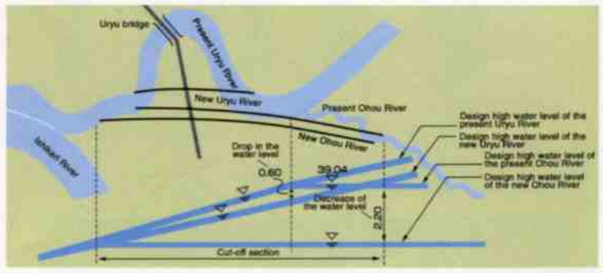


Figure 26 Decrese of the water level with the cut-off channel (cut-off channel of the Uryu River)

2) Plan

■ Necessity for revision in the plan and the transition

The previous plan that was established in 1965 was based on the 1/100 of a representative rainfall observatory with consideration to the scale of the river, importance of the hinterland, etc. and basic high-water discharge was set at 4,450 m^3/s for the Inou reference point at the upper reach of the river (350 m^3/s controled with dam, 4,100 m^3/s channel distribution) and set at 9,300 m^3/s for the Ishikari Oh-hashi reference point at the lower reach of the river (300 m^3/s controled with dam, 9,000 m^3/s channel distribution).

However, flooding of 8,620 m^3/s (inundation return to water discharge) in August of 1975 was about the same scale as the design flood discharge at the Ishikari Oh-hashi point and 12,080 m^3/s (inundation return to water discharge) in August of 1981 exceeded the plan water discharge by more than 3,000 m^3/s at the Ishikari Oh-hashi point and caused great damages.

On the other hand, there are 48 cities, towns, and villages including Sapporo City in the Ishikari River basin, the Ishikari River basin is 20% of the total area of Hokkaido, and more than half of the population is concentrated in this area. In order to protect the assets, the degree of safety was enhanced further, an analysis was made on the rainfall and discharge including all data collected after the plan, and all the flood control measures were reexamined. The safety was determined according to the degree of importance with 1/150 for the mainstream of the Ishikari River excluding the upper reach of the river, 1/150 even for the major tributaries that flow through the large cities such as Sapporo city and Asahikawa city, and 1/100 for other tributaries.

Enhancing the overall flood control became necessary due to change in the safety requirement. For example, the basic High-water discharge at the Ishikari Oh-hashi point (reference point at the lower reach of the river) was changed from 9,300 to 18,000, the design flood discharge was changed from 9,000 to 14,000 m^3/s, and control once in 100 years of 4,000 m^3/s was to be made with flood control facilities such as dams, retarding basins, etc.

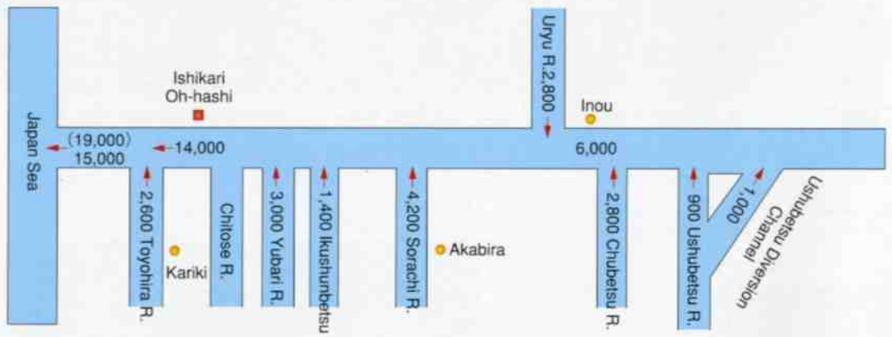


Figure 27 Design flood discharge distribution diagram of the Ishikari River

■ Flood control facilities (dams • retarding basins)

■ Dams in the Ishikari River System

Dam		Katsurazawa	Kanayama	Hoheikyo	Taisetsu	Izarigawa	Jozankei	Takisato	Chubetsu
Name of river		Ikushunbetsu	Sorachi	Toyohira	Ishikari	Izari	Otarunai	Sorachi	Chubetsu
Catchment area (km^2)		298.7	470.0	134.0	291.6	113.3	104.0	1,662.0	238.9
Droughty water area (km^2)		5.0	9.2	1.5	2.9	1.1	2.3	6.8	3.7
Dam	Type	Gravity	Hollow gravity	Arch	Rock-fill	Rock-fill	Gravity	Gravity	Gravity and rock-fill
	Height (m)	63.8	57.3	102.5	86.5	45.5	117.5	50.0	86.0(L) 78.5(R)
	Volume ($\times 10^3 m^3$)	350.0	288.5	285.0	3,874.0	647.0	1,185.0	455.0	980.0 7,740.0
Effective Capacity ($\times 10^3 m^3$)		81,800	130,420	37,100	54,700	14,100	78.600	85,000	79,000
Purpose	Flood control capacity	10,400	51,400	20,200	30,000	11,900	19,000	50,000	20,000
	Irrigated area (ha)	16,300	28,500	-	17,800	-	-	40,700	21,400
	Power generation max ($\times 10^3 m^3$)	15,000	25,000	50,000	20,000	-	7,000	57,000	10,000
	Water supply (m^3/day)	86,300	9,500	528,000	100,000	77,100	375,000	65,100	70,000
	Industrial water supply(m^3/day)	-	-	-	-	-	-	-	-
Completed		1957	1967	1973	1975	1980	1990	2000	under construction

■ Retarding basin of the Ishikari River System

[Sunagawa Retarding basin]

Section	IshikariRiverKP85.00+100~KP86.5+150
Design water level	EL24.28m
Effective capacity	About 10.5 10^3 m^3
Area	About 1.8 km^2
Reservoir area	About 1.6 km^2,

Hoheikyo Dam

Jozankei Dam

Katsurazawa Dam

Izarigawa Dam

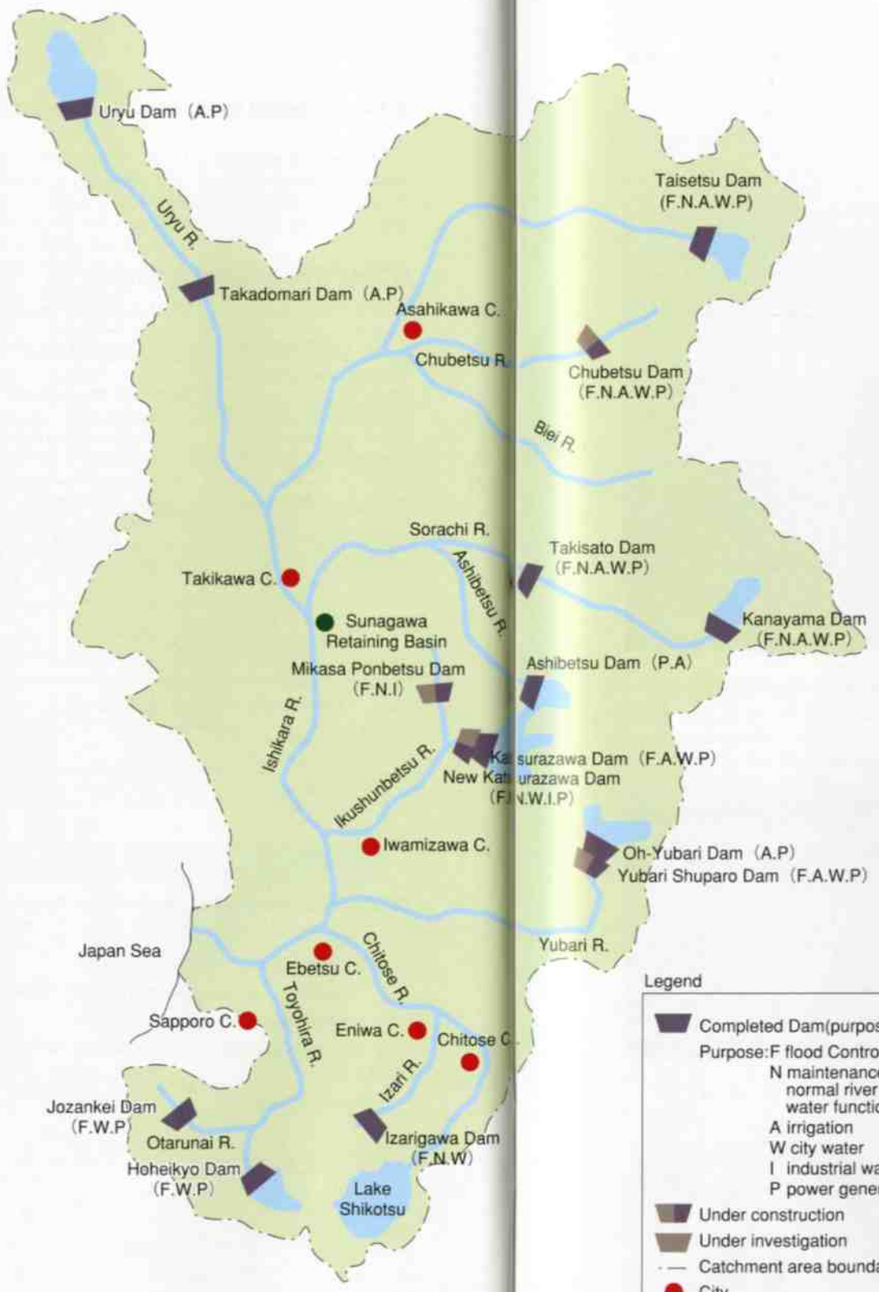
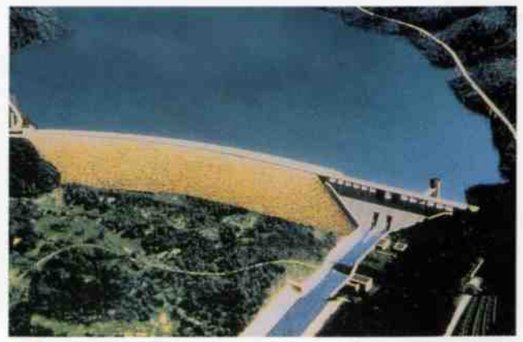


Figure 28 Map of the dam positions on the Ishikari River System

Kanayama Dam

Takisato Dam

Taisetsu Dam



Photographs showing what the Chubetsu Dam is projected to look like when completed

3) Major River Improvement Project

Improvement measures for poor subsoil

[Hill-like bank]

Due to the destructive damages caused by the flood in 1981 to the Ishikari plains over a vast area, efficient and economical completion of the levees became necessary. On the other hand, the flood duration time in this region is long hence there was a concern over leaking and slipping. Also, the peat layer is distributed widely in the lower basins of the Ishikari River and most have a poor subsoil, that is another problem. Therefore, construction of hill-like bank that make the most of the dredged soil was planned in order to over come these problems.

Whereas the standard embankments are 1:2 ~ 3, these embankments were designed to have a slope of 1:5 by giving consideration to safety including during earthquakes, etc. As the engineering method, the preloading method, the sand compaction pile method, the pile net method, and in the recent years, the deep mixing method of soil stabilization for improvement of the foundation are being adopted.

Hill-like bank
Mitoi embankment of the Ishikari River

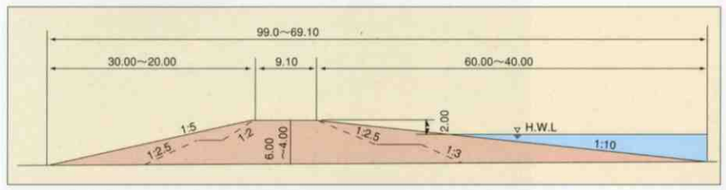


Figure 29 Diagram of a standard for hill-like bank

[Pile net method]

This is a method for preventing the embankment from sinking after driving in the precast piles into the poor subsoil by connecting the pile tops with reinforcing steel and creating a foundation for the embankment. Until recently, this method was the majority for stabilizing the foundation. Also, this engineering method was made from actual experiences of the engineers who were involved in the flood control works on the Ishikari River at that time.

Pile net method

Dredging

The design flood discharge was increased by the 1982 plan revision hence dredging was also planned in combination with constructing the embankments to enhance the ability of the discharge capacity.

Dredging was mainly done at the lower reach of the Ishikari river and the ability to discharge capacity was enhanced by widening the low channels and lowering the riverbeds.

In the dredging, the riverbed is excavated with a cutter and suctioned with a pump using a dredger. After the mud is desicated, it is reused as filling for the hill-like bank, etc. Also, measures such as setting up a sludge holdback fence, etc. are taken while carrying out the work so that the sludge does not influence the lower reach of the river during the dredging.

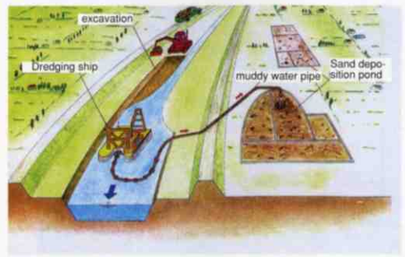


Figure 30 Dredging and excavation of the channel

New channel of the Ikushunbetsu River

An image showing what the new channel will look like when completed

The lower reach of the Ikushunbetesu River and the Kyubibai River has been a flood inundation zone in past due to its characteristics of having a poor subsoil, the ground being lower than the peripheral areas, and having a tendency to be influenced by the backwater of the Ishikari River, which has a long flood duration time when heavy rain falls and there were extensive damages in this basin during the floods of 1975 and 1981. As a countermeasure, the new channel of the Ikushunbetsu River was planned.

1981 flood (Kitamura)

The purpose was to reduce the water level at the confluence of the Ikushun-betsu River and reduce the influence from the back water, which has a long duration time, by diverting the Kyubibai River (tributary of Ishikari River in past) to the Ikushunbetsu River and position-ing the confluence of the Ikushun-betsu River with the Ishikari River 5.4 km downstream.

An image showing the position of the new channel

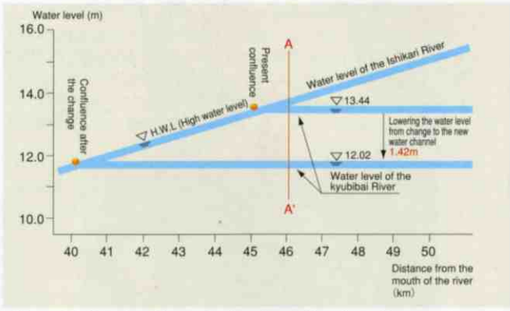


Figure 31 Graph of the water level resulting from the new channel

Work in progress on the new channel

Cut-off channel of the Uryu River

The Uryu River is a meandering river like Ishikari River and has a tendency for dam-up of the water level during flooding and bank erosion. The heavy rain in August of 1988 caused a flooding and great damages were caused particularly at this Uryu River and the Ohou River, a tributary of the Uryu River. Also, the damages at the Ohou River were caused by the influence from the backwater of the Uryu River. Therefore, cut-off channel of the Uryu River and construction of a new channel for the Ohou River were planned in 1991 and completed in 2002.

Flood in 1988

Projected image when the cut-off channel is completed

The purpose was to reduce the influence from the backwater of the Uryu River by excavating a channel at the bend part of the Uryu River. And the confluence of Ohou river changes to downstream for reducing of the influence of backwater.

Work in progress on the cut-off channel

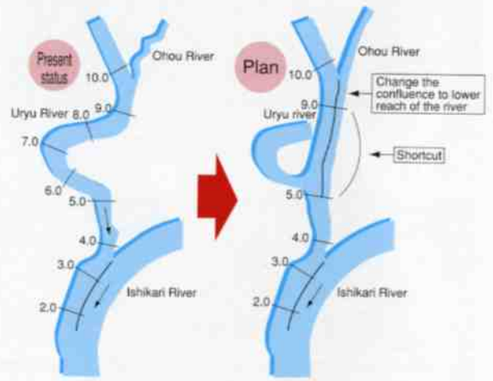


Figure 32 Plan of the cut-off channel

Flood control measure for the Chitose River

The Chitose River is a tributary of the Ishikari River with a length of 108 km and basin area of 1,244 km^2 and it is a basin composed of 4 cities and 2 towns including Chitose City. This basin includes vast farmlands, a residential district as the bed town of the Sapporo area, and an industrial zone centering on the Chitose Airport. It is a basin that is projected to grow in the future.

However, the Chitose River is an area where a flood occurs at a frequency of about once every two years. This is due to the fact that the height of the peripheral ground at the middle reach of the Chitose River is low and is influenced by the backwater of the Ishikari River for a long time due to the slope being gentler than the mainstream of Ishikari River. Even the water level of the Chitose River is high for a long time due to the influence of the Ishikari River and this is the cause for the discharge defect that occurs in the median and small tributaries flowing into the Chitose River.

Flood of August 1981

In the plan established in 1988, the flow of the river was to be separated from the Ishikari River during floods, diverted to the Chitose River Floodway, and discharged into the Pacific Ocean.

However, this plan was suspended since an agreement could not be reached with the nature conservancy groups and the fishing industry due to the destructive effect on the natural environment caused by dividing the ground water and on the fishing industry caused by the muddy water flowing out to the mouth of the river during floods.

As a consequence, putting together a comprehensive flood control measure for the Chitose River basin to include even the opinions of the residents living in the basin become a matter of urgency and flood control measures based on retarding basins, reinforcing the levee, etc. were planned.

Confluence with the Ishikari River (Ebetsu City)

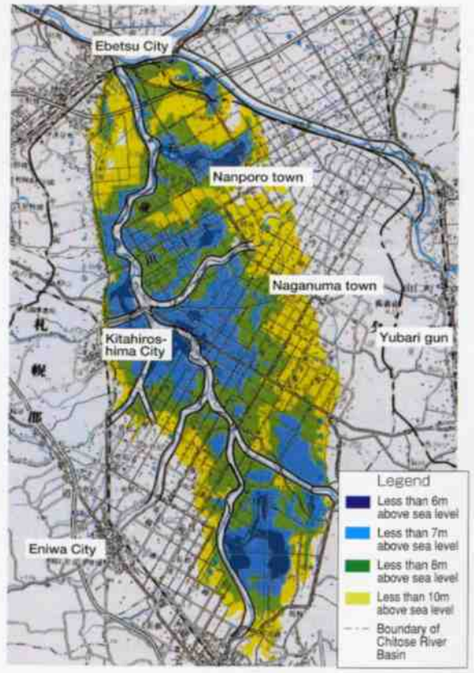
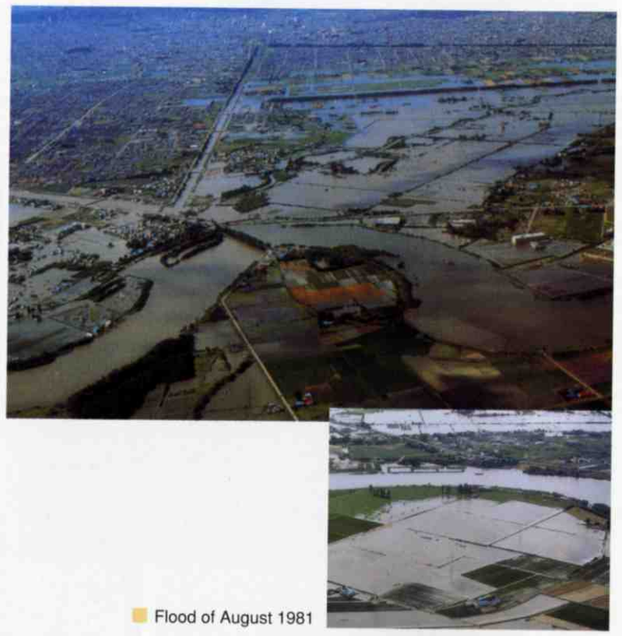


Figure 33 Section map showing the heights of the basin

Comprehensive flood control measure for the Fushiko River

[Summary]
In the Fushiko River and Barato River basins that adjoins the Ishikari River at the north potion of Sapporo City, urbanization is progressing rapidly.

On the other hand, the water retention and retarding function that the basins have intrinsically has become inferior with urbanization, the amount of flood discharge is increasing annually, the river maintenance cannot catch up with the develop-ment, and the degree of safety in the flood control is de-creasing considerably. Also, the Fushiko River flows into the Barato River, which is the old Ishikari River, and joins with the Ishikari River. However, the slopes of the Hassamu River and the Sosei River, which are the tributaries of Barato River and Fushiko River, are gentle slopes of 1/1,000 and cause flood damages frequently during heavy rains due to being affected by the back water of the Ishikari River.



Flood of August 1981

As a countermeasure, "A council for comprehensive flood control of the Fushiko River basin" was established in 1980 by Hokkaido Development Bureau, Hokkaido prefecture, Sapporo City, an Ishikari City, which are the organizations affiliated with the Fushiko River basin.

This council is planning and implementing a comprehensive flood control measure that includes immediate construction of flood control facilities, maintenance and enhancement of water retention andwater retarding function that the basin had from before, conformance with the city plans, collaboration with the sewage plan, and software measures.

Specifically, in addition to the river improvement, improvement of the drainage pumping station and Moere retarding basin is being made to remove the discharge. Also, various other measures are being taken such as projects to popularize basin reservoirs that utilize the schools and park grounds in the urban districts, maintain and enhance the water retention and water retarding functions by creating rain storage lakes in the developing regions, raise the floors of the homes in lowlands where there is a concern over being submerged, etc.

Figure 34
Record of inundation at the basin in 1981

[Ishikari Floodway]
The Barato River is the oxbow lake created by the cut-off channel of the Ishikari River. Also, the ground is low hence there is a tendency to receive the back water of Ishikari River. As a consequence, flooding occurred frequently.

Therefore, a floodway that discharges the water directly into the Sea of Japan during floods without discharging to the Ishikari River, which has a high water level was planned, the main construction work was started in 1976, progressed as one part of the Fushiko River comprehensive flood control measure in 1980, and was completed in 1982.

Flooding occurred twice in this basin in August of 1981. In the first flood, the work was close to completion hence it was possible to decrease the damages to the basin by allowing the water to pass through quickly.

Ishikari Floodway

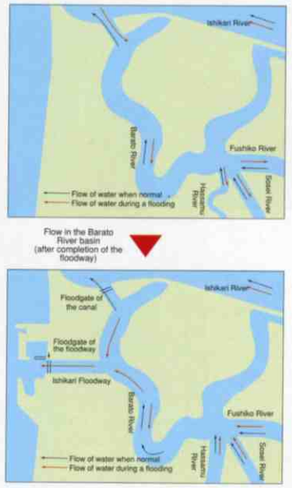
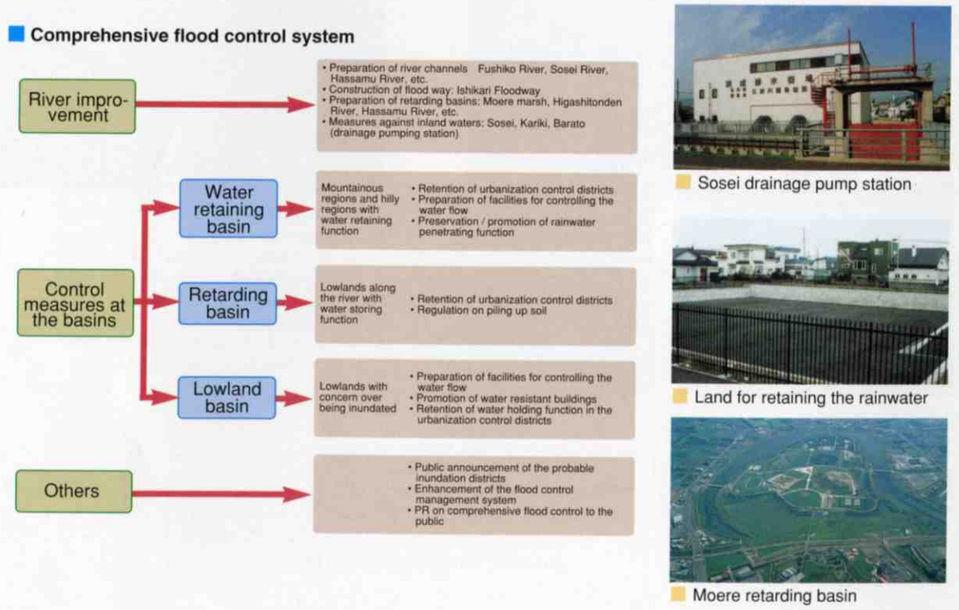


Figure 35 Schematic diagram of the floodway

Comprehensive flood control system



Sosei drainage pump station

Land for retaining the rainwater

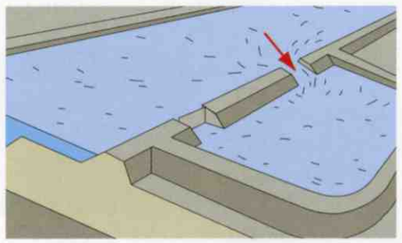
Moere retarding basin

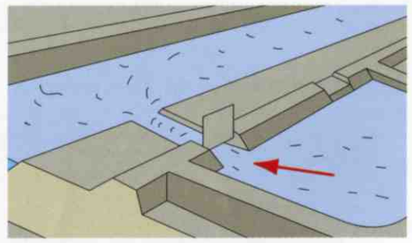
Sunagawa Retarding Basin

The Sunagawa new channel under construction (1968)

[Summary]

Flood control amount of 4,000 m^3/s was necessitated according to the 1982 revision in the plan. Therefore, a group of dams at the upper reach of the river and a group of retarding basins at the middle reach of the river were positioned as flood control facilities. The Sunagawa retarding basin is a retarding basin that utilized an oxbow lake created by the cut-off channel. It has effective water storage capacity of 10.5 million m^3 and area of 180 ha. This basin allows inflow of the water from the Ishikari River during floods and discharges the water collected in the retarding basin to lower reach of the river after the flood subsides. It has the same effect as the dams at the upper reach of the river. In one operation, the sand use resource within the retarding basin was excavated with the help of the residents and the sales profit from this operation was used to promote maintenance of the public facilities, etc.





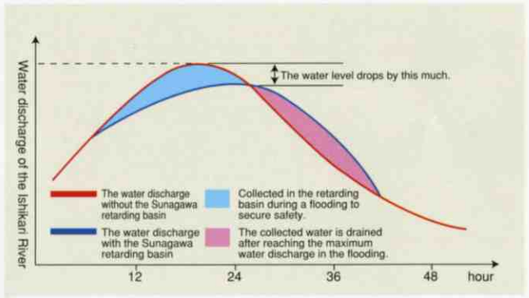


Figure 37 Graph of a retarding basin

Ushubetsu River Diversion Channel

[Summary]

The Ushubetsu River was a river that flowed while meandering through the Asahikawa city until the beginning of the Showa Era and flooding occurred frequently. The water channel that was newly excavated so that the flood drains smoothly is the present Ushubetsu River.

However, the width of the Ushubetsu River is narrower in the urban districts at the lower reach of the river than at the upper reach of the river. Also, a condition for flooding remained due to the urbanization. Therefore, a plan was made to construct a diversion channel of the Ushubetsu River, which directly drains the water to the Ishikari River, with an artificial water channel at the upper reach of the river to prevent the flood from passing through the narrow urban districts.

The diversion channel is a water channel with a length of 5,500m and a width of 170m and can reduce the discharge of the Ushubetsu River in the urban districts to half during floods.

Figure 38 Schematic diagram of the Ushubetsu River Diversion Channel

[Creation of new waterfront spaces]

To be accessible to the residents and to retain the natural environment of the river, new waterfront spaces such as a wild bird observation park, barrier free walkways, a facility left with the form of a historical structure, etc. were created in the diversion channel of the Ushubetsu River and a new name of "Nagayama Shinkawa" was decided on by appealing for publicsuggestions.

Fish way

[Summary]

In the recent years, lives of the animals, plants, fishes, etc. in the basins are being given consideration to for the purpose of preserving the natural environment.

The Hanazono Headworks was started in 1916 for irrigation on the right side of the Ishikari River (inland of Fukagawa City) and this resulted to a concrete dam in 1964. The Hanazono Headworks was integrated with the head works at the upper reach of the river in 1987 when national irrigation project was started and the function thereof was abolished.

It was dismantled in 1998 but there was a concern that it may affect the stability of the national highway bridge located at the upper reach of the headwork due to lowering of the riverbed and a decision was made to leave the dam as is up to a height that does not have an affect on the surroundings. However, the fishes cannot swim upstream at the head of the remaining dam hence a decision was made to construct a fishway.

The fish way was completed in 1999 with consideration given to the position, scale, and form of the targeted type of fishes. In the survey conducted in 2000, salmons were found swimming up the river after 36 years of absence and the effectiveness of the fish way was confirmed.

Hanazono Headworks

Installed position	Gradient	Type	Extension	Width	Maximum flow rate
Right bank of the Hanazono Headworks	1/20	Vertical slot step type	L=110m	W=4.0m	20m³ /s
Targeted type of fishing	River lamprey, chub, salmon, rainbow trout, East Siberian char				

Project to conduct water used for melting snow

[Summary]

To handle the snowfalls during the winter season smoothly and with little effort is an important and necessary condition for passing the winter months comfortably in a snow country. Therefore, a project to conduct water used for melting snow in the urban areas is being promoted by conduct water from large rivers and increasing the amount of discharge in the small rivers during the winter season in addition to making improvements such as providing road heating, snow draining channels, etc. In Asahikawa City referred to as "a city of water" in particular, a project to conduct water used for melting snow named "Yukinko River Strategy" is being implemented as first in the nation to enhance the snow removing effect along the rivers by conducting the water in the Chubetsu River to the Ainu River, etc. flowing through the urban areas.

Figure 39 Map of the locations

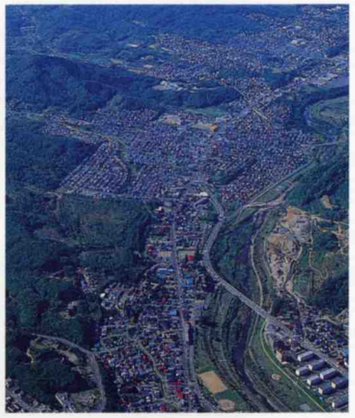
Snow being removed

3. Erosion Control Works

1) Sabo Works

Sabo in the urban communities along the Toyohira River

The Toyohira River joins with the Ishikari River by passing through the central area of Sapporo City. The slope is steeper than 1/100 and this is apparent from the alluvial fan of Sapporo City itself. There are many tributaries at the upper reach of the Toyohira River that are steeper than 1/30, have a weak foundation, and have a large volume of unstable earth and sand. Also, urbanization has expanded even in the upper reach area of the river, which is increasing the danger of disasters caused by the earth and sand.



Present status of Ishiyama / Fujino in Sapporo City

Disaster from debris floods at Nonosawa River (1981)

Embedded river course of the Nonosawa River (1981)

In 1981, more than 332 mm of rainfall was recorded in a short period at the upper reach of the Toyohira River and caused great damages from debris floods whereby 1 person died, 16 houses were destroyed, and 678 houses were inundated.

Since 1982, Sabo dams, channel works ,groundsills and sand retarding basin have been constructed at each tributary in the upper reach area. Also, construction of a warning system against debris floods and educational activities to guard against disasters have started since 1985 in addition to development of facilities as a "comprehensive debris floods measure."

Groundsills in the Nonosawa River

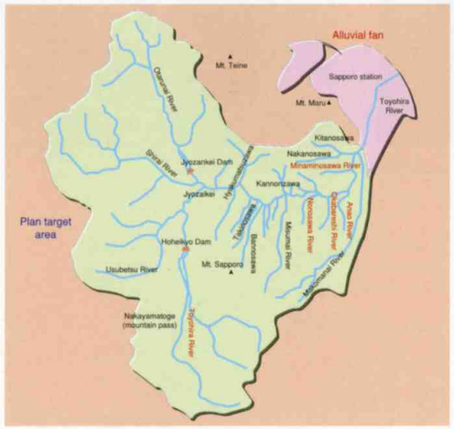


Figure 39 Map of the plan target area

Ananokawa River

Sand retarding basin in the Okabarushi River

Mt. Tokachi-dake Volcanic Sabo Works

Mt. Tokachi-dake is an active volcano 2,077m above the sea level located on the south side of the Taisetsuzan National Park, which is positioned at the center of Hokkaido. Five eruptions have been recorded in the recent years and eruptions have occurred at intervals of about 30 ~ 40 years.

The greatest damage was from volcanic mud flow in 1926. On May 26, 1926 when one of a series of eruptions occurred, about 650,000 m^3 of lava was discharged which melted the snow on the mountainside. The earth and sand at the mountainside was stripped by the lava and melted snow causing a large volume of volcanic mud to flow covering an area of about 19 km^2. The debris flow traveled down the Biei River and Furano River and covered Biei town and Kamifurano town. It caused a destruction whereby 144 people were killed or missing in addition to destroying the farmlands.

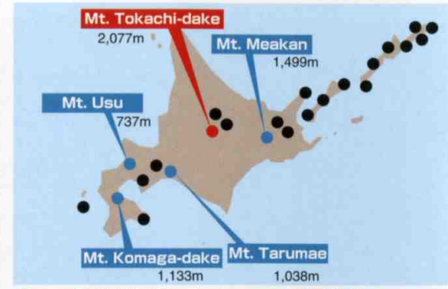


Figure 40 Distribution of volcanoes in Hokkaido

State of destruction from eruption of Mt. Tokachi-dake in 1926

Eruption in 1988

As a measure against volcanic mud flow, in addition to the Sabo facilities, information, etc. are being prepared so that a system for quick evacuation can be taken in an event there is a sudden volcanic mud flow. The Volcanic Sabo Information Center that centralizes all the information related to volcanic activities was completed in 1992.

Mt. Tokachi-dake Volcanic Sabo Information Center

Shirinashizawa Channel Work

Armor Levee in Biei River

4. Environment

1) River environment

Management rivers with nature conservation

Levees and concrete revetment were constructed in the river improvement with prevention of disaster as the priority. However, in the recent years, reconsideration is being given to the environment of the rivers as a natural space valuable for the urban districts and to the importance of the functions intrinsic to rivers as an ecological system. Therefore, river projects are being promoted with consideration given to realizing safety of the rivers and co-existence with nature.

[Neo-Natural River Reconstruction]

Even after the completion of river improvement, consideration is given so that the role of the conventional eco-system is not lost.

Creation of a river surrounded by rich greenery (Barato River)

Creation of a river surrounded by rich greenery (Fukurotappu River)

[Creation of forestry with the participation of the residents based on an ecological mixed seed sowing method]

The ecological mixed seed sowing method is a method of growing trees capable of adapting to the locale by planting seeds and seedlings of various trees in the area and leaving it up to natural selection. It is economical and is superior even from the standpoint of the eco-system. Forests are being created in collaboration with the residents living in the basin.

Sloping road by the Izari River

Ecological Mixed-seeding method

[Wand regeneration]

The riverbanks and high-water channels that were straightened by the improvement were given diversity such as shallows and deep poor to form a shape favorable as a river.

Imaginary Picture of Wand

Wand (Shimoshinshinotsu)

[Utilization of River Space]

Due to the strong requests from the residents to use the river space as a place for communing with nature and enjoying sports, etc. in ordinary times, the riverbeds and the riversides are being maintained in collaboration with the region for use by many people.

The rivers are used for events such as river rafting and canoeing, fireworks display, etc.

River Festival in Toyohira River.

Fireworks display at Toyohira River

Rafting race on Toyohira River

[Universal design]

In rivers close to the urban communities, slopes, handrails, etc. are being installed at the river spaces to enable use by everyone including the elderly and the handy caped persons. Consideration is given so that facilities are created to include the opinions of the welfare groups, etc.

Toyohira River

Universal design of Izari River

2) Waterfront fun schools

Waterfront fun schools

Waterfront fun schools are provided in various areas for the purpose of allowing children to easily enjoy the river, which is a valuable natural resource. The basic concept thereof is that "allowing children to play in a natural surrounding without creating a boundary between play and study is a valuable lesson for children." An environment is provided for cultivating children's creative abilities and feeling of sympathy with concerning for nature as the teacher by interacting with fishes, insects, wild plants, observing nature, and playing with water at the riverbanks such as canoeing and river rafting.

Waterfront fun school in Sorachi River

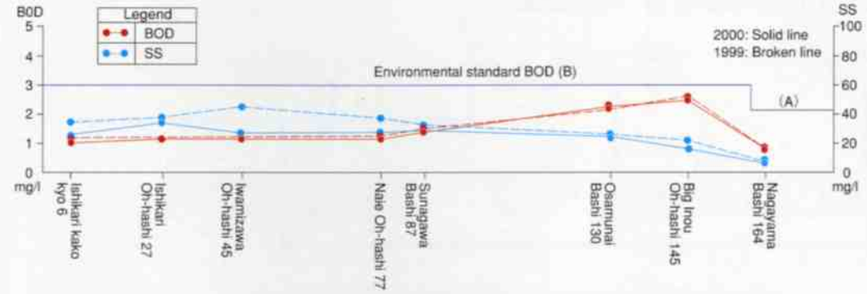
Deai: Waterfront fun school in Ikushunbetsu River

3) Preservation of the water quality and purification

Water quality of the Ishikari River

With diversification in the life style of the residents in the recent years, expectation from the waterside environment has increased and a favorable form of river environment in the basins is a vital consideration in relation to rivers.

With regards to the water quality, rivers were polluted by the industrial waste water, livestock waste water, city sewage, etc. as the level of economical growth increased in postwar Japan and a huge social problem was concerned. Therefore, in order to purify the water quality, laws such as the Water Pollution Prevention Act, etc. were established. Environmental standard values were set in 1970 and by enforcing waste water regulations and performing sewage maintenance with the objective of purification for the water quality, the water quality improved gradually.



Purification of the Barato River

The Barato River is an oxbow lake created by the cut-off channel hence it is enclosed. Also, due to increase in the city waste water from the Fushiko River, etc. that flows into the Barato River, the river environment is poor and a social problem was concerned from increase in water pollution, sludge sedimentation, generation of water-bloom in large volume, etc. Fast action to solve this problem was demanded by the residents living in the basin.

Therefore, a "Barato River Environmental Conservation Liaison Committee" was established and dredging of the sludge was started in 1990 as one part of the water purification project.

However, the target has not yet been reached. Therefore, a project called "Clear Water Renaissance II" was established and a measure that collaborates with the river works and sewage works is being examined at the committee meetings, etc. with an objective of improving the water quality of the rivers flowing into the Barato River, etc.

Dredging of the Barato River

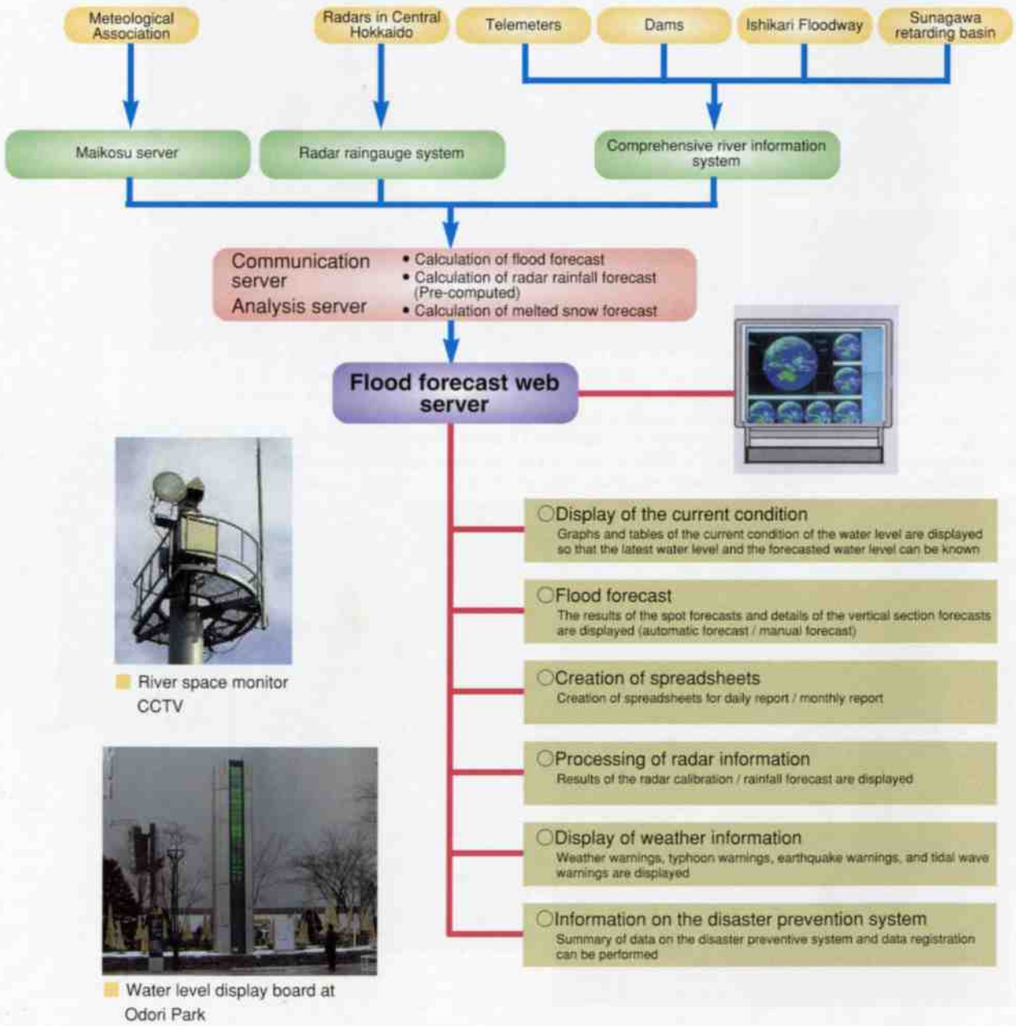
5. Software measures

River information • flood forecast system

In addition to developing facilities, flood management and facility management are also important elements in the flood control project. Flood management is being carried out with "a comprehensive river information system" that collects and provides information on the water level · rainfall at the basins using telemeters, "radar raingauge" that provides information on the rain zone at real time using radars, and "a flood forecast system" that forecasts a flood based on the collected data.

With the recent construction of an optical fiber network having a high-speed · big capacity , speedy response to floods and speedy notification to the residents in the basins are enabled.

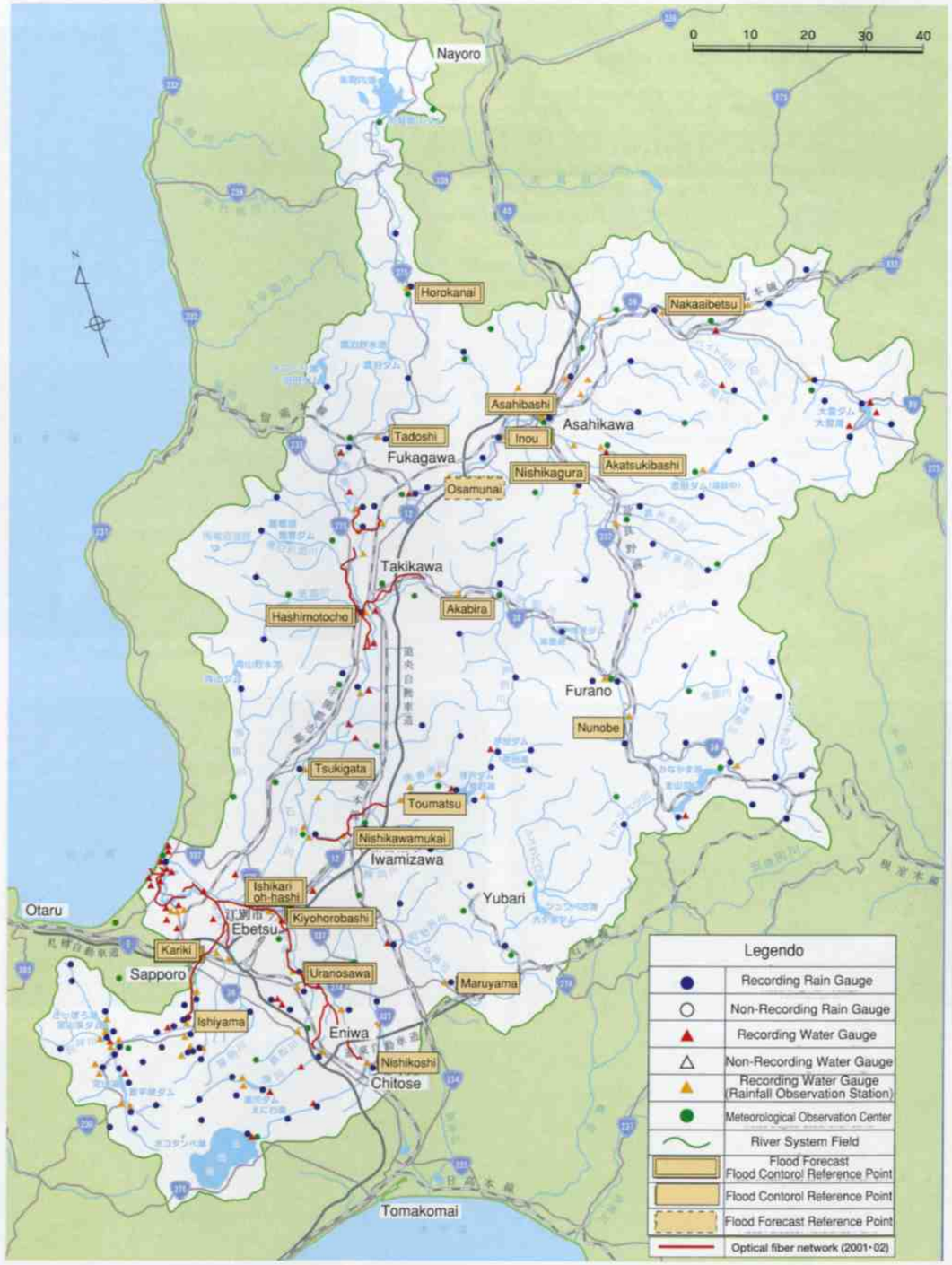
■Collecting to furnishing of information



River space monitor CCTV

Water level display board at Odori Park

Arrangement plan of the observation facilities for the Ishikari River System



VOL.4. Hokkaido Development Bureau

1. Main project

1) Construction of dams

The rivers in Japan are generally steep and have a characteristic of the rain that fall at the upper reach of the river flowing to the lower reach quickly. So the flood damage is increasing. Dam became the mainstream as a flood control facility for preventing and reducing the damages from these floods. In addition, dam fulfills many functions such as power generation, agricultural water, industrial water, municipal water, water for irrigation, securing a stabilized water discharge during droughts, etc. Also, dam also has a face of being a tourist spot where the residents can commune with the rich and beautiful natural environment.

These multi-purpose dams are currently being planned and constructed by the Hokkaido Development Bureau at seven locations on four river systems with six projects. The Chubetsu Dam is currently at the peak of construction and the construction of the Yubari Shuparo Dam was started in 1995 at the downstream spot of the Oh-Yubari Dam. It will become the fourth largest dam in Japan.

Yubari Shuparo Dam (Yubari River)

Shinkatsurazawa Dam (Ikushunbetsu River)

Mikasa Ponbetsu Dam (Ponbetsu River, a tributary of Ikushunbetsu River)

Biratori Dam (Saru River)

Chubetsu Dam (Chubetsu River)

Sanru Dam (Sanru River of the Teshio River System)

Rumoi Dam (Rumoi River System)

2) Kushiro Marshland · Shibetsu River

Kushiro Marshland

The Kushiro Marshland is a world renown natural resource as a habitat for rare flora and fauna but with the development of the basin in the recent years, the size of the marshland has decreased. Also, drying caused by inflow of earth and sand and change in the plant life are progressing at a rapid pace. Therefore, to conserve and restore the eco-system in the Kushiro Marshland, an investigation committee on conserving the river environment in the marshland was established and survey · investigation necessary for conserving the marshland was performed. A proposal that incorporated real targets and twelve real policies for conservation was prepared and movement towards the realization there · of has been started in collaboration with the affiliated organizations.

Kushiro Marshland Committee

Shibetsu River

The Shibetsu River is a class B river of 10.4 km that starts in Mt. Shibetsu-dake, passes through Naka-Shibetsu town and the urban district of Shibetsu town, and flows into the Sea of Ohotsuku. After the Pacific War, attention was given to this area as a region suited for national reclamation projects. So reclamation project and a river improvement project for straightening the meandering river course were under taken in order to defend against floods. As a result, the expansive marshland turned into grassland and one area is turning into one of the leading dairy farming region in Japan.

Thereafter, the situation surrounding the Shibetsu River changed and demand by the residents in the basin to restore the river to its natural state grew hence a project to "River Improvement with nature restoration" was started as a new way of improvement rivers based on the concept of "maintenance and preservation of the river environment" in the revised River Law of 1997. This project is the first in Japan for restoring the meandering course of the river by connecting the main river and the many old rivers left at the periphery and restoring the original shape of the river.

Tested construction work to restore to a meandering river

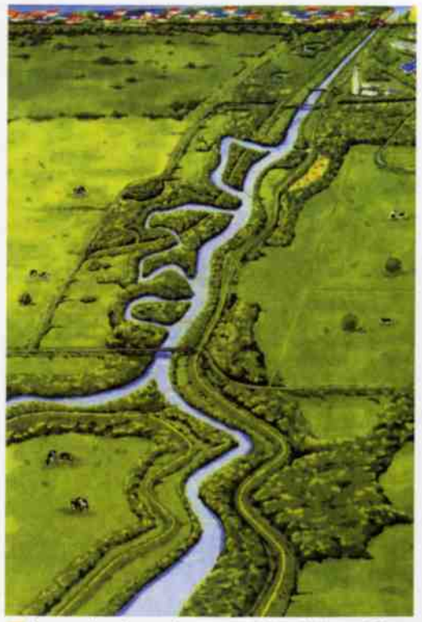


Image showing maintenance of the Shibetsu River

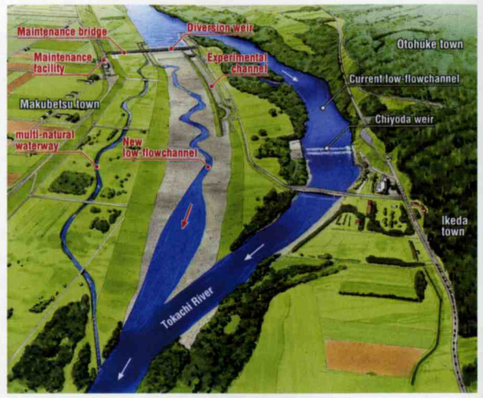
3)Chiyoda New Channel · Owada Retarding Basin

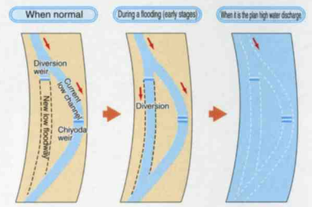
Chiyoda New Channel

The Chiyoda Weir was constructed in 1935 at a position 43.2 km from the mouth of the Tokachi River. This weir functions to intake water for agriculture and water for farming salmon and trout. It is a place enjoyed by the residents for fishing and cycling and is a tourist spot that attracts 400,000 ~ 500,000 tourists annually.

The crest of the weir was constructed to be about 5.6m higher than the height of the design riverbed hence a need for reconstruction was pointed out due to the considerable obstruction to flow during floods. In response, a project to construct the Chiyoda new channel was conceived with the objective of decreasing of water discharge capacity of river prevented by the Chiyoda Weir and removing the bent parts.

The plan is to achieve a solution to the insufficient water discharge capacity by leaving the current weir and the low water channel as is, excavating a new channel with a width of 160m on the right side of the corrent low channel, installing a new tilting weir at the upper reach of the new channel, allowing the water to flow down on the current river channel during ordinary times, and passing water through to the new channel during floods by opening the newly constructed tilting weir. Also, an ecology park is being developed simultaneously along the new low floodway to make most of its natural environment.



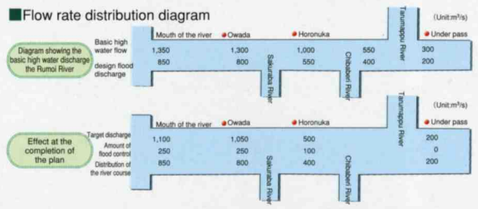


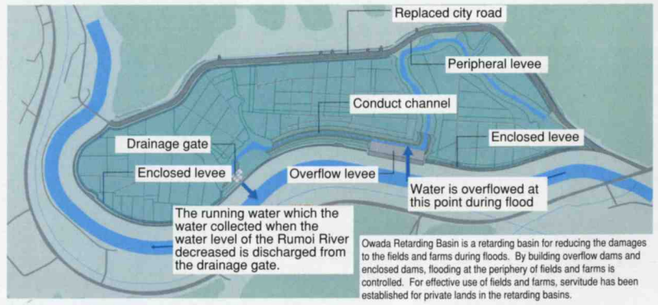
Owada Retarding Basin

The Rumoi River is a class A river with a length of 44 km that flows into the Sea of Japan from the riverhead with Rumoi City as the basin. Flooding occurred repeatedly from way back in history every time there was torrential rain. Therefore, flood control projects were under taken such as switching the mouth of the river, constructing bank protections, etc. but the safety of the Rumoi urban district located at the lower reach area of the river is not yet sufficient standard.

Currently, Owada retarding basin project is underway to enhance the safety of flood control at the lower reach area by providing a retarding basin in the Owada district where the flood control effect is the greatest and has no embankment. This retarding basin is a type that surrounds the periphery of the fields exposed to flood damages with embankment and the area is about 38 ha. The effective storage capacity is 500,000 m³ and flood control storage capacity is 50 m³/s.

■Flow rate distribution diagram





Owada Retarding Basin is a retarding basin for reducing the damages to the fields and farms during floods. By building overflow dams and enclosed dams, flooding at the periphery of fields and farms is controlled. For effective use of fields and farms, servitude has been established for private lands in the retarding basins.

Figure 40 Plan for the Owada retarding basin

4) Water purification project

Purification of Lake Abashiri

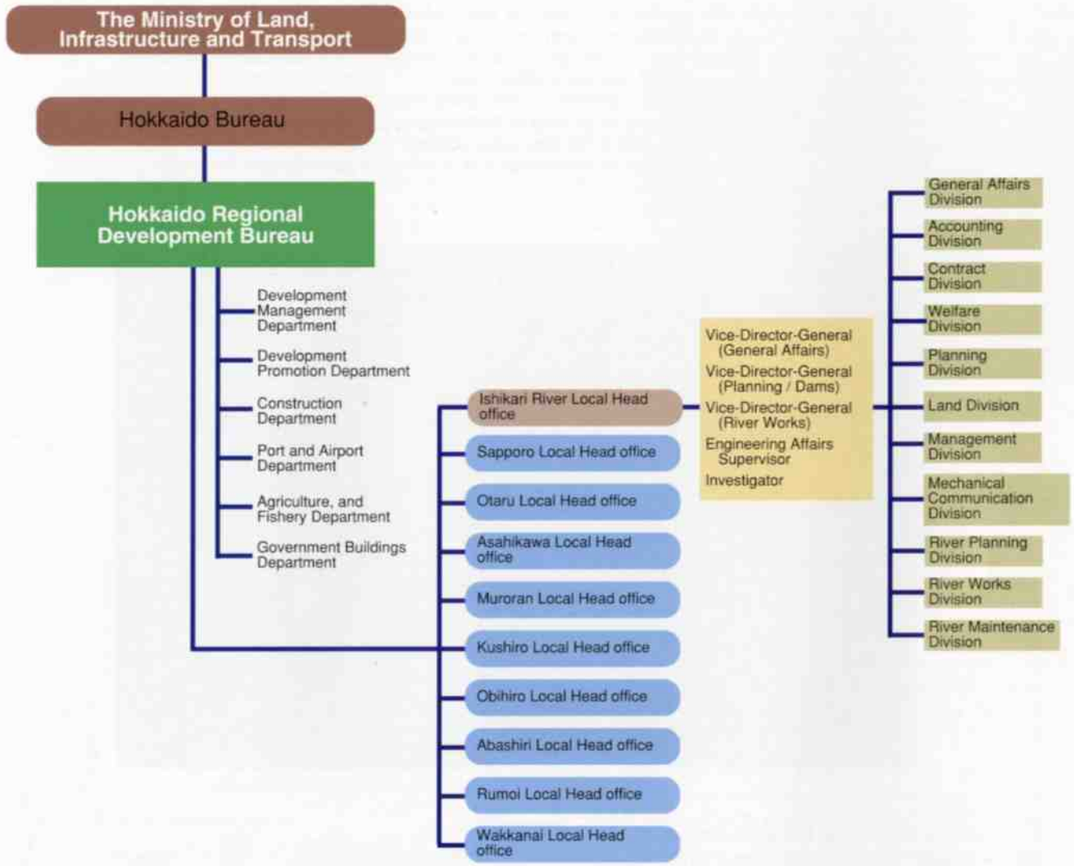
Lake Abashiri is positioned at the lower reach of the Abashiri River, which has a channel length of 115km. This is an inland sea-lake that was formed a few thousand years ago and it is enjoyed by many as a quasi-national park where colonies of gray herons and groups of skunk cabbage (Lysichiton Camtschatcense) designated as a National Protected Plants can be seen at the lakeshores.

The water quality of the lake has started to be worse in the recent years with the bad smell becoming prominent from eutrophication and “water-blooming” originating in the sludge occurring annually. This influences the fresh-water smelt fishing enjoyed in the lake and is not a favorable situation as a quasi-national park and as a tourist spot. Therefore, the Abashiri Local Head Office started a project to purify the Lake Abashiri in 1993.

Panoramic view of Lake Abashiri

“Dredging to remove the Lake bottom sludge” and “cutting of aquatic plants responsible for new sludge” are measures that were taken in the past. Furthermore, steps such as “preparation of a facility for filtering the river water with gravel then returning to the river,” “micro-organism purification test for purifying the waste water from the livestock industry,” etc. are being taken as control measures against the water that flows into the lake.

Organization of Hokkaido Regional Development Bureau



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