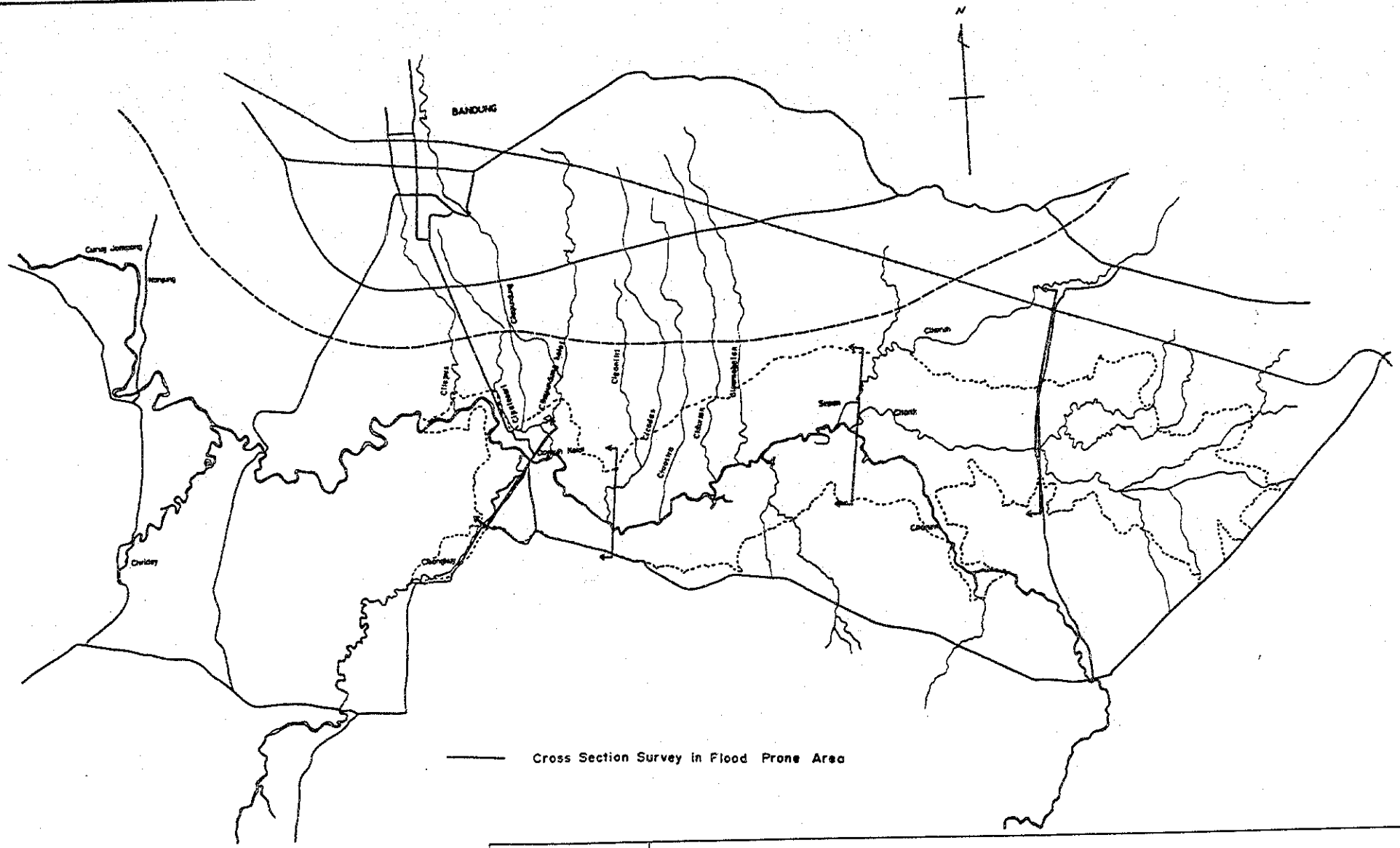

FIG. L.9	CROSS SECTION SURVEY IN FLOOD PRONE AREA

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

SUPPORTING REPORT M

SCOPE OF WORK

SCOPE OF WORK
FOR
THE STUDY
ON
THE FLOOD CONTROL PLAN
OF
THE UPPER CITARUM BASIN

I. INTRODUCTION

In response to the request of the Government of the Republic of Indonesia, the Government of Japan, in accordance with the relevant laws and regulations in force in Japan, has decided to conduct the Study on the Flood Control Plan of the Upper Citarum Basin in the Republic of Indonesia (hereinafter referred to as "the Study").

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will extend technical cooperation, in close cooperation with the authorities of the Republic of Indonesia.

The Directorate General of Water Resources Development, The Ministry of Public Works (hereinafter referred to as "DGWRD") shall act as counterpart agency to the Japanese study team and also as coordinating body to other relevant organizations for the smooth implementation of the Study.

II. OBJECTIVES

The objectives of the Study are:

1. to prepare a flood control plan of the upper Citarum basin,
2. to conduct a feasibility study on an urgent project corresponding to the identified component of the flood control plan, and
3. to perform technology transfer to the Indonesian counterpart personnel.

III. STUDY AREA

The study area will cover the upper Citarum basin (the catchment area of Curug Jompong) which is approximately 2,000 sq. km.

IV. SCOPE OF WORK

1. Collection and Review of Existing Data

   (1) topographical maps, and profile and cross-section maps of the main river and its tributaries

   (2) development plans and socio-economic condition of the study area

   (3) existing flood control measures and facilities

   (4) present land use

   (5) damages caused by flood

   (6) hydrological and meteorological data

2. Field Surveys

   (1) Hydrological and meteorological surveys

   (2) geological survey

   (3) supplementary surveys on profile and cross-section of the river, if necessary

3. Analysis and Examination

   (1) hydrological and hydraulic analysis

   (2) socio-economic feature of the study area

   (3) flood damage analysis

4. Formulation of a Flood Control Plan

   (1) formulation of flood control scheme of the study area

   (2) identification of a project to be urgently implemented

5. Feasibility Study on an Urgent Flood Control Project

   (1) preliminary design

   (2) operation & maintenance plan

   (3) cost estimation and implementation schedule

   (4) evaluation and justification of the project

V. STUDY SCHEDULE

The Study will be executed in accordance with the attached tentative schedule.

VI. R E P O R T S

JICA shall prepare and submit the following reports in English to the Government of Indonesia.

1. Inception Report

   Thirty (30) copies within one (1) month from the commencement of the Study.

2. Progress Report (I)

   Thirty (30) copies within seven (7) months from the commencement of the Study.

3. Progress Report (II)

   Thirty (30) copies within nine (9) months from the commencement of the Study.

4. Interim Report

   Thirty (30) copies within fourteen (14) months from the commencement of the Study.

5. Draft Final Report

   Thirty (30) copies within seventeen (17) months from the commencement of the Study.
   The authorities concerned shall submit their comments within fourty-five (45) days after receipt of the draft final report.

6. Final Report

   Fifty (50) copies within one and a half (1.5) months after receipt of the comments from the authorities concerned on the Draft Final Report.

VII. UNDERTAKING OF THE GOVERNMENT OF INDONESIA.

The Government of Indonesia shall accord privileges and other benefits to the Japanese study team, and through the authorities concerned, take necessary measures to facilitate the smooth implementation of the Study.

1. DGWRD shall make necessary arrangement with the cooperation of other relevant organizations for the followings:

   (1) to secure the safety of the Japanese study team,

(2) to permit the members of the Japanese study team enter, leave and sojourn in Indonesia for duration of their assignment therein, and exempt them from alien registration requirements (and consular fees),

(3) to exempt the members of the Japanese study team from taxes, duties and other charges on equipment, machinery and other materials brought into Indonesia necessary for the implementation of the Study,

(4) to exempt the members of the Japanese study team from income tax and other charges imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the Study,

(5) to provide necessary facilities to the Japanese study team for remittance as well as utilization of funds introduced into Indonesia from Japan in connection with the implementation of the Study,

(6) to provide medical services as needed. Its expenses will be chargeable on the members of the Japanese study team, and

(7) to secure permission to take all data, documents and necessary materials related to the Study out of Indonesia to Japan by the Japanese study team.

2. DGWRD shall, at its own expense, provide the Japanese study team with the followings, in cooperation with other relevant organizations:

(1) available data and information related to the Study

(2) counterpart personnel

(3) suitable office with necessary equipment in Bandung

(4) credential or identification cards

3. The Government of Indonesia shall bear claims, if any arises against the members of the Japanese study team resulting from, occuring in the course of, or otherwise connected with the dicharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Japanese study team.

4. The Government of Indonesia shall carry out following works:

R

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(1) topographical survey

(2) geological survey

5. The Government of Indonesia shall provide necessary vehicles for the implementation of the Study.

VIII. UNDERTAKING OF JICA

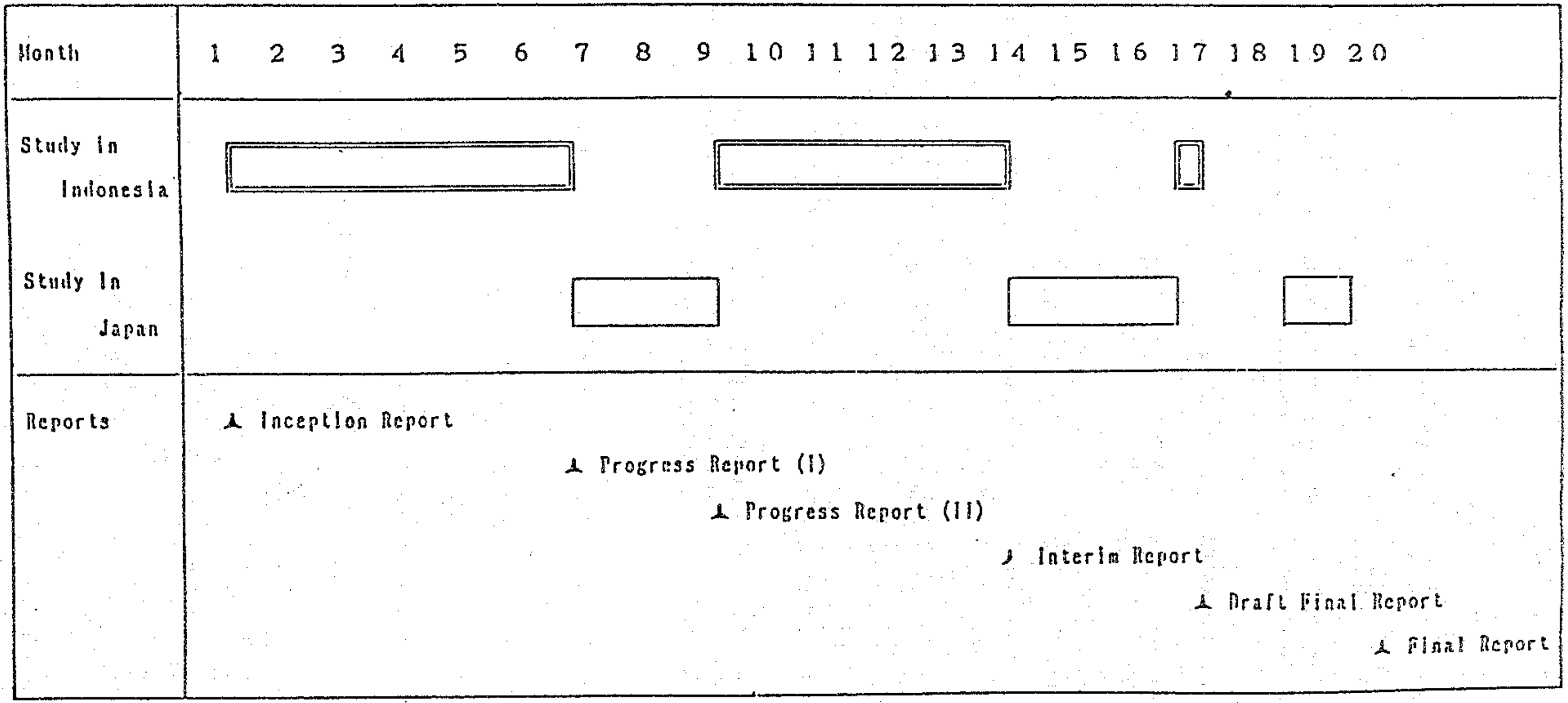
For the implementation of the Study, JICA shall take the following measures :

1. to dispatch as its own expense, study team to Indonesia,
2. to provide equipment necessary for the Japanese study team, and
3. to perform technology transfer to the Indonesia counterpart personnel in the job site in Japan in the course of the Study.

IX. CONSULTATION

JICA and DGWRD will consult each other in respect of any matter that is not mentioned in this document and may arise from or in connection with the Study.

TENTATIVE STUDY SCHEDULE



MINUTES OF MEETING
BETWEEN DGWRD AND JICA PRELIMINARY STUDY TEAM
ON
THE SCOPE OF WORK FOR THE STUDY
ON
THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

The preliminary Study Team of Japan International Cooperation Agency (JICA) of the Government of Japan for the Study on the Flood Control Plan of the Upper Citarum Basin and the Directorate General of Water Resources Development (DGWRD), Ministry of Public Works, the Government of the Republic of Indonesia exchanged their views concerning the Scope of Work for the Study on the Flood Control Plan of the Upper Citarum Basin.

Both sides agreed to adopt the Scope of Work as attached hereto with the following understandings:

(1) The Study on the Flood Control Plan of the Upper Citarum Basin is considered as an initial stage of Comprehensive Water Resources Development Plan of the Upper Citarum Basin.

(2) The Flood Control Plan covers the aspects necessary for the river basin management.

(3) Feasibility study of urgent flood control will be conducted with emphasis on the habitual inundation area in the southern part of Bandung.

(4) GDWRD strongly requested to JICA to take into account the current budget condition of the Government of Indonesia in conducting the field survey.

(5) A simple monthly report for the periodical meeting at Bandung will be prepared.

(6) The involvement of the Institute of Hydraulic Engineering

for the Study will be considered.

(7) JICA Study Team agreed to take into consideration of necessity of training programme during the Study in Japan.

(8) DGWRD will provide drivers, fuel and maintenance cost while JICA will provide vehicles.

(9) The Study is expected to commence at the latest on May 1987.

Jakarta, December 11, 1986

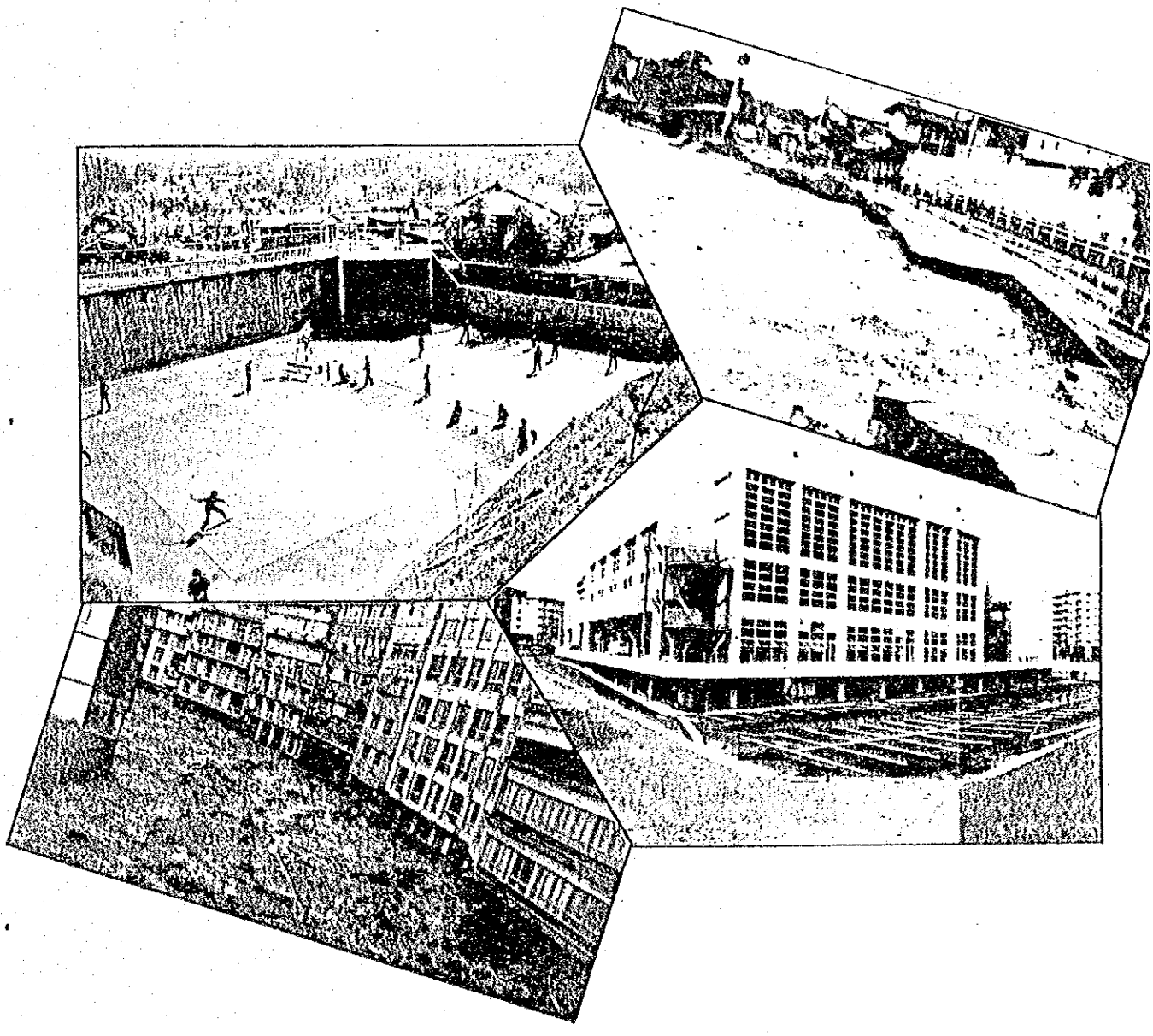
IR. PUTRA DUARSA
ASSISTANT DIRECTOR GENERAL
FOR RIVER DEVELOPMENT,
MINISTRY OF PUBLIC WORKS,
GOVERNMENT OF THE REPUBLIC
OF INDONESIA

MR. TOSHIYUKI YAMAGISHI
LEADER OF THE JICA PRELIMINARY
STUDY TEAM,
THE JAPAN INTERNATIONAL
COOPERATION AGENCY

ANNEX

COMPREHENSIVE FLOOD DISASTER PREVENTION MEASURES IN JAPAN

Comprehensive Flood Disaster Prevention Measures



FLOOD DISASTER PREVENTION DIVISION
PUBLIC WORKS RESEARCH INSTITUTE
MINISTRY OF CONSTRUCTION

1. Characteristics of Rivers and Flood Disasters in Japan

(1) Characteristics of Japanese Rivers

Japan is a mountainous and rainy country. 75% of the total area is covered by mostly steep mountains. Since Japan is located in the northern end of the Asian monsoon region, she is periodically hit by typhoons. Owing to these topographic and meteorological conditions, rivers in Japan are characterized by the following factors:

1) Steep bed slope
2) Large and sharp flood discharge
3) Large flow variation
4) Large sediment load

(2) Land Use and Flood Disasters

Most of the social and economic activities of Japan are done on the flood plains whose area is only 10% of the total land area. About 50% of the total population and 70% of the total assets of Japan are accumulated on the flood-prone area.

Although river improvement works have been carried out from the olden times, we are not completely successful in regulating river flows. According to the statistics from 1946 to 1984, the average annual flood damage reaches $4.4 billion.

As shown in Table 2, the Ministry of Construction and local governments have to take care of a large number of river systems. It still needs a long time and great amount of investment to complete river improvement works in these rivers.

Table 1 Population and Asset in Flood Prone Area

		1960		1965		1970		1975		1980	
		Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%
Area (km^2)	Nation	377,700	100	377,700	100	377,700	100	377,700	100	377,700	100
	Flood Prone Area	38,000	10	38,000	10	38,000	10	38,000	10	38,000	10
Population (million)	Nation	93.4	100	98.3	100	103.7	100	111.9	100	117.1	100
	Flood Prone Area	41.7	44.7	45.1	45.8	48.0	46.3	52.3	46.7	56.4	48.2
Asset* ($billion)	Nation	756	100	1,231	100	1,944	100	3,088	100	3,706	100
	Flood Prone Area	388	51	725	59	1,225	63	2,088	68	2,669	72

Remark: Price in 1980, 1 dollar = 160 yen (1986)

Table 2 Survey on Number and Other Details of Japanese Rivers

Type of river	Number of river systems	Number of rivers	Total length of rivers (km)		Catchment area (km²)
Class A rivers	109	13,302	85,831.5		239,357
			Beyond designated sections	10,041.1	
			Designated sections	75,790.4	
Class B rivers	2,626	6,566	34,813.5		106,681
Designated rivers	15	38	202.8		
Hokkaido	8	27	168.4		
Okinawa prefecture	7	11	34.4		
Class C rivers		11,355	16,884.0		Municipalities concerned 1,305
Other rivers		112,900	175,770.0		

1. As of April 1981 for Class A rivers, Class B rivers and Class C rivers
2. For other rivers, estimated values as of 10 April, 1979.
3. Class A rivers are managed by the Ministry of Construction
   Class B rivers are managed by the prefectural governments
   Class C rivers are managed by the municipalities

2. Advance of Urbanization and Its Influence

From 1960's Japan experienced rapid urbanization specially around the major three city areas (Tokyo, Osaka and Nagoya). This urbanization, which is still going on, put another heavy burden on the urban rivers. Changes in the hydrological cycle and increase in damage potential brought aggravated flood damage in urban areas.

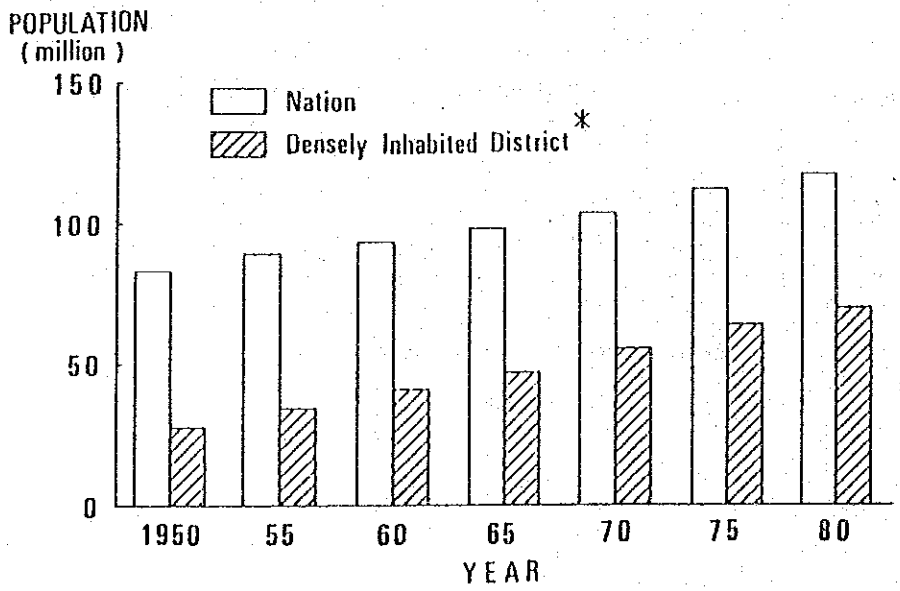


Fig. 1 Increase of Population in City Area
Remark: Population is more than 5,000 and population density is more than 4,000/km²

(1) Change of Run-Off Mechanism

Before urbanization, rainfall is intercepted by trees, retained in natural ground depressions and infiltrated into the ground. However, after urbanization, permeable ground is changed into non-permeable area such as roofs and roads, and drainage system gathers water efficiently. Thus rain water immediately flows into a river with a larger and sharper hydrograph than ever.

(2) Increase of Damage Potential by Development in Lowlands

In the past, people were very careful about flood hazard. Banked houses and emergency boats are good examples.

However, cities are now extremely unprotected against flood, since houses and factories are built up at any places without any consideration of flood, as long as the land price is low. As a result, damage potential has increased especially in lowlands.

(3) Recent Trend of Flood Damage

Thanks to the continuous effort of constructing flood control facilities, flooded area is decreasing (Fig. 2). However, the density of flood damage is increasing due to the increase of inundation in urban areas.

When we look into the cause of flooding, Fig. 3 shows that dyke breaks have almost disappeared and inner water is becoming the major cause of inundation. This is also related with the progress of urbanization.

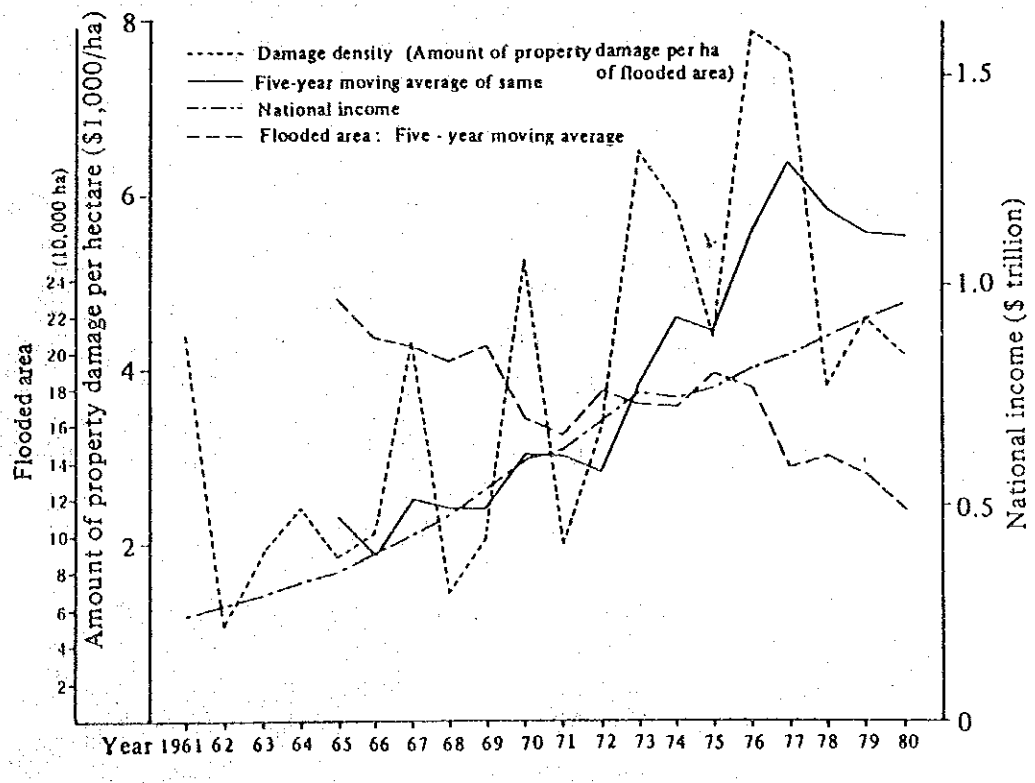


Fig. 2 Trends of Property Damage Density per Hectare of Flooded Area
Remark: 1 dollar = 160 yen (1986)

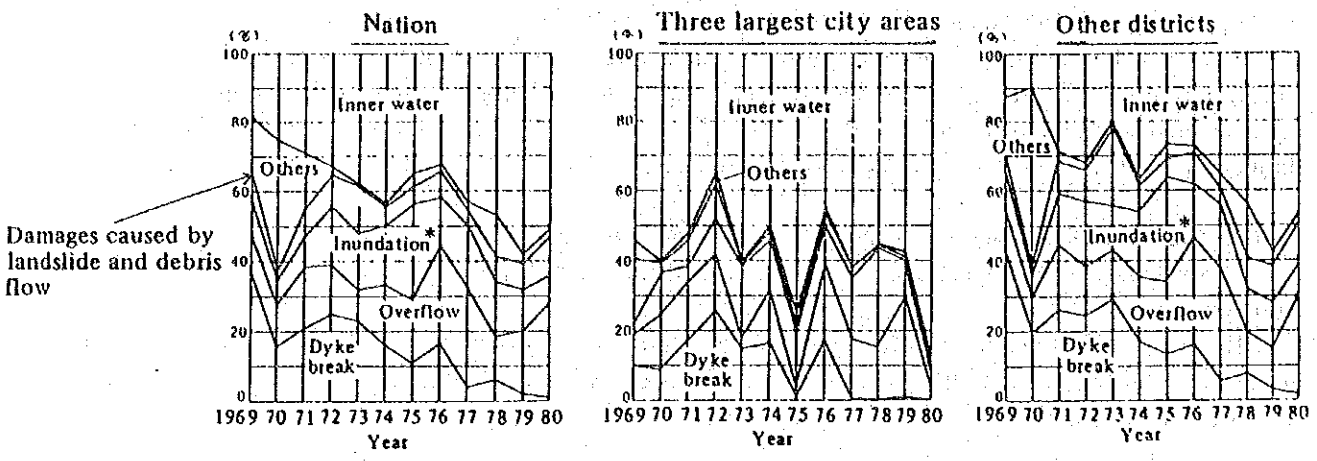


Fig. 3 Cause of Flood Disaster
Remark: non-levee section

3. Influence of Urbanization on Flood Outflow

Let's take the Tsurumi River basin as an example and see how the land development affected the run-off.

The Tsurumi River, whose catchment area is 235 km^2, flows in the western part of Tokyo megalopolis, and has a very well-organized railway and road networks. In 1958 the urbanized area was only 10% of the basin. After that, the basin has been rapidly developed. Urbanized area covered 60% of the basin in 1975, and is supposed to cover 80% of the basin in the near future (Fig. 4).

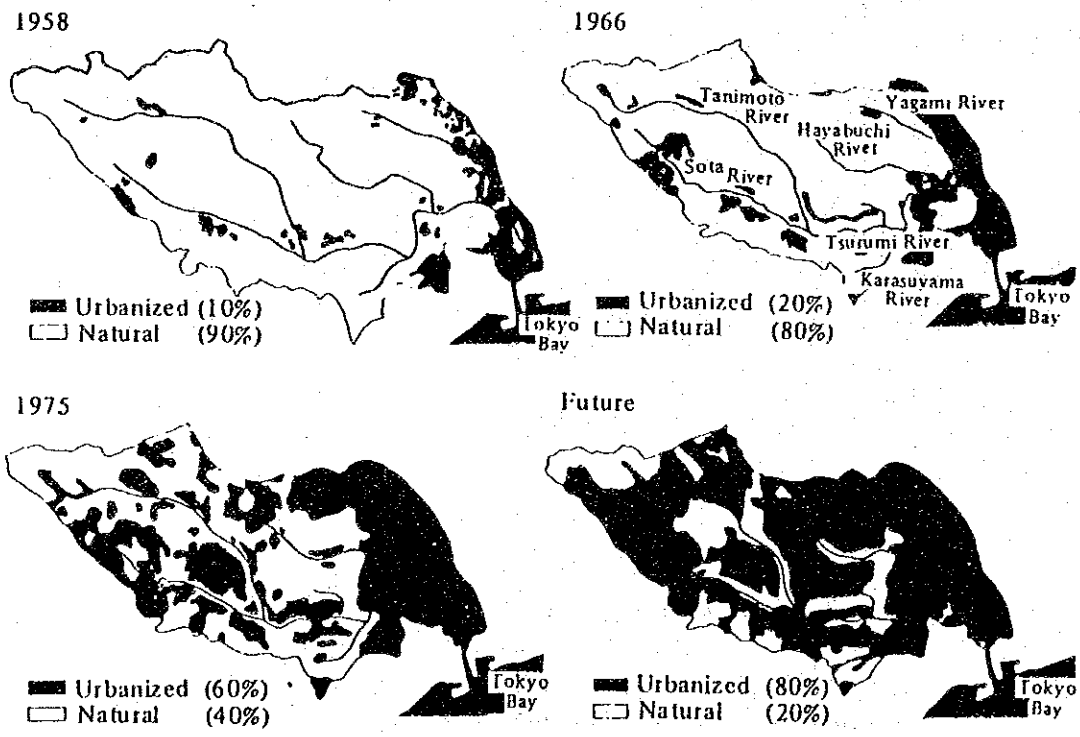


Fig. 4 Changes of Land Use in Tsurumi River Basin

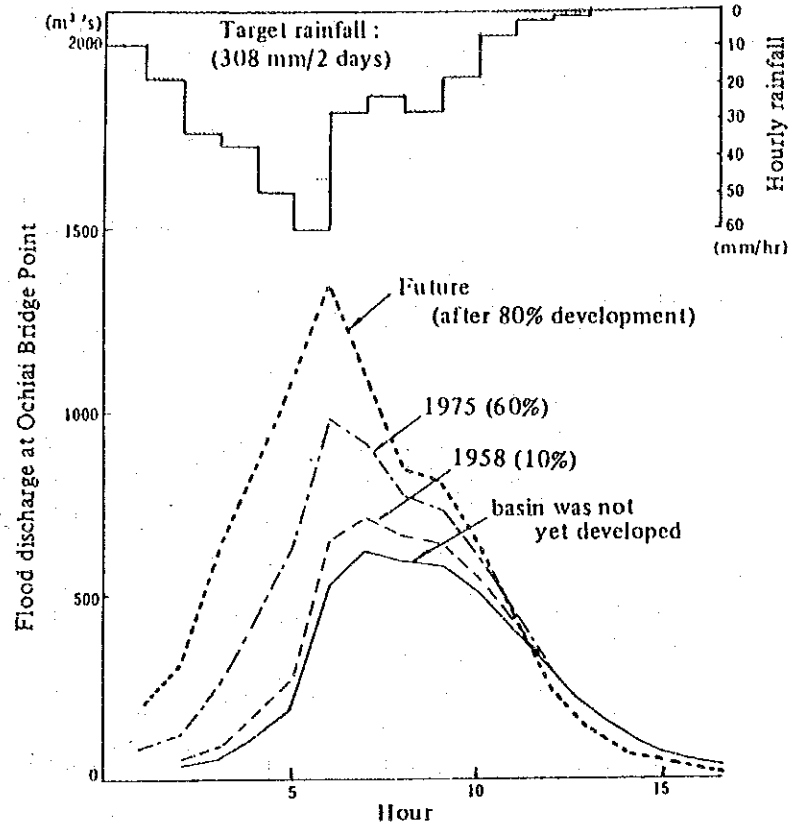


Fig. 5 Change of Flood Discharge due to Development in Tsurumi River Basin

(1) Increase of Flood Discharge due to Urbanization

Fig. 5 shows the transformation of flood hydrograph caused by the progress of the land development. In this case, urbanization of 60% of the basin raised the peak discharge from 600 m^3/sec to 1000 m^3/sec.

This indicates that, if the discharge capacity at the Ochiai Bridge point is fixed, the safety degree (probability of yearly exceedence) is deteriorated from 1/80 in 1958 to 1/10 in 1975.

(2) Shortening of Flood Concentration Time

According to the observation at the Sueyoshi Bridge(6 km from the river mouth), the flood concentration time is only 2 to 3 hours in these days, while it was about 10 hours in 1968.

This shortening of the concentration time, along with the increase in peak discharge, not only enlarges flood hazards but also limits the time for flood forecast and warning, which consequently makes flood fighting activities more difficult.

4. Comprehensive Flood Disaster Prevention Measures

(1) Basic Idea of the Comprehensive Flood Disaster Prevention Measures

As stated above, the retaining and retarding function of the basin originally maintained by soil and vegetation have been impaired due to rapid progress of urbanization.

Thus low land has become more prone to flood disaster than ever, and once flood occurs, the damage to the inhabitants and their properties would be enormous.

On the other hand, the execution of flood control works in these areas requires so much time and cost, since houses are very densely located along the river. This delay of projects makes the matter more complicated in coordinating the river improvement plan and the regional plan.

Therefore, it is indispensable not only to accelerate the river improvement works but also to apply non-structural measures including proper guidance to the public in the basin.

Under these circumstances, in October 1976, the Minister of Construction inquired the River Council on the guideline of the comprehensive flood control measures focusing on the way to cope with the said difficulties caused by urbanization. After the extensive study in the sub-committee of the Council, the interim report was submitted to the Minister in June 1977.

The interim report reads as follows:

Severe flood disasters occur every year, because provision of the flood control facilities was not able to keep up with the development in the river basin, more precisely, rapid urbanization. In order to overcome this situation, it is necessary to promote the Comprehensive Flood Disaster Prevention Measures which is the proper combination of adequate flood control facilities and the utmost efforts to check the increase of flood discharge and sediment run-off by conserving the water retaining and retarding functions in the river basin.

The report enumerates what to be done:

a) Conservation of the water retaining and retarding functions of the basin, and preparation of the administrative measures for their execution
b) Designation and publication of the predicted inundation areas (flood risk map) as well as the areas dangerous to debris flow
c) Setting up the urgent target for the improvement of the flood control facilities in proportion to the safety degree of the area
d) Introduction of better land use and housing structure from the view point of mitigation of flood damage
e) Improvement of the communication system for the prompt delivery of flood information to citizens
f) Improvement of warning and evacuation system for the debris flow damage reduction
g) Improvement of flood fighting system
h) Establishment of the institutions to facilitate the execution of the said measures

Chronicle on the Comprehensive Flood Disaster Prevention Measures

(Increase of flood damages in urbanized areas
Decrease of the retaining and retarding capacity of the basin)

⇩

Necessity of
1) Promotion of river improvement
2) Conservation of retaining and retarding function
3) Guide to proper land use

⇩

Sep., 1976 Major Flood Disaster in the Nagara River basin

Oct., 1976 Consultation to the River Council

Jun., 1977 Submission of the interim report on the promotion of the Comprehensive Flood Disaster Prevention Measures by the River Council

Apr., 1979 Start of the Comprehensive Flood Disaster Prevention Project (Designation of the rivers for the project)

(2) Outline of the Comprehensive Flood Disaster Prevention Project

In response to this recommendation, the River Bureau of the Ministry of Construction started the Comprehensive Flood Disaster Prevention Project in 1979. The project is now being carried out in the 14 specified river basins which are listed in Table 3.

The standard goal of the project is to secure the safety of the basin against the target rainfall of 50 mm/hr, which corresponds to 5 – 10 year flood, approximately in 10 years.

For the purpose of drawing up a concrete and effective program, the Basin Conservation Plan is determined based on the agreement of the members of the Basin Council for the Comprehensive Flood Disaster Prevention. The Basin Council, a newly established organization for an each project area, consists of the representatives of the Ministry of Construction and local governments concerned with river administration, drainage, city planning, housing and land development.

The frame of the Basin Conservation Plan is as follows:

a) To classify the basin into 3 categories (retaining area, retarding area and lowland area) according to the water retention or retarding function of the area.
b) To promote river improvement works.
c) To maintain or further strengthen the retaining function of the retaining area by constructing various types of storm water detention and infiltration facilities.
d) To conserve the retarding function of the retarding area.
e) To inform the public of the past inundated area for guiding the land use to a proper direction and for the convenience of flood fighting and evacuation activities.
f) To decide the most appropriate ways to use areas prone to flood.
g) To make the lowland area safer against flood hazards by the aforementioned measures.
h) To appeal to the public for the better understanding of the Comprehensive Flood Disaster Prevention Measures and their cooperation.

Table 3-(1) A Summary of Conditions of River Basins Designated for Comprehensive Flood Disaster Prevention Measures

Name of river system	Name of river	Class	Name of prefecture	Municipalities concerned	Summary of basin condition	Data on basin				Adoption year
						Area	Population		Urbaniza-tion rate	
Tone R.	Naka R. Ayase R.	A	Saitama Tokyo	37 municipalities including Kasukabe and Koshigaya Cities	These basins are in the alluvial plain of the Tone River and have been developed as commuter housing areas so much that the water retarding areas have decreased and submergence damage has increased in developed areas themeselves.	km^2 987	(10,000 people) 1955 : 127 Present : 256		1955 : 21 1965 : 26 1975 : 39 Future : 59	1980
Ara R.	Shingashi R.	A	Saitama Tokyo	26 municipalities including Kawagoe and Tokorozawa Cities	The so-called Arakawa lowland represents most of this basin. Urbanization of the area along private railway line to form Tokyo's commuter districts has progressed and the condition of the river has yearly deteriorated.	390	1955 : 65 Present : 199		1955 : 7 1965 : 20 1975 : 34 Future : 50	1979
Tsurumi R.	Tsurumi R.	A	Tokyo	Four cities including Yokohama, Kawasaki and Machida	As the river flows along the large cities of Tokyo, Yokohama and Kawasaki, the water retaining and retarding functions of its basin has greatly deteriorated in recent years due to the development of hills and the reclamation of lowlands. Consequently, submergence damage has frequently occurred.	235	1955 : 45 Present : 122		1955 : 10 1965 : 20 1975 : 60 Future : 80	1979
Yodo R.	Ina R.	A	Osaka Hyogo	10 cities and towns including Kawanishi and Ikeda Cities	Located within the commuting distance of Osaka and Kobe, the upper reaches of the river have been greatly developed and submergence damage has been caused by the deterioration of the basin's water retaining function in recent years.	382	1965 : 120 1975 : 155		1955 : 6 1965 : 8 1975 : 19 Future : 32	1979
Tone R.	Mama R.	A	Chiba	Cities of Ichikawa, Matsudo, Kamagaya and Funabashi	Great sprawling has occurred in the basins of Tokyo's commuter districts, and the water retaining and retarding functions have yearly deteriorated due to the development of hills and the reclamation of lowlands and submergence damage in lowlands has increased in recent years.	63	1955 : 9 Present : 35		1955 : 15 1965 : 37 1975 : 53 Future : 66	1979
Shonai R.	Shin R.	A	Aichi	19 municipalities including Kasugai and Ichinomiya Cities	The basin is generally level. It has been developed as Nagoya's commuter district so that the river's run-off has increased and submergence in developed lowlands has increased	260	1955 : 40 Present : 82		1955 : 10 1965 : 25 1975 : 45 Future : 65	1979
Ishikari R.	Fushiko R.	A	Hokkaido	Sapporo City	The basin includes downtown Sapporo and the lowlands in the river's lower reaches have been greatly developed as suburban housing sites and submergence damage there has increased.	106	1955 : 15 Present : 32		1955 : 13 1965 : 21 1975 : 33 Future : 58	1980

Table 3-(2) A Summary of Conditions of River Basins Designated for Comprehensive Flood Disaster Prevention Measures

Name of river system	Name of river	Class	Name of prefecture	Municipalities concerned	Summary of basin condition	Area	Data on basin		Adoption year
							Population	Urbanization rate	
Sakai R.	Sakai R.	B	Tokyo Kanagawa	Seven cities and towns including Yokohama, Machida and Sagamihara Cities	The basin has been rapidly urbanized as bed towns of Keihin (Tokyo - Yokohama) District, its water retaining function has deteriorated and, in recent years, submergence damage has occurred in Fujisawa City and elsewhere.	213	1955 : 22 Present : 109	1955 : 14 1965 : 33 1975 : 52 Future : 63	1979
Hikiji R.	Hikiji R.	B	Kanagawa	Six cities including Yokohama and Fujisawa	Same as above	65	1955 : 7 Present : 28	1955 : 15 1965 : 37 1975 : 51 Future : 66	1979
Tomoe R.	Tomoe R.	B	Shizuoka	Shizuoka and Shimizu Cities	The basin is generally divided into mountains in the upper reaches and lowlands in the lower reaches. Recently, with the expanded urbanization of Shizuoka City as the prefectural capital, lowlands have been developed and, as the water retarding area decreased, submergence damage has become heavier than ever.	105	1955 : 22 Present : 35	1955 : 10 1965 : 18 1975 : 46 Future : 48	1979
Tama R.	Zambori R.	A	Tokyo	Four cities including Ohme and Tachikawa and a town	The basin has been rapidly urbanized as Tokyo's commuter districts. Further, with the return of the Tachikawa Air Base from the U.S. Forces, there is a plan to turn Tachikawa City into a subsidiary center of Metropolitan Tokyo. Thus, the basin, with its water retaining function, is expected to be urbanized.	35	1955 : 58 Present : 126	1955 : 14 1965 : 38 1975 : 43 Future : 78	1981
Sagami R.	Mekujiri R.	A	Kanagawa	Five cities including Zama and Sagamihara and a town	The basin has been rapidly urbanized as Tokyo's commuter districts and its water retaining function has deteriorated. Thus, measures including the provision of an adjusting reservoir on rented ground have been taken by some cities in the basin when constructing sewers.	36	1955 : 40 Present : 220	1955 : 13 1965 : 20 1975 : 42 Future : 59	1981
Yamato R.	Northern Area of Yamato R.	A	Nara	Eight cities including Nara and Yamato - Koriyama, 15 towns and two villages	The basins have been rapidly urbanized as Osaka's commuter districts and their population increase rate is one of the highest in Japan. As the result, their water retaining function has deteriorated and submergence damage has occurred in the lowlands.	712	1955 : 56 Present : 98	1955 : 5 Present : 20	1982
Sakai R.	Sakai R.	B	Aichi	Six cities including Kariya and Toyota and three towns	Urbanization in the basin including its development as Nagoya's commuter districts has progressed and its water retaining and retarding functions have greatly deteriorated. Thus, submergence damage there has increased.	257	1955 : 14 Present : 33	1955 : 8 Present : 35	1982

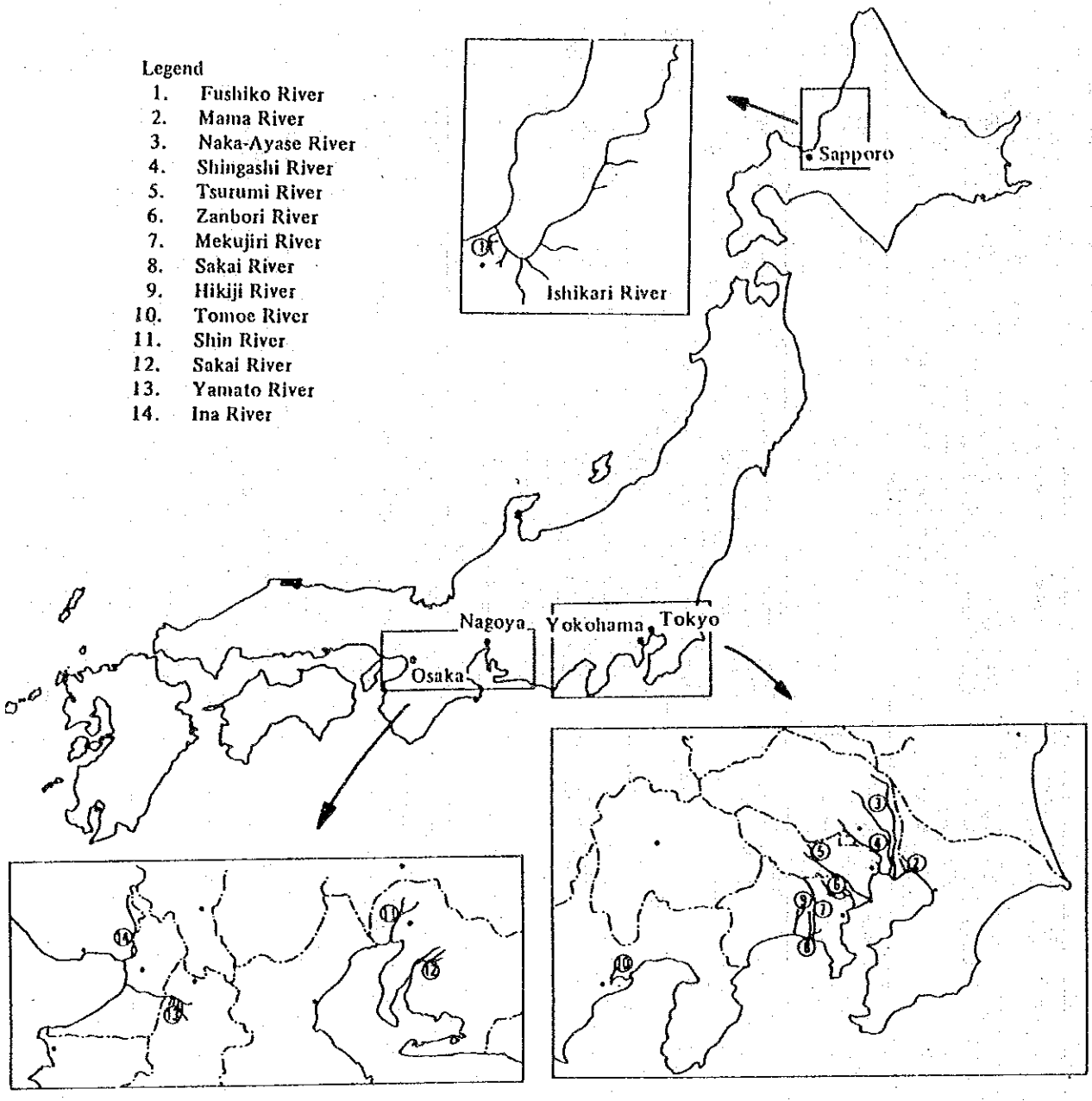


Fig. 6 A Map of River Designated for Comprehensive Flood Disaster Prevention Measures

5. Examples of the Comprehensive Flood Disaster Prevention Measures

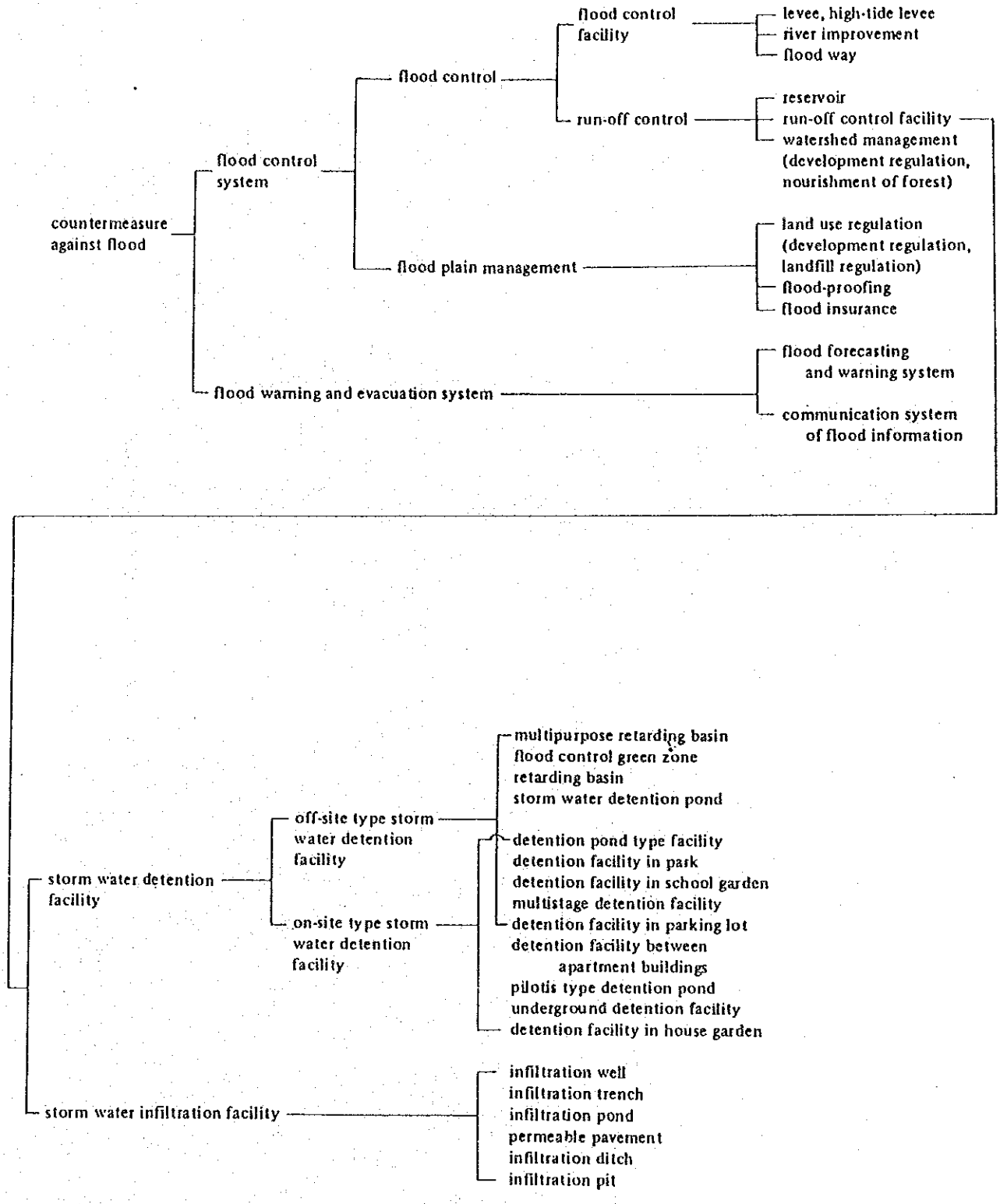


Fig. 7 Comprehensive Flood Disaster Prevention Measures

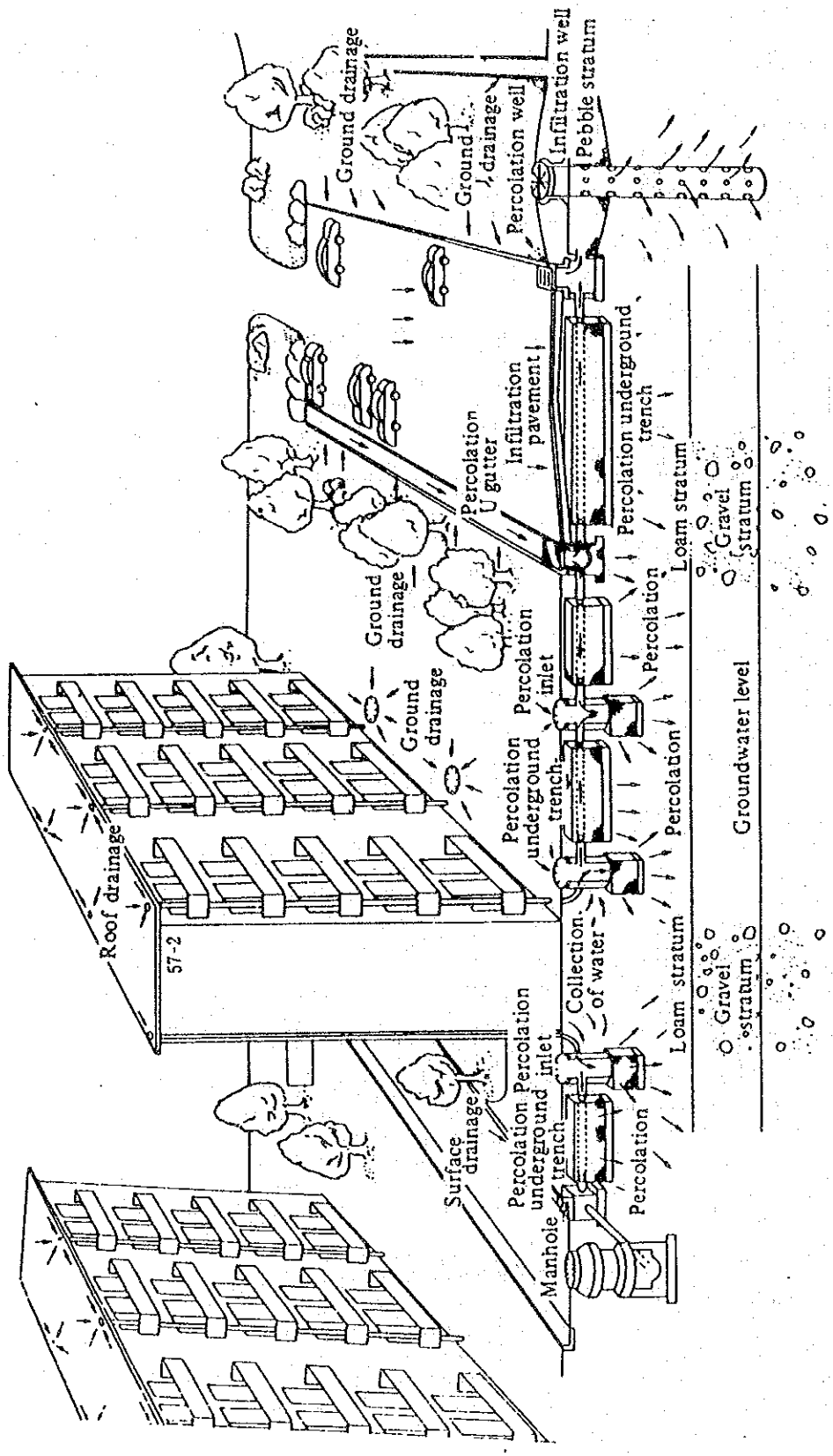


Fig. 8 Storm Water Infiltration Facilities

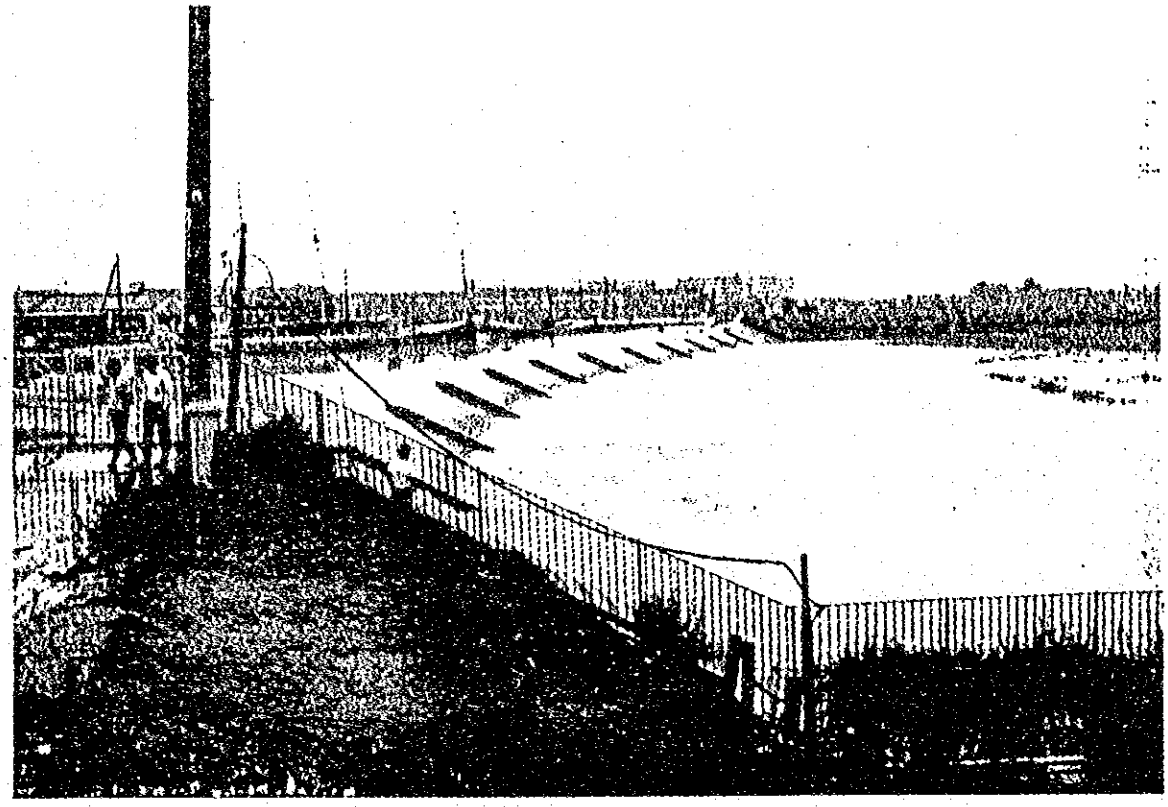


Photo. 1 Multipurpose Retarding Basin
(Neya River, Osaka)

Photo. 2 Storm Water Detention Pond
(Tsurumi River Basin, Machida City, Tokyo)

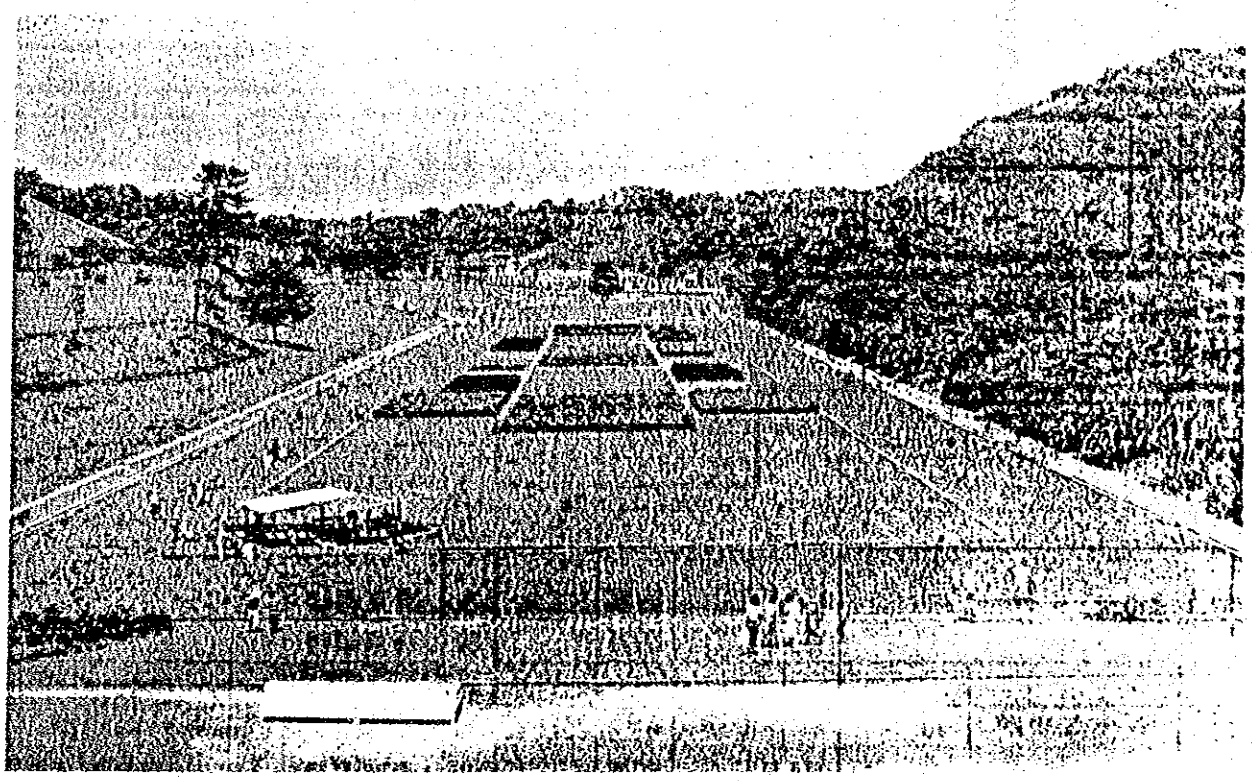


Photo. 3 Detention Facility in Kodomonokuni Park
(Tsurumi River Basin, Midori Ward, Yokohama)

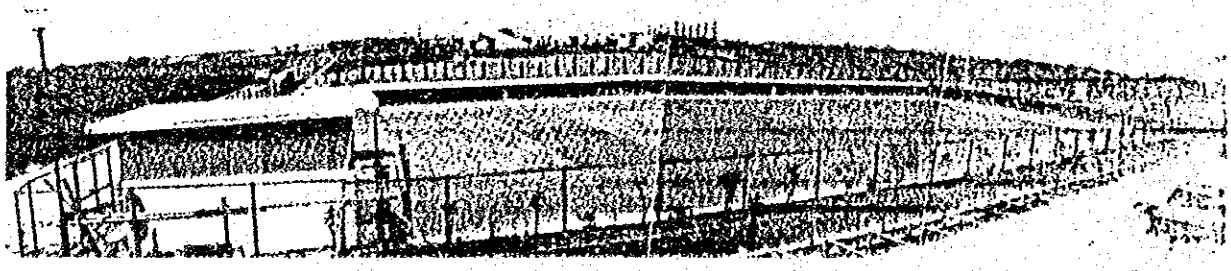


Photo. 4 Detention Facility in Playground of Bunkyo Univ.
(Moto-Ara River Basin, Saitama Pref.)

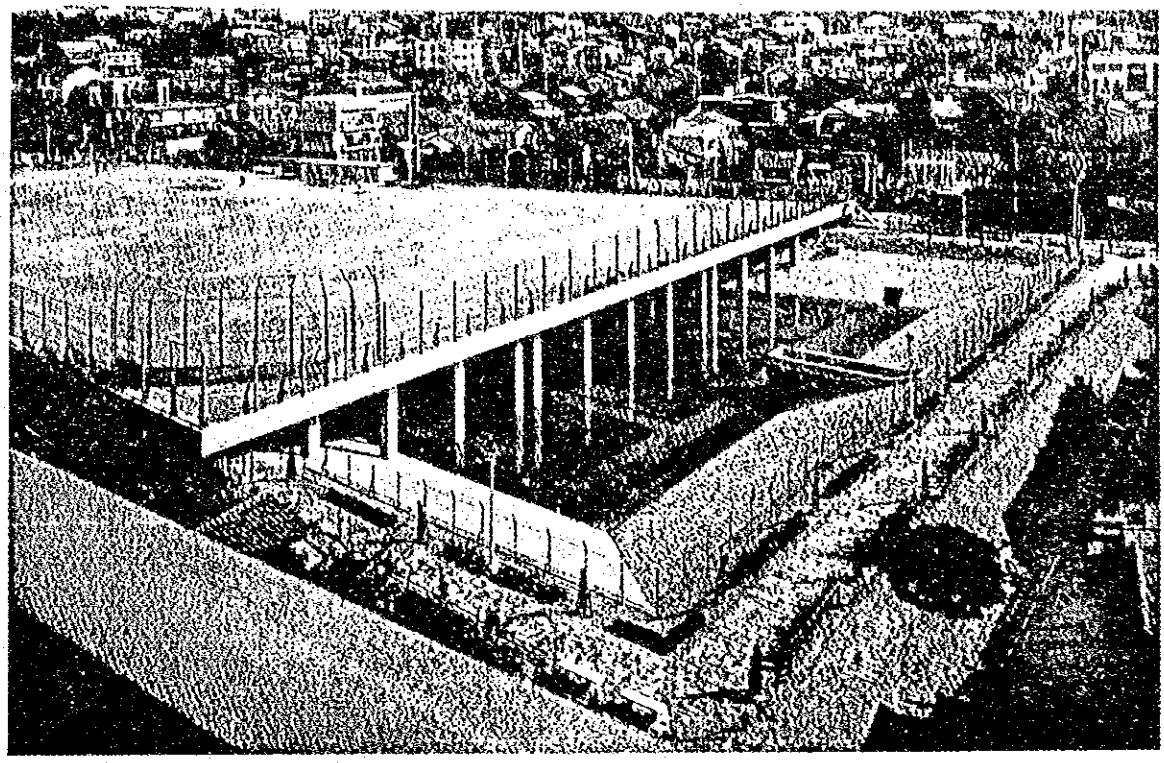


Photo. 5 Multistage Detention Facility (Pilotis Type)
(Syonai River Basin, Nagoya)

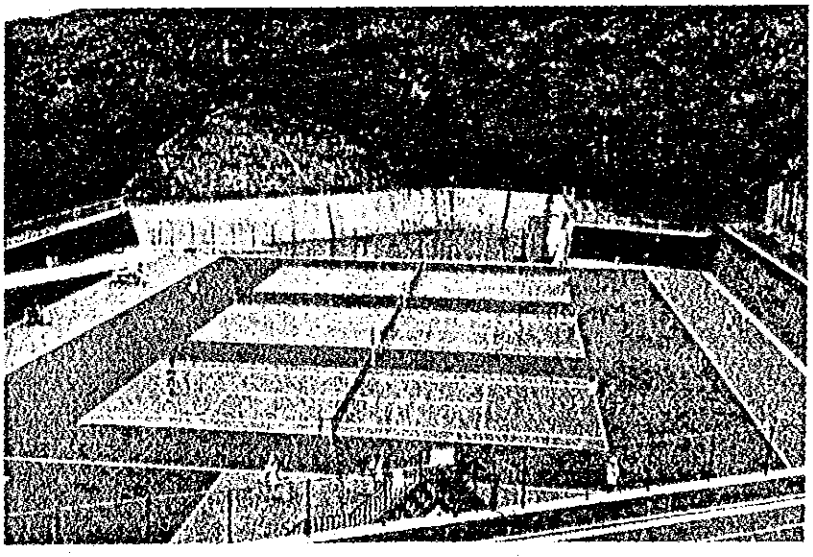


Photo. 6 Multistage Detention Facility
(Ohta River Basin, Hiroshima)

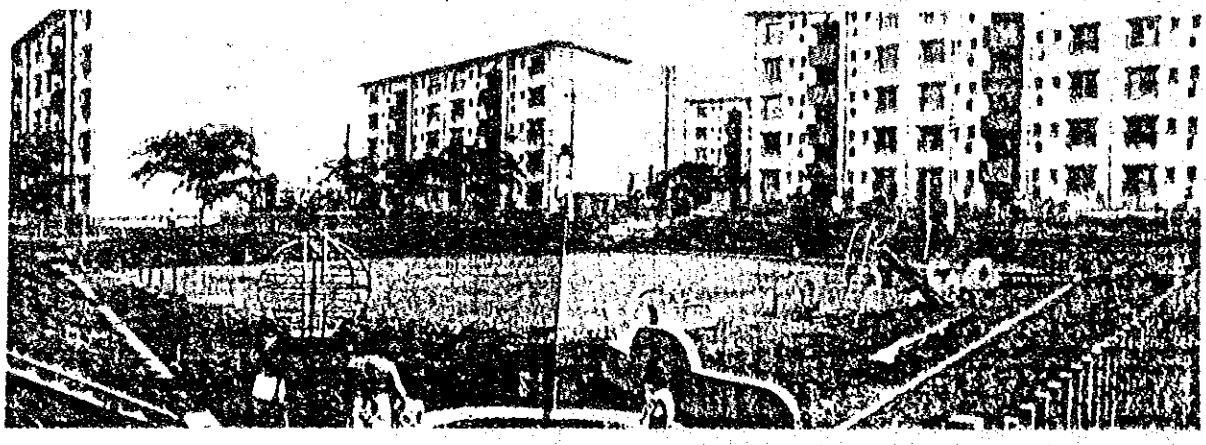


Photo. 7 Detention Facility between Apartment Buildings
(Shibazono Apartment, Kawaguchi City, Saitama Pref.)

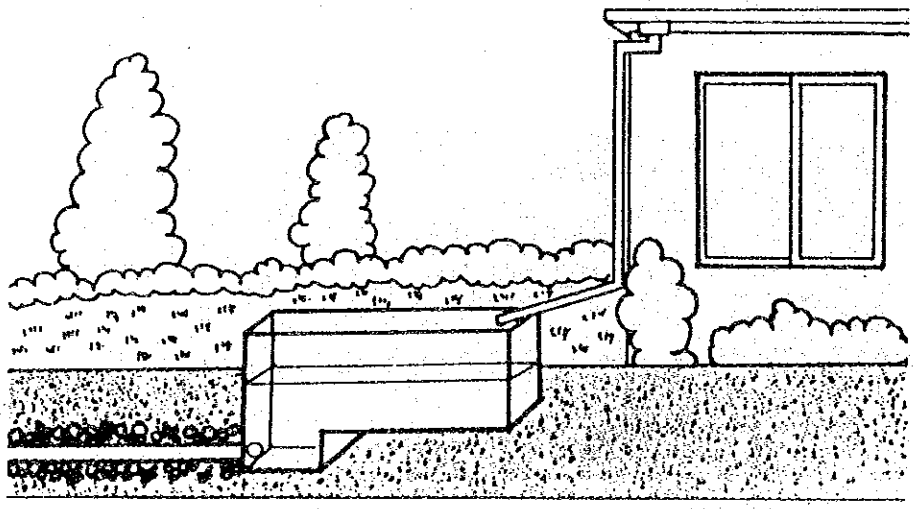


Fig. 9 Detention Facility in House Garden

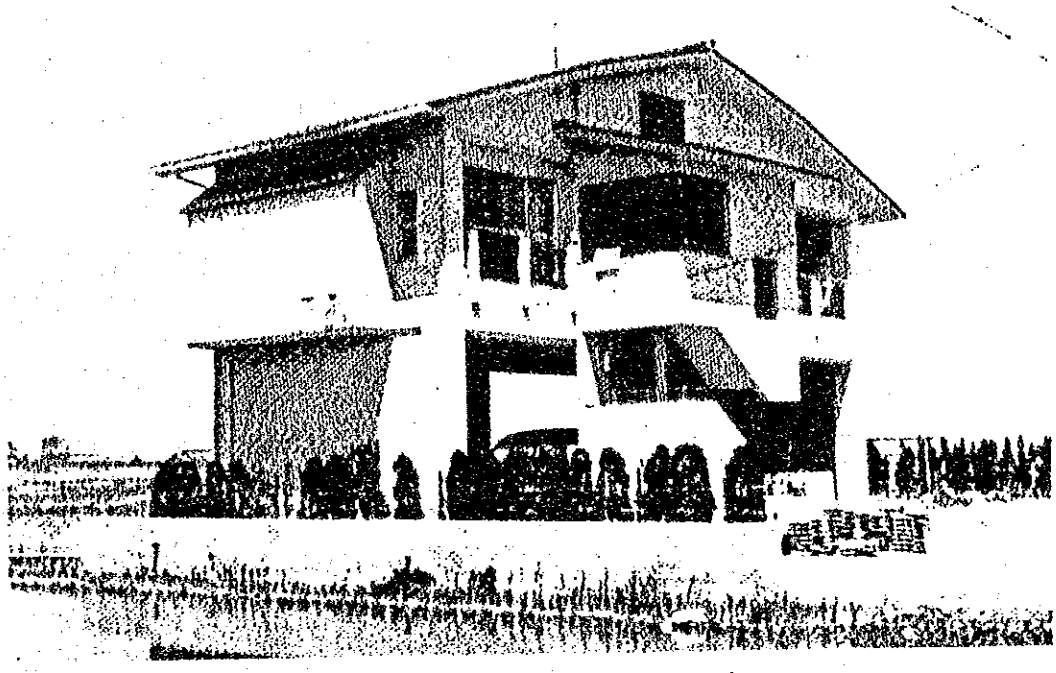


Photo. 8 Flood-Proofing (Elevated Type)
(Nabeta Reclaimed Land, Nagoya)

Photo. 9 Flood-Proofing Gate
(Kanda River Basin, Toshima Ward, Tokyo)

List of Publications by the Flood Disaster Prevention Division (1979 ~ 1986)

Journal of Research, P.W.R.I.

TITLE	AUTHOR	YEAR	VOL.
• Study on the Flood Disaster Prevention Planning and its Evaluation (I)	T. Yamaguchi K. Yoshikawa M. Tsunoda	March 1981	156–2
• Study on the Characteristics of Alluvial River Channels	K. Yamamoto	March 1986	168

Technical Memorandum of P.W.R.I.

TITLE	AUTHOR	YEAR	NO.
• Recent Trend of Storm Water Detention Facilities	F. Yoshino K. Yoshikawa H. Homma R. Ogawa	March 1980	1579
• Report on the Flood-Proofing Method of Buildings (2)	M. Tominaga F. Yoshino H. Homma	February 1981	1645
• Flood Plain Management in U.S.A. (Japanese Translation)	F. Yoshino S. Matsuura K. Yoshikawa J. Sago Y. Terakawa	March 1981	1657
• Report on the Hydraulic Model Experiment of the Storm Water Infiltration Facilities	F. Yoshino K. Yamamoto K. Yoshikawa M. Kaneki H. Homma M. Saito	March 1982	1767
• Report on the Flood Risk Map in the Shira River Basin	K. Yoshikawa N. Kiryu Y. Yokoyama	"	1826
• Study on Problems of Flood Disaster Prevention in Larger Rivers	S. Matsuura	November 1982	1867
• Fundamental Survey on Acts and Gists concerning Comprehensive Flood Disaster Prevention Measures – Explanation Edition – – Data Edition –	K. Yamamoto	"	1888
• Survey on Flood-Proofing Method of Buildings	K. Yamamoto H. Homma	February 1983	1916
• Flood Simulation – For More Rational Land Use of Flood Plains –	T. Suetsugi N. Kiryu Y. Yokoyama	"	1922
• Observed Data on Hydraulic Function of Storm Water Detention Pond in Makinohara	M. Saito	March 1983	1905
• Interim Report on Hydraulic Function of Asaka Reservoir along the Shingashi River	K. Yamamoto N. Kiryu K. Yoshikawa	"	1917
• Study on Relief Measures of Sufferers from Flood Disaster – Case Study of Flood Disaster in Nagasaki, July 1982 –	K. Yamamoto	"	1918

TITLE	AUTHOR	YEAR	NO.
· Present Status and Problems of the Flood Fighting System (1) – For Improvement of Flood Fighting System –	K. Yamamoto T. Suetsugi N. Kiryu	March 1984	2059
· Final Report on Armoured Levee – Investigation on Hydraulic Characteristics of Overtopping Flow and Problem in Application –	K. Yamamoto T. Suetsugi Y. Yokoyama	"	2081
· Report on Investigation and Estimate of Comprehensive Flood Disaster Prevention Measures – Case Study in mainly Urbanized Area –	Division (M. Kaneki)	"	2082
· Report on Prediction Method of Infiltration Capacity of Infiltration Trenches	K. Yamamoto M. Saito	August 1984	2126
· Data on Comprehensive Flood Disaster Prevention	K. Yamamoto T. Suetsugi	January 1985	2158
· Flood Simulation (2) – Investigation on Inundation Phenomenon and Applicability of Flood Simulation Method –	K. Yamamoto T. Suetsugi N. Kiryu	March 1985	2175
· Report on Hydraulic Model Test on the Ina River Channel	"	"	2222
· Report on Prediction Method of Infiltration Capacity of Infiltration Well	K. Yamamoto M. Kaneki	"	2176
· Report on Present Status of Open Levees – Including Survey on Gentle Slope Reach –	T. Hamaguchi M. Kaneki T. Nakajima	January 1986	2286
· Report on Preservation Method of Open Levee in Gentle Slope Reach – For Phased River Improvement and Preservation of Retarding Function –	T. Hamaguchi M. Kaneki	March 1986	2324
· Report on Communication System of Flood Information in Flood Fighting	T. Hamaguchi T. Suetsugi N. Kiryu	"	2327
· Report on Present Status of Secondary Levees in the Ara River Basin	T. Hamaguchi T. Kamada T. Nakajima	"	2328
· Investigation on Present Status of Flood Fighting Brigades	T. Hamaguchi T. Suetsugi N. Kiryu	September 1986	2407

TITLE	AUTHOR	YEAR	NO.
· Study on Intake and Drainage System in River Basin	T. Yamaguchi K. Yoshikawa	September 1979	21–9
· Analysis of the Change of Flood Disaster accompanied with the Change of Land Use and Estimate of Flood Disaster Prevention Measure	F. Yoshino K. Yoshikawa	February 1980	22–2
· Estimate of Storm Water Detention Facilities as Flood Disaster Prevention Measure – Estimate of Flood Disaster Prevention Function and Cost-Benefit Analysis –	F. Yoshino H. Homma K. Yoshikawa	December 1980	22–12
· Study on Flood Proofing Method of Building as Flood Disaster Prevention Measure	F. Yoshino H. Homma	July 1981	23–7
· Investigation on Run-Off Control Effect by Storm Water Infiltration Facility	F. Yoshino M. Kaneki M. Saito R. Ogawa	September 1981	23–9
· Flood Risk Map	F. Yoshino K. Yoshikawa M. Yamamoto	May 1982	24–5
· Survey on Present Status of Flood-Proofed Building in Lowland Area	T. Yamaguchi F. Yoshino K. Yamamoto H. Homma	January 1983	25–1
· Width of Alluvial River	K. Yamamoto	October 1983	25–10
· Flood Simulation	K. Yamamoto T. Suetsugi	December 1983	25–12
· Investigation on Infiltration Capacity of Storm Water Infiltration Facility through Field Survey	K. Yamamoto M. Saito	January 1984	26–1
· Study on Present Status of Flood Fighting System – Through the Investigation in the Downstream Area of the Tone River –	K. Yamamoto T. Suetsugi	May 1984	26–5
· Historical Inundation Map	H. Homma	August 1984	26–8
· Study on Infiltration Characteristics of Storm Water Infiltration Facility through Hydraulic Model Test	K. Yamamoto M . Saito	October 1984	26–10
· Present Status and its Problem of Flood Fighting System in Urbanized River Basin –Through the Survey on the Yedo, Naka River Basin –	K. Yamamoto T. Suetsugi N. Kiryu	December 1984	26–12
· Analysis of Public Consciousness to Flood Damage using Newspaper Accounts	T. Suetsugi	May 1985	27–5
· Applicability of Flood Simulation Model to Various Geographical Characteristics	K. Yamamoto T. Suetsugi	July 1985	27–7
· Storm Water Storage and its Use in Urban Area	T. Yamaguchi H. Homma	November 1985	27–11
· Study on River Improvement Plan considering the Construction of Floodways	K. Yamamoto T. Suetsugi N. Kiryu	December 1985	27–12
· Present Status of Comprehensive Flood Disaster Prevention Measures and River Conservation Plan	H. Homma	"	"

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