OFFICE OF NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD (NESDB)

ROYAL IRRIGATION DEPARTMENT (RID)
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KINGDOM OF THAILAND

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

Final Report

Volume 3: Supporting Report (1/2)

September 2013

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CTI ENGINEERING INTERNATIONAL CO., LTD.
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COMPOSITION OF FINAL REPORT

Volume 1: Summary Report

Volume 2: Main Report

Volume 3: Supporting Report (1/2)

Sector A.	GIS Database
Sector B.	Natural and Social Environment
Sector C.	Hydrological Observation and Analysis
Sector D.	Hydrological and Hydraulic Model Development and Analysis
Sector E.	Evaluation of Countermeasures with Other Rainfall Pattern
Sector F.	Study on River Channel Improvement
Sector G.	Study on Efficient Operation of Existing Dam Reservoirs

Volume 3: Supporting Report (2/2)

Sector H.	Construction of New Dams
Sector I.	Retarding and Retention Area
Sector J.	Construction of Diversion Channel
Sector K.	Controlled Inundation
Sector L.	Land Use Control in Inundation Area
Sector M.	Inland Rain Storm Drainage
Sector N.	Forest Restoration
Sector O.	Cost Estimation
Sector P.	Economic Evaluation
Sector Q.	Environment
Sector R.	Climate Change
Sector S.	Storm Surge
Sector T.	Examination of Observed Data by RID
Sector U.	Materials of Workshop on July 16-17, 2013

Addendum Report: The Flood Analysis on the Chao Phraya River with RRI Model

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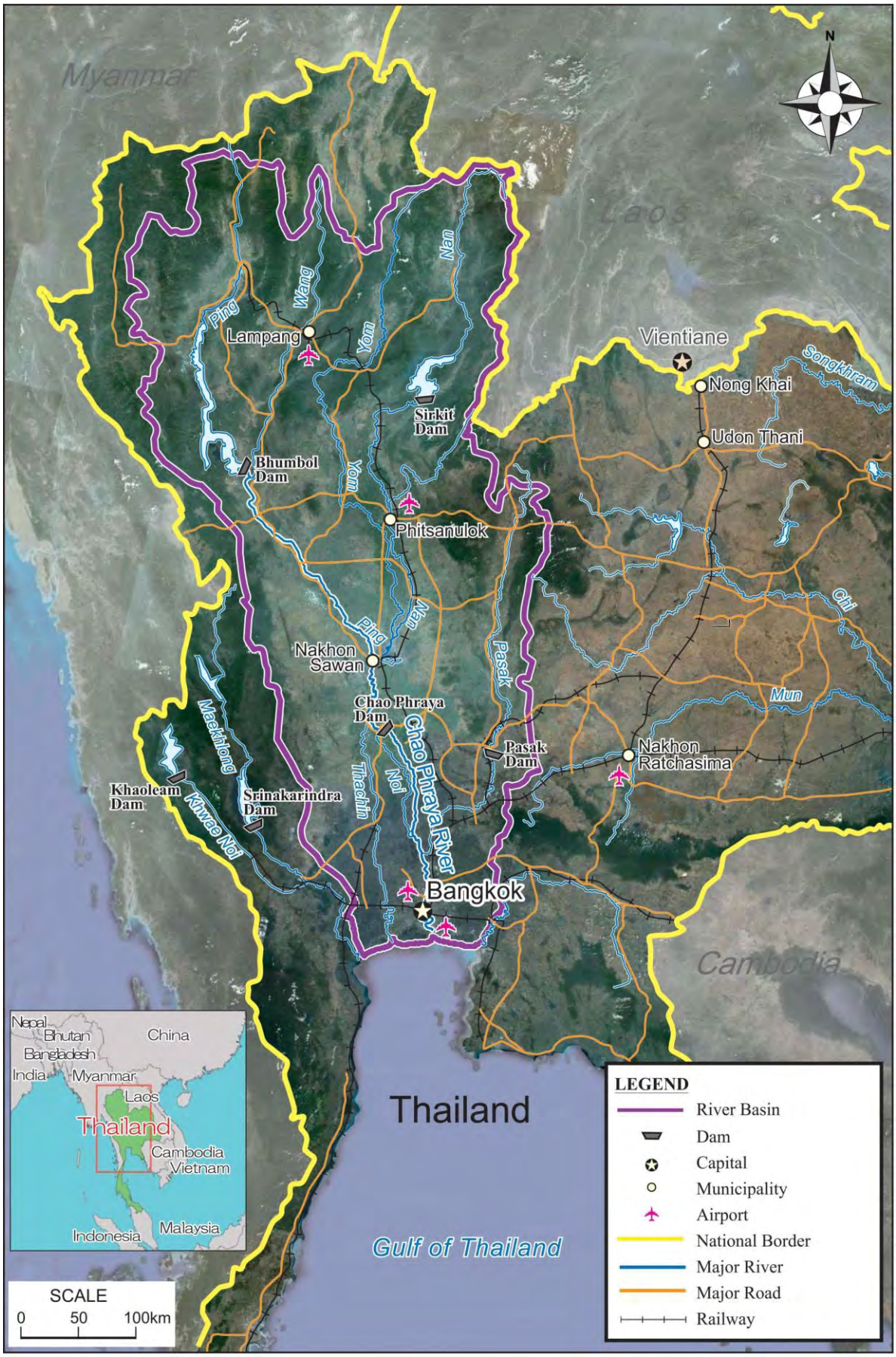


LOCATION MAP

ABBREVIATIONS

AIT	Asian Institute of Technology
ALRO	Agricultural Land Reform Office
BMA	Bangkok Metropolitan Administration
CAT	Communication Authority of Thailand
CPB	The Crown Property Bureau
DDPM	Department of Disaster Prevention and Mitigation
DDS	Department of Drainage and Sewerage, BMA
DEDP	Department of Energy Development and Promotion
DF	Department of Fisheries
DGR	Department of Groundwater Resources
DIW	Department of Industrial Works
DOH	Department of Highway
DOLA	Department of Local Administration
DOR	Department of Rural Road
DPT	Department of Public Works and Town and Country Panning
DPW	Department of Technical and Economic Cooperation
DTCP	Department of Town and Country Planning
DWR	Department of Water Resources
EGAT	Electricity Generating Authority of Thailand
FFC	Flood Forecasting Center
GISTDA	Geo-Informatics and Space Technology Development Agency
GOT	Government of the Kingdom of Thailand
ICHARM	International Center for Water Hazard and Risk Management
IEC	Irrigation Engineering Center
IMPAC-T	Integrated Study Project on Hydro-meteorological Prediction and Adaptation to Climate Change in Thailand
JETRO	Japan External Trade Organization
LAO	Local Authority Organizations
MD	Marine Department
MI	Ministry of Industry
MOAC	Ministry of Agriculture and Cooperative
MOI	Ministry of Interior
MNRE	Ministry of Natural Resources and Environment
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Transport
MST	Ministry of Science and Technology
NDPMC	National Disaster Prevention and Mitigation Committee
NESDB	National Economic and Social Development Board
NEB	National Environmental Board
NWRFPC	National Water Resources and Flood Policy Committee
NWRC	National Water Resources Committee
NSO	National Statistic Office
OBI	Office of the Board of Investment
OCS	Office of the Council of the State
OEPP	Office of Environmental Policy and Planning
ONWRFPC	Office of National Water Resources and Flood Policy Committee

OPM	Office of the Prime Minister
OSCWRM	Office of Strategic Committee for Water Resources Management
PAT	Port Authority of Thailand
PCD	Pollution Control Department
RBC	River Basin Committee
RFD	Royal Forest Department
RID	Royal Irrigation Department
RTN	Royal Thai Navy
RTSD	Royal Thai Survey Department
SCRFD	Strategic Committee for Reconstruction and Future Development
SCWRM	Strategic Formulation Committee for Water Resources Management
SRT	State Railways of Thailand
THB	Thai Baht
TMD	Thai Meteorological Department
TOT	Telecommunication Organization of Thailand
WRFMC	Water Resources and Flood Management Committee
WT	Public Works Department

MEASUREMENT UNITS

(Length)

mm	:	millimeter(s)
cm	:	centimeter(s)
m	:	meter(s)
km	:	kilometer(s)

(Time)

s, sec	:	second(s)
min	:	minute(s)
h, hr	:	hour(s)
d, dy	:	day(s)
y, yr	:	year(s)

(Area)

mm^2	:	square millimeter(s)
cm^2	:	square centimeter(s)
m^2	:	square meter(s)
km^2	:	square kilometer(s)
ha	:	hectare(s)

(Volume)

cm^3	:	cubic centimeter(s)
m^3	:	cubic meter(s)
l, ltr	:	liter(s)
MCM	:	million cubic meter(s)

(Weight)

g, gr	:	gram(s)
kg	:	kilogram(s)
ton	:	ton(s)

(Speed/Velocity)

cm/s	:	centimeter per second
m/s	:	meter per second
km/h	:	kilometer per hour

Sector A: GIS Database

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

FINAL REPORT
VOLUME 3: SUPPORTING REPORT

SECTOR A: TABLE OF CONTENTS

LIST OF TABLES

CHAPTER A1 DATA LIST

A1.1 Vector Data

Following Vector data were collected and rearranged in the project.

Table A1.1.1 List of Vector Data (1/2)

Layer Name	File Name	Data Format	From Where	Description
Administrative	Amp_Pt_CPRB	Shape file (Point)	RID	Location of Apmphoe
	Amphoe_CPRB	Shape file (Polygon)	RID	Amphoe Boundary
	District_BMA	Shape file (Polygon)	BMA	Boundary of district of BMA
	Subdistrict_BMA	Shape file (Polygon)	BMA	Boundary of subdistrict of BMA
	Municipa_CPRB	Shape file (Polygon)	RID	Boundary of municipality
	Prov_Pt_CPRB	Shape file (Point)	RID	Location of Provincial office
	Province_CPRB	Shape file (Polygon)	RID	Boundary of province
	Tambon_CPRB	Shape file (Polygon)	RID	Boundary of Tambon
	Village_CPRB	Shape file (Polygon)	RID	Location of Village
Basin	Basin_CPRB	Shape file (Polygon)	RID	River Basin Boundary
	Boundary_CPRB	Shape file (Polygon)	RID	Chao Praya River Basin Boundary
	Subbasin_CPRB	Shape file (Polygon)	RID	Sub Basin boundary
Culture	BMA_Office	Shape file (Point)	RID	Location of BMA District office
	Educate_BMA	Shape file (Point)	BMA	Location of School, University and Collage
	Hospital_BMA	Shape file (Point)	BMA	Location of hospital in BMA
	Landmark_BMA	Shape file (Point)	BMA	Location of landmark in BMA
	Landmark_CPRB_MOT	Shape file (Point)	MOT	Location of landmark in CPRB
	Police_Area_MOT	Shape file (Polygon)	MOT	Boundary of police station reponsible area
	School_BMA	Shape file (Point)	BMA	Location of school in BMA
Dam	Dam_CPRB	Shape file (Point)	RID	Location of dam in CPRB
	Existing_Dam_CPRB	Shape file (Point)	RID	Location of Existing dam in CPRB
	Proposed_Dam_CPRB	Shape file (Point)	RID	Location of proposed dam in CPRB
Flood_Area	Flood2005_CPRB	Shape file (Polygon)	GISTDA	Flooded area in 2005
	Flood2006_CPRB	Shape file (Polygon)	GISTDA	Flooded area in 2006
	Flood2007_CPRB	Shape file (Polygon)	GISTDA	Flooded area in 2007
	Flood2008_CPRB	Shape file (Polygon)	GISTDA	Flooded area in 2008
	Flood2009_CPRB	Shape file (Polygon)	GISTDA	Flooded area in 2009
	Flood2010_CPRB	Shape file (Polygon)	GISTDA	Flooded area in 2010
	Flood_08_2011_CPRB	Shape file (Polygon)	GISTDA	Flooded area in Aug 2011
	Flood_09_2011_CPRB	Shape file (Polygon)	GISTDA	Flooded area in Sep 2011
	Flood_10_2011_CPRB	Shape file (Polygon)	GISTDA	Flooded area in Oct 2011
	Flood_11_2011_CPRB	Shape file (Polygon)	GISTDA	Flooded area in Nov 2011
	Flood_12_2011_CPRB	Shape file (Polygon)	GISTDA	Flooded area in Dec 2011
	Flood_Grid_CPRB	Shape file (Polygon)	Study Team	Grid plan 2x2 sq.km for surveying
	Flood_Potential_Area	Shape file (Polygon)	GISTDA	Flood risk area
	Floodmark_CPRB	Shape file (Point)	Study Team	Location of flood depth serveying point
Flood_Structure	Floodway_longterm	Shape file (Line)	Study Team	Alignment of flood way
	King_Dike	Shape file (Polygon)	RTSD	Boundary of king dike
	Protection_Area	Shape file (Polygon)	Study Team	Boundary of protection area
	Retention_Area_2012	Shape file (Polygon)	Study Team	Boundary of retention area
	Retention_Area_Masterplan	Shape file (Polygon)	Study Team	Boundary of retention area from RID's master plan
	Retention_Area_Study	Shape file (Polygon)	Study Team	Boundary of retention area from study team
	Retention_Area_TOR	Shape file (Polygon)	Study Team	Boundary of retention area from TOR
Forest	Forest2004_CPRB	Shape file (Polygon)	Forest Dep.	Forest area 2004
	Forest2008_CPRB	Shape file (Polygon)	Forest Dep.	Forest area 2008

Table A1.1.2 List of Vector Data (2/2)

Layer Name	File Name	Data Format	From Where	Description
Geology	Geol_Str_CPRB	Shape file (Polygon)	DMR	Geology structure
	Geology_CPRB	Shape file (Polygon)	DMR	Geology
Irrigation_Structure	Canal	Shape (Line)	RID	Location of canal
	Pump	Shape (Point)	RID	Location of pump station
	Regulator	Shape Point)	RID	Location of regulator
Land_Use	Land use 2002_CPRB	Shape file (Polygon)	LDD	Land use 2002 in CPRB
	Land use 2009_CPRB	Shape file (Polygon)	LDD	Land use 2009 in CPRB
Population	POP_CPRB	Shape file (Polygon)	DOPA	Population in Tambon level year 2011 in CPRB
RID	Hydro_Center_CPRB	Shape file (Point)	RID	Location of water management and hydrology office
	Hydro_Region_CPRB	Shape file (Polygon)	RID	Responsible area of water management and hydrology department regional office
	Irrigation_Office_CPRB	Shape file (Point)	RID	Location of RID regional office
	Irrigation_Project_Area_CPRB	Shape file (Polygon)	RID	Responsible area of RID project office
	Prov_RID_CPRB	Shape file (Point)	RID	Location of RID provincial office office
	RID_CPRB	Shape file (Polygon)	RID	Responsible area of RID regional office
Station	Coastal_Water_Level_Station	Shape file (Point)	GISTDA	Location of coastal water level station
	DWR_Early_Warning_Station_CPRB	Shape file (Point)	DWR	Location of early warning station in CPRB
	DWR_Rain_Station_Manual_CPRB	Shape file (Point)	DWR	Location of rain station in CPRB (Manual)
	DWR_Telemetry_Station_CPRB	Shape file (Point)	DWR	Location of telemetry station in CPRB
	DWR_Water_Level_Station_Manual_CPRB	Shape file (Point)	DWR	Location of water level station in CPRB (Manual)
	GISTDA_Bouy_Station	Shape file (Point)	GISTDA	Location of bouy station
	RID_Rain_Station_Manual_CPRB	Shape file (Point)	RID	Location of rain station in CPRB (Manual)
	RID_Rain_Station_Telemetry_CPRB	Shape file (Point)	RID	Location of rain station in CPRB (Telemetry)
	RID_Station_Location_CPRB	Shape file (Point)	RID	Location of Observation station
	RID_Water_Level_Station_Manual_CPRB	Shape file (Point)	RID	Location of level station in CPRB (Manual)
	RID_Water_Level_Station_Telemetry_CPRB	Shape file (Point)	RID	Location of level station in CPRB (Telemetry)
	Tidal_Station	Shape file (Point)	RID	Location of tidal station
	TMD_Coastal_Radar_Station	Shape file (Point)	TMD	Location of coastal radar station
	TMD_Rain_Station_Manual_CPRB	Shape file (Point)	TMD	Location of rain station in CPRB (Manual)
	TMD_Rain_Station_Telemetry_CPRB	Shape file (Point)	TMD	Location of rain station in CPRB (Telemetry)
	TMD_Weather_Station_CPRB	Shape file (Point)	TMD	Location of weather station
Topographic	Contour_CPRB	Shape file (Line)	RID	Contour line
	Spot height_CPRB	Shape file (Point)	RID	Spot height
	Index50000	Shape file (Polygon)	RID	Legend of topographic map
Transport	BTS_MOT	Shape file (Line)	RID	Alignment of BTS and MRT
	Mainroad_BMA	Shape file (Line)	RID	Main road in BMA
	Rail_MOT_CPRB	Shape file (Line)	MOT	Rail track alignment in CPRB
	Road_MOT_CPRB	Shape file (Line)	MOT	Road network in CPRB from MOT
	Road_RID_CPRB	Shape file (Line)	RID	Road network in CPRB from RID
	Station_MOT_CPRB	Shape file (Line)	MOT	Train station in CPRB
Water_Body	Main River_CPRB	Shape file (Line)	RID	Main river in CPRB
	Stream_CPRB	Shape file (Line)	RID	Stream in CPRB
	Water body_CPRB	Shape file (Polygon)	RID	Water body in CPRB

A1.2 Raster Data

Following raster data were collected and rearranged in the project.

Table A1.2.1 List of Raster Data

Layer Name	File Name	Data Format	From Where	Description
DEM	GDEM_CPRB	GRID file	ASTER	Digital Elevation Data with 30m resolution in Chao Phraya River Basin
	SRTM_CPRB	GRID file	NASA	Digital Elevation Data with 90m resolution in Chao Phraya River Basin
Satellite	L5_129048_19960116	ERDAS Imagine	USGS	LANDSAT-5 observed in 1996
	L5_129049_19960116			LANDSAT-5 observed in 1996
	L5_129050_19960523			LANDSAT-5 observed in 1996
	L5_129051_19960523			LANDSAT-5 observed in 1996
	L5_130048_19960123			LANDSAT-5 observed in 1996
	L5_130049_19960123			LANDSAT-5 observed in 1996
	L5_130050_19960208			LANDSAT-5 observed in 1996
	L5_129048_20110415			LANDSAT-5 observed in 2011
	L5_129049_20110415			LANDSAT-5 observed in 2011
	L5_129050_20110415			LANDSAT-5 observed in 2011
	L5_129051_20110415			LANDSAT-5 observed in 2011
	L5_130048_20091212			LANDSAT-5 observed in 2009
	L5_130049_20091212			LANDSAT-5 observed in 2009
	L5_130050_20091212			LANDSAT-5 observed in 2009
Topographic	(Map sheet No.)	JPEG Image	RID	Scanned topographic maps at the scale of 1: 50,000

A1.3 Tabular Data

Following raster data were collected and rearranged in the project.

Table A1.3.1 List of Tabular Data

Layer Name	File Name	Data Format	From Where	Description
Factory	Factory data 2012	Exel	MOI	Factory data in 2012 from MOI

CHAPTER A2 GIS DATA DICTIONARY

There are 19 layers (categories) in the GIS database. In this chapter, detailed attributes information for each data in the each category is described as a GIS data dictionary.

A2.1 Administrative Boundary

(1) Province Boundary in Chao Phraya River Basin

THEME : Province_CPRB.shp
TYPE : Polygon
DESCRIPTION : Province Boundary in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Prov_id	S	8		8 Digits Province code
2	Prov_code	S	2		2 Digits Province code
3	Prov _nam_t	S	50		Province Name in Thai
4	Prov _nam_e	S	50		Province Name in English
5	Reg_code	S	1		Region code
6	Reg_name	S	50		Region name in Thai
Format Type					Scale: 1 : 50,000
S : String					Resource : RTSD
					Source of Data : Topographic Map

(2) Province Location in Chao Phraya River Basin

THEME : Prov_Pt_CPRB.shp
TYPE : Point
DESCRIPTION : Province Location in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Prov_id	S	8		8 Digits Province code
2	Prov_code	S	2		Province code
3	Prov_name	S	50		Provincial office's Name
4	Prov _nam_t	S	50		Province Name in Thai
5	Prov _nam_e	S	50		Province Name in English
6	Peasting	N	16	5	UTM Coordination Easting
7	Pnorthing	N	16	5	UTM Coordination Northing
8	Reg_code	S	1		Region code
Format Type					Scale: 1 : 50,000
S : String					Resource : RTSD
N : Numeric					Source of Data : Topographic map

(3) Amphoe Boundary in Chao Phraya River Basin

THEME : Amphoe_CPRB.shp
TYPE : Polygon
DESCRIPTION : District boundary in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec	
1	Amp_id	S	8		8 Digits District code
2	Amp_code	S	2		District code
3	Amp_nam_t	S	50		District Name in Thai
4	Amp_nam_e	S	50		District Name in English
5	Prov_code	S	2		Province code
6	Reg_code	S	1		Region code
Format Type:					Scale: 1 : 50,000
S : String					Resource : RTSD
					Source of Data : Topographic map

(4) Amphoe Location in Chao Phraya River Basin

THEME : Amp_Pt_CPRB.shp
TYPE : Point
DESCRIPTION : Amphoe location in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec	
1	Amp_code	S	2		District code
2	Amp_name	S	50		Government office's name
3	Amp_nam_t	S	50		District Name in Thai
4	Amp_nam_e	S	50		District Name in English
5	Peasting	N	16	5	UTM Coordination Easting
6	Pnorthing	N	16	5	UTM Coordination Northing
7	Prov_code	S	2		Province code
8	Reg_code	S	1		Region code
9	Amp_id	S	8		District ID
Format Type					Scale: 1 : 50,000
S : String					Resource : RTSD
N : Numeric					Source of Data : Topographic map

(5) Amphoe Boundary in BMA

THEME : District_BMA.shp
TYPE : Polygon
DESCRIPTION : District boundary in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec		
1	DNAME	S	25		District name in Thai	ชื่ออำเภอภาษาไทย
2	Name_E	S	50		District name in English	ชื่ออำเภอภาษาอังกฤษ
Format Type					Scale:	
S : String					Resource : BMA	
					Source of Data :	

(6) Tambon Boundary in Chao Phraya River Basin

THEME : Tambon_CPRB.shp
TYPE : Polygon
DESCRIPTION : Sub-District Boundary in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec	
1	Tambon_id	S	8		8 Digits Sub-District code
2	Tam_code	S	2		Sub-District code
3	Tam_nam_t	S	50		Sub-District Name in Thai
4	Amp_code	S	2		District code
5	Prov_code	S	2		Province code
6	Reg_code	S	1		Region code
Format Type					Scale:
S : String					Resource :
					Source of Data :

(7) Tambon Boundary in BMA

THEME : Subdistrict_BMA.shp
TYPE : Polygon
DESCRIPTION : Sub-District Boundary in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec		
1	DNAME	S	20		District name in Thai	ชื่ออำเภอภาษาไทย
2	SNAME	S	20		Sub-district name in Thai	ชื่อตำบลภาษาอังกฤษ
Format Type					Scale:	
S : String					Resource : BMA	
					Source of Data :	

(8) Municipal Boundary in Chao Phraya River Basin

THEME : Municipa.shp
TYPE : Polygon
DESCRIPTION : Municipality Boundary in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec	
1	Municipa_id	S	8		8 Digits Municipal code
2	Muni_name	S	50		Municipality name in Thai
3	Amp_name	S	50		District name in Thai
4	Prov_name	S	50		Province name in Thai
5	Tam_code	S	16		Sub-district code
6	Amp_code	S	5		District code
7	Prov_code	S	2		Province code
8	Reg_code	S	1		Region code
Format Type:					Scale:
S : String					Resource :
					Source of Data :

(9) Village Location in Chao Phraya River Basin

THEME : Village.shp
TYPE : Point
DESCRIPTION : Village location in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec	
1	Vill_code	S	8		8 Digits Village code
2	Vill_nam_t	S	50		Village Name in Thai
3	Vill_nam_e	S	50		Village Name in English
4	Tb_code	S	6		Sub-District code
5	Tambon	S	50		Sub-District name
6	Amp_code	S	4		District code
7	Amphoe	S	50		District name
8	Prv_code	S	2		Province code
9	Province	S	50		Province name
10	Reg_code	S	1		Region Code
11	Lat_n	S	16		Latitude
12	Long_e	S	16		Longitude
13	Utm	S	20		UTM Coordination
14	Sheet	S	50		Map Sheet Number (1:50,000)
15	Zone	S	20		UTM Zone
16	Utm_x	N	6		X UTM Coordination
17	Utm_y	N	7		Y UTM Coordination
18	Reg_name	S	25		Region Name
DATA TYPES :					Scale: 1 : 50,000
S : String					Resource : RTSD
N : Numeric					Source of Data : Topographic map

A2.2 Basin Boundary

(1) Boundary of Chao Phraya River Basin

THEME : Boundary_CPRB.shp
TYPE : Polygon
DESCRIPTION : Boundary of whole Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Name	S	30		8 Digits Municipal code
2	Area_sqkm	N	20	2	Municipality name in Thai
Format Type:					Scale: 1 : 50,000
S : String					Resource : RID
					Source of Data :

(2) River Basin Boundary in Chao Phraya River Basin

THEME : Basin_CPRB.shp
TYPE : Polygon
DESCRIPTION : Boundary of river basin in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	BASIN_CODE	S	4		Basin code
2	BASIN_NT	S	50		Basin name in Thai
3	Basin_NE	S	50		Basin name in English
4	Basin_GRP	S	2		Basin group number
5	Area_sqkm	N	20	2	Area (km^2)
Format Type:					Scale: 1 : 50,000
S : String					Resource : RID
N : Numeric					Source of Data :

(3) Sub-basin Boundary in Chao Phraya River Basin

THEME : Subbasin_CPRB.shp
TYPE : Polygon
DESCRIPTION : Boundary of sub-basin in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	SUB_CODE	S	8		Sub-basin code
2	SUB_NT	S	50		Sub-basin name in Thai
3	SUB_NE	S	50		Sub-basin name in English
4	BASIN_CODE	S	4		Basin code
5	BASIN_NT	S	50		Basin name in Thai
6	BASIN_NE	S	50		Basin name in English
7	Area_sqkm	N	20	2	Area (km2)
Format Type:					Scale: 1 : 50,000
S : String					Resource : RID
N : Numeric					Source of Data :

A2.3 Culture

(1) Location of BMA Office

THEME : BMA_Office.shp
TYPE : Point
DESCRIPTION : Location of BMA office

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	ID	S	8		ID Number (Empty)
Format Type:					Scale:
S : String					Resource : BMA
					Source of Data :

(2) Location of Educational Facility in BMA

THEME : Educate_BMA.shp
TYPE : Point
DESCRIPTION : Location of educational facility in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME	S	60		Facility name in Thai	ชื่อสถานศึกษาภาษาไทย
2	TYPE	S	4		Type number of Landmark	ประเภทของสถานที่สำคัญ
Format Type:					Scale:1:20,000	
S : String					Resource : BMA	
					Source of Data :	

(3) Location of Hospital in BMA

THEME : Hospital_BMA.shp
TYPE : Point
DESCRIPTION : Location of hospitals in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME	S	60		Hospital's name in Thai	ชื่อสถานพยาบาลภาษาไทย
2	TYPE	S	4		Type number of Landmark	ประเภทของสถานที่สำคัญ
Format Type:					Scale:1:20,000	
S : String					Resource : BMA	
					Source of Data :	

(4) Location of Landmark in BMA

THEME : Landmark_BMA.shp
TYPE : Point
DESCRIPTION : Location of landmarks in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME	S	60		Landmark's name in Thai	ชื่อสถานที่สำคัญภาษาไทย
2	TYPE	S	4		Type number of Landmark	ประเภทของสถานที่สำคัญ
Format Type:					Scale:1:20,000	
S : String					Resource : BMA	
					Source of Data :	

(5) Location of Landmark in Chao Phraya River Basin

THEME : Landmark_CPRB_MOT.shp
TYPE : Point
DESCRIPTION : Location of landmarks in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	NAME_T	S	105		Name of landmark in Thai
2	NAME_E	S	105		Name of landmark in Englich
3	TYPE	S	9		Type number of landmark
4	CRE_DATE	D			Created date
5	MOD_DATE	D			Modified date
6	APP_DATE	D			Applied date
Format Type:					Scale:
S : String					Resource : Ministry of Transport
D : Date					Source of Data :

(6) Responsible Area by Police in BMA

THEME : Police_Area_MOT.shp
TYPE : Polygon
DESCRIPTION : Responsible boundary of police station in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME_T	S	105		Name of responsible area in Thai	ชื่อพื้นที่รับผิดชอบภาษาไทย
2	NAME_E	S	105		Name of responsible area in English	ชื่อพื้นที่รับผิดชอบภาษาอังกฤษ
3	CRE_DATE	D			Created date	วันที่จัดทำ
4	MOD_DATE	D			Modified date	วันที่แก้ไข
5	APP_DATE	D			Applied date	วันที่นำไปใช้
Format Type:					Scale:	
S : String					Resource : Ministry of Transport	
D : Date					Source of Data :	

(7) Location of School in BMA

THEME : School_BMA.shp
TYPE : Point
DESCRIPTION : Location of schools in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME_T	S	60		Name of school in Thai	ชื่อสถานศึกษาภาษาไทย
2	NAME_E	S	60		Name of school in English	ชื่อสถานศึกษาภาษาไทยอังกฤษ
3	CODE	S	6		Code	รหัสสถานศึกษา
4	DCODE	N	2		District code	รหัสอำเภอ
5	SCODE	N	4		Sub-district code	รหัสตำบล
6	ADDRESS	S	75		Address of school	ที่อยู่
7	ROOM	N	3		Number of room	จำนวนห้องเรียน
8	TEACHER	N	3		Number of teacher	จำนวนผู้สอน
9	STUDENT	S	6		Number of student	จำนวนนักเรียน
10	TYPE	S	2		Type of school	ประเภทของสถานศึกษา
Format Type:					Scale: 1:20,000	
S : String					Resource : BMA	
N : Numeric					Source of Data :	

A2.4 Dam

(1) Location of Dam in Chao Phraya River Basin

THEME : Dam_CPRB.shp
TYPE : Point
DESCRIPTION : Location of dams in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	ID	N	10		ID number	ลำดับ
2	NAME_T	S	254		Name of dam in Thai	ชื่อภาษาไทย
3	NAME_E	S	254		Name of dam in English	ชื่อภาษาอังกฤษ
4	ORG	S	254		Data Original	ที่มาของข้อมูล
5	BASIN_T	S	254		Basin name in Thai	ชื่อลุ่มน้ำภาษาไทย
6	BASIN_E	S	254		Basin name in English	ชื่อลุ่มน้ำภาษาอังกฤษ
7	LOCATION_T	S	254		Location name in Thai	ที่ตั้ง ภาษาไทย
8	LOCATION_E	S	254		Location name in English	ที่ตั้ง ภาษาอังกฤษ
9	SUBDIS_T	S	254		Sub-district name in Thai	ชื่อตำบล ภาษาไทย
10	SUBDIS_E	S	254		Sub-district name in English	ชื่อตำบล ภาษาอังกฤษ
11	DIS_T	S	254		District name in Thai	ชื่ออำเภอ ภาษาไทย
12	DIS_E	S	254		District name in English	ชื่ออำเภอ ภาษาอังกฤษ
13	PRV_T	S	254		Province name in Thai	ชื่อจังหวัด ภาษาไทย
14	PRV_E	S	254		Province name in English	ชื่อจังหวัด ภาษาไทย
15	REGION	S	254		Region name	ชื่อจังหวัด ภาษาอังกฤษ
16	CAPAC_MCM	S	254		Capacity of dam	ความจุของเขื่อน
17	LON	N	10	4	Longitude of Location	พิกัด X
18	LAT	N	10	4	Latitude of Location	พิกัด Y

Format Type:	Scale:
S : String	Resource : RID and EGAT
N : Numeric	Source of Data :

(2) Location of Existing Dam in Chao Phraya River Basin

THEME : Existing_Dam_CPRB.shp
TYPE : Point
DESCRIPTION : Location of existing dams in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	ID	N	10		ID number	ลำดับ
2	NAME_T	S	254		Name of dam in Thai	ชื่อภาษาไทย
3	NAME_E	S	254		Name of dam in English	ชื่อภาษาอังกฤษ
4	ORG	S	254		Data Original	ที่มาของข้อมูล
5	BASIN_T	S	254		Basin name in Thai	ชื่อลุ่มน้ำภาษาไทย
6	BASIN_E	S	254		Basin name in English	ชื่อลุ่มน้ำภาษาไทย
7	LOCATION_T	S	254		Location name in Thai	สถานที่ตั้งภาษาไทย
8	LOCATION_E	S	254		Location name in English	สถานที่ตั้งภาษาไทย
9	SUBDIS_T	S	254		Sub-district name in Thai	ชื่อตำบลภาษาไทย
10	SUBDIS_E	S	254		Sub-district name in English	ชื่อตำบลภาษาอังกฤษ
11	DIS_T	S	254		District name in Thai	ชื่ออำเภอภาษาไทย
12	DIS_E	S	254		District name in English	ชื่ออำเภอภาษาอังกฤษ
13	PRV_T	S	254		Province name in Thai	ชื่อจังหวัดภาษาไทย
14	PRV_E	S	254		Province name in English	ชื่อจังหวัดภาษาอังกฤษ
15	REGION	S	254		Region name	ภาค
16	CAPAC_MCM	S	254		Capacity of dam	ความจุของเขื่อน
17	LON	N	10	4	Longitude of Location	พิกัด X
18	LAT	N	10	4	Latitude of Location	พิกัด Y
Format Type:					Scale:	
S : String					Resource : RID and EGAT	
N : Numeric					Source of Data :	

(3) Location of Proposed Dam

THEME : Proposed_Dam_CPRB.shp
TYPE : Point
DESCRIPTION : Location of proposed dam in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Project_E	S	254		Project name in English	ชื่อภาษาอังกฤษ
2	Basin	S	254		Basin name in English	ชื่อลุ่มน้ำภาษาอังกฤษ
3	Size	S	254		Size of dam	ขนาดของเขื่อน
4	E	E	15	6	X UTM coordinate of location	พิกัด X
5	N	N	15	6	Y UTM coordinate of location	พิกัด Y
Format Type:					Scale:	
S : String					Resource : RID	
N : Numeric					Source of Data :	

A2.5 DEM

(1) SRTM Data in Chao Phraya River Basin

There is no attribute table in the data because of raster data.

(2) ASTER GDEM Data in Chao Phraya River Basin

There is no attribute table in the data because of raster data.

A2.6 Factory

There is no attribute table in the data because of tabular data.

A2.7 Flood Area

(1) Flood Potential Area in Chao Phraya River Basin

THEME : Flood_Potential_Area.shp
TYPE : Polygon
DESCRIPTION : Area of flood potential (Flood risk)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Area_sqkm	N	20	2	ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : RID
					Source of Data :

(2) Flooded Area in 2005 in Chao Phraya River Basin

THEME : Flood2005_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in 2005

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Year	N	4		ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : GISTDA
					Source of Data : RADARSAT

(3) Flooded Area in 2006 in Chao Phraya River Basin

THEME : Flood2006_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in 2006

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Year	N	4		ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : GISTDA
					Source of Data : RADARSAT

(4) Flooded Area in 2007 in Chao Phraya River Basin

THEME : Flood2007_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in 2007

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Year	N	4		ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : GISTDA
					Source of Data : RADARSAT

(5) Flooded Area in 2008 in Chao Phraya River Basin

THEME : Flood2008_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in 2008

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Year	N	4		ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : GISTDA
					Source of Data : RADARSAT

(6) Flooded Area in 2009 in Chao Phraya River Basin

THEME : Flood2009_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in 2009

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Year	N	4		ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : GISTDA
					Source of Data : RADARSAT

(7) Flooded Area in 2010 in Chao Phraya River Basin

THEME : Flood2010_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in 2010

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Year	N	4		ID Number (Empty)
Format Type:					Scale:
N : Numeric					Resource : GISTDA
					Source of Data : RADARSAT

(8) Flooded Area in August 2011 in Chao Phraya River Basin

THEME : Flood_08_2011_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in August 2011

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Amphoe_T	S	50		Name of flooded amphoe area in Thai	ชื่ออำเภอภาษาไทย
2	PROV_NAM_T	S	50		Name of flooded province area in Thai	ชื่อจังหวัดภาษาไทย
3	Area	N	9		Flooded area in sqm	ขนาดพื้นที่น้ำท่วม ตารางเมตร
4	Area_rai	N	9		Flooded area in rai	ขนาดพื้นที่น้ำท่วม ไร่
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data : RADARSAT	

(9) Flooded Area in September 2011 in Chao Phraya River Basin

THEME : Flood_09_2011_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in September 2011

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Amphoe_T	S	50		Name of flooded amphoe area in Thai	ชื่ออำเภอภาษาไทย
2	PROV_NAM_T	S	50		Name of flooded province area in Thai	ชื่อจังหวัดภาษาไทย
3	Area	N	9		Flooded area in sqm	ขนาดพื้นที่น้ำท่วม ตารางเมตร
4	Area_rai	N	9		Flooded area in rai	ขนาดพื้นที่น้ำท่วม ไร่
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data : RADARSAT	

(10) Flooded Area in October 2011 in Chao Phraya River Basin

THEME : Flood_10_2011_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in October 2011

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Amphoe_T	S	50		Name of flooded amphoe area in Thai	ชื่ออำเภอภาษาไทย
2	PROV_NAM_T	S	50		Name of flooded province area in Thai	ชื่อจังหวัดภาษาไทย
3	Area	N	9		Flooded area in sqm	ขนาดพื้นที่น้ำท่วม ตารางเมตร
4	Area_rai	N	9		Flooded area in rai	ขนาดพื้นที่น้ำท่วม ไร่
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data : RADARSAT	

(11) Flooded Area in November 2011 in Chao Phraya River Basin

THEME : Flood_11_2011_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in November 2011

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Amphoe_T	S	50		Name of flooded amphoe area in Thai	ชื่ออำเภอภาษาไทย
2	PROV_NAM_T	S	50		Name of flooded province area in Thai	ชื่อจังหวัดภาษาไทย
3	Area	N	9		Flooded area in sqm	ขนาดพื้นที่น้ำท่วม ตารางเมตร
4	Area_rai	N	9		Flooded area in rai	ขนาดพื้นที่น้ำท่วม ไร่
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data : RADARSAT	

(12) Flooded Area in December 2011 in Chao Phraya River Basin

THEME : Flood_12_2011_CPRB.shp
TYPE : Polygon
DESCRIPTION : Flooded area in December 2011

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Amphoe_T	S	50		Name of flooded amphoe area in Thai	ชื่ออำเภอภาษาไทย
2	PROV_NAM_T	S	50		Name of flooded province area in Thai	ชื่อจังหวัดภาษาไทย
3	Area	N	9		Flooded area in sqm	ขนาดพื้นที่น้ำท่วม ตารางเมตร
4	Area_rai	N	9		Flooded area in rai	ขนาดพื้นที่น้ำท่วม ไร่
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data : RADARSAT	

(13) Grid Data (2km x 2km) in Flooded Area in Chao Phraya River Basin

THEME : Flood_Grid_CPRB.shp
TYPE : Polygon
DESCRIPTION : 2km x 2km grid data in flooded area

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	GRID_No	S	50		Grid number	เลขประจำกริด
Format Type:					Scale:	
N : String					Resource : JICA Study Team	
					Source of Data : Flooded Area	

(14) Location of Flood Survey Data in Chao Phraya River Basin

THEME : Floodmark_CPRB.shp
TYPE : Point
DESCRIPTION : Location of flood survey point in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Grid_numbe	S	254		Grid number	เลขประจำกริด
2	Date_infor	S	254		Survey Date	วันที่สำรวจ
3	Field_lat	S	18		Latitude	พิกัด Y 5 ตำแหน่ง
4	Field_lng	N	18		Longitude	พิกัด X 5 ตำแหน่ง
5	Height	N	18		Flood height	ระดับความสูงของคราบน้ำ
6	Pic	S	254		Picture taken in the field	หมายเลขรูป
7	Surveyor_n	S	254		Surveyor name	ชื่อผู้สำรวจ
8	ID	N	10		ID number	ลำดับ
9	Time_infor	S	254		Surveyed time	เวลาที่สำรวจ
10	Download_la	N	18		Downloaded latitude	พิกัด Y 6 ตำแหน่ง
11	Download_l	N	18		Downloaded longitude	พิกัด X 6 ตำแหน่ง
12	Gps_number	S	254		GPS survey number	หมายเลขลำดับการสำรวจ
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Flood Survey Data in 2012	

A2.8 Flood Structure

(1) King Dike Data in Chao Phraya River Basin

THEME : King_Dike.shp
TYPE : Polygon
DESCRIPTION : Area of king dike

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	ID	S	6		ID number
Format Type:					Scale:
N : String					Resource : JICA Study Team
					Source of Data : Point data from RTSD

(2) Floodway Data in Chao Phraya River Basin

THEME : Floodway_longterm.shp
TYPE : Line
DESCRIPTION : Aligment of floodway

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Descrip	S	75		Description	ชื่อภาษาอังกฤษ
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Hardcopy	

(3) Protection Area in Chao Phraya River Basin

THEME : Protection_Area.shp
TYPE : Polygon
DESCRIPTION : Protection area

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	ID	N	6		ID number	ลำดับ
2	Descrip	S	75		Description	ชื่อโซน
3	Area_sqkm	N	6		Area	พื้นที่ ตารางกิโลเมตร
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Hardcopy	

(4) Retention Area in 2012 in Chao Phraya River Basin

THEME : Retention_Area_2012.shp
TYPE : Polygon
DESCRIPTION : Retention area in 2012

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Elevation	N	11		Elevation	ระดับความสูง
2	Remark	S	100		Remark	หมายเหตุ
3	Code	S	50		Code	รหัสพื้นที่ลุ่มต่ำ
4	Name_Block	S	50		Name of block	ชื่อพื้นที่ลุ่มต่ำ ภาษาไทย
5	Name_PJ	S	18		Name of project	ชื่อโครงการ ภาษาไทย
6	Irr_Office	S	50		Number of regional irrigation office	สำนักชลประทานที่รับผิดชอบ
7	Zone	S	2		Zone code	โซน
8	Depth_M	N	18		Depth	ระดับความลึก
9	Area_Cal_R	N	18		Calculated area in Rai	พื้นที่ (ไร่)
10	Name_Area	S	50		Name of area	ที่ตั้งของพื้นที่ลุ่มต่ำ
11	Sub_Type	S	50		Sub-type	ประเภทรอง
12	Type	N	4		Type	ประเภทหลัก
13	Name_E	S	50		Name in English	ชื่อพื้นที่ลุ่มต่ำภาษาอังกฤษ
14	Capacity	N			Capacity of area	ความจุพื้นที่
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Report	

(5) Retention Area in Master Plan in Chao Phraya River Basin

THEME : Retention_Area_Masterplan.shp
TYPE : Polygon
DESCRIPTION : Retention area in master plan

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Zone	S	10		Zone	รหัสโซน
2	Name_Zone	S	80		Name of zone in Thai	ชื่อภาษาไทย
3	Area_sqkm	N			Area in sqkm	ขนาดพื้นที่ ตารางกิโลเมตร
4	Name_Zone_E	S	100		Name of zone in English	ชื่อภาษาอังกฤษ
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Report	

(6) Retention Area in Study in Chao Phraya River Basin

THEME : Retention_Area_Study.shp
TYPE : Polygon
DESCRIPTION : Retention area in Study Area

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Elevation	N	11		Elevation	ระดับความสูง
2	Remark	S	100		Remark	หมายเหตุ
3	Code	S	50		Code	รหัสพื้นที่ลุ่มต่ำ
4	Name_Block	S	50		Name of block	ชื่อพื้นที่ลุ่มต่ำ ภาษาไทย
5	Name_PJ	S	18		Name of project	ชื่อโครงการ ภาษาไทย
6	Irr_Office	S	50		Number of regional irrigation office	สำนักชลประทานที่รับผิดชอบ
7	Zone	S	2		Zone code	โซน
8	Depth_M	N	18		Depth	ระดับความลึก
9	Area_Cal_R	N	18		Calculated area in Rai	พื้นที่ (ไร่)
10	Name_Area	S	50		Name of area	ที่ตั้งของพื้นที่ลุ่มต่ำ
11	Sub_Type	S	50		Sub-type	ประเภทรอง
12	Type	N	4		Type	ประเภทหลัก
13	Name_E	S	50		Name in English	ชื่อพื้นที่ลุ่มต่ำภาษาอังกฤษ
14	Capacity	N			Capacity of area	ความจุพื้นที่
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Report	

(7) Retention Area in TOR in Chao Phraya River Basin

THEME : Retention_Area_TOR.shp
TYPE : Polygon
DESCRIPTION : Retention area in TOR

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	Name_Block	S	50		Name of block	ชื่อภาษาอังกฤษ
4	Prj_Code	S	14		Number of project code	รหัสโครงการ
5	Prj_Name	N	50		Project name	ชื่อโครงการภาษาไทย
6	Area_sqkm	N			Area	ขนาดพื้นที่ ตารางกิโลเมตร
Format Type:					Scale:	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : TOR	

A2.9 Forest

(1) Forest Distribution Map in 2004 in Chao Phraya River Basin

THEME : Forest2004_CPRB.shp
TYPE : Polygon
DESCRIPTION : Distribution data of forest in 2004

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NRF_CODE	S	10		Code of NRF	รหัส NRF
2	Fname_T	S	100		Name of forest in Thai	ชื่อป่าภาษาไทย
3	Province_T	S	50		Province name in Thai	ชื่อจังหวัดภาษาไทย
4	Remark	S	50		Remark	หมายเหตุ
5	Announce_T	S	50		Announcement in Thai	วันที่ประกาศ ภาษาไทย
6	Index	S	100		Map Index	ระวางแผนที่
7	No	N	4		Number	ลำดับ
8	Status	N	4		Status	สถานะ
9	Year	N	4		Year	ปี
10	Fname_E	S	254		Name of forest in English	ชื่อป่าภาษาอังกฤษ
11	Province	S	254		Province name in English	ชื่อจังหวัดภาษาอังกฤษ
12	Announceme	S	254		Announcement in English	วันที่ประกาศ ภาษาอังกฤษ
Format Type:					Scale:	
S : String					Resource : RFD	
N : Numeric					Source of Data : Cabinet resolution	

(2) Forest Distribution Map in 2008 in Chao Phraya River Basin

THEME : Forest2008_CPRB.shp
TYPE : Polygon
DESCRIPTION : Distribution data of forest in 2008

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	DIS	N	4		District code	รหัสอำเภอ
2	OBJECTID	N	9		Object ID number	รหัส object
3	PRV_NAME	S	30		Province name in Thai	ชื่อจังหวัดภาษาไทย
4	AREA_RAI	N			Forest area in RAI	พื้นที่ป่า (ไร่)
5	DESCRIP_T	S	50		Description in Thai	ประเภทป่า ภาษาไทย
6	AREA_SQKM	N			Forest area in SQKM	พื้นที่ป่า (ตารางกิโลเมตร)
7	Desc_E	S	50		Description in English	ประเภทป่า ภาษาอังกฤษ
Format Type:					Scale:	
S : String					Resource : RFD	
N : Numeric					Source of Data : Cabinet resolution	

A2.10 Geology

(1) Geological Data in Chao Phraya River Basin

THEME : Geology_CPRB.shp
TYPE : Polygon
DESCRIPTION : Geological map in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	RCKUNIT_ID	S	10		Rock unit ID	หน่วยของหิน
2	SYMBOL	S	20		Symbol	สัญลักษณ์
3	RU_NAME_T	S	150		Name of rock unit in Thai	ชื่อกลุ่มหินภาษาไทย
4	RU_NAME_E	S	150		Name of rock unit in English	ชื่อกลุ่มหินภาษาอังกฤษ
5	RU_TYPE_ID	S	10		ID number of rock unit type	รหัสของประเภทหน่วยหิน
6	RU_TYPE_T	S	50		Rock unit type in Thai	ชื่อของรหัสภาษาไทย
7	RU_TYPE_E	S	50		Rock unit type in English	ชื่อของรหัสภาษาอังกฤษ
8	N_TYPE_ID	S	10		Code of name type	รหัสประเภทของชื่อหิน
9	N_TYPE_T	S	20		Name of type in Thai	ประเภทของชื่อหินภาษาไทย
10	N_TYPE_E	S	20		Name of type in English	ประเภทของชื่อหินภาษาอังกฤษ
11	F_NAME_ID	S	10		Code of formation name	รหัสของหมวดหิน
12	F_NAME_T	S	150		Name of formation in Thai	ชื่อของหมวดหินภาษาไทย
13	F_NAME_E	S	150		Name of formation in English	ชื่อของหมวดหินภาษาอังกฤษ
14	G_NAME_ID	S	10		Code of rock group	รหัสของกลุ่มหิน
15	G_NAME_T	S	100		Name of rock group in Thai	ชื่อกลุ่มหินภาษาไทย
16	G_NAME_E	S	100		Name of rock group in English	ชื่อกลุ่มหินภาษาอังกฤษ
17	R_TYPE_ID	S	10		ID number of rock type	รหัสประเภทของหิน
18	R_TYPE_T	S	100		Name of rock type in Thai	ชื่อประเภทหินภาษาไทย
19	R_TYPE_E	S	100		Name of rock type in English	ชื่อประเภทหินภาษาอังกฤษ
20	AGE_ID	S	10		ID number for age	อายุของหิน
21	AGE_DESC	S	254		Description of age	ชื่อของยุคหิน
22	DESC_T1	S	254		Description 1 in Thai	คำอธิบายลักษณะของหิน ภาษาไทย 1
23	DESC_T2	S	254		Description 2 in Thai	คำอธิบายลักษณะของหิน ภาษาไทย 2
24	DESC_E1	S	254		Description 1 in English	คำอธิบายลักษณะของหิน ภาษาอังกฤษ 1
25	DESC_E1	S	254		Description 2 in English	คำอธิบายลักษณะของหิน ภาษาอังกฤษ 2
26	SHAPE_Leng	N			Length of polygon	ความยาว
27	SHAPE_Area	N			Area of polygon	ขนาดพื้นที่
Format Type:					Scale:	
S : String					Resource :	
N : Numeric					Source of Data : Geological map*	

*Compile: Bureau of Geological Survey, Department of Mineral Resources, 1999-2003
*Database construction: Geological Survey Section 5, Bureau of Geological Survey, Department of Mineral Resources, 2005

(2) Geological Structure in Chao Phraya River Basin

THEME : Geol_Str_CPRB.shp
TYPE : Line
DESCRIPTION : Geological structure data in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	ST_TYPE_ID	S	10		ID of geological structure type	รหัสประเภทโครงสร้างทางธรณีวิทยา
2	ST_TYPE_T	S	150		Structure type in Thai	ชื่อโครงสร้างภาษาไทย
3	ST_TYPE_E	S	150		Structure type in English	ชื่อโครงสร้างภาษาอังกฤษ
4	ST_GRP_ID	S	10		Structure group ID	รหัสกลุ่มโครงสร้าง
5	ST_GRP_T	S	10		Structure group in Thai	ชื่อกลุ่มโครงสร้างภาษาไทย
6	ST_GRP_E	S	50		Structure group in English	ชื่อกลุ่มโครงสร้างภาอังกฤษ
7	PLUNGE_DIR	S	20		Plunge direction	
8	OTHER_DIR	S	20		Other direction	ทิศทางอื่นๆ
9	NAME	S	50		Name	ชื่อ
10	REMARK	S	254		Remark	หมายเหตุ
11	SHAPE_Leng	N			Length of structure	ความยาว
Format Type:					Scale:	
S : String					Resource : RID	
N : Numeric					Source of Data : Geological map	

*Compile: Bureau of Geological Survey, Department of Mineral Resources, 1999-2003
*Database construction: Geological Survey Section 5, Bureau of Geological Survey, Department of Mineral Resources, 2005

A2.11 Irrigation Structure

(1) Canal Data in Chao Phraya River Basin

THEME : Canal.shp
TYPE : Line
DESCRIPTION : Canal network data

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	C_CODE	S	20		Canal code	รหัสคลอง
2	PRJ_CODE	S	14		Project code	รหัสโครงการ
3	PRJ_NAME	S	50		Project name	ชื่อโครงการ
4	PRV_CODE	S	2		Province code	รหัสจังหวัด
5	RID_CODE	S	2		Royal Irrigation Department code	รหัสสำนักชลประทาน
6	C_GRP	S	1		Canal group	กลุ่มคลอง
7	C_TYPE	S	3		Code of canal type	รหัสประเภทคลอง
8	C_NAME	S	100		Canal name	ชื่อคลอง
9	LENGHT	N	9		Length of canal	ความยาว
10	START_KM	S	10		Starting point(km. unit)	กิโลเมตรตั้งต้น
11	START_FROM	S	100		Starting point	บริเวณจุดตั้งต้น
12	REMARK	S	200		Remark	หมายเหตุ
13	NO	S	3		No. of canal	ลำดับ
14	Type	S	100		Description of type canal	คำอธบายประเภทคลอง
Format Type:					Scale:	
S : String					Resource : RID	
N : Numeric					Source of Data : Data of Regional Office	

(2) Pumping Station in Chao Phraya River Basin

THEME : Pump.shp
TYPE : Point
DESCRIPTION : Location of pumping station in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	PRJ_CODE	S	14		Project code	รหัสโครงการ
2	PRJ_NAME	S	50		Project name	ชื่อโครงการ
3	PUMP_CODE	S	17		Pump code	รหัสปั๊ม
4	PUMP_TYPE	S	2		Pump type	ประเภทปั๊ม
5	PUMP_NAME	S	50		Name of pumping station	ชื่อปั๊ม
6	STREAM	S	40		Name of stream	ชื่อแหล่งน้ำ
7	X	S	15		X coordinate	พิกัด X
8	Y	N	15		Y coordinate	พิกัด Y
9	NO	N	3		Number	ลำดับ
Format Type:					Scale:	
S : String					Resource : RID	
N : Numeric					Source of Data : Data of Regional Office	

(3) Location of Regulator in Chao Phraya River Basin

THEME : Regulator.shp
TYPE : Point
DESCRIPTION : Location of regulator in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME	S	254		Name of regulator	ชื่อประตูระบายน้ำ
2	PROJECT	S	254		Name of project	ชื่อโครงการ
3	TYPE	S	254		Type of regulator	ประเภทของประตู
4	TUMBOL	S	254		Code of sub-district	รหัสตำบล
5	AMPHOE	S	254		Code of district	รหัสอำเภอ
6	CHANGWAT	S	254		Code of province	รหัสจังหวัด
7	REMARK	S	254		Remark	หมายเหตุ
8	X	N	21	6	X coordinate	พิกัด X
9	Y	N	21	6	Y coordinate	พิกัด Y
Format Type:					Scale:	
S : String					Resource : RID	
N : Numeric					Source of Data : Data of Regional Office	

A2.12 Land Use

(1) Land Use Data in 2002 in Chao Phraya River Basin

THEME : Land_Use2002_CPRB.shp
TYPE : Polygon
DESCRIPTION : Land use data in 2002 in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	LU_CODE	S	20		Land use code	รหัสการใช้ที่ดิน
2	DESCRIPT_T	S	100		Description in Thai	คำอธิบายภาษาไทย
3	DESCRIPT_E	S	100		Description in English	คำอธิบายภาษาอังกฤษ
4	LU_LEVEL1	S	1		Land use code in level 1	ระดับการจำแนกการใช้ที่ดินระดับที่1
5	LU_LEVEL2	S	3		Land use code in level 2	ระดับการจำแนกการใช้ที่ดินระดับที่2
6	Group	S	20		Land use group	กลุ่มการใช้ที่ดิน
7	AREA_SQM	N	20	2	Area	ขนาดพื้นที่
Format Type:					Scale:	
S : String					Resource : LDD	
N : Numeric					Source of Data : Aerial Photo and surveying	

(2) Land Use Data in 2009 in Chao Phraya River Basin

THEME : Land_Use2009_CPRB.shp
TYPE : Polygon
DESCRIPTION : Land use data in 2009 in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	LU_CODE	S	15		Land use code	รหัสการใช้ที่ดิน
2	DES_TH	S	100		Description in Thai	คำอธิบายภาษาไทย
3	DES_EN	S	100		Description in English	คำอธิบายภาษาอังกฤษ
4	LU_GROUP	S	16		Land use group	กลุ่มการใช้ที่ดิน
5	AREA_SQM	N	20	2	Area	ขนาดพื้นที่
Format Type:					Scale:	
S : String					Resource : LDD	
N : Numeric					Source of Data : Aerial Photo and surveying	

A2.13 Population

(1) Population Data in 2011 in Chao Phraya River Basin

THEME : Population.shp
TYPE : Polygon
DESCRIPTION : Population data in sub-district in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	TAMBON_ID	S	8		Sub-district ID number	เลขประจำตำบล
2	TAM_CODE	S	2		Sub-district code number	รหัสตำบล
3	TAM_NAM_T	S	50		Sub-district name in Thai	ชื่อตำบลภาษาไทย
4	AMP_CODE	S	2		District code	รหัสอำเภอ
5	PROV_CODE	S	2	6	Province code	รหัสจังหวัด
6	REG_CODE	S	1		Region code	รหัสภาค
7	PROV_NAM_T	S	50		Province name in Thai	ชื่อจังหวัดภาษาไทย
8	PROV_NAM_E	S	50		Province name in English	ชื่อจังหวัดภาษาอังกฤษ
9	FEMALE2011	N	9	6	Number of female population in 2011	จำนวนประชากรเพศหญิง 2554
10	MALE2011	N	9	6	Number of male population in 2011	จำนวนประชากรเพศหญิง 2554
11	POP2011	N	9	6	Number of total population in 2011	จำนวนประชากร 2554
12	HH2011	N	9		Number of household in 2011	จำนวนครัวเรือน 2554
13	TAM_NAME_E	S	50		Sub-district name in English	ชื่อตำบลภาษาอังกฤษ
14	Area_SQKM	N	20	2	Area	ขนาดพื้นที่
Format Type:					Scale: 1:50,000 level	
S : String					Resource : JICA Study Team	
N : Numeric					Source of Data : Census 2011	

A2.14 RID

(1) Location of Center for Hydrology in Chao Phraya River Basin

THEME : Hydro_Center_CPRB.shp
TYPE : Point
DESCRIPTION : Location of hydrological center in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	NO	N	4		Number of center
2	NAME	S	23		Name of center
3	PHONE	S	24		Phone number of center
4	EMAIL	S	20		Email address of center
5	ADDRESS	S	76		Address of center
6	LAT	N	14	4	Latitude of center
7	LONG	N	15	4	Longitude of center
8	X	N	10	1	X coordinate of center
9	Y	N	13	2	Y coordinate of center
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data : RID

(2) Responsible Area of Hydrological Office

THEME : Hydro_Region_CPRB.shp
TYPE : Polygon
DESCRIPTION : Responsible area of hydrological office in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	PROV_ID	S	8		Province ID
2	PROV_CODE	S	2		Province code
3	PROV_NAM_T	S	50		Province name in Thai
4	PROV_NAM_E	S	50		Province name in English
5	REG_CODE	S	1		Region code
6	REG_NAME	S	50		Region name
7	PROVE_CD	N	9		Province code
8	HydroOffic	N	4		Code number of hydrological office
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data : RID

(3) Location of Irrigation Office in Chao Phraya River Basin

THEME : Irrigation_Office_CPRB.shp
TYPE : Point
DESCRIPTION : Location of irrigation office in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	RID_CODE	S	2		Code number of regional office
2	PRV_CODE	S	2		Province code
3	ADDRESS	S	100		Address of regional office
4	TEL	S	30		Telephone number
5	FAX	S	30		Fax number
6	TOTAL_AREA	N			Responsible area of regional office
7	REMARK	S	200		Remark
8	X	S	15		X coordinate of regional office
9	Y	S	15		Y coordinate of regional office
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data : RID

(4) Irrigation Project Area in Chao Phraya River Basin

THEME : Irrigation_Project_Area_CPRB.shp
TYPE : Polygon
DESCRIPTION : Irrigation project area in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	PRJ_CODE	S	14		Project code
2	PRJ_NAME	S	50		Project name
3	PRJ_AREA	N			Area of project
4	IRR_AREA	N			Area of irrigation
5	AREA_SQKM	N			Total area in SQKM
6	AREA_RAI	N			Total area in RAI
7	DF_IRR_CAL	N			
8	SIZE	S	2		Project size
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data : RID

(5) Location of Provincial Irrigation Office in Chao Phraya River Basin

THEME : Prov_RID_CPRB.shp
TYPE : Point
DESCRIPTION : Location of provincial irrigation office in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	NAME	S	50		Name of office
2	ADDRESS	S	100		Address of office
3	TEL	S	30		Telephone number
4	FAX	S	30		Fax number
5	TOTAL_AREA	N			Responsible area
6	REMARK	N			Remark
7	X	S	15		X coordinate of location
8	Y	S	15		Y coordinate of location
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data : RID

(6) Responsible Area by Regional Irrigation Office in Chao Phraya River Basin

THEME : RID_CPRB.shp
TYPE : Polygon
DESCRIPTION : Responsible area by regional irrigation office in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	RID_CODE	S	2		Name of office
2	RID_NAME	S	30		Address of office
3	SHOT_NAME	S	8		Telephone number
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data : RID

A2.15 Satellite

There is no attreibute table because of raster data.
Scale : 1:250,000 level
Resource : USGS
Source of Data : LANDSAT 5

A2.16 Station

(1) Location of Coastal Water Station

THEME : Coastal_Water_Level_Station.shp
TYPE : Point
DESCRIPTION : Location of coastal water station

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	No	S	254		Number of station	หมายเลขของสถานี
2	Station_Name	S	254		Name of station	ชื่อสถานี
3	Latitude	N	21	6	Latitude of station	พิกัด Y
4	Longitude	N	21	6	Longitude of station	พิกัด X
5	Period	S	254		Period	ปี
6	Predicted	S	254		Observation interval	ความถี่ในการสังเกตการณ์
7	ReOrganiza	S	50		Responsible organization	หน่วยงานที่รับผิดชอบ
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data : Installation list	

(2) Location of Buoy Station

THEME : GISTDA_Buoy_Station.shp
TYPE : Point
DESCRIPTION : Location of buoy station

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	No	N	21	6	Number of station	หมายเลขของสถานี
2	Name	S	254		Name of station	ชื่อสถานี
3	X	N	20	2	Latitude of station	พิกัด Y
4	Y	N	20	2	Longitude of station	พิกัด X
Format Type:					Scale:	
S : String					Resource : GISTDA	
N : Numeric					Source of Data :	

(3) Location of Early Warning Station in Chao Phraya River Basin

THEME : DWR_Early_Warning_Station_CPRB.shp
TYPE : Point
DESCRIPTION : Location of early warning station

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	S	254		Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : DWR
N : Numeric					Source of Data :

(4) Location of Rain Station in Chao Phraya River Basin

THEME : DWR_Rain_Station_Manual_CPRB.shp
TYPE : Point
DESCRIPTION : Location of rain station (Manual)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	N	21	6	Station ID number
4	Station_N	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : DWR
N : Numeric					Source of Data :

(5) Location of Telemetry Station in Chao Phraya River Basin

THEME : DWR_Telemetry_Station_CPRB.shp
TYPE : Point
DESCRIPTION : Location of telemetry station

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	S	254		Station ID number
4	Station_N	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : DWR
N : Numeric					Source of Data :

(6) Location of Water Level Station (Manual) in Chao Phraya River Basin

THEME : DWR_Water_Level_Station_Manual_CPRB.shp
TYPE : Point
DESCRIPTION : Location of water level station (Manual)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	N	21	6	Station ID number
4	Station_N	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : DWR
N : Numeric					Source of Data :

(7) Location of Rain Station (Manual) in Chao Phraya River Basin

THEME : RID_Rain_Station_Manual_CPRB.shp
TYPE : Point
DESCRIPTION : Location of rain station (Manual)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	N	21	6	Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data :

(8) Location of Rain Station (Telemetry) in Chao Phraya River Basin

THEME : RID_Rain_Station_Telemetry_CPRB.shp
TYPE : Point
DESCRIPTION : Location of rain station (Telemetry)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	N	21	6	Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data :

(9) Location of Station

THEME : RID_Station_Location_CPRB.shp
TYPE : Point
DESCRIPTION : Location of station in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	No	N			Station number
2	CODE	S	5		Station code
3	STATION_NA	S	49		Station name
4	LATITUDE	N			Location of latitude
5	LONGITUDE	N			Location of longitude
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data :

(10) Location of Water Level Station (Manual) in Chao Phraya River Basin

THEME : RID_Water_Level_Station_Manual_CPRB.shp
TYPE : Point
DESCRIPTION : Location of water level station (Manual)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	S	254		Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data :

(11) Location of Water Level Station (Telemetry) in Chao Phraya River Basin

THEME : RID_Water_Level_Station_Telemetry_CPRB.shp
TYPE : Point
DESCRIPTION : Location of water level station (Telemetry)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	S	254		Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : RID
N : Numeric					Source of Data :

(12) Location of Tidal Station

THEME : Tidal_Station.shp
TYPE : Point
DESCRIPTION : Location of tidal station

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : Refer to Attributes
N : Numeric					Source of Data :

(13) Location of Coastal Radar Station managed by TMD in Chao Phraya River Basin

THEME : TMD_Coastal_Radar_Station.shp
TYPE : Point
DESCRIPTION : Location of coastal radar station

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	No	N	21	6	Station number	หมายเลขสถานี
2	Station_Na	S	254		Name of station	ชื่อสถานี
3	Radar_Type	S	254		Type of radar	ประเภทของเรดาร์
4	Frequency	N	21	6	Frequency	ความถี่
5	Lat_N	N	21	6	Location of latitude	พิกัด Y
6	Long_E	N	21	6	Location of longitude	พิกัด X
7	Tambon	S	254		Name of tambon	ชื่อตำบล
8	District	S	254		Name of district	ชื่ออำเภอ
9	Province	S	254		Name of province	ชื่อจังหวัด
10	Remark	S	254		Remark	หมายเหตุ
Format Type:					Scale:	
S : String					Resource : TMD	
N : Numeric					Source of Data :	

(14) Location of Rain Station (Manual) in Chao Phraya River Basin

THEME : TMD_Rain_Station_Manual_CPRB.shp
TYPE : Point
DESCRIPTION : Location of rain station (Manual)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	S	254		Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : TMD
N : Numeric					Source of Data :

(15) Location of Rain Station (Telemetry) in Chao Phraya River Basin

THEME : TMD_Rain_Station_Telemetry_CPRB.shp
TYPE : Point
DESCRIPTION : Location of rain station (Telemetry)

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	Data_Type	S	254		Type of data
2	Station_Ty	S	254		Type of station
3	Station_ID	S	254		Station ID number
4	Station_Na	S	254		Station name
5	X	N	21	6	X UTM coordinate
6	Y	N	21	6	Y UTM coordinate
7	Organizati	S	254		Name of organization
Format Type:					Scale:
S : String					Resource : TMD
N : Numeric					Source of Data :

(16) Location of Weather Station in Chao Phraya River Station

THEME : TMD_Weather_Station_CPRB.shp
TYPE : Point
DESCRIPTION : Location of weather station

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	No	N	21	6	Station number	ลำดับ
2	Station_CO	S	254		Station code	รหัสสถานี
3	LAT	S	21	6	Latitude of station	พิกัด Y
4	LONG	N	21	6	Longitude of station	พิกัด X
5	Province	S	254		Province name	ชื่อจังหวัด
6	District	S	254		District name	ชื่ออำเภอ
7	Sub_Distri	S	254		Sub-district name	ชื่อตำบล
8	Region	S	254		Region name	ภาค
Format Type:					Scale:	
S : String					Resource : TMD	
N : Numeric					Source of Data :	

A2.17 Topographic

(1) Contour Line in Chao Phraya

THEME : Contour_CPRB.shp
TYPE : Line
DESCRIPTION : Contour line data in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	LENGTH	N	23	5	Length of each contour line
2	ELEVATION	N	4		Elevation of contour line
Format Type:					Scale: 1:50,000
N :Numeric					Resource : RTSD
					Source of Data : Topographic map

(2) Spot Height Data in Chao Phraya River Basin

THEME : Contour_CPRB.shp
TYPE : Line
DESCRIPTION : Contour line data in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	SPOT_ID	N	11		ID number of spot height
2	SP_ELEV	N	4		Elevation
Format Type:					Scale: 1:50,000
N : Numeric					Resource : RTSD
					Source of Data : Topographic map

(3) Index Map of 1:50,000

THEME : Index50000.shp
TYPE : Polygon
DESCRIPTION : Index map of 1:50,000

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	SH_50K_ID	N	11		ID number of sheet (1:50,000)
2	MAPSHEET	S	7		Map sheet number (1:50,000)
3	SHEET_NAME	S	40		Map sheet name in English
4	THAI_NAME	S	25		Map sheet name in Thai
5	EDITION	S	10		Edition number
6	RTSD_YEAR	N	4		Year
7	MAP250K	S	10		Map sheet number (1:250,000)
Format Type:					Scale: 1:50,000
S : String					Resource : RTSD
N : Numeric					Source of Data : Topographic Map

(4) Scanned Topographic Map (1:50,000)

There is no attribute table because of raster data.
Scale : 1:50,000
Resource : RTSD
Source of Data : Topographic Map

A2.18 Transport

(1) BTS Network in BMA

THEME : BTS_MOT.shp
TYPE : Line
DESCRIPTION : BTS network data in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	NAME_T	S	157		Line name in Thai	ชื่อเส้นทางภาษาไทย
2	NAME_E	S	157		Line name in English	ชื่อเส้นทางภาษาอังกฤษ
3	CRE_DATE	D			Date of creation	วันที่สร้าง
4	MOD_DATE	D			Date of modification	วันที่แก้ไข
5	APP_DATE	D			Date of application	วันที่นำไปใช้
Format Type:					Scale:	
S : String					Resource : MOT	
D : Date					Source of Data :	

(2) Main Road in BMA

THEME : Mainroad_BMA.shp
TYPE : Line
DESCRIPTION : Main road network data in BMA

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	LENGTH	N	14	3	Road length	ความยาวถนน
2	RDLNCLASS	N	11		Road class	ประเภทถนน
3	RDLNNAMT	S	60		Road name in Thai	ชื่อถนนภาษาไทย
Format Type:					Scale:	
S : String					Resource : BMA	
N : Numeric					Source of Data :	

(3) Railway network in Chao Phraya River Basin

THEME : Rail_MOT_CPRB.shp
TYPE : Line
DESCRIPTION : Railway network data in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	ROAD_TYPE	N	4		Code number of road type	ประเภทถนน
2	NAME_T	S	70		Name in Thai	ชื่อเส้นทางภาษาไทย
3	NAME_E	S	70		Name in English	ชื่อเส้นทางภาษาอังกฤษ
4	SHAPE_Leng	N			Length of line	ความยาว
Format Type:					Scale:	
S : String					Resource : MOT	
N : Numeric					Source of Data :	

(4) Road Network Data in Chao Phraya River Basin (MOT)

THEME : Road_MOT_CPRB.shp
TYPE : Line
DESCRIPTION : Road network data in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	ROAD_TYPE	S	4		Road type	ประเภทถนน
2	ROAD_NUM	S	8		Road number	หมายเลขถนน
3	NAME_T	S	70		Road name in Thai	ชื่อถนนภาษาไทย
4	NAME_E	S	70		Road name in English	ชื่อถนนภาษาอังกฤษ
5	SURFACE	N	4		Surface type	ผิวถนน
6	WIDTH	N	4		Road width	ความกว้าง
7	LANE	N	4		Number of lanes	จำนวนช่องทาง
8	ONEWAY	S	2		One way	เดินรถทางเดียว
9	LENGTH_M	N	20	2	Road length	ความยาว
Format Type:					Scale:	
S : String					Resource : MOT	
N : Numeric					Source of Data :	

(5) Road Network Data in Chao Phraya River Basin (RID)

THEME : Road_RID_CPRB.shp
TYPE : Line
DESCRIPTION : Road network data in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	ROAD_TYPE	S	4		Road type
2	ROAD_NUM	S	8		Road number
3	NAME_T	S	70		Road name in Thai
4	NAME_E	S	70		Road name in English
5	SURFACE	N	4		Surface type
6	WIDTH	N	4		Road width
7	LANE	N	4		Number of lanes
8	ONEWAY	S	2		One way
9	LENGTH_M	N	20	2	Road length
Format Type:					Scale:
S : String					Resource : RID
D : Date					Source of Data :

(6) Location of Railway Station in Chao Phraya River Basin

THEME : Station_MOT_CPRB.shp
TYPE : Point
DESCRIPTION : Location of railway station in Chao Phraya River Basin

No.	Field Name	Format			Description	คำอธิบาย
		Type	Width	Dec. P.		
1	TYPE	S	2		Type	ประเภทของสถานี
2	NAME_T	S	70		Name of station in Thai	ชื่อสถานีภาษาไทย
3	NAME_E	S	70		Name of station in English	ชื่อสถานีภาษาอังกฤษ
Format Type:					Scale:	
S : String					Resource : MOT	
D : Date					Source of Data :	

A2.19 Water Body

(1) Main River Data in Chao Phraya River Basin

THEME : Main_River_CPRB.shp
TYPE : Line
DESCRIPTION : Main river network data in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	STR_CLASS	S	1		Structure class
2	STR_NAM_T	S	50		Structure name in Thai
3	STR_NAM_E	S	50		Structure name in English
4	NAME	S	50		Name of river in Thai
5	Name_E	S	50		Name of river in English
Format Type:					Scale:
S : String					Resource : RID
					Source of Data : Topographic Map

(2) Stream Data in Chao Phraya River Basin

THEME : Stream_CPRB.shp
TYPE : Line
DESCRIPTION : Stream network data in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	STR_CLASS	S	1		Structure class
2	STR_NAM_T	S	50		Structure name in Thai
3	STR_NAM_E	S	50		Structure name in English
4	NAME	S	50		Name of river in Thai
Format Type:					Scale: 1:50,000
S : String					Resource : RID
					Source of Data : Topographic map

(3) Water Body in Chao Phraya River Basin

THEME : Water_Body_CPRB.shp
TYPE : Polygon
DESCRIPTION : Water body data in Chao Phraya River Basin

No.	Field Name	Format			Description
		Type	Width	Dec. P.	
1	WTR_TYPE	S	2		Type of water body
2	WTR_NAM_T	S	50		Name of water body type in Thai
3	WTR_NAM_E	S	50		Name of water body type in English
4	WTR_NAME	S	50		Name of water body in Thai
5	WTR_MRIVER	S	35		Name of river in Thai
Format Type:					Scale: 1:50,000
S : String					Resource : RID
					Source of Data : Topographic

Sector B: Natural and Social Environment

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

FINAL REPORT
VOLUME 3: SUPPORTING REPORT

SECTOR B: TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER B1 SOCIO-ECONOMY

B1.1 Demography

The population of Thailand is approximately 64 million, of which 9.3 million live in Bangkok and its vicinity. Ninety-four (94) percent of the population are Thai-speaking Buddhists. The national population growth rate is 0.68%, according to the 2006 Census. About 93% of the people in Thailand is functionally literate.

The Basin has some 40 percent of the country's population. The total population of the Chao Phraya Basin was 23 million inhabitants according to a survey in 1996. Approximately half of the population (11.5 million) resides in the Lower Chao Phraya Basin. Approximately 68 percent of the total population of the basin is in rural area. The average population density is 136 inhabitants per km^2, but varies greatly from 44 in the Nan sub-basin to 533 inhabitants per km^2 in the Chao Phraya sub-basin. Bangkok and its vicinity have the highest population density, with 1,500 inhabitants per km^2.

B1.2 Economy

B1.2.1 Economy and Industries

Thailand experienced firm growth from 2000 to 2007, averaging more than 4% per year, thanks to the developed infrastructure, the free-enterprise economy, generally pro-investment policies, and strong export industries, after recovering from the Asian financial crisis of 1997-98.

After the global financial crisis of 2008-09, Thailand's economy expanded 7.8%, with the fastest pace since 1995 in 2010. However, steady economic growth at just below 4% for most of 2011 was interrupted by historic flooding in October and November in the industrial areas north of Bangkok.

Chao Phraya River Basin employs 78% of the nation's work force and generates over two-thirds of the country's GDP. The BMA contributes 78% of the total GDP of the basin. Regarding the GDP distribution of industry in the basin, manufacturing is dominant for 33%, following wholesale and retail trade for 17%, while about 5% in agriculture.

Nominal GDP in 2011 marked at 10.5 trillion THB, corresponding to about 6% of nominal GDP in Japan. Regarding per capita GDP, 5,394 USD in 2011 corresponds to 10% of the index in Japan (45,920 USD).

B1.2.2 Economic Prospects of Thailand

One of Japanese prestigious commercial banks, the Bank of Tokyo-Mitsubishi UFJ publicized a report on middle-term economic prospects of Thailand in January 2013. Following is the scenario of the economic growth of Thailand up to 2022.

(1) 2012 to 2014: Average growth rate is 4.5% - 4.9%.

The growth rate in 2012 would be increased to the middle of 5% level due to the rebound of flood damage in 2011 but that in 2013 will be lowered again due to the rebound of high growth in 2012. Investment by the Thai Government for flood management as well as increase in direct investment with expectation of AEC establishment will keep a steady growth. Significant increase in minimum wage in 2012 -2013 will increase consumption and will support the growth.

(2) 2015 to 2018: Average growth rate is a middle of 4% level.

Thailand will strengthen its role as a production center of ASEAN with taking advantage of AEC establishment. Expansion of consumption as well as increase in export within ASEAN will speed up the growth gradually and the growth rate will reach at 5% level in 2018.

(3) 2019 to 2022: Average growth rate is 4.0% - 4.4%.

Growth rate will be lowered gradually as Thailand will enter a population onus period and an effect of transition of Chinese economy to stable growth economy will be materialized. Production of low value-added products will shift to CLM countries due to the increase in labor costs in Thailand. Its dependence on export will be lowered relatively although it is still a driving force of growth. On the other hand, increase in urbanization as well as increase in per capita GDP to 8,000 USD will pull up the growth by expanding matured consumption such as services.

[Reference]

Oxford Economics, an economic forecasting company in UK, made the following forecast for the Thai economy in "County Economic Forecast" dated May 24, 2012. It forecasted higher growth than that of the Bank of Tokyo-Mitsubishi UFJ for a few years after the flood recovery.

Year	2011	2012	2013	2014	2015	2016
GDP Growth (%)	0.1	5.3	6.5	5.6	5.4	4.9

Source: Oxford Economics, "Country Economic Forecast," May 24, 2012.

CHAPTER B2 AGRICULTURE

B2.1 Agriculture General

Mountainous and hilly area predominates in the upstream basin of Chao Phraya River where the rate of irrigated farmland is limited to 2~10% and most lands remains rain-fed. Many dams are located, but their storage is released for far-downstream beneficiaries and the upstream area only depends on intake of stream water by weirs. Downstream areas are located at Suphanburi, Phitsanulok, Lopburi and further south provinces where alluvial plain is dominant, forming the so-called "Chao Phraya Delta." The major granary area develops here (27~100% of farmland is irrigated) in which double/triple rice cropping has been practiced. Limited upland is prepared by filling earth in paddy field for cultivating vegetables and fruit trees. This granary area wholly depends on stored water in two grand dams (Sirikit and Bhumipol). The area experienced flood damages 7 times, and 6 drought periods during these 40 years after both dam's construction. In this basin, annual precipitation tends to increase from the north (1,000mm) to the south (>2,000mm). In the downstream basin, south of Ayutthaya Province, drainage is a major issue where water drained from northern areas is utilized for irrigation.

Paddy cultivation consists of rain-season crop (from April/May to July/August), following flood rice and dry-season crop (from November/December to March/April). Recently, farmers tend to avoid cropping flood season rice as officially advised, reflecting an steady increase of dry season rice. Since 2000, cultivation of upland crops and perennial fruit trees has been increasing. In this basin, 1,665 thousand farm households are cultivating 10,390 thousand ha of farmland (6ha/household).

Table B2.1.1 Land Use in Chao Phraya River Delta and Its Hinterland

(unit: rai =1/6.25 ha)

Province	Land	Utility	Residence	Paddy	Upland	Fruit tree	Vegetables	Forages	Wasted	Others	Forest	Water
Phecha Bun	7,917.8	6,249.8	82,066	1,374.4	1,828,1	298,957	39,071	21,451	22,821	38,924	2,544.1	166.8
Phitsanulok	6,759.9	4,983.4	76,231	1,569.3	615.5	163,925	13,363	8,689	13,233	38,548	2,484.6	177.7
Phichit	2,831.8	2,049.1	61.9	1,621.5	190.6	118,094	10,206	6,287	5,546	27,000	8.0	78.3
Nakhon Sawan	5,998.3	4,568.3	106.3	2,394.4	1.3	110,731	36,216	39,866	9,370	35,203	550.6	143.0
Uthai Thani	4,206.4	3,568.4	39.9	554.6	0.7	82,297	8,228	15,741	8,170	19,706	2,170.6	63.8
Chainat	1,543.6	1,232.9	41.8	914.0	0.2	44,859	6,924	8,208	5,683	7,092	47.9	31.1
Lop Buri	3,874.8	3,031.8	46.4	954.0	1.2	71,587	24,030	26,683	10,685	11,623	684.8	84.3
Sara Buri	2,235.3	1,497.5	30.9	420.5	0.4	93,723	14,167	44,302	5,907	11,702	504.2	73.8
Suphan Buri	3,348.8	2,505.6	78.3	1,260.4	0.6	89,259	30,219	5,434	3,285	35,339	384.2	84.3
Ang Thong	605.2	485.0	24.1	378.9	17.6	51,332	6,999	1,622	1,742	2,658	0	12.0
Sing Buri	514.0	442.6	8.7	394.6	18.3	11,628	1,502	1,726	2,690	3,492	0	7,142
Kanchanaburi	12,177.0	9,720.8	64.1	459.4	1,203.5	209.6	52,966	24,075	18,933	10,082	7,678.2	245.7
Pathum Thani	953.7	470.8	15.8	336.0	233	92.9	16,190	0	1,321	8,317	0	48.3
Nakhon Nayok	1,326.3	971.9	14.3	461.1	120	74.0	6,370	1,559	1,961	12,482	400.0	35.4
Nakhon	1,355.2	727.3	39.9	376.6	89.4	94.6	50,658	2,448	4,112	69,680	0	62.8
Prachin Buri	2,976.5	2,021.9	32.4	743.9	188.0	132.5	16,983	5,436	15,884	20,404	866.4	95.5
Ayutthaya	1,597.9	1,112.4	41.8	1,015.5	392	36.9	6,848	1,396	1,635	7,848	0	48.6
Nonthaburi	388.9	176.3	3.4	119.0	0	32.1	18,496	0	984	2,300	0	21.3
Bangkok	978.3	115,922	4.3	95.5	0	10.7	3,987	5	75	872	0.4	86.2
Samut Sakhon	545.2	167.7	4.2	23.1	0	79.4	3,696	0	41	33,619	23.8	37.8
Samut Prakan	627.6	187.2	81.2	39.6	0	14.2	372	0	41	39,059	12.6	44.0
Chachoeng Sao	3,344.4	2,129.3	47.2	775.8	492.3	190.8	13,465	8,250	22,241	95,185	484.1	121.5
Total	66,107.0	48,416.2	945.3	16,281.9	8,948,529	2,104.2	380,956	223.2	156.4	531.1	18,844	1,769.1

Source: Agricultural Statistics of Thailand

B2.2 Agricultural Area in Inundation Area

B2.2.1 Inundation Area and Zoning by Flood Type

The following is a result of the examination of the retention areas that have newly been delineated by the Study Team, the upper (UP) and the lower (LO) areas, from agricultural and ecological points of view. As the zoning criteria, five zones are used as given in the following table and figure:

Table B2.2.1 Classification of Inundation Area

Zone	Flooding Period	Depth of Flooded W.	Topographic Features	Flood Movement
FS	Short	Shallow	Alluvium	Pathway
FL	Long	Deep	Depression	Pathway
W	Partial	Partial	Terrace	from FL/CM*
M	Long	Deep	Swamp	Flood-Plain

note: CM; Catchment watershed as hinterland, Terrace includes piedmont area of hill/ Plateau

* ; Runoff discharge from hill slope & upper fan top

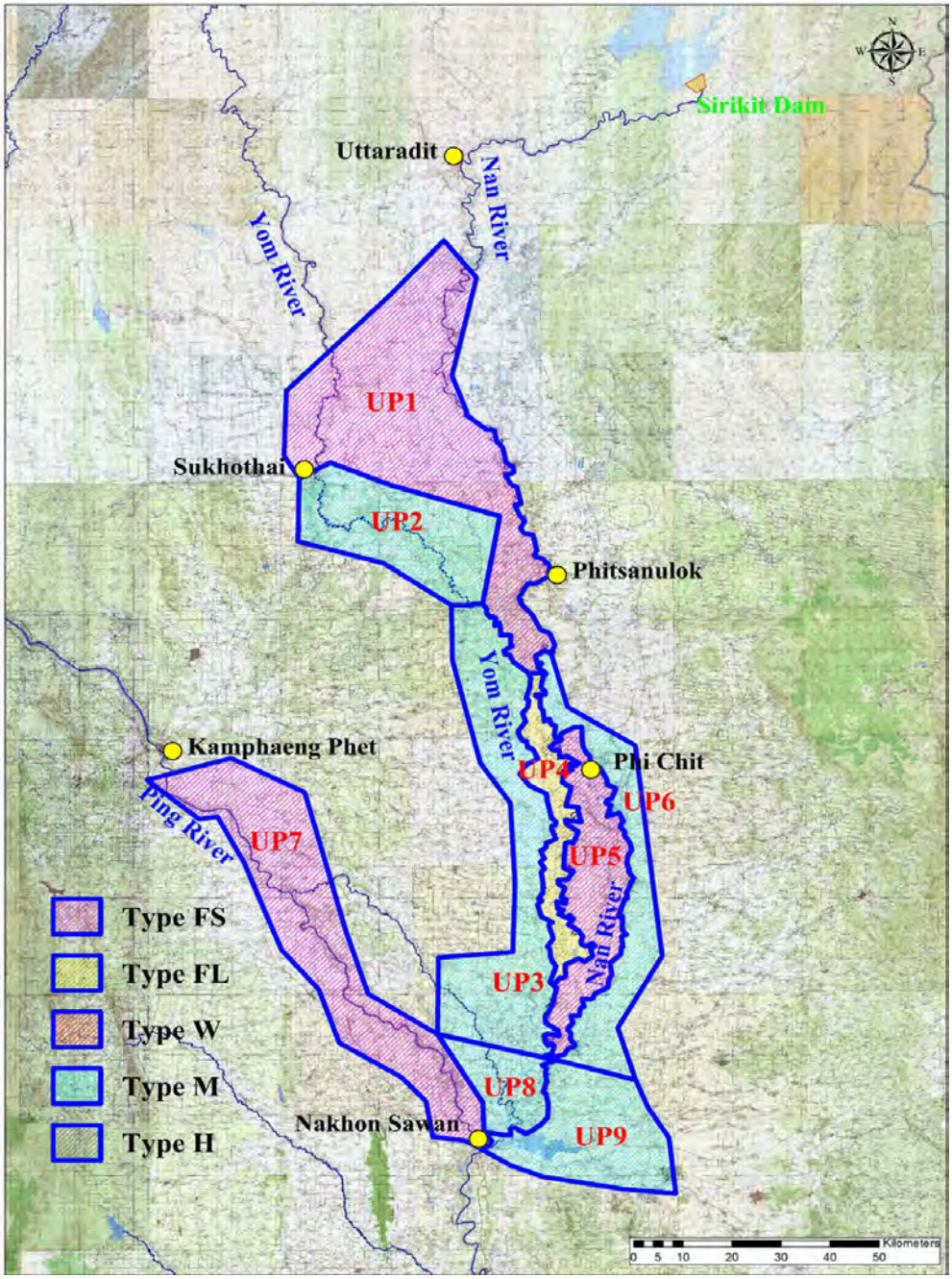


Figure B2.2.1 Inundation Area and Classification (Upper Central Plain)

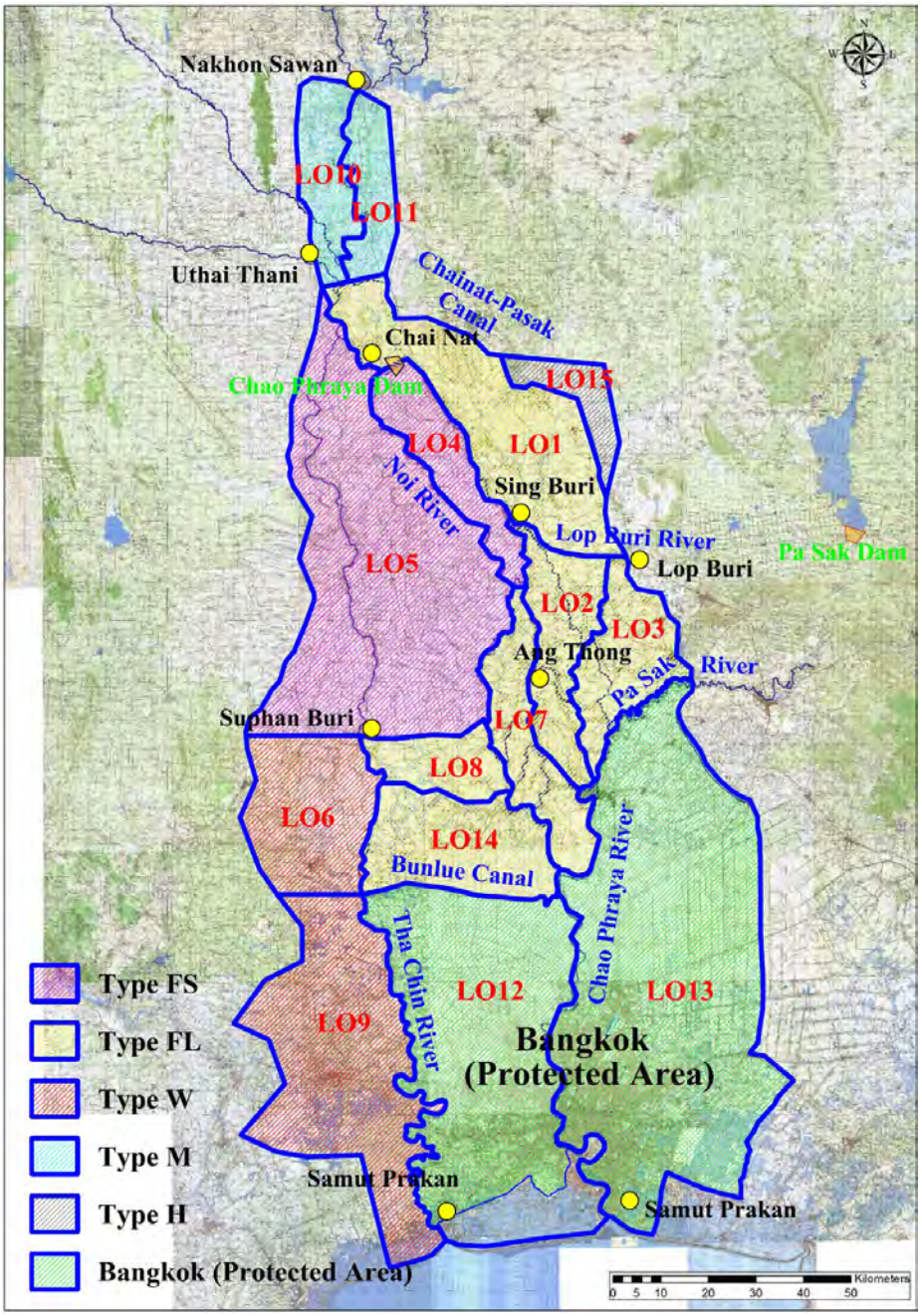


Figure B2.2.2 Inundation Area and Classification (Lower Central Plain)

This classification is based on the result of the survey on flood records and also on flood-trace-marks in the catastrophic flood in 2011. The zones shown in the figure are retention blocks, in which FS, W and H have their own catchment area behind them. The retentive functions of these zones include (1) retaining rainwater precipitated within their own watersheds, (2) simultaneously retaining rainwater flowing from their own watershed area behind them and (3) temporarily retaining inflow from the streams that overflow or have breakage(s) within their own areas or in their neighboring areas. This function is nothing but currently equipped one without any artificial improvement or additional works thereon. Countermeasures desired to be taken for each retentive zone include structural (engineering) and institutional supports so as to retrieve original state for the inhabitants as soon as flood recedes or their retentive function terminates. The relationship between public irrigation areas and newly delineated upper retention areas is given in the following table.

Table B2.2.2 Relationship between Inundation Area and Irrigation Area in Upper Nakhon Sawan

Upper Basin	Delineation	Irrigation Project	Zone Area (km^2)	Irrigable Area (ha)	Rain-fed Paddyland (ha)	Flood Plain (ha)	Share of area (%)
UP-1	**FS**	Phai Chum Phon	1,798	0	8,092	711	4.9%
UP-2	**M**	Phai Chum Phon	747	12,939	0	363	18.1%
UP-3	**M**	Yom West	1,152	0	10,465	964	10.0%
UP-4	**FL**	Yom-East Nam-West	331	0	8,132	272	25.4%
UP-5	**W**	Tha Bua, TumSam Ka, Bueng Mai	612	12,939	2,165	998	26.9%
UP-6	**M**	Tha Bua, Dong Setti	651	9,031	0	687	28.6%
UP-7	**FS**	-	1,318	0	9,780	0	7.5%
UP-8	**M**	Nan-W. Chum Saeng	268	0	12,050	945	46.4%
UP-9	**M**	Nan-E. Bung Boraphet	671	1,662	2,518	6,723	16.4%
Total		Upper Nakhon Sawan	7,548	36,571	53,202	11,663	13.5%

Flood damages in 2011 took place on farmland and irrigation facilities as the result of stream-bank overflow or breakages at the right bank of the Ping River in UP-7, at the left bank of the Yom River in UP-2 and the left bank of the Nan River in UP-9. In the upper Basin, flood plains and lowlands are concentrated along the area from the south of Phitsanulok to the north of Nakhon Sawan where the Yom River and the Nan River flow side by side in parallel, forming a core area of flood retention encompassing Bung Boraphet (lake) at its south. The relationship between public irrigation areas and newly delineated lower retention areas is given in the following table.

Table B2.2.3 Relationship between Inundation Area and Irrigation Area in Lower Nakhon Sawan

Upper Basin	Delineation	Irrigation Project	Zone Area (km^2)	Irrigable Area (ha)	Rain-fed Paddyland (ha)	Flood Plain (ha)	Share of area (%)
LO-1	**FL**	Manorom	1,283	12,848	0	168	10.1%
LO-2	**FL**	Maharaj, Tun Ban Kum, Tung Chang	579	52,740	0	55	91.1%
LO-3	**FL**	Kok Kra Tiam, Loeng Rang	550	51,672	0	77	94.1%
LO-4	**W**	Borom That, Channasut	477	38,164	0	30	80.1%
LO-5	**FS**	Tha Bot, Donchedee, Krasao	1,500	128,881	0	7	85.9%
LO-5	**W**	Pollathep, Samchuk	1,293	39,642	0	14	30.7%
LO-6	**FL**	Pho-Phraya, Song Phi-Nong	814	80,094	0	10	98.4%
LO-7	**FL**	Yang.Mane, Bang Ban	559	38,283	0	1,579	71.3%
LO-8	**FL**	Phakhai	328	30,340	0	568	94.3%
LO-9	**W**	Bang Lane, KPS., Nak-Pat, DNSD etc	1,716	163,306	0	0	95.2%

Upper Basin	Delineation	Irrigation Project	Zone Area (km^2)	Irrigable Area (ha)	Rain-fed Paddyland (ha)	Flood Plain (ha)	Share of area (%)
LO-10	**M**	Grot Pra Payuha	418	5,672	1,148	1,039	18.8%
LO-11	**M**	-	337	0	22,550	9	67.0%
LO-12	**H**	Phraya Banlue, Phra Phimon, Phasi Charoen	2,577	189,768	0	0	73.7%
LO-13	**H**	K.D., PCYC, R.S., Pasakthai, N.L.	3,788	333,572	0	0	88.0%
LO-14	**FS**	Chao Chet, Bang Yi-hon	777	77,458	0	27	99.7%
LO-15	**H**	Chong-Kae	233	22,310	0	9	95.8%
Total		Lower Nakhon Sawan	17,228	1,264,750	23,698	3,593	75.0%

The surface area and elevations of the newly delineated upper retention areas by province are shown in the following table.

Table B2.2.4 Surface Area and Elevation of inundation Area by Province (1/2)

Upper zone	Area	Elevation	Upper zone	Area (km^2)	Elevation
UP - 01	**1,797.6**		**UP - 05**	**611.8**	
Uttaradit	364.0	43 ~ 71	Phi Chit	579.1	34~ 39
Sukhothai	775.4	47 ~ 78	Nakhon Sawan	32.7	37~ 48
Phitsanulok	658.1	41 ~ 48	**UP - 06**	**651.2**	
UP - 02	**746.9**		Phitsanulok	74.2	38~ 42
Sukhothai	497.4	41 ~ 55	Phi Chit	447.0	32~ 41
Phitsanulok	249.5	41 ~ 50	Nakhon Sawan	129.9	38~ 50
UP - 03	**1,152.2**		**UP – 07**	**1,318.0**	
Phitsanulok	198.6	25~ 49	Kampaeng Phet	839.7	43 ~ 77
Phi Chit	703.9	28~ 41	Nakhon Sawan	478.4	28 ~ 47
Nakhon Sawan	249.6	23~ 39	**UP - 08**	**268.1**	
UP - 04	**331.0**		Nakhon Sawan	268.1	23~ 36
Phitsanulok	20.7	35~ 39	**UP - 09**	**670.7**	
Phi Chit	310.2	23~ 38	Nakhon Sawan	670.7	14 ~ 32

Salient features of the upper retention area lie in higher rate of rain-fed paddy field, lower rate of paddy area as compared to that of lower retention area, inclined (not flat) topography of paddy-land areas with fairly large difference in elevation within a zone. Due to these features and small size of paddy parcels, flood retentive capacity in the upper retention area is very poor. The surface area and elevations of the newly delineated lower retentive zones by province are shown in the following table.

Table B2.2.5 Surface Area and Elevation of inundation Area by Province (2/2)

Upper zone	Area (km^2)	Elevation	Upper zone	Area (km^2)	Elevation
LO- 01	**1,298.0**		**LO - 09**	**1,724.6**	
Uthai Thani	10.1	37 ~ 62	Nakhon Pathom	1,303.4	0 ~ 3
Chai Nat	370.7	1 ~ 19	Ratchaburi	287.7	0 ~ 2
Nakhon Sawan	168.4	13 ~ 48	Samut Sakhon	133.5	0 ~ 2
Sing Buri	240.1	9 ~ 15	**LO – 10**	**401.2**	
Lop Buri	508.7	11 ~ 30	Nakhon Sawan	319.7	13 ~ 48
LO - 02	**579.3**		Uthai Thani	81.5	37 ~ 62
Sing Buri	52.8	9 ~ 15	**LO - 11**	**332.6**	
Lop Buri	197.2	11 ~ 30	Nakhon Sawan	270.7	13 ~ 48
Ang Thong	121.5	2 ~ 9	Chai Nat	61.8	1 ~ 19
Ayutthaya	210.8	2 ~ 9	**LO - 12**	**2,470.5**	
LO- 03	**550.0**		Ayutthaya	78.7	-4 ~ 6
Lop Buri	86.5	3 ~ 27	Nakhon Pathom	551.0	1 ~ 4
Sing Buri	243.8	5 ~ 21	Nonthaburi	538.5	2 ~ 5
Ayutthaya	241.2	2 ~ 6	Pathum Thani	333.0	0 ~ 4
LO - 04	**464.2**		Samut Sakhon	341.4	0 ~ 2
Chainat	209.7	1 ~ 19	Bangkok	448.4	1 ~ 4
Sing Buri	254.6	9 ~ 15	Samut Prakan	179.4	2 ~ 6
LO - 05	**2,793.4**		**LO - 13**	**3,771.0**	
Uthai Thani	8.3	37 ~ 62	Ayutthaya	871.0	-4 ~ 6
Chainat	599.8	1 ~ 19	Saraburi	116.7	1 ~ 23
Sing Buri	240.2	5 ~ 21	Pathum Thani	1,132.6	0 ~ 4
Suphanburi	1,259.9	2 ~ 12	Nonthaburi	79.3	2 ~ 5
Ang Thong	592.8	2 ~ 9	Bangkok	1,082.9	1 ~ 4
LO - 06	**814.3**		Samut Prakan	451.8	2 ~ 6
Saraburi	814.4	2 ~ 12	Chachoengsao	36.8	1 ~ 3
LO – 07	**552.7**		**LO-14**	**779.6**	
Ang Thong	209.0	2 ~ 9	Suphanburi	273.3	2 ~ 12
Ayutthaya	343.7	1 ~ 9	Ayutthaya	506.3	-4 ~ 6
LO - 08	**328.8**		**LO-15**	**235.8**	
Suphanburi	144.0	2 ~ 12	Nakhon Sawan	67.7	13 ~ 48
Ayutthaya	184.8	1 ~ 9	Lop Buri	168.1	11 ~ 30

The lower retention area is characterized by relatively large size of each delineated zone mainly consisting of irrigated paddy field with higher percentage of paddy-land as compared with the upper area. Paddy areas occupy lowland without much elevation difference within a zone with larger size of each paddy-field parcel, hence with much larger flood retentive capacity. However, the southern part of this upper retention area is currently on the way to get gradually converted from farming zone into industrial one, thus it'll be anticipated that the area is becoming a site that is not suitable for flood retention but rather one to be protected as an industrial park in the near future. In order to cope with unimaginable size of floods as occurred in Delluvial Era beyond the treatable capacity of drain by-passes, there seems no other way than to take radical measures in the top-watershed area of Chao Phraya as mentioned later.

Flood retentive capacity of the upper and the lower retention areas newly delineated by the Study Team is estimated as follows: In this estimation, retention capacity of rain-fed paddy field is assumed in a way that effective water depth is at maximum 50cm, while it is 1m in the case of irrigable paddy field.

As to the retaining water depth of flood plains intervening in between two major streams, 1.5m is assumed.

In the zone delineation, FS, W and H have their own catchments behind them. The overall surface areas of these zones were tentatively estimated from their length of outer boundary, but it is required to measure them on the topographic-maps for elaborating the estimation more accurately. It is assumed that floodwater doesn't pass from their up-stream side, thereby limiting their function to retain precipitated rainwater and inflow from behind their catchments for some period. The rest zones, FL and M form wide waterways that allow flood to pass from up-stream side. The retentive function of these zones would be improved by raising the elevation of the road surface that passes from the east to the west. As regards runoff yield ratio, 75% of forest land with the runoff rate of 15% and 25% of upland crop area etc with that of 35% or 20% on average is assumed as the composition of their watershed area (in this context, residential area is commonly located on stream banks or within the retention area). As to runoff ratio of retention area itself, 50% is assumed where the rest 50% is vertically infiltrated into groundwater or evaporated in the air.

Table B2.2.6 Estimation of Retention Capacity of the Upper Retention Area

Zone	Zone Area (km^2)	Self Catchment area	Total Watershed (km^2)	Annual Rainfall (mm)	Total Run-off (MCM)
UP-1	1,798.0	2,500	3,800	1,379	1,584
UP-2	746.9	600	1,350	1,482	731
UP-3	1,152.2	1,400	2,550	1,209	1,035
UP-4	331.0	0	350	1,118	185
UP-5	611.8	0	600	1,113	340
UP-6	651.2	1,100	650	1,186	647
UP-7	1,318.0	2,500	2,800	1,534	1,778
UP-8	268.1	0	250	1,363	183
UP-9	670.7	4,300	4950	1,363	1,630
Total	7,547.9	12,400	17,300	1,305	7,837

Zone	Total Rice Field (ha)	Of which, Irrigated	Flood Plain (ha)	estimated Retention Capacity (MCM, max. mm)	
UP-1	8,092	0	711	40	35
UP-2	12,939	12,939	363	135	273
UP-3	10,465	0	964	67	78
UP-4	8,132	0	272	81	491
UP-5	15,104	12,939	998	155	507
UP-6	1,994	1,994	119	22	40
UP-7	9,780	0	0	49	42
UP-8	12,050	0	945	74	555
UP-9	4,180	1,662	6,723	130	109
Total	82,736	29,534	11,095	754	126

The above table gives the result of the estimation of retentive capacity of the upper retention area, extending to around 7 thousand square kilometer, though only flood plains and lowlands intervening in between two rivers, the Yom River and the Nan River, are actually serve as substantial flood retention but the rest areas have poorer capacity. Among upper retention zones, UP-1,UP-3, UP-6 and UP-7have large watershed areas behind them and the retentive capacity is almost saturated when they receive 35 ~78mm of rainfall.

Table B2.2.7 Estimation of Retention Capacity of the Lower Retention Area

Zone	Zone Area (km^2)	Self Catchment area	Total Watershed (km^2)	Annual Rainfall (mm)	Total Run-off (MCM)
LO-1	1,282.9	300	1,600	1,137	798
LO-2	579.3	0	600	1,071	310
LO-3	550.0	0	550	935	257
LO-4	476.9	0	500	1,009	241
LO-5	2,793.4	2,200	5,000	960	1,763
LO-6	814.3	700	1,500	758	415
LO-7	559.3	0	550	1,018	285
LO-8	327.8	0	350	815	134
LO-9	1,715.8	2,500	4,200	961	1,305
LO-10	418.2	500	900	1,331	411
LO-11	336.7	4,800	5,150	1,307	1,475
LO-12	2,574.8	0	2,600	1,242	1,599
LO-13	3,688.8	1,000	4,700	1,320	2,699
LO-14	777.2	0	800	824	320
LO-15	233.1	1,600	1,850	1,245	544
Total	17,128.5	13,600	30,850	1,062	12,555
Zone	Total Rice Field (ha)	Of which, Irrigated	Flood Plain (ha)	estimated Retention Capacity (MCM, max. mm)	
LO-1	12,848	12,848	168	131	187
LO-2	52,740	52,740	55	528	1,824
LO-3	51,672	51,672	77	518	1,883
LO-4	38,164	38,164	30	382	1,602
LO-5	168,523	168,523	21	1,686	918
LO-6	80,094	80,094	10	801	1,464
LO-7	38,283	38,283	1,579	407	1,454
LO-8	30,340	30,340	568	312	1,903
LO-9	163,306	163,306	10	1,633	1,203
LO-10	6,820	5,672	1,039	78	252
LO-11	22,550	0	9	113	100
LO-12	189,768	189,768	0	1,898	1,474
LO-13	333,572	333,572	0	3,336	1,632
LO-14	77,458	77,458	27	775	1,994
LO-15	22,310	22,310	9	223	511
Total	1,288,448	1,264,750	3,602	12,820	1,085

As the entire upper retention area, its retentive capacity is filled with only 126mm of rainfall that actually took place several times in 2011, without any room for retaining over this amount of rainfall. The original problem may stem from the fact that RID initially chose such narrow spaced zone as upper retention area where two large streams run side by side.

As compared with the upper retention area, the lower one has much larger surface areas seen in the above table with smaller self-catchments behind them. They have enough flood retentive capacity except the upper-most stream side, LO-11. Besides, annual rainfall was comparatively low in comparison with the upper retention area in 2011. Only if allowing 1 meter of inundation depth, the zones in the lower retention area can sustain water inside them even if they receive 100mm of daily rain for the period of half a month. If several roads passing from the east to the west through middle number of LO are raised their surface elevation with lower density of culverts, they would greatly serve as flood barriers that can retard flood reaching as far as metropolitan area. Very few crops are found in this area other than rice, flood damages might be negligible because farmers keep their field fallow during flooding season.

B2.2.2 Countermeasures

Countermeasures to be taken for the newly delineated zones:

These measures include both structural (engineering) and non-structural (institutional) assistance as listed below: they have been proposed by RID as common measures applicable to all retention areas.

(1) Structural Measures:

- Strengthening measures for retention areas by the government,
- Dredging of drainage channels and lakes/mashes,
- Construction of community-based small scale retention ponds,
- Improvement of small scale irrigation facilities (gates, weirs etc.),
- Strengthening (and raising) the existing levees,
- Installation of drainage pumps (reduction of inundation depth and duration),
- Proper maintenance of canals (increase of drainage capacity to main canal)

(2) Non-structural ones:

- Compensation for farmland damaged by inundation,
- Agricultural guidance like changing forms of farming schedule, introduction of floating vegetable gardens etc,
- Measures to secure income during inundation period (combine agriculture and fishery or aquaculture etc.),
- Measures to secure domestic water supply for inundation period,
- Measures to secure feeds for livestock,
- Preparation of community-based hazard map and land-use control and
- Improvement of flood information.

In addition to the above common measures, the individual ones intrinsic to each zone as tabulated below should be taken. Also, as common measures applicable to plural zones after watershed hinterland are added in the new zoning, those to minimize runoff from their watersheds would be required. For instance, improvement of vegetative cover by means of reforestation of timber trees or development of fruit orchards for the zones FS, W and H that accompany watershed areas behind them would be required to mitigate or control runoff, or provision of runoff collecting, horizontal channels coupled with enlarged or deepened reservoirs to retard runoff discharge from their watershed.

Zone	Intrinsic issues	Possible measures taken for solving them
UP-1	Narrow section of Yom River fosters breakage	Provide two-fold dyke inside of which is utilized as farmland
UP-2	Meandered part of Yom leads to easy breakage	Provide two-fold right-bank dyke inside of which is utilized as farmland
UP-3	Runoff from western hills ponded at river bank lowland	Runoff flow is primarily cut off by newly provided reservoirs
UP-4	The area becomes flood plain in high-water period	The inundated area can be utilized as a long monkey cheek at floods
UP-5	A lot of swamps are found where long inundation occur	Encircle Phichit Town by a polder dyke & the rest is utilized as MC
UP-6	Runoff from eastern hills long stays lowland along River	Runoff flow is primarily cut off by newly provided reservoirs
UP-7	Surrounded both-sides by hills, field is apt to get long submersion	Runoff flow is primarily cut off by newly built reservoirs later using it for irrigation
UP-8	The area has many swamps hit by frequent inundation	Convert paddy field to fish ponds that can also be used as MC
UP-9	No dike at Tha Tako River that has huge watershed area	Damaged southern dike of Bung Boraphet is replaced by River dike at the south

Zone	Intrinsic issues	Possible measures taken for solving them
LO-1	Locate at mid-Delta, floods are apt to stay for a long period	Chainat-Pasak Canal can also be used as drainage stream
LO-2	Being originally a flood plain, floods too often remain here	Ditto
LO-3	Ditto	Ditto
LO-4	Because of a low-lying area, water table is also high in dry season	Since paddy yield remains low due to poor drainage, better to convert into fish ponds
LO-5	The area has suffered from alternate droughts and floods	Many Mc cum reservoirs must be created utilizing them as fish ponds/ irrigation
LO-6	Suffering from chronic water deficit wells are used for supplement it	Many MC reservoirs can recharge groundwater, also serving as fish ponds
LO-7	Being a typical wetland. Famous for chronic flood damages	Not suitable for paddy area, better convert it into fishponds, duckeries etc
LO-8	Situated at mid-delta, flood water is apt to stay here	Strengthening paddy field's flood retentive capacity by raising surrounding dikes*
LO-9	Situated at lower-delta, flood water is apt to remain here	Use draining function of Tha Chin River during low-tide period
LO-10	Right bank of Ping River is apt to break & flood passes here through	A flood shield wall is provided from N.Sawan to western hill-edge
LO-11	Lowland surrounds river-side, Tha Tako R. overflows to the south	A robust dike is needed at its southern bank in place of the existing dike at B. Boraphet
LO-12	Being a typical wetland. Famous for chronic flood damages	Field soil can be sold for molding brick, thus converting rice field into multi-purpose MCs
LO-13	Strongly affected by tidal action, reversal river flow occurs at high tide	Strengthening functions of anti-tidal gates & drainage capacity at low tide
LO-14	Situated at lower-delta, flood water is apt to remain here	Use draining function of Tha Chin River during low-tide period
LO-15	Runoff from NE hills is apt to stay at side-area of the Canal	Cut runoff at newly-built reservoirs serving later also as irrigation source

Note: *: Such an action should be accompanied with reasonable compensatory measures such as subsidy for building raised-floor houses, sufficient compensatory payments for flood damages once they take place, and flood shelters for inhabitants.

CHAPTER B3 LAND USE

B3.1 Collected Data

Satellite images of LANDSAT-M photographed in 1996 and 2010 covering Upper Central Plain and the Lower Central Plain of the Chao Phraya River Basin have been collected and processed into land use maps as shown in Figure B3.1.1 and Figure B3.2.1, Table B3.2.1 and Table B3.2.2 present breakdowns by province for the 1996 and 2010 land use.

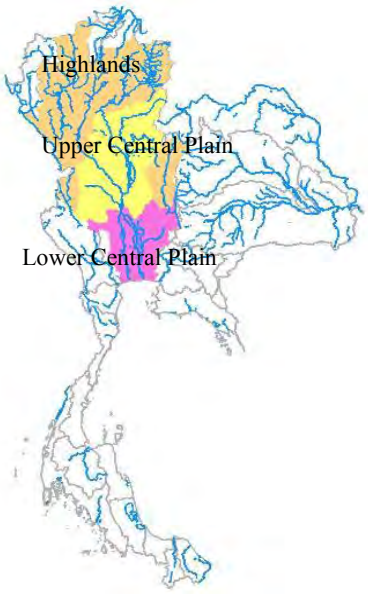
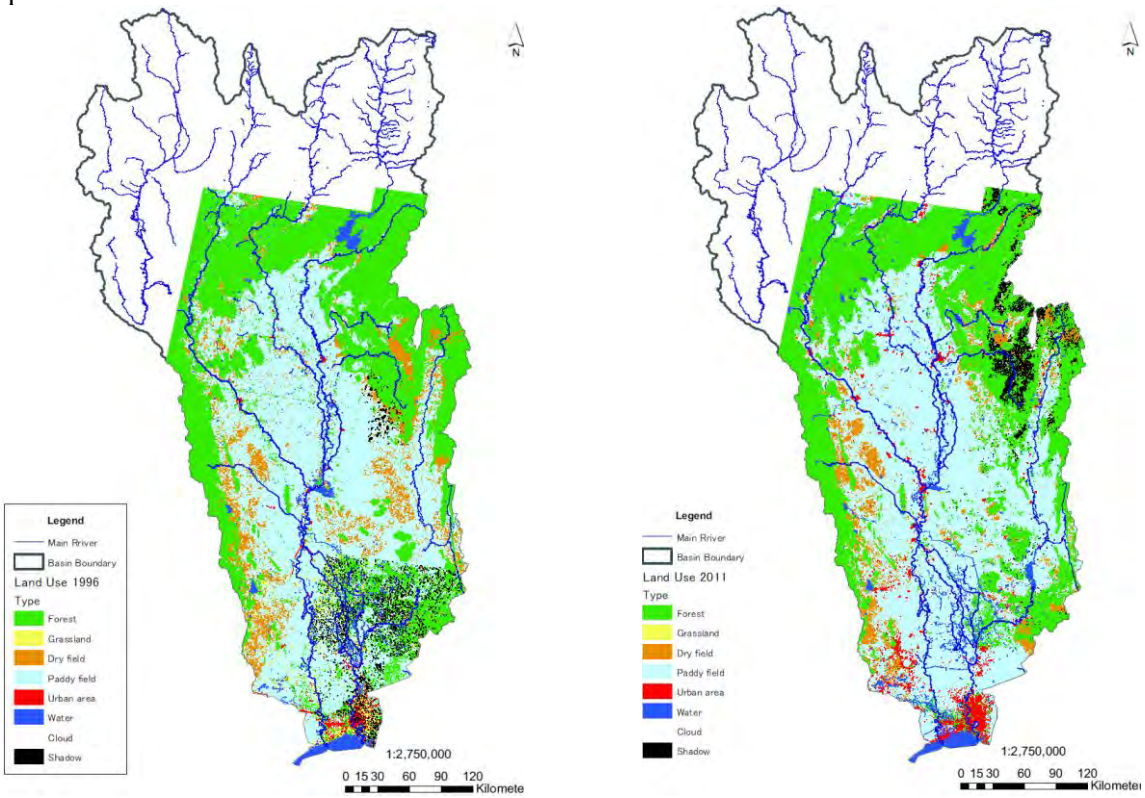


Figure B3.1.1 Divisions of Chao Phraya Basin

B3.2 Regional Land Use Conditions

Land Use conditions of the Study Area are preliminarily discussed as follows, from the viewpoint of comparison with the share of land use in 1996 and 2010.



(a) 1996 Land Use (b) 2010 Land Use

Figure B3.2.1 Comparison of Land Use Between 1996 and 2010

(1) The Upper Central Plain

The Upper Central Plain mainly consists of riverine terraces and alluvial fans, as well as flood plain along the major tributaries of the Chao Phraya River such as the Ping, Wang, Yom and Nan rivers. The share of dry field is significant with 39% in 1996, but it has a tendency of reduction, declined to 36% in 2010. On the other hand, paddy field, third share in the Area, has a tendency of increase from 27% (1996) to 30% (2010). Urban Area has also increased from 0.11% (1996) to 0.37% (2010).

Taking a look at the breakdown by province, paddy fields of Phichit and Nakhon Sawan are enormous with 63% and 49%, respectively, and have an increasing tendency. The increase of the share of urban area of Nakhon Sawan is also significant with the 306% of growth rate.

(2) The Lower Central Plain

The Lower Central Plain is said to be simply characterized as a delta. It is significant that the highest share was dry field with 37% in 1996 and replaced by paddy field with 38% in 2010.

Taking a look at the breakdown by province, there has been an increase in the share of paddy field in most provinces. Also seen is a significant increase of the share of urban area in most provinces. Elongation of the share of urban area in Suphan Buri, Nonthaburi and Samut Sakhon are particularly remarkable. The share of urban area in Bangkok is high, of course, has continued to increase, and in 2010 it has become 28%.

Table B3.2.1 Land Use in Chao Phraya River Basin (1996)

(Unit: ha)

Province	Unspecified due to clouds	Dry field	Forest	Grassland	Paddy field	Unspecified due to shadows	Urban area	Water	Grand Total
Upper Central Plain									
Sukhothai		274,300.72	185,678.70		203,275.14		739.53	2,462.91	666,457.01
Uttaradit	2.32	145,705.19	466,785.27		120,818.15		216.54	26,760.61	760,288.08
Phitsanu Lok	15,410.91	401,957.75	421,895.30		214,245.34	1,433.34	1,194.59	3,521.74	1,059,658.96
Kampaeng Phet		426,573.31	197,708.91		222,104.95		1,206.00	3,493.89	851,087.05
Phichit	2,269.11	169,006.68	1,300.81		255,611.52	173.82	760.18	2,780.98	431,903.10
Nakhon Sawan	5,148.34	468,450.66	78,568.76	618.66	385,631.29	343.98	1,607.00	12,414.81	952,783.49
Uthai Thani	416.49	235,381.96	326,898.07	82.89	98,895.47		230.31	2,990.91	664,896.09
Sub Total	**23,247.16**	**2,121,376.27**	**1,678,835.81**	**701.55**	**1,500,581.86**	**1,951.14**	**5,954.15**	**54,425.85**	**5,387,073.78**
Lower Central Plain									
Chainat	197.20	113,909.69	3,022.47	1,033.20	128,939.70	249.01	716.12	2,458.86	250,526.24
Singburi	3,259.13	34,126.16	6,663.58	3,195.41	31,104.58	1,657.89	268.33	1,425.58	81,700.67
Lopburi	30,918.79	258,199.80	96,527.76	1,540.74	249,325.23	9,940.95	1,121.63	2,696.65	650,271.55
Suphan Buri	1,027.69	223,500.86	71,591.21	3,164.93	233,111.46	1,143.13	748.57	6,071.01	540,358.85
Ang Thong	3,802.34	38,052.68	3,418.07	3,148.00	41,093.31	4,029.01	310.49	1,195.77	95,049.68
Ayutthaya	8,530.15	40,130.56	6,216.64	2,798.85	185,033.34	5,529.07	1,829.26	4,666.89	254,734.78
Saraburi	38,719.46	114,980.35	70,215.32	104.56	106,899.95	14,772.26	1,711.26	1,414.55	348,817.71
Nakhon Pratthom	503.52	71,350.66	4,411.93	1,700.88	131,585.43	438.38	2,545.45	1,428.30	213,964.55
Nonthaburi	543.35	11,688.51	2,782.58	457.58	45,377.84	1,122.06	1,005.73	662.39	63,640.05
Pathum Thani	10,155.63	23,028.63	7,035.08	941.38	105,237.33	3,122.74	1,517.26	1,041.99	152,080.04
Samut Sakhon	17.91	11,397.51	2,786.11	701.79	50,200.22	32.85	3,214.67	18,711.24	87,062.31
Bangkok	8,401.02	30,933.55	4,324.36	2,995.65	72,838.36	3,822.92	26,448.52	6,897.96	156,662.34
Samut Prakarn	8,161.66	15,915.88	6,220.83	1,608.95	36,735.23	5,680.77	6,772.35	15,615.94	96,711.61
Sub Total	**114,237.86**	**987,214.85**	**285,215.96**	**23,391.92**	**1,417,482.00**	**51,541.05**	**48,209.63**	**64,287.13**	**2,991,580.39**
Grand Total	**137,485.02**	**3,108,591.12**	**1,964,051.77**	**24,093.47**	**2,918,063.86**	**53,492.19**	**54,163.78**	**118,712.97**	**8,378,654.17**

Table B3.2.2 Land Use in Chao Phraya River Basin (2010)

(Unit: ha)

Province	Unspecified due to clouds	Dry field	Forest	Grassland	Paddy field	Unspecified due to shadows	Urban area	Water	Grand Total
Upper Central Plain									
Sukhothai	309.60	201,072.88	223,163.81		236,004.48		2,304.05	3,602.19	666,457.01
Uttaradit	28,973.54	142,738.19	447,086.75	631.77	14,868.58	2,763.09	2,527.29	20,698.86	760,288.09
Phitsanu Lok	77,332.60	397,763.58	334,278.62	168.06	219,780.07	18,502.68	4,581.91	7,251.43	1,059,658.96
Kampaeng Phet	839.79	418,226.60	189,680.68	277.48	34,796.47		3,174.19	4,091.85	851,087.05
Phichit	108.00	154,233.66	3,006.37	59.04	271,264.99	59.73	1,051.02	2,120.30	431,903.10
Nakhon Sawan	1,769.18	380,008.95	86,019.02	654.39	471,130.22	180.34	4,993.74	8,027.65	952,783.49
Uthai Thani	491.43	248,431.86	340,275.22	13.32	70,879.13		1,165.65	3,639.48	664,896.09
Sub Total	**109,824.14**	**1,942,475.72**	**1,623,510.46**	**1,804.06**	**1,618,723.94**	**21,505.84**	**19,797.85**	**49,431.76**	**5,387,073.79**
Lower Central Plain									
Chainat	124.56	143,095.51	4,247.38	58.59	99,031.19		1,755.84	2,213.17	250,526.24
Singburi	14.53	23,628.04	242.89		56,036.64		158.94	1,619.63	81,700.67
Lopburi	2,137.14	200,165.77	102,915.15		328,918.16	805.39	1,283.76	14,046.18	650,271.55
Suphan Buri	425.79	245,342.35	59,372.45	41.85	220,141.63	14.94	8,898.83	6,121.0	540,358.85
Ang Thong	5.40	29,001.69	214.51		63,300.05		102.44	2,425.58	95,049.68
Ayutthaya	2,022.99	38,636.06	7,696.85		197,372.73		3,158.59	5,847.56	254,734.78
Saraburi	5,552.62	125,888.00	109,789.27		102,650.01	331.16	1,772.62	2,834.04	348,817.71
Nakhon Pratthom	366.19	57,108.17	3,258.57	141.75	145,454.75		3,649.17	3,985.94	213,964.55
Nonthaburi	903.60	4,083.74	425.67		52,238.22	190.53	5,201.36	596.93	63,640.05
Pathum Thani	15,643.53	772.62	175.68		133,633.60	100.71	1,038.29	715.61	152,080.04
Samut Sakhon	204.27	4,449.17	812.41		56,125.63	2.25	7,599.77	17,868.82	87,062.31
Bangkok	14,883.80	6,774.98	2,265.79	81.54	82,252.11	120.65	43,545.58	6,737.89	156,662.34
Samut Prakarn	11,039.23	2,025.11	1,701.95	13.05	57,455.79	89.32	10,154.38	14,232.79	96,711.61
Sub Total	**53,323.66**	**880,971.20**	**293,118.58**	**336.78**	**1,594,610.50**	**1,654.95**	**88,319.57**	**79,245.15**	**2,991,580.39**
Grand Total	**163,147.80**	**2,823,446.92**	**1,916,629.04**	**2,140.84**	**3,213,334.44**	**23,160.80**	**108,117.42**	**128,676.91**	**8,378,654.18**

CHAPTER B4 RIVER CHARACTERISTICS

B4.1 Longitude Profile

Longitudinal profiles of the rivers/canals in Chao Phraya river basin are shown in the following Figures.

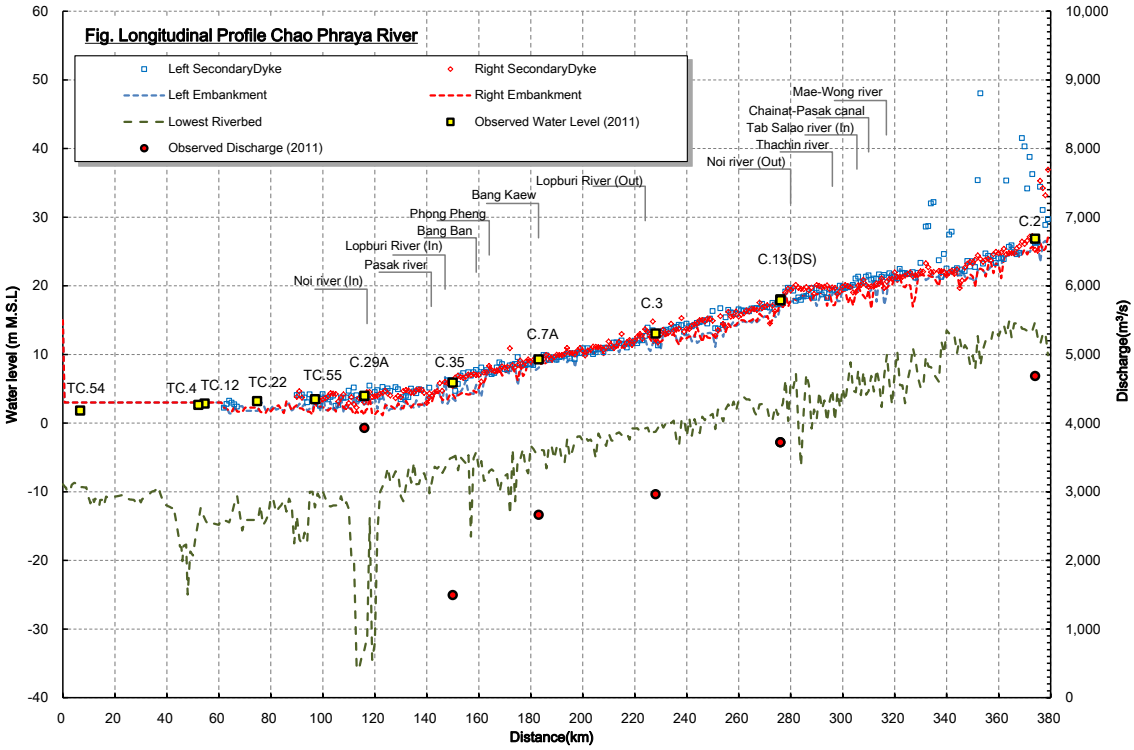


Figure B4.1.1 Longitude Profiles of Chao Phraya River

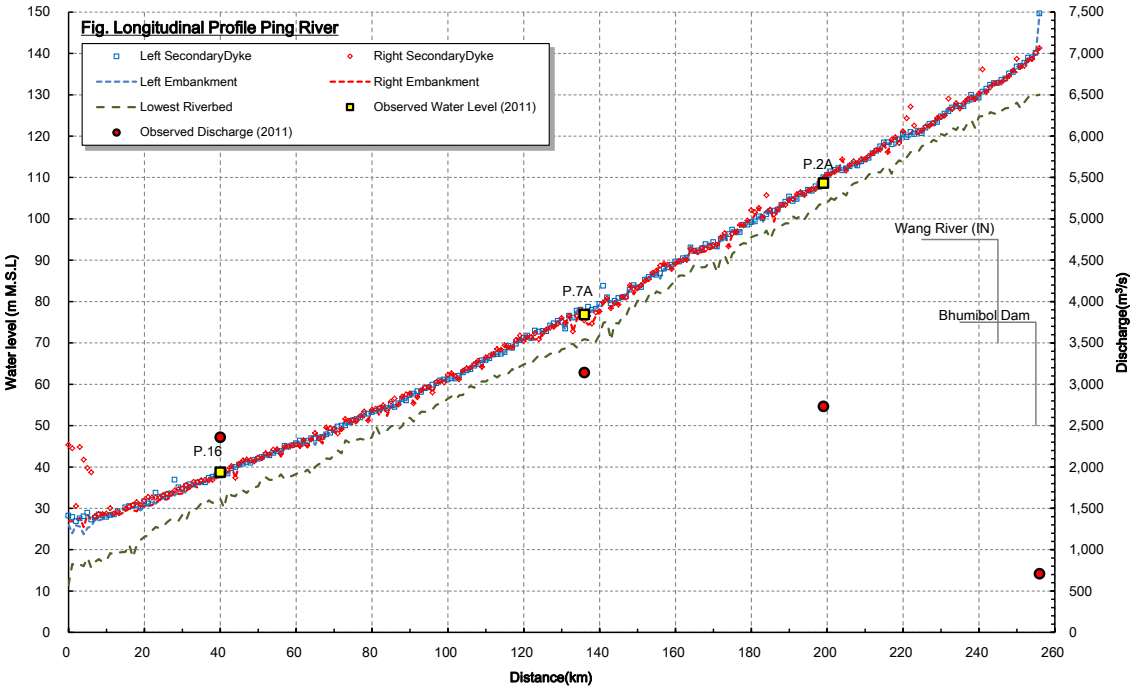


Figure B4.1.2 Longitude Profiles of Ping River

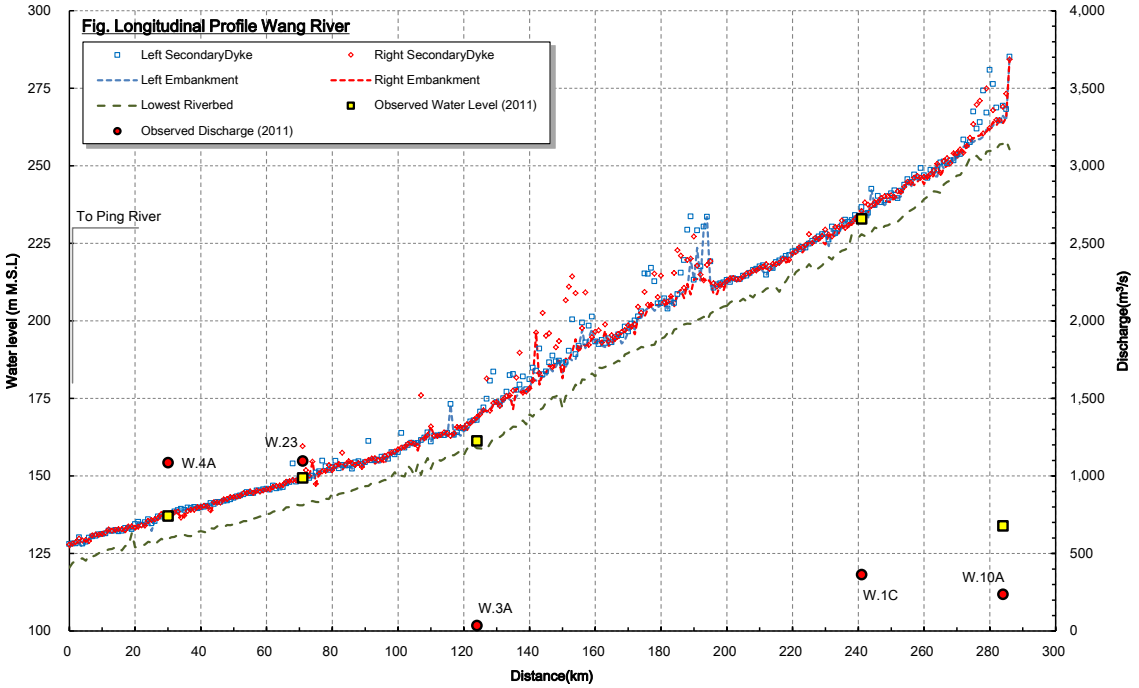


Figure B4.1.3 Longitude Profiles of Wang River

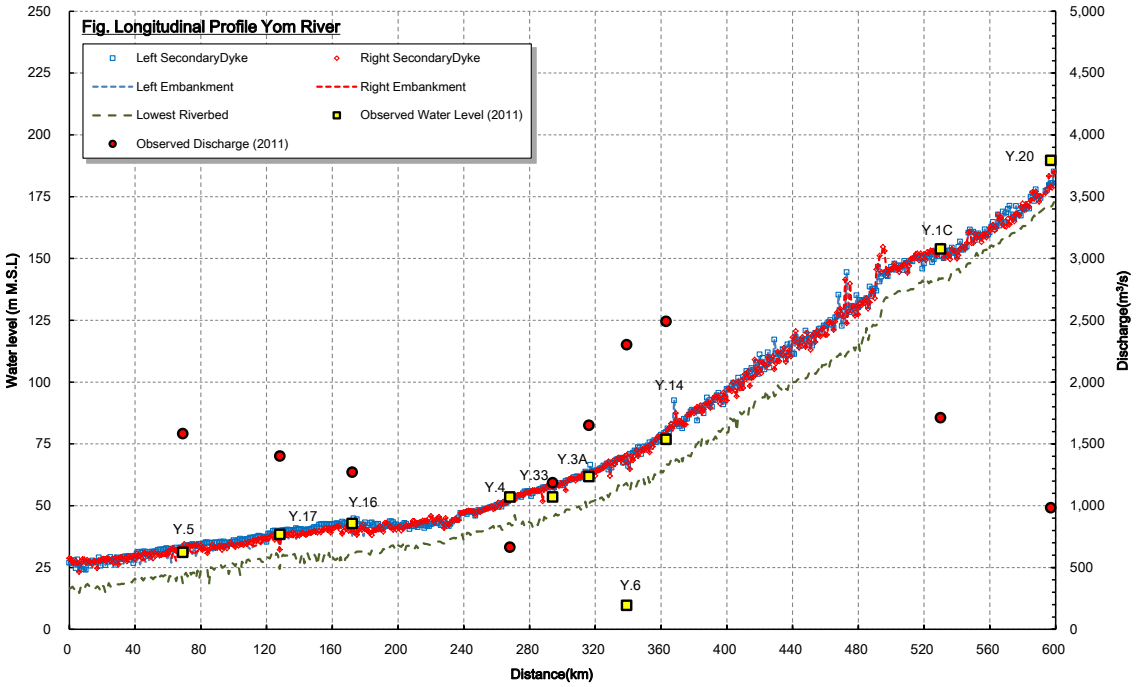


Figure B4.1.4 Longitude Profiles of Yom River

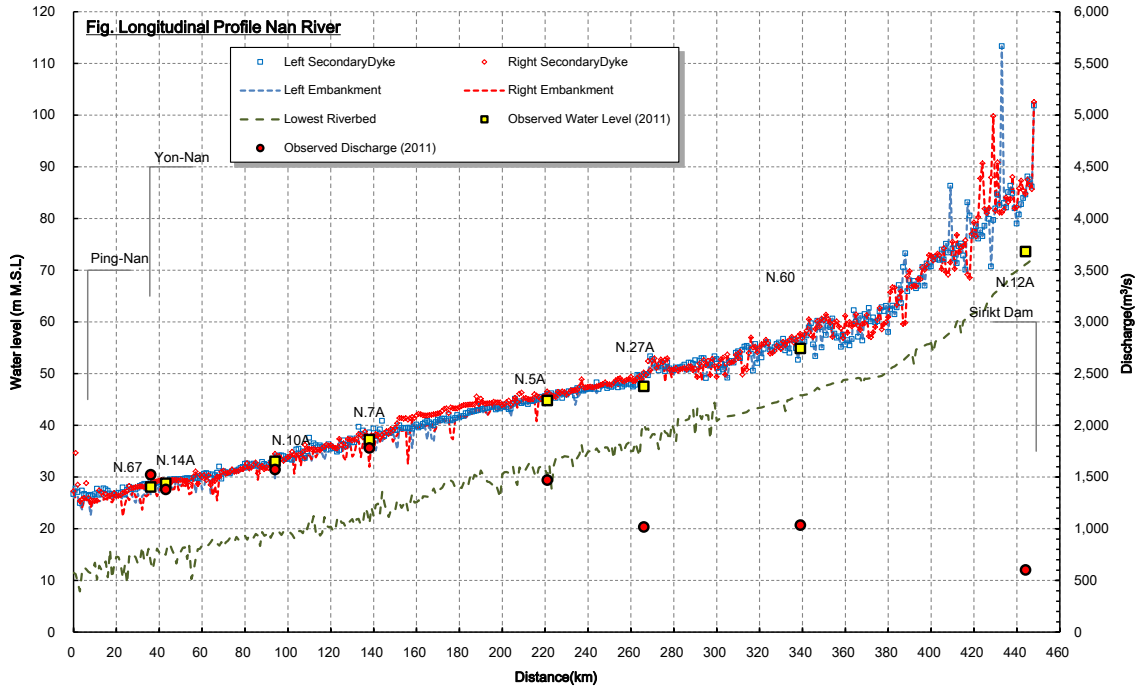


Figure B4.1.5 Longitude Profiles of Nan River

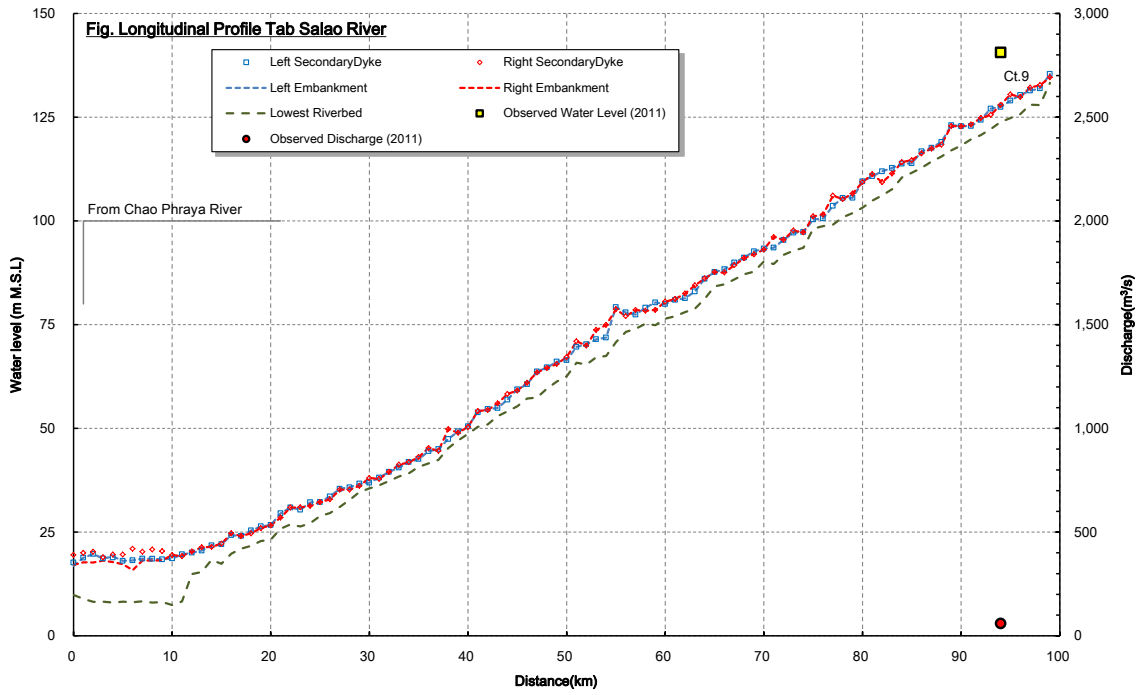


Figure B4.1.6 Longitude Profiles of Tab Salao River

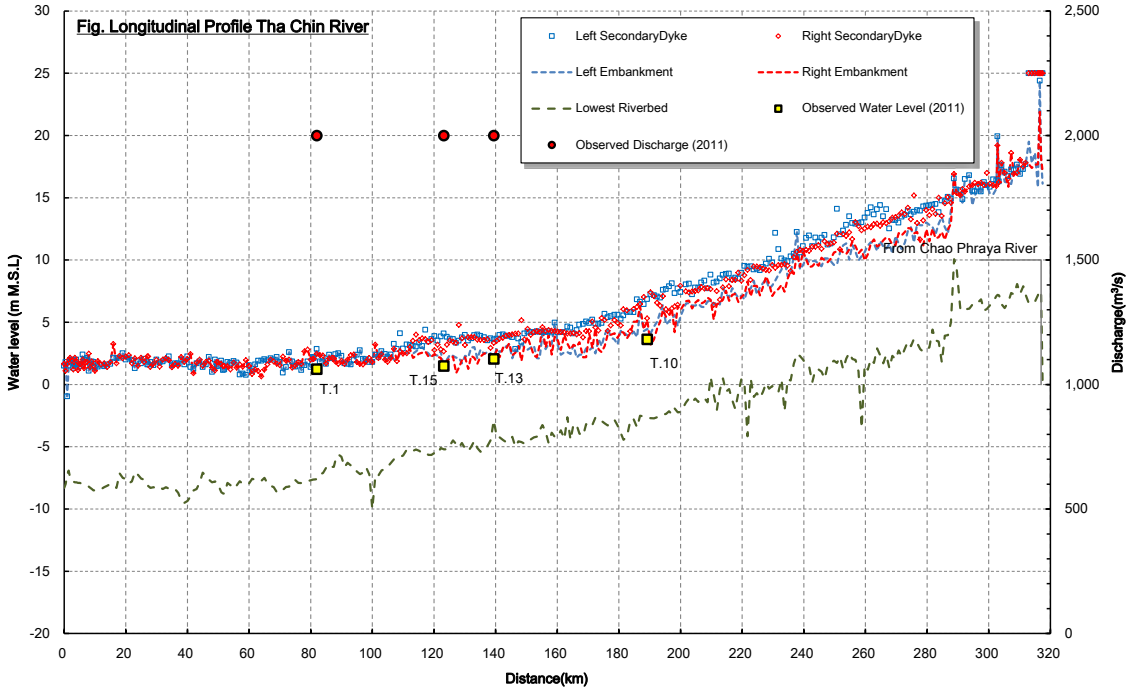


Figure B4.1.7 Longitude Profiles of Tha Chin River

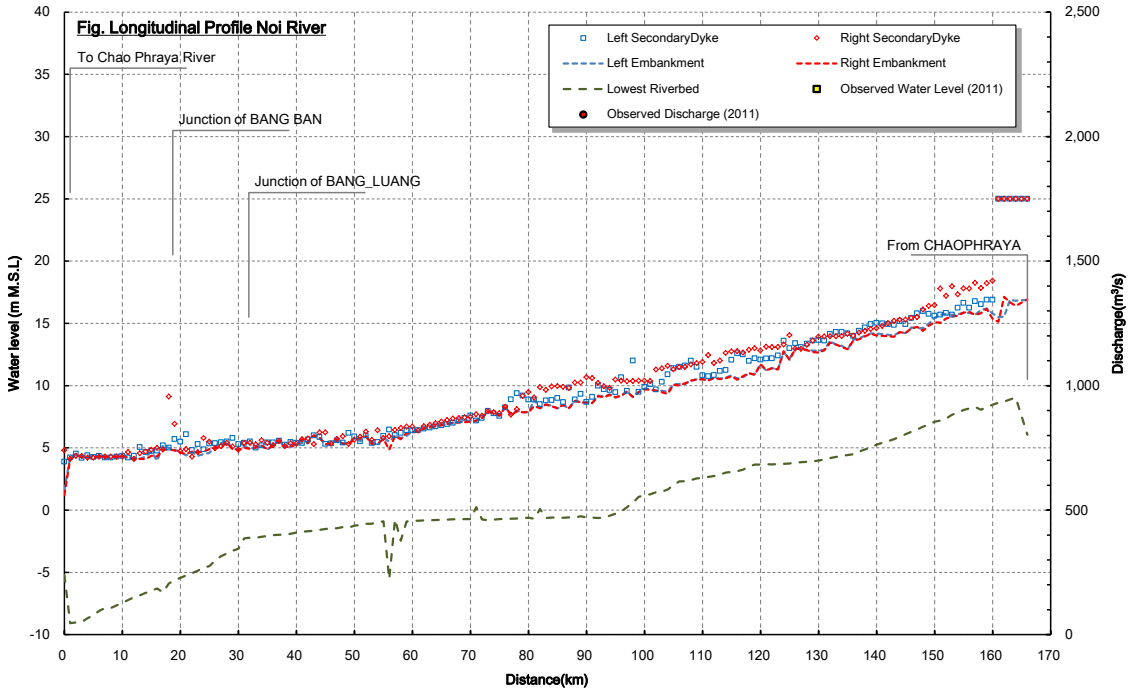


Figure B4.1.8 Longitude Profiles of Noi River

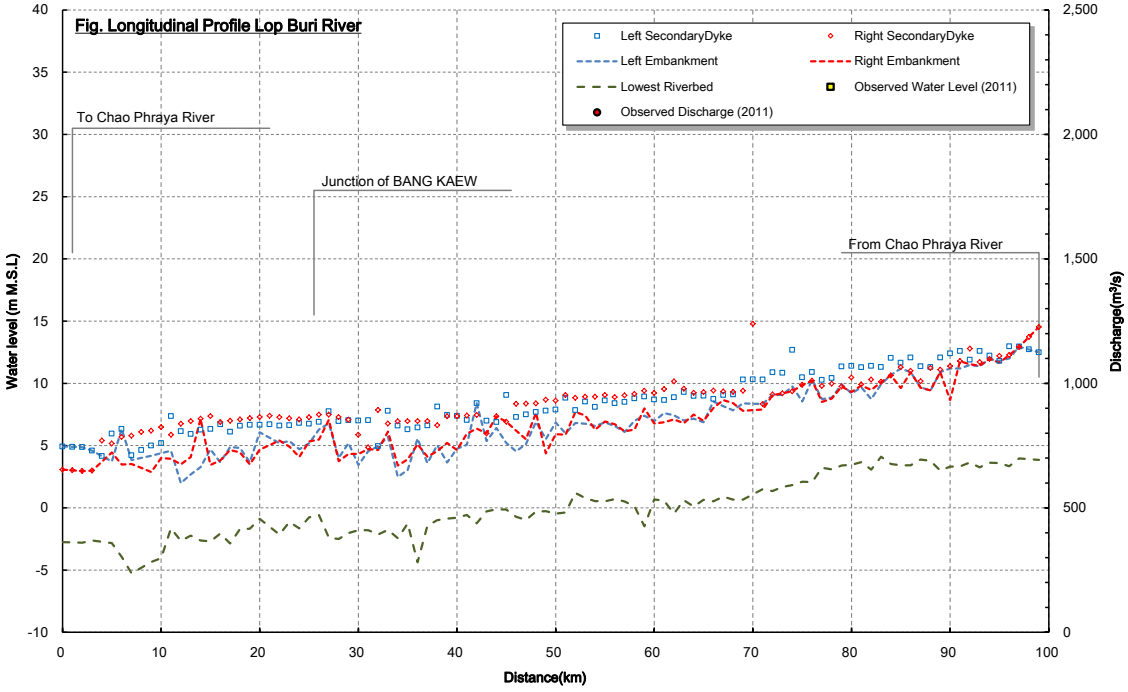


Figure B4.1.9 Longitude Profiles of Lop Buri River

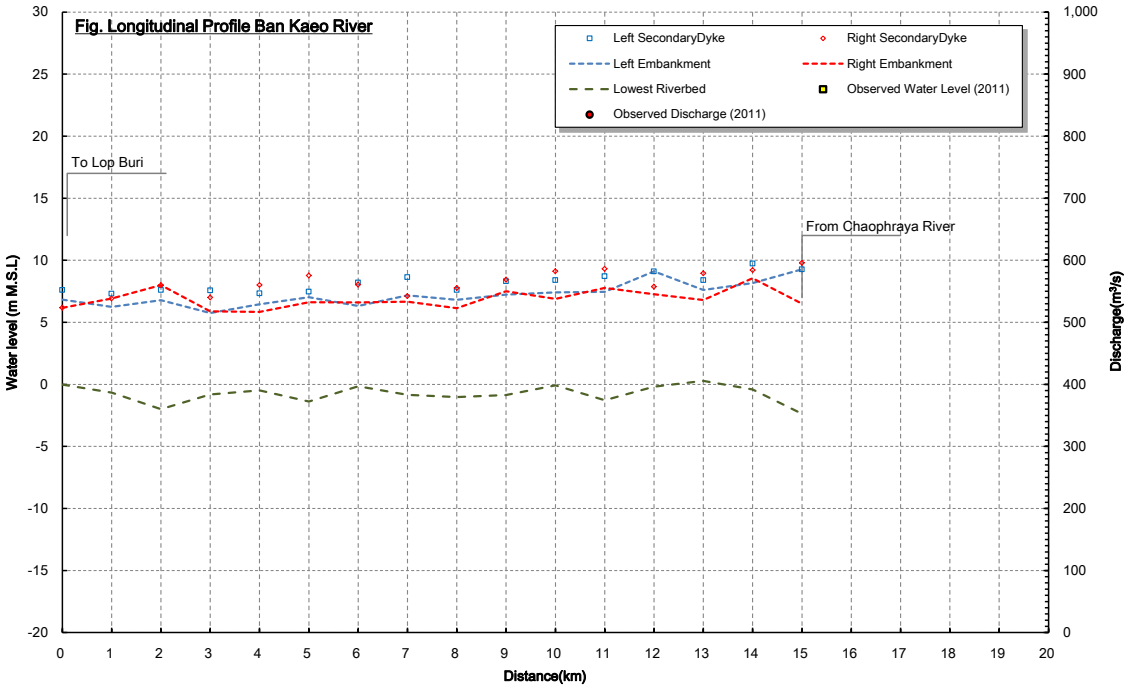


Figure B4.1.10 Longitude Profiles of Ban Kaeo Canal

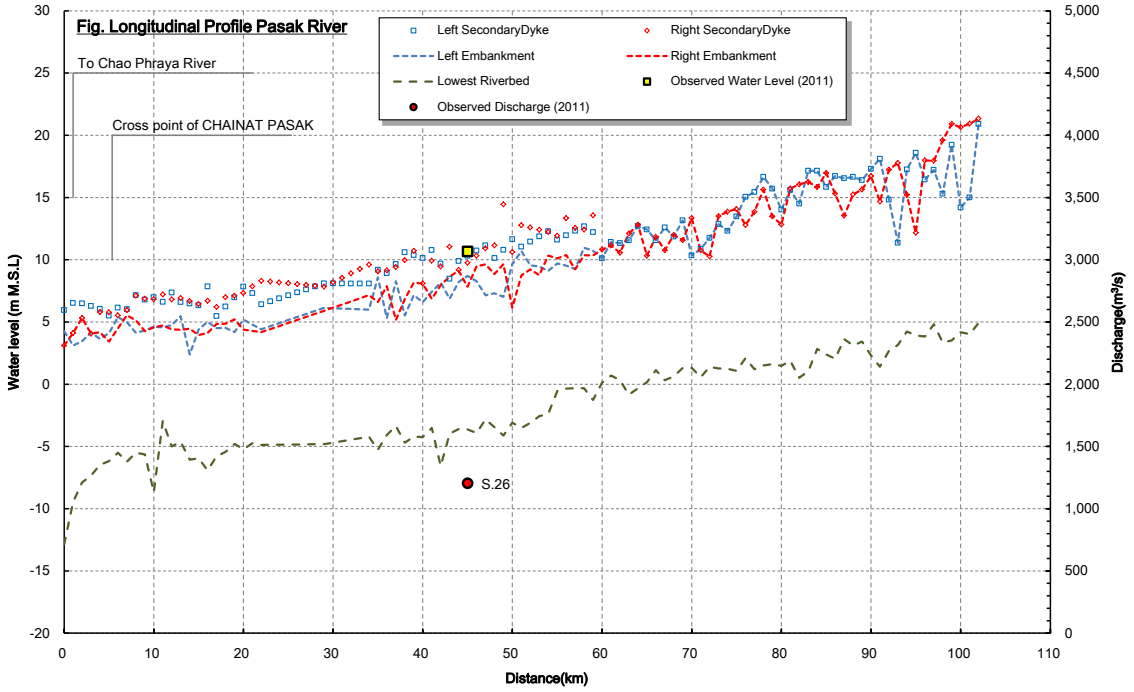


Figure B4.1.11 Longitude Profiles of Pasak River

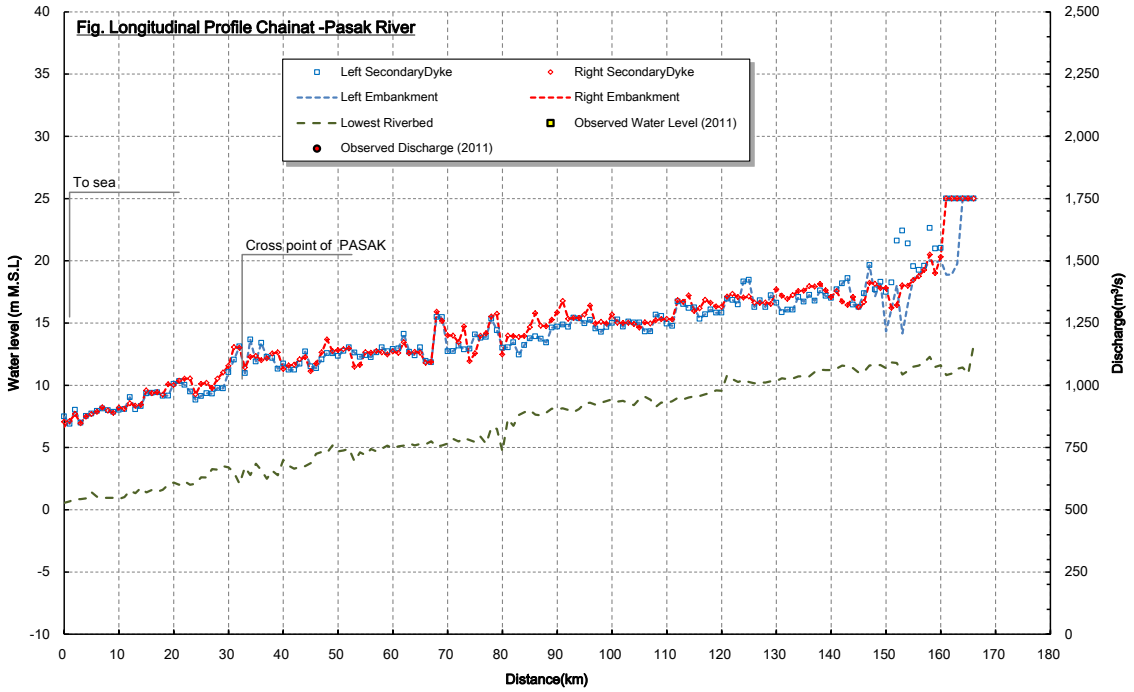


Figure B4.1.12 Longitude Profiles of Chainat-Pasak Canal

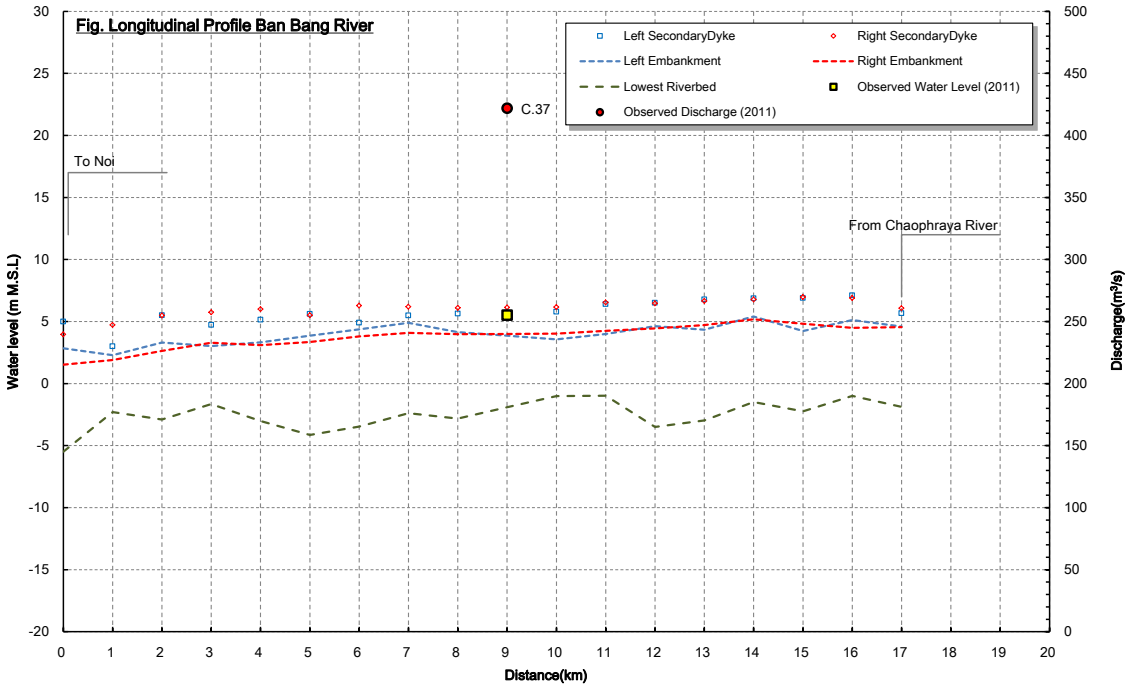


Figure B4.1.13 Longitude Profiles of Ban Bang Canal

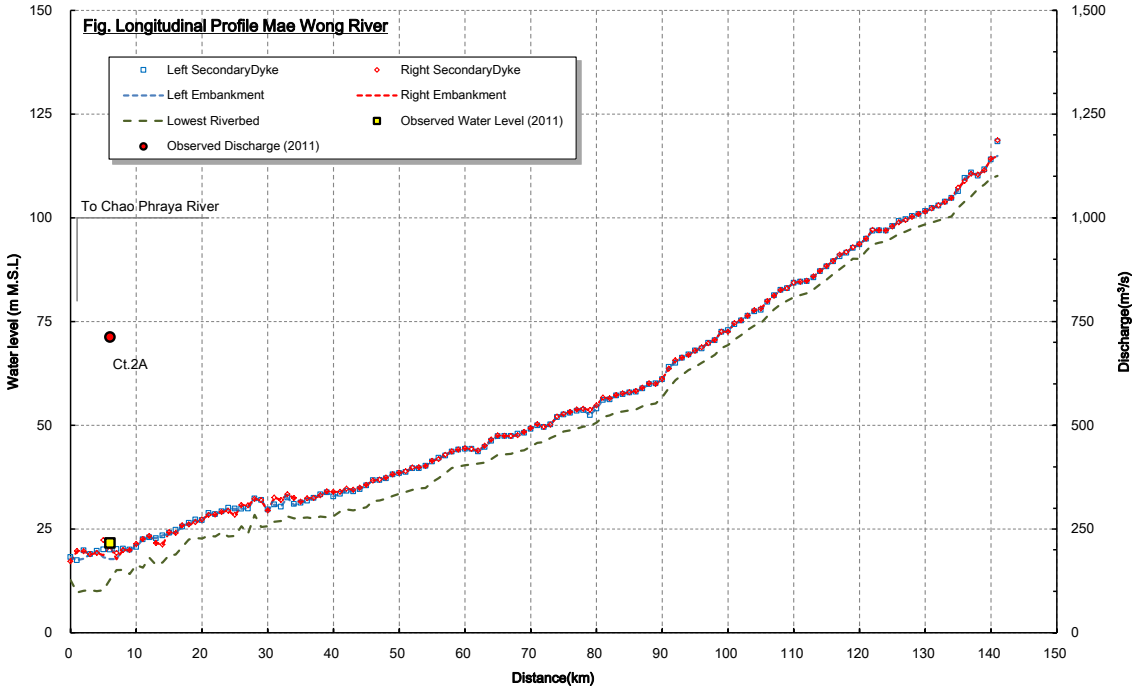


Figure B4.1.14 Longitude Profiles of Mae Wong River

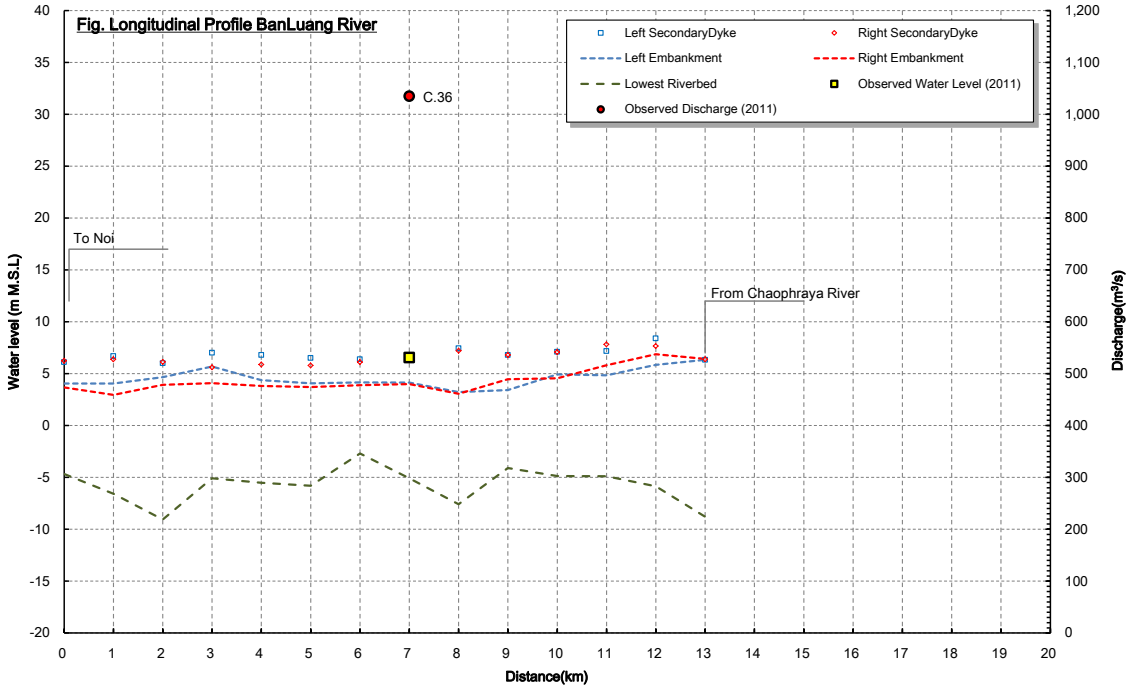
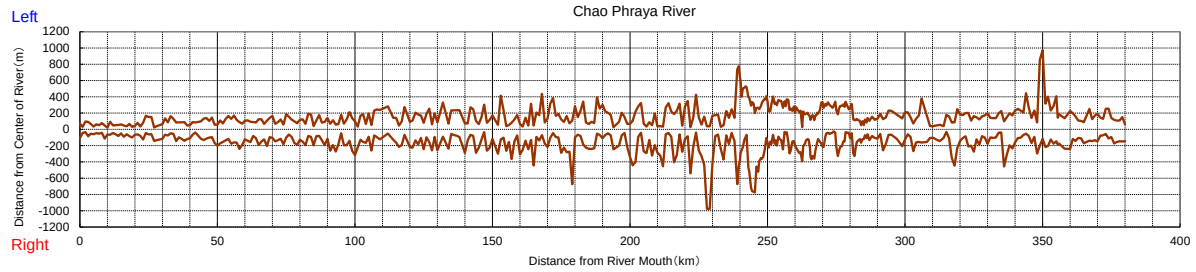


Figure B4.1.15 Longitude Profiles of Ban Luang Canal

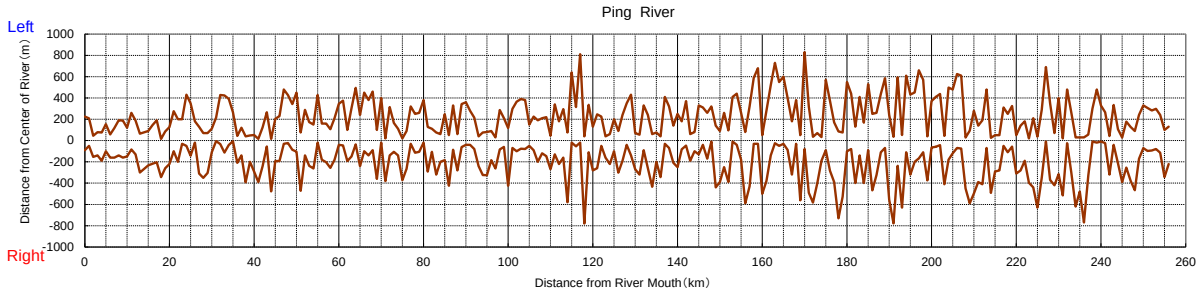
B4.2 River Width

Longitudinal profiles of channel width of the rivers in Chao Phraya river basin are shown in the following Figures.



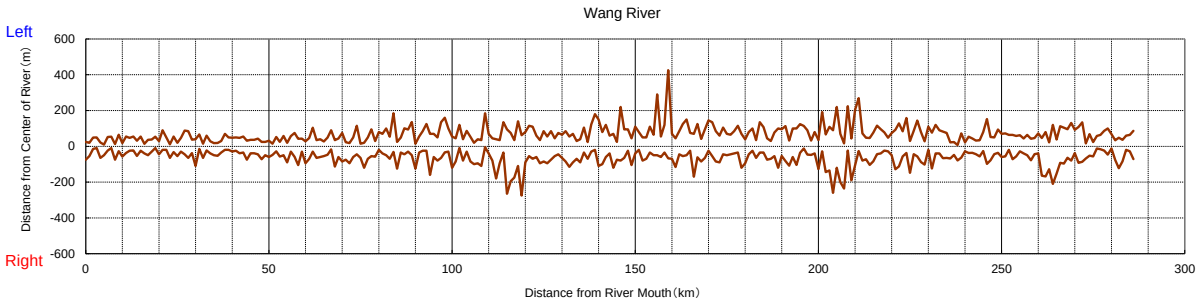
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.1 River Width of Chao Phraya River



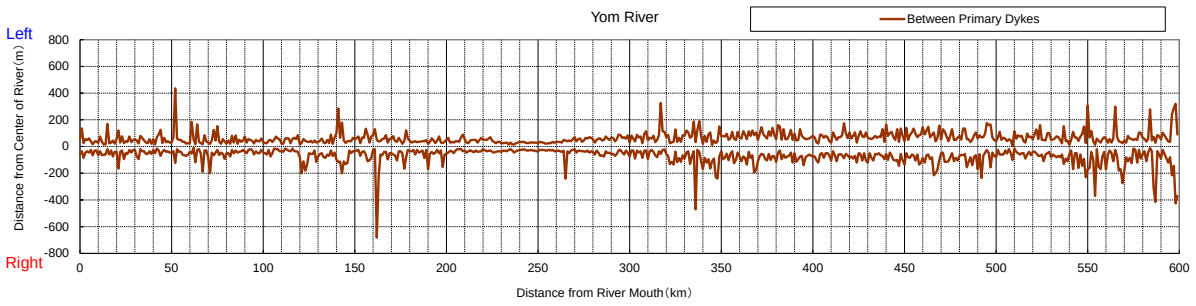
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.2 River Width of Ping River



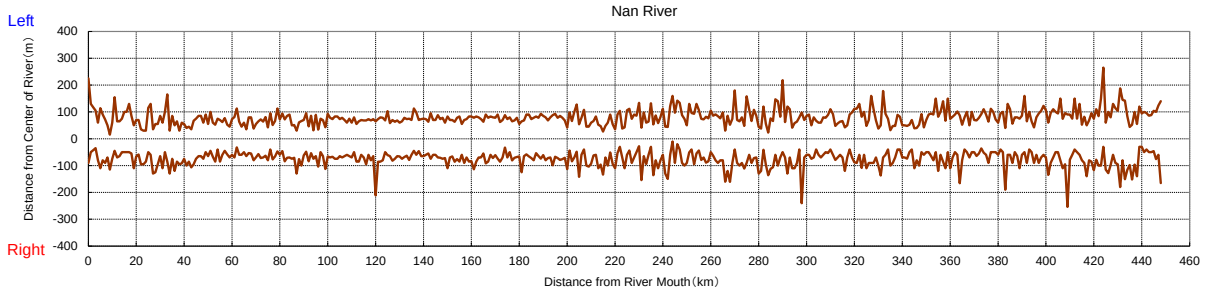
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.3 River Width of Wang River



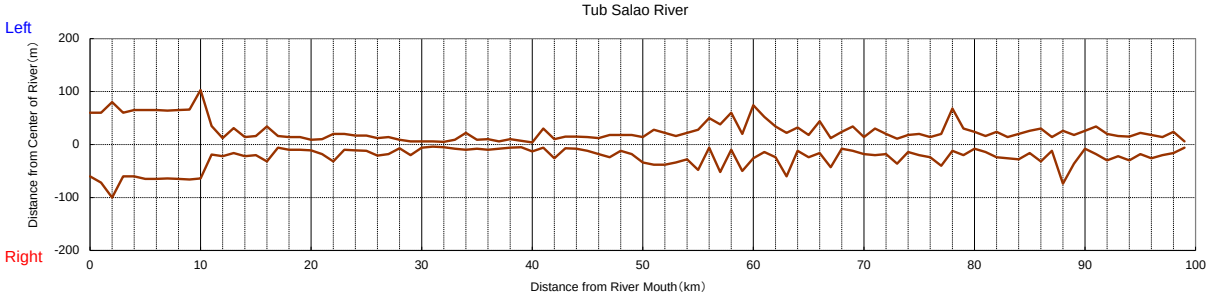
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.4 River Width of Yom River



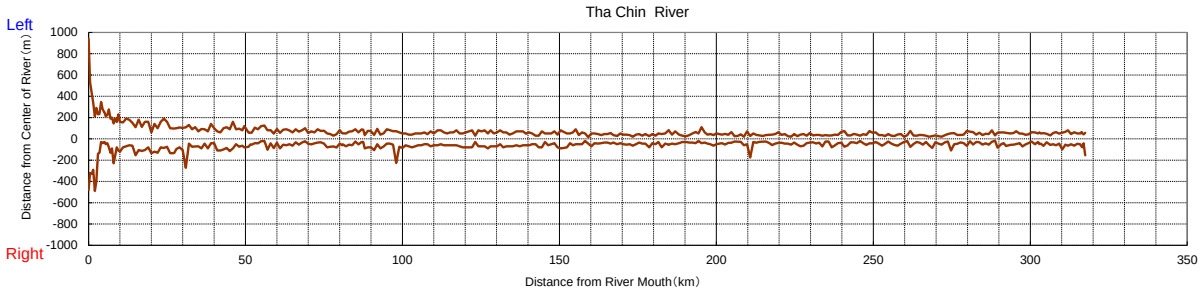
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.5 River Width of Nan River



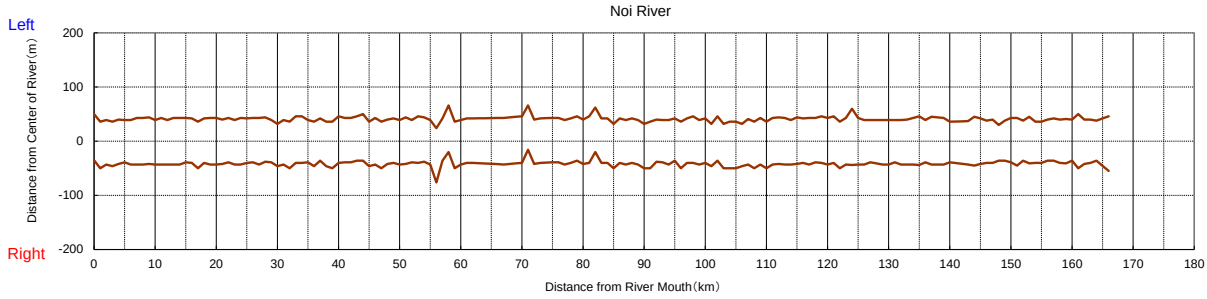
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.6 River Width of Tab Salao River



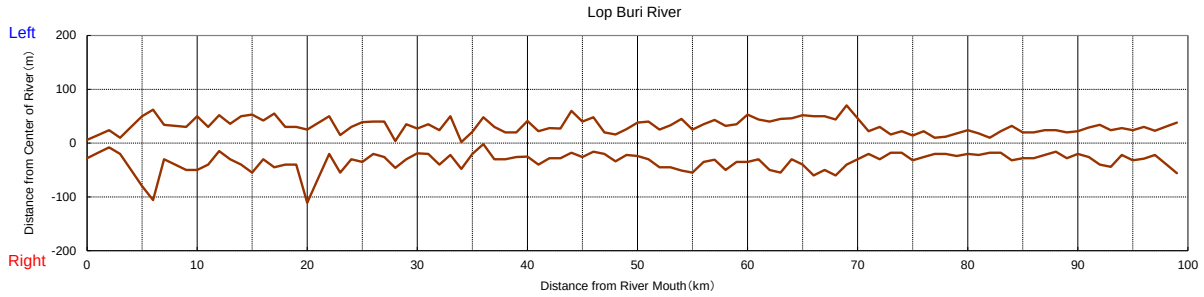
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.7 River Width of Tha Chin River



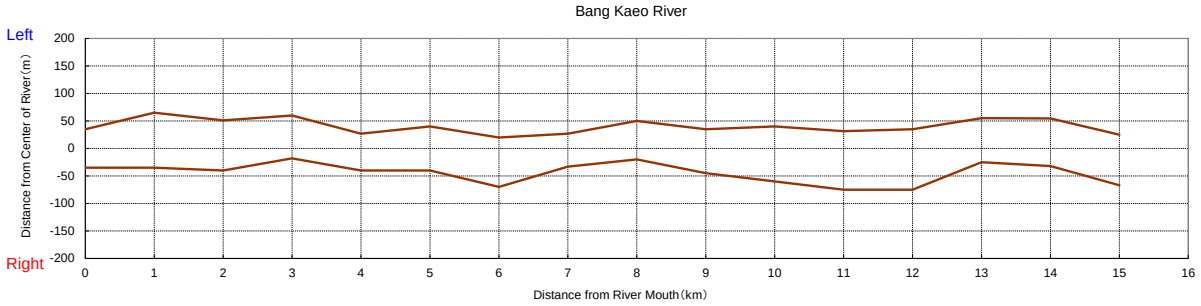
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.8 River Width of Noi River



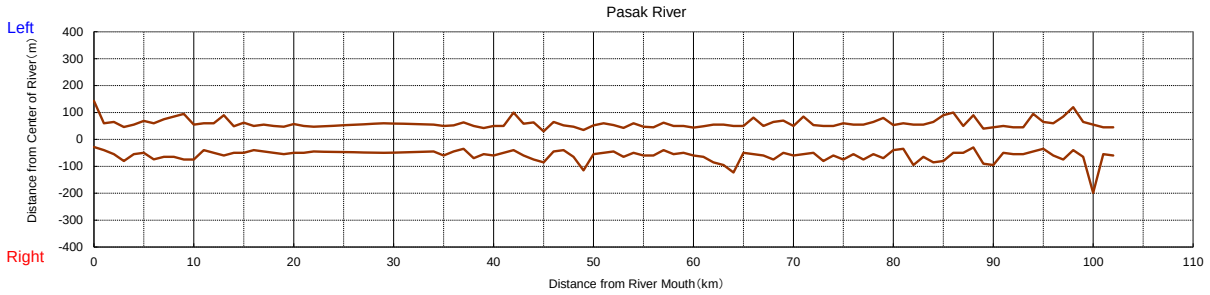
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.9 River Width of Lop Buri River



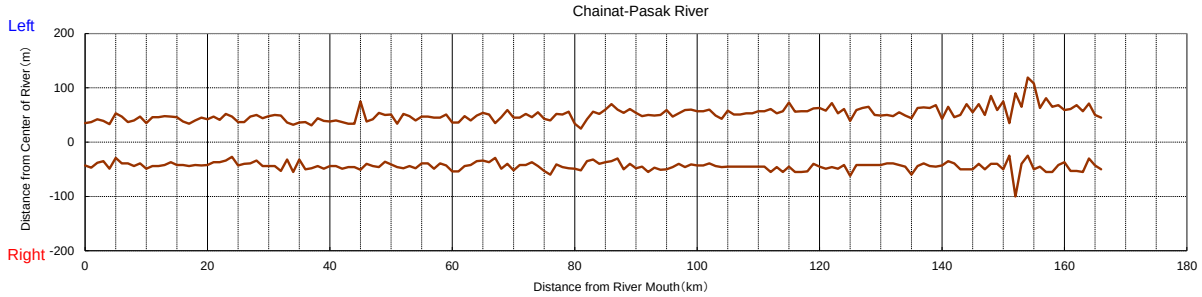
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.10 River Width of Bang Kaeo Canal



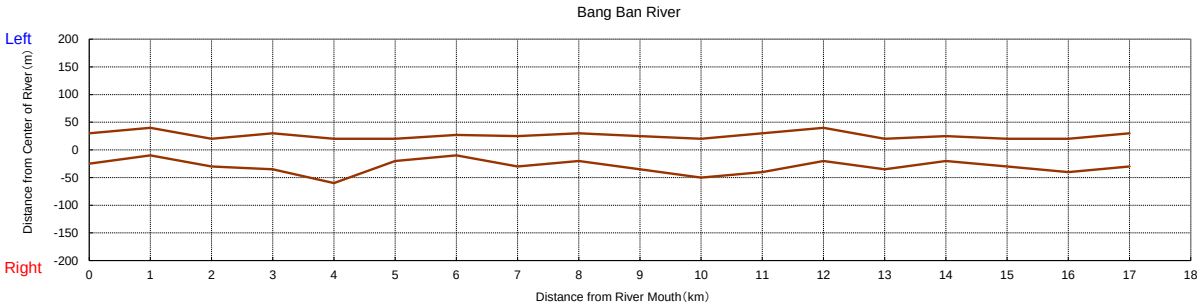
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.11 River Width of Pasak River



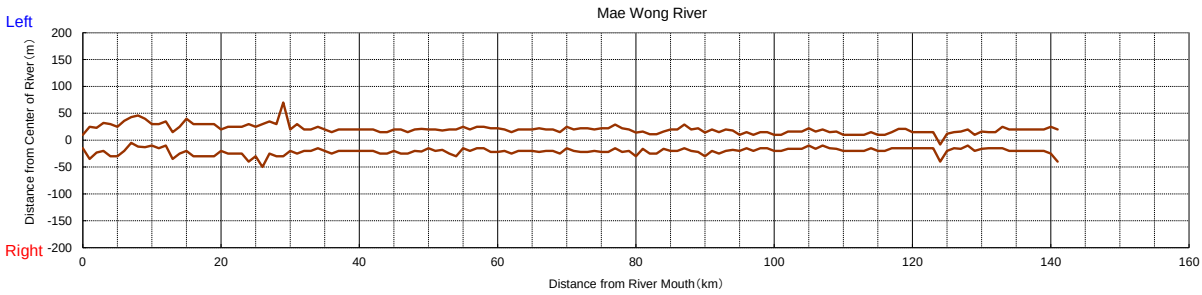
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.12 River Width of Chainat-Pasak Canal



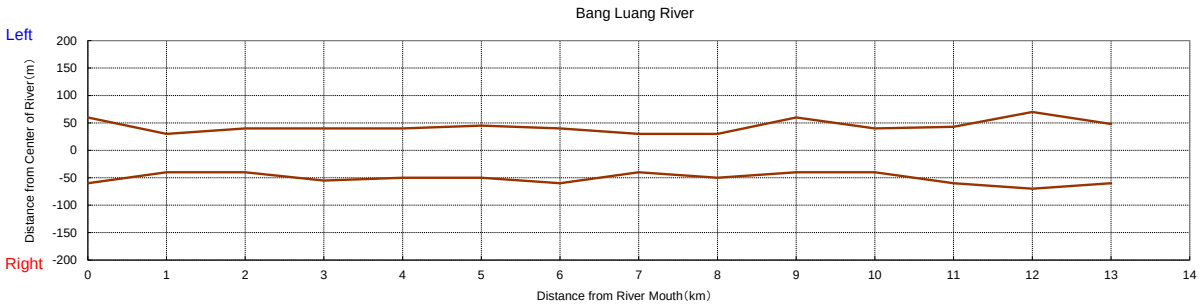
※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.13 River Width of Bang Ban Canal



※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.14 River Width of Mae Wong River



※ The center of cross-section provided by RID is defined as center of river.

Figure B4.2.15 River Width of Bang Luang Canal

Sector C: Hydrological Observation and Analysis

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

FINAL REPORT
VOLUME 3: SUPPORTING REPORT

SECTOR C: TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER C1 INTRODUCTION

C1.1 Introduction

In order to determine one of the most important conditions for the Master Plan, Target Design Floods, a variety of hydrological analyses were conducted in accordance with the following flow:

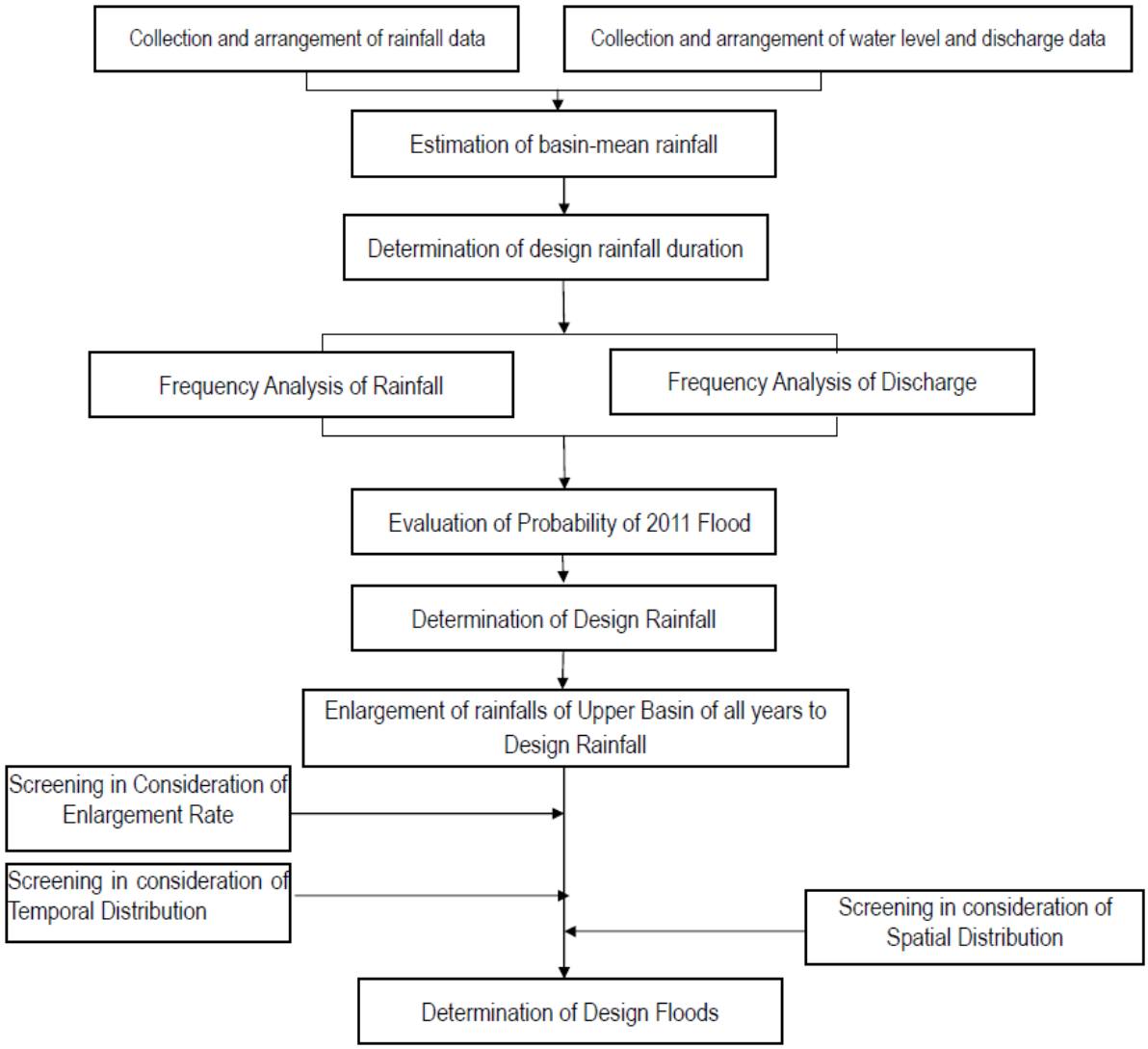


Figure C1.1.1 Flow of Determination of Target Design Floods

CHAPTER C2 HYDROLOGICAL OBSERVATION

C2.1 Observation Stations

To have a better understanding on the hydrological characteristics of the study area, field measured data, including water level, tidal level, discharge, and rainfall data needs to be collected and analyzed. In Thailand, there are several governmental agencies that are responsible for data collection, and installation and operation of observation stations. In this section, general information on meteorological and hydrological observation systems and collected data such as the number of stations, the information of data quality, quantity and frequency, data transmission method, utilization of such collected data are summarized.

C2.1.1 Water Level and Discharge Measurements

Water level and discharge in the study area are observed mainly by two agencies, the Royal Irrigation Department (RID) and the Department of Water Resources (DWR). The total number of water level (discharge) stations in the Cho Phraya River Basin is 417, and among them 306 are RID stations and 111 are DWR stations. (Table C2.1.1).

Table C2.1.1 Water Level Stations (RID, DWR)

Measurement Method	RID	DWR	TOTAL
	Hydro Center	BRDH*1	
Telemetry	217	15	232
Staff Gauge	89	96	185
TOTAL	**306**	**111**	**417**

*1 BRDH: Bureau of Research, Development and Hydrology

(1) Royal Irrigation Department (RID)

In the Chao Phraya River Basin, there are three RID Hydro Centers, Upper Northern Hydrological Center (Hydro Center #1), Lower Northern Hydrological Center (Hydro Center #2) and Central Hydrological Center (Hydro Center #5). Each Hydro Center is responsible for 1) data collection at telemetry stations and staff gauging stations, 2) data analysis by creating/updating rating curves, and 3) data submission to RID Headquarter in Samsen. The total number of RID water level and discharge stations are over 300 stations spreading out in the Cho Phraya River Basin (Figure C2.1.1). .

Figure C2.1.1 Location Map of RID and DWR Water Level Stations (Manual and Telemetry)

At the telemetry station, a real-time system collects water level data automatically every 15 minutes including the emergency time such as flooding, and transmits the collected data to the server installed at RID Headquarter. RID officers at each Hydro Center calculate hourly data from the 15 minute interval data.

At the staff gauging station, RID staff or assigned local people are sent to the gauging station and collect the water level data three times a day at 6:00 AM, 12:00 PM and 18:00 PM every day. In case of flooding time, the data is collected every 1 hour or 3 hours, depending on the situation. The collected data is then organized in a tabular data format and submitted to RID Headquarter once a month. This staff gauge data is used for checking and calibration of telemetry data.

All three Hydro Centers disseminate collected data at both telemetry stations and staff gauge stations on their websites. Also, the Hydrology Division at RID Headquarter publishes Year Book of collected data. Data validation and checking are conducted by "Staff Experience Check" before the data utilization.

Table C2.1.2 RID Stations

STAFF GAUGING STATION	TELEMETRY STATION
Staff Gauge	**Telemetry**
	
Source: http://hydro-1.net/	*Source:http://www.scadachaopraya.com/Page/pageTCY31.aspx?sub=sub03&st=TCY31*,

As for discharge measurement, RID employ three survey methods, 1) current meter (Table C2.1.3), 2) Acoustic Doppler Current Meter (River Surveyor M9, Table C2.1.4), 3) Horizontal Acoustic Doppler Current Profiler (WinH-ADCP, Table C2.1.5). Generally, RID uses current meter as a base measurement method, and other two methods for the detailed survey. These equipments are especially beneficial for the observation of hydraulic characteristics in detail at stations where the observation data is important for structural operation or the observed flow condition is unique, including adverse flow due to the tidal effect.

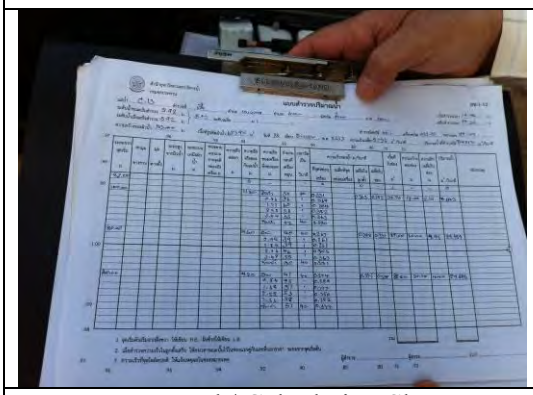
Table C2.1.3 Survey Method: Propeller Current Meter

Propeller Current Meter

Survey Method

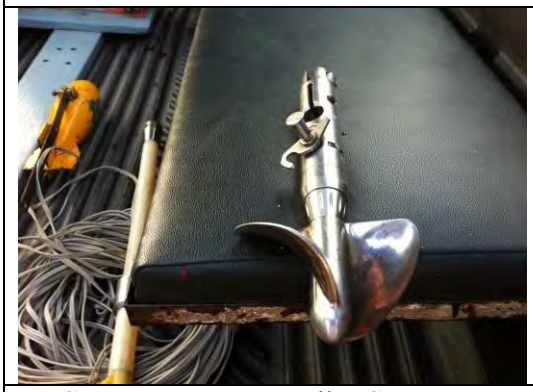
- Propeller Current Meter is attached to a measuring rod with counter. The counter is used to count the current meter.
- Propeller Current Meter is used only during the dry season (low velocity season).
- The area of discharge measurement is divided into 10 sub-sections: T/10 (where T is a channel width). The measurement of velocity is taken at 6 locations along the vertical line including at water surface, 0.2d, 0.4d, 0.6d, 0.8d, and channel bottom (where d is water depth at each survey location). These 6 measurements are then averaged and used for discharge calculation at each sub-section.
- A counter is used to count Propeller Current Meter (40 seconds per measurement). Then velocity is calculated by using a conversion table which converts the counted number into velocity (m/s). The conversion table is unique for each Current Meter, therefore, a calibration of the Current Meter and the conversion table is conducted once a year at an Institute.
- Measurement is taken only one way per survey from left bank to right bank. (River Surveyor conducts a roundtrip measurement whereas Current Meter conducts only one way.)

Equipment



Record / Calculation Sheet

Counter for Current Meter



Current Meter : Propeller Current Meter

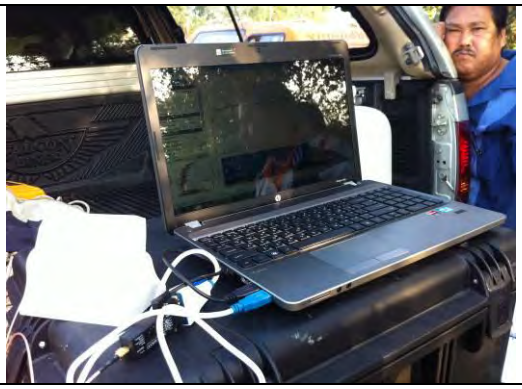
Measuring Rod (to measure water depth)

Discharge Calculation

- Discharge is simply velocity times cross-sectional area: Q=AV.

Table C2.1.4 Survey Method: ADCP River Surveyor M9

ADCP: River Surveyor M9 (Sontek)	
Survey Method	
• River Surveyor M9 is mounted on a boat which is operated by two staff. Wakitoki is used for the communication between staff on the boat and land. The land staff uses his laptop computer for checking the real-time survey data transmitted from River Surveyor M9 to the laptop computer. • The cross sectional survey is conducted along rope stretched across the river channel. At the time of site visit on December 13th, 2012, the velocity was slow enough to conduct the manual survey (Manual Survey: staff pulls a rope to navigate the boat manually. No motor engine was used.). Motor engine is used only when the velocity is too fast that manual navigation cannot secure the straight path along the rope. According to the RID officer, the manual navigation can collect stable and accurate survey results than the motor engine survey. • The first and end points of measurement are taken about 5 m from right and left banks respectively. • A roundtrip survey (measurement taken from right to left, and then left to right) is considered as one set. In total, surveyors take 4 sets per field survey. • Among the 4 sets of measurements, if difference is more than 5 percent, the survey team discuss about the validity of the measurements. If the measurement is deemed to be abnormal, additional surveys will be conducted. • The discharge will be calculated by averaging all measurements (4 sets data). • The cross sectional survey at C13 is taken roughly 1 km downstream of the Chao Phraya Dam. The channel width is approximately 150 m which takes about 10 minutes to conduct one set of survey (roundtrip). • RID officer commented that they would like to conduct the survey by River Surveyor at every station under jurisdiction of Hydro5 Center, however it is difficult due to the availability of the equipment (Hydro 5 owns only one machine at the time of field survey in 2012).	
Equipment	
	
River Surveyor M9	Mount On Plat Form for River Surveyor



Data Checking on Computer

Cross Section Survey by River Surveyor

Discharge Calculation

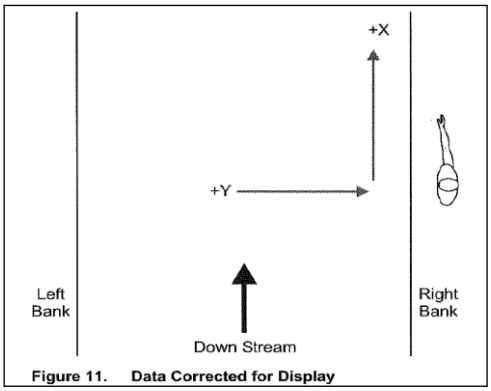
- River Surveyor measures water depth and velocity, and calculate area to determine discharge.
- No calculation at office is necessary.

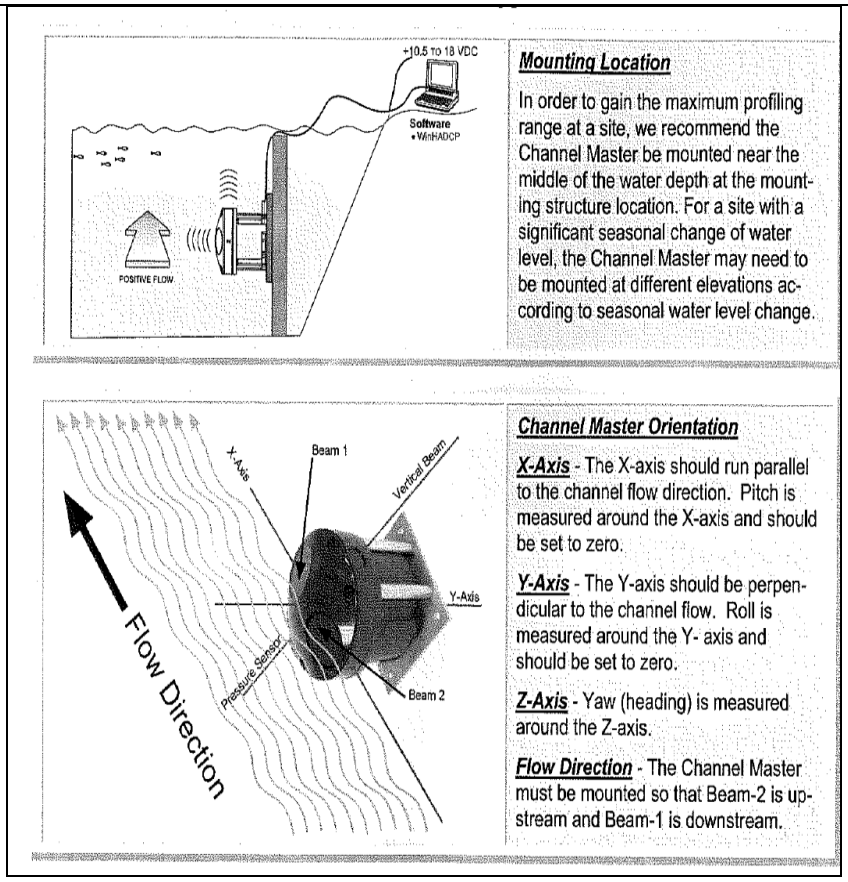
Specifications of SonTek/YSI River Surveyor M9

Item	M9
Velocity Measurement	
Profiling Range (Distance)	0.06 to 40m
Profiling Range (Velocity)	±20 m/s
Accuracy	±0.25% of measured velocity
Resolution	0.001 m/s
Number of Cells	Up to 128
Cell Size	0.02 to 4m
Transducer Configuration	Nine (9) Transducers
	Dual 4-beam 3.0 MHz/1.0 MHz
	Janus at 25° Slant Angle
	0.5 MHz Vertical Beam
Depth Measurement	
Range	0.20 to 80m
Accuracy	1%
Resolution	0.001 m
Discharge Measurement	
Range with Bottom-Track	0.3 to 40m
Range with RTK GPS	0.3 to 80 m
Computations	Internal

Source: http://www.sontek.com/riversurveyor-s5-m9.php

Table C2.1.5 Survey Method: H-ADCP WinH-ADCP

H-ADCP : WinH-ADCP
Survey Method
1. Cross-Secion Area (A) by Sonar (Echo Sounding) is measured first, then input the value to H-ADCP. 2. H-ADCP measures water level (H) by Z direction beam whereas velocity by X&Y direction beams. Different from River Surveyor M9, H-ADCP is fixed on a pole in water, specifically fixed at about 6 m from the water surface. 3. Velocity measurement is taken every one hour, then H-ADCP system calculates discharge based on the measured velocity. This discharge will be stored with other measured information in modem which is set up near by the H-ADCP mounted pole. Officer at Hydro 5 centre calculates daily average discharge from the hourly observed data. ・No discharge calculation is required. ・H-ADCP has the maximum survey distance of 300m. The river width at C29A is approximately 500 m. The measured data must be calibrated in order to reflect the flow condition in the unmeasured section of 200 m. For the calibration, measurement result of River Surveyor M9 is utilized. (Three times per year, simultaneous measurements of River Surveyor M9 and H-ADCP are conducted)**.**
 Side Looking: Channel Master WINH-ADCP (TELEDYNE RD Instruments)    **Figure 11. Data Corrected for Display** Source: WinH-ADCP User's Guide, Teledyne RD Instruments



Source: Channel Master Quick Start Guide, TELEDYNE RD Instruments

Horizontal Acoustic Doppler Current Profiler

Channel Master Horizontal ADCP (TELEDYNE RD Instruments)

Key Specifications: RID apply the equipment with 300kHz and Max Range 300m.

Frequency:	**300 kHz**	**600 kHz**	**1200 kHz**
# Cells:	1 - 128 cells		
Resolution:	0.1 cm/s		
Max Range:	**300m**	90m	20m

Source: Teledyne RDI webpage, http://www.rdinstruments.com/channelmaster.aspx

Technical Specifications

Model Name	CM300	CM600	CM1200
System frequency	300kHz	600kHz	1200kHz
Water Velocity Profiling (Broadband mode)			
Profiling range	4m[a] to 300m[b]	2m[a] to 90m[b]	1m[a] to 25m[b]
Velocity range	±5m/s default, ±20m/s maximum		
Accuracy	±0.5% of water velocity relative to ADCP, ±2mm/s		
Resolution	1mm/s	1mm/s	1mm/s
Number of cells	1-128	1-128	1-128
Cell size	1m to 8m	0.5m to 4m	0.2m to 2m
Blanking distance	1m	0.5m	0.2m
Data output rate	User-programmable		
Physical Properties			
Weight in air	6.8kg	4.76kg	3.4kg
Weight in water	3.17kg	2 kg	1.58kg
Height	18.3cm	18.3cm	18.3cm
Width	32.5cm	26.4cm	18.3cm
Depth	19.8cm	19.3cm	18.9cm
Transducer			
Geometry	2 beams, ±20°	2 beams, ±20°	2 beams, ±20°
Beam width	2.2°	1.5°	1.5°

[a] Assume one good cell (minimum cell size); range measured from the transducer surface.
[b] Assume fresh water; actual range depends on temperature and suspended solids concentration.

Source: http://www.rdinstruments.com/datasheets/channelmaster_ds_lr.pdf

Calibration Method of H-ADCP Data

Calibration Method

- Simultaeous measuremts of H-ADCP and River Surveyor 9 (H-ADCP continuously measures vertically along cross section) are conducted.
- Calculate average of 〖V_{x1} (Velocity of x direction)〗 from H-ADCP measurement (Average of per minute measurement by ADCP).
- Based on the measured discharge by River Surveyor M9 (ADCP) and cross sectional area (A) by H-ADCP, 〖V_{mean} (mean velocity)〗 is calculated.
- Calculate the correlation between 〖V_{x1}〗 and 〖V_{mean}〗. Based on the determined correlation equation, recalculate 〖V_{mean}〗 from 〖V_{x1}〗. Then H-ADCP discharge is calculated by 〖V_{mean} x A_1〗.

RID Station Information

C29A: Bang Sai (14°9' 8.28", 100°30' 55.96") Chao Phraya River

—RID Hydrological Station is installed at a peir.
—Due to tidal effect, RID installed H-ADCP to measure velocity and water level at every one hour (Measurement is taken from left bank to right bank).

	
H-ADCP Modem Box	H-ADCP Modem Box
	
H-ADCP Installation Location	H-ADCP Installation Location
	
Location of Measurement along Cross Section (Approx.500m)	Water Mark of the 2011 Flood (4.15 m MSL)

The frequency of measurement is determined according to following two conditions 1) whenever the change in water level is more than 30 to 50 cm, or 2) when there is no change in water level, survey will be conducted once or twice a week.

Official H-Q curve is prepared by responsible Hydro Center, RID at the end of RID Water Year which starts April and end March next year (Figure C2.1.2 and Figure C2.1.3). The calibration of the official H-Q curve is conducted whenever new data is available after the field survey. The new data is plotted in the H-Q curve, and the curve is adjusted as required. To determine the discharge which does not fall within the range of the existing H-Q curve, RID officer will first extend the existing curve by following the trend, and then read the discharge based on the modified H-Q curve.

Figure C2.1.2 H-Q Curve Preparation by RID Hydro Center Officer

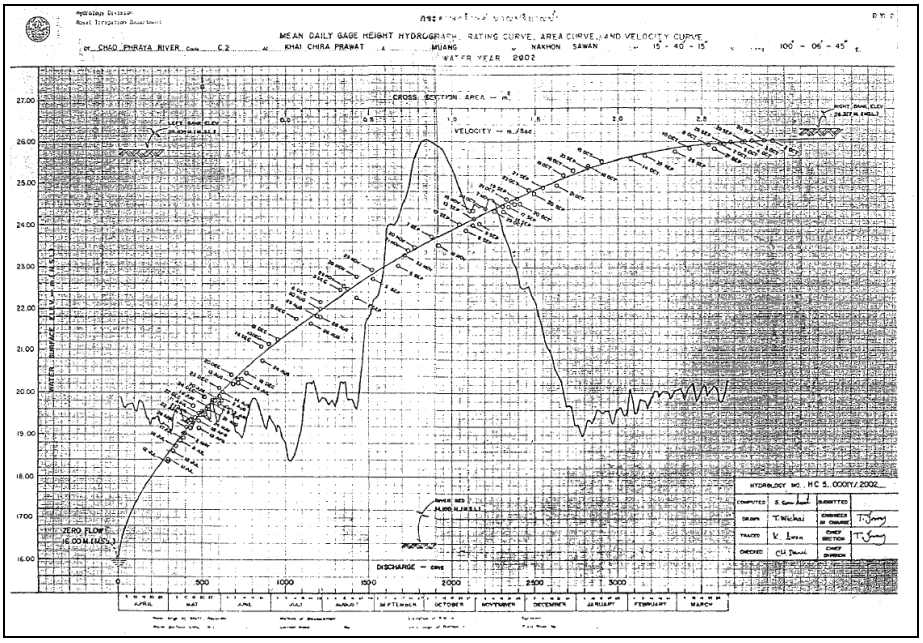
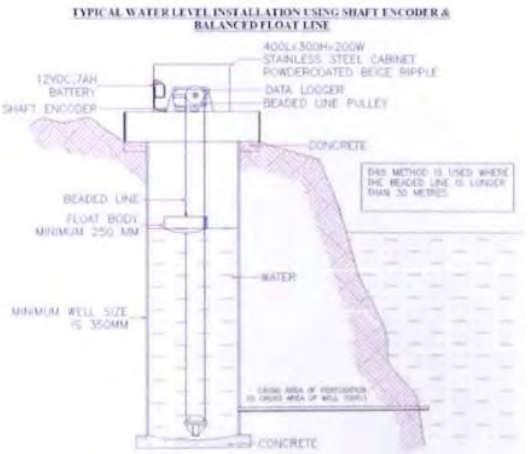


Figure C2.1.3 H-Q Curve at Nakhon Sawan C.2 Station (2002)

(2) Department of Water Resources (DWR)

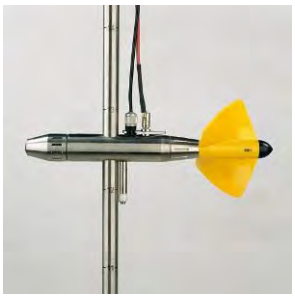
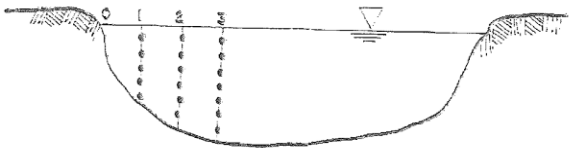
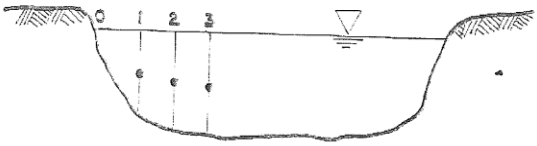
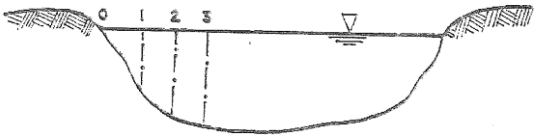
Bureau of Research, Development of Hydrology is responsible for data collection, transmission and analysis at 15 telemetry stations installed in the Chao Phraya River Basin (Figure C2.1.1, Table C2.1.6). The real-time data are transmitted to the database in Bureau of Research, Development and Hydrology (BRDH) which is used to publish Year Book. Data validation and checking are conducted by "Staff Experience Check" before the data utilization.

Table C2.1.6 DWR Stations

STAFF GAUGE STAATION	**TELEMETRY STATION**
Staff Gauge	**Telemetry**
	 
Source: Chao Phraya Basin Telemetry Report, DWR, 2010	
TELEMETRY STATION	
Telemetry Station Schematic Plan	**Telemetry Server Room at DWR Office**
	
Source: Tha Chin Basin Telemetry Report, DWR	*Source: Chao Phraya Basin Telemetry Report, DWR, 2010*

As for discharge measurement, DWR employ current meter, using cup type current meter and propeller type current meter, depending on the size of the surveyed river (Table C2.1.7). Cup type current meter is used for narrower width river, typically smaller rivers. This type can take measurement at lower flow. Propeller type current meter is used for river with wider channel width. The measurement is taken two times per month for dry season and four times per month for flood season.

Table C2.1.7 DWR Velocity and Discharge Measurement

<table>
<tr><th colspan="2">Discharge Measurement Equipment</th></tr>
<tr><td>Cup type current meter
  </td><td>Propeller type current meter
  </td></tr>
<tr><td colspan="2">Measurement Method</td></tr>
<tr><td>Velocity Distribution
  </td><td>Mean Velocity (One Point Method)
  </td></tr>
<tr><td>Measure the velocity from water surface to bottom. Surface velocity is maximum</td><td>Measure the velocity at 6/10 of depth from surface</td></tr>
<tr><td>Mean Velocity (Two Point Method)
  </td><td>Interval of Measuring Points
  </td></tr>
<tr><td>Measure the at 2/10 and 8/10 of depth from surface. Velocity is average of velocity at 2/10 and 8/10 of depth</td><td>For small river, measure every 1 m. River width more than 100 m, measure every 5 m. River width 100-200 m, measure every 10 m. River width more than 200 m, measure about 20-30 points or 10 m interval</td></tr>
<tr><td colspan="2">Velocity measuring method and Accuracy</td></tr>
<tr><td colspan="2">- Vertical velocity measuring can measure from 1 point up to 6 points
- No. 1 and 3 are widely Method for measurement.</td></tr>
</table>

No.	Velocity Measuring	Number of Measurement Point	Mean error (%)	Standard deviation (%)
1	$V = V_{0.6}$	1	1.6	7.5
2	$V = 0.96\ V_{0.5}$	1	3.3	4.8
3	$V = 0.5(\ V_{0.2}+\ V_{0.8})$	2	2.2	3.4
4	$V = 0.25\ V_{0.2}+0.5\ V_{0.6}+0.25V_{0.8}$	3	1.9	4.4
5	$V = 0.4\ V_{0.2}+0.3\ V_{0.6}+0.25V_{0.8}$	3	-0.8	3.3
6	$V = 1/3(V_{0.2}+\ V_{0.6}+V_{0.8})$	3	2.0	3.7
7	$V = 1/3(V_{0.2}+\ V_{0.4}+V_{0.7+}\ V_{0.9})$	4	-0.9	2.2
8	$V = 0.1V_s+0.3\ V_{0.2}+0.3V_{0.6+}0.2\ V_{0.8}+0.1V_b$	5	0.2	2.2
9	$V = 1/6(V_s+V_{0.2}+V_{0.4}+V_{0.6}+\ V_{0.8}+V_b)$	6	-1.6	2.5
10	$V = 0.1V_s+0.2\ V_{0.2}+0.2\ V_{0.4}+0.2V_{0.6+}0.2\ V_{0.8}+0.1V_b$	6	0.9	2.1

Remark: $V_{0.6}$=Velocity at 6/10 of depth, V_s= Velocity at surface, V_b= Velocity at bottom

Source: Water survey manual , DWR

C2.1.2 Tidal Data Measurement

Tidal data is observed mainly by four agencies, Royal Thai Navy (RTN), Marine Department (MD), and Port Authority of Thailand (PAT). In the Chao Phraya River Basin, there are total 264 stations with two measurement methods, digital measurement and graphical measurement. RTN have 9 stations, one digital station and 8 graphical station, whereas MD and PAT stations are only graphical, 8 and 7 stations, respectively (Figure C2.1.4 and Table C2.1.8).

Table C2.1.8 Summary of Tidal Stations in the Chao Phraya River Basin

Measurement Method	RTN	MD	PAT	TOTAL
	Oceanographic Division	Hydrology Division	Marine Survey Division	
Digital	1	-	-	1
Graphical	8	8	7	23
TOTAL	**9**	**8**	**7**	**24**

(1) Royal Thai Navy (RTN)

Oceanographic Division is responsible for data collection, transmission and analysis. There are total 9 stations, including one (1) digital measurement station in the Chao Phraya River and eight (8) graphical measurement stations in the Gulf of Thailand (Table C2.1.9). Digital station records a real-time water level at every 2 minutes and the data is transmitted to Oceanographic Division office for quality check before utilizing for the tidal prediction. On the other hand, at the graphical stations, local officer is responsible to collect the graph data sheet from each station and read the water level from the data sheet at every one hour. This information is rearranged to generate a tabular data sheet once a month. Based on these observed data, RTN predicts the tidal level at each RTN stations and publishes the predicted data in digital form (CD) and hardcopy (book). Digital measurement is checked by "experience check", however no data quality check is done for graphical measurement before utilization.

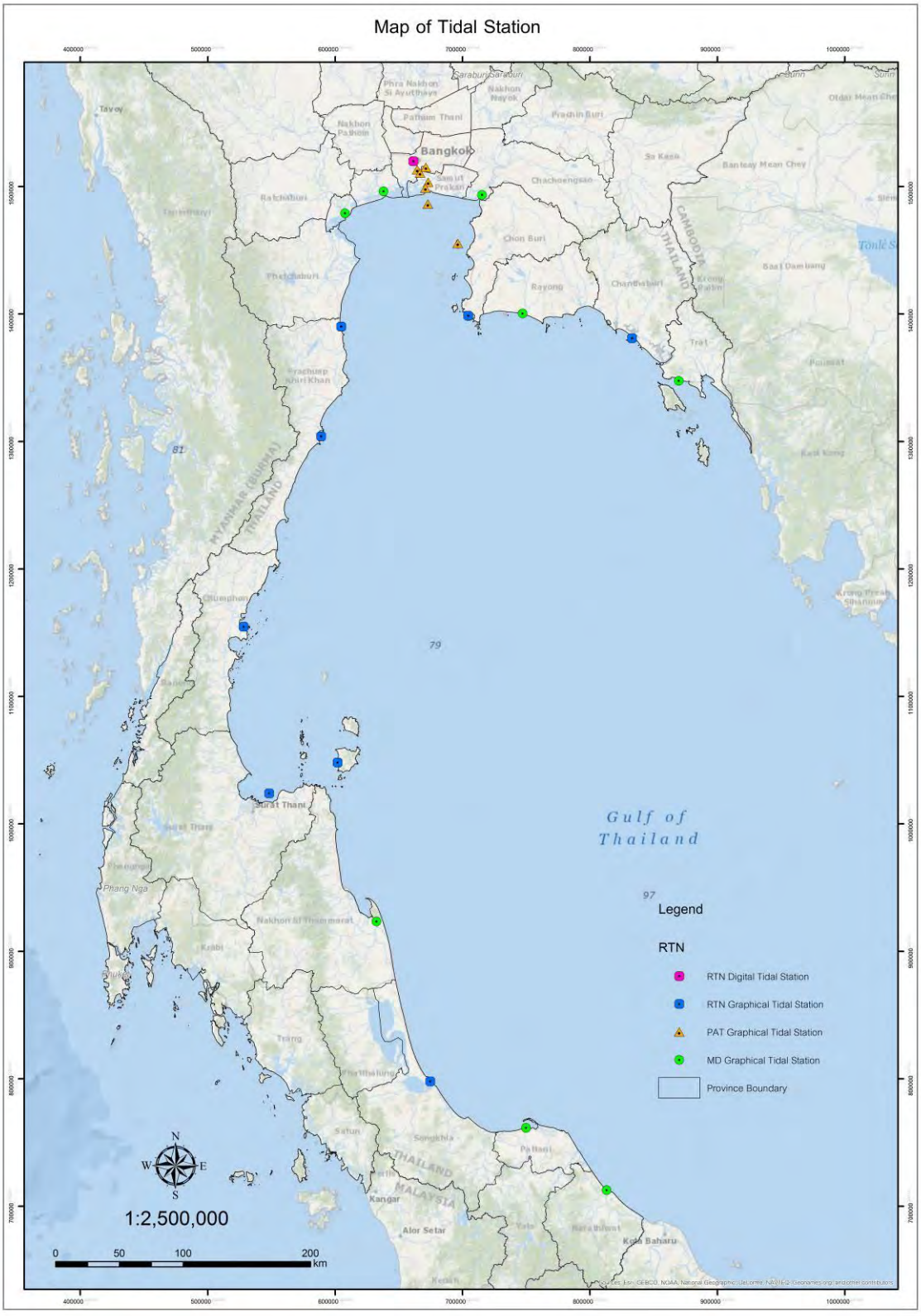


Figure C2.1.4 Location Map of Tidal Stations (RTN, PAT, MD)

Table C2.1.9 RTN Station

DIGITAL STATION	GRAPHICAL STATION
Acoustic Tide Gauge	Floating Tide Gauge
	
Source: Water Level in the waters of Thailand book, RTN, 2007	*Source: Water Level in the waters of Thailand book, RTN, 2007*

(2) Marine Department (MD)

Local staff is responsible for data collection and transmission, and Hydrology Division Office is responsible for data analysis. All eight (8) graphical stations using floating tidal gauge are located in the Gulf of Thailand (Figure C2.1.4 and Table C2.1.10). Once a month, local staff visits the station to collect the graph data, and reads water level at every one hour to generate a tabular data sheet. This data sheet is then submitted to Hydrology Division for further utilization, including transportation and dredging projects. No data quality check is done before utilization.

Table C2.1.10 MD Station

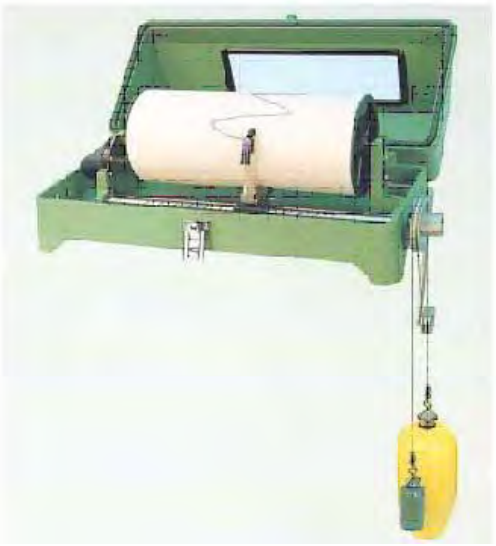
GRAPHICAL STATIO
Floating Tide Gauge

Source: MD officer, 2013

(3) Port Authority of Thailand (PAT)

Marine Survey Division is responsible for managing all seven (7) stations, five (5) installed in the Chao Phraya River and two (2) installed in the Gulf of Thailand (Figure C2.1.4). These are graphical measurement stations using floating tidal gauge (Table C2.1.11) that local staff visits stations once a month to collect the graph data, and submits them to the assigned officer at Marine Survey Division for data rearrangement. The assigned officer reads the graph and collects tide level at every one hour to rearrange the graph data into a tabular data sheet. This information is utilized for transportation activities. No data quality check is done before utilization.

Table C2.1.11 PAT Station

GRAPHICAL STATION	
Floating Tide Gauge	
	
Source: PAT officer, 2013	

C2.1.3 Rainfall Measurement

Rainfall is observed mainly by three agencies, Royal Irrigation Deparment, Thai Meteorological Department, and Department of Water Resources. The total number of rainfall stations installed in the Chao Phraya River Basin is 1334 (Table C2.1.12). Of all, the number of stations of TMD, RID and DWR are 487, 494, 353 respectively. TMD and RID have two type of stations, telemetry station (TMD 33 stations and RID 167 stations) and manual station (TMD 454 stations and RID 327 stations), whereas DWR has three station types, telemetry station (15 stations), manual station (31 stations) and early warning station (307 stations). These stations spread over a wide area within the Cho Phraya Basin as shown in Figure C2.1.5. RID stations concentrate covering the lower Chao Phraya Basin around Bangkok area, and DWR stations covering the upper Chao Phraya Basin. On the other hand, TMD stations are well distributed covering the enter river basin.

Table C2.1.12 Summary of Rainfall Stations in the Chao Phraya River Basin

Measurement Method	RID	TMD	DWR	TOTAL
	Hydro Center	Meteorology Development Division	BRDH	
Telemetry	167	33	15	215
Manual	327	454	31	812
Early Warning	-	-	307	207
TOTAL	**494**	**487**	**353**	**1334**

(1) Royal Irrigation Department (RID)

Each Hydro Center is responsible for data collection, transmission and analysis. There are two measurement methods, standard rain gauge at manual stations and tipping bucket rain gauge at telemetry stations (Table C2.1.13). At manual stations, RID staff collects the data everyday once a day at 6:00 AM or automated tipping bucket rain gauge collects hourly data. This frequency does not change even under the emergency condition such as flooding time. At the telemetry stations, real-time rain data is automatically collected every 15 minutes and transmitted to the server installed at RID Headquarter in Samsen. The officer at Hydro Center prepares the daily averaged record in a tabular data sheet, and submits them to the Hydrology Division of RID Headquarter once a month, generally 45 days after the end of each month. The daily data is also updated at each Hydro Center Website everyday. The daily average of yesterday is calculated by averaging the data collected from 6:00 AM of yesterday to 6:00 AM of today. Data validation and checking are conducted by "Staff Experience Check" before the data utilization including simulation.

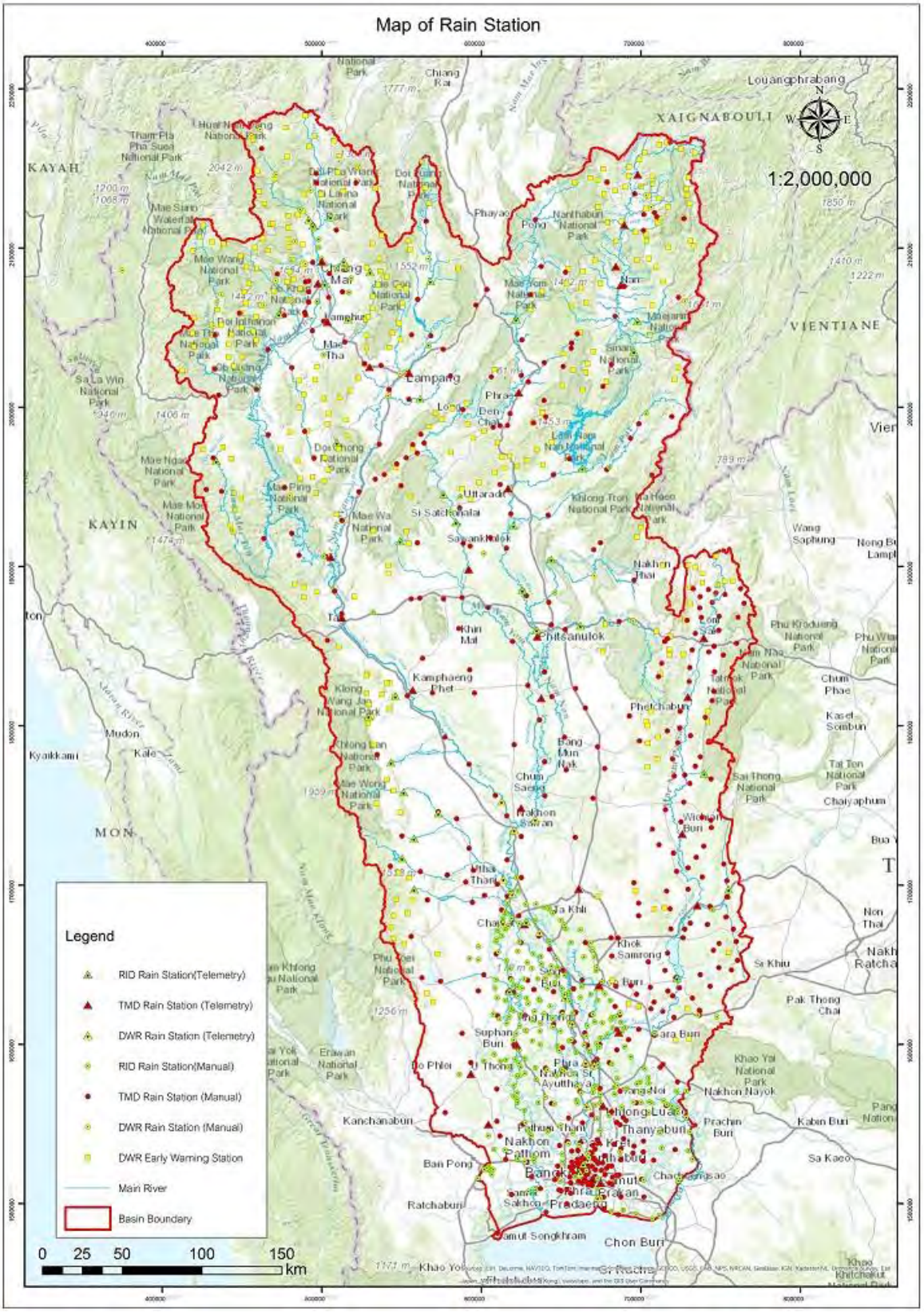


Figure C2.1.5 Location Map of Rainfall Stations (RID, TMD, DWR)

Table C2.1.13 RID Rainfall Station

MANUAL STATION	
Standard Rainfall Gauge (Daily)	**Syphon Rain Gauge and Tipping Bucket Rainfall Gauge (Hourly)**
	
TELEMETRY STATION	
Tipping Bucket Rainfall Gauge	**Telemetry Server Room in RID Head Office**
	

Source : Hydro-geology tool Report, Office of Hydrology and Water Management, RID

(2) Thai Meteorological Department (TMD)

There are two measurement methods, ordinary rain gauge at manual stations and tipping bucket rain gauge at telemetry meteorological stations (Table C2.1.14). At manual rainfall stations, assigned local staff reads the data every 3 hours starting at 7:00 AM and uploads the readings in TMD server. On the other hand, Meteorology Development Division is responsible for telemetry meteorological stations where a real-time rain data is collected at every 15 minutes and transmitted to the TMD server located in the TMD Headquarter. The daily average of yesterday is calculated by averaging the data collected from 7:00 AM of yesterday to 7:00 AM of today. These rainfall data is available for purchase at TMD Headquarter. No information on data quality check process was available.

Table C2.1.14 TMD Rainfall Station

MANUAL STATION	TELEMETRY METEOROLOGICAL STATION
Ordinary Rainfall Gauge	**Tipping Bucket Rainfall Gauge**
	
Source: Meteorological Station Information Book, TMD, 2011 and Manual of Meteorological Equipment Book, TMD, 1884	*Source: Meteorological Station Information Book, TMD, 2011*

In each meteorological station, additional meteorological parameters are collected. These parameters include pressure, dry bulb temperature, wet bulb temperature, maximum temperature, minimum temperature, relative humidity, wind (speed and direction), rainfall, evaporation, sunshine. The regional office staff collects and records data in the data sheet every day. The data sheet is then sent to the head office (TMD) once a month.

(3) Department of Water Resources (DWR)

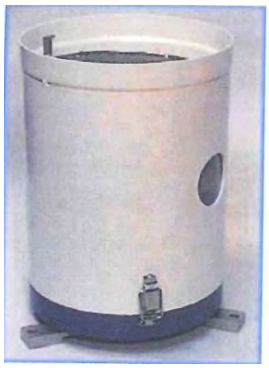
There are two measurement methods, standard rain gauge at manual stations, tipping bucket rain gauge at telemetry stations and early warning stations (Table C2.1.15). Most of early warning stations are located in northern region of the Cho Phraya River Basin whereas the telemetry stations are installed along main stem of the Cho Phraya River downstream of Nakhon Sawan. Bureau of Research, Development and Hydrology is responsible for data collection, transmission and analysis.

At manual station, regional office staff or assigned local people read the rain data at 7:00 AM, once a day, then the regional office staff submit the collected data to the main office, Bureau of Research, Development and Hydrology, once a month.

At telemetry stations, real-time rainfall data is collected at every 15 minutes and transmitted to the server at Bureau of Research, Development and Hydrology. The daily average data is calculated by averaging the telemetry data collected from 0:00 AM of yesterday to 0:00 AM of today. “Staff Experience Check” is conducted for data validation and checking before the data is stored in Year Book.

In each meteorological station, additional meteorological parameters are collected. These parameters include Evaporation, temperature, relative humidity, wind (speed and direction), sunshine.

Table C2.1.15 DWR Rainfall Station

<table>
<tr><th>MANUAL STATION</th><th>TELEMETRY METEOROLOGICAL STATION</th></tr>
<tr><th>Standard Rainfall Gauge</th><th>Tipping Bucket Rainfall Gauge</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Source: Meteorological survey of rainfall Report, DWR</td><td>Source: Tha Chin Basin Telemetry Report, DWR</td></tr>
<tr><th colspan="2">EARLY WARNING STATION</th></tr>
<tr><th colspan="2">Tipping Bucket Rainfall Gauge</th></tr>
<tr><td colspan="2">   </td></tr>
<tr><td colspan="2">Source: Meteorological survey of rainfall Report, DWR</td></tr>
</table>

CHAPTER C3 RAINFALL STATIONS FOR RAINFALL ANALYSIS

C3.1 Data Arrangement

Collected rainfall data are compiled as follows:

- Until June 8, 2012 when a working group meeting of the Japanese Advisory Committee was held in Tokyo, Japan, datasets 1 and 2 in Table C3.1.1 had been already collected. However, it was considered that they were still too insufficient to estimate basin-mean rainfall.
- After the meeting, rainfall data of more than 200 stations were additionally collected from RID Regional Offices, DWR, etc, although some of them include many errors (data year, data codes, formats, values, etc.)
- Regarding the spatial distribution of the rainfall stations, the initially collected data before June 8, 2012 were mainly concentrated in Bangkok and the delta area. However, additionally collected data cover the upper basin too, and the station distribution became more over the Chao Phraya River, as shown in Figure C3.1.1.

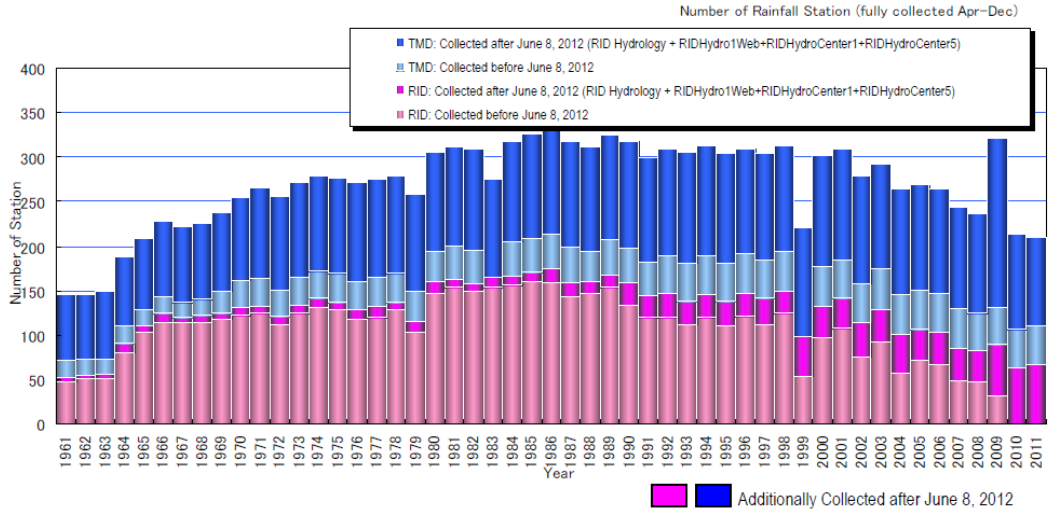
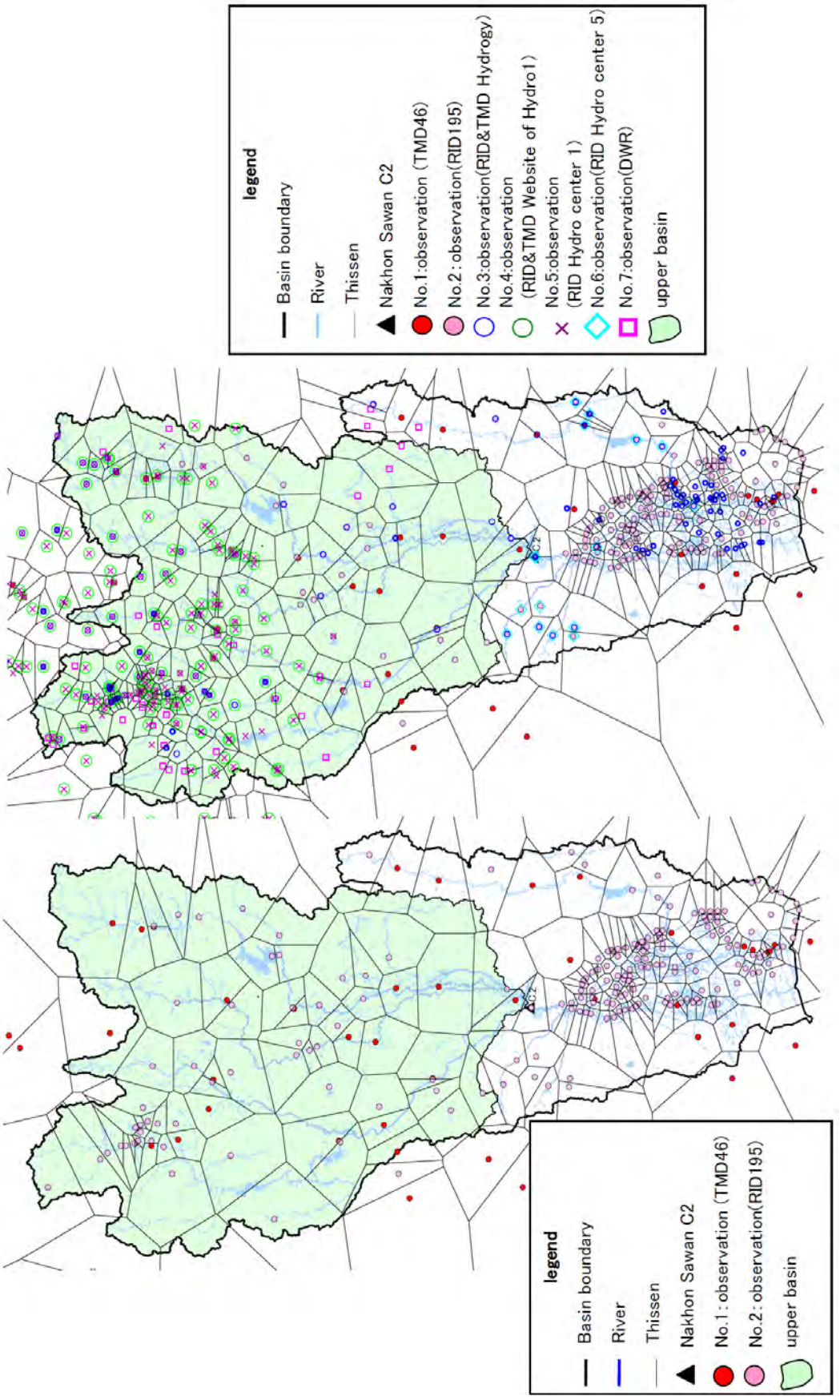


Figure C3.1.1 Number of Rainfall Stations that Have No Data Lack from April and December

Table C3.1.1 Collected Rainfall Data

Data Set No.	Data Source	No. of Stations	Remarks
1	RID(RID data center)	195	
2	TMD	46	
3	RID&TMD (Hydrogy)	292	● Data period is as short as 4 years from 2009 to 2012.
4	RID&TMD (Website of RID Hydro-1)	145	● There are many data errors (data year, code number, data format). ● Many same data as Data Set 1 and 2are included.
5	RID&TMD (Hydro center 1)	185	● Most of the data are for the stations upstream of Nakhon Sawan. ● There are many data errors (data year, code number, data format). ● Many same data as Data Set 1 and 2are included.
6	RID (Hydro Center 5)	16	● There are many data errors (data year, code number, data format). ● Many same data as Data Set 1 and 2are included.
7	DWR	35	● Although the number of stations is 35, only those of 28 stations can be used because the others include long-term data lacking.
8	HAII	-	● Data period is as short as 5 years from 2008 to 2012.

: Collected after June 8, 2012



a) 241 Stations of Datasets 1 and 2 **b) 505 Stations (Datasets 1 to 7)**

Figure C3.1.2 Location of Rainfall Stations and Thiessen Polygons

C3.2 Rainfall Stations to be Used for Calculation of Basin Mean Rainfall

C3.2.1 Conditions

(1) Cases

It is very important to fix rainfall stations that are used for calculation of basin mean rainfall in consideration of data lacking situations and data periods. In this subsection, the relationship between basin mean rainfall and selected rainfall stations for the basin mean rainfall calculation is studied for the following four cases, focusing the station density:

Case 1: TMD 46 Stations (TMD46)
Case 2: TMD46 + RID 195 Stations (TMD+RID)
Case 3: TMD46 + RID 195 + Additional 169 Stations (TMD+RID+169)
Case 4: All 505 Stations (Full)

(2) Thiessen Polygon Division

For the calculation of basin mean rainfall the Thiessen Method is applied. The Thiessen polygon division is fixed annually, and stations that have no data between April and December are used for the calculation. If there data lacking between January and March, a special Thiessen polygon division made for the period from January and March of the year without the lacking stations, and basin mean rainfall is calculated.

(3) Rainfall Duration

The rainfall duration for the basin mean rainfall calculation is set to be six months for the three floods as shown below:

1995 flood: May 5 to October 30
2006 flood: April 14 to October 13
2011 flood: April 19 to October 18

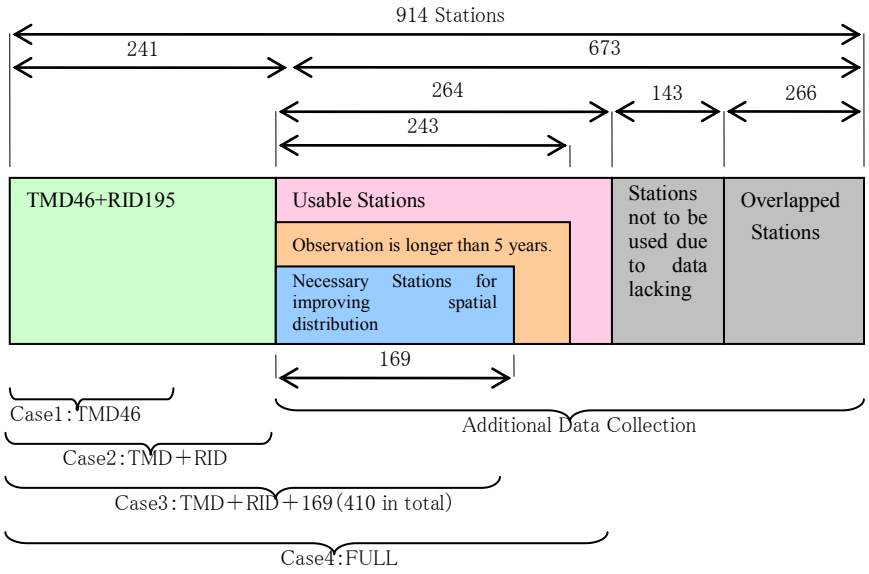


Figure C3.2.1 Numbers of Selected Stations for Four Cases

C3.2.2 Rainfall Stations of Case 3

Case 3 (TMD+RID+169) is the case that is expected to improve the accuracy of the basin mean rainfall by adding stations. In setting up the Case 3, following procedure was taken:

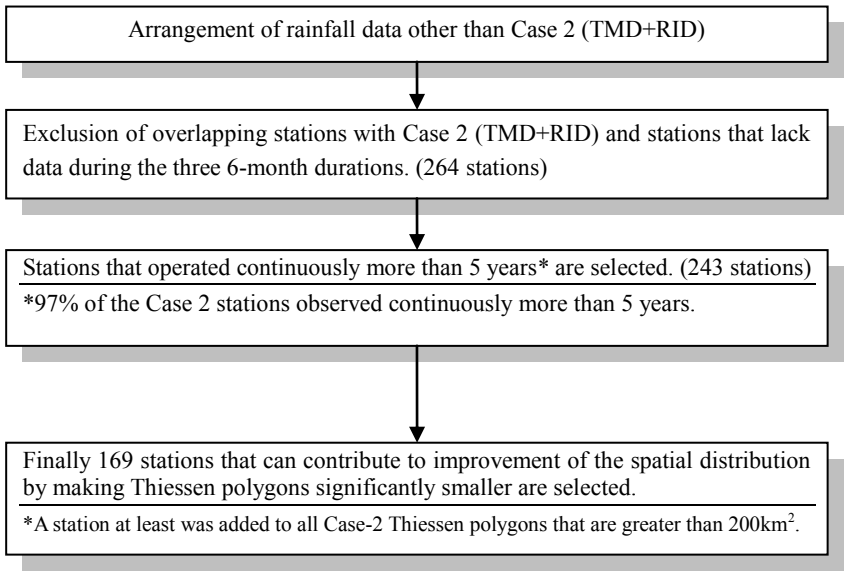


Figure C3.2.2 Flow of Selection of Additional Stations for Case 3

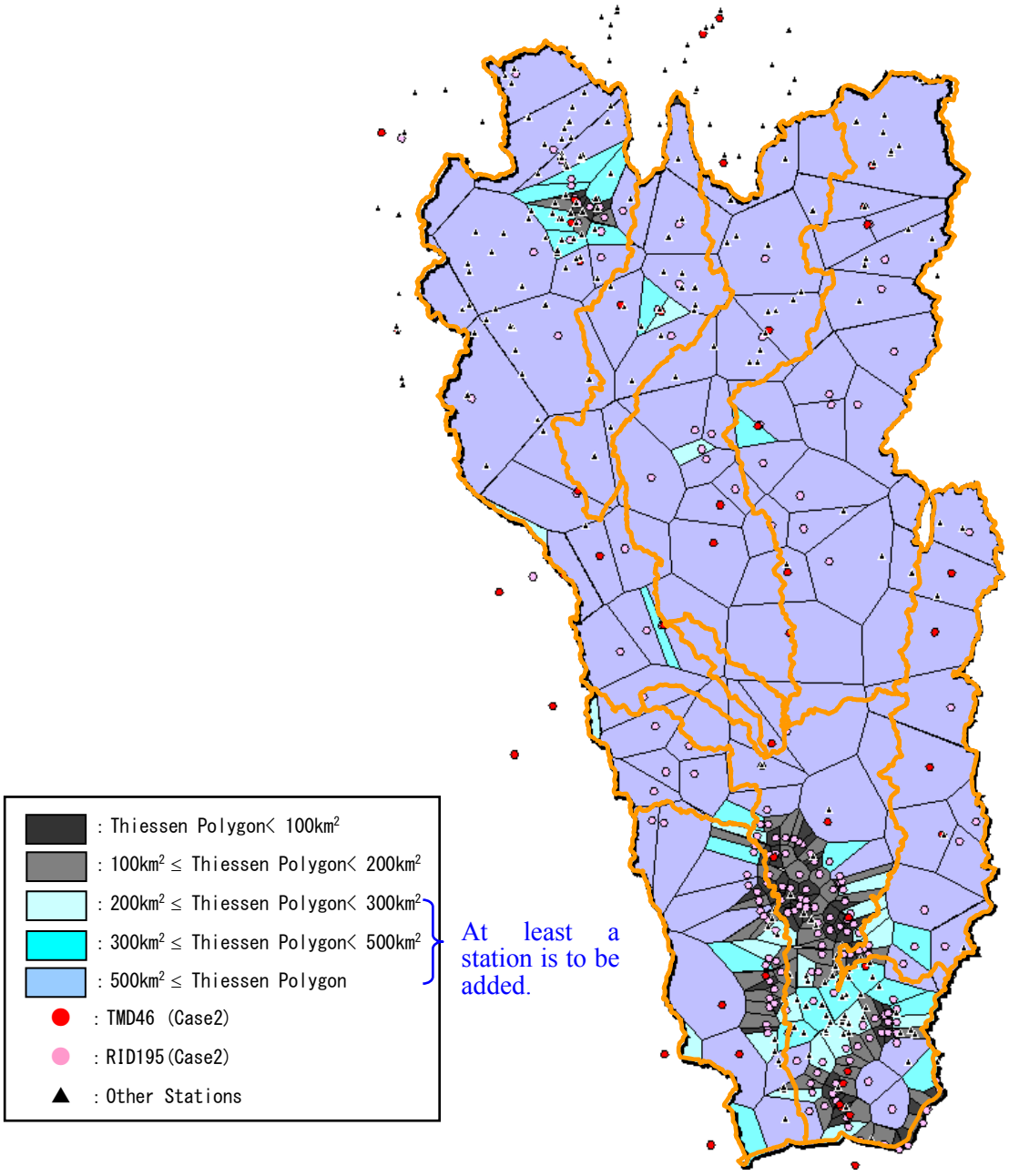


Figure C3.2.3 Areas of Thiessen Polygons of Case 2 (TMD+RID)

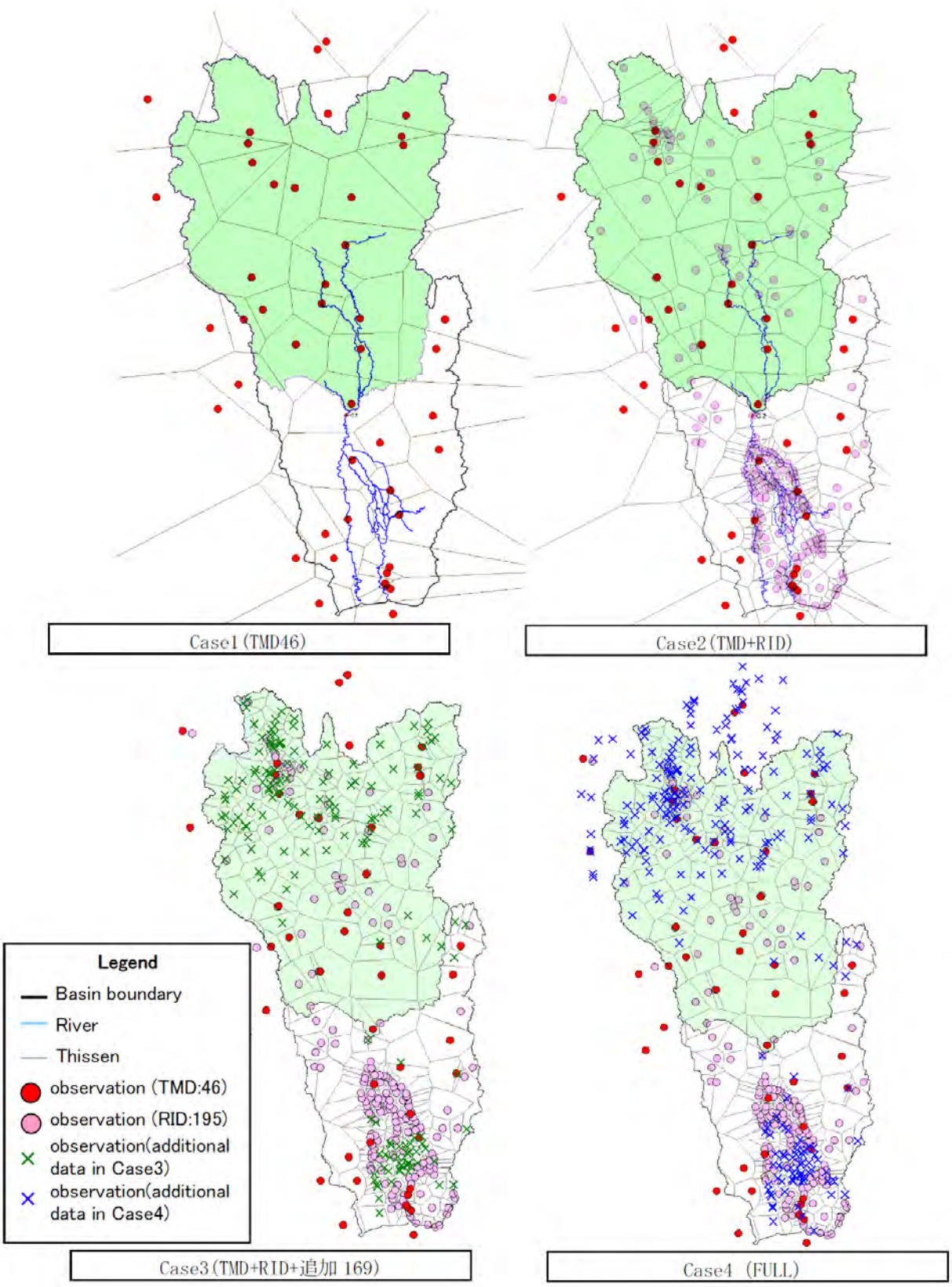


Figure C3.2.4 Thiessen Polygons of Cases 1 to 4

C3.3 Comparison of Basin Mean Rainfalls of 4 Cases

Basin mean 6-month rainfalls of the entire Chao Phraya River Basin and the upper basin above Nakhon Sawan of the three objective floods were calculated for each of the four cases as shown in Table C3.3.1 and Table C3.3.2.

According to the tables, the differences of the basin mean rainfalls of both the river basins are less than 2%. Therefore, it can be said that the addition of rainfall stations to Case 2 does not improve the accuracy of the basin mean rainfalls so much.

Table C3.3.1 Basin Mean 6-Month Rainfalls of Upper Basin upstream of Nakhon Sawan

Division	Case1 (TMD46)	Case2 (TMD+RID)	Case3 (TMD+RID+ addition of 136)	Case4 (FULL)
1995 Flood	1,196 (-3.6%)	1,240 (-0.1%)	1,243 (0.2%)	1,241
2006 Flood	1,398 (0.9%)	1,344 (-2.9%)	1,375 (-0.7%)	1,385
2011 Flood	1,533 (3.6%)	1,474 (-0.3%)	1,483 (0.3%)	1,479

Note: Values in % are differences from Case 4.

Table C3.3.2 Basin Mean 6-Month Rainfalls of Entire Chao Phraya Basin

Division	Case1 (TMD46)	Case2 (TMD+RID)	Case3 (TMD+RID+ addition of 136)	Case4 (FULL)
1995 Flood	1,171 (-3.5%)	1,211 (-0.2%)	1,216 (0.2%)	1,214
2006 Flood	1,312 (3.2%)	1,251 (-1.6%)	1,266 (-0.5%)	1,271
2011 Flood	1,437 (3.6%)	1,386 (-0.1%)	1,390 (0.3%)	1,387

Note: Values in % are differences from Case 4.

C3.4 Basin Mean Rainfalls of Sub-Basins

Basin mean 6-month rainfalls of the Sub-basins are also calculated in the same way as those of the entire Chao Phraya River Basin and the Upper Basin above Nakhon Sawan as shown in Table C3.4.2, Table C3.4.6 and Table C3.4.10.

According to these tables, Case 1 gives a significant difference from Case 4 compared with Cases 2 and 3. The difference between Cases 3 and 4 is very small as both cases have enough station density.

Table C3.4.1 Catchment Area

division		Area(km^2)
Sub -basin	Ping	34,537
	Wang	10,793
	Yom	24,047
	Nan	34,682
	Chao Phraya	23,873
	SakaeKrang	4,907
	Pa Sak	15,626
	Tha Chin	14,196
Upper basin (Nakhon Sawan)		104,059
Chao Phraya basin		162,661

Figure C3.4.1 Sub-Basin Division

Table C3.4.2 Basin Mean 6-Month Rainfall of Sub-Basins (1995 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	1,044 -6.5%	1,095 -1.9%	1,123 0.5%	1,117
	Wang	925 -8.4%	943 -6.7%	1,010 -0.1%	1,010
	Yom	1,260 0.8%	1,285 2.8%	1,252 0.1%	1,250
	Nan	1,387 -3.0%	1,446 1.1%	1,430 0.0%	1,430
	Chao Phraya	1,209 2.4%	1,171 -0.8%	1,167 -1.1%	1,180
	Sakaekrung	1,311 0.8%	1,300 0.0%	1,300 0.0%	1,300
	Pa Sak	981 -13.4%	1,085 -4.2%	1,134 0.1%	1,133
	Tha Chin	1,087 -3.6%	1,168 3.6%	1,158 2.8%	1,127
All basin		1,171 -3.5%	1,211 -0.2%	1,216 0.2%	1,214
Upper basin (Nakhon Sawan)		1,196 -3.6%	1,240 -0.1%	1,243 0.2%	1,241
lower basin □		1,127 -3.2%	1,158 -0.6%	1,167 0.2%	1,165

Unit: mm
Note: Values in % are differences from Case 4.

Table C3.4.3 Number of Used Rainfall Stations (1995 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	14	26	77	84
	Wang	10	13	29	32
	Yom	14	19	34	37
	Nan	12	20	39	39
	Chao Phraya	15	92	122	135
	Sakaekrung	5	11	11	11
	Pa Sak	6	15	20	21
	Tha Chin	11	28	32	33
All basin		42	151	267	292
Upper basin (Nakhon Sawan)		26	47	129	141
lower basin		21	112	148	161

Unit: km^2

Table C3.4.4 Maximum Thiessen Polygon Area by Sub-Basin (1995 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	7,211	5,447	1,809	1,809
	Wang	3,757	2,100	1,368	1,356
	Yom	4,776	3,446	2,520	2,520
	Nan	6,140	5,915	4,156	4,156
	Chao Phraya	4,302	2,840	2,840	2,840
	Sakaekrung	2,060	972	972	972
	Pa Sak	6,279	3,517	3,517	3,517
	Tha Chin	4,645	2,616	2,616	2,559
All basin		8,972	5,912	4,594	4,594
Upper basin (Nakhon Sawan)		8,971	5,911	4,593	4,593
lower basin		7,104	3,892	3,892	3,892

Unit: km^2

Table C3.4.5 Average Thiessen Polygon Area by Sub-Basin (1995 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	2,467	1,328	449	411
	Wang	1,079	830	372	337
	Yom	1,718	1,266	707	650
	Nan	2,890	1,734	889	889
	Chao Phraya	1,592	259	196	177
	Sakaekrung	981	446	446	446
	Pa Sak	2,604	1,042	781	744
	Tha Chin	1,291	507	444	430
All basin		3,873	1,077	609	557
Upper basin (Nakhon Sawan)		4,002	2,214	807	738
lower basin		2,791	523	396	364

Unit: km^2

Table C3.4.6 Basin Mean 6-Month Rainfall of Sub-Basins (2006 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	1,309 8.1%	1,246 3.0%	1,180 -2.5%	1,210
	Wang	1,396 -3.6%	1,323 -8.7%	1,453 0.3%	1,449
	Yom	1,455 -1.6%	1,428 -3.4%	1,478 0.0%	1,478
	Nan	1,447 -1.8%	1,391 -5.6%	1,474 0.0%	1,474
	Chao Phraya	1,192 17.2%	1,049 3.1%	1,018 0.1%	1,017
	Sakaekrung	1,313 30.9%	1,003 0.0%	1,003 0.0%	1,003
	Pa Sak	1,245 2.9%	1,211 0.1%	1,210 0.0%	1,210
	Tha Chin	961 -6.6%	1,034 0.6%	1,032 0.4%	1,028
All basin		1,312 3.2%	1,251 -1.6%	1,266 -0.5%	1,271
Upper basin (Nakhon Sawan)		1,398 0.9%	1,344 -2.9%	1,375 -0.7%	1,385
lower basin		1,160 8.4%	1,085 1.4%	1,072 0.1%	1,070

Unit: mm
Note: Values in % are differences from Case 4te: Values in % are difference from Case 4.

Table C3.4.7 Number of Used Rainfall Stations (2006 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	14	27	51	57
	Wang	10	15	18	19
	Yom	15	22	34	36
	Nan	13	25	31	31
	Chao Phraya	15	46	50	54
	Sakaekrung	5	10	10	10
	Pa Sak	6	12	13	13
	Tha Chin	11	16	18	19
All basin		42	102	147	161
Upper basin (Nakhon Sawan)		27	52	92	101
lower basin		21	61	66	71

Unit: km^2

Table C3.4.8 Maximum Thiessen Polygon Area by Sub-Basin (2006 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	7,211	4,247	2,712	2,488
	Wang	3,757	2,639	1,667	1,667
	Yom	4,776	3,231	2,352	2,352
	Nan	6,140	5,844	4,277	4,277
	Chao Phraya	3,735	2,601	1,900	1,900
	Sakaekrung	2,060	1,407	1,407	1,407
	Pa Sak	4,173	2,647	2,647	2,647
	Tha Chin	4,645	2,629	2,629	2,629
All basin		9,076	5,840	4,442	4,442
Upper basin (Nakhon Sawan)		9,076	5,840	4,442	4,442
lower basin		7,104	3,253	3,253	3,253

Unit: km^2

Table C3.4.9 Average Thiessen Polygon Area by Sub-Basin (2006 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	2,467	1,279	677	606
	Wang	1,079	720	600	568
	Yom	1,603	1,093	707	668
	Nan	2,668	1,387	1,119	1,119
	Chao Phraya	1,592	519	477	442
	Sakaekrung	981	491	491	491
	Pa Sak	2,604	1,302	1,202	1,202
	Tha Chin	1,291	887	789	747
All basin		3,873	1,595	1,107	1,010
Upper basin (Nakhon Sawan)		3,854	2,001	1,131	1,030
lower basin		2,791	961	888	825

Unit: km^2

Table C3.4.10 Basin Mean 6-Month Rainfall of Sub-Basins (2011 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	1,373 5.0%	1,346 2.9%	1,306 −0.2%	1,308
	Wang	1,468 2.1%	1,468 2.2%	1,437 0.0%	1,437
	Yom	1,589 −1.9%	1,548 −4.4%	1,620 0.0%	1,619
	Nan	1,674 6.9%	1,553 −0.8%	1,579 0.8%	1,566
	Chao Phraya	1,395 4.7%	1,349 1.2%	1,341 0.6%	1,333
	Sakaekrung	1,463 19.6%	1,224 0.0%	1,224 0.0%	1,224
	Pa Sak	1,192 0.6%	1,185 0.0%	1,185 0.0%	1,185
	Tha Chin	1,063 −1.5%	1,080 0.0%	1,080 0.0%	1,080
All basin		1,437 3.6%	1,386 −0.1%	1,390 0.3%	1,387
Upper basin (Nakhon Sawan)		1,533 3.6%	1,474 −0.3%	1,483 0.3%	1,479
lower basin		1,266 3.6%	1,229 0.5%	1,226 0.3%	1,223

Unit: mm
Note:Values in % are differences from Case 4.

Table C3.4.11 Number of Used Rainfall Stations (2011 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	2,302	1,439	735	664
	Wang	1,199	830	491	469
	Yom	1,603	1,266	829	751
	Nan	2,668	1,652	1,156	1,051
	Chao Phraya	1,592	1,256	1,137	1,085
	Sakaekrung	981	491	491	491
	Pa Sak	2,604	1,736	1,736	1,736
	Tha Chin	1,420	1,291	1,291	1,291
All basin		3,873	2,502	1,520	1,378
Upper basin (Nakhon Sawan)		3,854	2,420	1,239	1,107
lower basin		2,791	1,831	1,724	1,674

Unit: km^2

Table C3.4.12 Maximum Thiessen Polygon Area by Sub-Basin (2011 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	15	24	47	52
	Wang	9	13	22	23
	Yom	15	19	29	32
	Nan	13	21	30	33
	Chao Phraya	15	19	21	22
	Sakaekrung	5	10	10	10
	Pa Sak	6	9	9	9
	Tha Chin	10	11	11	11
All basin		42	65	107	118
Upper basin (Nakhon Sawan)		27	43	84	94
lower basin		21	32	34	35

Unit: km^2

Table C3.4.13 Average Thiessen Polygon Area by Sub-Basin (2011 Flood)

division		Case1(TMD46)	Case2(TMD+RID)	Case3(TMD+RID+追加136)	Case4(FULL)
Sub-basin	Ping	9,122	5,447	3,454	3,256
	Wang	3,757	2,205	1,456	1,456
	Yom	4,776	3,130	2,471	2,471
	Nan	6,140	6,573	5,811	5,594
	Chao Phraya	3,696	3,696	3,696	3,696
	Sakaekrung	2,060	1,141	1,141	1,141
	Pa Sak	4,173	3,047	3,047	3,047
	Tha Chin	4,645	2,729	2,729	2,729
All basin		9,386	6,569	5,807	5,590
Upper basin (Nakhon Sawan)		9,385	6,568	5,807	5,590
lower basin		7,104	5,575	5,575	5,575

Unit: km^2

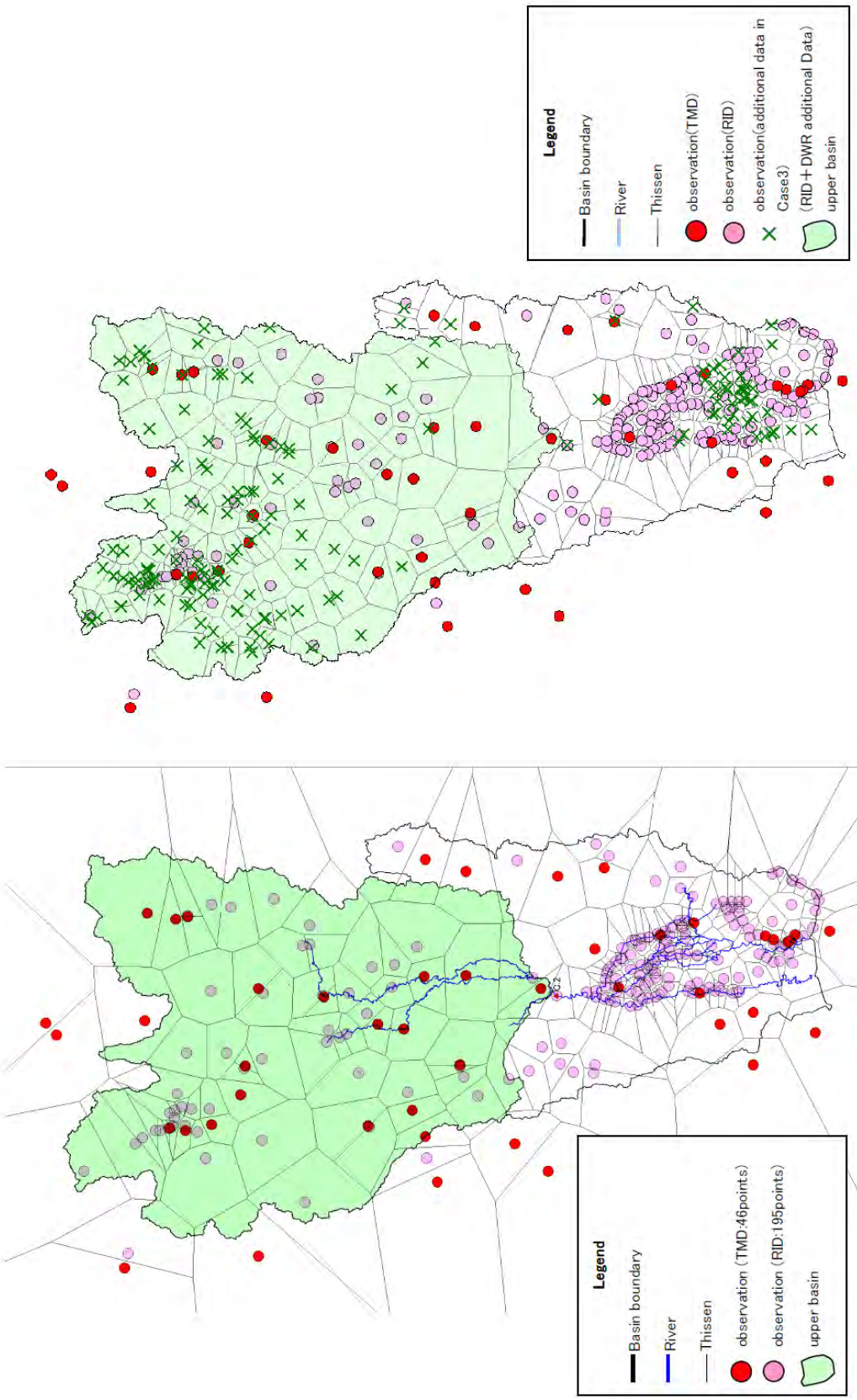
C3.5 Determination of Rainfall Stations for Rainfall Analysis

Based on the above examinations, Case 3 (TMD+RID+169) is adopted as the combination of rainfall stations for the rainfall analysis in the next section from the following reasons:

- Differences among Case 2 (TMD+RID), Case 3 (TMD+RID+169) and Case 4 (Full) are small. Especially that between Case 3 (TMD+RID+169) and Case 4 (Full) is very small even for the basin mean rainfalls of the sub-basins.
- The maximum Thiessen polygon areas of Case 3 and Case 4 are at the same level. The both cases have higher station density than Case 2.
- Therefore, Case 3, to which usable stations were properly added to improve low station-density areas of Case 2, is recommendable.

Table C3.5.1 Comparison of 4 Cases

Case	Accuracy of Basin Mean Rainfall	Thiessen Polygon Size	Data quality and Continuity of Observation	Comprehensive Evaluation
Case1 (TMD46)	Fair	Bad	Excellent	Bad
Case2 (TMD+RID)	Good	Fair	Excellent	Fair
Case3 (TMD＋RID＋169)	Excellent	Good	Excellent	Excellent
Case4 (FULL)	Excellent	Excellent	Bad	Good
Remarks	It is assumed that the more stations the higher the accuracy is.	Even Case 4 has polygons greater than 6,000km^2,	Good quality data were added to Case 3.	



a) Case 2 (TMD+RID) **b) Case 3(TMD+RID+169)**

Figure C3.5.1 Location of Rainfall Stations and Thiessen Polygons

C3.6 Treatment of 1999 Data

TMD Dataset lacks rainfall data in September 1999. Therefore, some of Thissen polygon areas are very large as shown in Figure C3.6.1. To solve this problem, the year 1999 is treated specally. Namely two different Thieesen polygon patterns are prepared for only September and for the other months.

Pattern 1 (Except for September):	The Case 3 stations are used.
Pattern 2 (Exclusively for September):	All the collected stations of which coordinate data are available and that do not have lacking data are used.

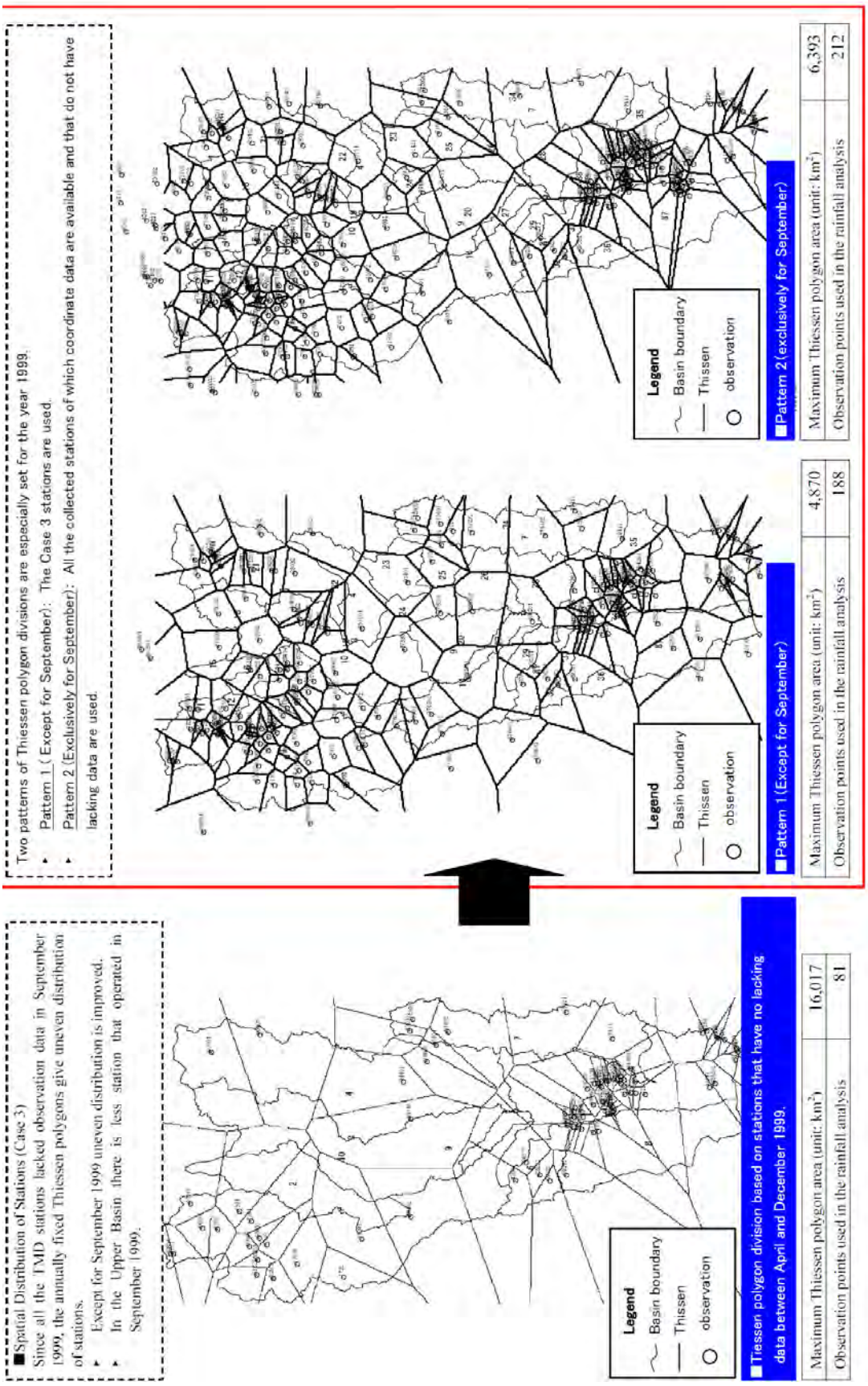


Figure C3.6.1 Location of Rainfall Stations and Thiessen Polygons for the Year 1999

CHAPTER C4 RAINFALL ANALYSIS

C4.1 Setting of Design Rainfall Duration

C4.1.1 Rainfall duration

Rainfall duration is one of the basic conditions for the planning of the Master Plan. The design rainfall duration should be as the rainfall duration that forms floods of the Chao Phraya River Basin. Although the flood phenomena are influenced by a variety of factors of the vast river basin, an examination is made to determine the most influential rainfall duration on the flood phenomena of the Chao Phraya River Basin in this subsection.

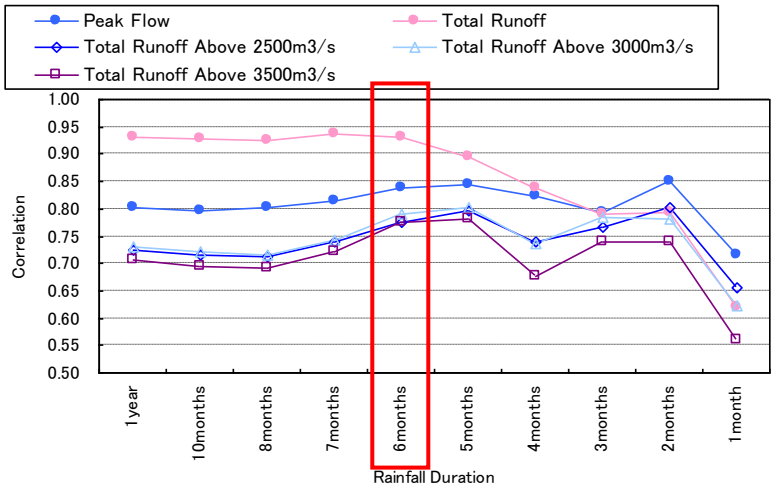
For this purpose, a regression analysis was made between basin mean rainfalls of different durations of the Upper River Basin upstream of Nakhon Sawan, the annual maximum discharges and the annual total discharge volumes and the annual total discharge volumes exceeding certain discharges (flow capacities of river channels) at C.2 Nakhon Sawan. Results are presented in Figure C4.1.1, Table C4.1.1, Table C4.1.2,

From the results the followings can be said:

- Regarding the correlation between rainfalls of different durations and peak discharges, 2-month and 6-month rainfalls have higher correlation coefficients.
- 6-month or longer rainfall have higher correlation coefficients with the total runoff discharge volume.
- 2, 3, 5 and 6-month rainfalls have higher correlation coefficients with the discharge volumes exceeding the flow capacities.

Based on the above results, it is proposed to adopt 6 months as the design rainfall duration for the Chao Phraya River Basin from the following reasons:

- Since the flood of the Chao Phraya River Basin is characterized by its long-time flood phenomenon extending a few months, discharge volume seems to be more important than peak discharges.
- The first and second largest flood volume floods, the 2011 and 2006 floods have also the first and second largest 6-month rainfalls as shown in Figure C4.1.2. It is deemed that the 6-month rainfalls reflect the flood scale very well.



Note: Three cases of flood capacities, 2500 m^3/s, 300 m^3/s and 3,500 m^3/s are assumed. 2,500 m^3/s is the minimum flow capacity between Nakhon Sawan and Chainat by JICA 1999 Study, 3,500 m^3/s is the flow capacity at C2. Nakhon Sawan by RID, and 3,000 m^3/s is the mean value of the other two.

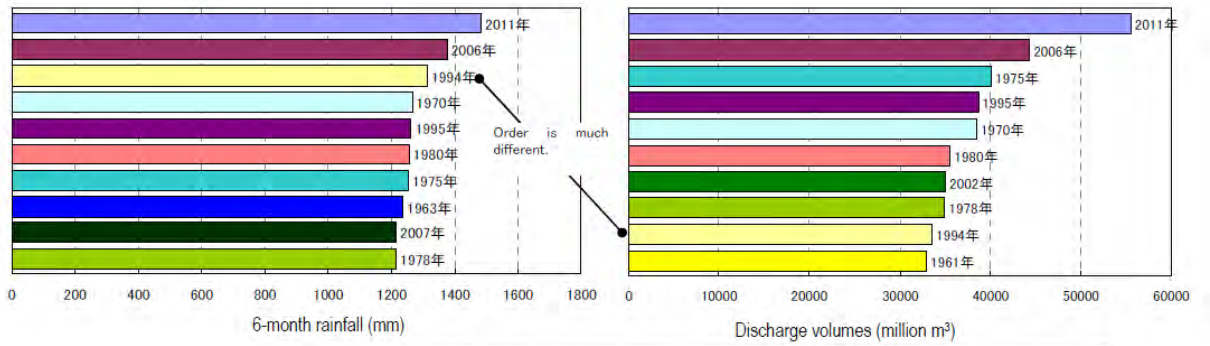
Figure C4.1.1 Correlation Coefficients between Rainfall of Different Durations and Discharges

Table C4.1.1 Correlation Coefficients between Rainfall of Different Durations and Discharges

	1year	10months	8months	7months	6months	5months	4months	3months	2months	1month
Peak Flow	0.80	0.80	0.80	0.81	0.84	0.84	0.82	0.79	0.85	0.72
Total Runoff	0.93	0.93	0.93	0.94	0.93	0.90	0.84	0.79	0.79	0.62

Table C4.1.2 Correlation Coefficients between Rainfall of Different Durations and Discharge Volumes Exceeding Certain Discharge

	1year	10months	8months	7months	6months	5months	4months	3months	2months	1month
Total Runoff Above 2500m3/s	0.72	0.72	0.71	0.74	0.78	0.79	0.74	0.77	0.80	0.66
Total Runoff Above 3000m3/s	0.73	0.72	0.72	0.74	0.79	0.80	0.74	0.79	0.78	0.62
Total Runoff Above 3500m3/s	0.71	0.70	0.69	0.72	0.78	0.78	0.68	0.74	0.74	0.56



	6-monthrainfall (183 days)		Discharge Volume	
Order	Year	Rainfall (mm)	Year	Discharge Volume (MCM)
1	2011	1,483	2011	55,570
2	2006	1,375	2006	44,332
3	1994	1,313	1975	40,180
4	1970	1,266	1995	38,741
5	1995	1,262	1970	38,524
6	1980	1,255	1980	35,623
7	1975	1,254	2002	35,129
8	1963	1,235	1978	34,990
9	2007	1,214	1994	33,587
10	1978	1,214	1961	33,006

Figure C4.1.2 Order of 6-Month and Discharge Volumes

C4.1.2 Rainfall Period of 6-Month Rainfall

In the preceding subsection, it is determined that 6 month is the design rainfall duration for the Chao Phraya River basin. The next step is to determine how to decide the 6-month period. 3 cases of 6-month periods are conceived, although the case 3 is further divided to 3 sub-cases with different flow capacities:

1. Maximum 6-Month (183-day) Rainfall
2. 6-Month Rainfall before Peak Discharge
3. 6-Month Rainfall before discharge goes down to flow capacity (three cases of flow capacities, 2,500 m^3/s, 3,000m^3/s, 3,500m^3/s are conceived.)

The 6-month rainfalls defined by the above cases are compared in Figure C4.1.3 and Figure C4.1.4.

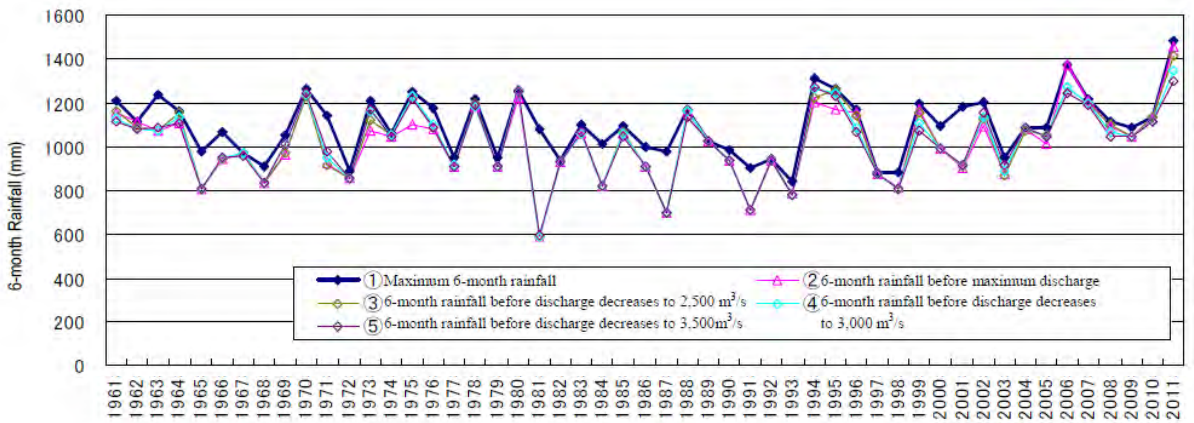


Figure C4.1.3 6-Month rainfalls of Five Period Cases

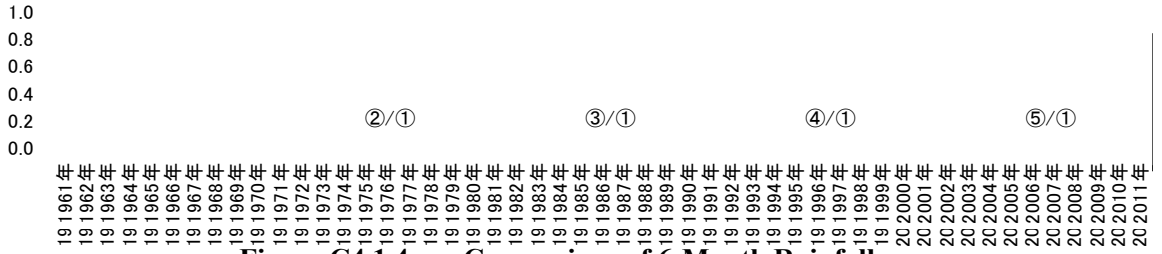


Figure C4.1.4 Comparison of 6-Month Rainfalls

According to these figures, all the cases generally show a similar tendency except for 1981, 1987, 1991 and 2001, when the peak discharges appeared in early stages of the flood seasons.

In the case of 2011 the maximum 6-month rainfall is almost same as that of Case 2, while the maximum 6 month is close to Case 3 in the 1975 case. It is guessed that in the 2011 flood the rainfalls before the peak discharge were more influential than those after it, and that in the 1975 flood rainfalls after the discharge peak as well as before it were influential as shown in Figure C4.1.3 and Figure C4.1.4. Anyway, it is considered that Case 1, the maximum 6-month rainfalls is the most influential among the three cases.

Therefore, the maximum 6-month rainfall is defined as the design rainfall.

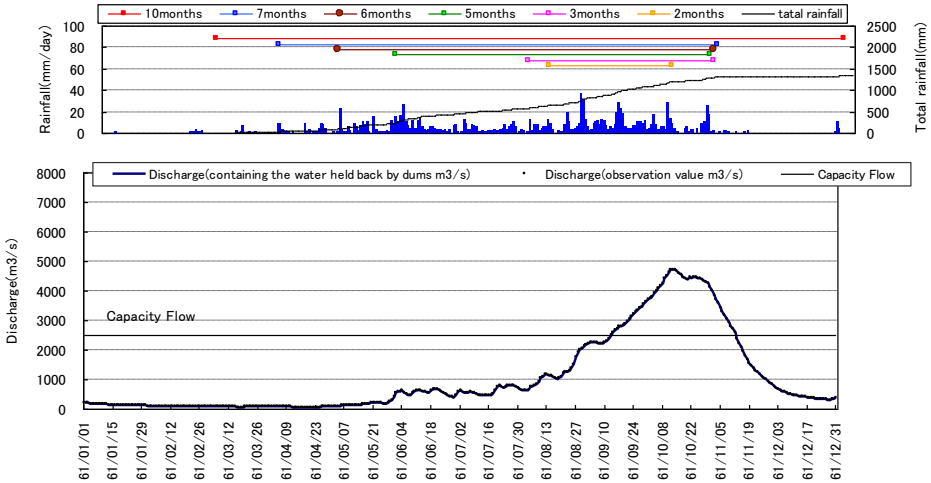


Figure C4.1.5 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1961）

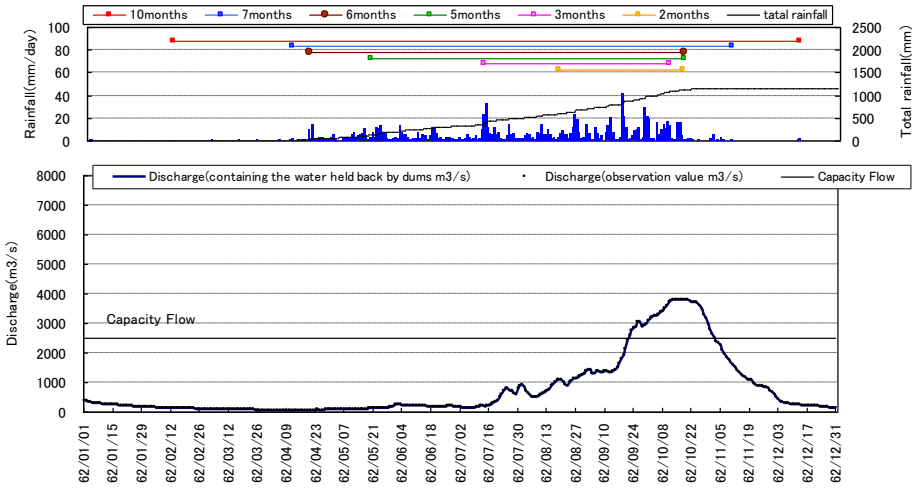


Figure C4.1.6 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1962）

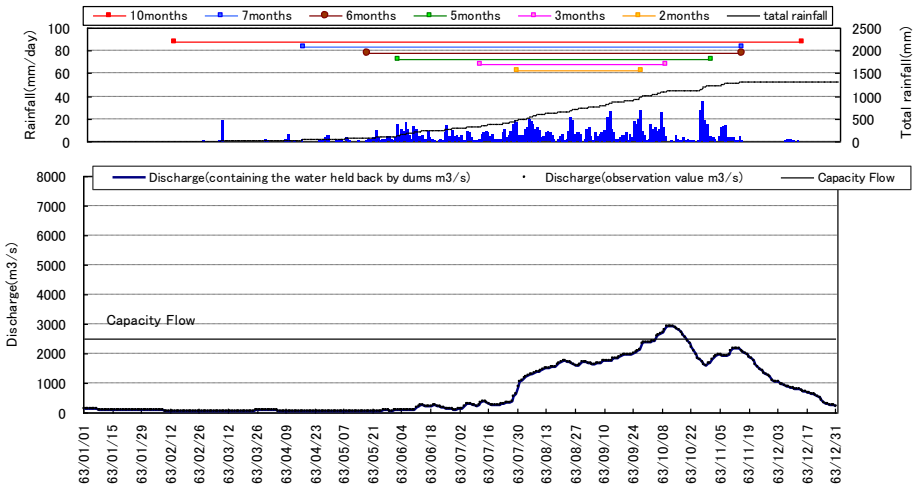


Figure C4.1.7 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1963）

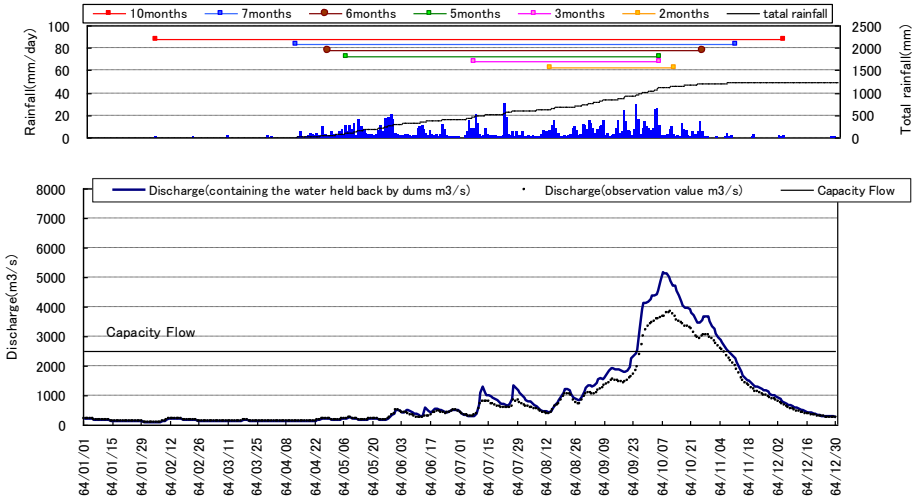


Figure C4.1.8 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1964）

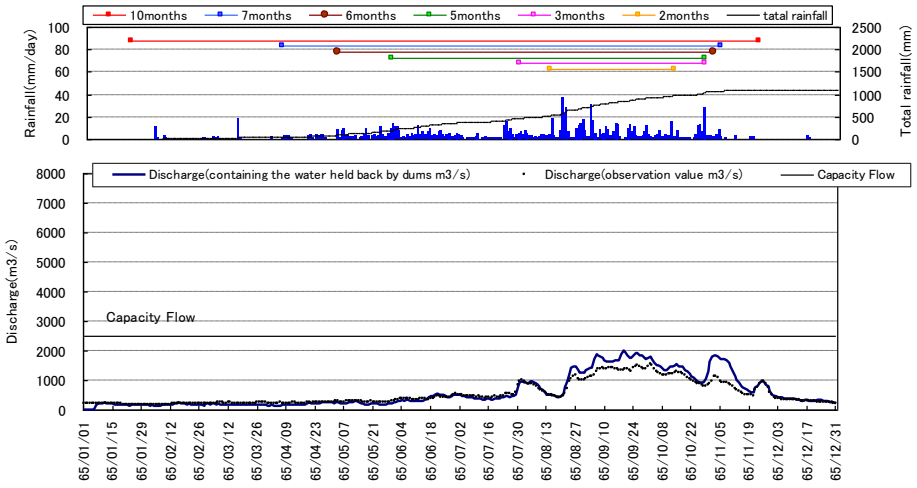


Figure C4.1.9 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1965）

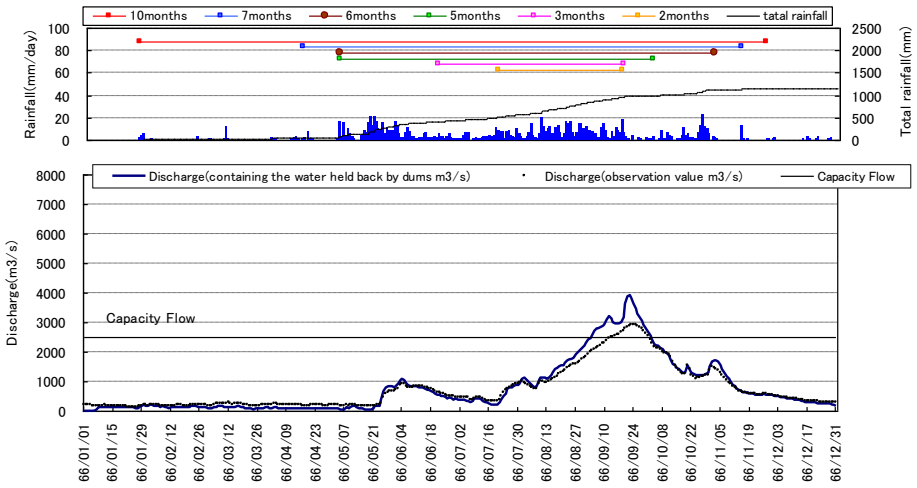


Figure C4.1.10 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1966）

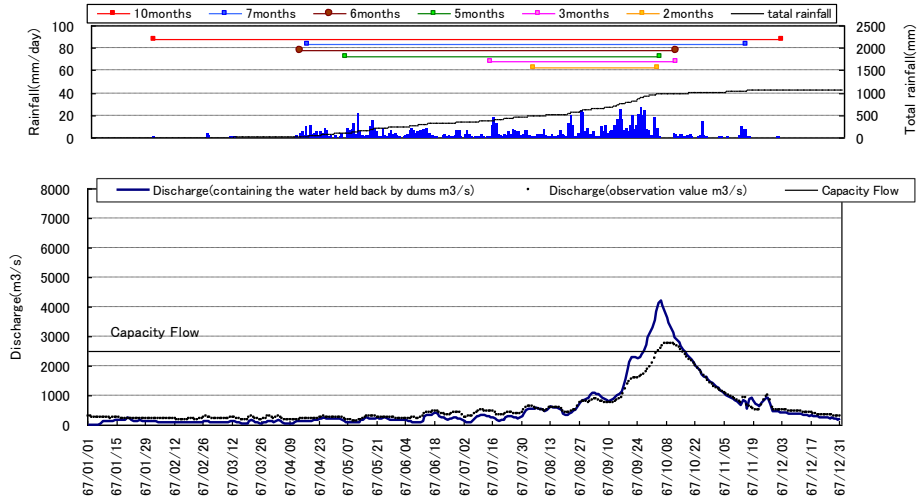


Figure C4.1.11 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1967）

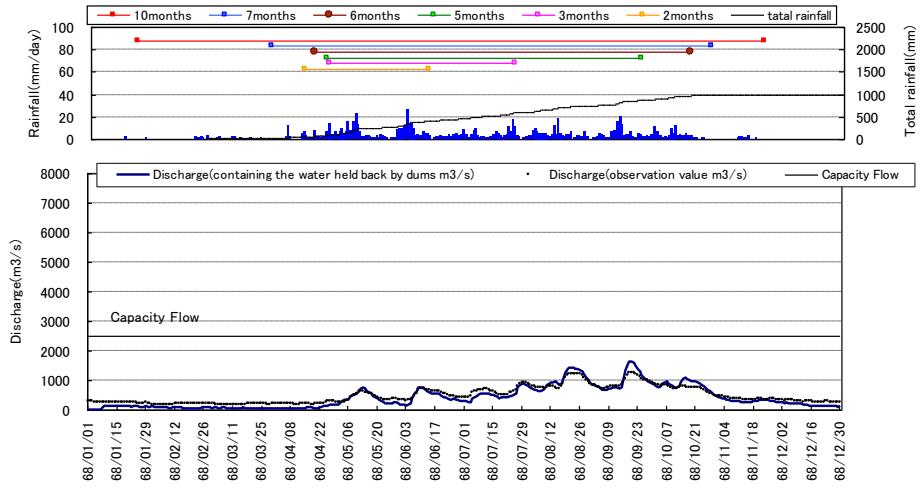


Figure C4.1.12 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1968）

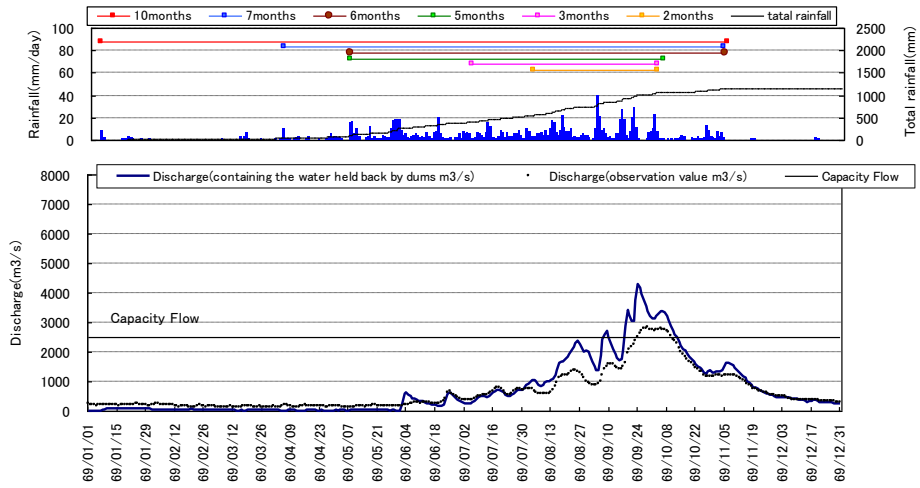


Figure C4.1.13 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1969）

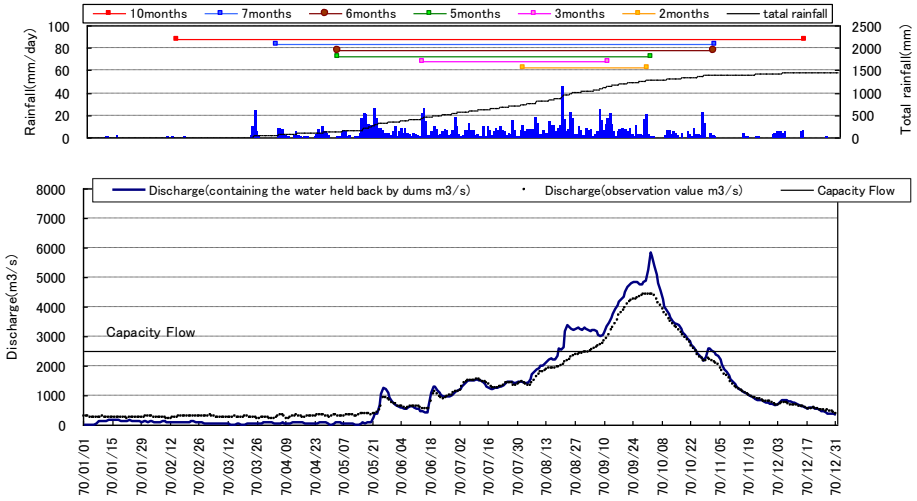


Figure C4.1.14 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1970）

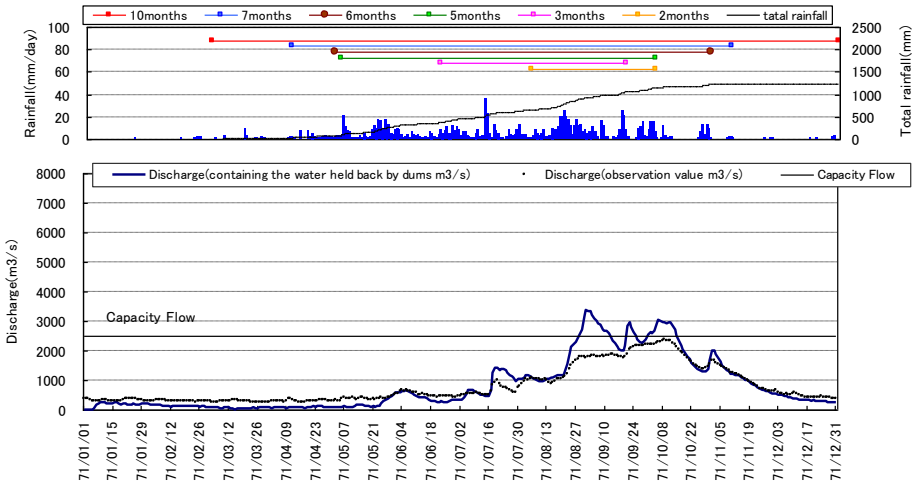


Figure C4.1.15 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1971）

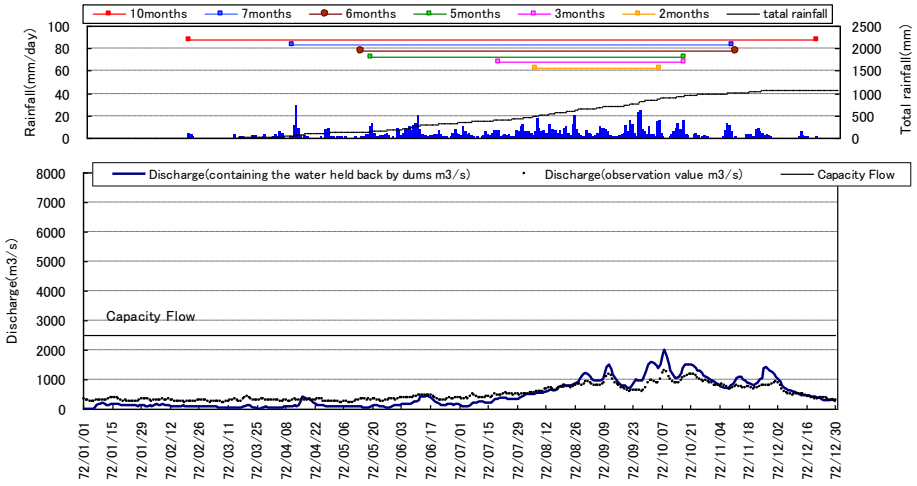


Figure C4.1.16 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1972）

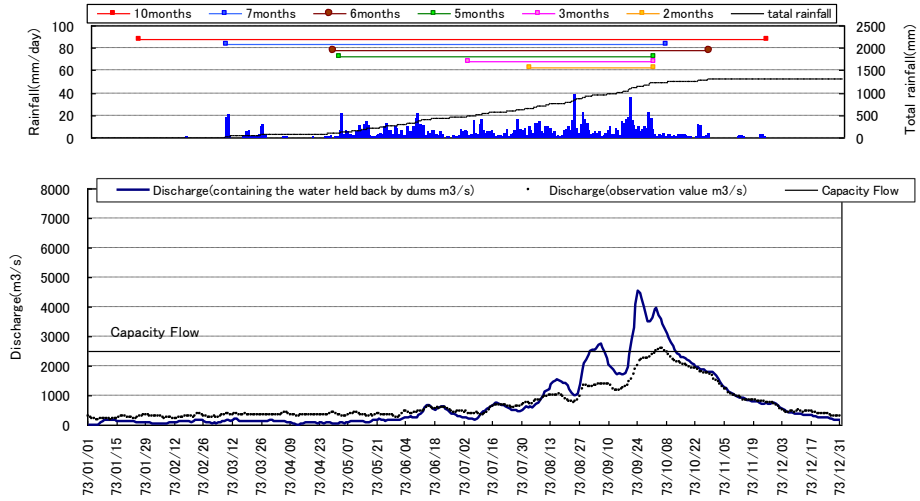


Figure C4.1.17 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1973）

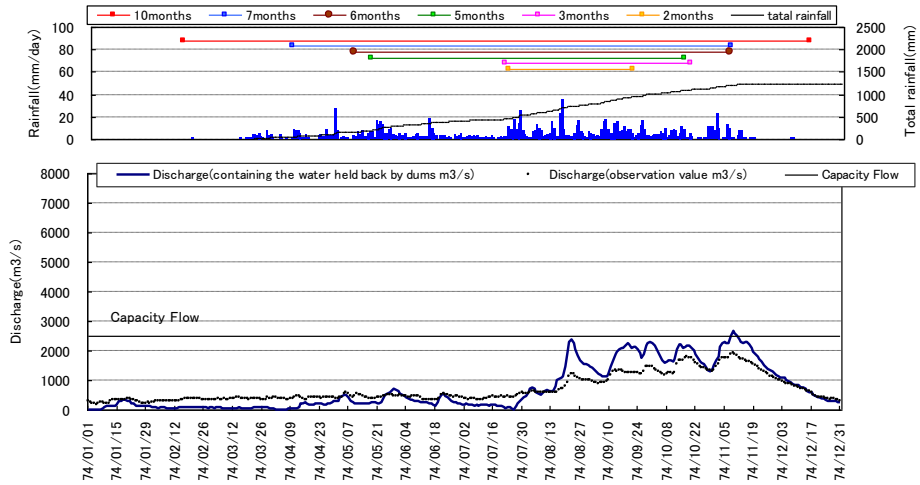


Figure C4.1.18 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1974）

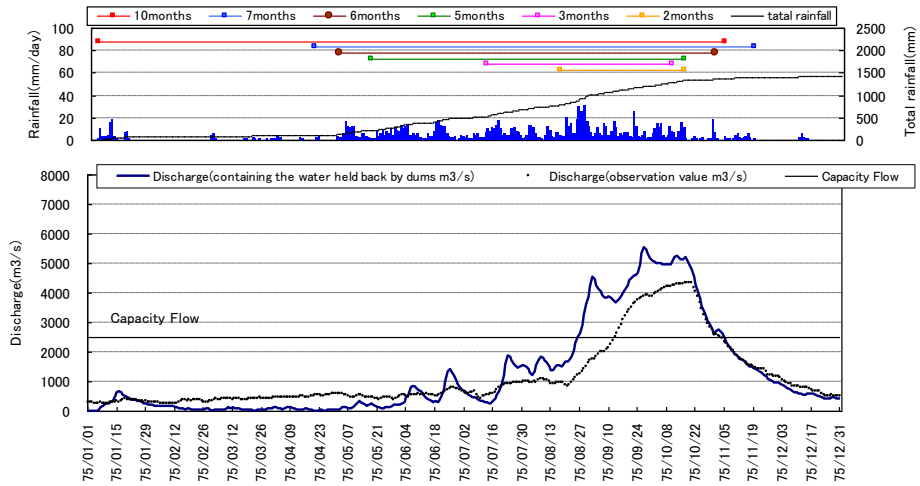


Figure C4.1.19 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1975）

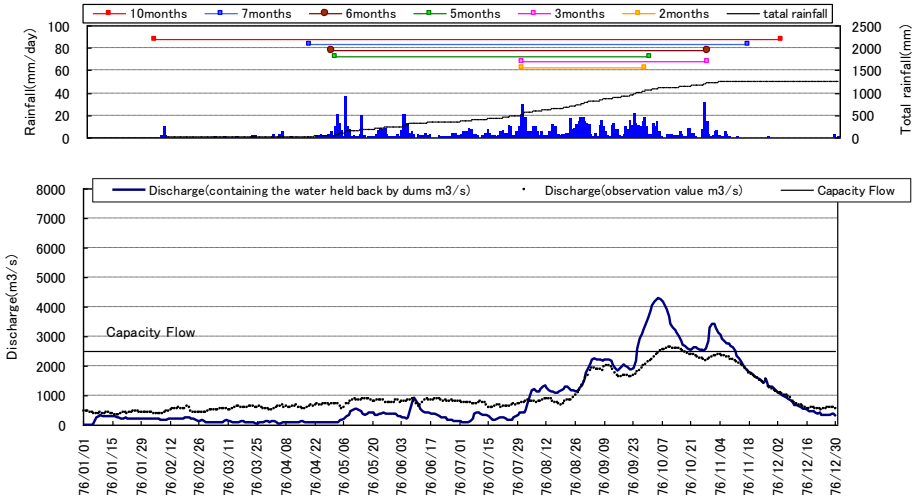


Figure C4.1.20 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1976）

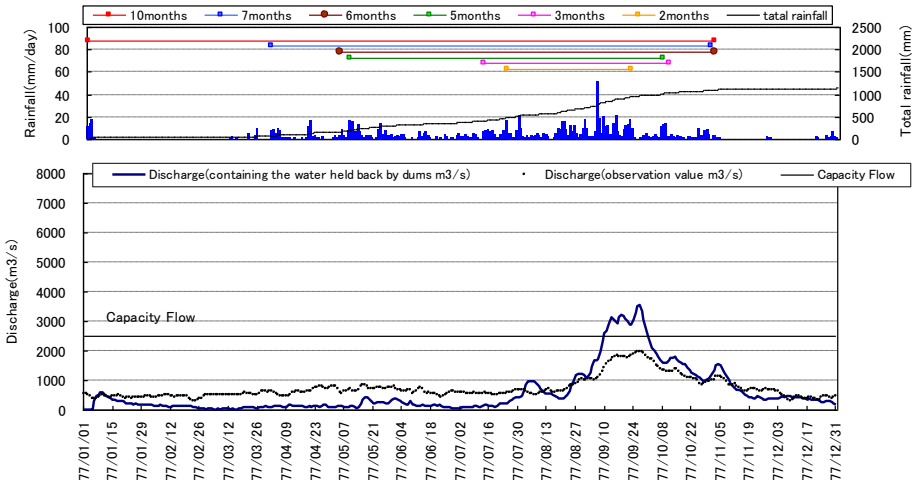


Figure C4.1.21 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1977）

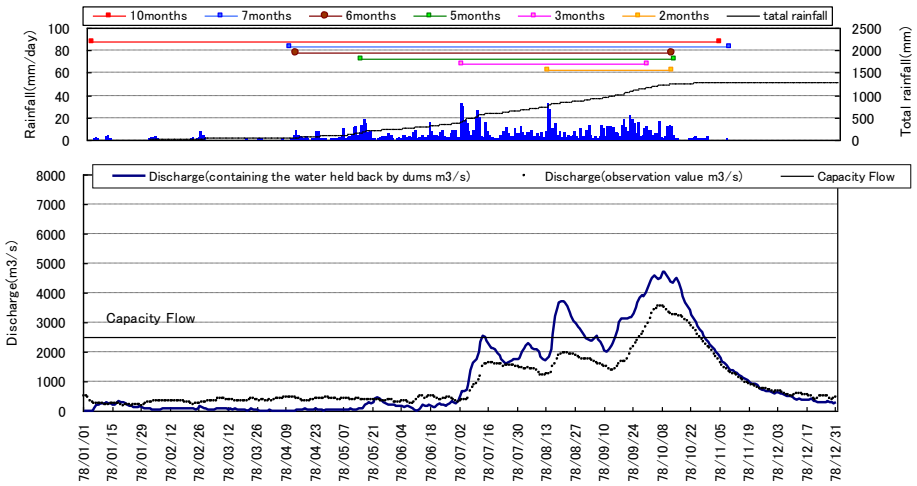


Figure C4.1.22 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1978）

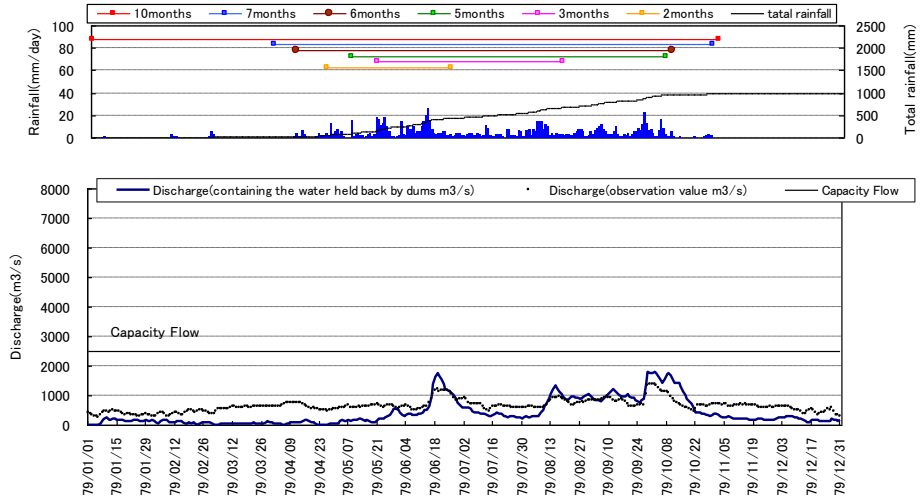


Figure C4.1.23 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1979）

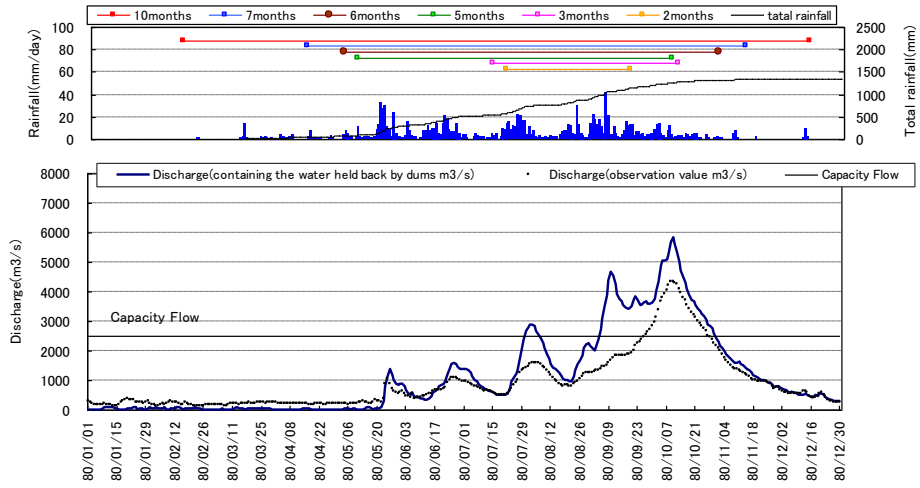


Figure C4.1.24 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1980）

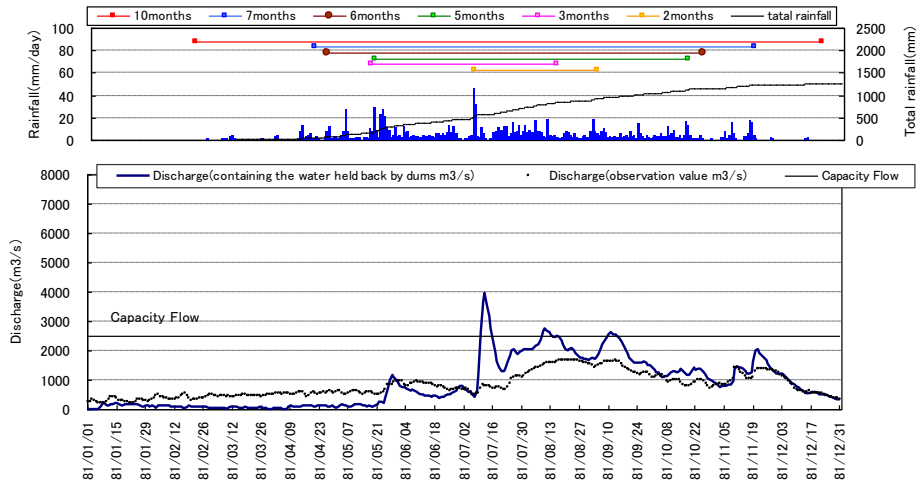


Figure C4.1.25 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1981）

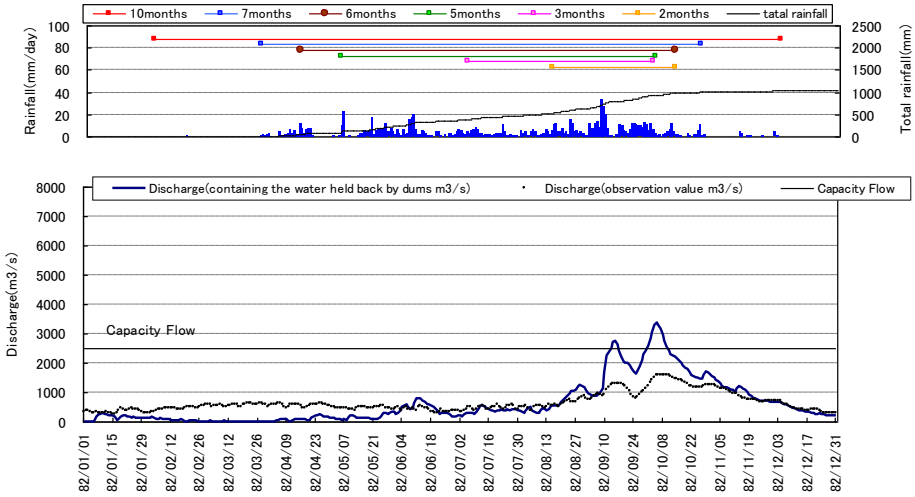


Figure C4.1.26 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1982）

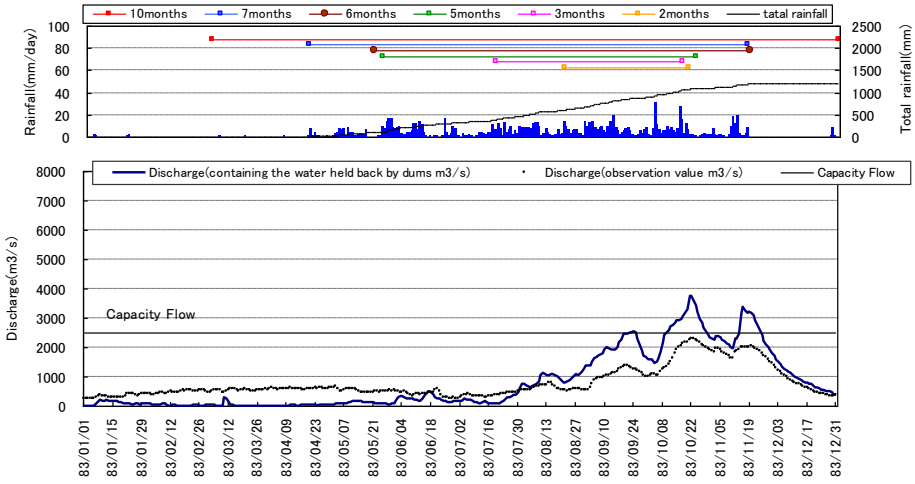


Figure C4.1.27 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1983）

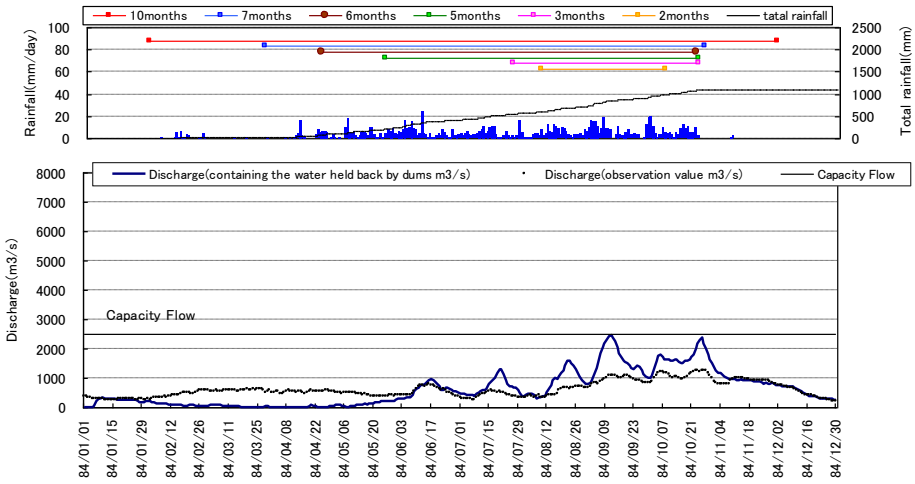


Figure C4.1.28 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1984）

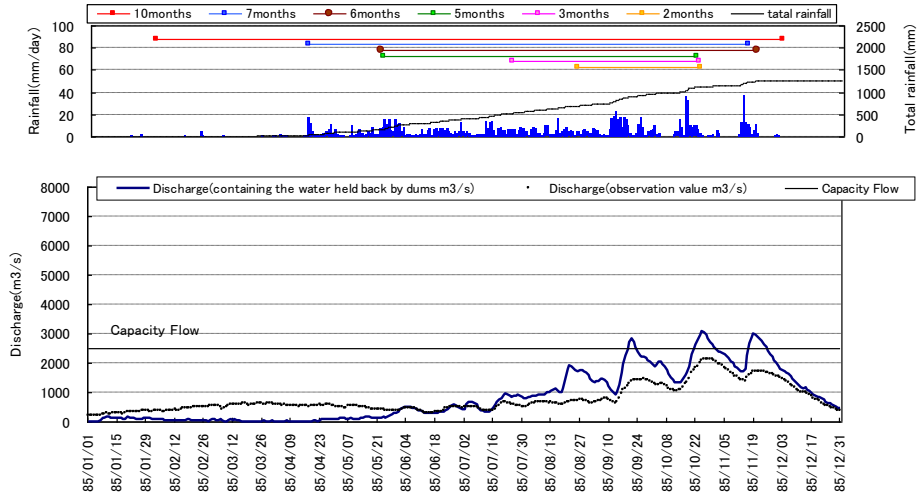


Figure C4.1.29 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1985）

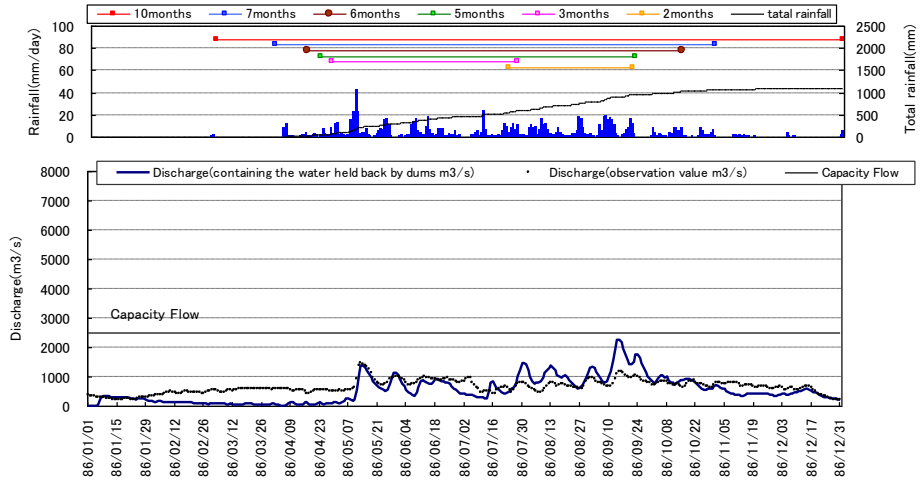


Figure C4.1.30 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1986）

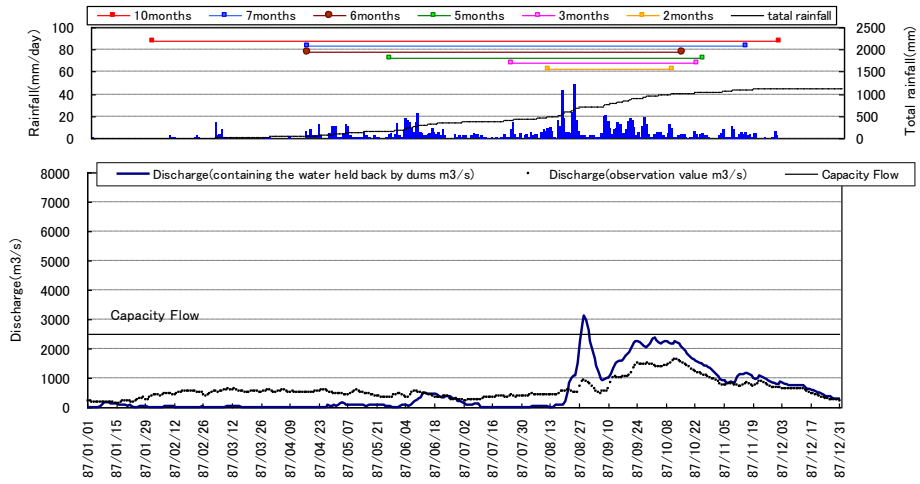


Figure C4.1.31 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1987）

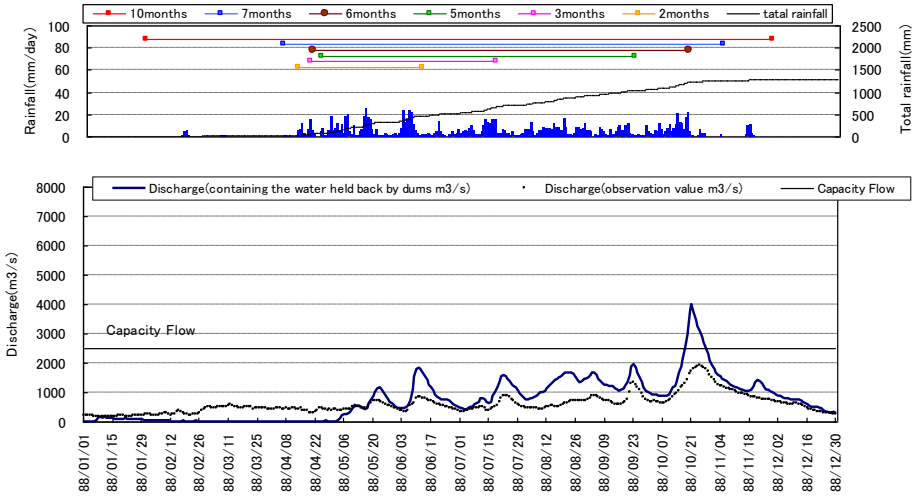


Figure C4.1.32 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1988）

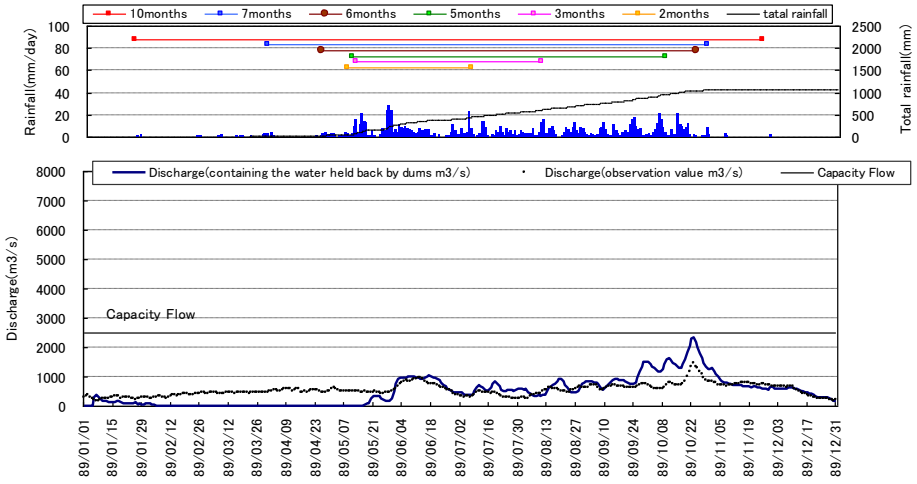


Figure C4.1.33 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1989）

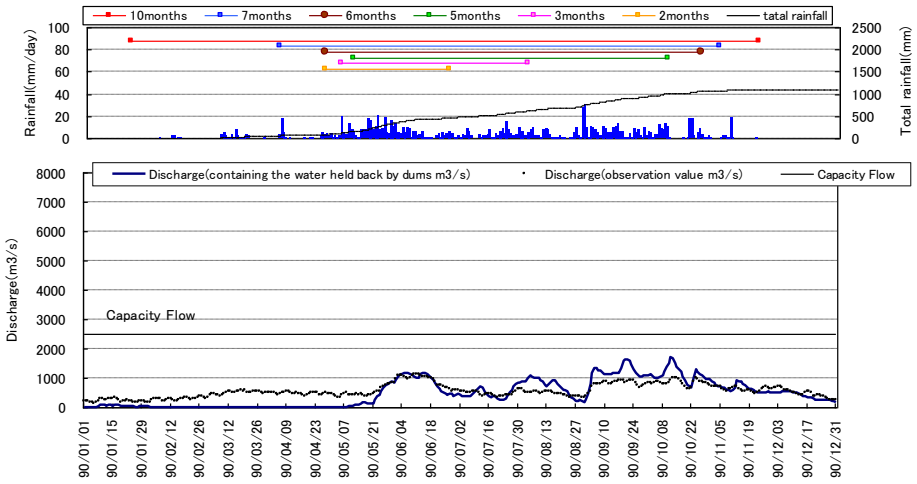


Figure C4.1.34 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1990）

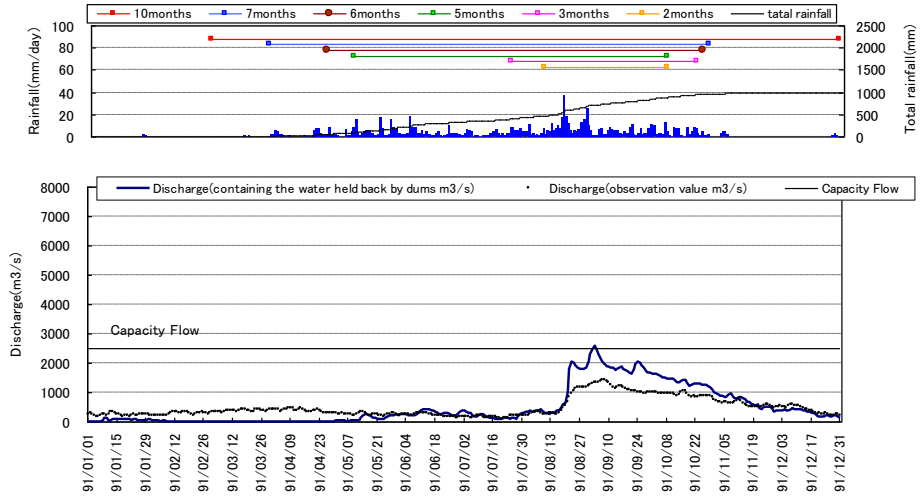


Figure C4.1.35 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1991）

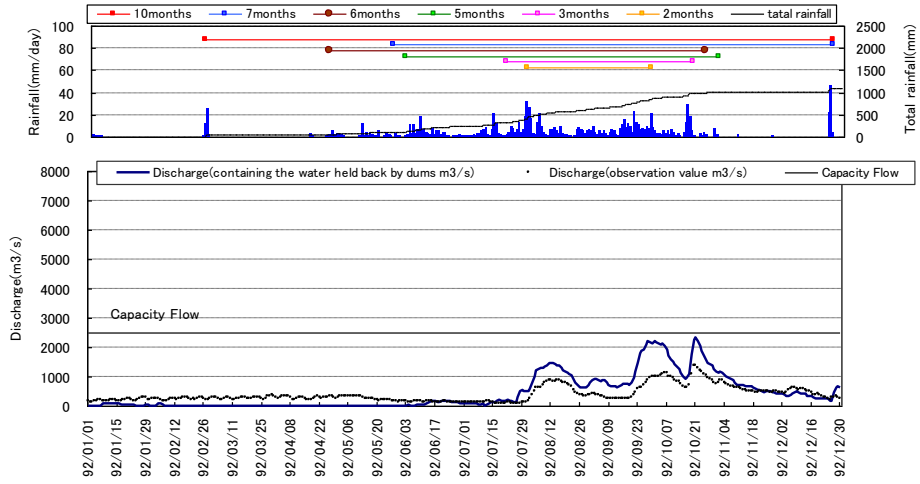


Figure C4.1.36 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1992）

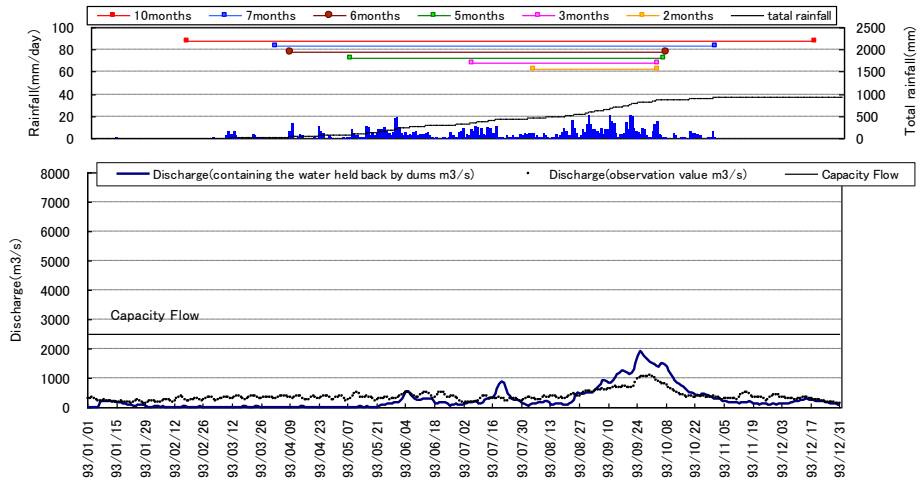


Figure C4.1.37 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1993）

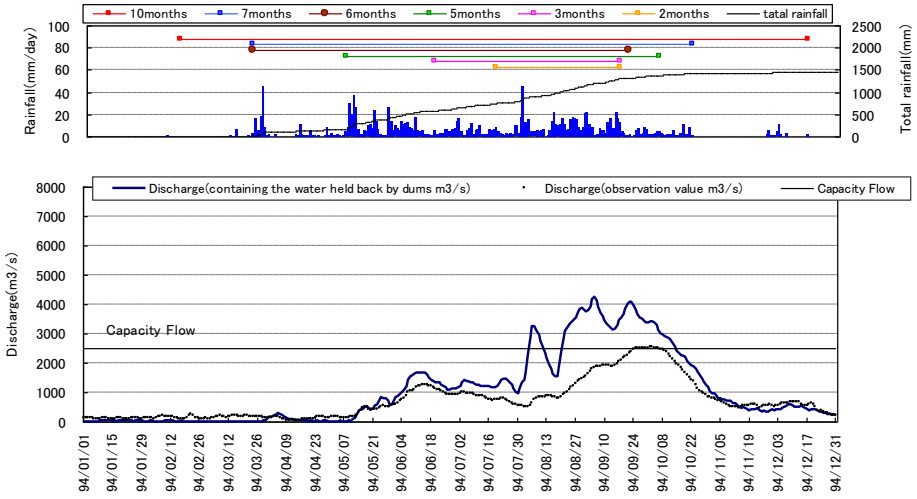


Figure C4.1.38 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1994）

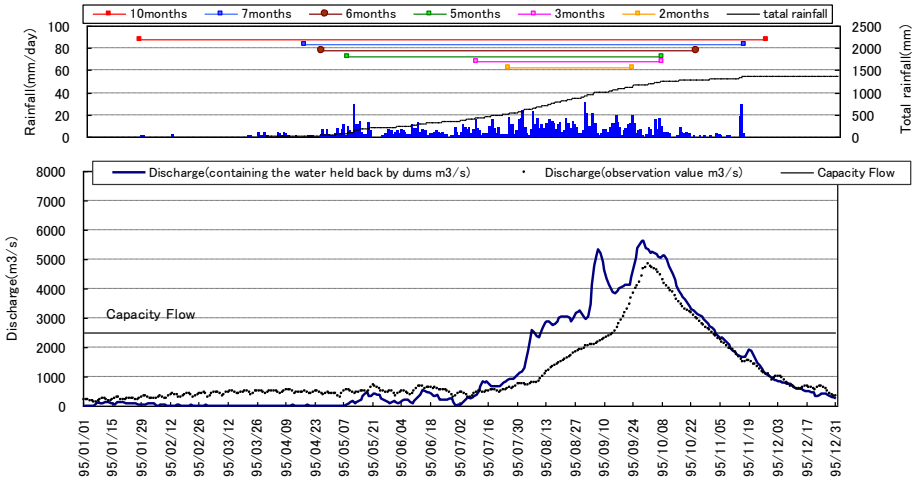


Figure C4.1.39 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1995）

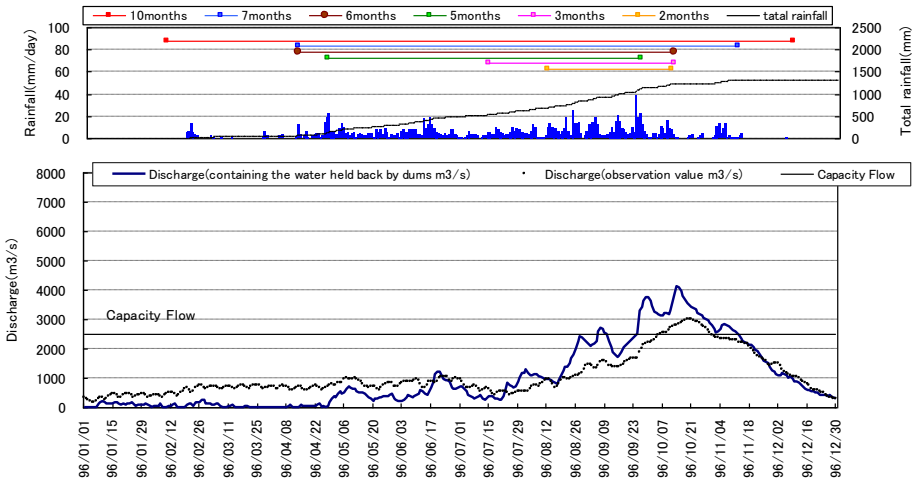


Figure C4.1.40 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1996）

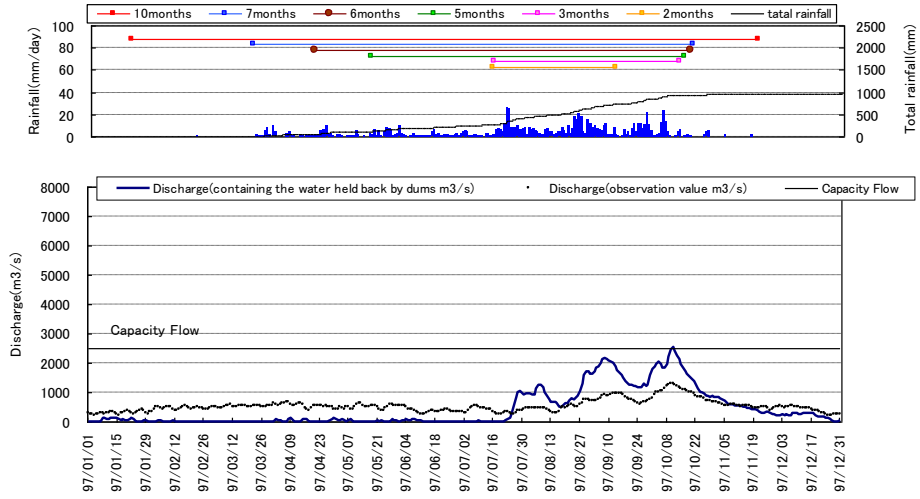


Figure C4.1.41 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1997）

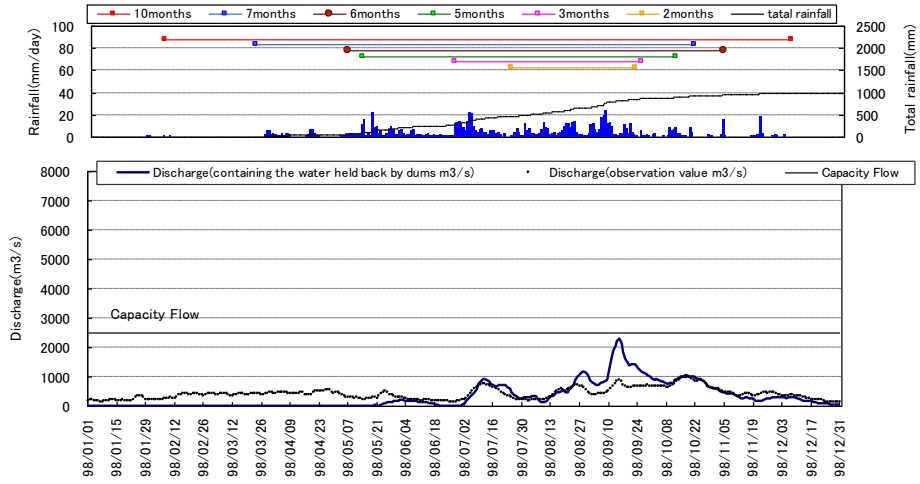


Figure C4.1.42 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1998）

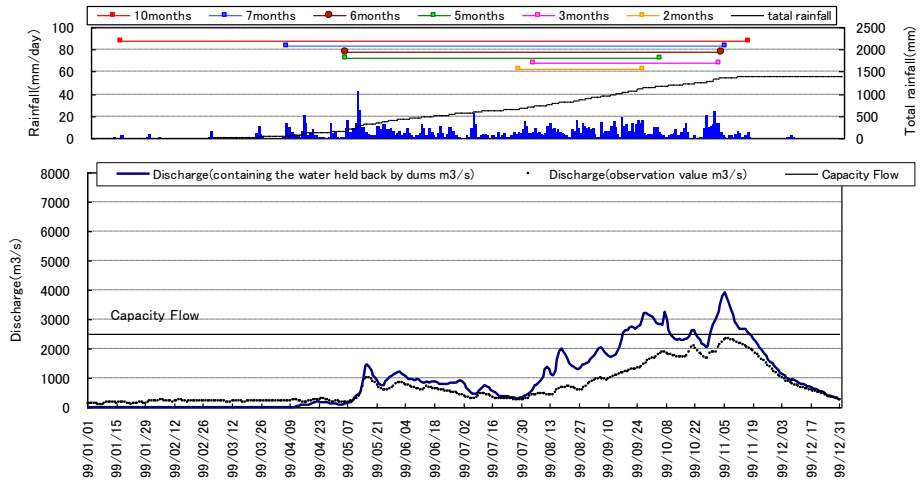


Figure C4.1.43 Hyeto- and Hydrographs at Nakhon Sawan（C.2,1999）

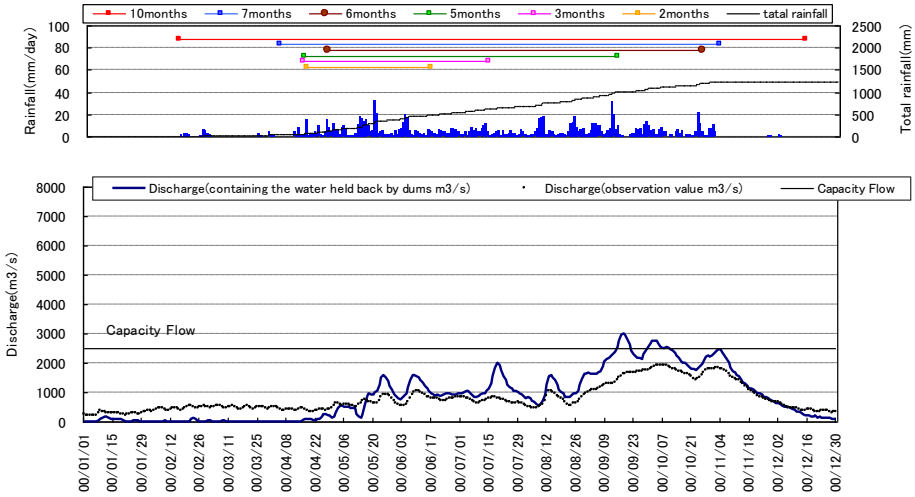


Figure C4.1.44 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2000）

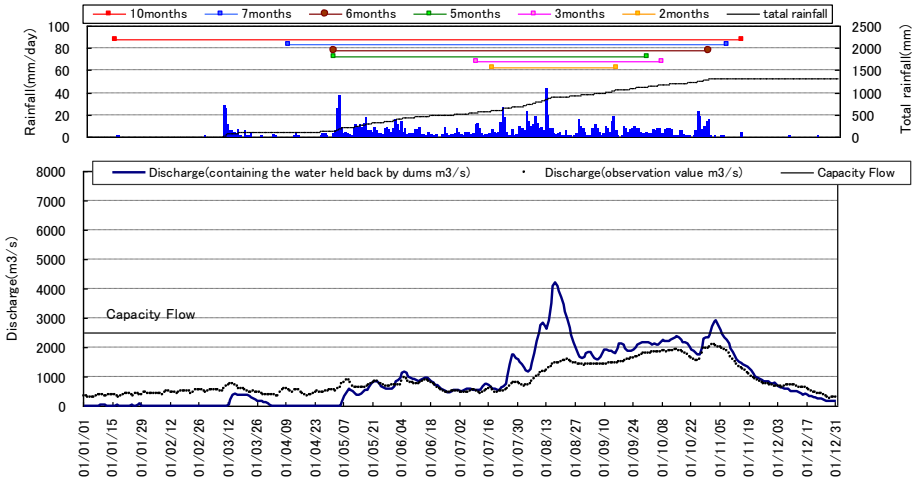


Figure C4.1.45 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2001）

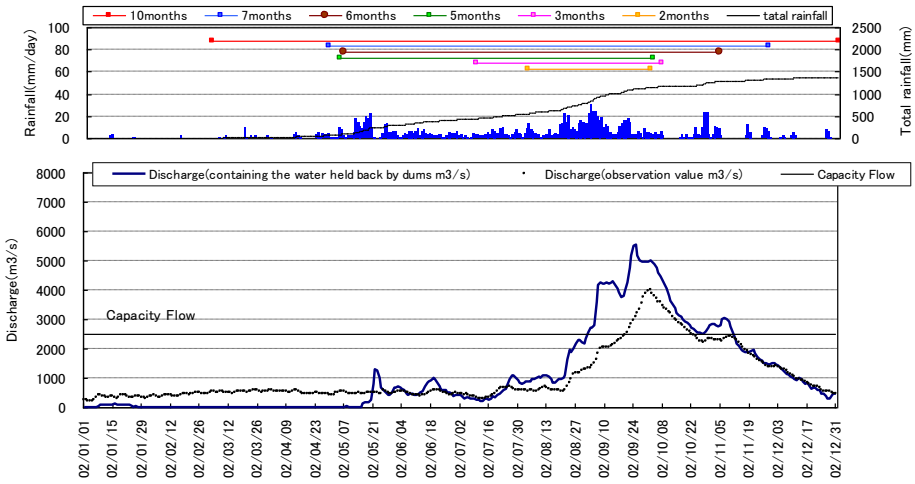


Figure C4.1.46 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2002）

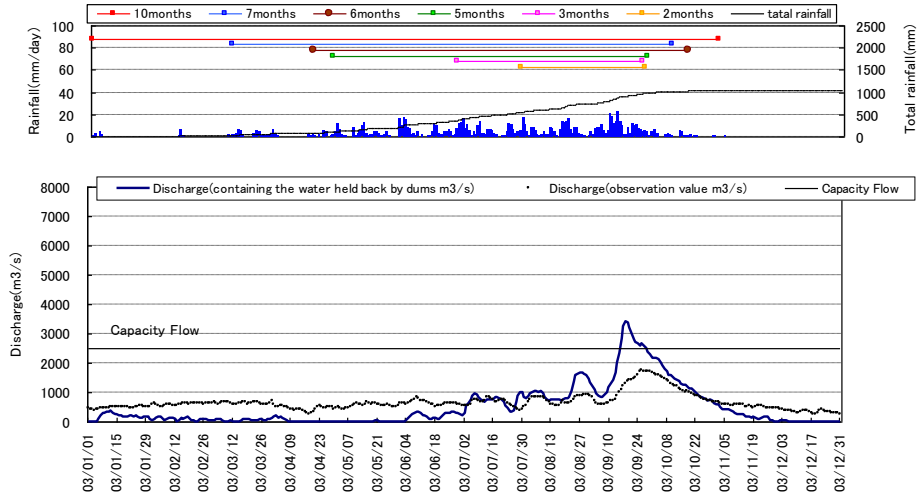


Figure C4.1.47 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2003）

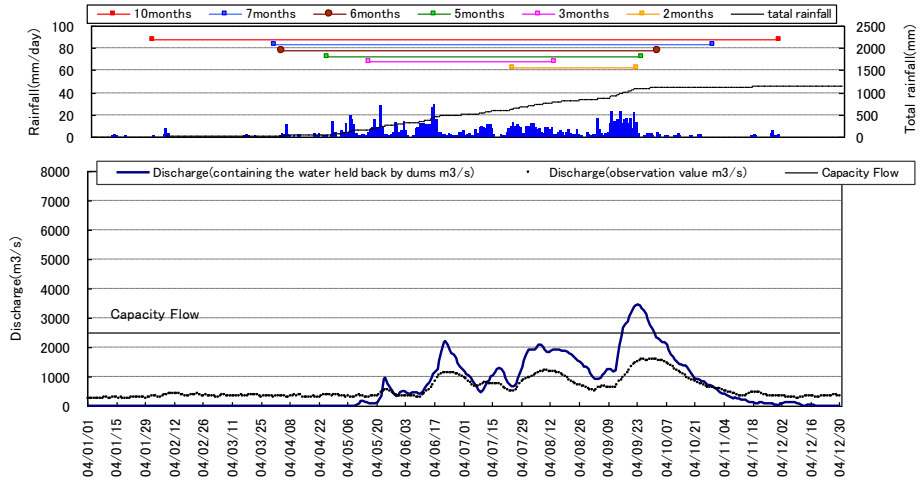


Figure C4.1.48 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2004）

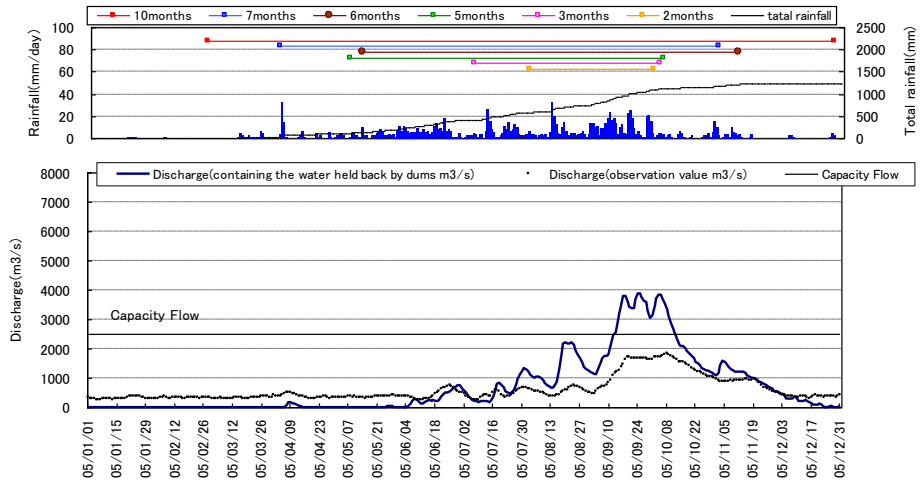


Figure C4.1.49 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2005）

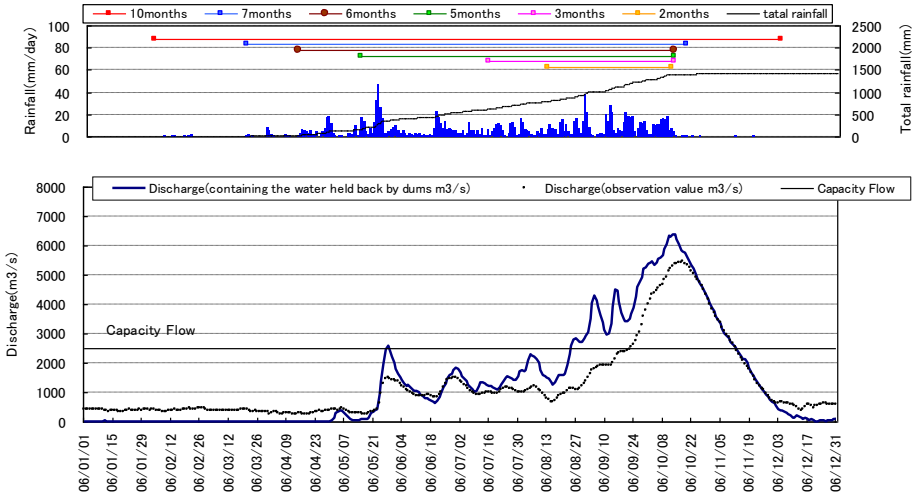


Figure C4.1.50 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2006）

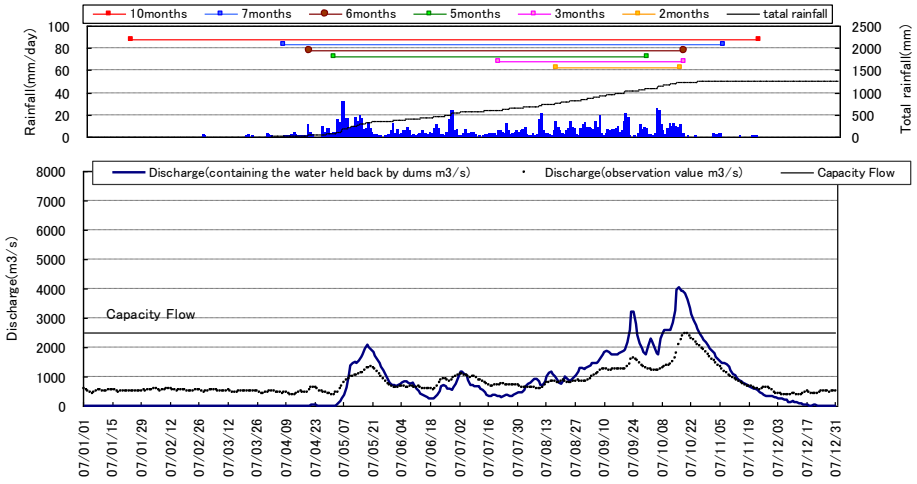


Figure C4.1.51 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2007）

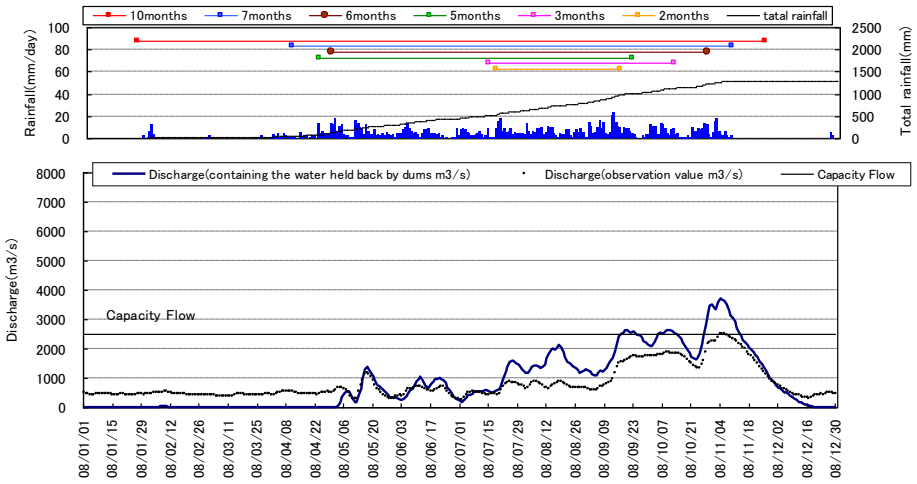


Figure C4.1.52 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2008）

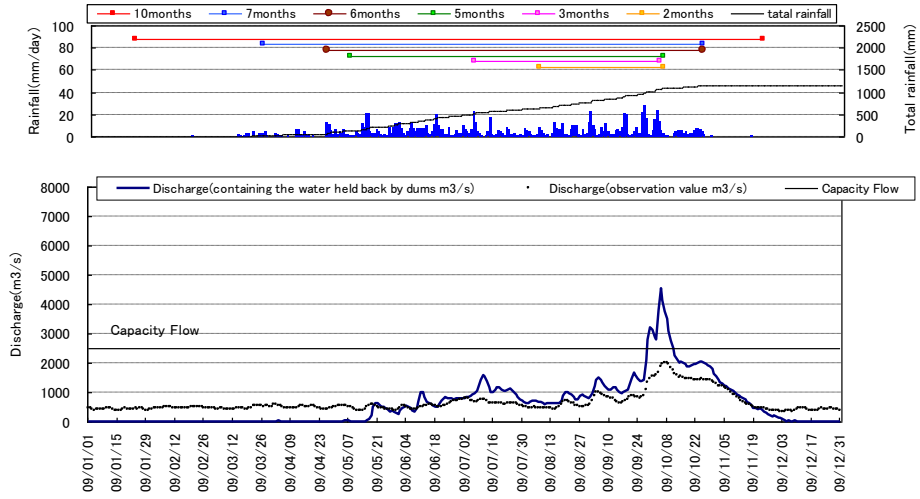


Figure C4.1.53 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2009）

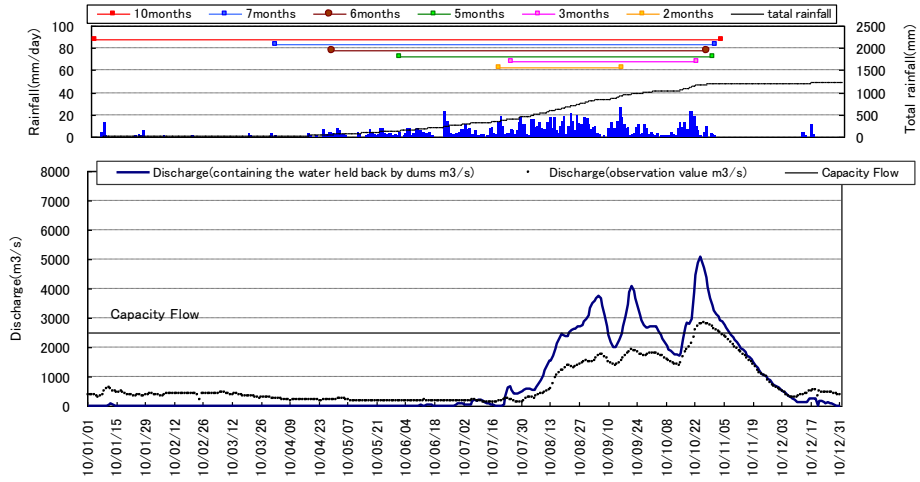


Figure C4.1.54 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2010）

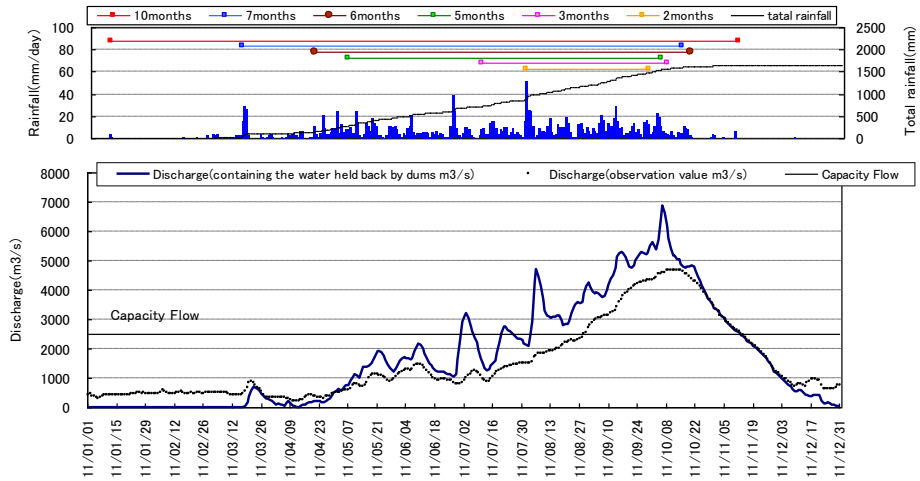


Figure C4.1.55 Hyeto- and Hydrographs at Nakhon Sawan（C.2,2011）

Table C4.1.3 6-Month Rainfalls of 3 Cases

Year	6-Month Rainfall (mm)					Proportion to ①			
	①Case 1	②Case 2	③Case 3 (2,500m3/s)	③Case 3 (3,000m3/s)	③Case 3 (3,500m3/s)	②/①	③/①	④/①	⑤/①
1961	1,208	1,157	1,162	1,127	1,113	0.96	0.96	0.93	0.92
1962	1,117	1,116	1,087	1,081	1,082	1.00	0.97	0.97	0.97
1963	1,235	1,075	1,075	1,075	1,088	0.87	0.87	0.87	0.88
1964	1,163	1,110	1,155	1,137	1,105	0.95	0.99	0.98	0.95
1965	979	806	804	804	804	0.82	0.82	0.82	0.82
1966	1,065	947	947	950	953	0.89	0.89	0.89	0.89
1967	974	969	969	974	959	0.99	0.99	1.00	0.98
1968	911	835	834	834	834	0.92	0.92	0.92	0.92
1969	1,055	967	974	1,011	1,010	0.92	0.92	0.96	0.96
1970	1,266	1,243	1,227	1,239	1,242	0.98	0.97	0.98	0.98
1971	1,144	923	917	947	978	0.81	0.80	0.83	0.85
1972	888	855	856	856	856	0.96	0.96	0.96	0.96
1973	1,207	1,071	1,118	1,162	1,169	0.89	0.93	0.96	0.97
1974	1,058	1,048	1,054	1,054	1,048	0.99	1.00	1.00	0.99
1975	1,254	1,102	1,230	1,232	1,219	0.88	0.98	0.98	0.97
1976	1,174	1,080	1,089	1,101	1,086	0.92	0.93	0.94	0.93
1977	948	908	908	917	911	0.96	0.96	0.97	0.96
1978	1,214	1,183	1,196	1,186	1,189	0.97	0.99	0.98	0.98
1979	949	907	906	906	906	0.96	0.96	0.96	0.96
1980	1,255	1,227	1,250	1,252	1,255	0.98	1.00	1.00	1.00
1981	1,083	585	586	587	594	0.54	0.54	0.54	0.55
1982	938	928	928	929	930	0.99	0.99	0.99	0.99
1983	1,099	1,061	1,062	1,063	1,069	0.96	0.97	0.97	0.97
1984	1,015	822	821	821	821	0.81	0.81	0.81	0.81
1985	1,093	1,063	1,067	1,057	1,044	0.97	0.98	0.97	0.96
1986	1,001	910	909	909	909	0.91	0.91	0.91	0.91
1987	975	697	696	697	700	0.71	0.71	0.71	0.72
1988	1,166	1,163	1,164	1,159	1,137	1.00	1.00	0.99	0.98
1989	1,024	1,024	1,023	1,023	1,023	1.00	1.00	1.00	1.00
1990	983	939	938	938	938	0.95	0.95	0.95	0.95
1991	906	711	710	710	711	0.78	0.78	0.78	0.78
1992	947	939	939	939	939	0.99	0.99	0.99	0.99
1993	842	789	781	781	781	0.94	0.93	0.93	0.93
1994	1,313	1,201	1,223	1,267	1,269	0.91	0.93	0.96	0.97
1995	1,262	1,171	1,257	1,246	1,232	0.93	1.00	0.99	0.98
1996	1,166	1,152	1,144	1,086	1,066	0.99	0.98	0.93	0.91
1997	884	873	872	872	873	0.99	0.99	0.99	0.99
1998	884	813	810	810	810	0.92	0.92	0.92	0.92
1999	1,196	1,168	1,158	1,108	1,071	0.98	0.97	0.93	0.90
2000	1,093	988	988	988	994	0.90	0.90	0.90	0.91
2001	1,185	902	908	915	917	0.76	0.77	0.77	0.77
2002	1,201	1,091	1,130	1,135	1,157	0.91	0.94	0.94	0.96
2003	947	875	867	887	915	0.92	0.91	0.94	0.97
2004	1,091	1,077	1,076	1,084	1,088	0.99	0.99	0.99	1.00
2005	1,085	1,011	1,054	1,046	1,046	0.93	0.97	0.96	0.96
2006	1,375	1,372	1,275	1,272	1,247	1.00	0.93	0.93	0.91
2007	1,214	1,212	1,199	1,199	1,190	1.00	0.99	0.99	0.98
2008	1,114	1,092	1,098	1,069	1,047	0.98	0.99	0.96	0.94
2009	1,090	1,047	1,047	1,047	1,045	0.96	0.96	0.96	0.96
2010	1,135	1,128	1,132	1,117	1,115	0.99	1.00	0.98	0.98
2011	1,483	1,454	1,413	1,345	1,297	0.98	0.95	0.91	0.87

C4.2 Estimation of Probable Rainfall

C4.2.1 Condition of Frequency Analysis

In order to assess the scale of the 2011 flood in terms of return period, frequency analysis of rainfall was conducted. Conditions of the analysis are summarized as shown in Table C4.2.1, and applied probability distribution models are listed in Table C4.2.2.

Table C4.2.1 Conditions of Frequency Analysis of Rainfall

Rainfall Data	Case3（TMD＋RID＋169）
Data Years	1961 to 2011（51years）
Number of Rainfall Station	410 stations at the maximum （different year to year）
Estimation of Basin Mean Rainfall	Thiessen Method
Thiessen Polygon Pattern	Annually fixed in principle. （However, if there are lacking rainfall data in three months from January to March, another Thiessen polygon pattern is created excluding the lacking stations.
Rainfall Duration	Eleven kinds of durations: 2weeks, 1, 2, 3, 4, 5, 6, 7, 8, 10 and 12 months Note: The maximum rainfall for each duration was calculated.

Table C4.2.2 Probability Distribution Model

NO	Probability Distribution Model	
1.	Exp	Exponential Distribution
2.	Gumbel	Gumbel Distribution
3.	SqrtEt	Square-root Exponential Type Maximum Distribution
4.	Gev	Extreme Value Distribution
5.	LP3Rs	Peason Type III Distribution (Real Space)
6.	LogP3	Peason Type III Distribution (Logarithmic Space)
7.	Iwai	Iwai Method
8.	IshiTaka	Ishihara･Tahase Method
9.	LN3Q	Log-normal Distribution (Quantile Method)
10.	LN3PM	Log-normal Distribution 3 (Slade II)
11.	LN2LM	Log-normal Distribution 2 (Slade I, L-moment method)
12.	LN2PM	Log-normal Distribution 2 (Slade I, Product moment method)

C4.2.2 Results of Frequency Analysis

Results of the frequency analysis for the Upper Basin upstream of Nakhon Sawan and the Entire Chao Phraya River Basin are presented in Figure C4.2.1 to Figure C4.2.4, Table C4.2.4 and Table C4.2.5. Used maximum 6-month rainfall data are also given in Table C4.2.6.

Based on the above results, the 2011 Flood is evaluated as summarized in Table C4.2.3. Namely the return period of the 6-month rainfall of the Upper Basin in 2011 is evaluated at about 50 to 350 years if those of models of which SLSCs (Standard Least-Square Criterion) are equal to or less than 0.04 are applied. If LN2PM (Log-normal Distribution 2 (Slade I, Product moment method) that gives the smallest SLSC of 0.028 is applied, the return period is evaluated at 141 years. For the Entire Chao Phraya River Basin, the return period is evaluated at about 90 to 210 years if models of SLSCs ≤ 0.04 are applied.

Table C4.2.3 Evaluation of Scale of 2011 Flood

Rainfall Duration	Upper Basin upstream of Nakhon Sawan			Entire Chao Phraya River Basin		
	Range of probability	Minimum SLSC		Range of probability	Minimum SLSC	
	SLSC ≤ 0.04	Probability	Model	SLSC ≤ 0.04	Probability	Model
6 months	1/53 to 1/345	1/141	LN2PM	1/90 to 1/207	1/100	LN2PM

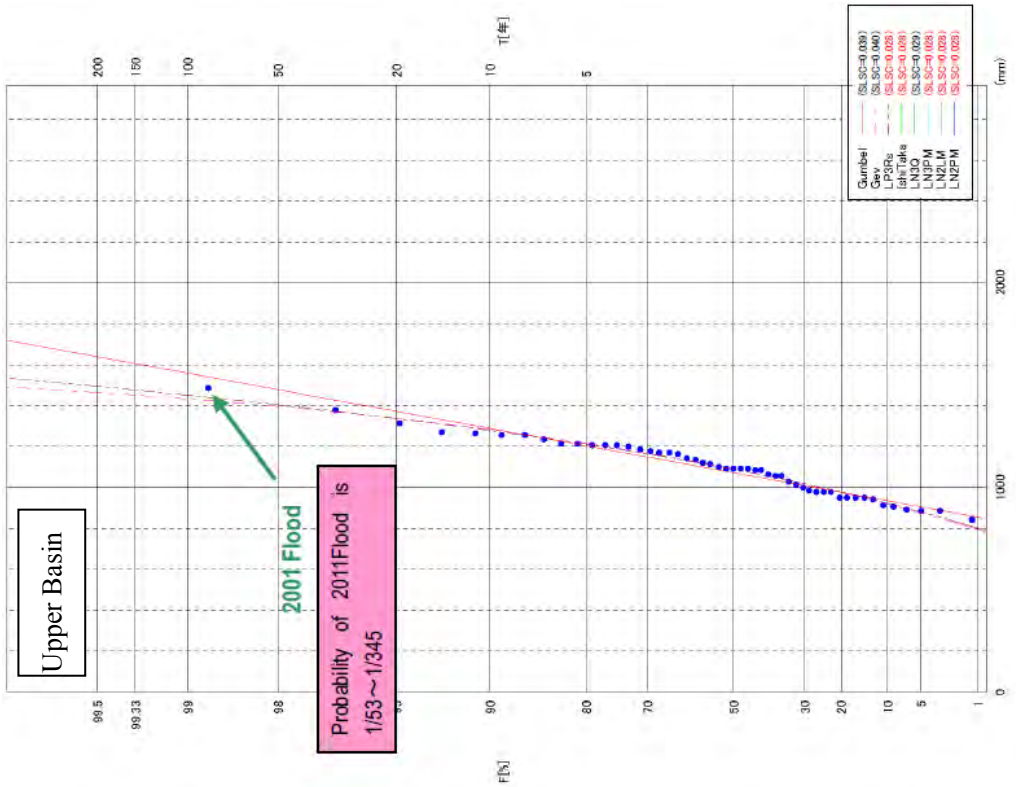


Figure C4.2.1 Probability Distribution on Gumbel Probability Paper (Upper Basin, 6-Month rainfall)

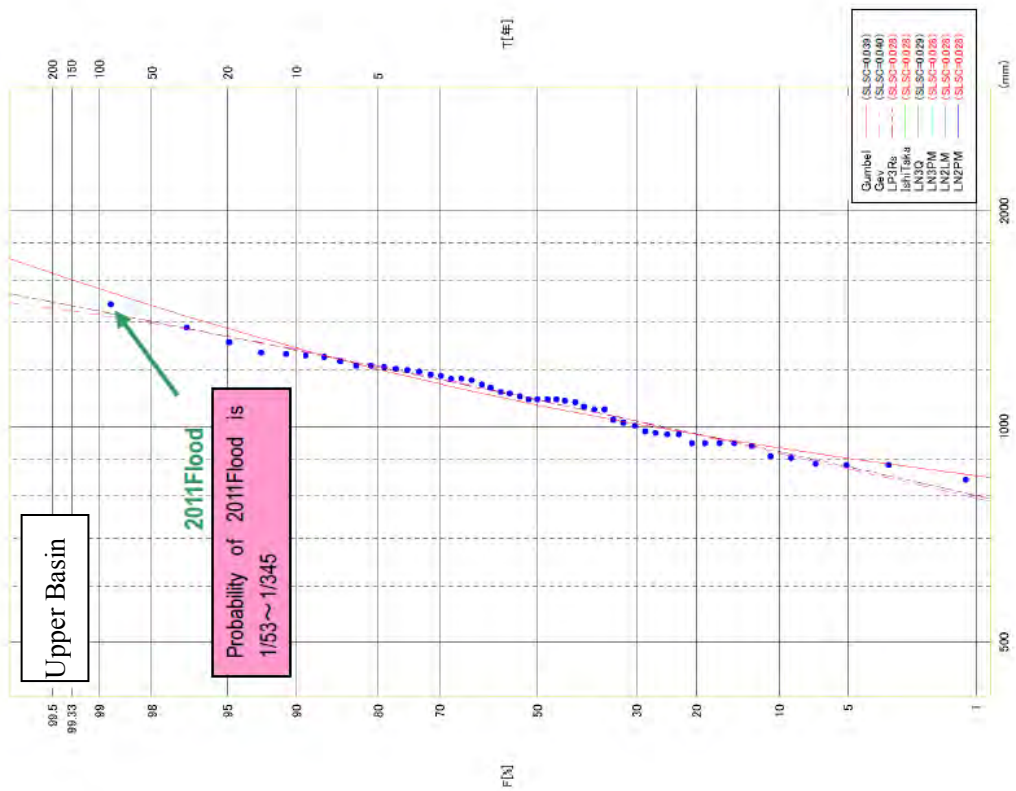


Figure C4.2.2 Probability Distribution on Log-normal Probability Paper (Upper Basin, 6-Month rainfall)

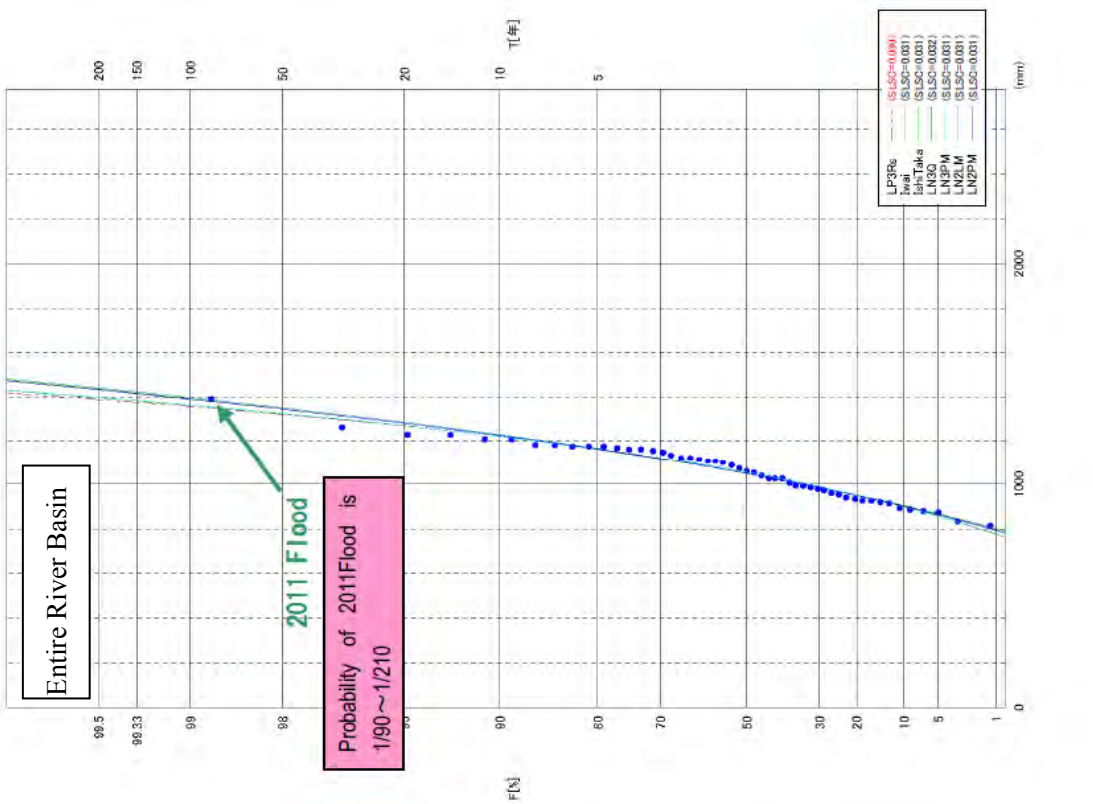


Figure C4.2.3 Probability Distribution on Gumbel Probability Paper (Entire Chao Phraya River Basin)

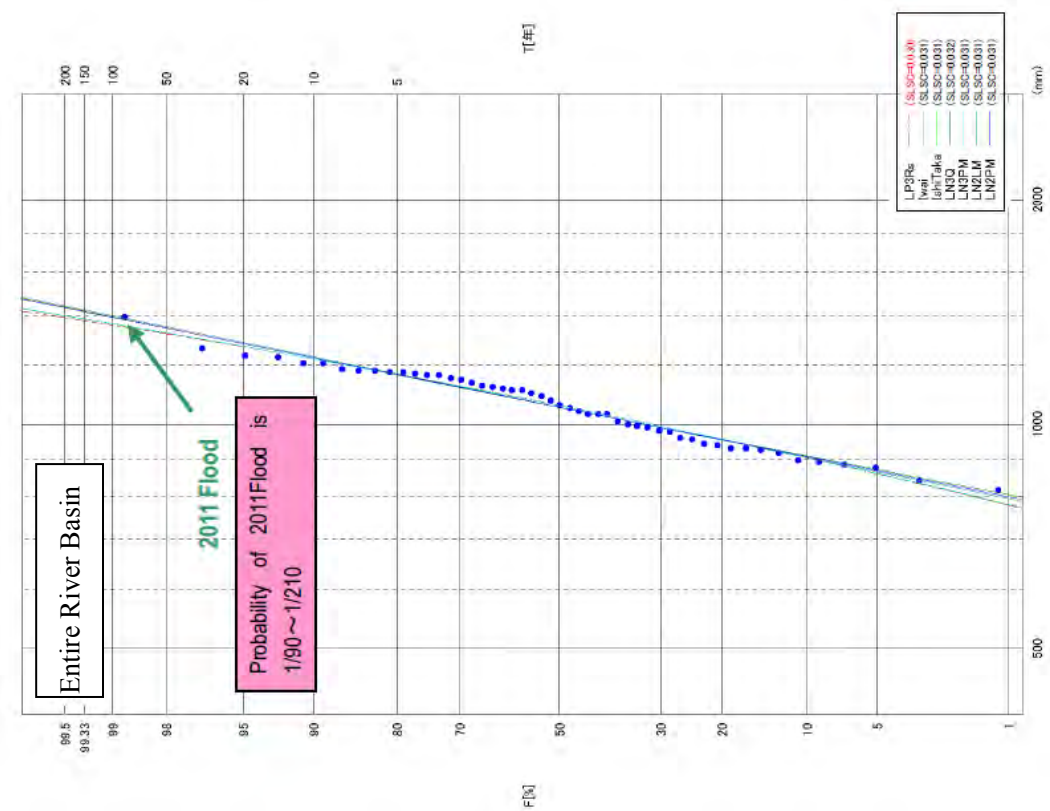


Figure C4.2.4 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin)

Table C4.2.4 Results of Frequency Analysis for Upper Basin

	annual rainfall series (size N=51)											
	exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.936	0.981	0.974	0.991	0.992	—	—	0.992	0.991	0.992	0.992	0.992
P-COR(99%)	0.920	0.986	0.986	0.995	0.994	—	—	0.994	0.992	0.994	0.994	0.994
SLSC(99%)	0.072	0.039	0.048	0.040	0.028	—	—	0.028	0.029	0.028	0.028	0.028
log likelihood	-309.500	-324.300	-324.700	-323.200	—	—	—	-323.100	-323.100	-323.100	-323.100	-323.100
pAIC	622.900	652.700	653.500	652.400	0.000	—	—	652.200	652.200	652.200	650.200	650.200
X-COR(50%)	0.983	0.986	0.986	0.976	0.981	—	—	0.982	0.984	0.982	0.982	0.982
P-COR(50%)	0.980	0.982	0.982	0.988	0.987	—	—	0.986	0.985	0.986	0.986	0.986
SLSC(50%)	0.098	0.066	0.089	0.077	0.048	—	—	0.048	0.053	0.048	0.048	0.048

	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	2	1,046	1,071	1,069	1,090	1,089	—	—	1,087	1,082	1,087	1,087	1,087
	3	1,111	1,133	1,137	1,153	1,150	—	—	1,148	1,143	1,148	1,149	1,148
	5	1,192	1,201	1,214	1,215	1,210	—	—	1,209	1,207	1,209	1,211	1,209
	10	1,302	1,287	1,315	1,282	1,277	—	—	1,278	1,281	1,277	1,282	1,278
	20	1,412	1,369	1,415	1,336	1,335	—	—	1,337	1,347	1,337	1,344	1,339
	30	1,477	1,417	1,474	1,363	1,366	—	—	1,369	1,384	1,368	1,377	1,371
	50	1,558	1,476	1,550	1,394	1,402	—	—	1,407	1,428	1,406	1,416	1,410
	80	1,633	1,531	1,620	1,420	1,434	—	—	1,440	1,467	1,439	1,451	1,444
	100	1,668	1,556	1,654	1,431	1,448	—	—	1,455	1,485	1,454	1,467	1,459
	120	1,697	1,577	1,682	1,439	1,460	—	—	1,467	1,500	1,467	1,480	1,472
	140	1,721	1,595	1,706	1,446	1,470	—	—	1,477	1,512	1,477	1,491	1,482
	150	1,732	1,603	1,717	1,449	1,474	—	—	1,482	1,518	1,481	1,495	1,487
	160	1,743	1,610	1,727	1,452	1,478	—	—	1,486	1,523	1,485	1,500	1,491
	180	1,761	1,624	1,745	1,457	1,485	—	—	1,494	1,532	1,493	1,508	1,499
	200	1,778	1,636	1,762	1,462	1,492	—	—	1,501	1,540	1,500	1,515	1,506
	300	1,843	1,683	1,826	1,477	1,516	—	—	1,526	1,572	1,525	1,542	1,533
	400	1,888	1,716	1,873	1,488	1,533	—	—	1,544	1,594	1,543	1,561	1,551
	600	1,953	1,762	1,939	1,501	1,556	—	—	1,569	1,625	1,568	1,587	1,577
2011Flood	1,483	—	1/53	—	1/345	1/173	—	—	1/153	1/98	1/154	1/126	1/141
1995Flood	1,262	—	1/21	—	1/49	1/38	—	—	1/36	1/25	1/36	1/31	1/34
2002Flood	1,166	—	1/16	—	1/36	1/28	—	—	1/27	1/19	1/27	1/24	1/26
2005Flood	1,201	—	1/18	—	1/40	1/31	—	—	1/30	1/21	1/30	1/26	1/29
2006Flood	1,375	—	1/30	—	1/87	1/63	—	—	1/59	1/40	1/59	1/51	1/56

flood scale occurred in 2011
less than 0.04(SLSC)
minimum value(SLSC)

Jackknife	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
estimate standard errors	2	19	19	20	24	22	—	—	22	18	22	19	19
	3	20	21	23	24	22	—	—	22	19	22	21	21
	5	23	24	27	25	24	—	—	25	24	25	24	24
	10	30	29	35	30	31	—	—	31	36	31	29	29
	20	39	35	43	41	42	—	—	42	52	41	34	34
	30	44	39	48	49	49	—	—	49	63	48	37	37
	50	51	44	55	59	59	—	—	58	78	58	41	41
	80	58	49	61	70	69	—	—	68	92	67	44	44
	100	61	51	64	75	74	—	—	72	99	72	46	46
	120	63	53	67	79	78	—	—	76	105	75	47	47
	140	66	54	69	83	81	—	—	79	110	79	48	48
	150	67	55	70	84	83	—	—	81	112	80	49	49
	160	67	56	71	86	84	—	—	82	114	81	49	49
	180	69	57	73	88	87	—	—	85	118	84	50	50
	200	71	58	75	91	90	—	—	87	122	86	51	51
	300	76	62	81	100	99	—	—	96	136	95	54	53
	400	81	65	86	106	106	—	—	103	146	101	56	56
	600	87	69	92	115	116	—	—	112	161	110	59	58

Table C4.2.5 Results of Frequency Analysis for Entire Chao Phraya River Basin

	annual rainfall series (size N=51)											
	exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.913	0.968	0.959	0.989	0.990	—	0.989	0.989	0.987	0.989	0.988	0.988
P-COR(99%)	0.903	0.985	0.986	0.994	0.993	—	0.992	0.992	0.991	0.992	0.992	0.991
SLSC(99%)	0.084	0.050	0.058	0.060	0.030	—	0.031	0.031	0.032	0.031	0.031	0.031
log likelihood	-304.500	-320.600	-320.800	-318.400	-318.100	—	-318.200	-318.200	-318.300	-318.200	-318.300	-318.300
pAIC	613.000	645.100	645.600	642.800	642.300	—	642.400	642.400	642.700	642.400	640.700	640.600
X-COR(50%)	0.971	0.974	0.975	0.960	0.968	—	0.969	0.969	0.972	0.969	0.971	0.971
P-COR(50%)	0.971	0.973	0.974	0.983	0.981	—	0.981	0.981	0.978	0.981	0.979	0.979
SLSC(50%)	0.122	0.095	0.116	0.119	0.070	—	0.070	0.070	0.078	0.070	0.076	0.076

	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	2	1,017	1,039	1,038	1,061	1,060	—	1,059	1,058	1,053	1,059	1,054	1,054
	3	1,075	1,095	1,101	1,118	1,114	—	1,113	1,113	1,108	1,113	1,110	1,109
	5	1,149	1,157	1,174	1,172	1,167	—	1,166	1,166	1,163	1,166	1,167	1,165
	10	1,249	1,235	1,268	1,227	1,223	—	1,223	1,223	1,226	1,223	1,231	1,227
	20	1,348	1,310	1,361	1,270	1,270	—	1,271	1,271	1,281	1,271	1,286	1,282
	30	1,407	1,353	1,416	1,291	1,294	—	1,296	1,297	1,311	1,297	1,316	1,311
	50	1,480	1,406	1,486	1,313	1,322	—	1,326	1,327	1,346	1,326	1,352	1,346
	80	1,548	1,456	1,552	1,331	1,346	—	1,351	1,352	1,377	1,352	1,383	1,376
	100	1,580	1,479	1,584	1,339	1,357	—	1,362	1,364	1,392	1,364	1,397	1,390
	120	1,607	1,498	1,610	1,345	1,366	—	1,372	1,373	1,403	1,373	1,409	1,401
	140	1,629	1,514	1,632	1,350	1,373	—	1,379	1,381	1,413	1,381	1,418	1,411
	150	1,639	1,521	1,642	1,352	1,376	—	1,383	1,384	1,417	1,384	1,423	1,415
	160	1,648	1,528	1,651	1,354	1,379	—	1,386	1,387	1,421	1,387	1,427	1,419
	180	1,665	1,540	1,669	1,357	1,384	—	1,392	1,393	1,428	1,393	1,434	1,426
	200	1,680	1,551	1,684	1,360	1,389	—	1,397	1,398	1,435	1,398	1,440	1,432
	300	1,739	1,594	1,744	1,370	1,406	—	1,415	1,417	1,459	1,417	1,464	1,455
	400	1,780	1,623	1,787	1,377	1,418	—	1,428	1,431	1,476	1,430	1,481	1,472
	600	1,838	1,666	1,848	1,385	1,434	—	1,446	1,449	1,499	1,448	1,504	1,494
2011Flood	1,390	—	—	—	—	1/207	—	1/176	1/170	1/98	1/171	1/90	1/101
1995Flood	1,230	—	—	—	—	1/50	—	1/40	1/40	1/27	1/40	1/26	1/30
2002Flood	1,116	—	—	—	—	1/33	—	1/26	1/26	1/18	1/26	1/17	1/20
2005Flood	1,110	—	—	—	—	1/32	—	1/26	1/26	1/17	1/25	1/17	1/20
2006Flood	1,266	—	—	—	—	1/60	—	1/48	1/49	1/32	1/48	1/31	1/36

flood scale occurred in 2011
less than 0.04(SLSC)
minimum value(SLSC)

Jackknife	return	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	iwai※	ishitaka※	LN3Q※	LN3PM	LN2LM	LN2PM
estimate	2	18	18	18	23	20	-	-	-	-	22	18	18
standard	3	18	18	21	22	20	-	-	-	-	22	18	19
errors	5	19	20	25	21	21	-	-	-	-	22	20	21
	10	24	23	32	24	25	-	-	-	-	22	24	24
	20	31	28	40	31	33	-	-	-	-	22	27	28
	30	35	31	45	37	39	-	-	-	-	23	30	30
	50	40	35	51	45	47	-	-	-	-	24	33	33
	80	46	39	58	53	54	-	-	-	-	26	35	36
	100	48	40	61	57	58	-	-	-	-	27	37	37
	120	50	42	63	60	61	-	-	-	-	28	38	38
	140	52	43	65	62	64	-	-	-	-	29	39	39
	150	53	44	66	63	65	-	-	-	-	30	39	40
	160	54	44	67	64	66	-	-	-	-	30	39	40
	180	55	45	69	66	68	-	-	-	-	31	40	41
	200	56	46	71	68	70	-	-	-	-	32	41	41
	300	61	49	77	74	77	-	-	-	-	34	43	44
	400	64	52	81	79	83	-	-	-	-	37	45	45
	600	69	55	88	84	90	-	-	-	-	40	47	47

Table C4.2.6 Maximum 6-Month Rainfalls for Upper Basin and Entire Chao Phraya River Basin

Year	Upper Basin		Entire Chao Phraya River Basin	
	Starting date; Month/day	Max. 6-Month Rainfall	Starting date; Month/day	Max. 6-Month Rainfall
1961	4/25	1,208	4/25	1,135
1962	4/18	1,117	4/18	1,124
1963	5/16	1,235	5/16	1,209
1964	4/26	1,163	4/28	1,186
1965	5/2	979	5/5	991
1966	5/3	1,065	5/3	1,113
1967	4/12	974	4/12	943
1968	4/18	911	4/18	891
1969	5/6	1,055	5/6	1,040
1970	5/2	1,266	5/2	1,232
1971	5/1	1,144	4/30	1,076
1972	5/12	888	5/28	930
1973	4/28	1,207	4/28	1,101
1974	5/8	1,058	5/8	1,061
1975	5/1	1,254	5/1	1,166
1976	4/28	1,174	4/28	1,150
1977	5/3	948	4/18	876
1978	4/12	1,214	4/12	1,179
1979	4/10	949	4/10	893
1980	5/2	1,255	4/26	1,207
1981	4/25	1,083	4/19	1,030
1982	4/14	938	4/14	915
1983	5/20	1,099	5/19	1,163
1984	4/23	1,015	4/21	960
1985	5/21	1,093	4/24	1,031
1986	4/15	1,001	4/15	975
1987	4/15	975	4/15	929
1988	4/19	1,166	4/27	1,177
1989	4/24	1,024	4/24	980
1990	4/26	983	4/26	995
1991	4/25	906	4/25	882
1992	4/25	947	5/2	954
1993	4/7	842	4/6	817
1994	3/22	1,313	3/20	1,168
1995	4/24	1,262	4/24	1,230
1996	4/12	1,166	4/12	1,116
1997	4/19	884	4/21	838
1998	5/5	884	5/5	926
1999	5/4	1,196	5/4	1,176
2000	4/26	1,093	4/10	1,053
2001	4/30	1,185	4/30	1,092
2002	5/5	1,201	5/3	1,110
2003	4/18	947	4/18	938
2004	4/2	1,091	4/3	1,007
2005	5/12	1,085	5/12	999
2006	4/13	1,375	4/14	1,266
2007	4/18	1,214	4/18	1,154
2008	4/28	1,114	5/10	1,122
2009	4/25	1,090	4/25	1,031
2010	4/27	1,135	4/27	1,180
2011	4/19	1,483	4/19	1,390

Unit: (mm)

Results of the frequency analysis for the Upper Basin upstream of Nakhon Sawan and the Entire Chao Phraya River Basin are presented in Figure C4.2.5 to Figure C4.2.26. And, rainfall duration is set to be eleven kinds of durations as shown below.

- 2weeks
- 1month
- 2months
- 3months
- 4months
- 5months
- 6months
- 7months
- 8months
- 10months
- 12months

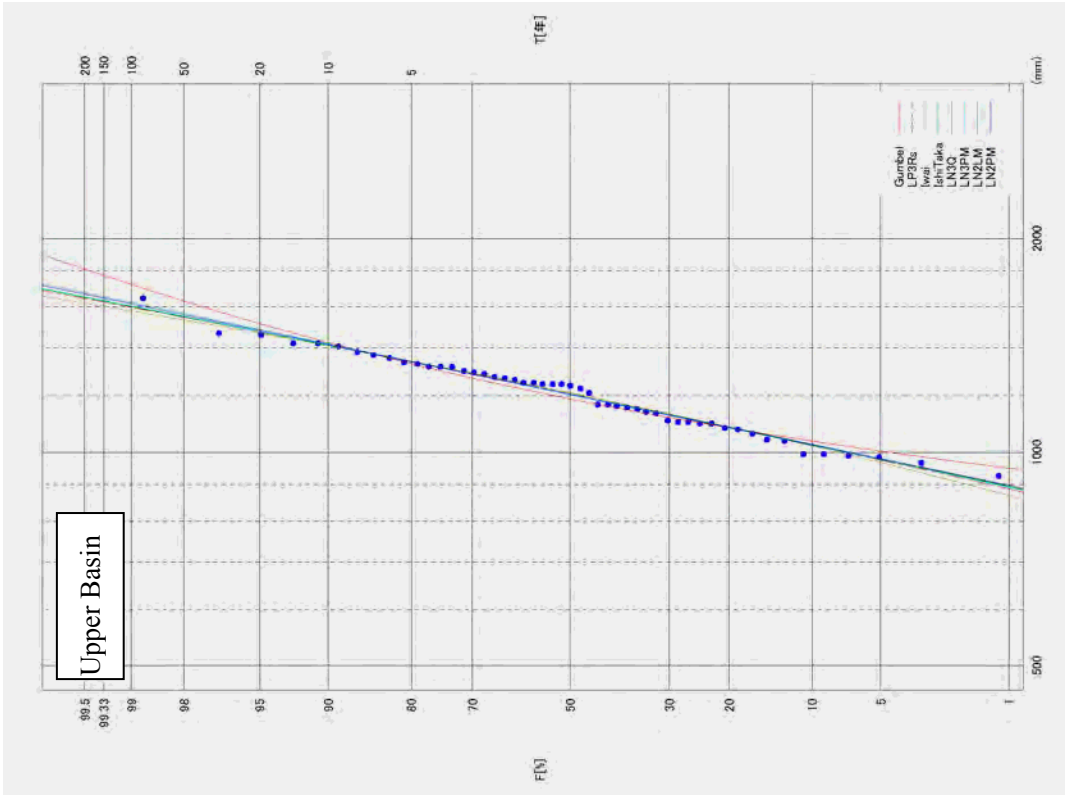


Figure C4.2.5 Probability Distribution on Log-normal Probability Paper (Upper Basin, 12-Month rainfall)

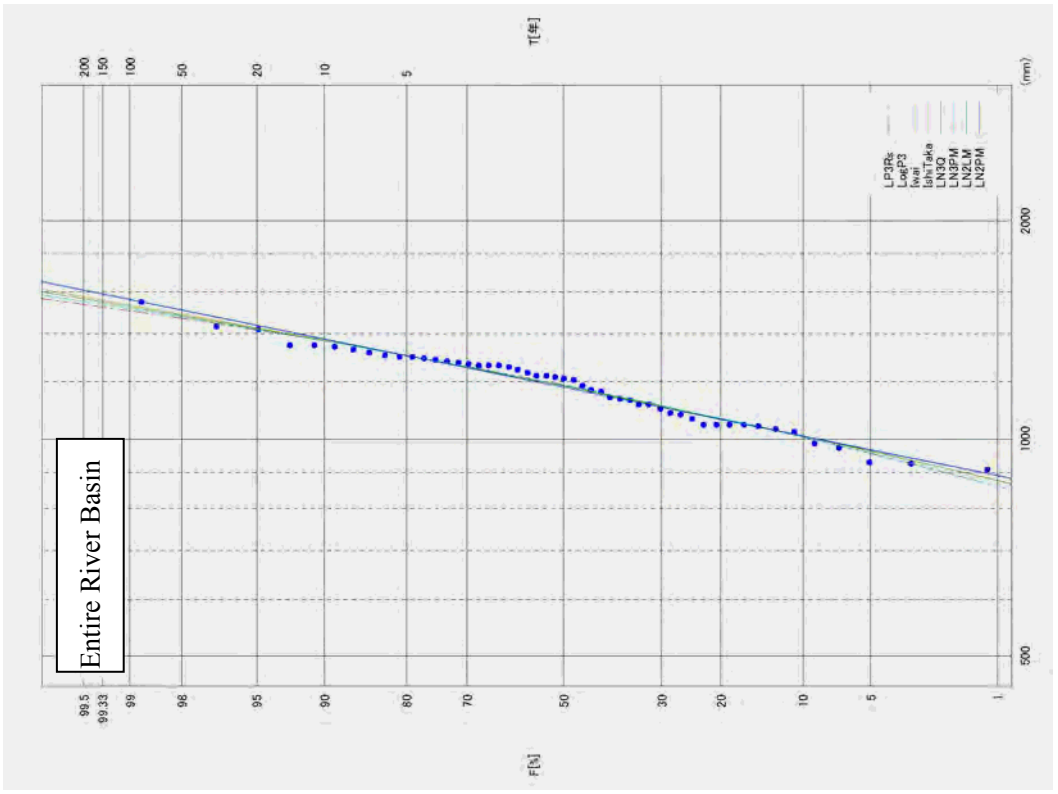


Figure C4.2.6 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 12-Month rainfall)

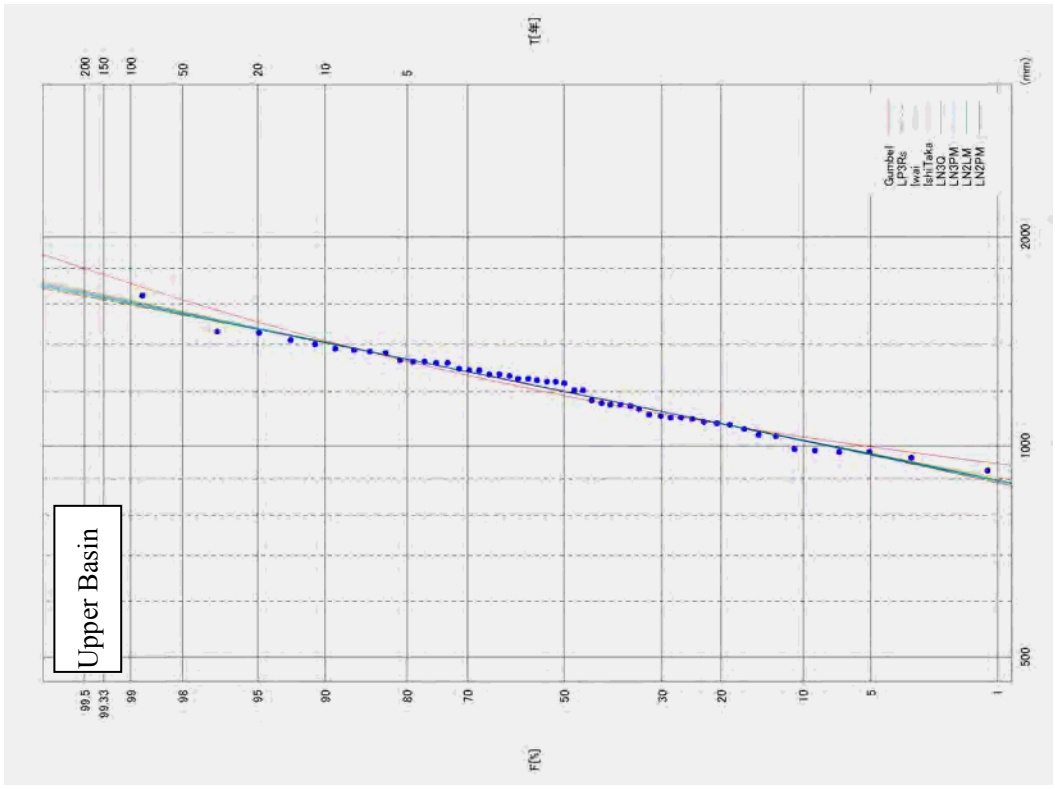


Figure C4.2.7 Probability Distribution on Log-normal Probability Paper (Upper Basin, 10-Month rainfall)

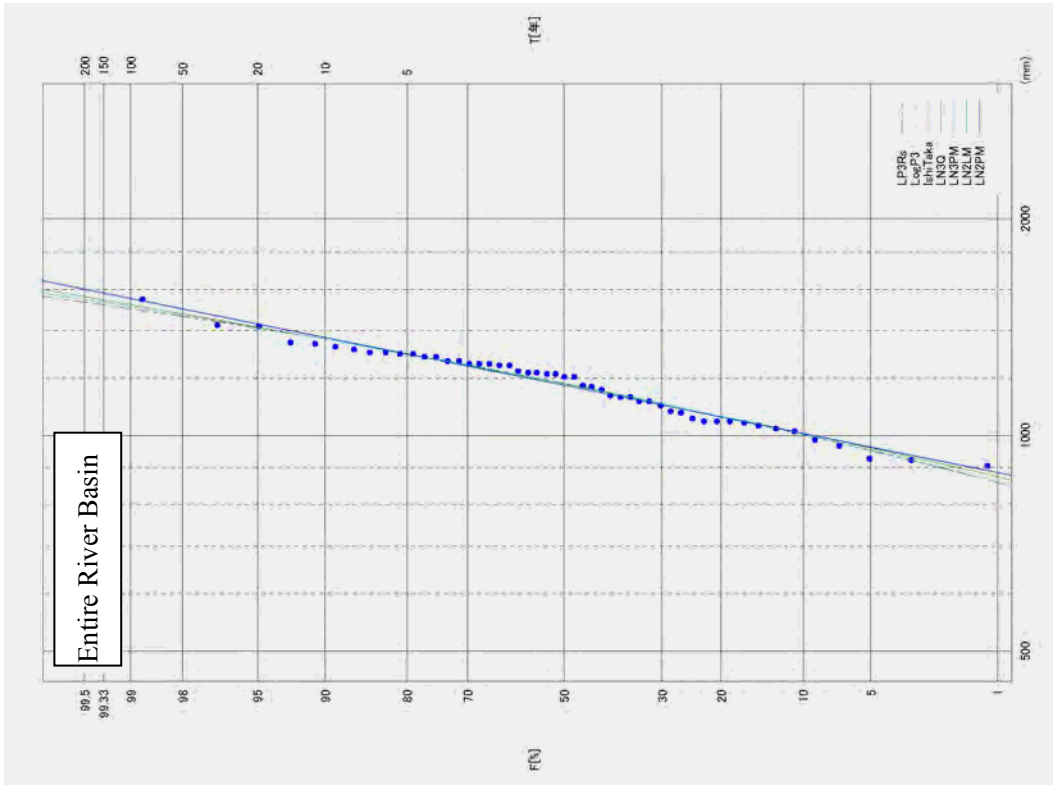


Figure C4.2.8 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 10-Month rainfall)

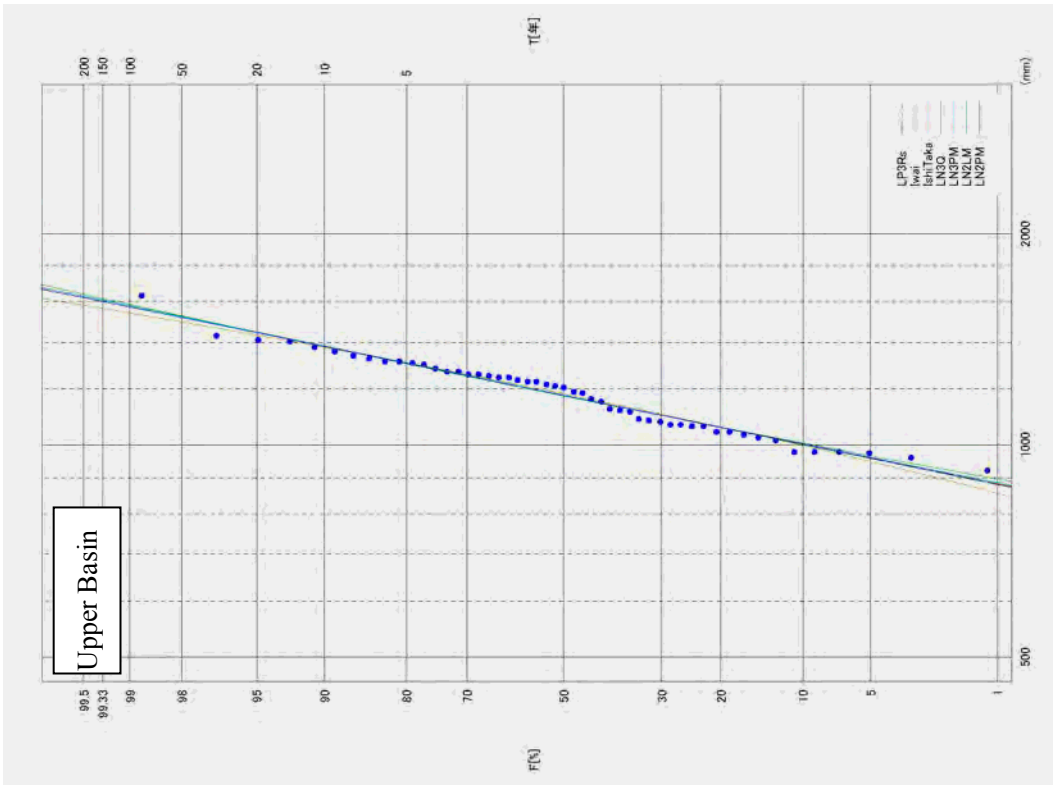


Figure C4.2.9 Probability Distribution on Log-normal Probability Paper (Upper Basin, 8-Month rainfall)

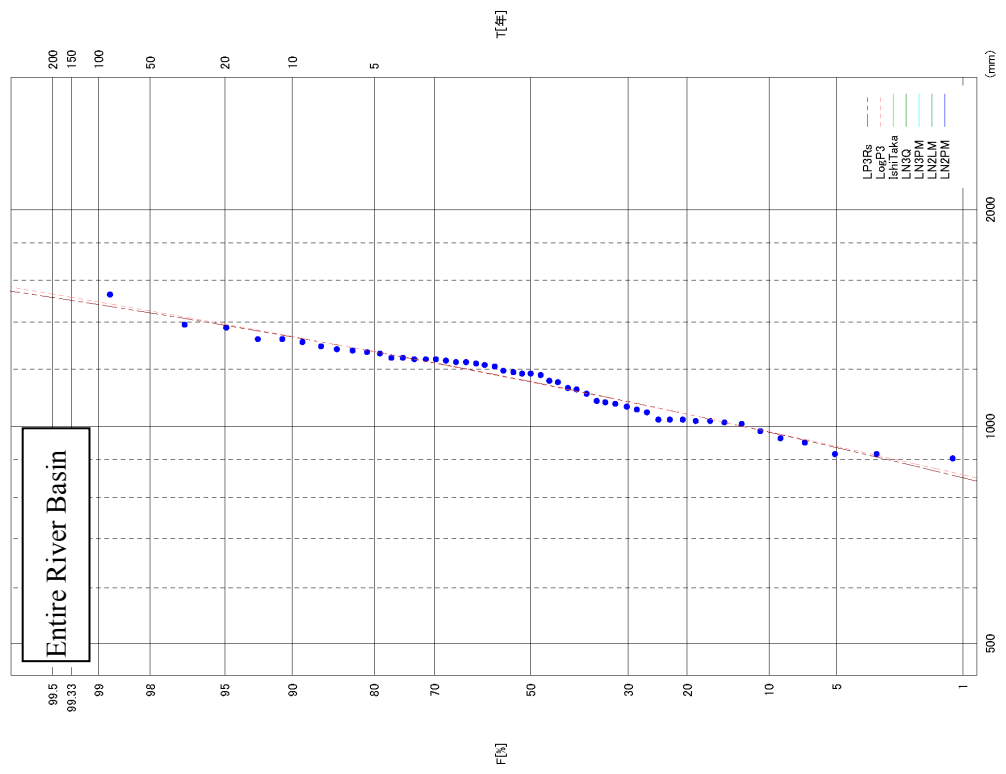


Figure C4.2.10 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 8-Month rainfall)

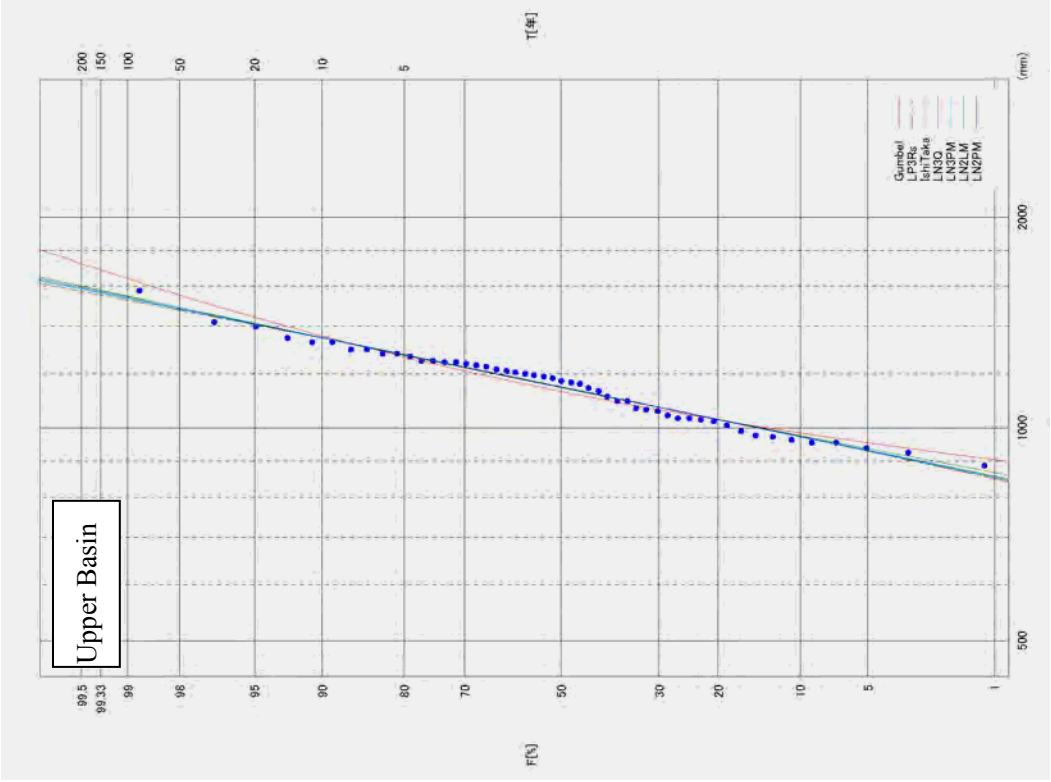


Figure C4.2.11 Probability Distribution on Log-normal Probability Paper (Upper Basin, 7-Month rainfall)

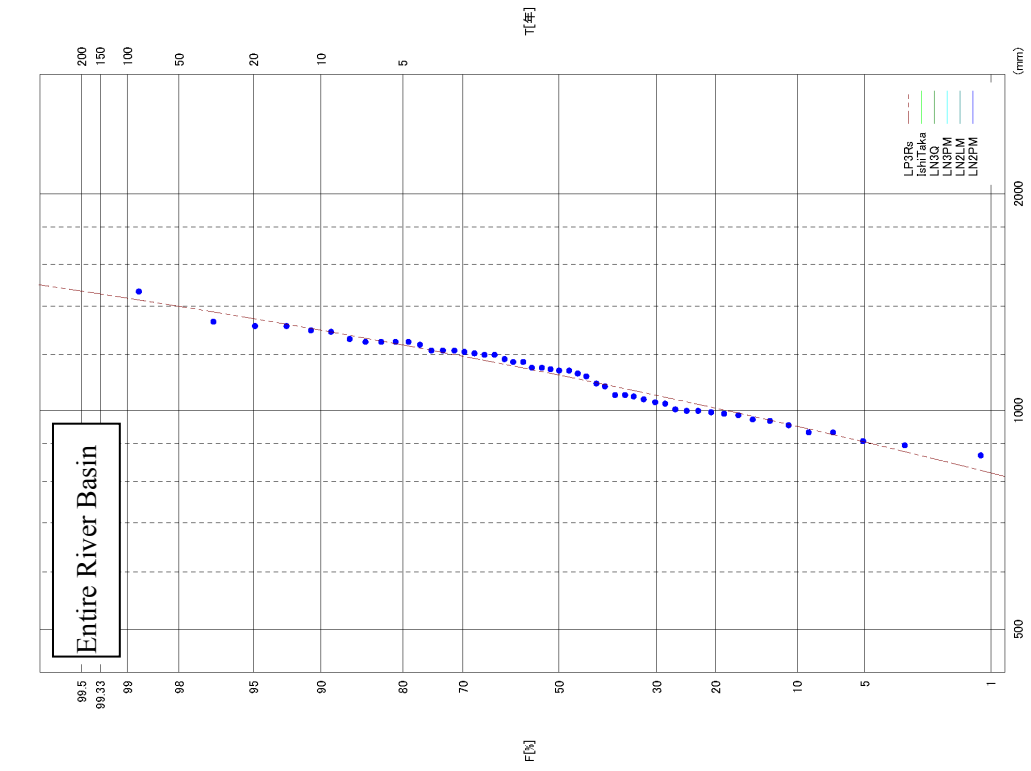


Figure C4.2.12 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 7-Month rainfall)

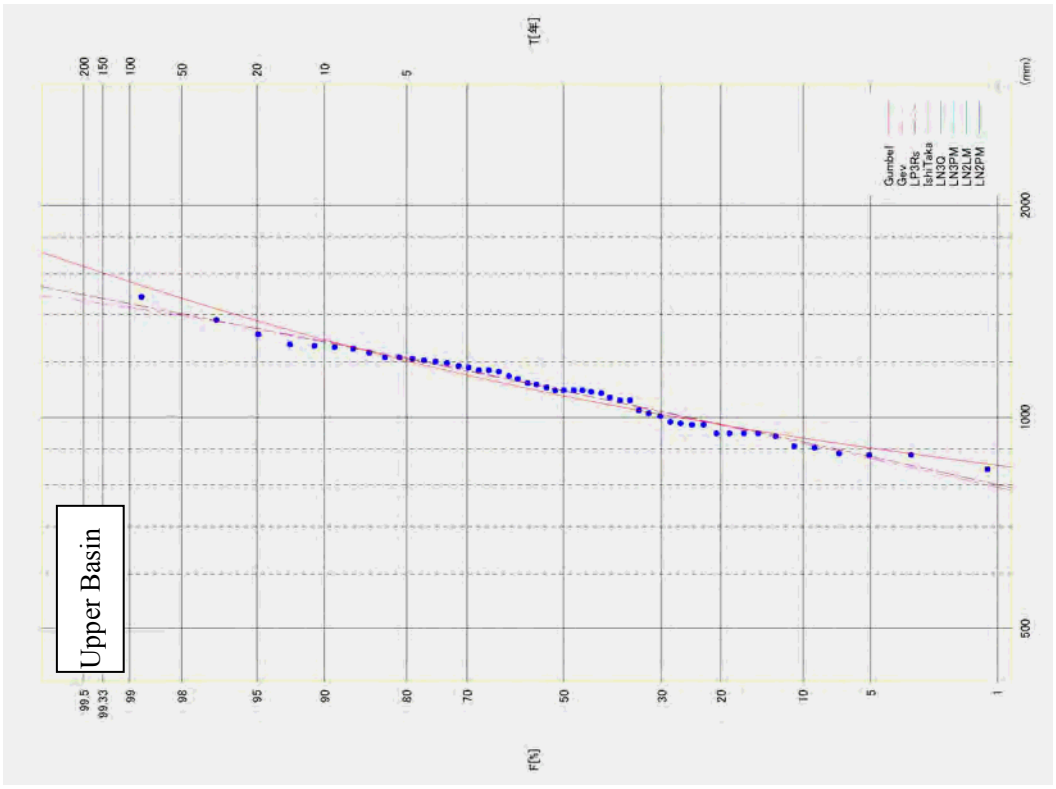


Figure C4.2.13 Probability Distribution on Log-normal Probability Paper (Upper Basin, 6-Month rainfall)

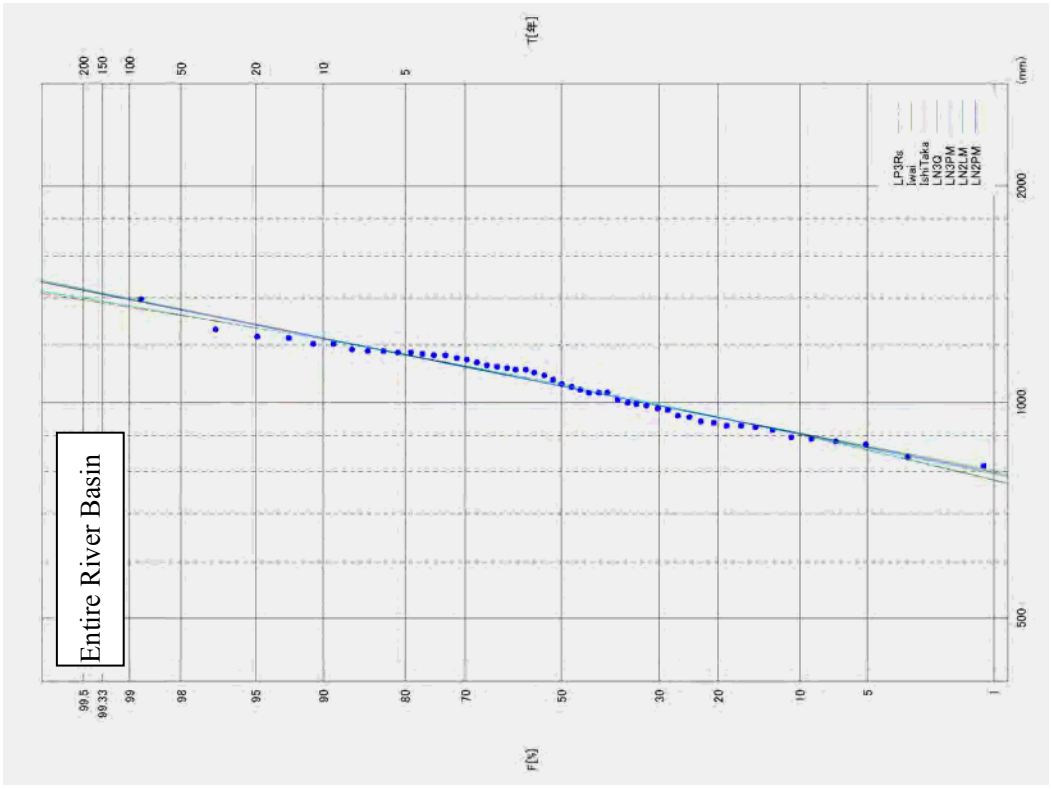


Figure C4.2.14 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 6-Month rainfall)

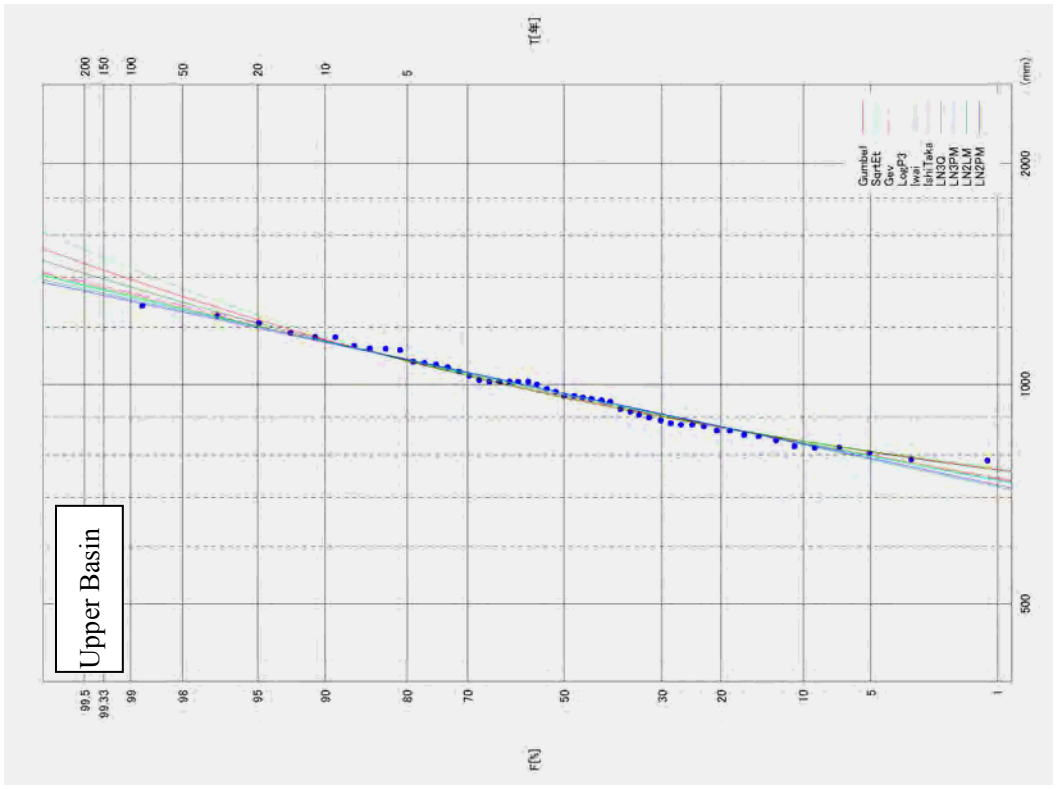


Figure C4.2.15 Probability Distribution on Log-normal Probability Paper (Upper Basin, 5-Month rainfall)

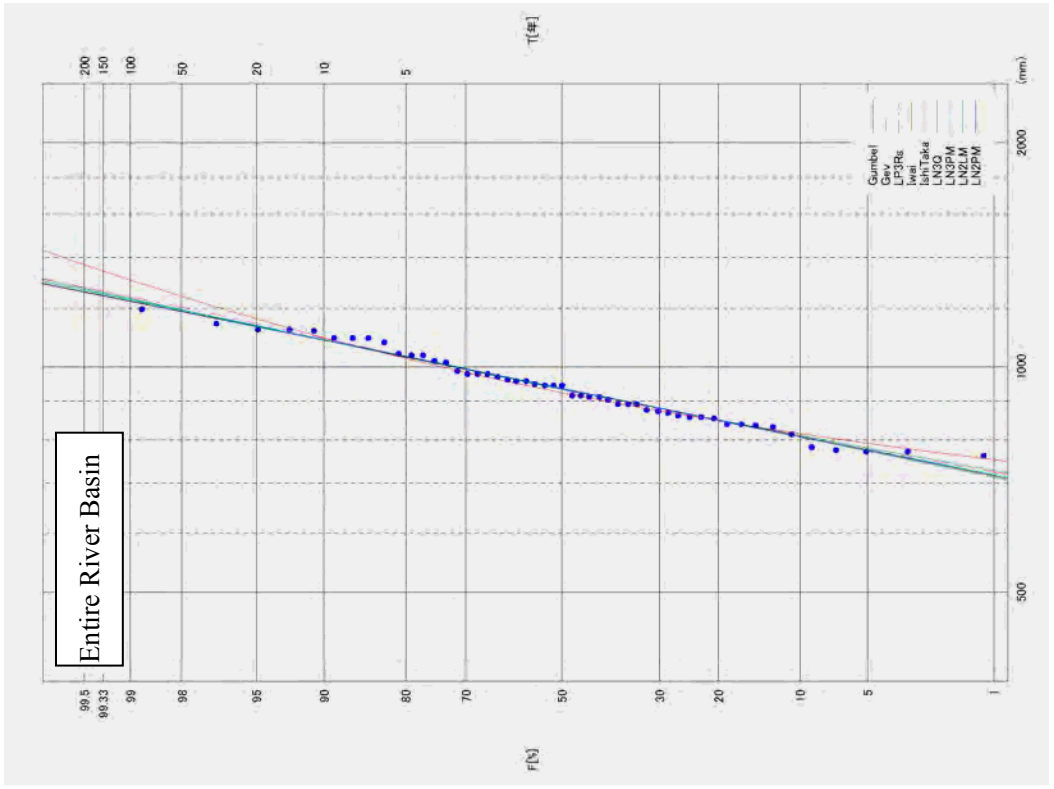


Figure C4.2.16 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 5-Month rainfall)

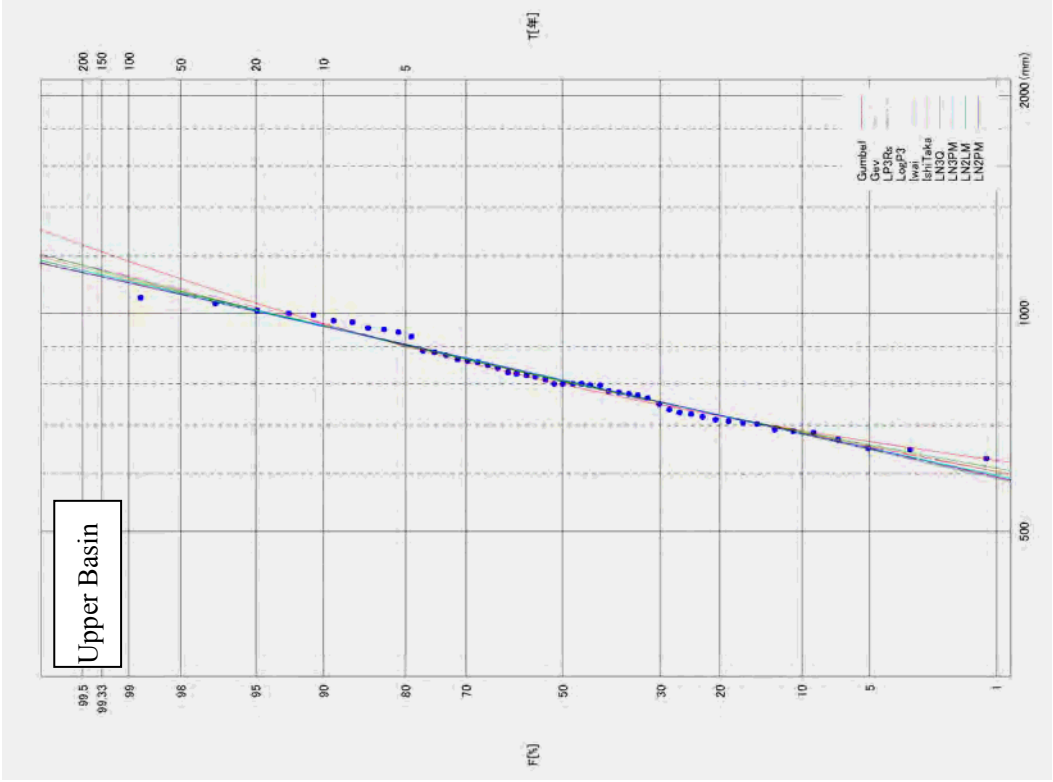


Figure C4.2.17 Probability Distribution on Log-normal Probability Paper (Upper Basin, 4-Month rainfall)

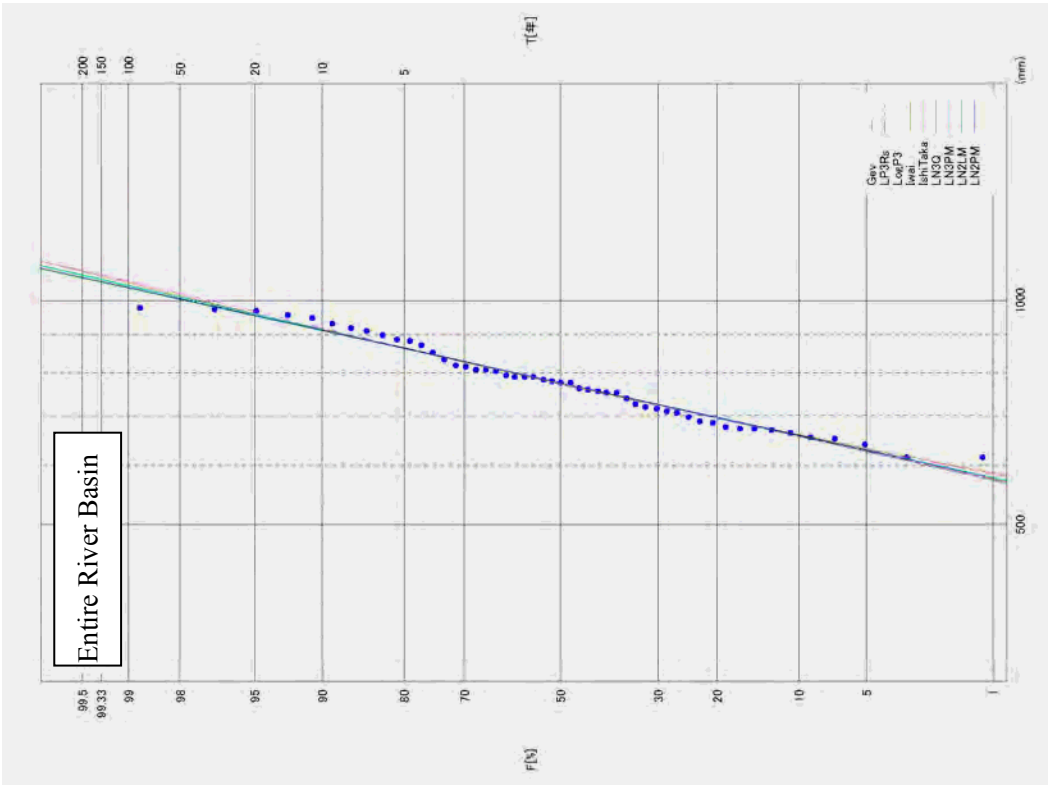


Figure C4.2.18 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 4-Month rainfall)

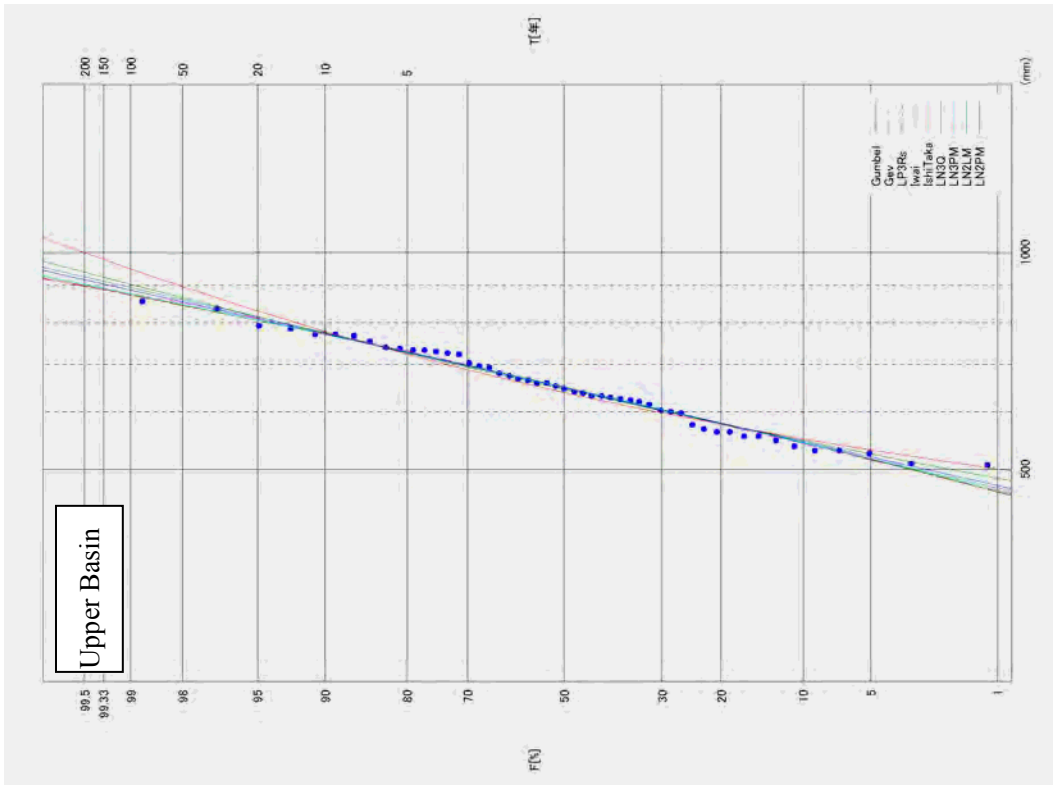


Figure C4.2.19 Probability Distribution on Log-normal Probability Paper (Upper Basin, 3-Month rainfall)

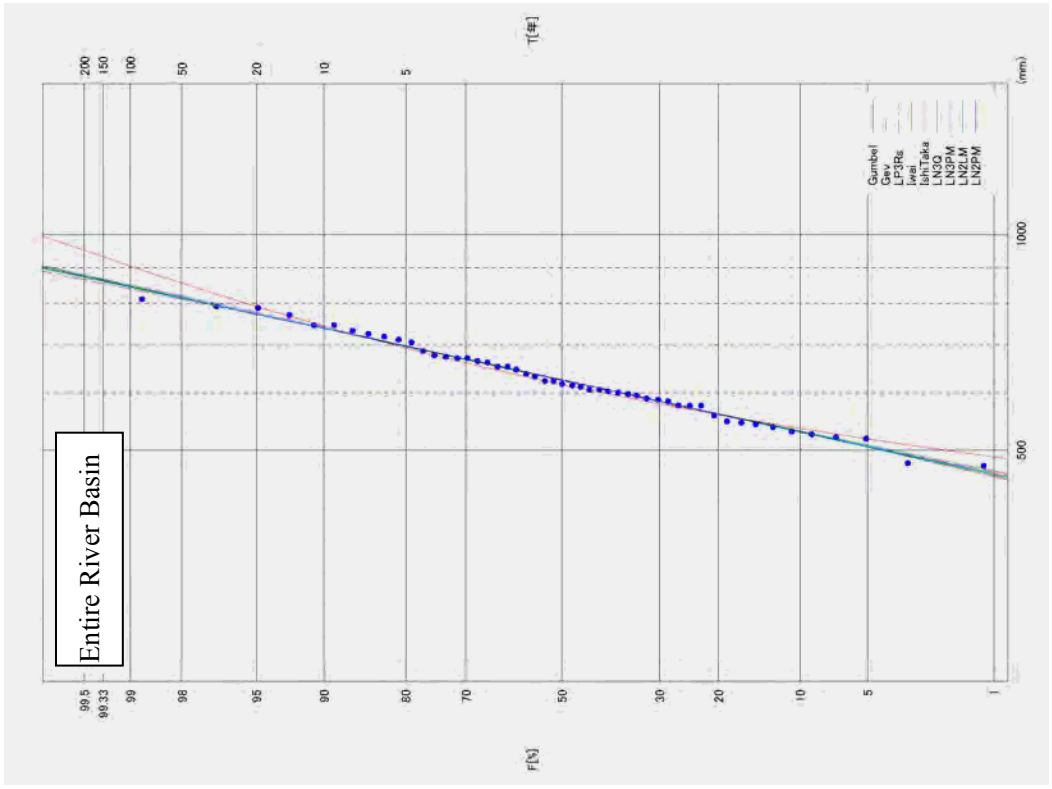


Figure C4.2.20 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 3-Month rainfall)

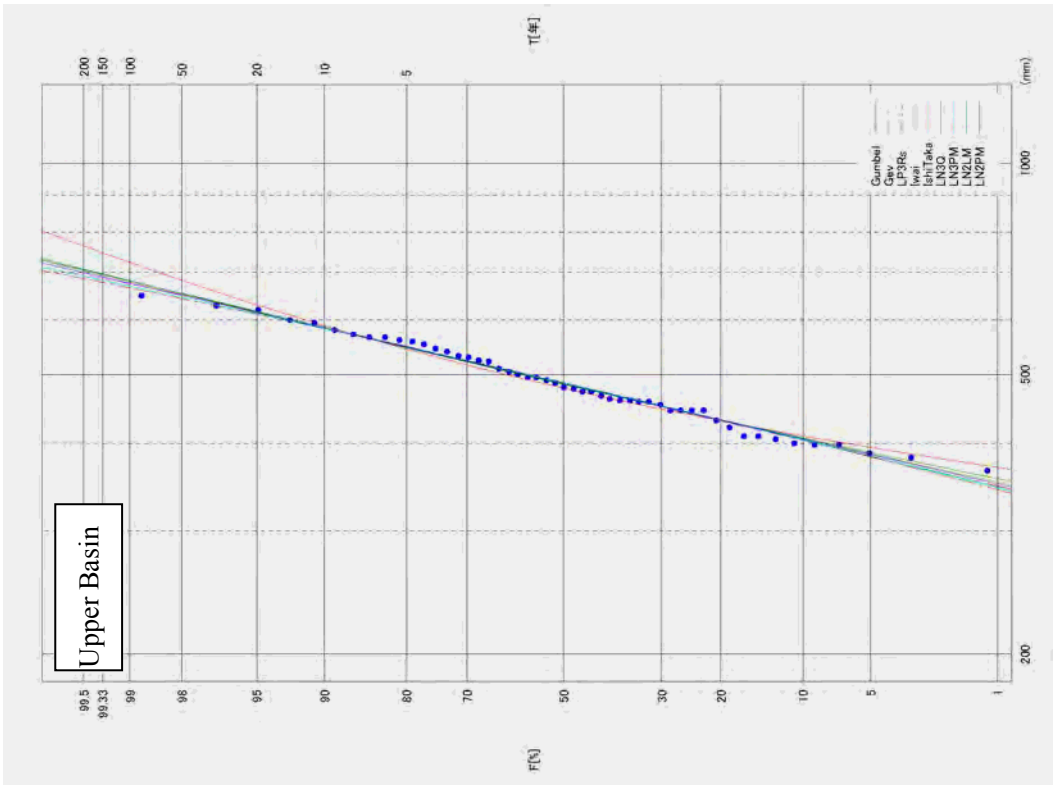


Figure C4.2.21 Probability Distribution on Log-normal Probability Paper (Upper Basin, 2-Month rainfall)

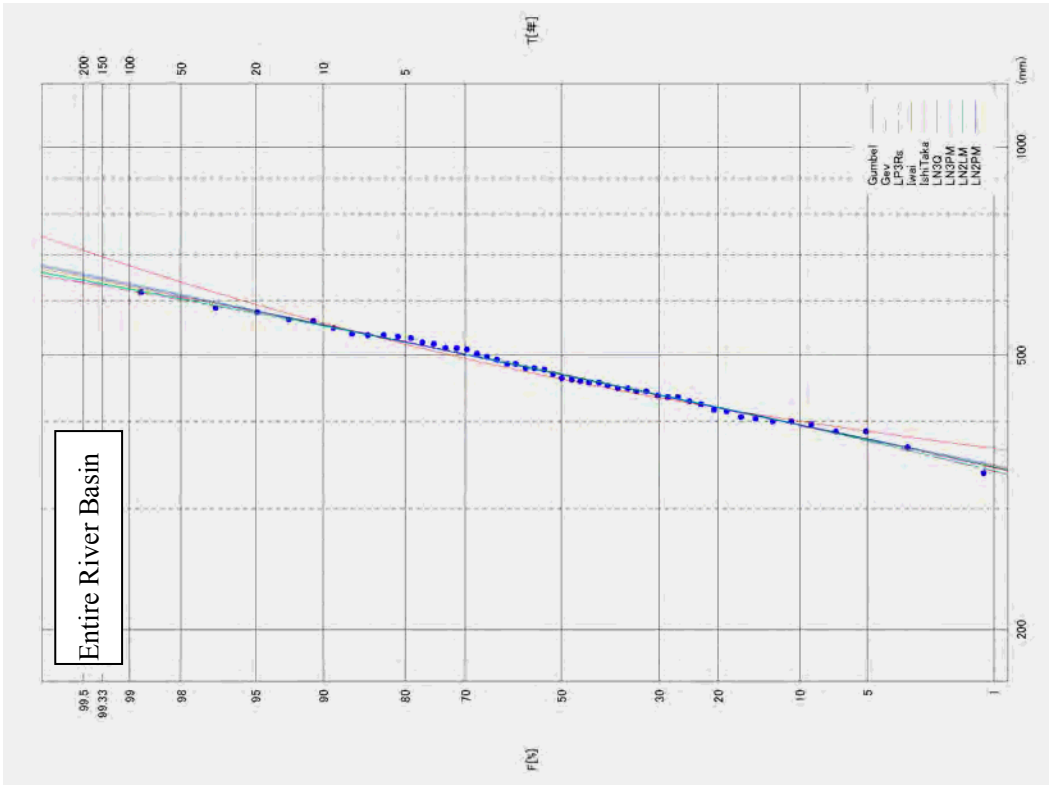


Figure C4.2.22 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 2-Month rainfall)

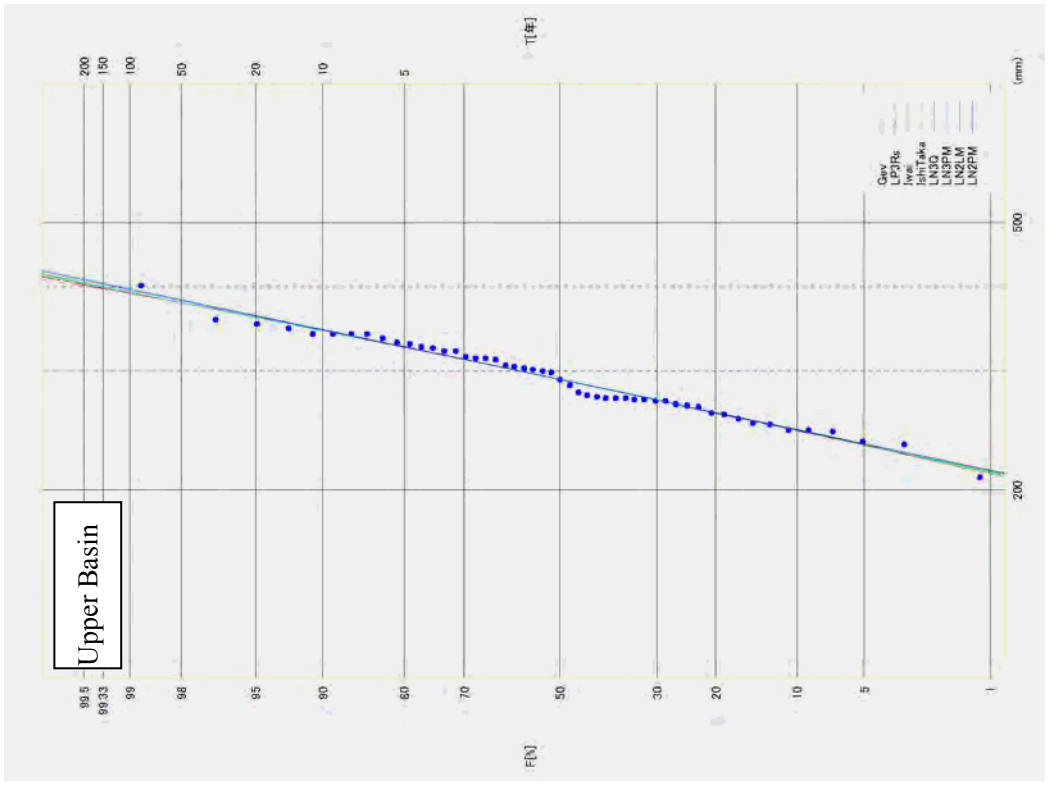


Figure C4.2.23 Probability Distribution on Log-normal Probability Paper (Upper Basin, 1-Month rainfall)

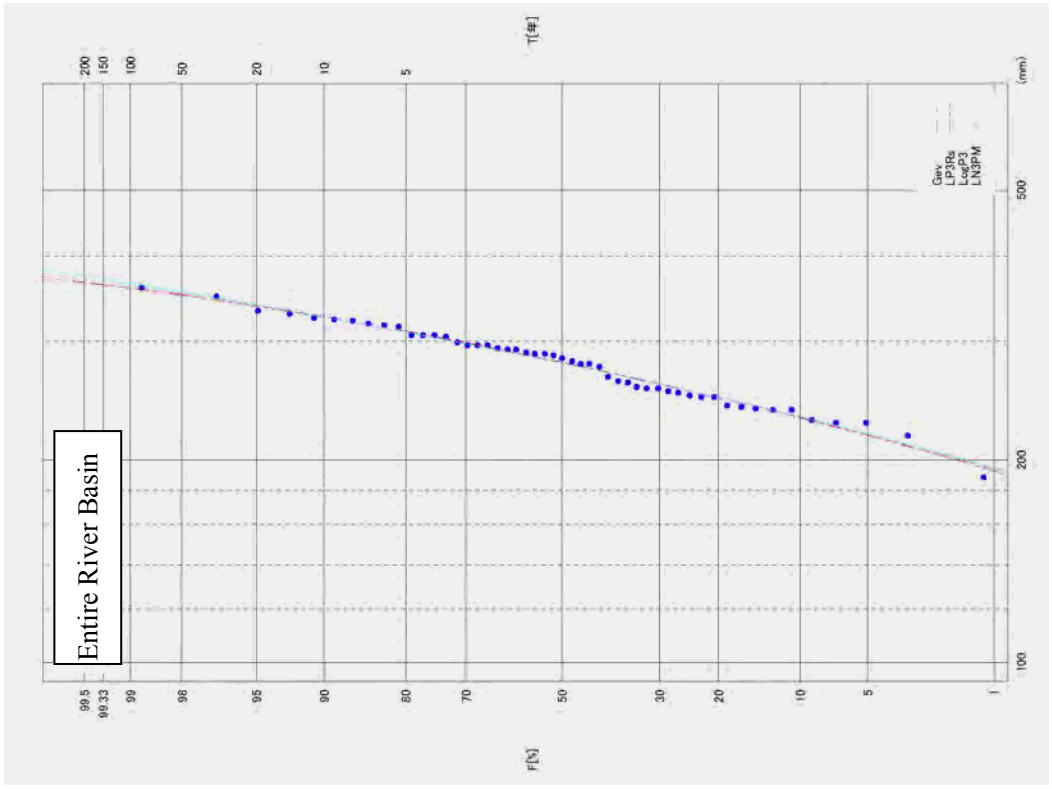


Figure C4.2.24 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 1-Month rainfall)

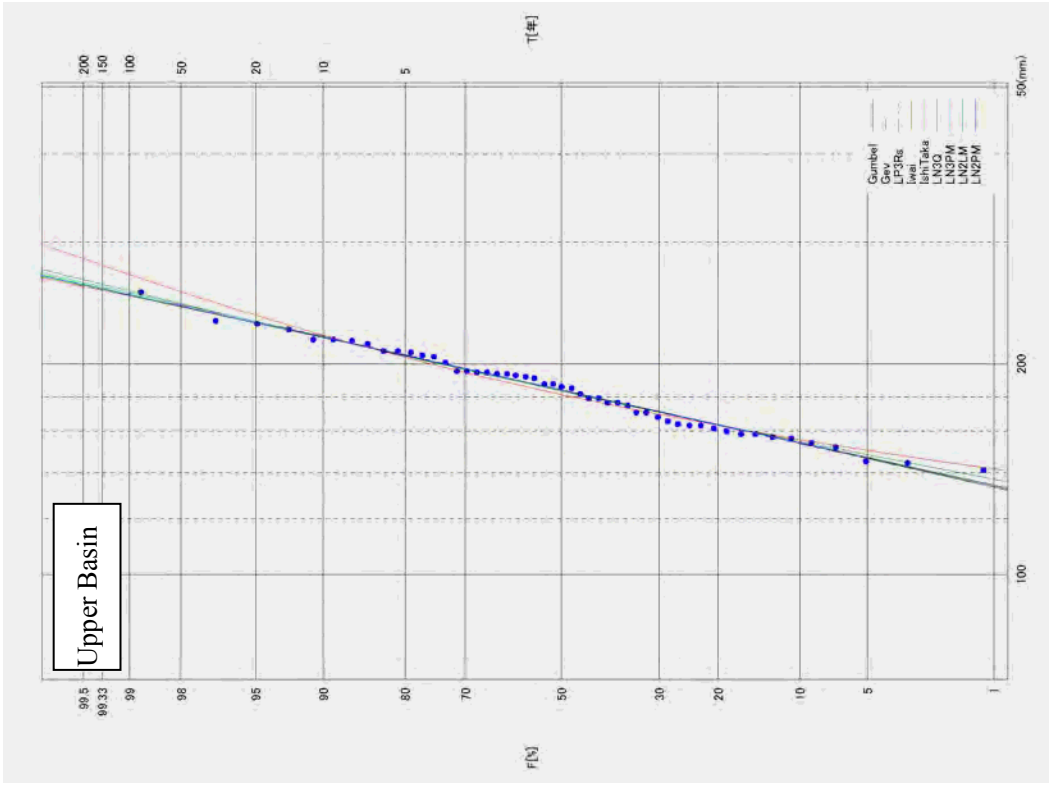


Figure C4.2.25 Probability Distribution on Log-normal Probability Paper (Upper Basin, 2-weeks rainfall)

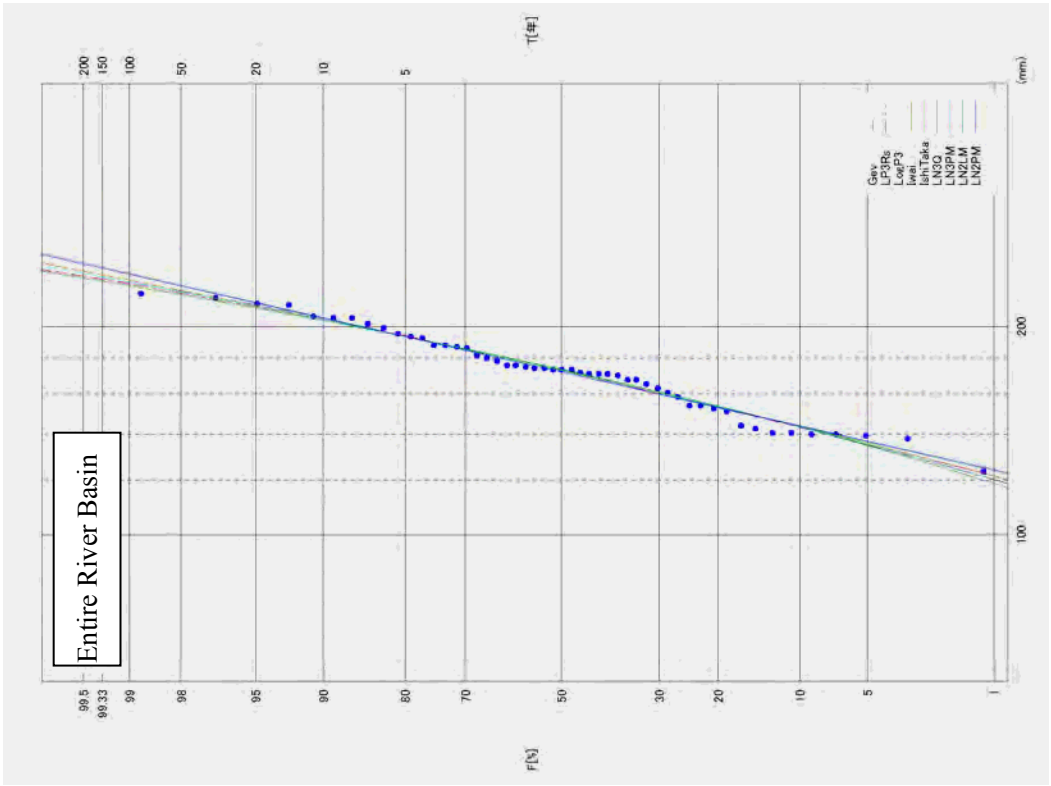


Figure C4.2.26 Probability Distribution on Log-normal Probability Paper (Entire Chao Phraya River Basin, 2-weeks rainfall)

CHAPTER C5 PROBABILITY OF DISCHARGE

The scale of rainfall of the 2011 flood was evaluated in the preceding section. In this section the scale of river discharge of the 2011 flood is evaluated.

C5.1 Study Procedure

C5.1.1 Discharge at Nakhon Sawan without Dams

Nakhon Sawan is one of the most important control points in terms of flood mitigation for the Chao Phraya River Basin. The location divides the river basin into the Upper Basin composed of three major tributaries, Nan, Yom and Ping and the Lower Delta Area where economical properties are concentrated. Therefore, discharge of C.2 Station at Nakhon Sawan is subject to the evaluation.

In order to correctly evaluate the discharge at Nakhon Sawan, influences of dam reservoirs should be removed from the observed data. There are many dam reservoirs in the Chao Phraya River Basin. Among them only two gigantic dams, Bhumibol and Sirikit, which started their operation in 1964 and 1974 respectively, significantly affect the discharge at Nakhon Sawan. Therefore, the observed discharge is modified by removing the influences of the two dam reservoirs.

C5.1.2 Study Procedure

The procedure for evaluating the discharge at Nakhon Sawan is presented as shown in Figure C5.1.1. The flow is divided to before and after Bhumibol Dam started its operation in 1964. The influences of the dam reservoirs that are mainly caused by flood regulation by the dam reservoir. This flood regulation discharge are assumed to be difference between outflow discharges estimated by MIKE11 routing models with and without the dam reservoirs.

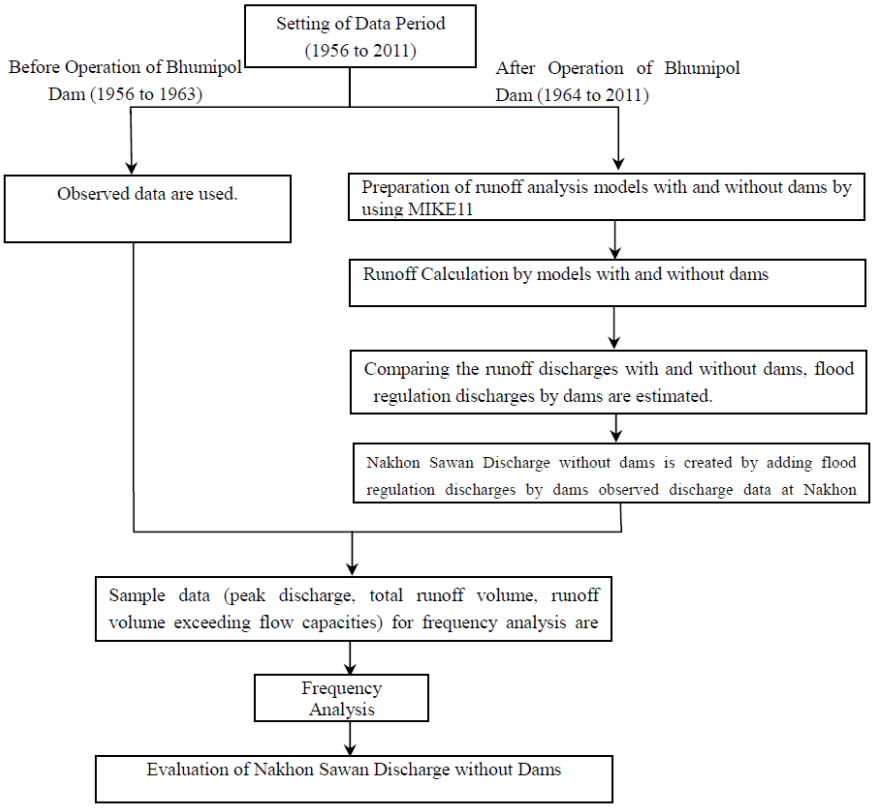
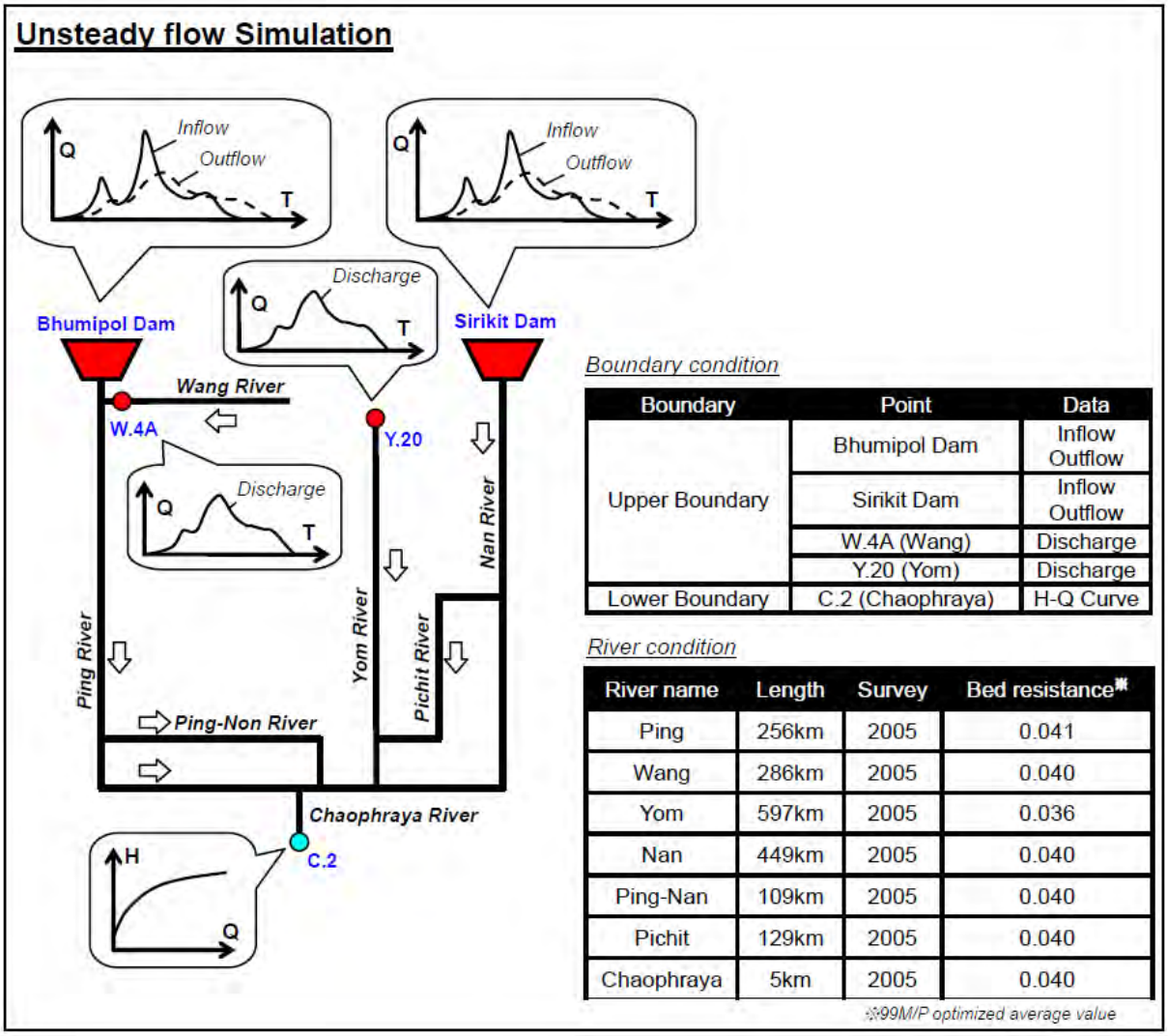


Figure C5.1.1 Procedure of Evaluation of Discharge of 2011 Flood at Nakhon Sawan

C5.1.3 Outline of MIKE11 Model

A package flood simulation software, MIKE11 is used to estimate discharges at Nakhon Sawan with and without the dams. The flood routing model is similar to the one used in the JICA 1999 Study as shown in Figure C5.1.2. Although there are available river cross section survey data of 2005 and 2006, the 2005 data were used because there is no significant difference between them.



Boundary condition

Boundary	Point	Data
Upper Boundary	Bhumipol Dam	Inflow Outflow
	Sirikit Dam	Inflow Outflow
	W.4A (Wang)	Discharge
	Y.20 (Yom)	Discharge
Lower Boundary	C.2 (Chaophraya)	H-Q Curve

River condition

River name	Length	Survey	Bed resistance*
Ping	256km	2005	0.041
Wang	286km	2005	0.040
Yom	597km	2005	0.036
Nan	449km	2005	0.040
Ping-Nan	109km	2005	0.040
Pichit	129km	2005	0.040
Chaophraya	5km	2005	0.040

*99M/P optimized average value

Figure C5.1.2 Outline of MIKE11 Flood Routine Model (JICA 1999 Study Model)

C5.2 Preparation of Discharge Data without Dams

C5.2.1 Dams to be considered

Since there are available observed data of 56 years from 1956 to 2011 for C.2 Nakhon Sawan, the 56 years are considered as the target period of the evaluation. Depending upon the existence of the Bhumibol and Sirikit Dams, modification of discharge data to remove influences of the dams is necessary depending the data period, as shown in Table C5.2.1 .

Table C5.2.1 Concept of Preparations of Discharge at Nakhon Sawan without Dams by Period

Data Period		Data Preparation	Remarks
1956 to 2011 (56 years)	1956 to 1963 (8 years)	Observed Discharge Data at C2. Nakhon Sawan	Observed data can be used directly without any treatment.
	1964～1973 (10 years)	Flood Regulation Discharge by Bhumibol Dam is added to the observed Nakhon Sawan Discharge.	Bhumibol Dam started its operation in 1964.
	1974～2011 (38 years)	Flood Regulation Discharge by Bhumibol and Sirikit Dams are added to the observed Nakhon Sawan Discharge.	Sirikit Dam started its operation in 1974.

C5.2.2 Methodology to Prepare Discharge without Dams

The observed discharge data at C2. Nakhon Sawan after Bhumibol Dam started its operation in 1964 are modified under the conditions if the two gigantic dam reservoirs had not been existent. The methodology is explained as follows:

1. By using the MIKE11 Flood Routing Model, discharges at Nakhon Sawan with and without the dam(s) are estimated respectively.
2. The flood regulation discharge at Nakhon Sawan is estimated by subtracting the discharge with the dam(s) from the discharge without the dam(s).
3. The regulation discharge is added to the observed discharge at C2. (Nakhon Sawan). The obtained discharge in this way can be regarded as the discharge after influences of the dams were removed.

Figure C5.2.1 shows an example of the procedure for the preparation of the discharge at Nakhon Sawan without the dam(s) for the year 2011. The conditions of the flood routing by MIKE11 are summarized in Table C5.2.2.

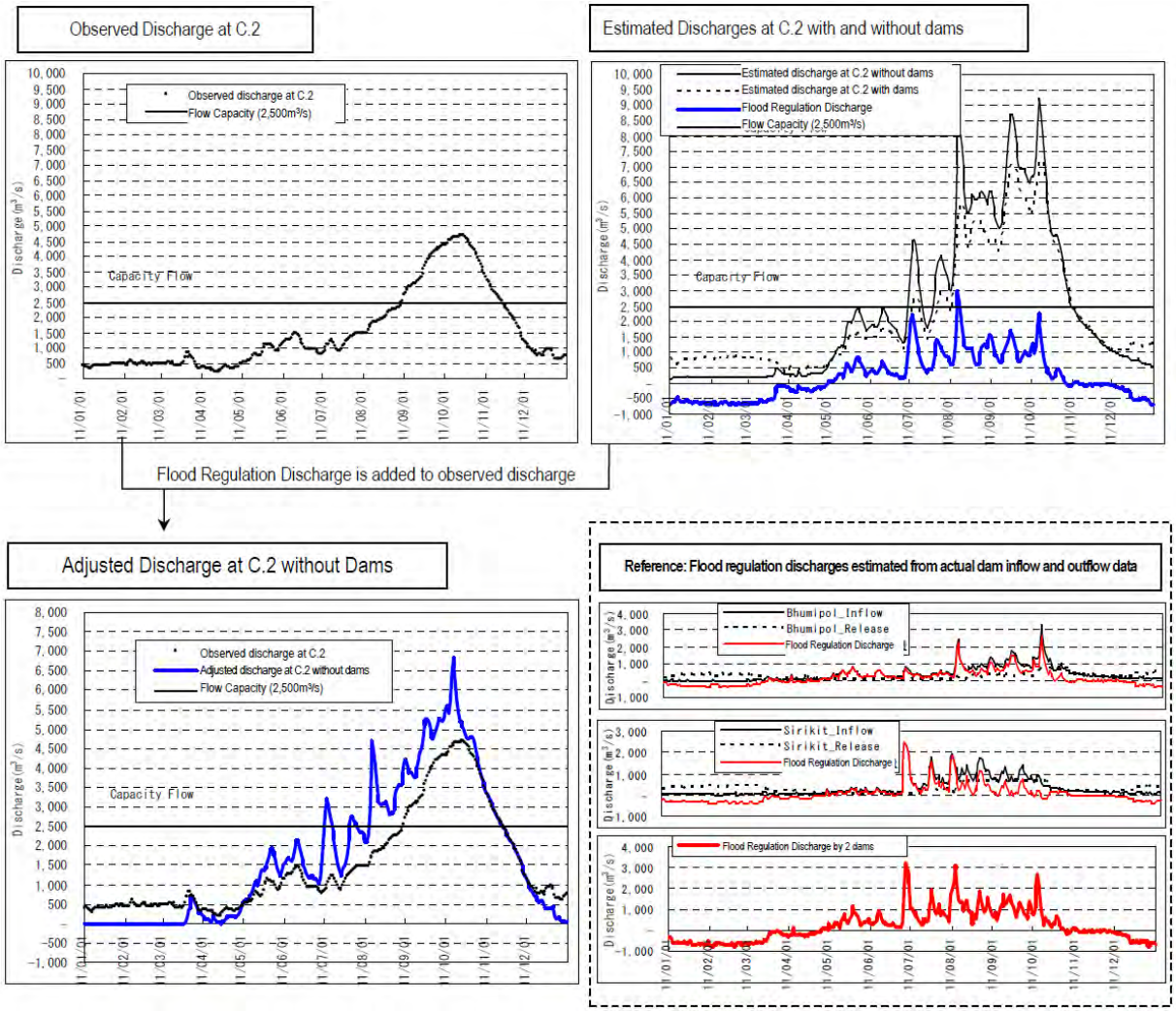


Figure C5.2.1 Example of Estimation of Discharge at Nakhon Sawan without Dams (2011)

Table C5.2.2 Conditions of Flood Routing by MIKE11

Item		Conditions		Remarks
Runoff from Sub-basins	Model	3-tier tank model		
	Rainfall	Basin mean rainfalls for 27 sub-basins are calculated by Thiessen Method.		27Sub-basin division
	Evapotranspiration	Basin mean evapotranspiration are calculated from observed pan evaporation data.		Pan evaporation × 0.6
Flood Routing	Model	One-dimensional unsteady flow model		
	Roughness Coefficient	n=0.036～0.041		
	Upstream-end discharge	PING	Without dam : Bhumibol Dam inflow With dam : Bhumibol Dam outflow	
		NAN	Before 1974: Observed Discharge(N.7, N.5A) In and after 1974 With dam : Sirikit Dam inflow Without dam : Sirikit Dam outflow	Refer to Table 5.2.3
		WANG	Observed discharge (W.4, W.3A, W4.A)	
		YOM	Observed discharge (Y.14)	

(1) Evapotranspiration

Based on a water balance calculation result of "Study on Flood Forecasting and Warning System in Chao Phraya River Basin, 1988, JICA", evapotranspiration is assumed to be 60% of pan evaporation. This evapotranspiration is used to estimate runoff from the sub-basins.

<Estimation of Evapotranspiration>

Table 2-6. COMPARISON BETWEEN HYDROLOGIC BALANCE AND PAN EVAPORATION DATA

River Basin	Discharge Observation Point: Upper	Discharge Observation Point: Lower	Pan Evaporation Observation Point	Hydrologic Year /1	(1) Hydrologic Balance (mm)	(2) Pan Evaporation (mm)	(3) Ratio (1)/(2) (%)
Wang	W10A	W3A	Lampang	1978	852	1,497	57
				1979	859	1,583	54
				1980	848	1,520	56
				1981	-Data Missing-		
				1982	778	1,563	50
				Average	834	1,541	54
Ping, No. P12	W4A	P7A	Phitsanulok	1978	1,040	1,686	62
				1979	937	1,816	52
				1980	1,163	1,797	65
				1981	1,084	1,695	64
				1982	844	1,681	50
				Average	1,014	1,735	58
Yom	Y20	Y14	Phitsanulok	1978	1,118	1,686	66
				1979	942	1,816	52
				1980	1,132	1,797	63
				1981	1,078	1,695	64
				1982	898	1,681	53
				Average	1,034	1,735	60
Nan	N12A	N5A	Phitsanulok	1978	996	1,686	59
				1979	880	1,816	48
				1980	1,150	1,797	64
				1981	1,044	1,695	62
				1982	910	1,681	54
				Average	996	1,735	57
Pasak	S4B	S9	Phetchabun	1978	1,018	1,689	60
				1979	1,032	1,791	58
				1980	966	1,719	56
				1981	1,180	1,598	74
				1982	967	1,529	63
				Average	1,033	1,665	62

Note: /1 From April in the subject year to March in the following year.

Source: "Study on Flood Forecasting and Warning System in Chao Phraya River Basin, Thailand", JICA, 1988.

(2) Upstream-end Discharge

Depending upon the data availability, discharge data that are to be used as the upstream-end discharges for the flood routing are selected as shown in Table C5.2.3. Lacking data of W.3A in 1967 and 1981 and Y.14 in 1964, which are fortunately all during the dry season, are assumed to be the same as data before and/or after the lacking period or interpolated from them.

Table C5.2.3 Used Discharge Data for Flood Routing

	Year	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	Period		①					②																						③																					④
NAMJII	N.7	◎	◎	◎	◎	◎	◎	■	○	●	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	●	◎	◎	◎	◎	◎	◎	◎	◎	※	N	N	N	N	N	N	N	N	N	N
	N.5A	N	N	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
WANGJII	W.4	◎	◎	◎	■	◎	■	◎	■	×	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W.3A	N	N	N	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	●	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	※
	W4.A	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	◎	◎	◎	○	◎	◎	◎	▲	×	×	▲	▲	◎	◎	◎
YOMJII	Y.14	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎

Used data.

◎: No data lacking from January to December
○: No data lacking from April to December
●: Data of 30 days or more from April to December are lacking
■: Data of more than 30 days but less than 100 days from April to December are lacking.
▲: Data of more than 99 days but less than 275 days from April to December are lacking.
※: All data form April to December are lacking.
×: All data of 365 days are lacking.
N: No collected yet.

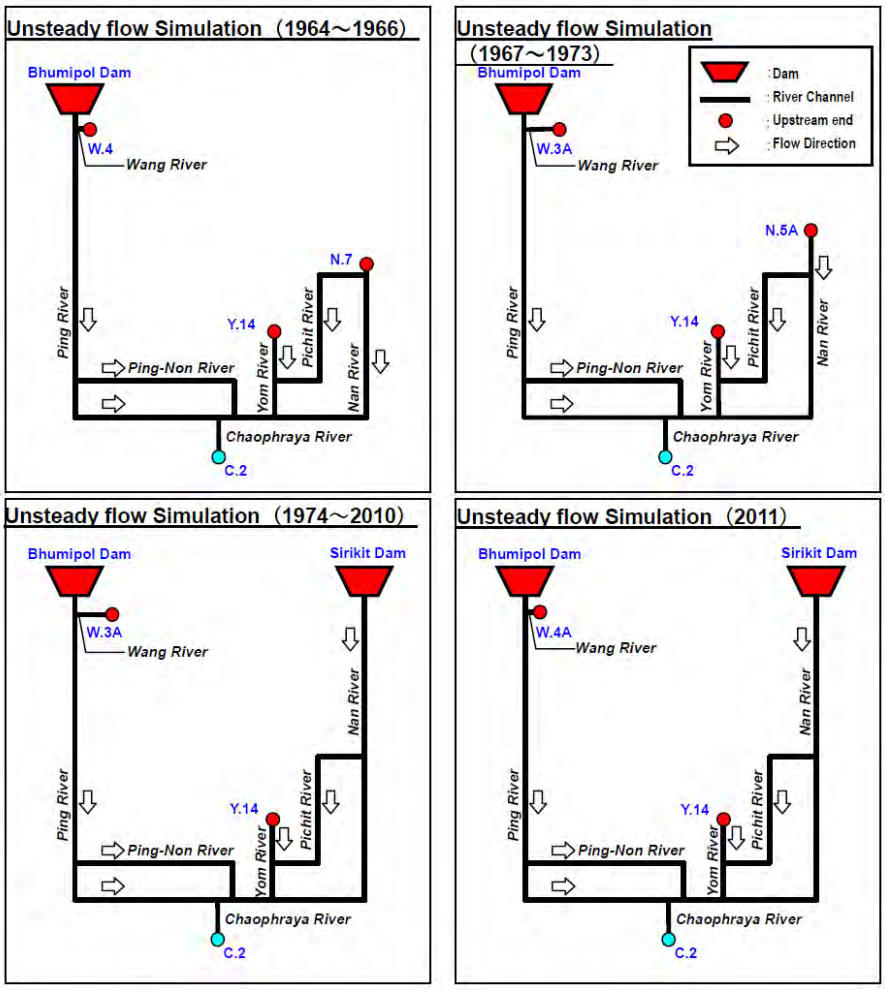


Figure C5.2.2 Different Flood Routing Models According to Existence of Dams

C5.2.3 Discharge Data Used for Frequency Analysis

A dataset of modified 56-year discharge data without dams at C.2 (Nakhon Sawan) are prepared by the calculation explained above. From this dataset, three kinds of discharge data that are subject to the frequency analysis are further prepared as presented in Table C5.2.4. They are:

1. Maximum Discharge
2. Annual Total Runoff Volume
3. Runoff Volume exceeding Flow Capacity of 2,500m^3/s

Table C5.2.4 Discharge Data Used for Frequency Analysis

Year	Peak Discharge (m^3/s)	Runoff Volume (million m^3)	Runoff Volume exceeding flow capacity (million m^3)	Remarks
1956	3, 392	26, 341	1, 682	Observed Data
1957	2, 584	16, 713	30	
1958	2, 066	12, 619	0	
1959	4, 390	23, 178	2, 525	
1960	2, 567	19, 945	13	
1961	4, 712	33, 006	6, 534	
1962	3, 812	24, 096	2, 989	
1963	2, 935	23, 717	339	
1964	5, 170	30, 419	5, 367	Bhumipol Dam
1965	2, 004	18, 657	0	started operation
1966	3, 919	24, 115	1, 494	in 1964
1967	4, 200	18, 446	1, 339	
1968	1, 642	12, 963	0	
1969	4, 300	23, 212	1, 797	
1970	5, 830	38, 524	7, 291	
1971	3, 356	25, 320	1, 080	
1972	2, 000	14, 596	0	
1973	4, 539	24, 164	2, 029	
1974	2, 672	22, 551	21	Sirikit Dam
1975	5, 535	40, 180	10, 518	started operation
1976	4, 285	28, 786	2, 669	in 1964
1977	3, 532	18, 486	1, 002	
1978	4, 700	34, 990	5, 585	
1979	1, 784	13, 013	0	
1980	5, 839	35, 623	7, 112	
1981	3, 943	27, 166	490	
1982	3, 362	19, 236	474	
1983	3, 763	25, 294	1, 386	Observed Data +
1984	2, 442	19, 200	0	Flood Regulation
1985	3, 068	26, 208	561	Discharge
1986	2, 251	16, 839	0	
1987	3, 109	16, 605	134	
1988	3, 980	23, 528	632	
1989	2, 347	15, 325	0	
1990	1, 688	14, 909	0	
1991	2, 602	15, 308	9	
1992	2, 343	13, 691	0	
1993	1, 900	8, 539	0	
1994	4, 268	33, 587	4, 877	
1995	5, 612	38, 741	10, 144	
1996	4, 109	31, 211	3, 008	
1997	2, 550	13, 625	4	
1998	2, 297	10, 027	0	
1999	3, 912	30, 476	1, 721	
2000	3, 017	27, 314	293	
2001	4, 215	28, 587	1, 170	
2002	5, 547	35, 129	7, 199	
2003	3, 403	15, 513	444	
2004	3, 450	20, 655	758	
2005	3, 869	22, 229	2, 313	
2006	6, 385	44, 332	12, 244	
2007	4, 032	23, 304	1, 180	
2008	3, 728	27, 243	1, 200	
2009	4, 559	19, 077	890	
2010	5, 077	26, 630	3, 810	
2011	6, 857	55, 570	15, 154	
Max	6, 857	55, 570	15, 154	
Min	1, 642	8, 539	4	
Ave	3, 669	24, 044	2, 361	
Number of samples	56	55	44※1	
Flow Capacity	–	–	2500	

The year 1956 that includes data lacking of C.2 discharge is excluded form samples for examination of runoff volume.
: Maximum

※1 : 44 years in which runoff volumes exceeding 2,500 m3/s are greater than 0, are subject to frequency analysis.

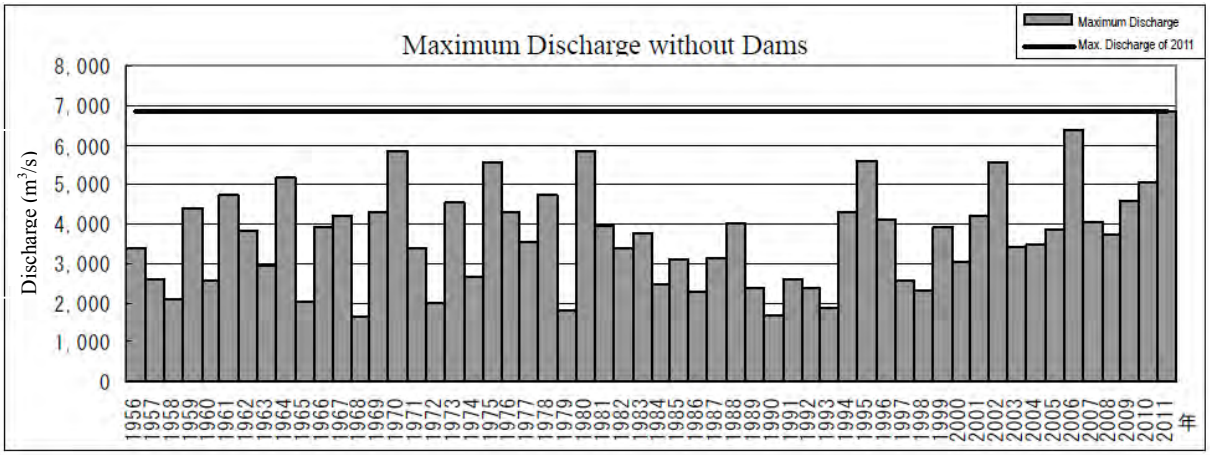


Figure C5.2.3 Adjusted Discharge without Dams at C.2 Nakhon Sawan (Peak Discharge)

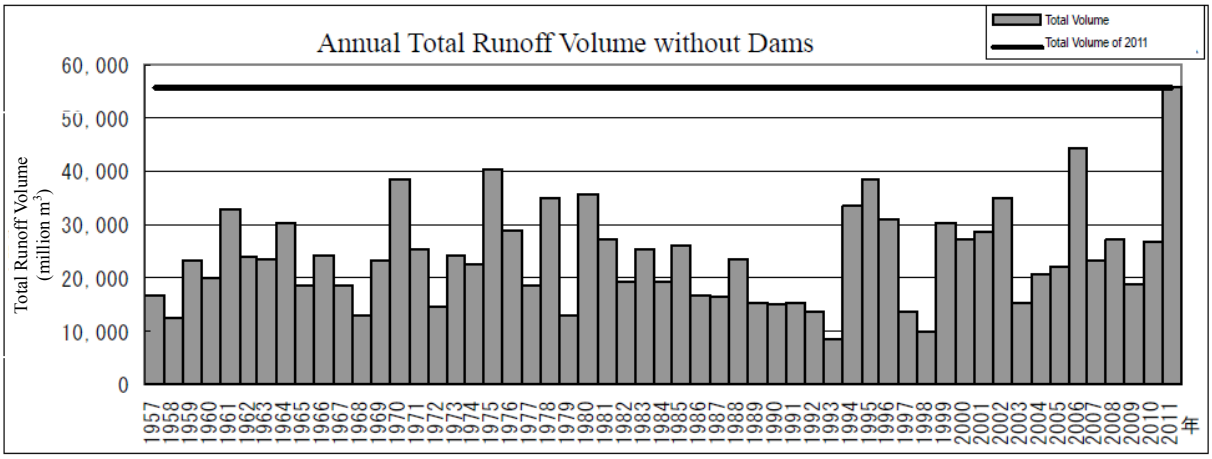


Figure C5.2.4 Adjusted Discharge without Dams at C.2 Nakhon Sawan (Total Runoff Volume)

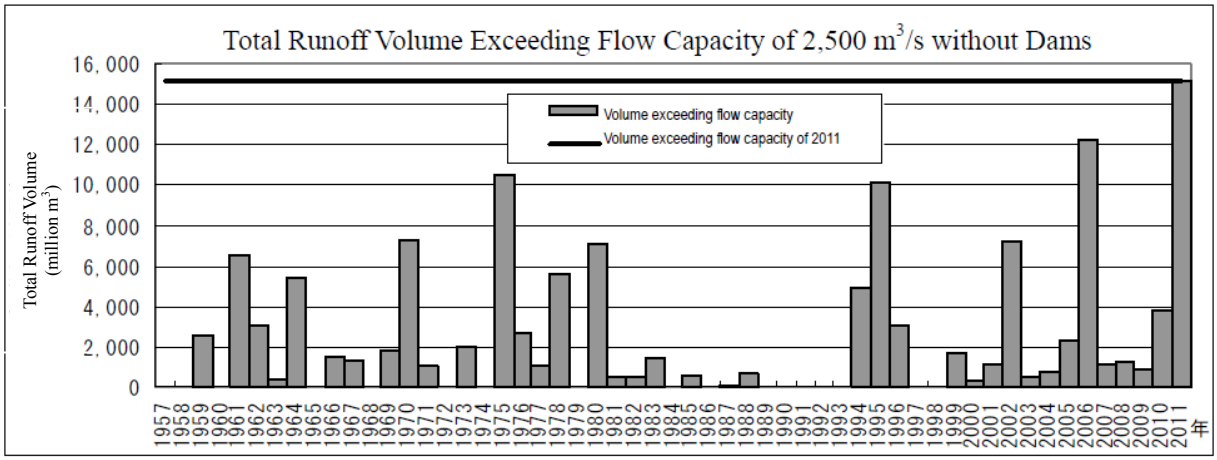


Figure C5.2.5 Adjusted Discharge without Dams at C.2 Nakhon Sawan (Runoff Volume Exceeding Flow Capacity of 2,500 m^3/s)

C5.3 Results of Frequency Analysis and Evaluation of Scale of 2011 Flood

The frequency analysis was conducted for the three kinds of discharge data at Nakhon Sawan. Results are presented in Table C5.3.1, Table C5.3.2, Table C5.3.3, Table C5.3.4, Figure C5.3.2 and Figure C5.3.3. Regarding the runoff volume exceeding the flow capacity of 2,500 m^3/s, it is partial duration series data. Therefore, another frequency analysis method (partial duration series probability analysis method) was applied.

Based on these results, the scale of the 2011 flood discharge is also evaluated as shown in Table C5.3.1, namely:

- The maximum discharge of 2011 is evaluated at about 30 to 120 years of return period.
- The annual total runoff volume of 2011 is evaluated at about 100 to 210 years of return period.
- The runoff volume exceeding the flow capacity of 2011, which might be regarded as inundation volume, is evaluated at about 100 years of return period.

Table C5.3.1 Evaluation of Used Discharge Data for Frequency Analysis

Item	Value of 2011	Probability by Evaluation Criteria		
		Range of Probability (SLSC≤0.04)	Selected Frequency Function	Probability
Maximum Peak Discharge (m^3/s)	6,857	1/32 to 1/122	Gev	1/70
Total Runoff Volume (MCM)	55,570	1/102 to 1/207	Iwai	1/127
Runoff Volume Exceeding Flow Capacity (MCM)	15,154	1/102	Lexp	1/102

Table C5.3.2 Results of Frequency Analysis (Maximum Discharge)

	annual peak series (sample size N=56)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.948	0.986	0.966	0.994	0.994	0.993	0.992	0.994	0.994	0.993	0.986	0.986
P-COR(99%)	0.943	0.991	0.987	0.995	0.996	0.994	0.994	0.995	0.995	0.995	0.992	0.991
SLSC(99%)	0.066	0.033	0.050	0.021	0.032	0.028	0.028	0.027	0.027	0.027	0.031	0.031
log likelihood	-464	-478	-480	-478	-477	-477	-478	-478	-478	-478	-478	-478
pAIC	931	961	963	962	961	961	962	962	962	962	960	960
X-COR(50%)	0.984	0.987	0.979	0.991	0.990	0.993	0.990	0.991	0.990	0.991	0.988	0.988
P-COR(50%)	0.990	0.991	0.990	0.988	0.987	0.994	0.990	0.989	0.990	0.989	0.990	0.990
SLSC(50%)	0.094	0.059	0.095	0.032	0.041	0.044	0.046	0.037	0.040	0.037	0.062	0.060

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	3,225	3,449	3,379	3,562	3,593	3,513	3,505	3,574	3,548	3,576	3,451	3,451
	1/3	3,811	4,008	3,996	4,136	4,170	4,086	4,070	4,128	4,099	4,130	4,041	4,030
	1/5	4,550	4,632	4,737	4,724	4,738	4,691	4,674	4,691	4,671	4,692	4,698	4,673
	1/10	5,553	5,415	5,746	5,392	5,353	5,404	5,398	5,334	5,335	5,333	5,521	5,475
	1/20	6,556	6,166	6,796	5,967	5,857	6,043	6,065	5,898	5,928	5,895	6,307	6,241
	1/30	7,142	6,598	7,436	6,271	6,115	6,394	6,438	6,204	6,254	6,200	6,760	6,681
	1/50	7,881	7,138	8,273	6,625	6,409	6,818	6,897	6,572	6,648	6,565	7,328	7,231
	1/80	8,561	7,632	9,074	6,926	6,654	7,194	7,310	6,895	6,998	6,887	7,850	7,737
	1/100	8,884	7,867	9,466	7,062	6,763	7,368	7,504	7,044	7,161	7,035	8,098	7,977
	1/120	9,148	8,058	9,791	7,169	6,849	7,508	7,662	7,165	7,292	7,155	8,301	8,174
	1/140	9,371	8,219	10,069	7,257	6,920	7,625	7,795	7,265	7,403	7,255	8,474	8,341
	1/150	9,470	8,291	10,195	7,296	6,951	7,677	7,854	7,310	7,452	7,299	8,551	8,415
	1/200	9,886	8,592	10,727	7,454	7,075	7,893	8,101	7,494	7,655	7,482	8,874	8,728
	1/300	10,473	9,016	11,498	7,665	7,241	8,190	8,447	7,749	7,937	7,735	9,332	9,170
	1/400	10,889	9,317	12,059	7,807	7,352	8,398	8,691	7,927	8,135	7,911	9,659	9,486
	1/500	11,212	9,550	12,503	7,913	7,435	8,557	8,880	8,063	8,286	8,046	9,914	9,732
	1/1000	12,215	10,274	13,929	8,221	7,674	9,041	9,465	8,478	8,752	8,458	10,716	10,504
jackknife error estimates	1/2	160	164	170	197	192	197	202	191	183	190	166	166
	1/3	174	182	204	211	211	213	213	206	196	205	186	188
	1/5	209	214	256	226	230	230	223	223	218	223	223	225
	1/10	275	265	336	266	259	267	249	256	267	256	288	287
	1/20	351	321	427	338	303	333	299	303	336	302	367	360
	1/30	398	354	485	395	337	386	340	336	383	335	419	407
	1/50	459	398	564	478	387	467	402	385	449	383	488	470
	1/80	515	438	641	564	441	552	469	435	515	431	555	532
	1/100	543	457	679	608	468	596	503	460	548	455	589	562
	1/120	565	473	711	644	491	634	532	481	575	476	617	588
	1/140	584	487	739	675	511	667	558	499	599	494	641	609
	1/150	593	493	751	689	520	682	569	508	609	502	652	619
	1/200	628	518	805	750	558	746	619	543	655	536	698	661
	1/300	678	554	883	837	614	842	694	595	721	587	766	723
	1/400	714	579	940	900	654	913	750	634	769	624	816	767
	1/500	742	599	986	949	686	970	794	664	807	653	855	803
	1/1000	829	661	1,134	1,105	788	1,157	941	763	930	748	983	918
2011Flood	6,857	—	1/37	—	1/70	1/122	1/52	1/47	1/75	1/64	1/76	1/32	1/34

: flood scale occurred in 2011

Table C5.3.3 Results of Frequency Analysis (Total Runoff Volume)

	annual volume series (sample size N=55)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.977	0.997	—	0.996	0.996	—	0.997	0.997	0.996	0.997	0.996	0.996
P-COR(99%)	0.945	0.997	—	0.997	0.997	—	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(99%)	0.044	0.017	—	0.018	0.018	—	0.017	0.018	0.017	0.018	0.018	0.019
log likelihood	-563	-576	—	-576	-576	—	-576	-576	-576	-576	-576	-576
pAIC	1130	1156	—	1158	1158	—	1158	1158	1158	1158	1156	1156
X-COR(50%)	0.994	0.994	—	0.993	0.991	—	0.994	0.993	0.993	0.993	0.994	0.994
P-COR(50%)	0.996	0.996	—	0.996	0.996	—	0.996	0.996	0.996	0.996	0.996	0.996
SLSC(50%)	0.056	0.027	—	0.030	0.030	—	0.025	0.026	0.027	0.026	0.027	0.026

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	20,892	22,483	—	22,623	22,758	—	22,500	22,543	22,633	22,584	22,384	22,384
	1/3	25,057	26,456	—	26,624	26,815	—	26,514	26,484	26,581	26,536	26,475	26,427
	1/5	30,305	30,882	—	31,015	31,172	—	30,964	30,827	30,892	30,874	31,073	30,963
	1/10	37,426	36,443	—	36,438	36,394	—	36,511	36,209	36,186	36,224	36,884	36,685
	1/20	44,546	41,777	—	41,541	41,160	—	41,797	41,308	41,160	41,273	42,494	42,200
	1/30	48,712	44,846	—	44,434	43,807	—	44,832	44,225	43,988	44,152	45,743	45,390
	1/50	53,960	48,682	—	48,006	47,031	—	48,628	47,863	47,500	47,735	49,834	49,405
	1/80	58,788	52,193	—	51,234	49,908	—	52,112	51,193	50,701	51,009	53,615	53,111
	1/100	61,080	53,856	—	52,750	51,249	—	53,768	52,773	52,215	52,559	55,420	54,879
	1/120	62,954	55,213	—	53,980	52,334	—	55,123	54,063	53,450	53,825	56,900	56,328
	1/140	64,537	56,360	—	55,015	53,244	—	56,270	55,156	54,493	54,896	58,156	57,558
	1/150	65,246	56,873	—	55,476	53,649	—	56,784	55,645	54,960	55,375	58,719	58,110
	1/200	68,201	59,011	—	57,391	55,326	—	58,932	57,687	56,907	57,374	61,079	60,419
	1/300	72,367	62,022	—	60,063	57,657	—	61,975	60,575	59,654	60,198	64,434	63,701
	1/400	75,322	64,157	—	61,941	59,290	—	64,146	62,633	61,606	62,208	66,838	66,051
	1/500	77,615	65,813	—	63,387	60,545	—	65,839	64,235	63,123	63,771	68,716	67,887
	1/1000	84,735	70,953	—	67,826	64,388	—	71,149	69,251	67,858	68,658	74,636	73,670
jackknife error estimates	1/2	1,093	1,162	—	1,295	1,283	—	1,225	1,339	1,123	1,332	1,164	1,164
	1/3	1,318	1,421	—	1,492	1,476	—	1,404	1,515	1,283	1,507	1,388	1,388
	1/5	1,748	1,801	—	1,775	1,786	—	1,767	1,788	1,705	1,790	1,775	1,768
	1/10	2,445	2,344	—	2,387	2,502	—	2,521	2,465	2,634	2,470	2,424	2,399
	1/20	3,194	2,899	—	3,352	3,588	—	3,527	3,510	3,840	3,494	3,173	3,125
	1/30	3,643	3,226	—	4,080	4,369	—	4,211	4,261	4,640	4,223	3,650	3,586
	1/50	4,217	3,640	—	5,158	5,481	—	5,162	5,330	5,732	5,257	4,289	4,202
	1/80	4,749	4,023	—	6,297	6,614	—	6,118	6,420	6,811	6,307	4,912	4,802
	1/100	5,003	4,205	—	6,884	7,186	—	6,599	6,971	7,346	6,837	5,220	5,098
	1/120	5,211	4,355	—	7,386	7,668	—	7,004	7,437	7,795	7,284	5,477	5,345
	1/140	5,387	4,481	—	7,825	8,085	—	7,355	7,841	8,181	7,671	5,698	5,557
	1/150	5,466	4,538	—	8,026	8,275	—	7,514	8,025	8,356	7,847	5,798	5,653
	1/200	5,795	4,774	—	8,891	9,086	—	8,196	8,811	9,101	8,601	6,223	6,061
	1/300	6,260	5,108	—	10,185	10,277	—	9,203	9,973	10,189	9,712	6,842	6,656
	1/400	6,591	5,345	—	11,155	11,156	—	9,949	10,834	10,988	10,534	7,297	7,092
	1/500	6,847	5,529	—	11,936	11,856	—	10,545	11,523	11,623	11,191	7,658	7,438
	1/1000	7,646	6,102	—	14,515	14,126	—	12,498	13,776	13,679	13,337	8,829	8,558
2011Flood	55,570	—	1/126	—	1/152	1/207	—	1/127	1/148	1/163	1/154	1/102	1/109

: flood scale occurred in 2011

Table C5.3.4 Results of Frequency Analysis (Runoff Volume Exceeding 2,500 m^3/s)

	annual volume above capacity flow series (sample size N=44)		
	Exponential distribution	generalized pareto distribution	Exponential distribution
	Lexp	Gp	GpExp
X-COR(99%)	0.990	0.968	0.990
P-COR(99%)	0.982	0.997	0.990
SLSC(99%)	0.033	0.041	0.066
log likelihood	-404	-395	-396
pAIC	813	795	796
X-COR(50%)	0.990	0.954	0.990
P-COR(50%)	0.990	0.985	0.986
SLSC(50%)	0.051	0.054	0.105

Probable Value	return period (year)	Lexp	Gp	GpExp
	1/3	1,771	1,463	1,979
	1/5	3,920	3,096	3,761
	1/10	6,621	5,680	6,001
	1/20	9,212	8,865	8,150
	1/30	10,702	11,084	9,386
	1/50	12,566	14,339	10,931
	1/80	14,271	17,867	12,345
	1/100	15,078	19,747	13,015
	1/120	15,738	21,393	13,562
	1/140	16,295	22,865	14,024
	1/150	16,544	23,550	14,230
	1/200	17,582	26,583	15,092
	1/300	19,045	31,394	16,304
	1/400	20,082	35,233	17,164
	1/500	20,886	38,481	17,831
	1/1000	23,382	50,299	19,902
jackknife error estimates	1/3	349	356	361
	1/5	704	683	686
	1/10	1,179	1,116	1,094
	1/20	1,641	1,611	1,486
	1/30	1,908	1,982	1,711
	1/50	2,242	2,612	1,993
	1/80	2,548	3,435	2,251
	1/100	2,693	3,935	2,373
	1/120	2,811	4,407	2,473
	1/140	2,911	4,855	2,557
	1/150	2,956	5,072	2,595
	1/200	3,143	6,089	2,752
	1/300	3,405	7,885	2,973
	1/400	3,592	9,461	3,130
	1/500	3,736	10,883	3,252
	1/1000	4,185	16,652	3,629
2011Flood	15,154	1/102	—	—

: flood scale occurred in 2011

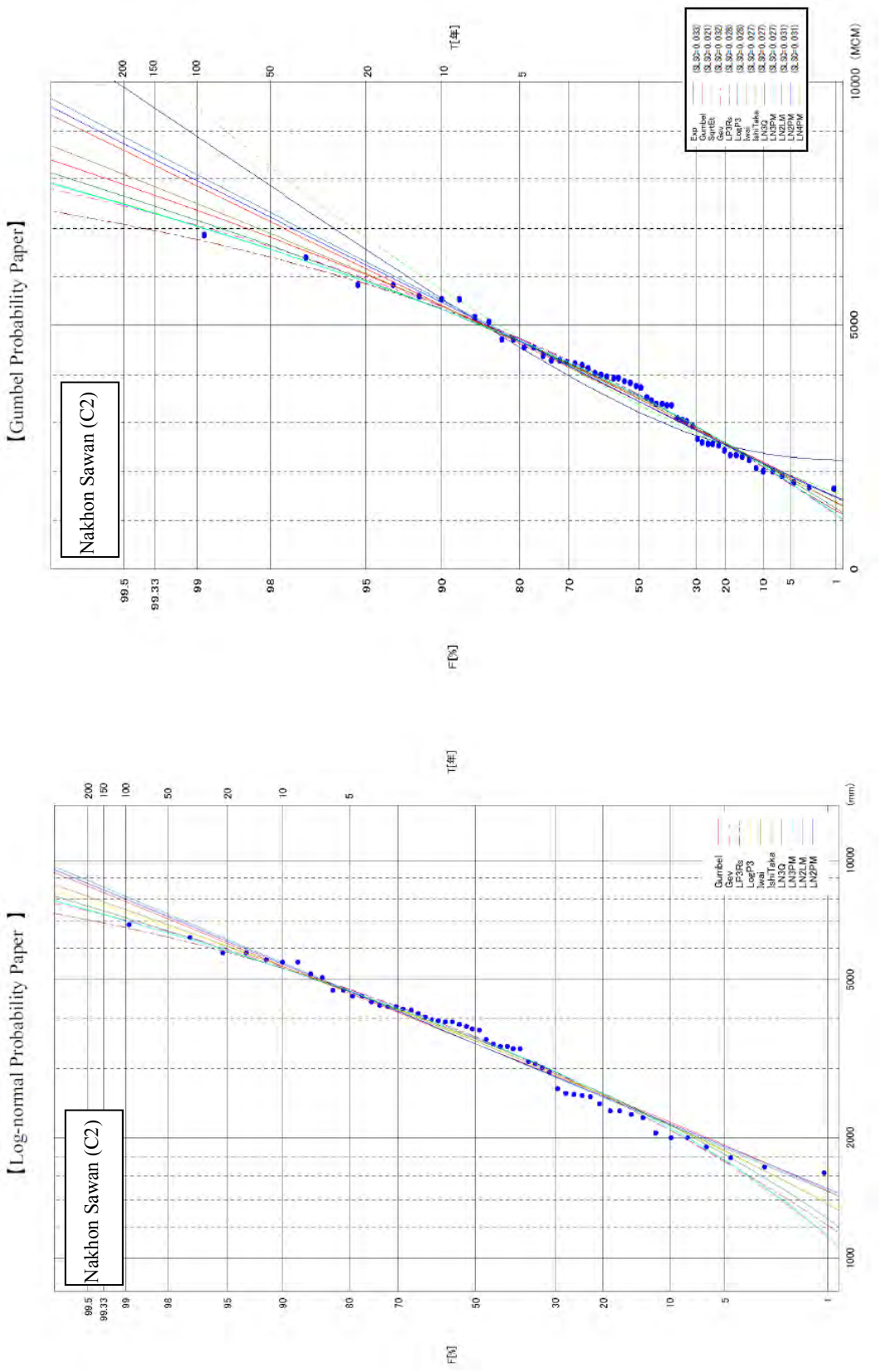


Figure C5.3.1 Frequency Analysis Results of Discharge without Dams at Nakhon Sawan (Maximum Discharge)

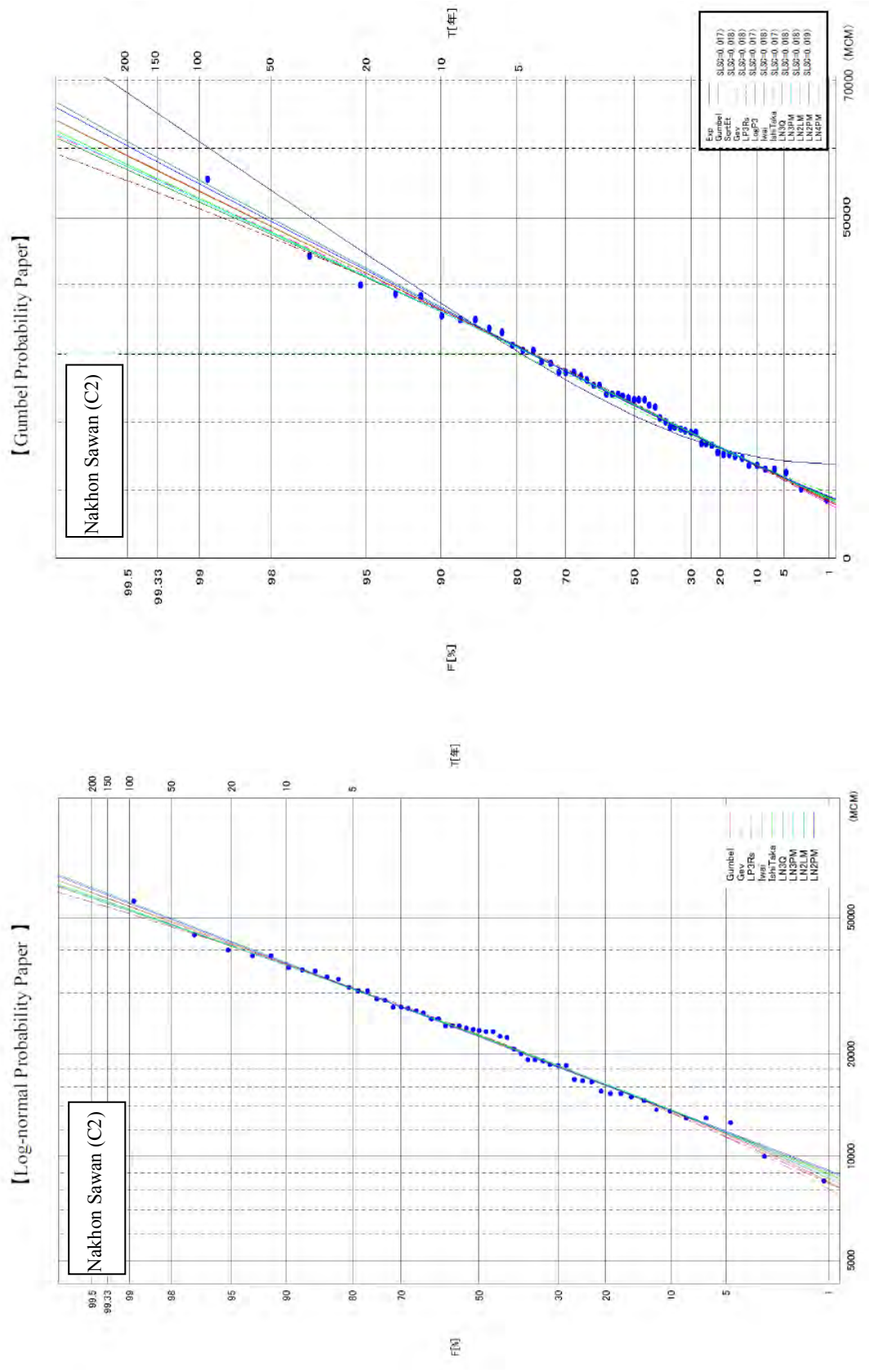


Figure C5.3.2 Frequency Analysis Results of Discharge without Dams at Nakhon Sawan (Total Runoff Volume)

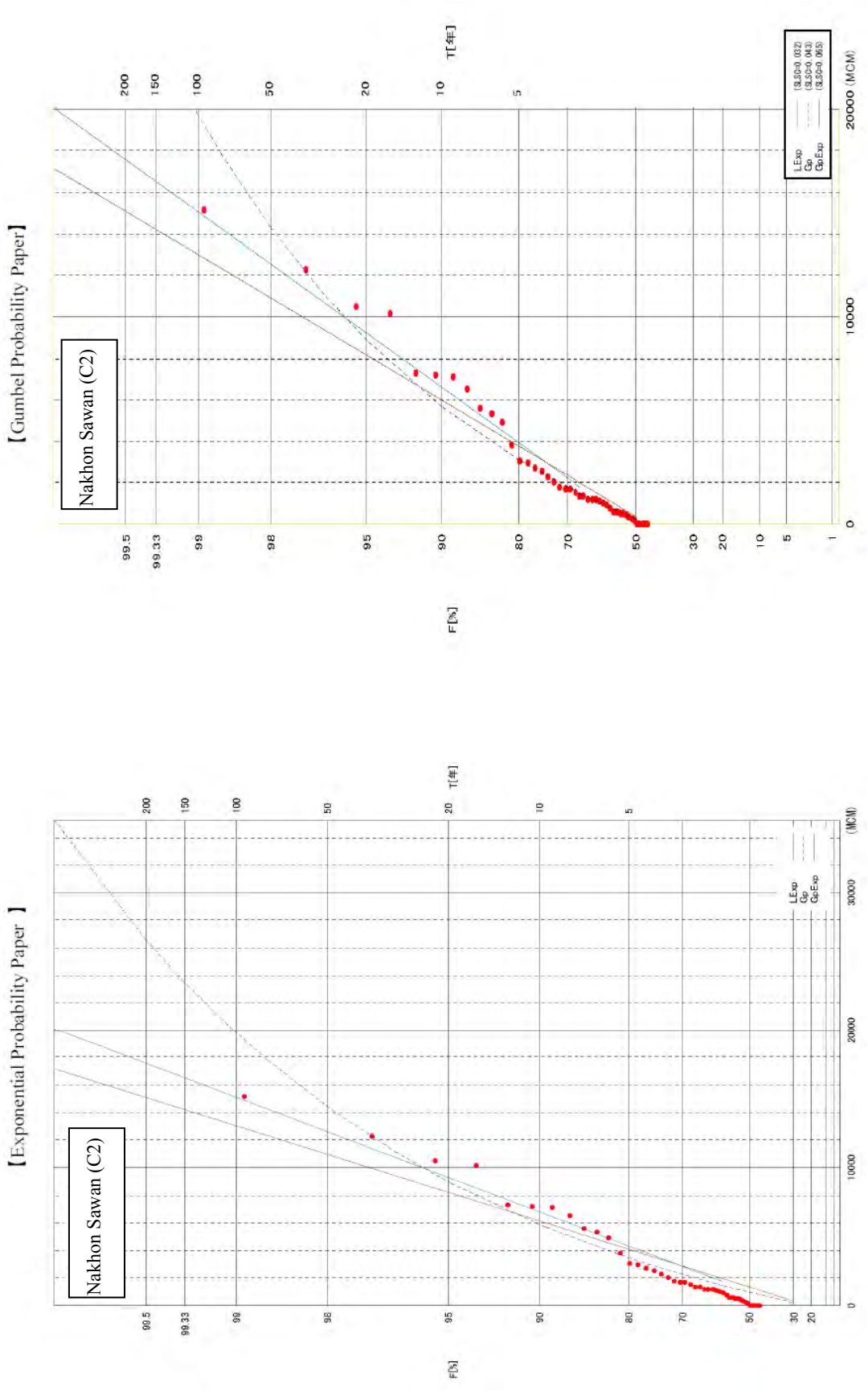


Figure C5.3.3 Frequency Analysis Results of Discharge without Dams at Nakhon Sawan (Total Volume Exceeding Flow Capacity of 2,500 m^3/s)

CHAPTER C6 DETERMINATION OF DESIGN TARGET FLOODS

C6.1 Basic Policy

C6.1.1 Evaluation of Scale of 2011 Flood

Based on the results of the preceding sections, the scale of the 2011 flood is concluded as follows:

- Based on the scale of 1,390 mm, the basin mean 6-month rainfall of the whole basin is evaluated at 90 to 210 years of return period depending on the probability model, while it is 100 years of return period according to results with a probability model that gives the minimum SLSC and suitability of the plotting position of rainfall samples.
- The scale of the runoff volume exceeding 2,500 m^3/s at Nakhon Sawan, which might be regarded as inundation volume, is evaluated at about 100 years of return period.

C6.1.2 External Force for Planning of Flood Mitigation Measures

There are generally two ways to assume an external force for planning of flood mitigation measures. The first way is to directly use observed water levels or river discharges as generally practiced in Thailand. This is much easier, but water levels and discharges will be influenced by future development of the river basin including construction of structural measures and change of land use as well as climate change. Another way is to go back to rainfall data that are not influenced by the ground condition of the river basin. Water levels and discharges that will be fundamental parameters for planning of flood mitigation measures are estimated according to the ground condition through flood simulation. Impact of climate change will be also able to be easily incorporated to rainfall. This second way seems to be more suitable for the Chao Phraya River Basin.

In conclusion, it is proposed to determine the 2011 Flood (1,390 mm/6months for the whole river basin) as the design external force for this Study from the following reasons:

- RID practically adopts 100 years of return period for structural measures for the Chao Phraya River Basin
- The Thai Government also considers flood mitigation measures to cope with floods equivalent to the 2011 Flood at least.
- The rainfall and the runoff discharge volume of the 2011 flood are evaluated at around 100 years of return period.

Howerver, to evaluate the countermeasures prepared in the study, the Flood analysis with other rainfall patterns shall be conducted.

C6.1.3 Evaluation of Scale of 2011 Flood

The design external force is proposed to be the actual rainfall in 2011 as explained in the preceding subsection. Considering possibility of spatial and temporal distribution of rainfall pattern other than that of 2011, it is desirable to check if proposed measures can be still effective against the other rainfall patterns as shown in Figure C6.1.1. Since the scales of rainfalls of the other years is less than 100 years of return period, these rainfalls should be enlarged to the same value as the 2011 Flood.

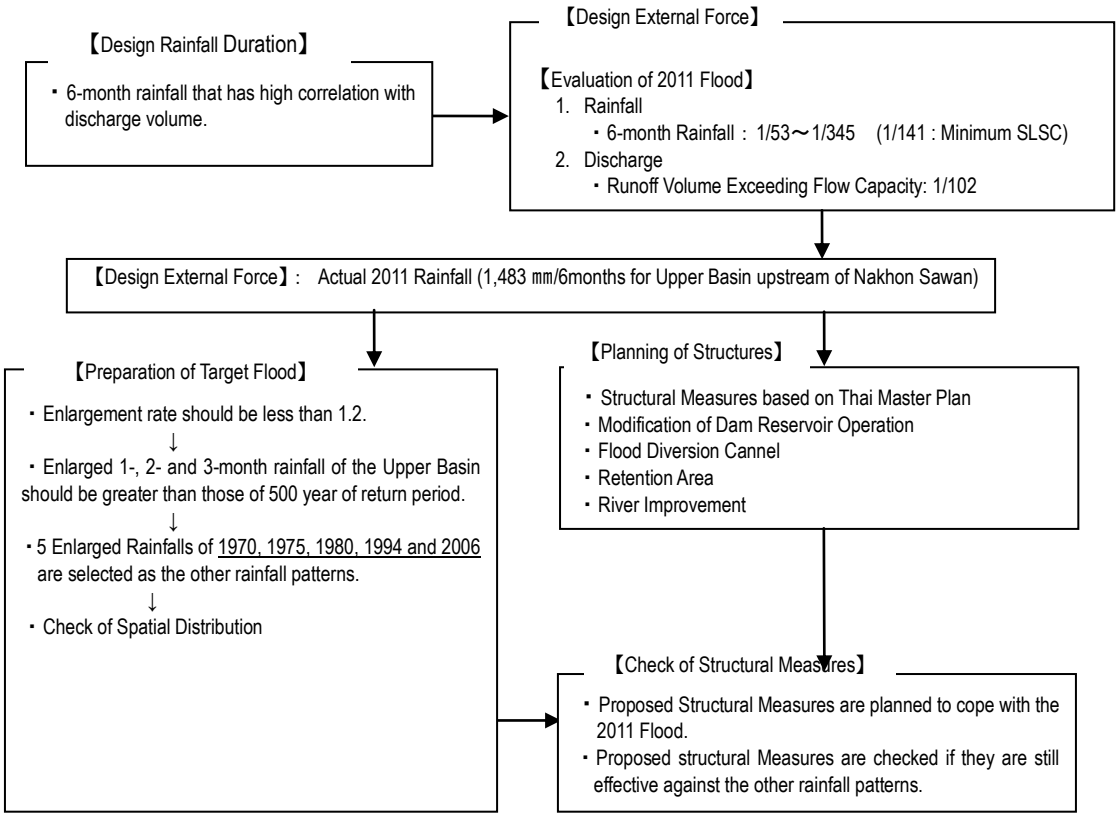


Figure C6.1.1 Flow of Planning of Structural Measures

C6.2 Rainfall Patterns

Rainfalls of the years other than 2011 are enlarged to the same quantity as the design external force. If small rainfalls are enlarged to the 2011 level, the enlarged rainfalls might produce abnormally large river discharges or abnormal shapes of hydrographs when they are used for flood simulation. To avoid this, the enlargement rates should be small and limited to less than a certain value.

Figure C6.2.1 shows a histogram of enlargement rates of 6 month rainfalls of the Upper Basin of the years from 1961 to 2011 (51 years in total) to the actual 6-month rainfall of 2011. According to this figure, the number of years of which enlargement rates are 1.1 or less is 2, and the number of years of which enlargement rates are 1.2 or less is 7. Since 7 rainfall patterns seem sufficient for checking effectiveness of structural measures, the enlargement rates of 1.2 or less are adopted.

From the above discussions, in addition to the 2011 Flood, rainfalls of six years; 1970, 1975, 1980, 1994, 1995 and 2006, are selected as the rainfall patterns to be evaluated.

Table C6.2.1 Enlargement Rates to Actual 2011 Rainfall

year	6-month Rainfall of Upper Basin 1,483mm				1-month rainfall		2-month rainfall		3-month rainfall	
		1,483								
	Actual	Enlargement	Judgement	Ranking	Actual	Enlarged	Actual	Enlarged	Actual	Enlarged
	(mm)	Rate			(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1961	1,208	1.228	Larger than 1.2	11	342	419	571	701	724	889
1962	1,117	1.328	Larger than 1.2	22	325	431	546	725	731	970
1963	1,235	1.201	Larger than 1.2	8	312	375	537	645	771	927
1964	1,163	1.275	Larger than 1.2	19	313	399	519	662	658	839
1965	979	1.515	Larger than 1.2	38	304	460	464	703	598	905
1966	1,065	1.393	Larger than 1.2	31	279	388	474	660	562	783
1967	974	1.522	Larger than 1.2	40	329	501	507	771	616	937
1968	911	1.628	Larger than 1.2	46	209	341	362	589	506	825
1969	1,055	1.406	Larger than 1.2	33	300	422	503	708	652	917
1970	1,266	1.172	○	4	335	393	578	677	733	858
1971	1,144	1.296	Larger than 1.2	20	305	396	511	662	692	897
1972	888	1.669	Larger than 1.2	48	234	391	414	691	555	927
1973	1,207	1.229	Larger than 1.2	12	322	396	577	710	754	927
1974	1,058	1.402	Larger than 1.2	32	273	383	504	706	660	925
1975	1,254	1.183	○	7	340	403	562	664	766	907
1976	1,174	1.263	Larger than 1.2	16	286	361	560	708	726	917
1977	948	1.565	Larger than 1.2	42	321	502	496	775	638	999
1978	1,214	1.222	Larger than 1.2	10	298	364	531	648	784	958
1979	949	1.563	Larger than 1.2	41	271	424	386	603	537	840
1980	1,255	1.181	○	6	326	385	573	677	739	873
1981	1,083	1.369	Larger than 1.2	30	276	377	453	620	681	932
1982	938	1.580	Larger than 1.2	45	292	461	466	737	555	877
1983	1,099	1.349	Larger than 1.2	24	245	330	491	662	675	911
1984	1,015	1.462	Larger than 1.2	35	236	346	401	586	547	800
1985	1,093	1.357	Larger than 1.2	26	245	333	450	610	604	820
1986	1,001	1.481	Larger than 1.2	36	251	373	412	610	531	786
1987	975	1.520	Larger than 1.2	39	316	480	532	809	626	951
1988	1,166	1.272	Larger than 1.2	17	255	324	450	572	625	795
1989	1,024	1.448	Larger than 1.2	34	268	388	401	581	531	770
1990	983	1.508	Larger than 1.2	37	273	411	391	589	510	768
1991	906	1.637	Larger than 1.2	47	275	450	436	714	563	921
1992	947	1.566	Larger than 1.2	44	274	429	467	732	668	1,046
1993	842	1.761	Larger than 1.2	51	274	482	411	723	526	927
1994	1,313	1.130	○	3	341	385	572	646	736	831
1995	1,262	1.175	○	5	358	420	655	770	838	985
1996	1,166	1.272	Larger than 1.2	18	302	384	550	700	696	885
1997	884	1.678	Larger than 1.2	50	251	421	470	788	666	1,118
1998	884	1.678	Larger than 1.2	49	246	413	403	676	601	1,008
1999	1,196	1.240	Larger than 1.2	14	272	337	469	582	647	802
2000	1,093	1.357	Larger than 1.2	25	266	361	421	571	559	759
2001	1,185	1.252	Larger than 1.2	15	313	392	478	598	631	790
2002	1,201	1.235	Larger than 1.2	13	402	496	605	747	728	899
2003	947	1.566	Larger than 1.2	43	266	417	450	705	621	973
2004	1,091	1.360	Larger than 1.2	27	271	369	486	661	624	849
2005	1,085	1.366	Larger than 1.2	29	347	474	525	717	702	959
2006	1,375	1.079	○	2	353	381	621	670	792	855
2007	1,214	1.221	Larger than 1.2	9	305	373	495	604	641	783
2008	1,114	1.331	Larger than 1.2	23	259	344	463	616	628	836
2009	1,090	1.361	Larger than 1.2	28	260	354	441	600	576	784
2010	1,135	1.306	Larger than 1.2	21	341	445	600	784	771	1,007
2011	1,483	1.000	○	1	332	332	629	629	857	857

※1-, 2- and 3-month rainfalls are maximum rainfalls within the period of the maximum 6-month rainfall.

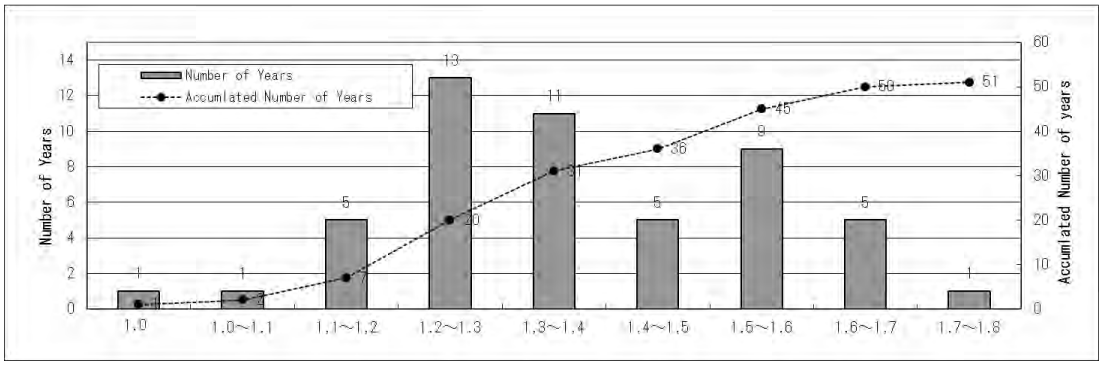


Figure C6.2.1 Histogram of Enlargement Rates to Actual 2011 Rainfall (1961 to 2011)

C6.3 Reference Study on Selection of Rainfall Patterns

Since some of rainfall patterns enraged to the 2011yr level could include the issues on temporal and spatial distribution of rainfall, both temporal and special distribution shall be examined just for reference.

(1) Temporal Distribution

To evaluate the unusual rainfall, it is necessary to examine temporal and spatial distributions of rainfall. However, observation density of rainfall is not so high, especially middle river basin and the results of screening of the examination of temporal and spatial distribution is treated as reference materials.

Regarding the temporal distribution, rainfalls of shorter duration of one to three months that influence very much the formation of peak discharges are focused. Criterion that the one-, two- and three- month rainfalls of the Upper Basin upstream of Nakhon Sawan exceed those of 500 years of return period is proposed for the evaluation of the unusual temporal distribution.

According to a frequency analysis of 6-month rainfalls of stations in the Upper Basin that have observation periods of more than 40 years, the maximum scale of 6-month rainfall, 2,875mm/6months that corresponds to as big as 500-year return period was observed in 1973 at a TMD station, "Doi Chiang Dao Watershed Research (code 7252)" as shown in Figure C6.3.1, Figure C6.3.2, Table C6.3.1 and Figure C6.3.3. This scale, 500-year return period is used as the maximum acceptable scale for the short duration rainfalls.

1	Ping_Ngad	15	Nan_M3
2	Ping_Kwang	16	Nan_M4
3	Ping_Bhumip	17	Nan_D
4	Ping_D	18	Chaophraya
5	Wang_Kiew_K	19	Chaophraya
6	Wang_Kiew_L	20	Chaophraya
7	Wang_D	21	Sakae_Krang
8	Yom_U	22	Tab_Salao_D
9	Yom_M	23	Tab_Salao_D
10	Yom_D	24	Pasak_Dam
11	Nan_U	25	Pasak_D
12	Nan_M1	26	Thachin_Kra
13	Nan_Kwae_No	27	Thachin
14	Nan_M2		

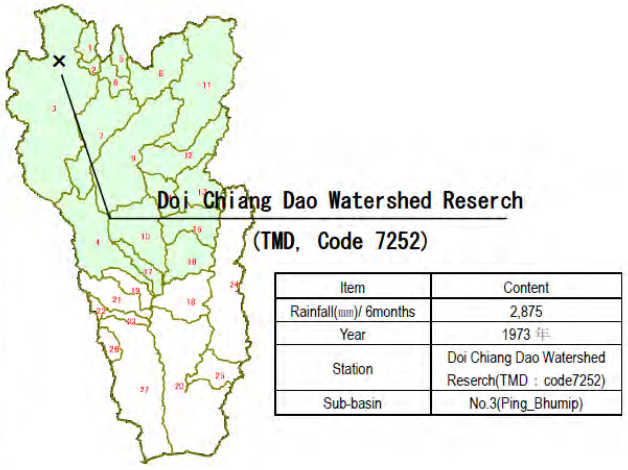


Figure C6.3.1 Location of Doi Chiang Dao Watershed Research (code 7252) Station

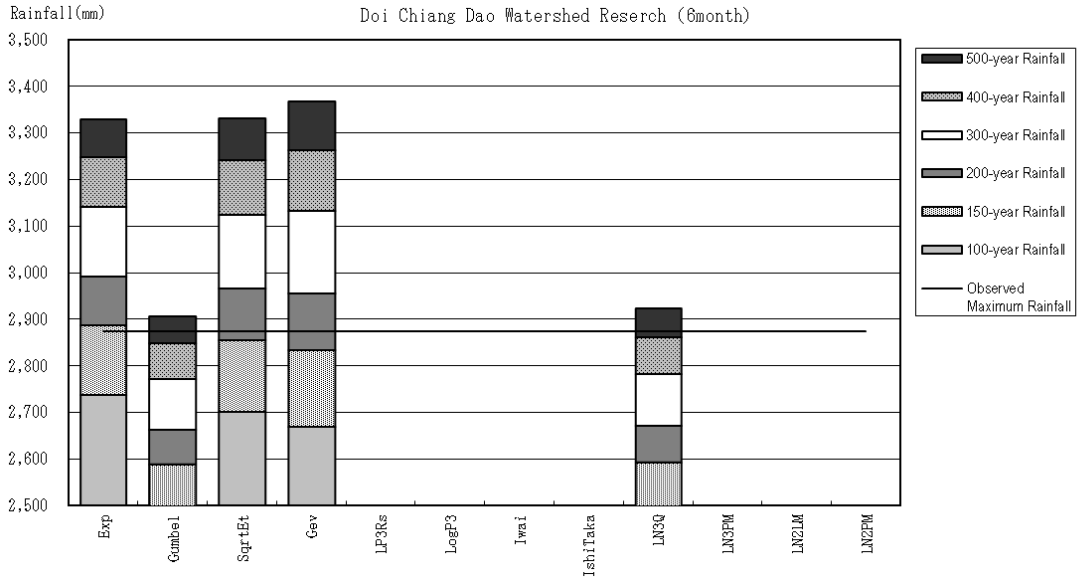


Figure C6.3.2 Probable Rainfalls by Probability Model

Table C6.3.1 Results of Frequency Analysis

		annual 6months rainfall series (sample size N=45)											
		Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
								Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
		Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)		0.964	0.957	0.969	0.972	—	—	—	—	0.957	—	—	—
P-COR(99%)		0.885	0.993	0.992	0.993	—	—	—	—	0.993	—	—	—
SLSC(99%)		0.058	0.067	0.047	0.046	—	—	—	—	0.048	—	—	—
log likelihood		-310.800	-321.600	-321.800	-322.400	—	—	—	—	-321.900	—	—	—
pAIC		625.700	647.100	647.600	650.800	—	—	—	—	649.900	—	—	—
X-COR(50%)		0.955	0.946	0.957	0.961	—	—	—	—	0.945	—	—	—
P-COR(50%)		0.986	0.991	0.989	0.992	—	—	—	—	0.991	—	—	—
SLSC(50%)		0.078	0.133	0.086	0.079	—	—	—	—	0.102	—	—	—
Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,299	1,356	1,345	1,335	—	—	—	—	1,353	—	—	—
	1/3	1,449	1,499	1,492	1,471	—	—	—	—	1,497	—	—	—
	1/5	1,636	1,657	1,665	1,633	—	—	—	—	1,657	—	—	—
	1/10	1,891	1,856	1,894	1,852	—	—	—	—	1,858	—	—	—
	1/20	2,146	2,047	2,127	2,080	—	—	—	—	2,049	—	—	—
	1/30	2,295	2,157	2,267	2,220	—	—	—	—	2,159	—	—	—
	1/50	2,483	2,294	2,447	2,404	—	—	—	—	2,297	—	—	—
	1/80	2,656	2,420	2,618	2,582	—	—	—	—	2,424	—	—	—
	1/100	2,738	2,479	2,701	2,669	—	—	—	—	2,484	—	—	—
	1/150	2,887	2,587	2,854	2,834	—	—	—	—	2,594	—	—	—
	1/200	2,993	2,664	2,965	2,955	—	—	—	—	2,672	—	—	—
	1/300	3,142	2,772	3,125	3,133	—	—	—	—	2,783	—	—	—
	1/400	3,248	2,848	3,241	3,264	—	—	—	—	2,862	—	—	—
	1/500	3,330	2,907	3,332	3,368	—	—	—	—	2,924	—	—	—
	1/700	3,454	2,997	3,471	3,531	—	—	—	—	3,017	—	—	—
	1/1000	3,585	3,091	3,622	3,710	—	—	—	—	3,118	—	—	—
Max=2875mm/6month			: Maximum value is sandwiched between the two values.										

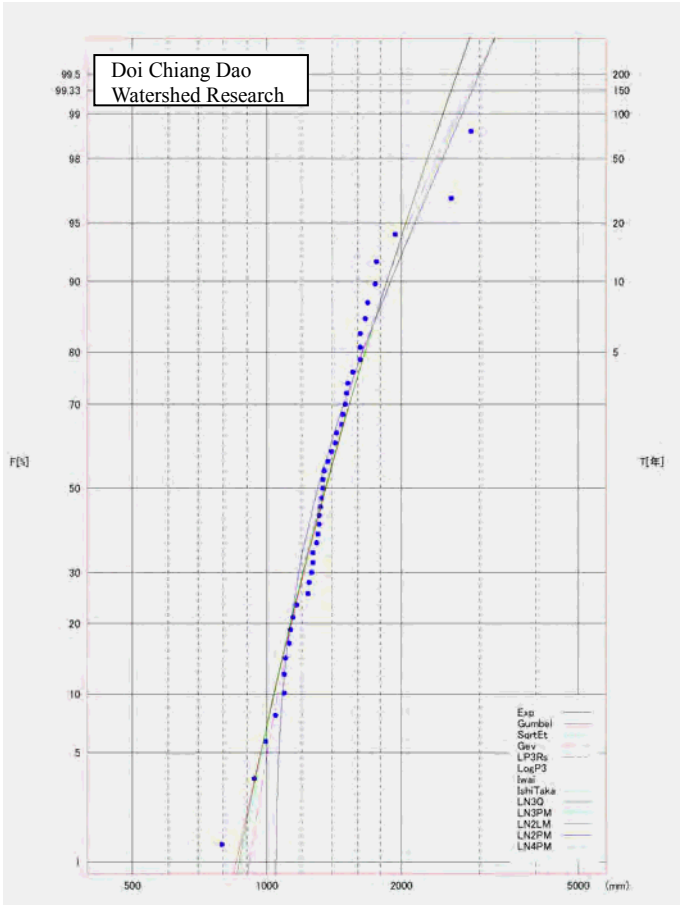


Figure C6.3.3 Results of Frequency Analysis (Log-normal Probability Paper)

1-, 2, and 3-month rainfalls of 500 years of return period of the Upper Basin upstream of Nakhon Sawan are estimated from a variety of probability models as shown in Table C6.3.3, Table C6.3.4 and Table C6.3.5, and then summarized in Table C6.3.2.

Table C6.3.2 Short Duration Rainfalls of 500-year Return Period of Upper Basin

Rainfall	500-year Rainfall (mm)	Probability Model
1-Month Rainfall	429	LN2LM (Minimum SLSC)
2-Month Rainfall	728	Average of models of Minimum SLSC
3-Month Rainfall	926	GEV (Minimum SLSC)

Table C6.3.6 shows the selection result after the rejection of rainfalls of abnormal temporal distribution based on the above-mentioned criterion. 1995, one of the 6 years that passed the criterion of enlargement rate is rejected because both the enlarged 2- and 3-month rainfalls of 761 and 985mm exceed those of 500-year return period of 728 and 926mm.

Table C6.3.3 Result of Frequency Analysis of 1-Month Rainfall of Upper Basin

	1month rainfall series (size N=51)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.932	0.978	0.970	0.990	—	—	0.990	—	—	0.990	0.990	0.990
P-COR(99%)	0.870	0.990	0.991	0.992	—	—	0.992	—	—	0.992	0.992	0.992
SLSC(99%)	0.075	0.042	0.052	0.035	—	—	0.029	—	—	0.029	0.028	0.029
log likelihood	-244.500	-260.100	-260.600	-258.100	—	—	-258.200	—	—	-258.200	-258.200	-258.200
pAIC	492.900	524.100	525.100	522.300	—	—	522.500	—	—	522.400	520.500	520.400
X-COR(50%)	0.973	0.978	0.977	0.976	—	—	0.979	—	—	0.979	0.979	0.979
P-COR(50%)	0.985	0.986	0.988	0.991	—	—	0.990	—	—	0.990	0.990	0.990
SLSC(50%)	0.108	0.078	0.102	0.065	—	—	0.055	—	—	0.056	0.057	0.057

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	280	287	287	292	—	—	292	—	—	292	291	291
	1/3	298	304	307	309	—	—	309	—	—	309	309	309
	1/5	321	323	329	327	—	—	326	—	—	326	326	326
	1/10	352	348	358	346	—	—	345	—	—	345	346	345
	1/20	383	371	388	363	—	—	361	—	—	361	363	362
	1/30	401	384	405	371	—	—	369	—	—	370	373	372
	1/50	423	400	427	381	—	—	379	—	—	380	384	383
	1/80	444	416	448	389	—	—	388	—	—	390	394	392
	1/100	454	423	458	392	—	—	392	—	—	394	398	397
	1/150	472	436	476	398	—	—	400	—	—	401	406	405
	1/200	485	445	490	402	—	—	404	—	—	406	412	410
	1/300	503	458	509	407	—	—	411	—	—	413	420	418
	1/400	516	467	522	411	—	—	416	—	—	418	425	423
	1/500	526	474	533	413	—	—	419	—	—	422	429	427
	1/700	540	485	549	417	—	—	425	—	—	427	435	433
	1/1000	556	497	567	421	—	—	430	—	—	433	441	439
jackknife	1/2	5	5	6	7	—	—	8	—	—	6	5	5
error estimates	1/3	6	6	7	7	—	—	8	—	—	7	6	6
	1/5	7	7	7	7	—	—	7	—	—	7	7	7
	1/10	9	8	8	8	—	—	7	—	—	9	8	8
	1/20	11	10	8	10	—	—	7	—	—	11	10	10
	1/30	12	11	9	12	—	—	8	—	—	13	11	11
	1/50	14	12	10	15	—	—	9	—	—	15	12	12
	1/80	16	14	10	18	—	—	11	—	—	17	13	13
	1/100	17	14	11	20	—	—	12	—	—	18	13	13
	1/150	19	15	11	23	—	—	13	—	—	20	14	14
	1/200	20	16	12	25	—	—	14	—	—	22	15	15
	1/300	21	17	12	28	—	—	16	—	—	24	16	16
	1/400	22	18	13	30	—	—	18	—	—	26	16	16
	1/500	23	19	13	32	—	—	19	—	—	27	17	17
	1/700	25	20	13	34	—	—	20	—	—	29	17	18
	1/1000	26	21	14	37	—	—	22	—	—	32	18	18

less than 0.04(SLSC)
minimum value(SLSC)
used as rainfall of 500-year return period

Table C6.3.4 Result of Frequency Analysis of 2-Month Rainfall of Upper Basin

	2months rainfall series (size N=51)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.938	0.982	0.973	0.995	—	—	0.994	0.995	0.994	0.995	0.994	0.994
P-COR(99%)	0.928	0.995	0.994	0.997	—	—	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(99%)	0.071	0.038	0.046	0.022	—	—	0.023	0.023	0.023	0.023	0.022	0.023
log likelihood	-274.500	-288.400	-288.900	-287.400	—	—	-287.500	-287.600	-287.500	-287.600	-287.600	-287.500
pAIC	553.000	580.700	581.800	580.800	—	—	581.100	581.200	581.000	581.300	579.200	579.100
X-COR(50%)	0.963	0.974	0.966	0.990	—	—	0.987	0.989	0.986	0.989	0.987	0.988
P-COR(50%)	0.989	0.988	0.989	0.992	—	—	0.990	0.990	0.989	0.990	0.991	0.990
SLSC(50%)	0.103	0.071	0.089	0.039	—	—	0.042	0.039	0.045	0.039	0.039	0.041

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	467	479	478	486	—	—	486	487	485	487	486	486
	1/3	499	510	511	518	—	—	516	518	515	518	518	517
	1/5	540	544	549	550	—	—	548	548	547	548	549	548
	1/10	595	588	599	586	—	—	583	582	583	582	585	583
	1/20	651	629	649	617	—	—	615	611	615	611	617	613
	1/30	683	653	679	633	—	—	632	627	633	627	634	630
	1/50	724	683	717	652	—	—	652	646	654	645	655	650
	1/80	762	710	752	667	—	—	670	662	673	662	673	667
	1/100	780	723	769	674	—	—	679	669	682	669	681	675
	1/150	812	747	801	686	—	—	693	683	697	682	696	690
	1/200	835	763	823	694	—	—	704	692	708	691	706	700
	1/300	868	787	856	705	—	—	718	704	723	704	720	713
	1/400	891	804	879	712	—	—	728	713	734	712	730	723
	1/500	908	816	897	718	—	—	736	720	742	719	738	730
	1/700	935	836	925	725	—	—	747	729	754	729	749	741
	1/1000	964	857	955	733	—	—	759	740	766	739	761	752
jackknife	1/2	9	10	10	12	—	—	11	11	12	11	10	10
error estimates	1/3	10	10	11	13	—	—	11	12	13	12	11	11
	1/5	12	12	14	13	—	—	12	13	13	13	12	12
	1/10	15	15	18	14	—	—	15	13	13	13	15	14
	1/20	19	17	22	16	—	—	19	15	16	15	18	17
	1/30	21	19	25	19	—	—	22	16	19	16	19	18
	1/50	25	21	29	22	—	—	26	18	23	18	21	20
	1/80	28	24	32	26	—	—	30	20	28	20	23	22
	1/100	29	25	34	28	—	—	33	21	30	21	24	22
	1/150	32	27	37	32	—	—	36	23	35	23	25	24
	1/200	34	28	39	35	—	—	39	25	38	25	26	25
	1/300	36	30	43	39	—	—	43	27	43	27	28	26
	1/400	38	31	45	42	—	—	46	29	47	29	29	27
	1/500	40	32	47	45	—	—	49	30	50	30	30	28
	1/700	42	34	50	48	—	—	52	32	55	32	31	29
	1/1000	45	36	53	52	—	—	56	35	60	34	32	30

less than 0.04(SLSC) average value used as rainfall of 500-year return period
minimum value(SLSC)

Table C6.3.5 Result of Frequency Analysis of 3-Month Rainfall of Upper Basin

	3months rainfall series (size N=51)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.934	0.980	0.971	0.994	0.993	—	0.993	0.993	0.991	0.993	0.993	0.993
P-COR(99%)	0.933	0.992	0.991	0.997	0.996	—	0.996	0.996	0.996	0.996	0.997	0.996
SLSC(99%)	0.074	0.040	0.048	0.022	0.028	—	0.027	0.027	0.028	0.027	0.026	0.027
log likelihood	-286.700	-300.800	-301.300	-299.700	-299.900	—	-299.900	-299.900	-299.900	-299.900	-299.900	-299.800
pAIC	577.400	605.600	606.500	605.300	605.800	—	605.900	605.800	605.700	605.800	603.800	603.700
X-COR(50%)	0.965	0.975	0.969	0.989	0.989	—	0.988	0.988	0.984	0.988	0.986	0.986
P-COR(50%)	0.986	0.985	0.987	0.989	0.988	—	0.988	0.988	0.987	0.988	0.988	0.987
SLSC(50%)	0.105	0.074	0.092	0.037	0.040	—	0.041	0.041	0.051	0.041	0.043	0.044

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	623	639	638	650	651	—	651	651	646	651	649	649
	1/3	665	678	680	690	690	—	689	689	685	689	689	688
	1/5	717	722	729	730	728	—	727	727	725	727	729	727
	1/10	787	777	792	775	770	—	769	770	773	770	774	771
	1/20	857	830	855	811	805	—	805	806	815	806	814	810
	1/30	899	860	893	830	823	—	824	825	839	825	836	830
	1/50	951	898	940	852	845	—	847	848	867	848	862	855
	1/80	998	933	985	870	864	—	866	869	892	868	884	877
	1/100	1,021	950	1,007	878	873	—	875	878	904	877	895	887
	1/150	1,062	979	1,047	891	888	—	891	894	925	894	913	905
	1/200	1,092	1,001	1,075	900	898	—	902	905	940	905	926	918
	1/300	1,133	1,030	1,116	912	913	—	916	920	960	920	944	935
	1/400	1,162	1,052	1,145	920	922	—	927	931	975	930	956	947
	1/500	1,185	1,068	1,168	926	930	—	934	939	986	939	965	956
	1/700	1,219	1,093	1,204	934	941	—	946	951	1,002	950	979	969
	1/1000	1,255	1,119	1,241	942	952	—	958	964	1,020	963	994	984
jackknife	1/2	12	12	13	15	14	—	19	14	16	14	12	12
error estimates	1/3	13	13	15	16	15	—	18	15	16	15	13	13
	1/5	15	15	18	16	16	—	17	16	16	16	15	15
	1/10	19	18	22	17	17	—	15	17	16	17	18	18
	1/20	23	21	27	21	19	—	18	19	20	19	21	21
	1/30	26	24	30	24	21	—	21	21	23	21	23	22
	1/50	30	26	35	29	24	—	26	24	28	24	25	25
	1/80	34	29	39	34	27	—	32	27	34	27	28	26
	1/100	36	30	40	36	29	—	35	29	37	29	29	27
	1/150	39	33	44	41	32	—	41	32	43	32	30	29
	1/200	42	34	47	45	34	—	45	34	47	34	32	30
	1/300	45	37	51	50	38	—	51	37	53	37	33	32
	1/400	47	38	53	54	40	—	56	40	58	39	35	33
	1/500	49	40	56	56	42	—	60	41	62	41	36	34
	1/700	52	42	59	61	45	—	65	44	67	44	37	35
	1/1000	55	44	63	65	49	—	71	47	74	47	39	37

less than 0.04(SLSC)
minimum value(SLSC)
used as rainfall of 500-year return period

Table C6.3.6 Selection of Other Rainfall Patterns than 2011 after Rejection after Consideration of Temporal Distribution

year	6-month rainfall of Upper Basin (1,483mm)				1-month Rainfall		2-month Rainfall		3-month Rainfall		Temporal	Comprehensive Judgement	Modified Discharge at C.2 Nakhon Sawan without Dam	
	2011Actual	1,483	(mm)		500-year Rainfall(mm)	429	500-year Rainfall(mm)	728	500-year Rainfall(mm)	926	Distribution			
	Actual	Enlargement	Judgement	Ranking	Actual	Enlarged	Actual	Enlarged	Actual	Enlarged	500-year Rainfall		Maximum Discharge	Total Annual Runoff Volume
	(mm)	Rate			(mm)	(mm)	(mm)	(mm)	(mm)	(mm)			(m^3/s)	(MCM)
1961	1,208	1.228	>1.2	11	342	419	566	695	724	889	○	Rejected	4,712	33,006
1962	1,117	1.328	>1.2	22	325	431	541	718	731	970	Rejected	Rejected	3,812	24,096
1963	1,235	1.201	>1.2	8	312	375	531	637	771	926	Rejected	Rejected	2,935	23,717
1964	1,163	1.275	>1.2	19	313	399	512	653	658	839	○	Rejected	5,170	30,419
1965	979	1.514	>1.2	38	304	460	460	696	598	905	Rejected	Rejected	2,004	18,657
1966	1,065	1.392	>1.2	31	279	388	462	643	562	783	○	Rejected	3,919	24,115
1967	974	1.522	>1.2	40	329	501	496	754	616	937	Rejected	Rejected	4,200	18,446
1968	911	1.628	>1.2	46	209	341	360	587	506	824	○	Rejected	1,642	12,963
1969	1,055	1.406	>1.2	33	300	422	505	710	652	917	○	Rejected	4,300	23,212
1970	1,266	1.171	○	4	335	393	561	658	733	858	○	○	5,830	38,524
1971	1,144	1.296	>1.2	20	305	396	501	649	692	897	○	Rejected	3,356	25,320
1972	888	1.669	>1.2	48	234	391	409	682	555	927	Rejected	Rejected	2,000	14,596
1973	1,207	1.228	>1.2	12	322	395	579	711	754	927	Rejected	Rejected	4,539	24,164
1974	1,058	1.402	>1.2	32	273	382	497	697	660	925	○	Rejected	2,672	22,551
1975	1,254	1.183	○	7	340	403	557	659	766	907	○	○	5,535	40,180
1976	1,174	1.263	>1.2	16	286	361	554	700	726	916	○	Rejected	4,285	28,786
1977	948	1.564	>1.2	42	321	502	491	768	638	999	Rejected	Rejected	3,532	18,486
1978	1,214	1.222	>1.2	10	298	364	522	638	784	958	Rejected	Rejected	4,700	34,990
1979	949	1.563	>1.2	41	271	424	388	606	537	839	○	Rejected	1,784	13,013
1980	1,255	1.181	○	6	326	385	565	667	739	873	○	○	5,839	35,623
1981	1,083	1.369	>1.2	30	276	377	446	610	681	932	Rejected	Rejected	3,943	27,166
1982	938	1.580	>1.2	45	292	461	458	723	555	877	Rejected	Rejected	3,362	19,236
1983	1,099	1.349	>1.2	24	245	330	481	649	675	911	○	Rejected	3,763	25,294
1984	1,015	1.461	>1.2	35	236	346	400	584	547	800	○	Rejected	2,442	19,200
1985	1,093	1.357	>1.2	26	245	333	445	604	604	819	○	Rejected	3,068	26,208
1986	1,001	1.481	>1.2	36	251	372	409	606	531	786	○	Rejected	2,251	16,839
1987	975	1.520	>1.2	39	316	480	533	810	626	951	Rejected	Rejected	3,109	16,605
1988	1,166	1.271	>1.2	17	255	324	434	552	625	795	○	Rejected	3,980	23,528
1989	1,024	1.448	>1.2	34	268	388	397	575	531	769	○	Rejected	2,347	15,325
1990	983	1.508	>1.2	37	273	411	382	576	510	768	○	Rejected	1,688	14,909
1991	906	1.637	>1.2	47	275	450	430	704	563	921	Rejected	Rejected	2,602	15,308
1992	947	1.566	>1.2	44	274	428	460	721	668	1,045	Rejected	Rejected	2,343	13,691
1993	842	1.761	>1.2	51	274	482	405	713	526	926	Rejected	Rejected	1,900	8,539
1994	1,313	1.129	○	3	341	385	571	645	736	831	○	○	4,268	33,587
1995	1,262	1.175	○	5	358	420	648	761	838	985	Rejected	Rejected	5,612	38,741
1996	1,166	1.272	>1.2	18	302	383	546	694	696	885	○	Rejected	4,109	31,211
1997	884	1.678	>1.2	50	251	421	467	784	666	1,117	Rejected	Rejected	2,550	13,625
1998	884	1.677	>1.2	49	246	413	398	667	601	1,008	Rejected	Rejected	2,297	10,027
1999	1,196	1.240	>1.2	14	272	337	478	593	647	802	○	Rejected	3,912	30,476
2000	1,093	1.356	>1.2	25	266	361	421	570	559	759	○	Rejected	3,017	27,314
2001	1,185	1.251	>1.2	15	313	392	474	594	631	790	○	Rejected	4,215	28,587
2002	1,201	1.234	>1.2	13	402	496	600	740	728	899	Rejected	Rejected	5,547	35,129
2003	947	1.565	>1.2	43	266	417	445	697	621	973	Rejected	Rejected	3,403	15,513
2004	1,091	1.360	>1.2	27	271	369	474	645	624	848	○	Rejected	3,450	20,655
2005	1,085	1.366	>1.2	29	347	474	525	717	702	959	Rejected	Rejected	3,869	22,229
2006	1,375	1.078	○	2	353	381	619	667	792	854	○	○	6,385	44,332
2007	1,214	1.221	>1.2	9	305	373	487	595	641	783	○	Rejected	4,032	23,304
2008	1,114	1.331	>1.2	23	259	344	459	610	628	835	○	Rejected	3,728	27,243
2009	1,090	1.360	>1.2	28	260	354	446	607	576	784	○	Rejected	4,559	19,077
2010	1,135	1.306	>1.2	21	341	445	593	774	771	1,007	Rejected	Rejected	5,077	26,630
2011	1,483	1.000	○	1	332	332	627	627	857	857	○	○	6,857	55,570
												Maximum	6,857	55,570
												Year of Maximum Value	2011	2011

: Rejected : Year of Maximum Value

※1: 1-, 2- and 3-month rainfalls are maximum rainfalls within the period of the maximum 6-month rainfall.

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(2) Spatial Distribution

In the same way of temporal distribution, the examination of spatial distribution is treated as reference material due to the short of observation density of rainfall.

(a) Criteria of Unusual Large Rainfall

As described in the preceding subsection (b) Temporal Distribution, the observed maximum 6-month rainfall of 2,875mm in 2011 at Doi Chiang Dao Watershed Research (code7252) corresponds to 500-year of return period. According to a frequency analysis, there are in the Upper Basin two stations of which actual 6-month rainfalls in 2011 are greater than those of 1,000-year return period on the other hand, as shown in Table C6.3.7 and Figure C6.3.4. Therefore, 500-year and 1,000-year return periods are considered as the criteria of the unusual large rainfall.

Table C6.3.7 Stations of which 6-Month Rainfall is Greater than Those of 1,000-Year Return Period

Station Code	28053	331201
Name of Station	Thung Chang	Nan*
Actual 2011 Rainfall (mm/6monts)	2,148	1,815
1,000-year Rainfall (mm/6monts)	2,046	1,810
Used Probability Model for Estimation of 1,000-year rainfall	Model of minimum SLSC	Models of minimum SLSC

Figure C6.3.4 Stations of which Rainfalls Were Greater Than 1,000-year Rainfall

(b) Target Stations

In order to check if the enlarged rainfall of a station is greater than 500-year and/or 1,000-year return period, the station should have a certain observation period. Here, 40 years is considered as the minimum observation period. There are in the Upper Basin upstream of Nakhon Sawan 67 stations of which observation period is longer than 40 years, as shown in Figure C6.3.5.

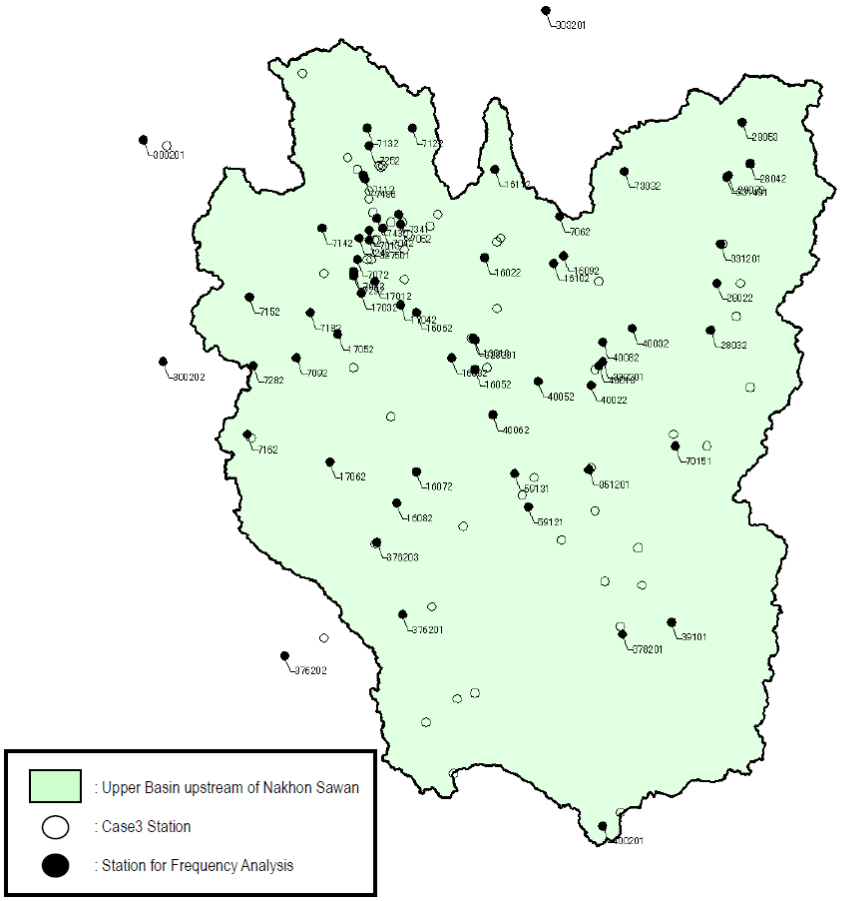

Figure C6.3.5 Location of Rainfall Stations Subjected to Frequency Analysis

(c) Estimation of Probable 500-year and 1,000-year 6-Month Rainfalls

For the 67 stations a frequency analysis is conducted to estimate 500-year and 1,000-year rainfalls as shown in Figure C6.3.6 to Figure C6.3.143, and Table C 6.3.9 to Table C 6.3.43. Following three methods are applied to select the optimum probability model.

1) Model that gives the minimum SLSC
2) Model that gives SLSC of 0.04 or less and gives the minimum error by Jackknife method (If there is no model that gives SLSC of 0.04 or less, the model that gives the minimum error by Jackknife method).
3) Model that gives SLSC of 0.04 or less and gives the minimum rainfall (If there is no model that gives SLSC of 0.04 or less, the model that gives the minimum rainfall).

Obtained 500-year and 1,000-year rainfalls are tabulated in Table C6.3.8.

Table C6.3.8 500-year and 1,000-year 6-Month Rainfalls by Station

No.	code	500-Year Rainfall			1,000-Year Rainfall		
		① SLSC Minumum	② Minimum Error by Jackknife	③ Minimum Rainfall	① SLSC Minumum	② Minimum Error by Jackknife	③ Minimum Rainfall
1	7341	1,782	1,913	1,782	1,821	1,991	1,821
2	7430	2,477	2,232	2,232	2,658	2,351	2,351
3	7480	1,562	1,535	1,528	1,587	1,555	1,542
4	39101	2,261	2,173	2,117	2,365	2,260	2,190
5	59121	1,938	1,927	1,887	2,023	2,010	1,959
6	59131	2,516	2,290	2,143	2,716	2,420	2,246
7	70151	2,014	2,102	1,903	2,106	2,220	1,981
8	7013	1,700	1,697	1,665	1,744	1,747	1,706
9	7042	1,637	1,634	1,524	1,686	1,684	1,549
10	7052	1,732	1,740	1,676	1,789	1,799	1,724
11	7062	1,688	1,728	1,681	1,747	1,806	1,747
12	7072	1,339	1,339	1,109	1,344	1,344	1,109
13	7082	1,166	1,166	1,166	1,172	1,172	1,172
14	7092	1,514	1,534	1,484	1,568	1,594	1,535
15	7112	1,623	1,729	1,623	1,655	1,793	1,655
16	7122	2,017	2,017	2,017	2,100	2,100	2,100
17	7132	2,234	2,122	2,094	2,358	2,220	2,188
18	7142	2,399	2,714	2,399	2,519	2,519	2,519
19	7152	2,164	2,155	2,068	2,309	2,307	2,194
20	7162	1,716	1,716	1,186	1,820	1,820	1,190
21	7182	1,239	1,212	1,208	1,255	1,222	1,220
22	7242	2,028	2,007	2,007	2,051	2,023	2,023
23	7252	3,367	2,907	2,907	3,708	3,091	3,091
24	7282	1,524	1,560	1,504	1,557	1,602	1,527
25	7292	1,554	1,802	1,513	1,612	1,915	1,564
26	16013	1,944	1,773	1,759	2,063	1,856	1,839
27	16022	1,828	1,816	1,703	1,911	1,899	1,856
28	16032	2,167	2,609	2,094	2,245	2,799	2,176
29	16042	1,539	1,419	1,398	1,587	1,437	1,417
30	16052	1,629	1,579	1,579	1,696	1,637	1,632
31	16062	1,910	2,073	1,733	1,998	2,205	1,795
32	16072	1,612	1,575	1,523	1,673	1,631	1,570
33	16082	1,819	1,932	1,716	1,908	2,054	1,793
34	16092	1,879	1,973	1,845	1,949	2,064	1,911
35	16102	1,954	2,016	1,910	2,032	2,339	1,967
36	16112	1,919	1,908	1,843	1,990	1,980	1,899
37	17012	1,794	1,927	1,690	1,891	2,051	1,764
38	17032	1,453	1,403	1,362	1,500	1,443	1,391
39	17042	2,101	2,018	1,836	2,242	2,136	1,905
40	17052	1,590	1,581	1,581	1,660	1,649	1,649
41	17062	1,432	1,374	1,355	1,487	1,452	1,395
42	28022	1,698	1,690	1,678	1,744	1,745	1,731
43	28032	1,654	1,965	1,611	1,704	2,093	1,662
44	28042	1,817	1,781	1,751	1,852	1,801	1,773
45	28053	2,046	2,046	2,046	2,058	2,058	2,058
46	28073	2,002	2,025	1,971	2,045	2,087	2,019
47	40013	1,557	1,557	1,557	1,579	1,579	1,579
48	40022	1,921	1,845	1,845	2,029	1,938	1,936
49	40032	3,401	2,744	2,744	3,831	2,940	2,940
50	40052	2,272	2,272	2,056	2,422	2,422	2,422
51	40062	3,356	3,356	2,904	3,593	3,593	3,045
52	40082	1,622	1,415	1,415	1,669	1,431	1,431
53	73032	1,728	1,730	1,721	1,783	1,795	1,783
54	300201	1,637	1,642	1,632	1,655	1,661	1,649
55	300202	1,560	1,563	1,560	1,582	1,585	1,576
56	303201	2,456	2,422	2,387	2,533	2,495	2,452
57	327501	1,683	1,668	1,629	1,734	1,717	1,668
58	328201	2,189	1,917	1,772	2,369	2,031	1,856
59	330201	1,558	1,557	1,537	1,586	1,592	1,568
60	331201	1,885	1,867	1,771	1,959	1,936	1,810
61	331401	2,268	2,099	2,039	2,363	2,163	2,089
62	351201	2,708	2,463	2,412	2,911	2,602	2,546
63	376201	1,453	1,457	1,420	1,492	1,497	1,451
64	376202	2,420	2,509	2,412	2,488	2,599	2,477
65	376203	2,081	1,907	1,904	2,256	2,025	2,025
66	378201	1,892	1,964	1,887	1,928	2,028	1,928
67	400201	1,657	1,671	1,610	1,694	1,722	1,647

Unit: mm/6months

Table C 6.3.9 Result of Frequency Analysis of 6-Month Rainfall

Station code 3100

	6months rainfall series (number of sumple N=61)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.911	0.970	0.948	0.995	0.994	0.993	—	—	—	—	—	—
P-COR(99%)	0.729	0.995	0.993	0.998	0.996	0.995	—	—	—	—	—	—
SLSC(99%)	0.086	0.049	0.078	0.020	0.030	0.030	—	—	—	—	—	—
log likelihood	-393.700	-420.000	-420.200	-410.900	-410.900	-411.200	—	—	—	—	—	—
pAIC	791.500	843.900	844.500	827.800	827.700	828.500	—	—	—	—	—	—
X-COR(50%)	0.959	0.970	0.957	0.991	0.992	0.993	—	—	—	—	—	—
P-COR(50%)	0.987	0.987	0.992	0.992	0.993	0.995	—	—	—	—	—	—
SLSC(50%)	0.112	0.080	0.148	0.034	0.045	0.059	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	941	977	981	1,008	1,017	1,023	—	—	—	—	—	—
	1/3	1,036	1,068	1,106	1,101	1,108	1,112	—	—	—	—	—	—
	1/5	1,156	1,169	1,252	1,191	1,191	1,192	—	—	—	—	—	—
	1/10	1,318	1,295	1,449	1,286	1,276	1,270	—	—	—	—	—	—
	1/20	1,480	1,417	1,649	1,362	1,342	1,330	—	—	—	—	—	—
	1/30	1,575	1,487	1,770	1,399	1,375	1,358	—	—	—	—	—	—
	1/50	1,694	1,574	1,926	1,441	1,411	1,389	—	—	—	—	—	—
	1/80	1,804	1,654	2,074	1,475	1,441	1,414	—	—	—	—	—	—
	1/100	1,856	1,692	2,147	1,490	1,454	1,425	—	—	—	—	—	—
	1/150	1,951	1,760	2,280	1,514	1,476	1,443	—	—	—	—	—	—
	1/200	2,018	1,809	2,377	1,530	1,490	1,454	—	—	—	—	—	—
	1/300	2,113	1,878	2,517	1,551	1,509	1,469	—	—	—	—	—	—
	1/400	2,180	1,926	2,619	1,564	1,521	1,479	—	—	—	—	—	—
	1/500	2,233	1,964	2,699	1,574	1,530	1,486	—	—	—	—	—	—
	1/700	2,311	2,021	2,822	1,588	1,544	1,496	—	—	—	—	—	—
	1/1000	2,395	2,081	2,955	1,601	1,557	1,505	—	—	—	—	—	—
jackknife	1/2	27	27	26	30	30	33	—	—	—	—	—	—
error estimates	1/3	26	27	38	32	32	34	—	—	—	—	—	—
	1/5	30	30	66	33	33	33	—	—	—	—	—	—
	1/10	39	37	111	36	34	37	—	—	—	—	—	—
	1/20	50	46	159	42	41	55	—	—	—	—	—	—
	1/30	58	51	189	48	47	71	—	—	—	—	—	—
	1/50	68	58	228	58	57	92	—	—	—	—	—	—
	1/80	77	64	267	68	68	114	—	—	—	—	—	—
	1/100	81	68	286	73	74	125	—	—	—	—	—	—
	1/150	90	73	321	83	84	145	—	—	—	—	—	—
	1/200	96	77	347	90	92	160	—	—	—	—	—	—
	1/300	104	83	384	100	104	181	—	—	—	—	—	—
	1/400	110	88	412	107	112	197	—	—	—	—	—	—
	1/500	114	91	434	112	118	209	—	—	—	—	—	—
	1/700	121	96	467	120	128	227	—	—	—	—	—	—
	1/1000	129	101	504	129	139	247	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7013

	6months rainfall series (number of sumple N=64)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.926	0.977	0.962	0.996	0.995	0.995	0.995	0.995	0.994	0.995	0.992	0.992
P-COR(99%)	0.894	0.993	0.992	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
SLSC(99%)	0.079	0.043	0.056	0.021	0.022	0.021	0.022	0.022	0.023	0.022	0.024	0.024
log likelihood	-410.400	-429.900	-430.900	-427.200	-427.400	-427.400	-427.500	-427.600	-427.600	-427.600	-427.800	-427.700
pAIC	824.800	863.800	865.800	860.400	860.700	860.900	861.100	861.100	861.200	861.100	859.500	859.500
X-COR(50%)	0.955	0.967	0.956	0.989	0.989	0.995	0.984	0.986	0.982	0.987	0.980	0.980
P-COR(50%)	0.982	0.981	0.985	0.988	0.987	0.996	0.985	0.986	0.984	0.986	0.985	0.985
SLSC(50%)	0.111	0.080	0.110	0.038	0.043	0.045	0.045	0.043	0.049	0.043	0.053	0.052

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,020	1,055	1,052	1,080	1,085	1,079	1,079	1,083	1,075	1,083	1,072	1,072
	1/3	1,111	1,142	1,151	1,169	1,171	1,165	1,164	1,168	1,161	1,168	1,161	1,159
	1/5	1,226	1,238	1,266	1,257	1,254	1,251	1,250	1,251	1,248	1,251	1,252	1,249
	1/10	1,381	1,360	1,418	1,353	1,343	1,347	1,346	1,343	1,347	1,343	1,358	1,353
	1/20	1,537	1,476	1,572	1,433	1,417	1,429	1,429	1,420	1,434	1,420	1,453	1,445
	1/30	1,627	1,543	1,663	1,473	1,456	1,473	1,474	1,461	1,482	1,461	1,505	1,496
	1/50	1,742	1,627	1,781	1,519	1,500	1,525	1,527	1,510	1,538	1,510	1,567	1,557
	1/80	1,847	1,703	1,893	1,557	1,538	1,570	1,573	1,552	1,588	1,552	1,622	1,611
	1/100	1,897	1,740	1,946	1,573	1,555	1,590	1,594	1,571	1,611	1,571	1,648	1,636
	1/150	1,988	1,806	2,046	1,602	1,585	1,627	1,632	1,605	1,652	1,604	1,694	1,681
	1/200	2,053	1,852	2,118	1,620	1,605	1,652	1,658	1,628	1,681	1,627	1,726	1,712
	1/300	2,144	1,918	2,221	1,645	1,632	1,686	1,694	1,660	1,720	1,659	1,770	1,755
	1/400	2,208	1,964	2,295	1,661	1,651	1,709	1,718	1,681	1,747	1,681	1,801	1,785
	1/500	2,258	2,001	2,354	1,673	1,665	1,727	1,737	1,698	1,768	1,697	1,825	1,809
	1/700	2,334	2,055	2,444	1,690	1,685	1,754	1,765	1,723	1,800	1,722	1,861	1,843
	1/1000	2,414	2,113	2,541	1,706	1,706	1,781	1,795	1,748	1,832	1,747	1,898	1,880
jackknife	1/2	24	24	25	29	28	28	27	28	49	28	24	24
error estimates	1/3	25	25	28	31	30	29	28	29	44	29	26	26
	1/5	28	29	35	32	31	31	30	30	32	30	30	30
	1/10	36	35	46	34	32	33	35	32	29	32	37	36
	1/20	46	42	59	39	36	39	43	36	56	36	44	43
	1/30	52	46	67	44	39	43	50	39	78	39	49	47
	1/50	60	52	78	51	44	49	58	44	109	44	54	52
	1/80	68	58	89	60	49	56	67	49	140	48	60	57
	1/100	72	60	94	64	52	60	71	51	155	51	62	60
	1/150	78	65	104	72	57	67	80	56	183	55	67	64
	1/200	83	68	111	78	62	72	86	59	204	59	70	67
	1/300	90	73	122	87	68	79	94	65	234	64	75	72
	1/400	95	77	130	93	72	85	101	69	255	68	79	75
	1/500	99	79	136	98	76	90	106	72	273	71	81	77
	1/700	104	83	145	106	82	97	114	77	299	76	85	81
	1/1000	111	88	156	113	88	104	122	82	328	81	90	85

less than 0.04(SLSC)
minimum value(SLSC)

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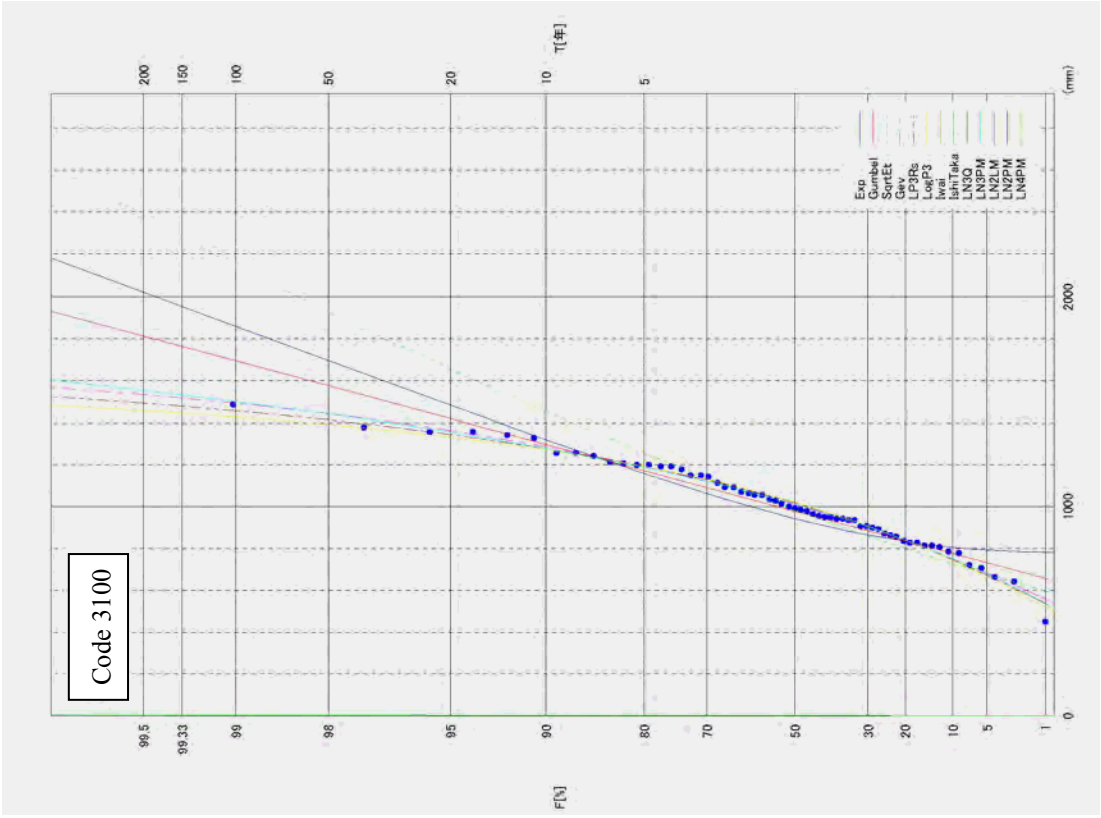

Figure C6.3.6 Probability Distribution on Gumbel Probability Paper (Station code 3100)

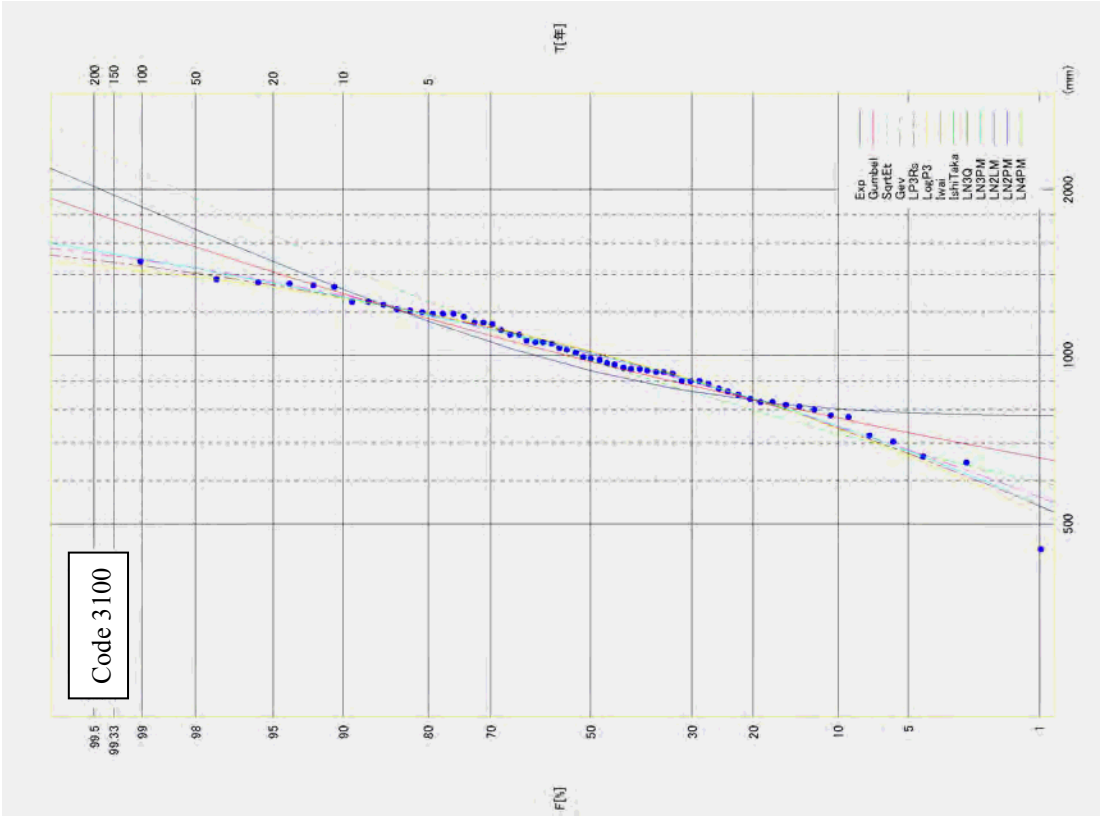

Figure C6.3.7 Probability Distribution on Log-normal Probability Paper (Station code 3100)

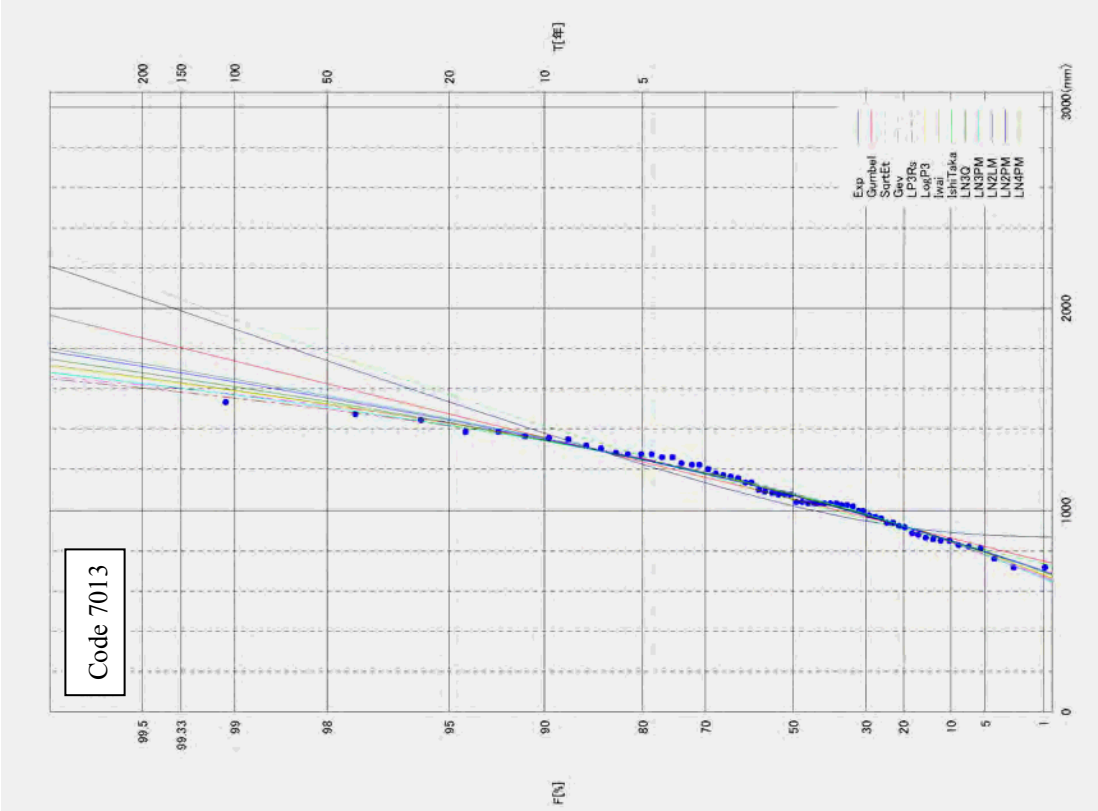

Figure C6.3.8 Probability Distribution on Gumbel Probability Paper (Station code 7013)

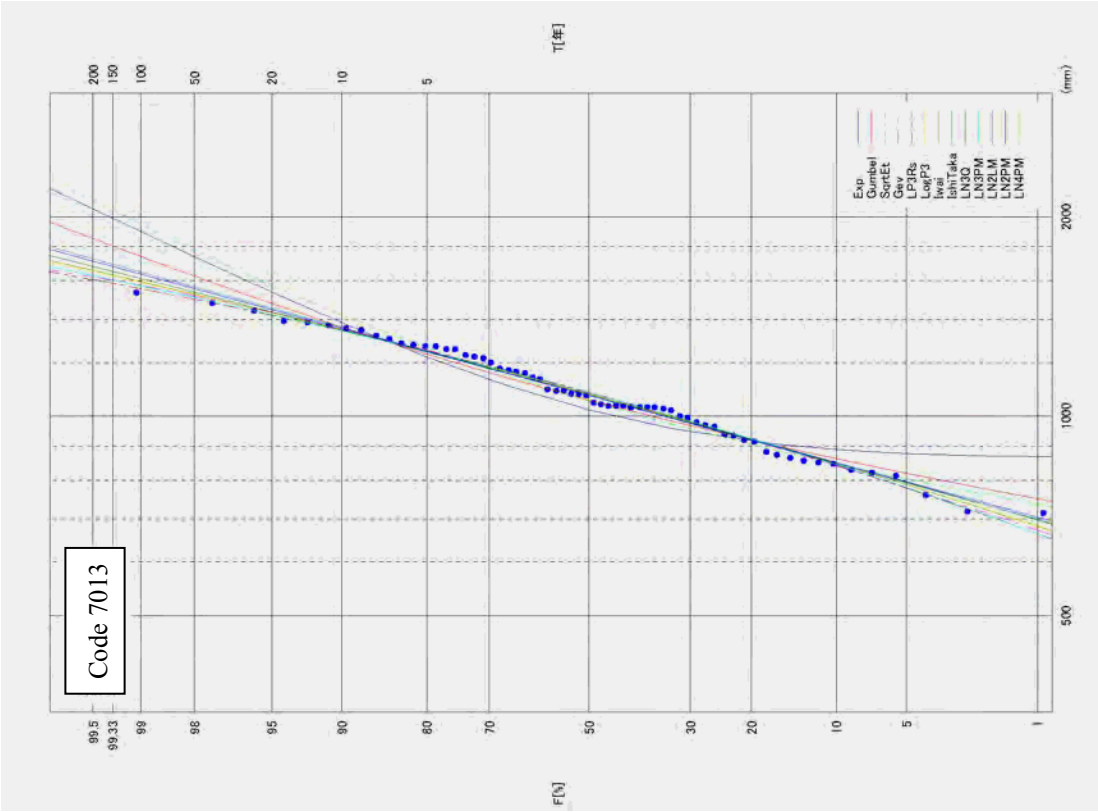

Figure C6.3.9 Probability Distribution on Log-normal Probability Paper (Station code 7013)

Table C 6.3.10 Result of Frequency Analysis of 6-Month Rainfall (1)

Station code 7042

	6months rainfall series (number of sumple N=49)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.910	0.969	0.945	0.994	0.995	0.994	0.994	0.994	0.994	0.994	—	—
P-COR(99%)	0.875	0.988	0.984	0.997	0.997	0.996	0.996	0.996	0.996	0.996	—	—
SLSC(99%)	0.085	0.050	0.067	0.032	0.024	0.023	0.023	0.023	0.024	0.023	—	—
log likelihood	-323.600	-340.400	-341.500	-336.600	-336.400	-336.500	-336.800	-336.800	-336.800	-336.800	—	—
pAIC	651.200	684.700	687.000	679.100	678.800	679.000	679.600	679.600	679.600	679.600	—	—
X-COR(50%)	0.979	0.984	0.978	0.981	0.980	0.994	0.985	0.985	0.985	0.985	—	—
P-COR(50%)	0.988	0.990	0.987	0.992	0.993	0.996	0.993	0.993	0.993	0.993	—	—
SLSC(50%)	0.118	0.089	0.131	0.063	0.051	0.054	0.050	0.049	0.050	0.049	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	870	912	907	956	958	948	951	953	952	953	—	—
	1/3	980	1,017	1,035	1,063	1,064	1,055	1,053	1,055	1,053	1,055	—	—
	1/5	1,119	1,134	1,188	1,163	1,160	1,157	1,151	1,152	1,150	1,152	—	—
	1/10	1,307	1,281	1,393	1,265	1,256	1,265	1,258	1,256	1,254	1,256	—	—
	1/20	1,495	1,422	1,604	1,343	1,329	1,353	1,347	1,342	1,340	1,342	—	—
	1/30	1,605	1,503	1,732	1,381	1,365	1,398	1,394	1,387	1,385	1,387	—	—
	1/50	1,744	1,605	1,897	1,421	1,403	1,448	1,448	1,439	1,438	1,439	—	—
	1/80	1,872	1,697	2,055	1,453	1,434	1,491	1,495	1,483	1,483	1,483	—	—
	1/100	1,932	1,741	2,132	1,467	1,448	1,510	1,516	1,503	1,503	1,503	—	—
	1/150	2,042	1,821	2,274	1,489	1,470	1,542	1,553	1,538	1,539	1,538	—	—
	1/200	2,121	1,878	2,378	1,503	1,484	1,564	1,578	1,562	1,563	1,562	—	—
	1/300	2,231	1,957	2,528	1,521	1,503	1,593	1,613	1,595	1,596	1,595	—	—
	1/400	2,309	2,014	2,636	1,533	1,515	1,613	1,637	1,617	1,619	1,617	—	—
	1/500	2,369	2,057	2,722	1,541	1,524	1,627	1,655	1,634	1,636	1,634	—	—
	1/700	2,461	2,123	2,854	1,552	1,537	1,648	1,681	1,658	1,661	1,659	—	—
	1/1000	2,558	2,193	2,996	1,563	1,549	1,669	1,709	1,684	1,687	1,684	—	—
jackknife	1/2	35	34	36	40	39	40	—	—	—	37	—	—
error estimates	1/3	34	34	40	40	39	40	—	—	—	38	—	—
	1/5	37	37	48	40	40	40	—	—	—	40	—	—
	1/10	46	45	63	45	45	45	—	—	—	41	—	—
	1/20	60	54	81	57	55	55	—	—	—	42	—	—
	1/30	68	60	93	66	63	64	—	—	—	43	—	—
	1/50	80	68	110	78	74	76	—	—	—	43	—	—
	1/80	90	76	126	90	85	88	—	—	—	44	—	—
	1/100	96	79	134	96	91	94	—	—	—	44	—	—
	1/150	105	86	149	106	101	105	—	—	—	45	—	—
	1/200	112	91	160	113	108	113	—	—	—	46	—	—
	1/300	122	98	177	122	118	125	—	—	—	46	—	—
	1/400	129	103	189	129	125	134	—	—	—	47	—	—
	1/500	134	107	199	134	131	140	—	—	—	48	—	—
	1/700	142	112	214	141	139	150	—	—	—	48	—	—
	1/1000	151	119	230	148	148	161	—	—	—	49	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7052

	6months rainfall series (number of sumple N=51)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.936	0.981	0.967	0.993	0.993	0.993	0.993	0.993	0.992	0.993	0.991	0.991
P-COR(99%)	0.856	0.996	0.993	0.996	0.995	0.995	0.995	0.995	0.994	0.995	0.996	0.996
SLSC(99%)	0.073	0.039	0.054	0.029	0.024	0.024	0.024	0.024	0.027	0.024	0.026	0.026
log likelihood	-328.400	-344.300	-345.300	-342.200	-342.300	-342.300	-342.300	-342.300	-342.500	-342.300	-342.400	-342.400
pAIC	660.800	692.600	694.500	690.400	690.500	690.500	690.600	690.600	691.000	690.600	688.900	688.900
X-COR(50%)	0.951	0.961	0.950	0.978	0.980	0.993	0.977	0.977	0.980	0.977	0.973	0.973
P-COR(50%)	0.992	0.991	0.991	0.989	0.988	0.995	0.988	0.988	0.987	0.988	0.989	0.989
SLSC(50%)	0.096	0.069	0.102	0.056	0.061	0.057	0.058	0.058	0.069	0.058	0.053	0.053

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	998	1,034	1,032	1,051	1,060	1,057	1,058	1,057	1,064	1,057	1,050	1,050
	1/3	1,091	1,123	1,136	1,143	1,149	1,146	1,146	1,146	1,151	1,146	1,141	1,140
	1/5	1,209	1,222	1,257	1,236	1,237	1,236	1,235	1,234	1,235	1,234	1,235	1,234
	1/10	1,368	1,346	1,418	1,343	1,334	1,336	1,334	1,334	1,327	1,334	1,344	1,342
	1/20	1,528	1,466	1,581	1,435	1,416	1,422	1,420	1,420	1,405	1,420	1,442	1,439
	1/30	1,621	1,535	1,678	1,483	1,460	1,468	1,466	1,467	1,445	1,466	1,495	1,492
	1/50	1,739	1,621	1,804	1,540	1,511	1,523	1,521	1,522	1,493	1,521	1,560	1,557
	1/80	1,847	1,699	1,922	1,588	1,554	1,570	1,568	1,570	1,534	1,569	1,618	1,614
	1/100	1,899	1,737	1,980	1,609	1,574	1,592	1,590	1,592	1,553	1,591	1,645	1,640
	1/150	1,992	1,804	2,086	1,647	1,609	1,630	1,629	1,631	1,586	1,630	1,692	1,688
	1/200	2,058	1,852	2,163	1,672	1,633	1,657	1,656	1,658	1,608	1,657	1,726	1,721
	1/300	2,152	1,920	2,273	1,706	1,665	1,693	1,693	1,696	1,639	1,694	1,772	1,767
	1/400	2,218	1,968	2,353	1,729	1,688	1,718	1,718	1,721	1,660	1,720	1,804	1,799
	1/500	2,269	2,005	2,416	1,746	1,705	1,737	1,738	1,741	1,676	1,740	1,829	1,823
	1/700	2,347	2,061	2,512	1,770	1,730	1,765	1,767	1,771	1,700	1,769	1,867	1,860
	1/1000	2,429	2,120	2,616	1,795	1,755	1,794	1,797	1,801	1,724	1,799	1,906	1,899
jackknife	1/2	27	28	28	30	31	30	32	31	32	31	28	28
error estimates	1/3	29	30	32	34	35	33	34	34	35	34	31	31
	1/5	35	36	42	38	38	37	37	37	37	37	37	36
	1/10	47	45	60	44	41	43	41	41	41	41	47	45
	1/20	61	55	81	52	45	51	48	45	48	45	58	55
	1/30	70	62	94	59	48	57	53	49	53	49	65	61
	1/50	81	70	111	68	52	66	60	54	61	53	73	69
	1/80	91	77	128	78	58	76	68	59	70	58	81	76
	1/100	96	81	136	84	61	81	71	61	75	61	84	79
	1/150	105	87	152	94	66	91	78	67	83	66	91	86
	1/200	112	92	163	102	71	98	84	71	90	70	96	90
	1/300	121	98	180	114	78	109	92	77	99	76	103	97
	1/400	128	103	192	123	83	118	97	81	106	80	108	101
	1/500	133	107	202	130	88	124	102	85	112	84	112	105
	1/700	141	112	217	141	94	134	109	91	121	89	117	110
	1/1000	149	118	233	153	102	146	117	97	130	95	124	116

less than 0.04(SLSC)
minimum value(SLSC)

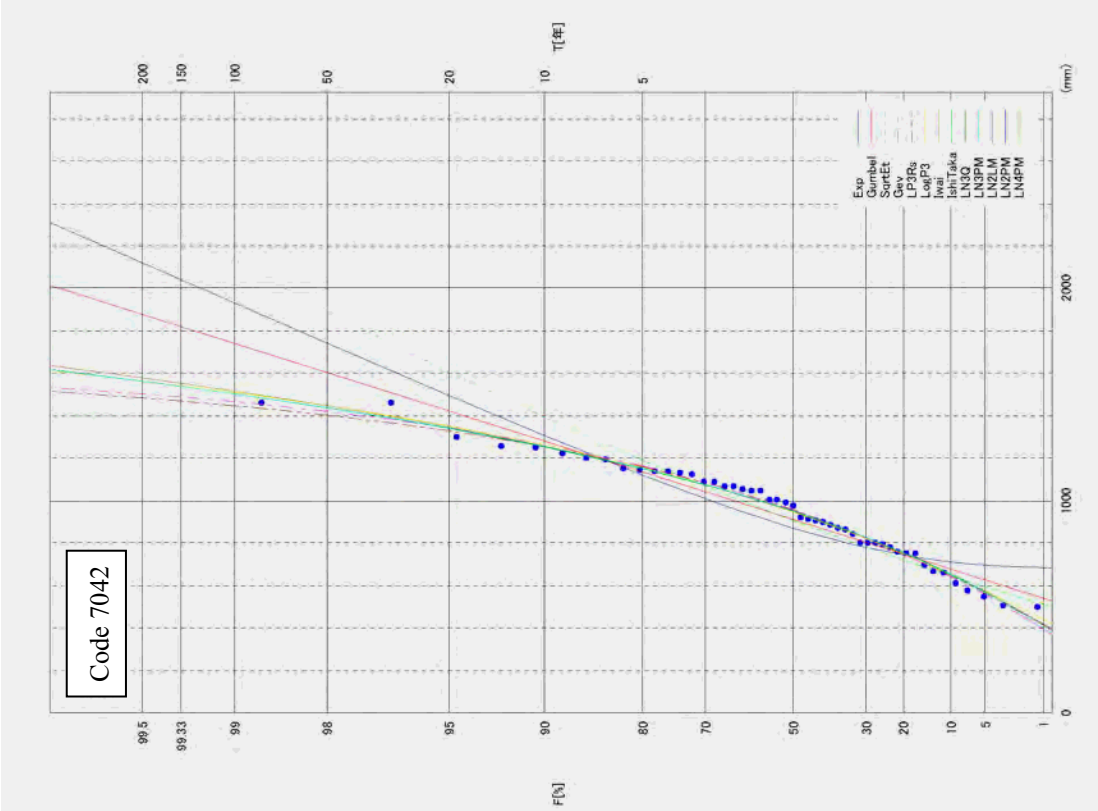

Figure C6.3.10 Probability Distribution on Gumbel Probability Paper (Station code 7042)

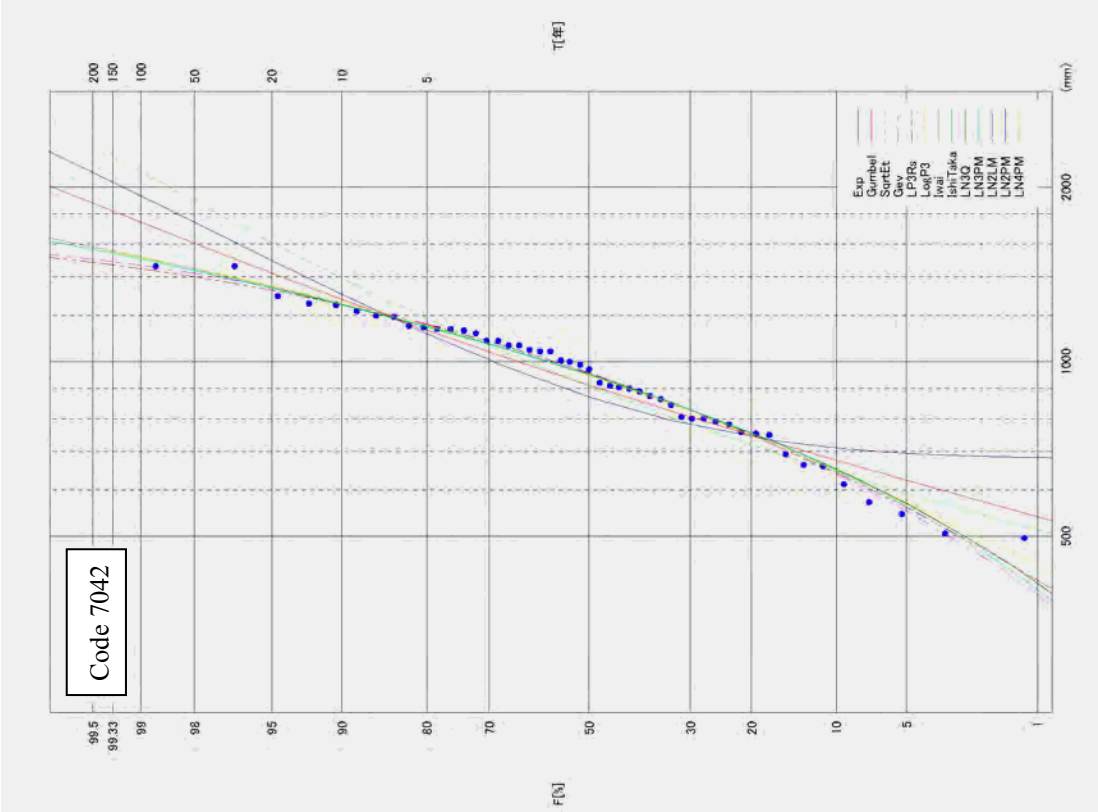

Figure C6.3.11 Probability Distribution on Log-normal Probability Paper (Station code 7042)

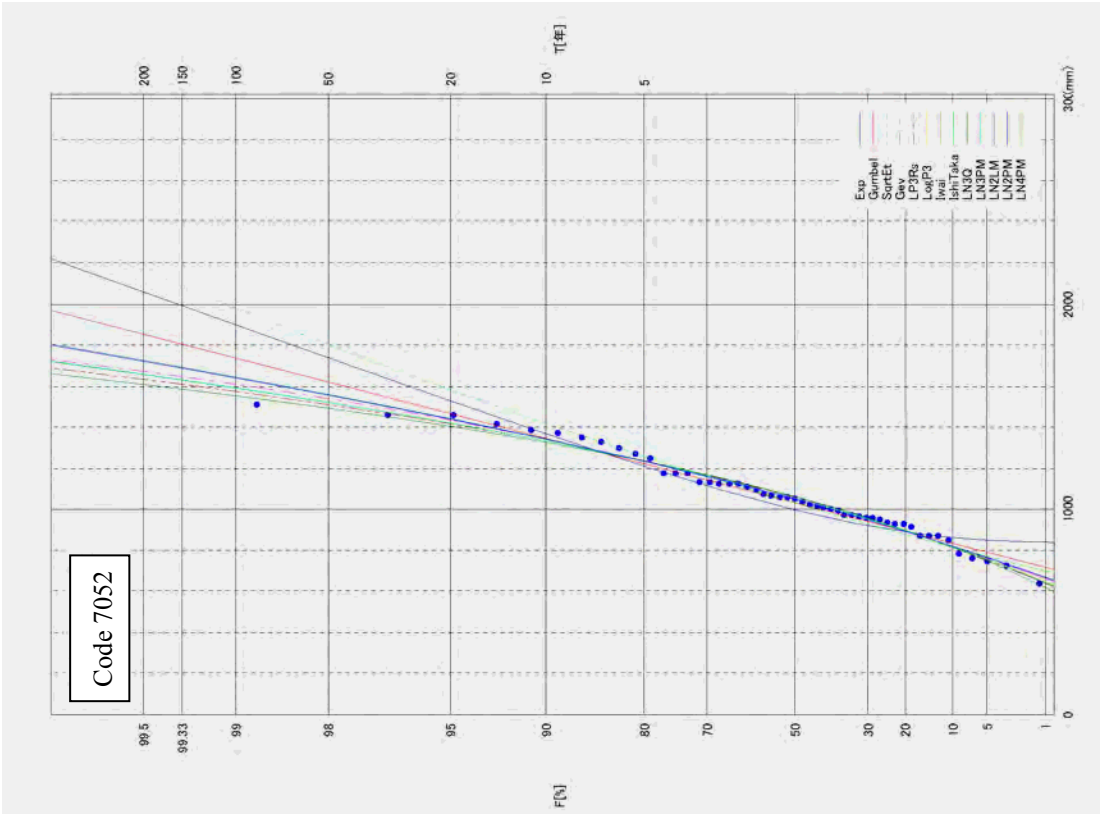

Figure C6.3.12 Probability Distribution on Gumbel Probability Paper (Station code 7052)

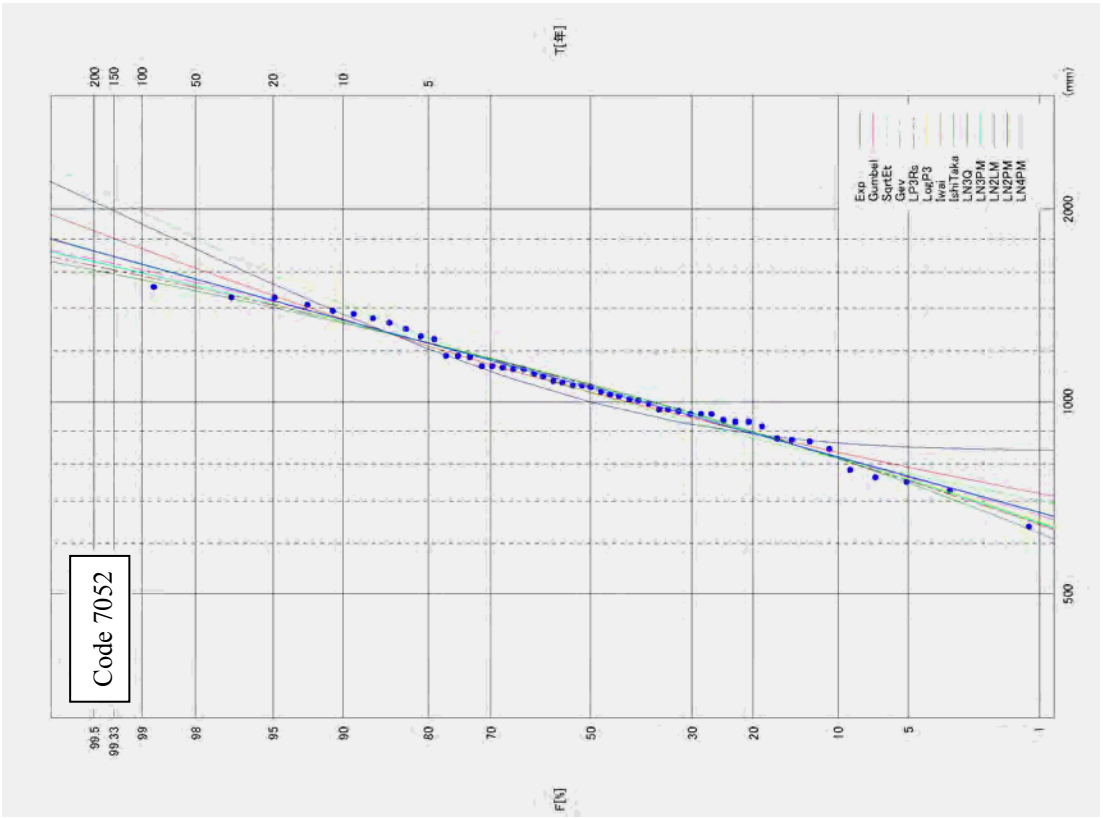

Figure C6.3.13 Probability Distribution on Log-normal Probability Paper (Station code 7052)

Table C 6.3.11 Result of Frequency Analysis of 6-Month Rainfall (2)

Station code 7062

table code7062地点 (rainfall duration 6 months)

	6months rainfall series (number of sumple N=43)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.959	0.993	0.985	0.996	0.995	—	0.995	0.996	0.996	0.996	0.996	0.996
P-COR(99%)	0.915	0.992	0.990	0.995	0.995	—	0.995	0.995	0.994	0.995	0.995	0.995
SLSC(99%)	0.058	0.024	0.038	0.019	0.021	—	0.021	0.021	0.022	0.021	0.020	0.020
log likelihood	-276.900	-288.400	-289.100	-287.900	—	—	-288.000	-287.900	-287.900	-287.900	-287.900	-287.900
pAIC	557.700	580.800	582.200	581.800	0.000	—	582.000	581.800	581.900	581.800	579.900	579.800
X-COR(50%)	0.988	0.992	0.988	0.994	0.994	—	0.994	0.994	0.994	0.994	0.994	0.994
P-COR(50%)	0.992	0.991	0.992	0.991	0.990	—	0.990	0.990	0.991	0.990	0.991	0.990
SLSC(50%)	0.069	0.034	0.066	0.030	0.040	—	0.040	0.035	0.031	0.035	0.033	0.034

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	896	931	926	946	950	—	950	946	941	946	946	946
	1/3	989	1,020	1,023	1,037	1,039	—	1,039	1,035	1,030	1,035	1,036	1,035
	1/5	1,107	1,120	1,137	1,132	1,131	—	1,129	1,127	1,125	1,127	1,131	1,128
	1/10	1,266	1,244	1,287	1,242	1,235	—	1,233	1,235	1,238	1,235	1,241	1,237
	1/20	1,426	1,364	1,439	1,339	1,328	—	1,325	1,332	1,341	1,331	1,341	1,335
	1/30	1,519	1,432	1,531	1,391	1,378	—	1,375	1,385	1,399	1,384	1,396	1,389
	1/50	1,636	1,518	1,648	1,453	1,438	—	1,436	1,450	1,470	1,449	1,462	1,454
	1/80	1,745	1,597	1,759	1,506	1,490	—	1,489	1,507	1,533	1,506	1,522	1,512
	1/100	1,796	1,634	1,813	1,531	1,515	—	1,514	1,534	1,563	1,532	1,549	1,539
	1/150	1,889	1,702	1,913	1,573	1,558	—	1,557	1,582	1,617	1,580	1,599	1,588
	1/200	1,956	1,750	1,985	1,602	1,588	—	1,588	1,616	1,654	1,613	1,634	1,622
	1/300	2,049	1,817	2,089	1,641	1,630	—	1,630	1,662	1,707	1,659	1,682	1,669
	1/400	2,115	1,865	2,164	1,668	1,659	—	1,660	1,695	1,744	1,691	1,716	1,702
	1/500	2,166	1,902	2,223	1,688	1,681	—	1,682	1,720	1,773	1,716	1,742	1,728
	1/700	2,244	1,958	2,314	1,717	1,714	—	1,716	1,758	1,816	1,754	1,781	1,766
	1/1000	2,326	2,017	2,412	1,747	1,748	—	1,752	1,798	1,862	1,793	1,822	1,806
jackknife	1/2	29	30	30	32	33	—	31	34	28	34	30	30
error estimates	1/3	32	34	35	36	37	—	35	37	31	37	35	34
	1/5	40	41	44	42	42	—	41	42	40	42	42	41
	1/10	55	53	58	54	53	—	53	53	60	53	53	52
	1/20	71	65	73	71	69	—	67	68	83	68	66	63
	1/30	82	72	84	84	79	—	77	79	99	79	73	70
	1/50	95	82	97	102	95	—	91	94	120	93	82	78
	1/80	107	90	110	120	110	—	104	109	140	108	91	86
	1/100	112	94	117	129	118	—	111	117	150	116	95	90
	1/150	123	102	129	146	133	—	123	131	169	129	103	97
	1/200	131	107	138	159	144	—	132	142	183	140	109	102
	1/300	141	115	151	177	160	—	146	157	202	155	116	109
	1/400	149	120	160	190	172	—	156	169	217	166	122	114
	1/500	155	125	168	201	181	—	163	178	228	174	126	118
	1/700	164	131	179	217	196	—	175	192	246	188	133	125
	1/1000	173	138	192	234	212	—	188	207	265	202	140	131

less than 0.04(SLSC)

Station code 7072

table code7072地点 (rainfall duration 6 months)

	6months rainfall series (number of sumple N=49)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type Ⅲ distribution(real-space)	Peason type Ⅲ distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.805	0.895	0.835	0.978	0.929	—	—	—	—	—	—	—
P-COR(99%)	0.413	0.978	0.953	0.996	-0.549	—	—	—	—	—	—	—
SLSC(99%)	0.127	0.094	0.137	0.057	0.174	—	—	—	—	—	—	—
log likelihood	-320.400	-409.500	-363.800	-333.100	—	—	—	—	—	—	—	—
pAIC	644.900	823.000	731.500	672.200	0.000	—	—	—	—	—	—	—
X-COR(50%)	0.956	0.967	0.943	0.995	0.846	—	—	—	—	—	—	—
P-COR(50%)	0.996	0.996	0.994	0.995	-0.815	—	—	—	—	—	—	—
SLSC(50%)	0.135	0.109	0.254	0.111	1.413	—	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	874	913	942	984	1,048	—	—	—	—	—	—	—
	1/3	977	1,012	1,191	1,078	1,091	—	—	—	—	—	—	—
	1/5	1,107	1,121	1,498	1,155	1,105	—	—	—	—	—	—	—
	1/10	1,283	1,259	1,926	1,223	1,109	—	—	—	—	—	—	—
	1/20	1,460	1,391	2,379	1,266	1,109	—	—	—	—	—	—	—
	1/30	1,563	1,467	2,660	1,284	1,109	—	—	—	—	—	—	—
	1/50	1,693	1,562	3,030	1,301	1,109	—	—	—	—	—	—	—
	1/80	1,813	1,649	3,387	1,313	1,109	—	—	—	—	—	—	—
	1/100	1,870	1,691	3,563	1,318	1,109	—	—	—	—	—	—	—
	1/150	1,973	1,765	3,891	1,325	1,109	—	—	—	—	—	—	—
	1/200	2,046	1,818	4,132	1,330	1,109	—	—	—	—	—	—	—
	1/300	2,149	1,893	4,483	1,335	1,109	—	—	—	—	—	—	—
	1/400	2,223	1,946	4,739	1,337	1,109	—	—	—	—	—	—	—
	1/500	2,279	1,987	4,943	1,339	1,109	—	—	—	—	—	—	—
	1/700	2,365	2,049	5,257	1,342	1,109	—	—	—	—	—	—	—
	1/1000	2,456	2,114	5,599	1,344	1,109	—	—	—	—	—	—	—
jackknife	1/2	41	37	31	33	69	—	—	—	—	—	—	—
error estimates	1/3	32	30	140	32	33	—	—	—	—	—	—	—
	1/5	29	29	305	31	55	—	—	—	—	—	—	—
	1/10	40	38	546	33	113	—	—	—	—	—	—	—
	1/20	60	52	808	40	159	—	—	—	—	—	—	—
	1/30	73	61	974	46	180	—	—	—	—	—	—	—
	1/50	90	73	1,195	55	203	—	—	—	—	—	—	—
	1/80	106	84	1,411	63	220	—	—	—	—	—	—	—
	1/100	114	90	1,517	66	228	—	—	—	—	—	—	—
	1/150	128	100	1,719	73	240	—	—	—	—	—	—	—
	1/200	138	107	1,867	77	247	—	—	—	—	—	—	—
	1/300	152	117	2,085	82	257	—	—	—	—	—	—	—
	1/400	162	124	2,244	86	263	—	—	—	—	—	—	—
	1/500	170	130	2,371	88	267	—	—	—	—	—	—	—
	1/700	182	138	2,569	92	273	—	—	—	—	—	—	—
	1/1000	194	147	2,784	95	278	—	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

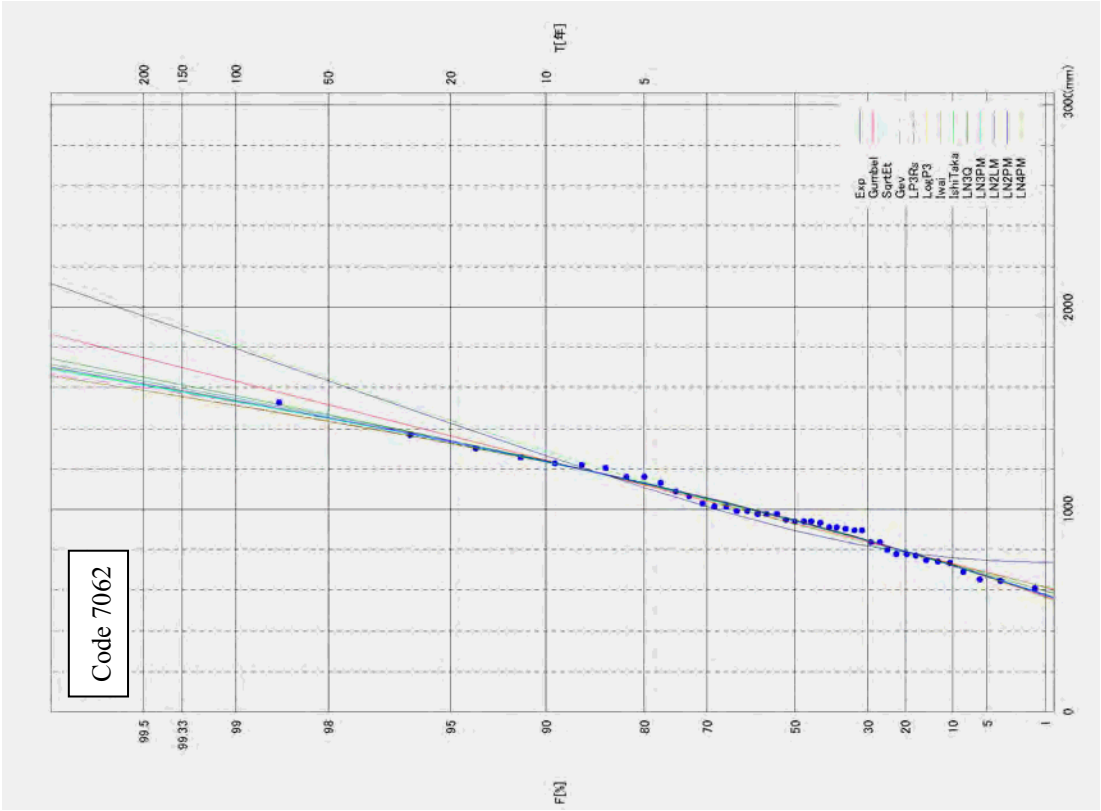

Figure C6.3.14 Probability Distribution on Gumbel Probability Paper (Station code 7062)

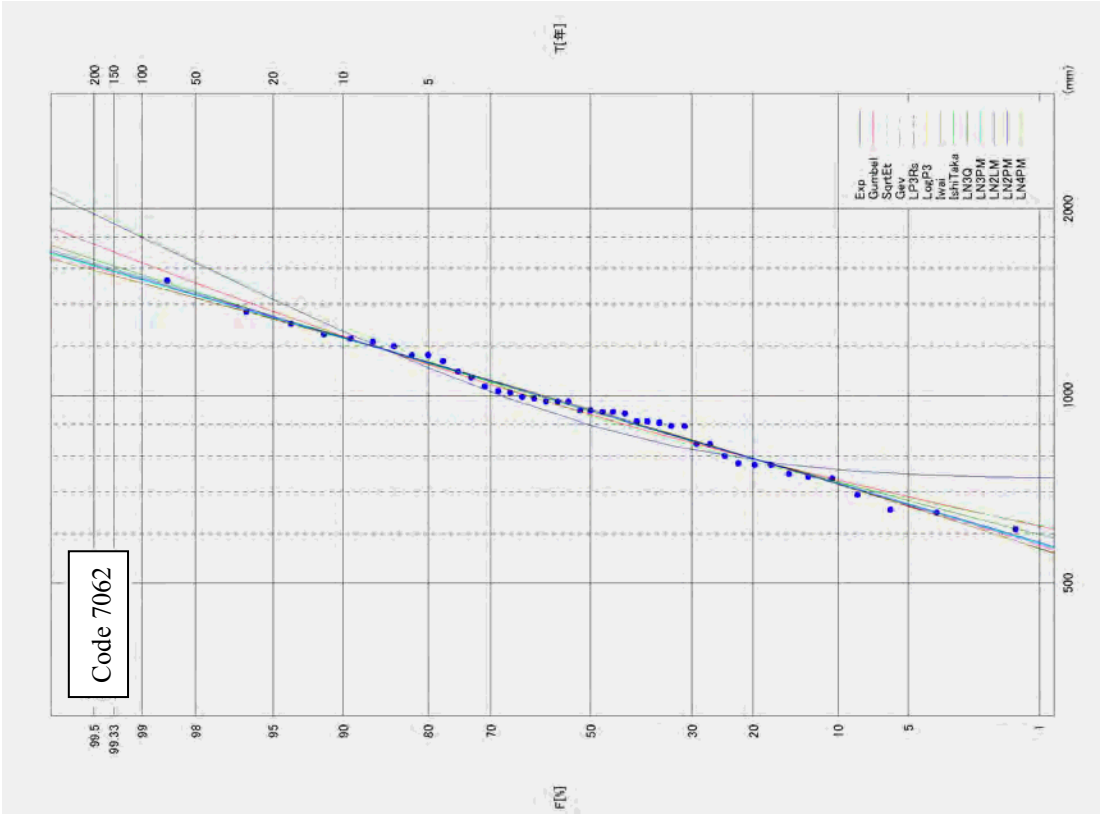

Figure C6.3.15 Probability Distribution on Log-normal Probability Paper (Station code 7062)

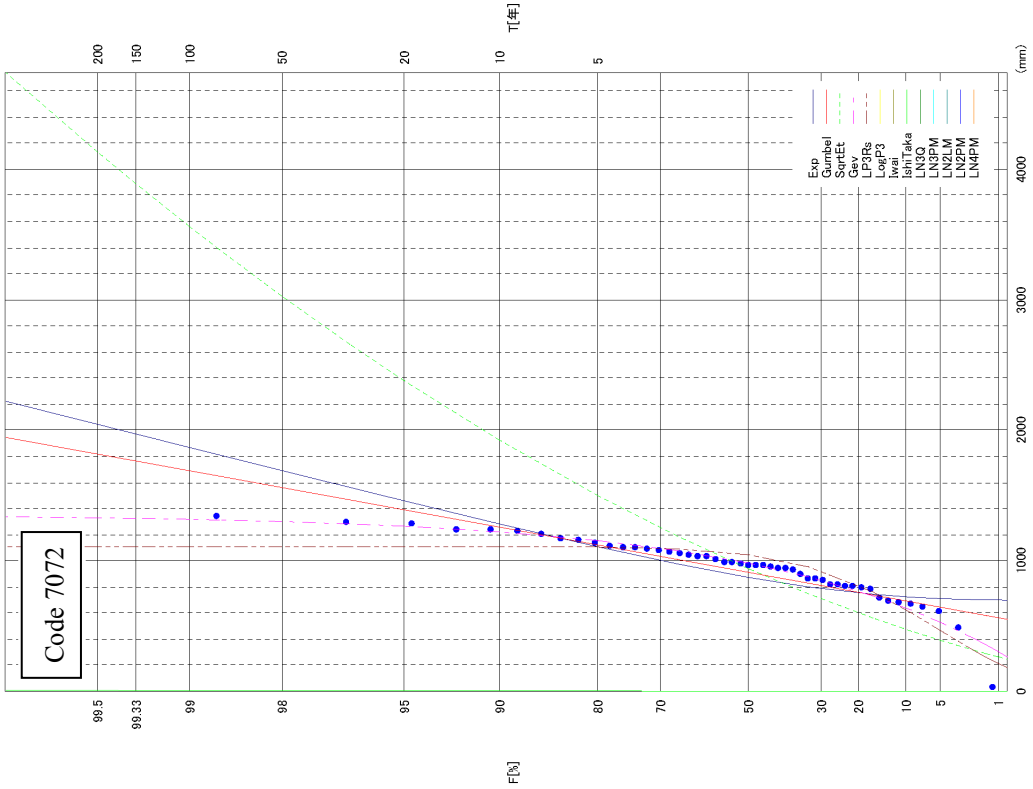

Figure C6.3.16 Probability Distribution on Gumbel Probability Paper (Station code 7072)

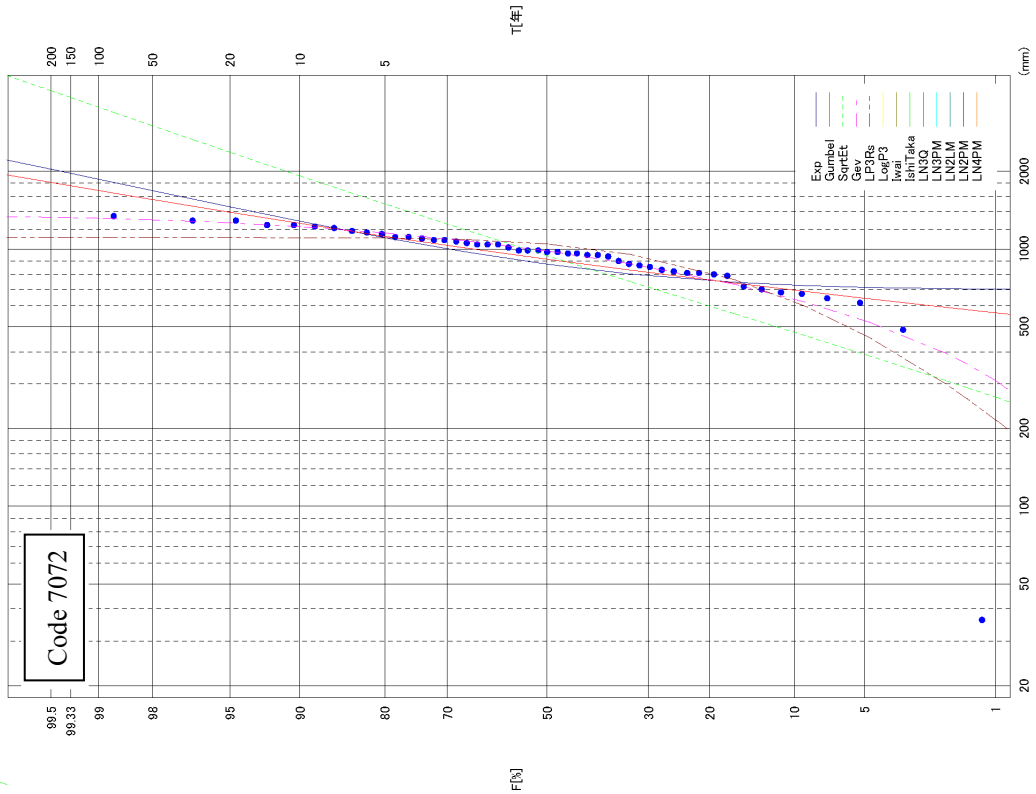

Figure C6.3.17 Probability Distribution on Log-normal Probability Paper (Station code 7072)

Table C 6.3.12 Result of Frequency Analysis of 6-Month Rainfall (3)

Station code 7082

	6months rainfall series (number of sumple N=42)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.890	0.959	0.929	0.995	0.993	—	—	—	—	—	—	—
P-COR(99%)	0.755	0.986	0.978	0.997	0.572	—	—	—	—	—	—	—
SLSC(99%)	0.093	0.057	0.084	0.058	0.025	—	—	—	—	—	—	—
log likelihood	-269.600	-289.400	-289.400	-281.300	—	—	—	—	—	—	—	—
pAIC	543.300	582.800	582.900	568.700	0.000	—	—	—	—	—	—	—
X-COR(50%)	0.982	0.986	0.981	0.978	0.969	—	—	—	—	—	—	—
P-COR(50%)	0.982	0.983	0.980	0.987	-0.027	—	—	—	—	—	—	—
SLSC(50%)	0.116	0.087	0.161	0.117	0.079	—	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	730	765	766	810	819	—	—	—	—	—	—	—
	1/3	822	853	892	898	904	—	—	—	—	—	—	—
	1/5	937	950	1,042	977	976	—	—	—	—	—	—	—
	1/10	1,094	1,072	1,245	1,053	1,041	—	—	—	—	—	—	—
	1/20	1,250	1,189	1,456	1,109	1,083	—	—	—	—	—	—	—
	1/30	1,342	1,257	1,584	1,134	1,102	—	—	—	—	—	—	—
	1/50	1,457	1,341	1,750	1,161	1,120	—	—	—	—	—	—	—
	1/80	1,563	1,418	1,910	1,181	1,134	—	—	—	—	—	—	—
	1/100	1,614	1,455	1,987	1,189	1,139	—	—	—	—	—	—	—
	1/150	1,705	1,521	2,132	1,203	1,148	—	—	—	—	—	—	—
	1/200	1,770	1,568	2,237	1,211	1,153	—	—	—	—	—	—	—
	1/300	1,862	1,634	2,389	1,221	1,159	—	—	—	—	—	—	—
	1/400	1,927	1,681	2,500	1,227	1,163	—	—	—	—	—	—	—
	1/500	1,977	1,718	2,588	1,232	1,166	—	—	—	—	—	—	—
	1/700	2,053	1,773	2,722	1,238	1,169	—	—	—	—	—	—	—
	1/1000	2,134	1,831	2,868	1,244	1,172	—	—	—	—	—	—	—
jackknife error estimates	1/2	33	32	33	33	36	—	—	—	—	—	—	—
	1/3	30	30	37	33	35	—	—	—	—	—	—	—
	1/5	32	32	58	34	34	—	—	—	—	—	—	—
	1/10	41	39	96	40	43	—	—	—	—	—	—	—
	1/20	55	49	139	50	59	—	—	—	—	—	—	—
	1/30	64	56	166	58	70	—	—	—	—	—	—	—
	1/50	76	64	203	67	84	—	—	—	—	—	—	—
	1/80	88	72	239	76	97	—	—	—	—	—	—	—
	1/100	93	76	257	80	103	—	—	—	—	—	—	—
	1/150	103	83	290	87	113	—	—	—	—	—	—	—
	1/200	110	88	315	92	121	—	—	—	—	—	—	—
	1/300	121	95	351	99	130	—	—	—	—	—	—	—
	1/400	128	101	377	103	136	—	—	—	—	—	—	—
	1/500	134	105	398	107	141	—	—	—	—	—	—	—
	1/700	142	111	430	111	148	—	—	—	—	—	—	—
	1/1000	151	117	466	116	155	—	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7092

	6months rainfall series (number of sumple N=48)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.951	0.990	0.981	0.997	0.996	—	0.996	0.997	0.996	0.997	0.997	0.997
P-COR(99%)	0.889	0.997	0.995	0.997	0.997	—	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(99%)	0.064	0.028	0.043	0.017	0.017	—	0.018	0.017	0.019	0.017	0.017	0.017
log likelihood	-300.100	-313.900	-314.700	-312.700	—	—	-312.800	-312.800	-312.800	-312.800	-312.800	-312.800
pAIC	604.100	631.700	633.300	631.400	0.000	—	631.600	631.500	631.500	631.500	629.600	629.500
X-COR(50%)	0.978	0.985	0.979	0.990	0.991	—	0.991	0.990	0.989	0.990	0.990	0.990
P-COR(50%)	0.988	0.986	0.988	0.988	0.987	—	0.987	0.987	0.987	0.987	0.987	0.987
SLSC(50%)	0.083	0.049	0.082	0.033	0.043	—	0.044	0.040	0.038	0.040	0.038	0.038

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	865	895	893	909	913	—	914	911	908	911	909	909
	1/3	943	969	975	985	987	—	987	984	981	985	984	983
	1/5	1,040	1,051	1,072	1,063	1,061	—	1,061	1,059	1,058	1,059	1,061	1,059
	1/10	1,173	1,154	1,198	1,152	1,145	—	1,143	1,145	1,146	1,145	1,151	1,148
	1/20	1,305	1,253	1,326	1,229	1,218	—	1,215	1,221	1,226	1,220	1,231	1,226
	1/30	1,382	1,310	1,403	1,270	1,257	—	1,254	1,262	1,269	1,261	1,274	1,269
	1/50	1,480	1,382	1,501	1,318	1,303	—	1,300	1,311	1,322	1,310	1,327	1,321
	1/80	1,569	1,447	1,594	1,359	1,343	—	1,340	1,355	1,369	1,354	1,373	1,366
	1/100	1,612	1,478	1,639	1,378	1,362	—	1,359	1,375	1,391	1,374	1,395	1,388
	1/150	1,689	1,534	1,721	1,410	1,395	—	1,392	1,411	1,430	1,409	1,434	1,425
	1/200	1,744	1,574	1,781	1,432	1,418	—	1,414	1,436	1,457	1,434	1,460	1,452
	1/300	1,822	1,629	1,867	1,461	1,449	—	1,446	1,470	1,495	1,468	1,498	1,489
	1/400	1,876	1,669	1,929	1,481	1,470	—	1,468	1,494	1,521	1,492	1,524	1,514
	1/500	1,919	1,700	1,978	1,496	1,487	—	1,484	1,513	1,542	1,510	1,544	1,534
	1/700	1,983	1,746	2,053	1,517	1,511	—	1,509	1,540	1,572	1,537	1,574	1,563
	1/1000	2,051	1,795	2,133	1,539	1,537	—	1,535	1,569	1,604	1,566	1,605	1,594
jackknife error estimates	1/2	23	24	24	26	26	—	26	27	22	27	24	24
	1/3	25	26	27	29	29	—	29	29	24	29	27	27
	1/5	31	31	34	33	32	—	32	32	30	32	32	31
	1/10	41	40	46	40	39	—	38	39	45	39	40	39
	1/20	53	49	59	51	49	—	44	49	62	49	49	47
	1/30	61	54	68	59	56	—	49	56	74	55	54	52
	1/50	71	61	80	71	65	—	55	65	89	65	61	58
	1/80	80	67	91	84	76	—	61	75	103	74	67	64
	1/100	84	70	96	91	81	—	65	80	110	79	70	67
	1/150	92	76	107	103	90	—	71	89	123	88	76	72
	1/200	98	80	114	112	98	—	75	96	132	94	79	75
	1/300	106	86	125	125	108	—	82	106	146	104	85	80
	1/400	111	90	133	135	116	—	87	113	156	111	89	84
	1/500	116	93	140	143	122	—	91	119	163	117	92	87
	1/700	122	98	149	155	132	—	97	128	175	125	96	91
	1/1000	129	103	160	167	143	—	103	137	188	135	101	95

less than 0.04(SLSC)
minimum value(SLSC)

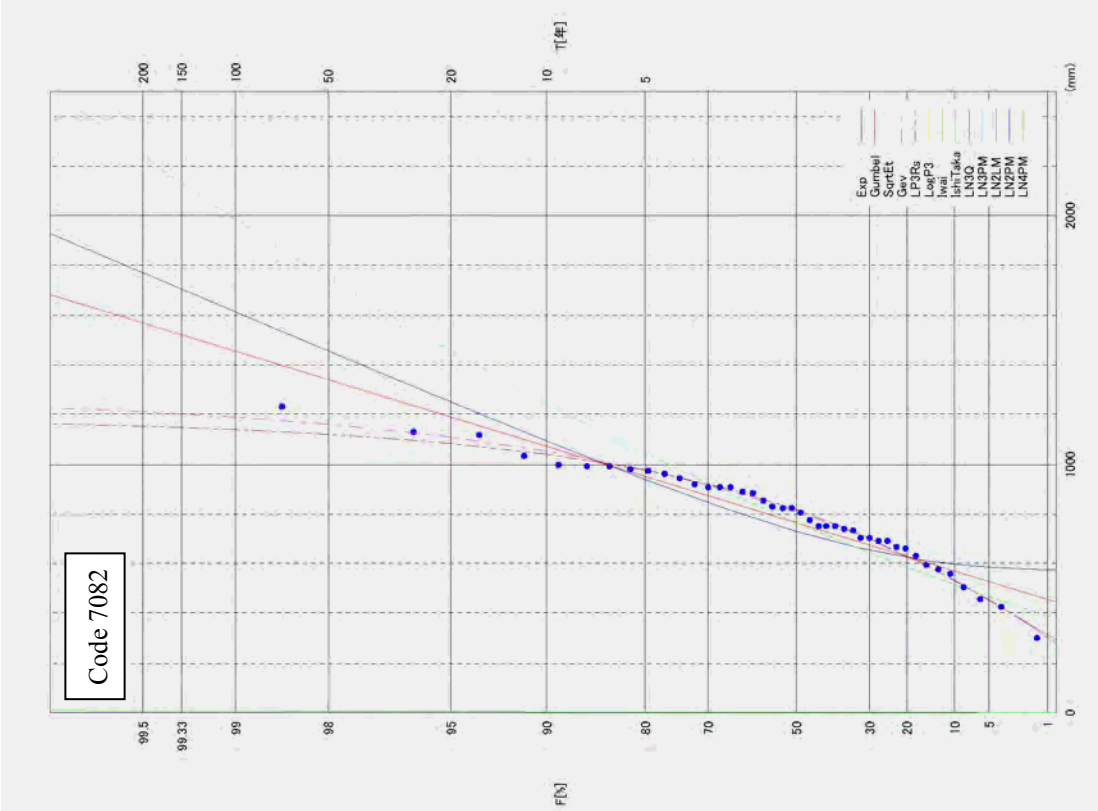

Figure C6.3.18 Probability Distribution on Gumbel Probability Paper (Station code 7082)

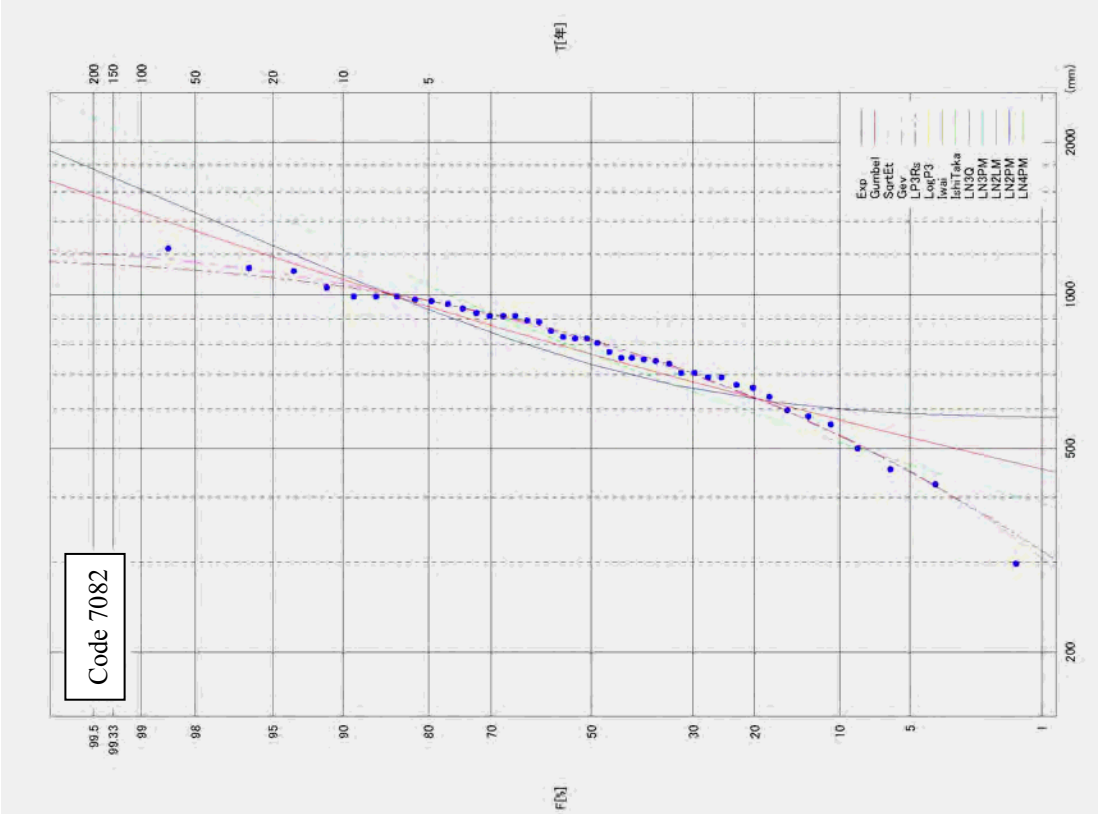

Figure C6.3.19 Probability Distribution on Log-normal Probability Paper (Station code 7082)

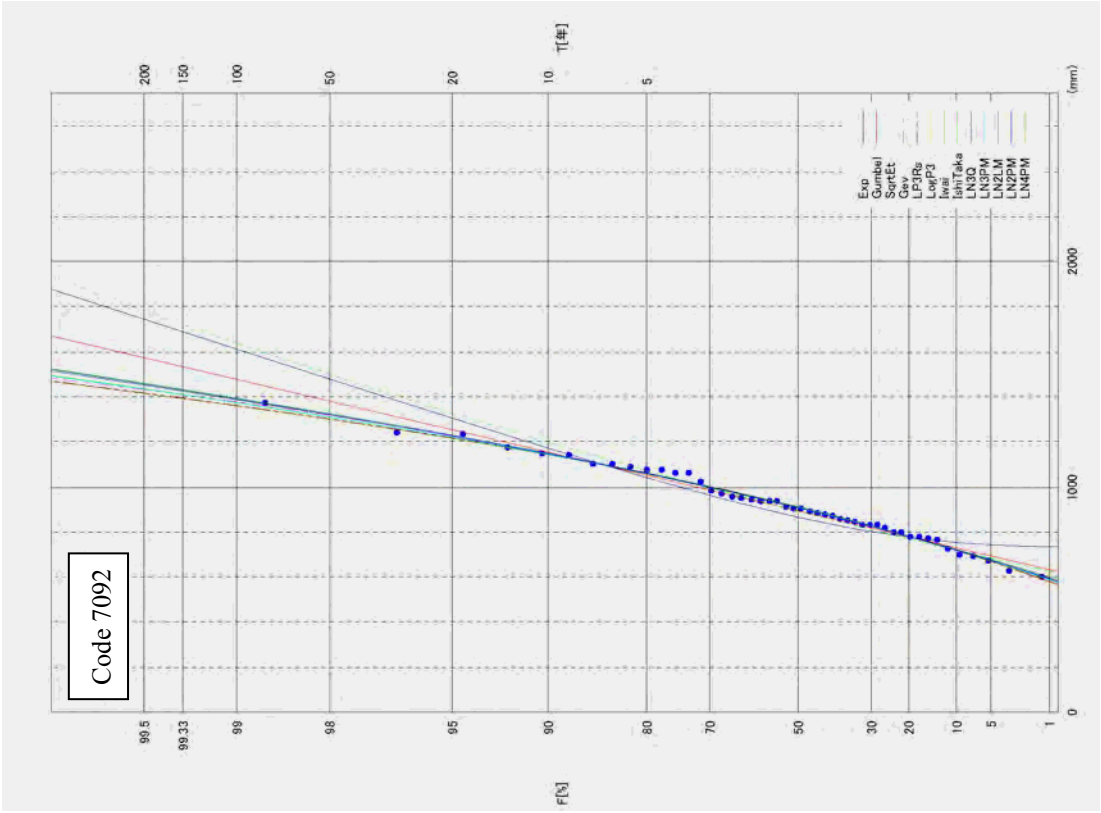

Figure C6.3.20 Probability Distribution on Gumbel Probability Paper (Station code 7092)

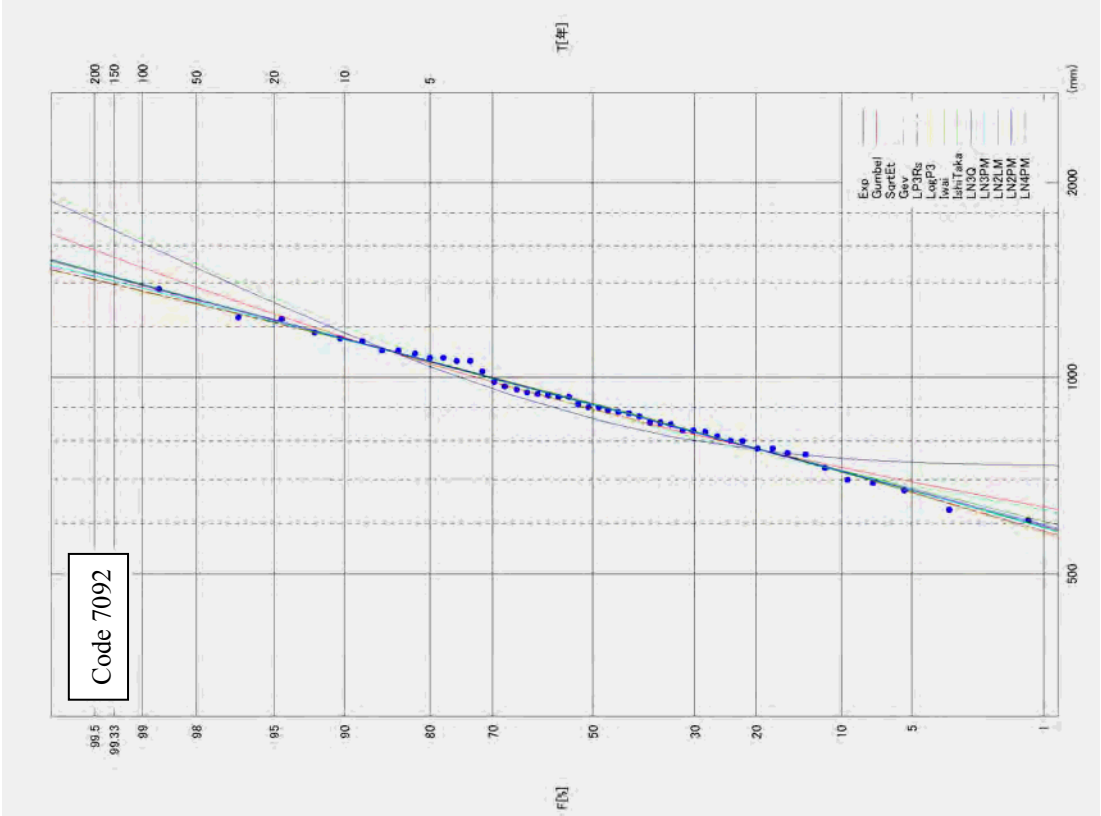

Figure C6.3.21 Probability Distribution on Log-normal Probability Paper (Station code 7092)

Table C 6.3.13 Result of Frequency Analysis of 6-Month Rainfall (4)

Station code 7112

	6months rainfall series (number of sumple N=48)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.936	0.983	0.971	0.997	0.996	—	0.996	0.996	0.996	0.996	0.995	0.995
P-COR(99%)	0.909	0.993	0.991	0.998	0.998	—	0.998	0.998	0.998	0.998	0.998	0.998
SLSC(99%)	0.072	0.037	0.049	0.016	0.022	—	0.021	0.020	0.021	0.020	0.021	0.022
log likelihood	-304.700	-318.700	-319.400	-317.100	-317.200	—	-317.300	-317.300	-317.300	-317.300	-317.400	-317.300
pAIC	613.300	641.300	642.700	640.200	640.400	—	640.500	640.600	640.500	640.600	638.700	638.600
X-COR(50%)	0.972	0.980	0.973	0.994	0.993	—	0.991	0.992	0.991	0.992	0.989	0.990
P-COR(50%)	0.996	0.995	0.996	0.995	0.995	—	0.995	0.995	0.995	0.995	0.995	0.995
SLSC(50%)	0.097	0.064	0.093	0.028	0.034	—	0.032	0.033	0.033	0.033	0.036	0.034

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,002	1,035	1,032	1,057	1,061	—	1,055	1,059	1,054	1,059	1,052	1,052
	1/3	1,088	1,116	1,123	1,141	1,141	—	1,136	1,139	1,134	1,139	1,134	1,133
	1/5	1,195	1,207	1,228	1,224	1,220	—	1,217	1,218	1,215	1,218	1,220	1,216
	1/10	1,340	1,320	1,367	1,315	1,305	—	1,308	1,305	1,307	1,305	1,318	1,312
	1/20	1,486	1,429	1,506	1,390	1,377	—	1,388	1,380	1,387	1,380	1,405	1,397
	1/30	1,571	1,492	1,589	1,429	1,414	—	1,431	1,421	1,431	1,420	1,453	1,443
	1/50	1,679	1,571	1,696	1,473	1,458	—	1,482	1,468	1,483	1,468	1,510	1,499
	1/80	1,777	1,642	1,797	1,510	1,496	—	1,527	1,509	1,529	1,509	1,561	1,549
	1/100	1,824	1,676	1,845	1,526	1,513	—	1,547	1,528	1,550	1,528	1,585	1,572
	1/150	1,909	1,738	1,935	1,553	1,542	—	1,584	1,562	1,588	1,561	1,627	1,612
	1/200	1,970	1,782	2,000	1,571	1,563	—	1,609	1,585	1,614	1,584	1,656	1,641
	1/300	2,055	1,843	2,093	1,595	1,590	—	1,644	1,616	1,650	1,615	1,696	1,680
	1/400	2,115	1,887	2,160	1,611	1,609	—	1,668	1,638	1,675	1,637	1,725	1,708
	1/500	2,162	1,921	2,213	1,623	1,623	—	1,687	1,655	1,694	1,654	1,747	1,729
	1/700	2,233	1,972	2,293	1,639	1,644	—	1,715	1,679	1,723	1,678	1,779	1,760
	1/1000	2,308	2,026	2,381	1,655	1,666	—	1,743	1,705	1,753	1,704	1,813	1,793
jackknife	1/2	26	26	27	30	30	—	30	30	26	30	26	26
error estimates	1/3	27	28	31	32	32	—	31	31	27	31	28	28
	1/5	31	32	37	34	34	—	33	33	32	33	33	33
	1/10	41	39	47	39	37	—	38	37	42	37	40	39
	1/20	52	48	59	47	42	—	46	43	55	43	49	47
	1/30	59	53	66	54	47	—	51	47	64	47	53	51
	1/50	69	59	76	63	53	—	60	53	75	53	60	57
	1/80	78	66	86	72	59	—	68	59	86	59	66	62
	1/100	82	69	91	77	62	—	72	62	91	62	68	64
	1/150	90	74	100	85	69	—	80	68	101	68	74	69
	1/200	95	78	106	92	74	—	86	73	108	72	77	72
	1/300	103	84	116	101	81	—	94	79	118	78	82	77
	1/400	109	88	123	107	86	—	100	84	126	83	86	80
	1/500	113	91	128	112	90	—	105	88	132	87	89	83
	1/700	120	95	137	120	97	—	112	93	140	92	93	87
	1/1000	127	100	146	128	104	—	121	100	150	98	98	91

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7122

	6months rainfall series (number of sumple N=54)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.894	0.938	0.926	—	0.939	—	—	—	0.943	—	—	—
P-COR(99%)	0.572	0.980	0.949	—	0.982	—	—	—	0.986	—	—	—
SLSC(99%)	0.096	0.076	0.104	—	0.120	—	—	—	0.069	—	—	—
log likelihood	-362.500	-405.000	-397.100	—	-389.100	—	—	—	-383.300	—	—	—
pAIC	729.100	813.900	798.200	—	784.200	—	—	—	772.500	—	—	—
X-COR(50%)	0.930	0.920	0.941	—	0.900	—	—	—	0.890	—	—	—
P-COR(50%)	0.979	0.986	0.932	—	0.979	—	—	—	0.979	—	—	—
SLSC(50%)	0.088	0.100	0.189	—	0.107	—	—	—	0.135	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	964	1,010	1,021	—	1,027	—	—	—	1,042	—	—	—
	1/3	1,086	1,128	1,235	—	1,158	—	—	—	1,171	—	—	—
	1/5	1,241	1,258	1,494	—	1,293	—	—	—	1,299	—	—	—
	1/10	1,451	1,422	1,850	—	1,451	—	—	—	1,442	—	—	—
	1/20	1,661	1,580	2,223	—	1,591	—	—	—	1,565	—	—	—
	1/30	1,784	1,670	2,451	—	1,667	—	—	—	1,631	—	—	—
	1/50	1,939	1,783	2,751	—	1,759	—	—	—	1,709	—	—	—
	1/80	2,081	1,887	3,039	—	1,840	—	—	—	1,777	—	—	—
	1/100	2,149	1,936	3,180	—	1,878	—	—	—	1,808	—	—	—
	1/150	2,272	2,025	3,443	—	1,944	—	—	—	1,863	—	—	—
	1/200	2,359	2,088	3,635	—	1,991	—	—	—	1,901	—	—	—
	1/300	2,482	2,177	3,914	—	2,055	—	—	—	1,953	—	—	—
	1/400	2,569	2,240	4,118	—	2,099	—	—	—	1,989	—	—	—
	1/500	2,637	2,289	4,279	—	2,133	—	—	—	2,017	—	—	—
	1/700	2,739	2,362	4,528	—	2,184	—	—	—	2,058	—	—	—
	1/1000	2,847	2,440	4,798	—	2,237	—	—	—	2,100	—	—	—
jackknife	1/2	41	40	39	—	1,013	—	—	—	923	—	—	—
error estimates	1/3	41	44	67	—	1,138	—	—	—	796	—	—	—
	1/5	54	56	138	—	1,271	—	—	—	671	—	—	—
	1/10	82	78	247	—	1,435	—	—	—	530	—	—	—
	1/20	114	101	367	—	1,591	—	—	—	410	—	—	—
	1/30	133	115	443	—	1,679	—	—	—	346	—	—	—
	1/50	158	133	544	—	1,788	—	—	—	272	—	—	—
	1/80	181	149	643	—	1,886	—	—	—	211	—	—	—
	1/100	192	157	692	—	1,932	—	—	—	185	—	—	—
	1/150	212	172	785	—	2,015	—	—	—	144	—	—	—
	1/200	226	182	853	—	2,073	—	—	—	123	—	—	—
	1/300	247	196	952	—	2,154	—	—	—	113	—	—	—
	1/400	261	207	1,025	—	2,211	—	—	—	121	—	—	—
	1/500	272	215	1,083	—	2,254	—	—	—	135	—	—	—
	1/700	289	227	1,173	—	2,320	—	—	—	163	—	—	—
	1/1000	307	240	1,272	—	2,389	—	—	—	198	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

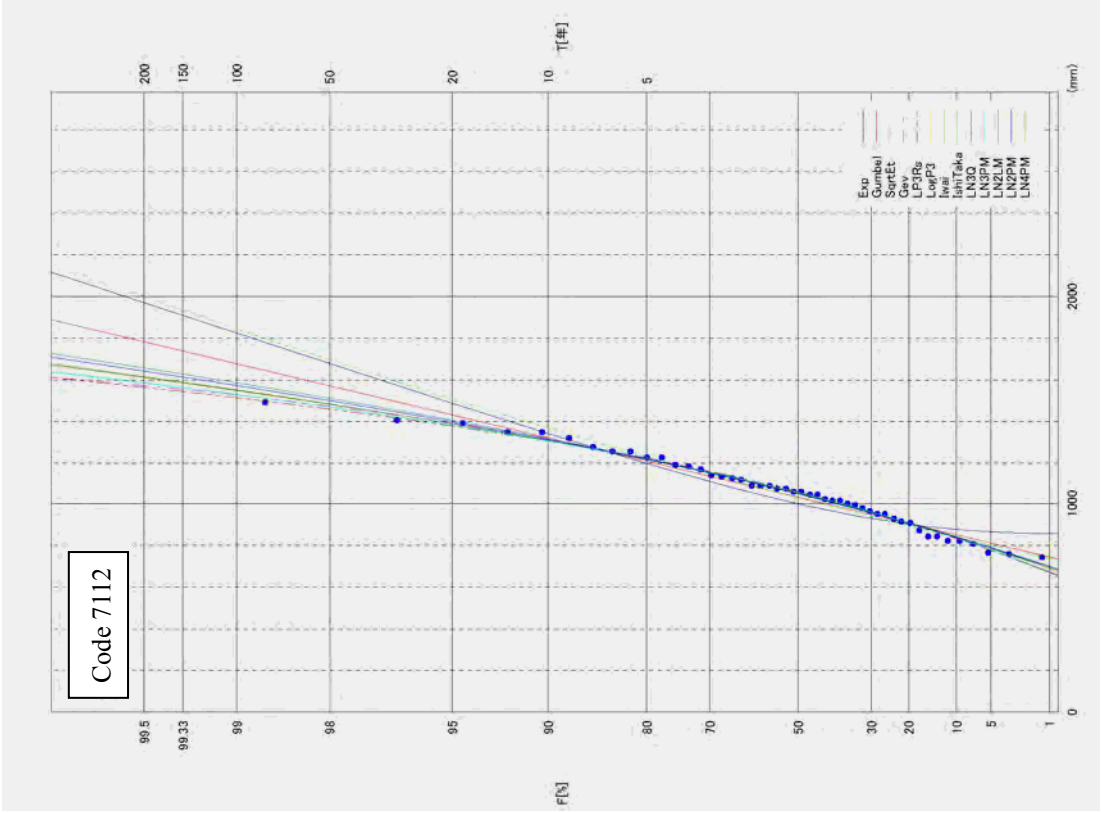

Figure C6.3.22 Probability Distribution on Gumbel Probability Paper (Station code 7112)

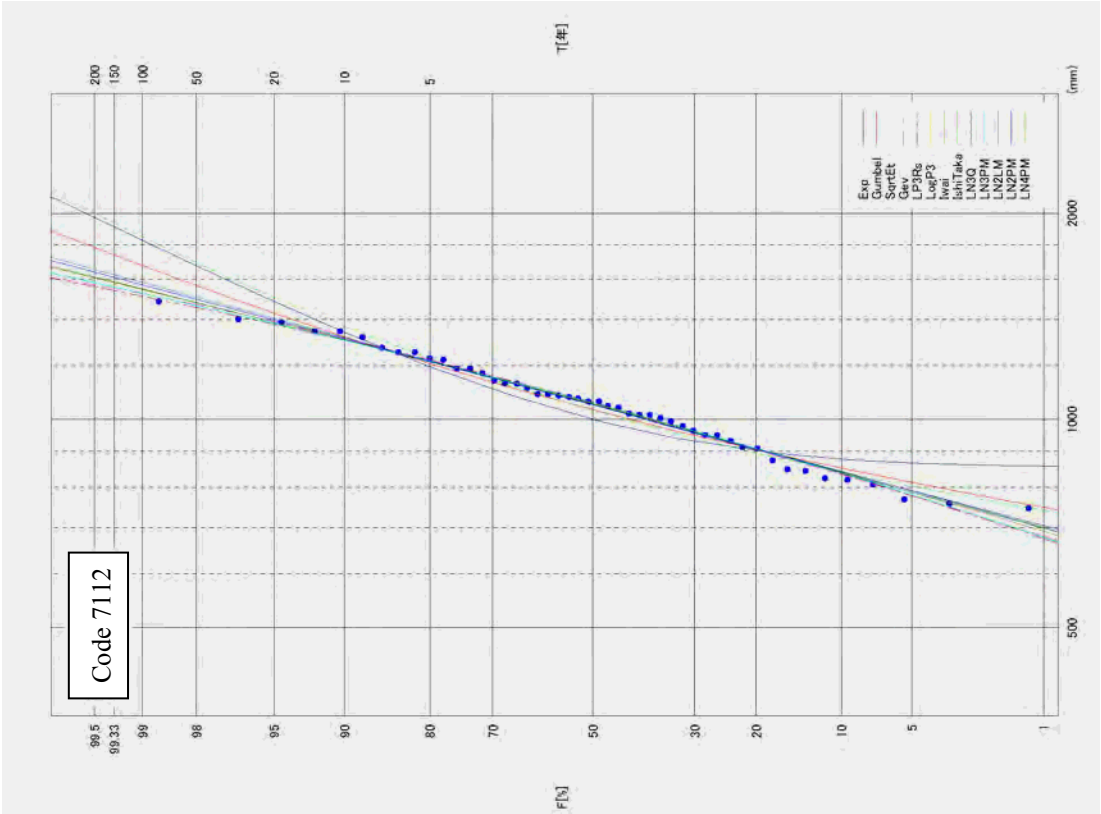

Figure C6.3.23 Probability Distribution on Log-normal Probability Paper (Station code 7112)

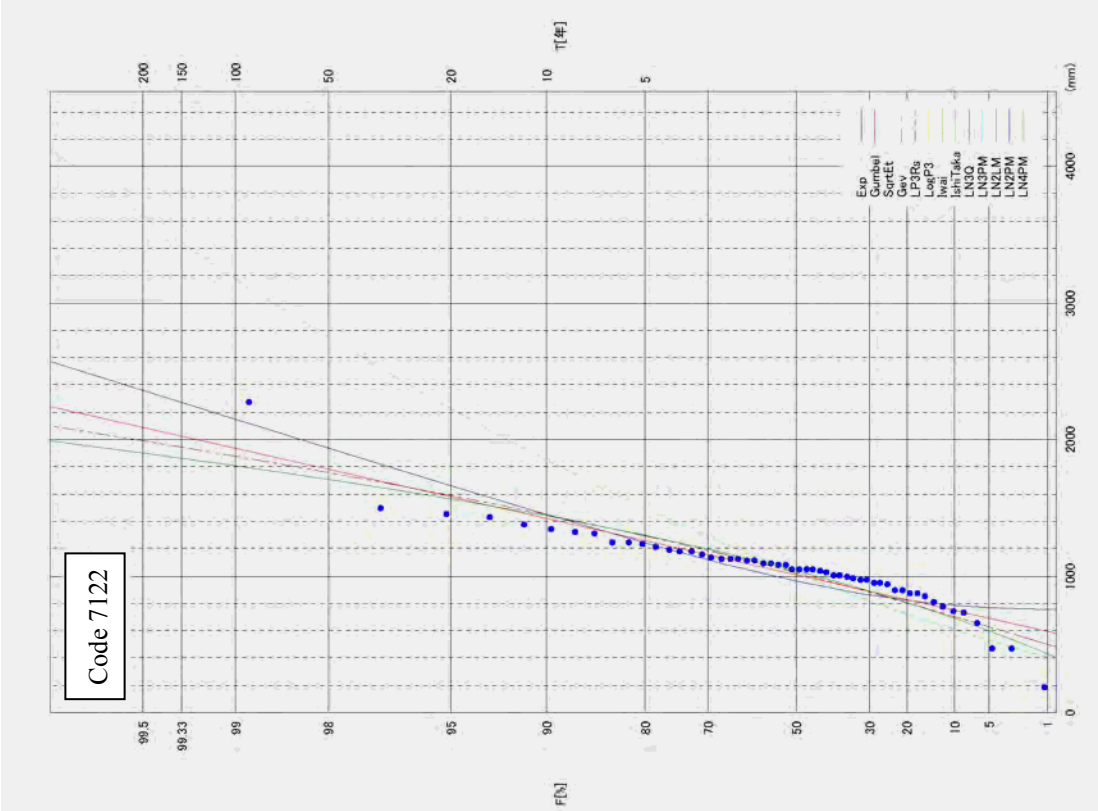

Figure C6.3.24 Probability Distribution on Gumbel Probability Paper (Station code 7122)

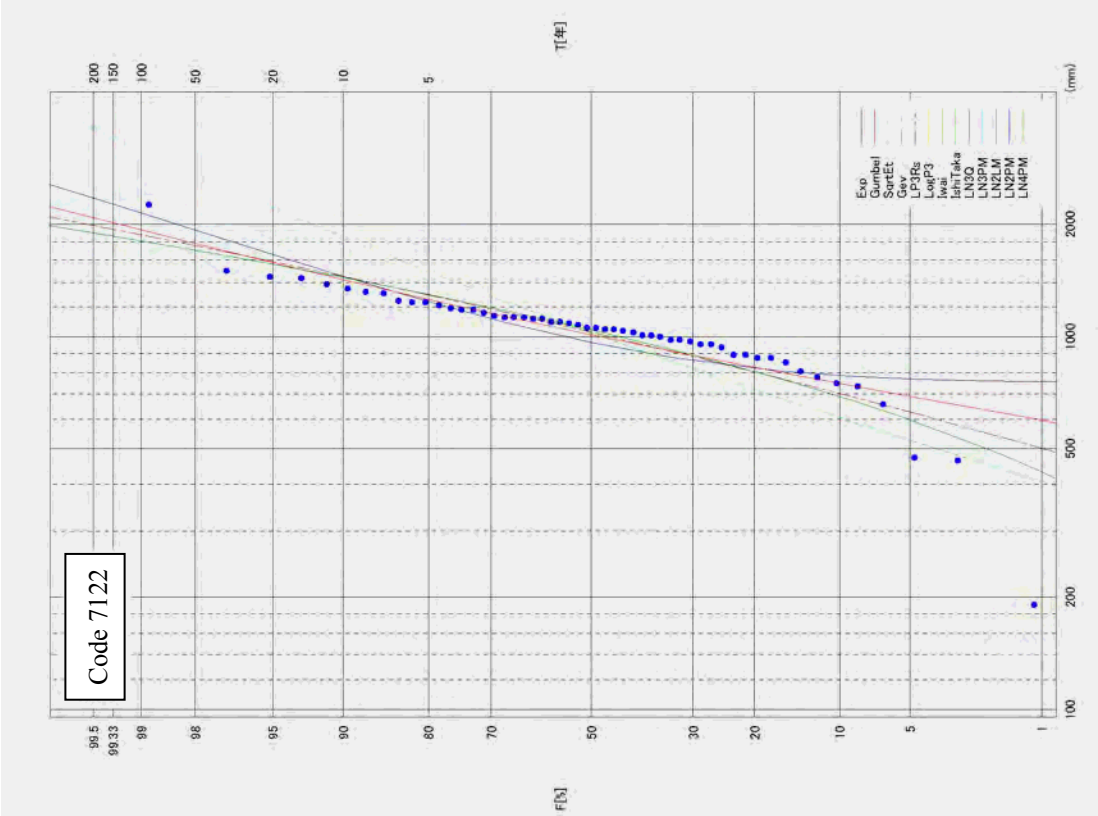

Figure C6.3.25 Probability Distribution on Log-normal Probability Paper (Station code 7122)

Table C 6.3.14 Result of Frequency Analysis of 6-Month Rainfall (5)

Station code 7132

	6months rainfall series (number of sumple N=45)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishiharu・takaoe	quantile	product momest	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.958	0.987	0.979	0.990	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989
P-COR(99%)	0.950	0.993	0.991	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
SLSC(99%)	0.059	0.033	0.038	0.032	0.029	0.027	0.027	0.028	0.030	0.028	0.028	0.029
log likelihood	-299.900	-310.800	-311.200	-310.800	—	-310.700	-310.600	-310.800	-310.900	-310.800	-310.900	-310.900
pAIC	603.800	625.600	626.300	627.600	0.000	627.500	627.300	627.500	627.900	627.600	625.800	625.800
X-COR(50%)	0.966	0.969	0.964	0.971	0.971	0.989	0.970	0.971	0.971	0.971	0.971	0.971
P-COR(50%)	0.985	0.987	0.987	0.986	0.987	0.995	0.987	0.987	0.988	0.987	0.987	0.987
SLSC(50%)	0.083	0.060	0.070	0.060	0.057	0.055	0.054	0.055	0.060	0.056	0.056	0.058

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,086	1,131	1,122	1,144	1,150	1,141	1,139	1,145	1,150	1,145	1,149	1,149
	1/3	1,203	1,242	1,237	1,257	1,262	1,252	1,251	1,256	1,259	1,256	1,261	1,259
	1/5	1,350	1,367	1,372	1,378	1,378	1,371	1,372	1,373	1,372	1,373	1,379	1,374
	1/10	1,550	1,523	1,550	1,521	1,513	1,515	1,518	1,512	1,504	1,512	1,517	1,510
	1/20	1,750	1,672	1,730	1,651	1,634	1,649	1,655	1,639	1,622	1,638	1,642	1,631
	1/30	1,867	1,759	1,838	1,722	1,701	1,724	1,731	1,710	1,687	1,708	1,710	1,698
	1/50	2,014	1,866	1,977	1,807	1,781	1,817	1,826	1,796	1,766	1,794	1,794	1,780
	1/80	2,150	1,965	2,108	1,882	1,853	1,902	1,912	1,874	1,836	1,870	1,868	1,852
	1/100	2,214	2,011	2,172	1,916	1,886	1,941	1,953	1,910	1,869	1,906	1,903	1,886
	1/150	2,331	2,096	2,289	1,977	1,946	2,013	2,026	1,975	1,927	1,971	1,966	1,947
	1/200	2,414	2,156	2,374	2,019	1,987	2,064	2,078	2,021	1,968	2,016	2,009	1,989
	1/300	2,531	2,241	2,497	2,076	2,045	2,136	2,151	2,085	2,024	2,079	2,070	2,048
	1/400	2,614	2,300	2,585	2,116	2,085	2,187	2,203	2,130	2,064	2,123	2,112	2,090
	1/500	2,678	2,347	2,655	2,146	2,117	2,226	2,243	2,164	2,094	2,158	2,145	2,122
	1/700	2,775	2,417	2,762	2,190	2,163	2,286	2,303	2,217	2,140	2,209	2,195	2,169
	1/1000	2,878	2,491	2,877	2,236	2,212	2,349	2,367	2,272	2,188	2,263	2,246	2,220
jackknife	1/2	35	36	37	42	—	41	42	41	38	41	37	37
error estimates	1/3	40	42	44	46	—	46	47	47	45	47	43	43
	1/5	50	52	55	53	—	53	53	54	52	54	53	52
	1/10	69	66	72	67	—	65	64	64	63	64	67	65
	1/20	89	81	91	89	—	82	81	77	75	77	81	79
	1/30	101	90	102	106	—	95	92	85	82	85	90	87
	1/50	116	101	118	131	—	113	109	97	92	97	101	97
	1/80	131	111	133	157	—	131	126	110	102	109	111	107
	1/100	138	116	140	170	—	141	134	116	107	115	116	111
	1/150	151	125	154	195	—	160	150	128	116	127	125	120
	1/200	160	132	164	214	—	174	163	137	123	135	132	126
	1/300	172	141	179	243	—	194	181	150	133	148	141	134
	1/400	181	147	190	263	—	210	194	160	140	157	147	140
	1/500	188	152	198	280	—	223	205	168	146	165	153	145
	1/700	199	160	211	306	—	243	221	180	155	177	160	152
	1/1000	210	168	226	333	—	265	239	194	165	190	169	160

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7142

	6months rainfall series (number of sumple N=55)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishiharu・takaoe	quantile	product momest	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.958	0.981	0.977	0.978	0.980	0.976	—	—	—	—	—	—
P-COR(99%)	0.876	0.991	0.983	0.994	0.992	0.993	—	—	—	—	—	—
SLSC(99%)	0.060	0.040	0.051	0.056	0.042	0.038	—	—	—	—	—	—
log likelihood	-384.000	-400.400	-402.100	-399.800	—	-399.900	—	—	—	—	—	—
pAIC	772.000	804.700	808.300	805.500	0.000	805.700	—	—	—	—	—	—
X-COR(50%)	0.968	0.963	0.971	0.952	0.960	0.976	—	—	—	—	—	—
P-COR(50%)	0.977	0.983	0.976	0.984	0.983	0.993	—	—	—	—	—	—
SLSC(50%)	0.066	0.068	0.088	0.109	0.069	0.086	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	981	1,042	1,028	1,063	1,049	1,065	—	—	—	—	—	—
	1/3	1,142	1,196	1,209	1,219	1,207	1,226	—	—	—	—	—	—
	1/5	1,344	1,366	1,426	1,384	1,380	1,393	—	—	—	—	—	—
	1/10	1,619	1,581	1,721	1,578	1,590	1,586	—	—	—	—	—	—
	1/20	1,893	1,787	2,028	1,751	1,787	1,756	—	—	—	—	—	—
	1/30	2,054	1,905	2,215	1,846	1,898	1,848	—	—	—	—	—	—
	1/50	2,257	2,053	2,458	1,958	2,036	1,958	—	—	—	—	—	—
	1/80	2,443	2,188	2,692	2,056	2,161	2,055	—	—	—	—	—	—
	1/100	2,531	2,253	2,806	2,101	2,220	2,100	—	—	—	—	—	—
	1/150	2,692	2,369	3,018	2,180	2,327	2,178	—	—	—	—	—	—
	1/200	2,806	2,451	3,173	2,235	2,403	2,233	—	—	—	—	—	—
	1/300	2,967	2,568	3,397	2,308	2,509	2,308	—	—	—	—	—	—
	1/400	3,081	2,650	3,560	2,359	2,584	2,360	—	—	—	—	—	—
	1/500	3,169	2,714	3,689	2,397	2,643	2,399	—	—	—	—	—	—
	1/700	3,302	2,810	3,887	2,453	2,731	2,458	—	—	—	—	—	—
	1/1000	3,444	2,912	4,103	2,511	2,824	2,519	—	—	—	—	—	—
jackknife	1/2	45	47	47	44	2,402	48	—	—	—	—	—	—
error estimates	1/3	52	57	54	48	2,766	53	—	—	—	—	—	—
	1/5	71	73	67	65	3,162	69	—	—	—	—	—	—
	1/10	102	97	90	104	3,645	105	—	—	—	—	—	—
	1/20	136	123	119	158	4,095	152	—	—	—	—	—	—
	1/30	157	138	138	194	4,351	183	—	—	—	—	—	—
	1/50	183	157	163	244	4,666	225	—	—	—	—	—	—
	1/80	208	174	188	293	4,953	266	—	—	—	—	—	—
	1/100	219	183	201	317	5,089	287	—	—	—	—	—	—
	1/150	241	198	225	363	5,334	325	—	—	—	—	—	—
	1/200	256	209	242	396	5,507	352	—	—	—	—	—	—
	1/300	277	224	268	445	5,751	392	—	—	—	—	—	—
	1/400	292	235	287	480	5,925	422	—	—	—	—	—	—
	1/500	304	244	302	507	6,059	445	—	—	—	—	—	—
	1/700	322	256	325	549	6,262	480	—	—	—	—	—	—
	1/1000	341	270	351	594	6,478	518	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

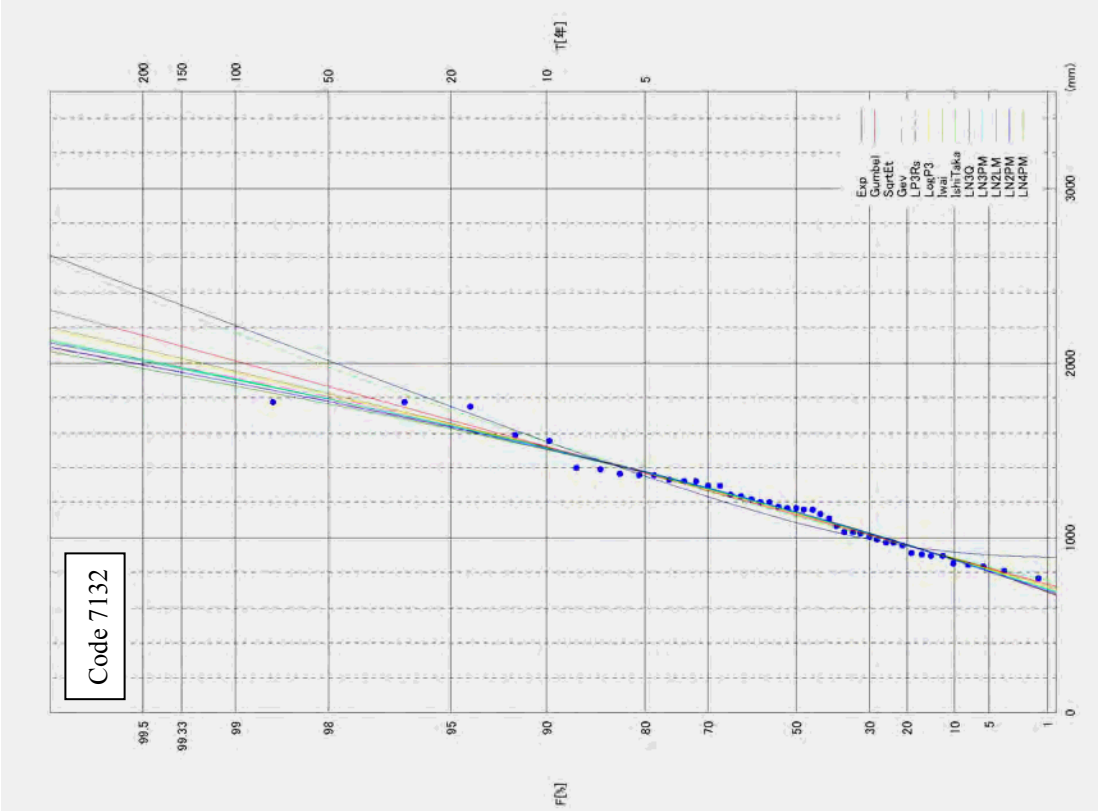

Figure C6.3.26 Probability Distribution on Gumbel Probability Paper (Station code 7132)

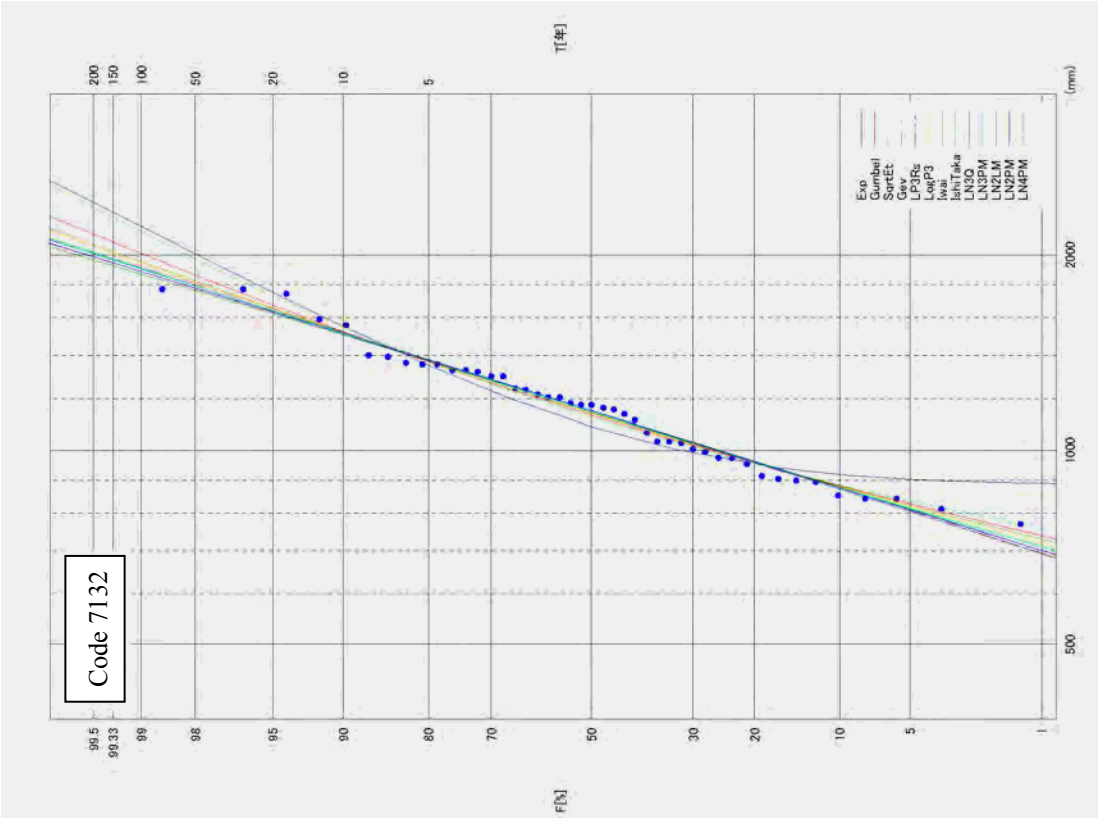

Figure C6.3.27 Probability Distribution on Log-normal Probability Paper (Station code 7132)

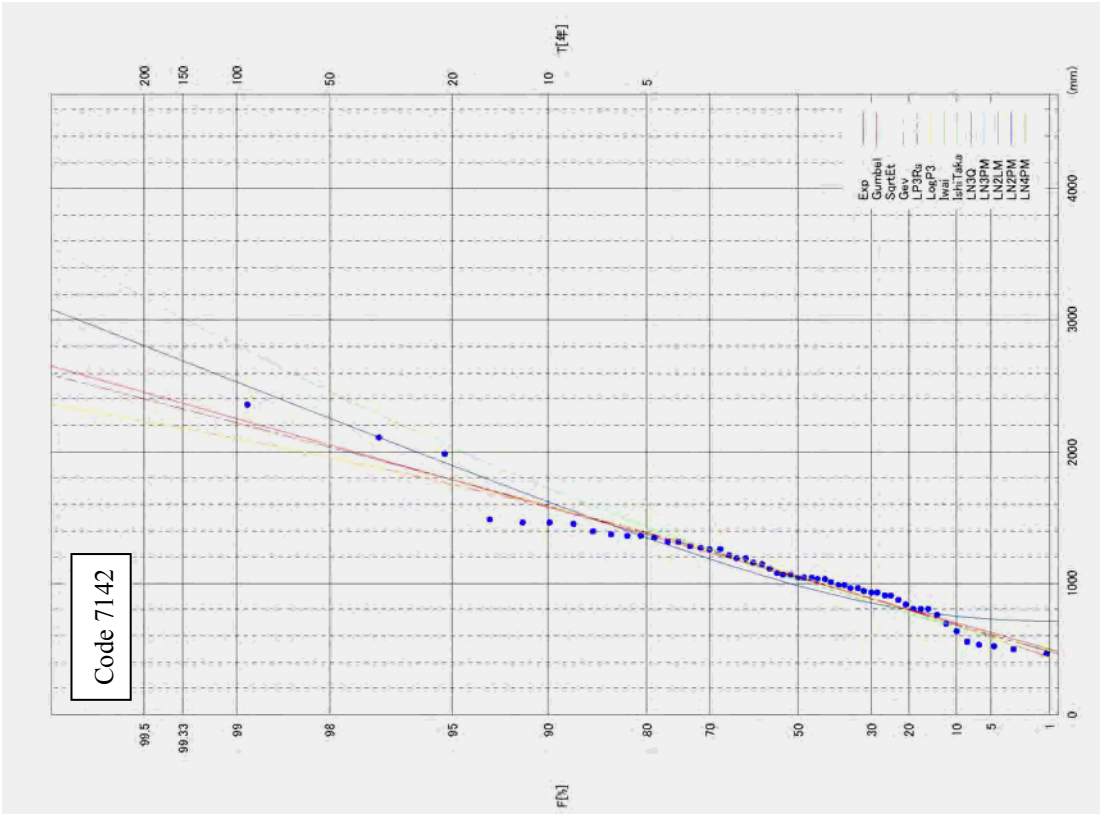

Figure C6.3.28 Probability Distribution on Gumbel Probability Paper (Station code 7142)

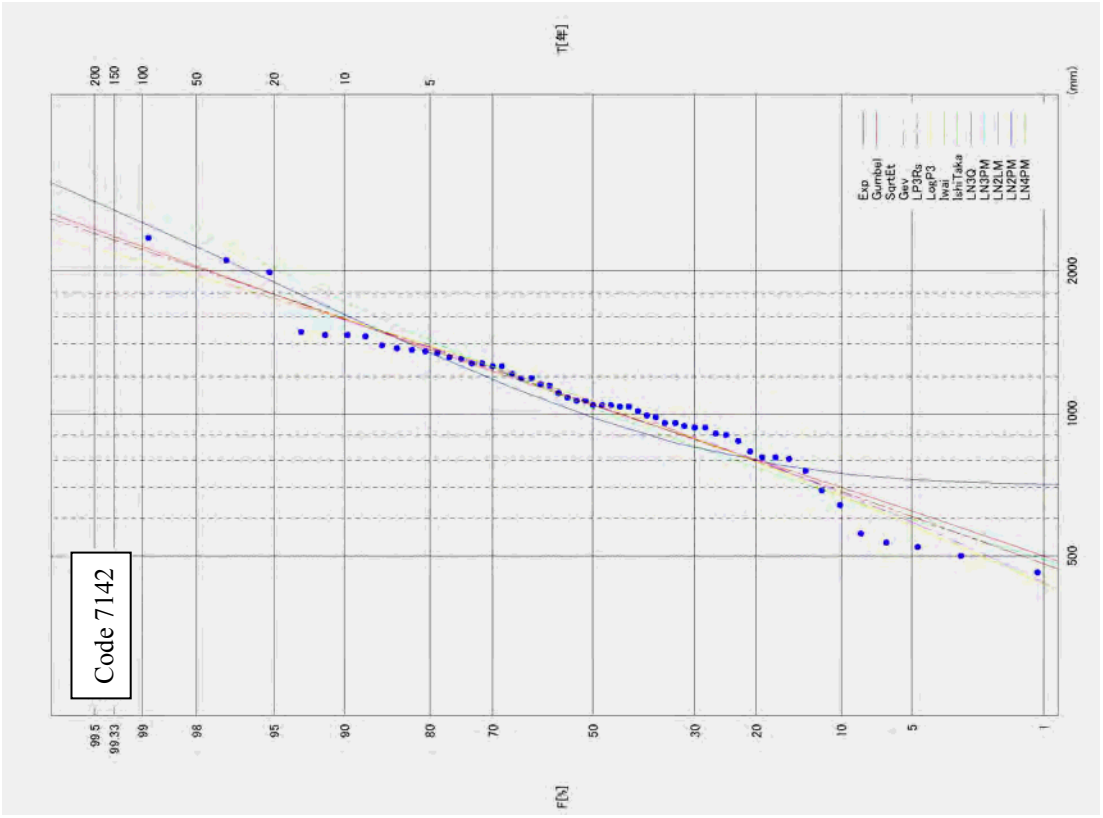

Figure C6.3.29 Probability Distribution on Log-normal Probability Paper (Station code 7142)

Table C 6.3.15 Result of Frequency Analysis of 6-Month Rainfall (6)

Station code 7152

	6months rainfall series (number of sumple N=45)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.913	0.918	0.932	0.913	—	—	—	—	0.911	—	—	—
P-COR(99%)	0.727	0.987	0.968	0.987	—	—	—	—	0.982	—	—	—
SLSC(99%)	0.094	0.096	0.077	0.112	—	—	—	—	0.076	—	—	—
log likelihood	-302.200	-320.000	-321.600	-319.100	—	—	—	—	-318.300	—	—	—
pAIC	608.400	643.900	647.200	644.100	—	—	—	—	642.600	—	—	—
X-COR(50%)	0.888	0.872	0.900	0.863	—	—	—	—	0.860	—	—	—
P-COR(50%)	0.946	0.960	0.915	0.959	—	—	—	—	0.947	—	—	—
SLSC(50%)	0.124	0.182	0.135	0.218	—	—	—	—	0.147	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	827	874	869	879	—	—	—	—	878	—	—	—
	1/3	950	992	1,031	998	—	—	—	—	1,009	—	—	—
	1/5	1,105	1,122	1,225	1,127	—	—	—	—	1,150	—	—	—
	1/10	1,316	1,287	1,491	1,287	—	—	—	—	1,321	—	—	—
	1/20	1,526	1,445	1,768	1,436	—	—	—	—	1,480	—	—	—
	1/30	1,650	1,535	1,937	1,520	—	—	—	—	1,570	—	—	—
	1/50	1,805	1,649	2,157	1,624	—	—	—	—	1,681	—	—	—
	1/80	1,947	1,752	2,369	1,718	—	—	—	—	1,781	—	—	—
	1/100	2,015	1,802	2,472	1,762	—	—	—	—	1,828	—	—	—
	1/150	2,138	1,891	2,665	1,840	—	—	—	—	1,913	—	—	—
	1/200	2,226	1,954	2,806	1,895	—	—	—	—	1,973	—	—	—
	1/300	2,349	2,043	3,009	1,972	—	—	—	—	2,058	—	—	—
	1/400	2,436	2,106	3,158	2,026	—	—	—	—	2,118	—	—	—
	1/500	2,504	2,155	3,275	2,068	—	—	—	—	2,164	—	—	—
	1/700	2,606	2,229	3,456	2,130	—	—	—	—	2,234	—	—	—
	1/1000	2,715	2,307	3,652	2,194	—	—	—	—	2,309	—	—	—
jackknife	1/2	40	43	40	33	—	—	—	—	39	—	—	—
error estimates	1/3	53	59	44	35	—	—	—	—	49	—	—	—
	1/5	80	84	69	64	—	—	—	—	84	—	—	—
	1/10	124	118	115	133	—	—	—	—	145	—	—	—
	1/20	170	152	169	220	—	—	—	—	212	—	—	—
	1/30	197	172	203	278	—	—	—	—	253	—	—	—
	1/50	231	197	249	357	—	—	—	—	307	—	—	—
	1/80	263	220	295	435	—	—	—	—	358	—	—	—
	1/100	278	230	317	474	—	—	—	—	383	—	—	—
	1/150	306	250	360	548	—	—	—	—	428	—	—	—
	1/200	325	264	391	602	—	—	—	—	462	—	—	—
	1/300	353	284	437	682	—	—	—	—	509	—	—	—
	1/400	372	298	471	740	—	—	—	—	544	—	—	—
	1/500	388	309	498	786	—	—	—	—	571	—	—	—
	1/700	411	326	539	858	—	—	—	—	613	—	—	—
	1/1000	435	343	585	936	—	—	—	—	658	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7162

	6months rainfall series (number of sumple N=45)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.880	0.943	0.917	0.968	0.957	—	—	—	—	—	—	—
P-COR(99%)	0.486	0.987	0.966	0.993	0.291	—	—	—	—	—	—	—
SLSC(99%)	0.099	0.069	0.111	0.362	0.089	—	—	—	—	—	—	—
log likelihood	-285.100	-333.300	-316.100	-308.300	—	—	—	—	—	—	—	—
pAIC	574.300	670.600	636.200	622.500	0.000	—	—	—	—	—	—	—
X-COR(50%)	0.980	0.979	0.980	0.952	0.919	—	—	—	—	—	—	—
P-COR(50%)	0.975	0.978	0.948	0.972	-0.221	—	—	—	—	—	—	—
SLSC(50%)	0.091	0.061	0.203	0.732	0.199	—	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	808	840	854	877	898	—	—	—	—	—	—	—
	1/3	892	920	1,010	959	979	—	—	—	—	—	—	—
	1/5	998	1,010	1,197	1,034	1,043	—	—	—	—	—	—	—
	1/10	1,142	1,122	1,452	1,108	1,097	—	—	—	—	—	—	—
	1/20	1,286	1,230	1,717	1,164	1,130	—	—	—	—	—	—	—
	1/30	1,370	1,292	1,879	1,190	1,144	—	—	—	—	—	—	—
	1/50	1,477	1,370	2,091	1,218	1,157	—	—	—	—	—	—	—
	1/80	1,574	1,441	2,293	1,240	1,167	—	—	—	—	—	—	—
	1/100	1,621	1,475	2,392	1,249	1,170	—	—	—	—	—	—	—
	1/150	1,705	1,536	2,577	1,263	1,176	—	—	—	—	—	—	—
	1/200	1,765	1,579	2,711	1,273	1,179	—	—	—	—	—	—	—
	1/300	1,849	1,640	2,906	1,284	1,183	—	—	—	—	—	—	—
	1/400	1,909	1,683	3,048	1,292	1,185	—	—	—	—	—	—	—
	1/500	1,955	1,716	3,160	1,297	1,186	—	—	—	—	—	—	—
	1/700	2,025	1,767	3,333	1,304	1,188	—	—	—	—	—	—	—
	1/1000	2,099	1,820	3,521	1,311	1,190	—	—	—	—	—	—	—
jackknife	1/2	32	30	25	25	40	—	—	—	—	—	—	—
error estimates	1/3	28	29	71	28	42	—	—	—	—	—	—	—
	1/5	32	33	154	34	45	—	—	—	—	—	—	—
	1/10	46	44	272	47	67	—	—	—	—	—	—	—
	1/20	65	57	400	64	102	—	—	—	—	—	—	—
	1/30	76	66	480	76	126	—	—	—	—	—	—	—
	1/50	91	76	585	92	157	—	—	—	—	—	—	—
	1/80	106	86	688	107	186	—	—	—	—	—	—	—
	1/100	112	91	738	115	200	—	—	—	—	—	—	—
	1/150	125	100	833	128	226	—	—	—	—	—	—	—
	1/200	134	106	903	137	244	—	—	—	—	—	—	—
	1/300	146	115	1,004	150	270	—	—	—	—	—	—	—
	1/400	155	122	1,079	159	288	—	—	—	—	—	—	—
	1/500	162	126	1,138	166	302	—	—	—	—	—	—	—
	1/700	172	134	1,230	175	324	—	—	—	—	—	—	—
	1/1000	183	142	1,330	186	346	—	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

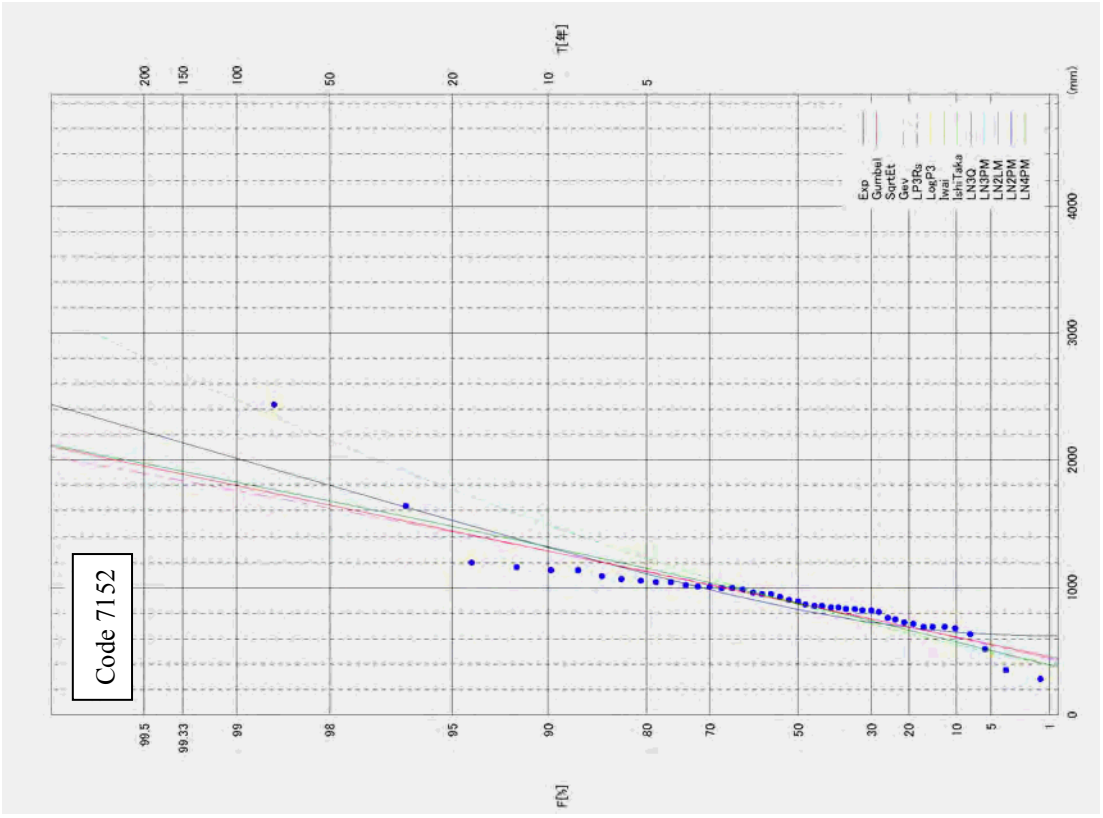

Figure C6.3.30 Probability Distribution on Gumbel Probability Paper (Station code 7152)

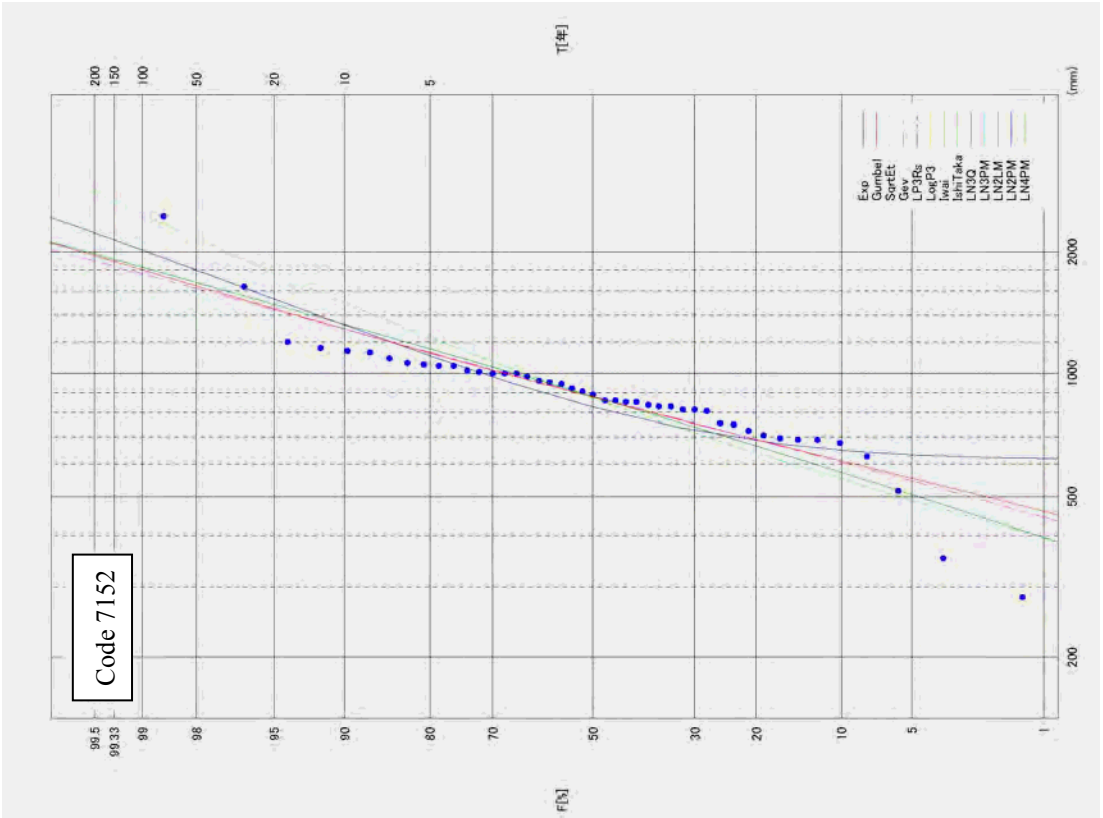

Figure C6.3.31 Probability Distribution on Log-normal Probability Paper (Station code 7152)

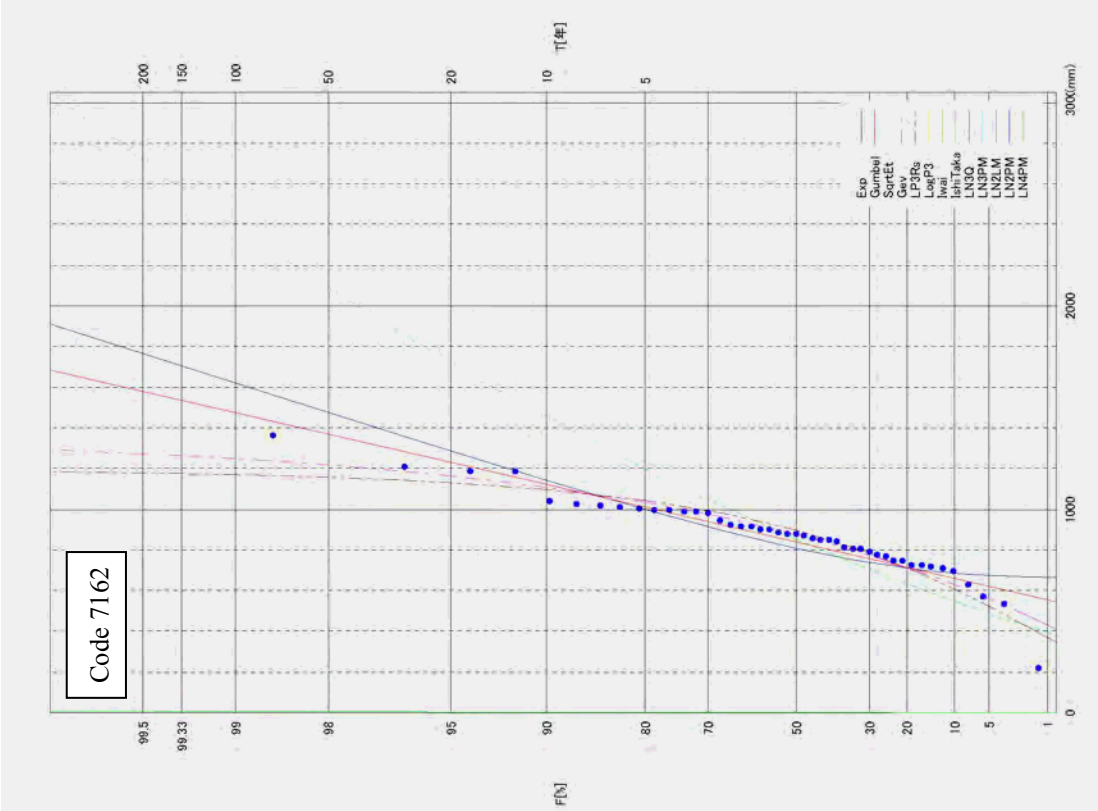

Figure C6.3.32 Probability Distribution on Gumbel Probability Paper (Station code 7162)

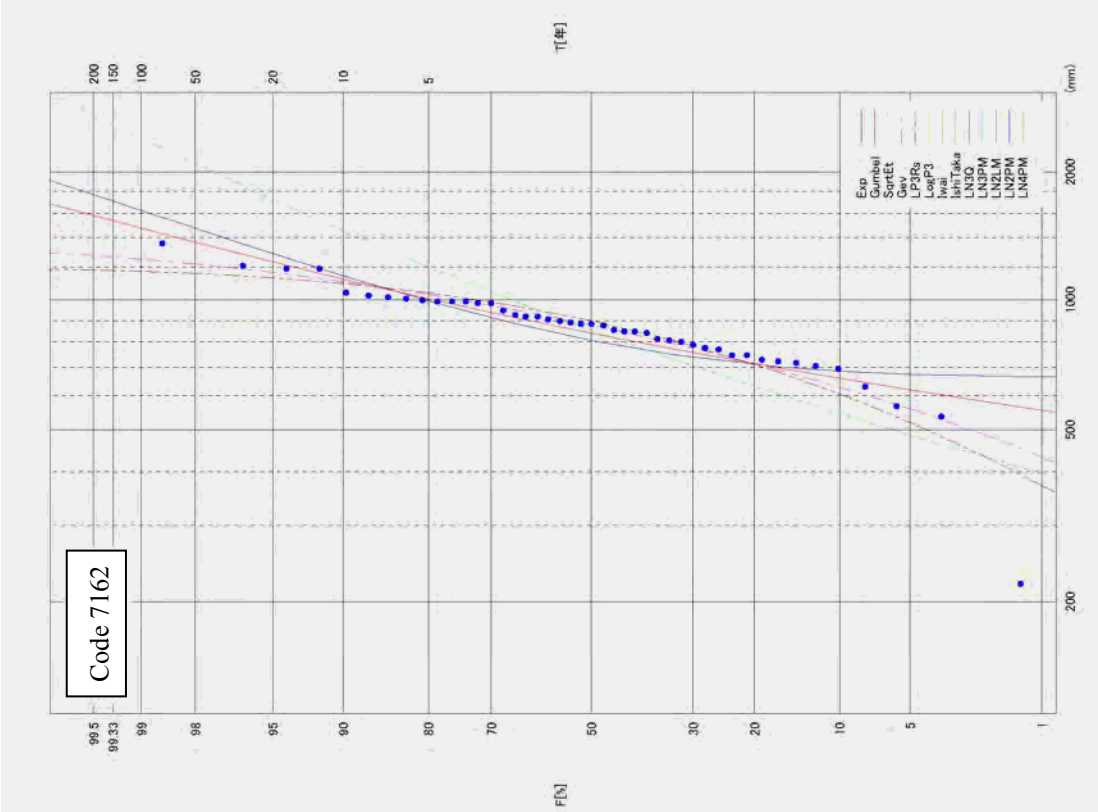

Figure C6.3.33 Probability Distribution on Log-normal Probability Paper (Station code 7162)

Table C 6.3.16 Result of Frequency Analysis of 6-Month Rainfall (7)

Station code 7182

	6months rainfall series (number of sumple N=55)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.885	0.956	0.931	0.997	0.998	0.997	—	—	—	—	—	—
P-COR(99%)	0.836	0.982	0.979	0.998	0.998	0.997	—	—	—	—	—	—
SLSC(99%)	0.096	0.059	0.077	0.021	0.017	0.017	—	—	—	—	—	—
log likelihood	-345.300	-367.300	-367.500	-359.300	-359.200	-359.400	—	—	—	—	—	—
pAIC	694.500	738.500	739.000	724.700	724.500	724.900	—	—	—	—	—	—
X-COR(50%)	0.973	0.982	0.972	0.994	0.994	0.997	—	—	—	—	—	—
P-COR(50%)	0.995	0.995	0.994	0.996	0.996	0.997	—	—	—	—	—	—
SLSC(50%)	0.128	0.100	0.148	0.041	0.030	0.033	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	782	813	811	852	854	847	—	—	—	—	—	—
	1/3	862	888	909	929	928	922	—	—	—	—	—	—
	1/5	962	973	1,024	996	993	991	—	—	—	—	—	—
	1/10	1,097	1,079	1,177	1,062	1,055	1,062	—	—	—	—	—	—
	1/20	1,233	1,180	1,332	1,109	1,100	1,116	—	—	—	—	—	—
	1/30	1,313	1,239	1,426	1,130	1,120	1,143	—	—	—	—	—	—
	1/50	1,413	1,312	1,548	1,153	1,143	1,172	—	—	—	—	—	—
	1/80	1,505	1,379	1,663	1,170	1,160	1,196	—	—	—	—	—	—
	1/100	1,549	1,411	1,719	1,177	1,167	1,207	—	—	—	—	—	—
	1/150	1,628	1,468	1,822	1,188	1,179	1,225	—	—	—	—	—	—
	1/200	1,684	1,509	1,897	1,195	1,187	1,237	—	—	—	—	—	—
	1/300	1,764	1,567	2,006	1,203	1,197	1,252	—	—	—	—	—	—
	1/400	1,820	1,607	2,084	1,209	1,203	1,262	—	—	—	—	—	—
	1/500	1,864	1,639	2,146	1,212	1,208	1,270	—	—	—	—	—	—
	1/700	1,930	1,686	2,241	1,217	1,214	1,280	—	—	—	—	—	—
	1/1000	2,000	1,737	2,343	1,222	1,220	1,291	—	—	—	—	—	—
jackknife	1/2	25	24	25	27	27	28	—	—	—	—	—	—
error estimates	1/3	23	22	27	26	26	26	—	—	—	—	—	—
	1/5	23	23	34	25	25	25	—	—	—	—	—	—
	1/10	28	27	47	26	26	27	—	—	—	—	—	—
	1/20	36	33	63	32	31	33	—	—	—	—	—	—
	1/30	42	37	73	36	35	38	—	—	—	—	—	—
	1/50	50	42	87	42	41	45	—	—	—	—	—	—
	1/80	57	47	100	47	47	53	—	—	—	—	—	—
	1/100	60	49	107	50	50	57	—	—	—	—	—	—
	1/150	67	54	119	54	56	64	—	—	—	—	—	—
	1/200	71	57	129	57	59	69	—	—	—	—	—	—
	1/300	78	62	142	61	65	76	—	—	—	—	—	—
	1/400	83	65	152	63	68	81	—	—	—	—	—	—
	1/500	86	68	160	65	71	85	—	—	—	—	—	—
	1/700	92	72	172	68	75	91	—	—	—	—	—	—
	1/1000	98	76	185	71	80	97	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7242

	6months rainfall series (number of sumple N=47)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.888	0.957	0.937	0.997	0.997	0.997	—	—	—	—	—	—
P-COR(99%)	0.818	0.984	0.982	0.998	0.998	0.998	—	—	—	—	—	—
SLSC(99%)	0.094	0.058	0.074	0.018	0.018	0.018	—	—	—	—	—	—
log likelihood	-311.500	-330.200	-330.000	-323.300	-323.300	-323.500	—	—	—	—	—	—
pAIC	626.900	664.300	664.100	652.600	652.700	653.100	—	—	—	—	—	—
X-COR(50%)	0.964	0.974	0.964	0.994	0.994	0.997	—	—	—	—	—	—
P-COR(50%)	0.997	0.997	0.996	0.995	0.995	0.998	—	—	—	—	—	—
SLSC(50%)	0.125	0.098	0.142	0.032	0.031	0.032	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,376	1,419	1,420	1,472	1,475	1,468	—	—	—	—	—	—
	1/3	1,488	1,526	1,557	1,580	1,579	1,574	—	—	—	—	—	—
	1/5	1,630	1,646	1,716	1,678	1,672	1,670	—	—	—	—	—	—
	1/10	1,823	1,796	1,927	1,775	1,762	1,768	—	—	—	—	—	—
	1/20	2,015	1,940	2,139	1,845	1,830	1,845	—	—	—	—	—	—
	1/30	2,128	2,023	2,266	1,878	1,862	1,883	—	—	—	—	—	—
	1/50	2,270	2,127	2,430	1,913	1,898	1,926	—	—	—	—	—	—
	1/80	2,401	2,222	2,584	1,939	1,926	1,961	—	—	—	—	—	—
	1/100	2,463	2,267	2,659	1,950	1,938	1,976	—	—	—	—	—	—
	1/150	2,575	2,349	2,797	1,968	1,958	2,002	—	—	—	—	—	—
	1/200	2,655	2,407	2,897	1,979	1,972	2,019	—	—	—	—	—	—
	1/300	2,768	2,488	3,041	1,993	1,989	2,042	—	—	—	—	—	—
	1/400	2,848	2,546	3,144	2,001	2,000	2,057	—	—	—	—	—	—
	1/500	2,910	2,591	3,226	2,007	2,008	2,069	—	—	—	—	—	—
	1/700	3,003	2,658	3,351	2,015	2,019	2,085	—	—	—	—	—	—
	1/1000	3,102	2,730	3,485	2,023	2,030	2,101	—	—	—	—	—	—
jackknife	1/2	38	36	37	41	41	42	—	—	—	—	—	—
error estimates	1/3	35	35	42	40	40	40	—	—	—	—	—	—
	1/5	36	36	56	39	38	39	—	—	—	—	—	—
	1/10	44	43	83	41	39	41	—	—	—	—	—	—
	1/20	57	52	114	48	44	50	—	—	—	—	—	—
	1/30	66	58	133	54	50	58	—	—	—	—	—	—
	1/50	78	66	159	63	58	70	—	—	—	—	—	—
	1/80	89	74	184	71	67	82	—	—	—	—	—	—
	1/100	95	78	196	75	72	88	—	—	—	—	—	—
	1/150	105	85	219	82	81	100	—	—	—	—	—	—
	1/200	112	90	235	87	87	108	—	—	—	—	—	—
	1/300	122	97	260	93	96	120	—	—	—	—	—	—
	1/400	129	102	278	98	102	129	—	—	—	—	—	—
	1/500	135	106	292	101	107	136	—	—	—	—	—	—
	1/700	144	112	314	106	114	146	—	—	—	—	—	—
	1/1000	153	119	337	111	122	157	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

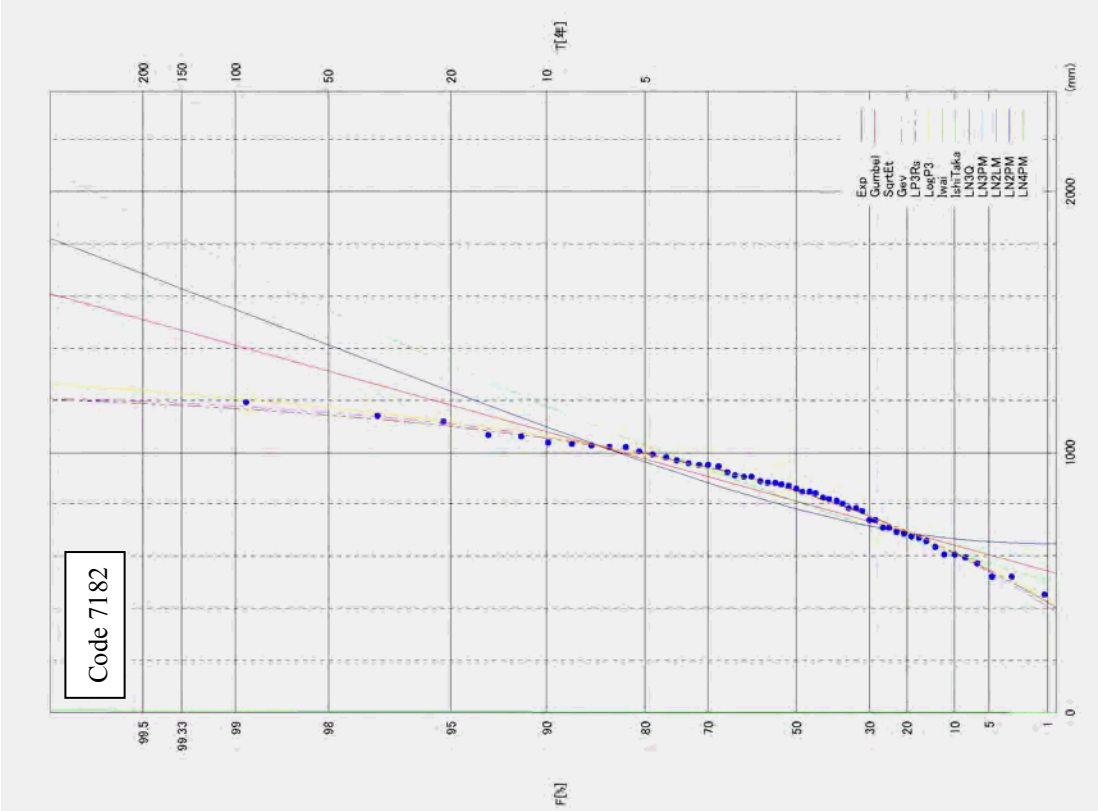

Figure C6.3.34 Probability Distribution on Gumbel Probability Paper (Station code 7182)

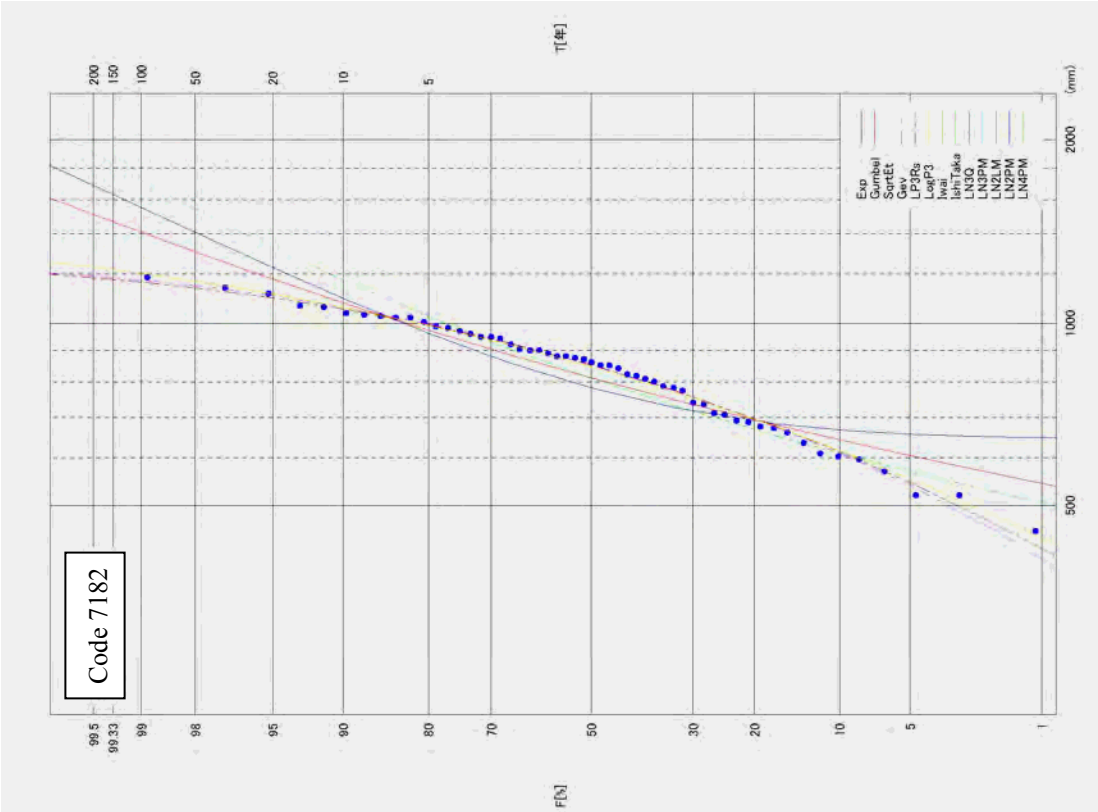

Figure C6.3.35 Probability Distribution on Log-normal Probability Paper (Station code 7182)

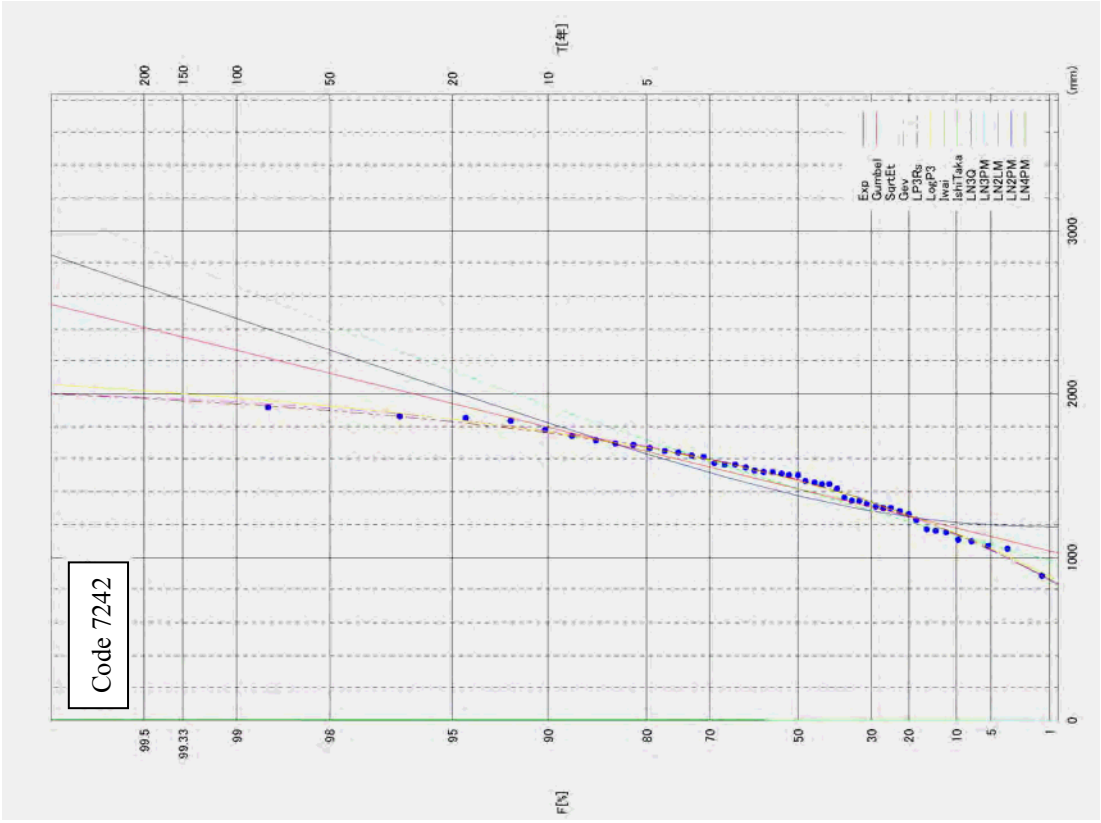

Figure C6.3.36 Probability Distribution on Gumbel Probability Paper (Station code 7242)

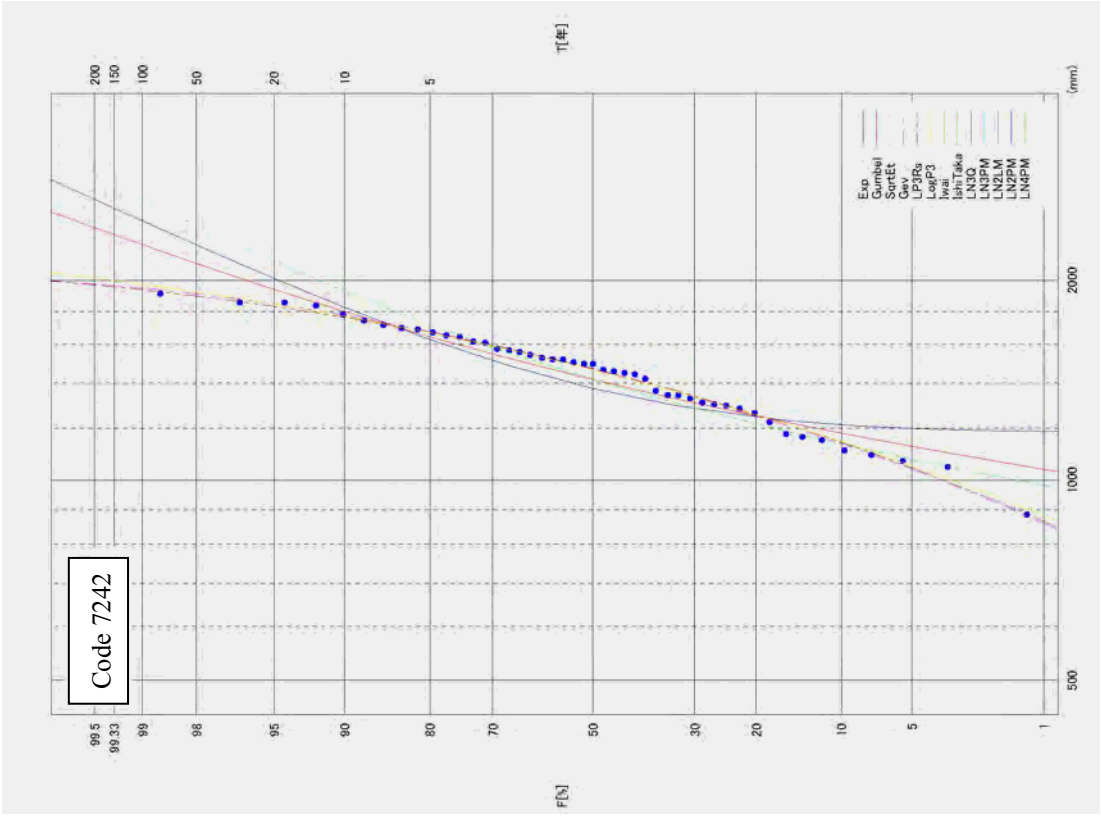

Figure C6.3.37 Probability Distribution on Log-normal Probability Paper (Station code 7242)

Table C 6.3.17 Result of Frequency Analysis of 6-Month Rainfall (8)

Station code 7252

	6months rainfall series (number of sumple N=45)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.964	0.957	0.969	0.972	—	—	—	—	0.957	—	—	—
P-COR(99%)	0.885	0.993	0.992	0.993	—	—	—	—	0.993	—	—	—
SLSC(99%)	0.058	0.067	0.047	0.046	—	—	—	—	0.048	—	—	—
log likelihood	-310.800	-321.600	-321.800	-322.400	—	—	—	—	-321.900	—	—	—
pAIC	625.700	647.100	647.600	650.800	—	—	—	—	649.800	—	—	—
X-COR(50%)	0.955	0.946	0.957	0.961	—	—	—	—	0.945	—	—	—
P-COR(50%)	0.986	0.991	0.989	0.992	—	—	—	—	0.991	—	—	—
SLSC(50%)	0.078	0.133	0.086	0.079	—	—	—	—	0.102	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,299	1,356	1,345	1,335	—	—	—	—	1,353	—	—	—
	1/3	1,449	1,499	1,492	1,471	—	—	—	—	1,497	—	—	—
	1/5	1,636	1,657	1,665	1,633	—	—	—	—	1,657	—	—	—
	1/10	1,891	1,856	1,894	1,852	—	—	—	—	1,857	—	—	—
	1/20	2,146	2,047	2,127	2,080	—	—	—	—	2,049	—	—	—
	1/30	2,295	2,157	2,267	2,219	—	—	—	—	2,159	—	—	—
	1/50	2,483	2,294	2,447	2,403	—	—	—	—	2,297	—	—	—
	1/80	2,656	2,420	2,618	2,581	—	—	—	—	2,423	—	—	—
	1/100	2,738	2,479	2,701	2,669	—	—	—	—	2,483	—	—	—
	1/150	2,887	2,587	2,854	2,833	—	—	—	—	2,593	—	—	—
	1/200	2,993	2,664	2,965	2,955	—	—	—	—	2,671	—	—	—
	1/300	3,142	2,772	3,125	3,132	—	—	—	—	2,782	—	—	—
	1/400	3,248	2,848	3,240	3,263	—	—	—	—	2,861	—	—	—
	1/500	3,330	2,907	3,331	3,367	—	—	—	—	2,923	—	—	—
	1/700	3,453	2,997	3,471	3,529	—	—	—	—	3,017	—	—	—
	1/1000	3,585	3,091	3,621	3,708	—	—	—	—	3,117	—	—	—
jackknife	1/2	42	48	43	38	—	—	—	—	41	—	—	—
error estimates	1/3	61	69	54	47	—	—	—	—	59	—	—	—
	1/5	92	96	77	71	—	—	—	—	85	—	—	—
	1/10	139	133	114	128	—	—	—	—	125	—	—	—
	1/20	188	169	156	215	—	—	—	—	172	—	—	—
	1/30	217	190	182	279	—	—	—	—	203	—	—	—
	1/50	253	216	216	376	—	—	—	—	246	—	—	—
	1/80	286	241	249	481	—	—	—	—	290	—	—	—
	1/100	302	252	265	536	—	—	—	—	312	—	—	—
	1/150	331	273	296	647	—	—	—	—	355	—	—	—
	1/200	352	288	318	735	—	—	—	—	387	—	—	—
	1/300	381	309	351	869	—	—	—	—	435	—	—	—
	1/400	402	324	375	974	—	—	—	—	472	—	—	—
	1/500	418	335	394	1,061	—	—	—	—	501	—	—	—
	1/700	442	353	423	1,201	—	—	—	—	547	—	—	—
	1/1000	468	371	455	1,363	—	—	—	—	598	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7282

	6months rainfall series (number of sumple N=44)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.914	0.969	0.953	0.991	0.991	0.991	0.991	0.991	—	0.991	—	—
P-COR(99%)	0.840	0.984	0.980	0.992	0.992	0.992	0.993	0.993	—	0.993	—	—
SLSC(99%)	0.083	0.049	0.065	0.032	0.027	0.027	0.028	0.028	—	0.028	—	—
log likelihood	-280.000	-295.700	-296.200	-291.900	-292.100	-292.100	-292.200	-292.200	—	-292.200	—	—
pAIC	563.900	595.400	596.400	589.900	590.100	590.100	590.400	590.400	—	590.400	—	—
X-COR(50%)	0.949	0.957	0.947	0.976	0.974	0.991	0.972	0.972	—	0.972	—	—
P-COR(50%)	0.983	0.982	0.979	0.975	0.975	0.992	0.977	0.977	—	0.977	—	—
SLSC(50%)	0.103	0.076	0.120	0.060	0.074	0.067	0.066	0.065	—	0.066	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	939	972	970	1,001	1,005	1,002	1,002	1,002	—	1,002	—	—
	1/3	1,025	1,054	1,072	1,086	1,087	1,084	1,083	1,083	—	1,083	—	—
	1/5	1,134	1,146	1,190	1,167	1,165	1,164	1,161	1,161	—	1,161	—	—
	1/10	1,282	1,262	1,347	1,252	1,246	1,248	1,246	1,246	—	1,246	—	—
	1/20	1,430	1,372	1,507	1,320	1,310	1,317	1,316	1,316	—	1,316	—	—
	1/30	1,516	1,436	1,602	1,353	1,343	1,352	1,352	1,353	—	1,353	—	—
	1/50	1,625	1,516	1,725	1,390	1,380	1,393	1,395	1,396	—	1,396	—	—
	1/80	1,726	1,589	1,841	1,419	1,411	1,427	1,432	1,433	—	1,433	—	—
	1/100	1,773	1,623	1,897	1,432	1,424	1,443	1,449	1,450	—	1,450	—	—
	1/150	1,860	1,686	2,002	1,453	1,448	1,469	1,478	1,479	—	1,479	—	—
	1/200	1,921	1,730	2,077	1,467	1,463	1,487	1,498	1,499	—	1,499	—	—
	1/300	2,008	1,793	2,185	1,485	1,484	1,511	1,525	1,527	—	1,527	—	—
	1/400	2,069	1,837	2,264	1,496	1,498	1,528	1,544	1,545	—	1,545	—	—
	1/500	2,117	1,872	2,326	1,504	1,508	1,540	1,558	1,560	—	1,560	—	—
	1/700	2,189	1,923	2,420	1,516	1,523	1,558	1,579	1,581	—	1,581	—	—
	1/1000	2,265	1,978	2,522	1,527	1,538	1,576	1,600	1,602	—	1,602	—	—
jackknife	1/2	29	28	29	29	31	32	51,523	978	—	31	—	—
error estimates	1/3	29	29	32	31	33	32	51,383	1,057	—	32	—	—
	1/5	32	33	42	34	34	34	51,249	1,133	—	34	—	—
	1/10	43	41	59	41	37	39	51,103	1,215	—	37	—	—
	1/20	56	51	79	50	42	48	50,982	1,283	—	42	—	—
	1/30	64	57	91	57	46	55	50,919	1,319	—	46	—	—
	1/50	75	64	109	65	52	65	50,845	1,361	—	51	—	—
	1/80	86	72	125	73	58	75	50,781	1,396	—	56	—	—
	1/100	91	75	133	77	61	79	50,752	1,412	—	58	—	—
	1/150	100	82	149	84	67	89	50,702	1,441	—	63	—	—
	1/200	106	86	160	89	72	96	50,667	1,460	—	67	—	—
	1/300	116	93	177	96	78	106	50,620	1,487	—	72	—	—
	1/400	122	97	189	100	83	113	50,588	1,505	—	76	—	—
	1/500	127	101	198	104	87	119	50,564	1,518	—	79	—	—
	1/700	135	107	213	110	93	128	50,528	1,539	—	83	—	—
	1/1000	143	112	229	115	100	137	50,491	1,559	—	88	—	—

less than 0.04(SLSC)
minimum value(SLSC)

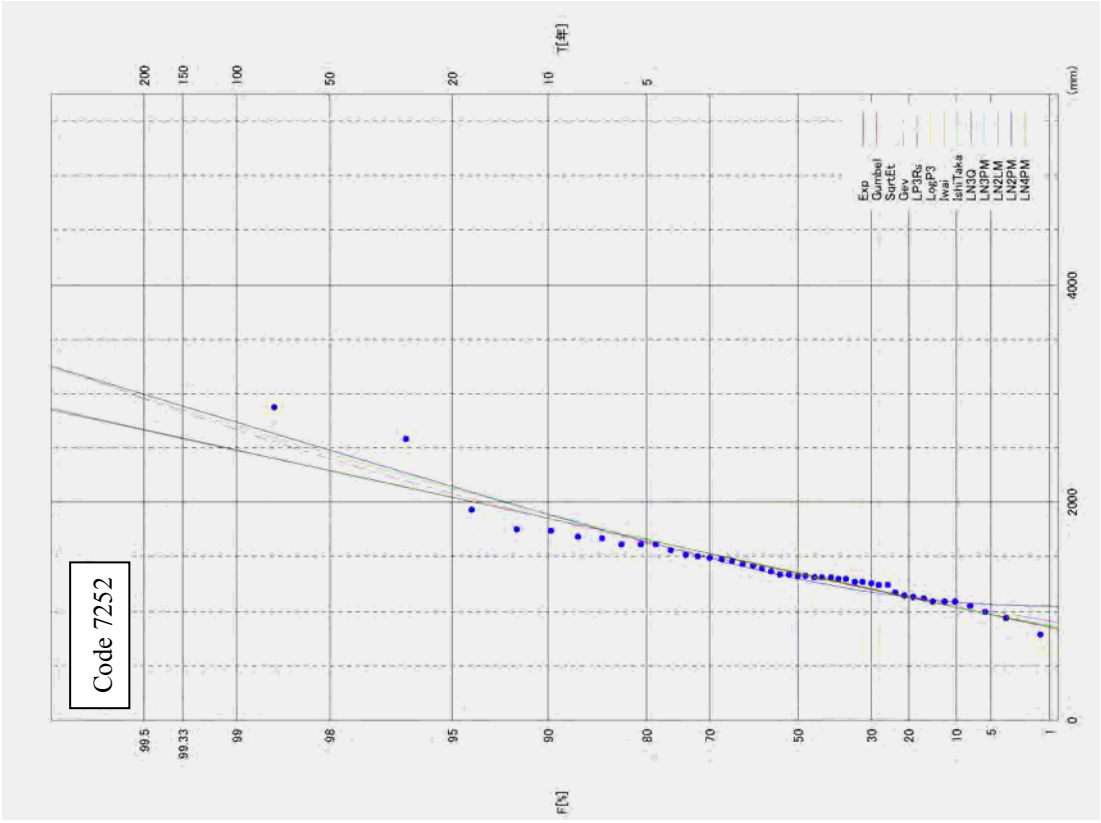

Figure C6.3.38 Probability Distribution on Gumbel Probability Paper (Station code 7252)

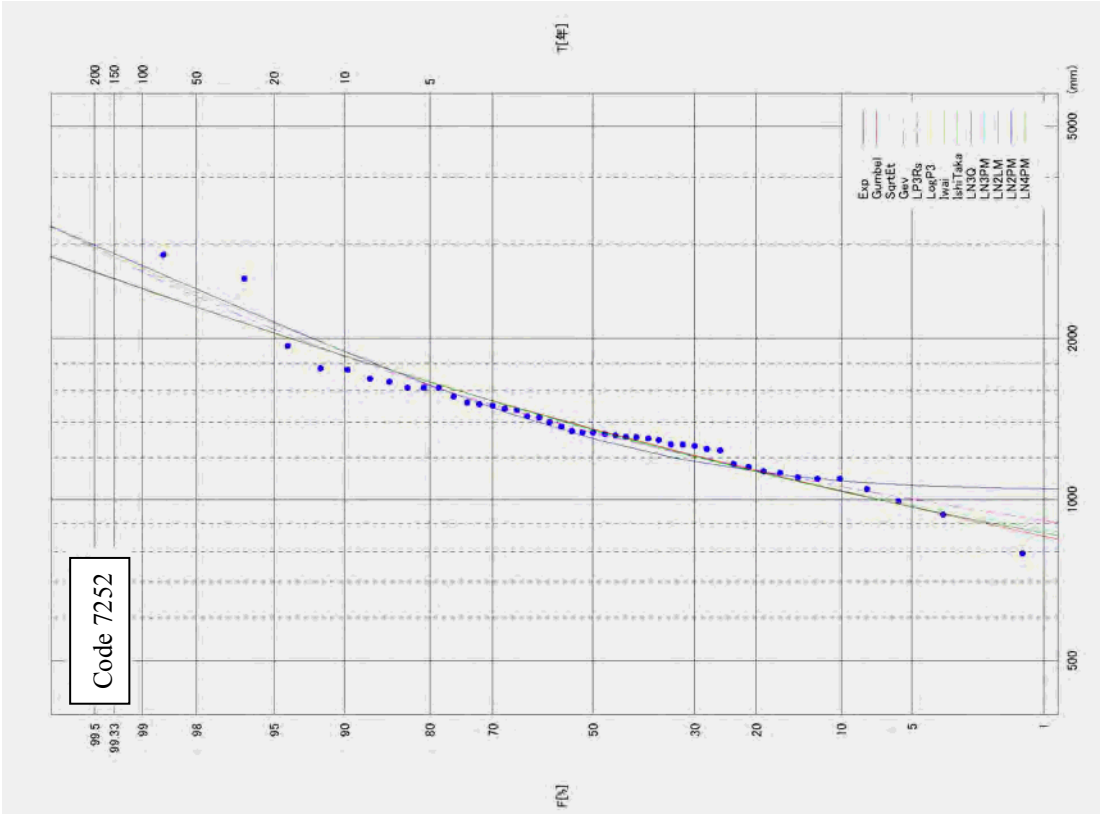

Figure C6.3.39 Probability Distribution on Log-normal Probability Paper (Station code 7252)

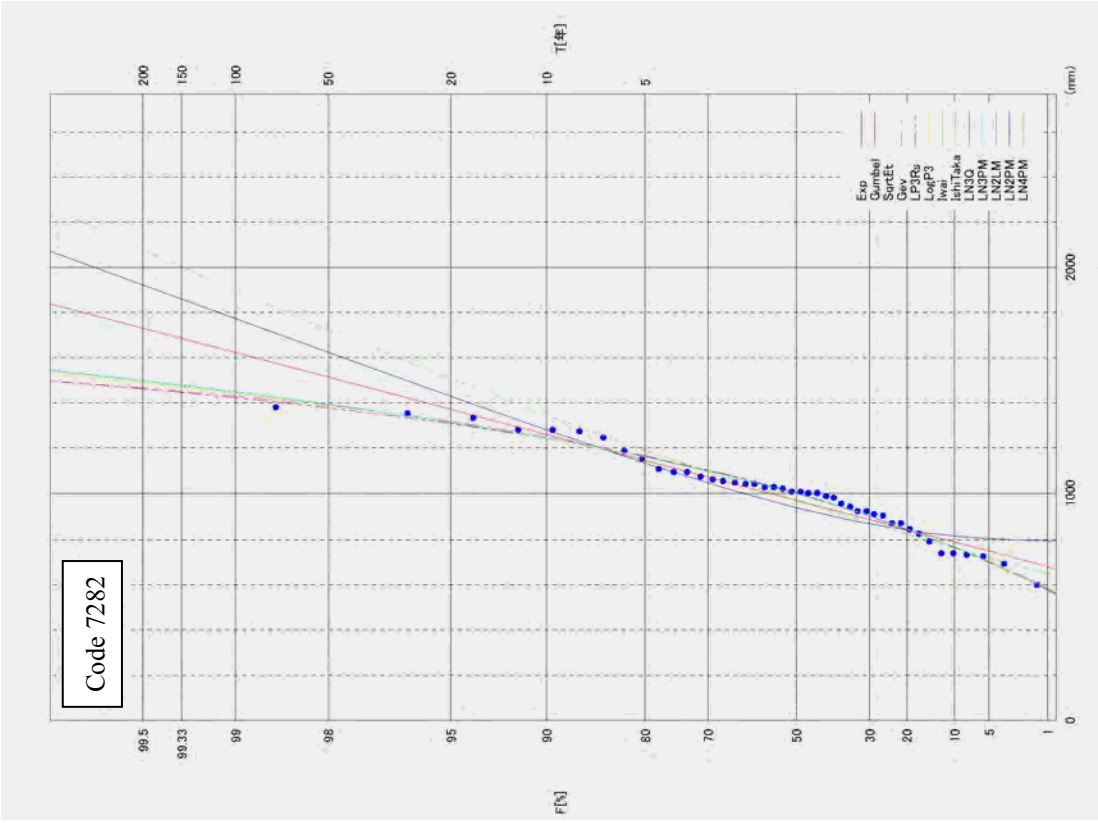

Figure C6.3.40 Probability Distribution on Gumbel Probability Paper (Station code 7282)

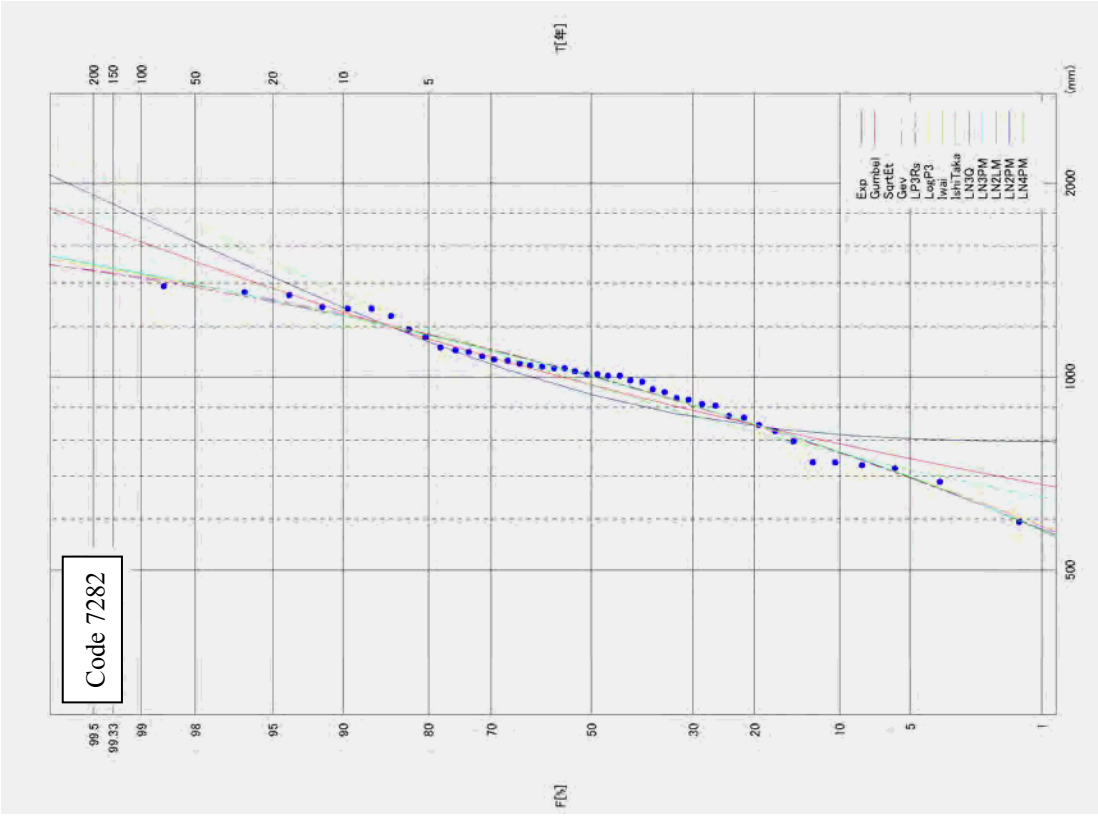

Figure C6.3.41 Probability Distribution on Log-normal Probability Paper (Station code 7282)

Table C 6.3.18 Result of Frequency Analysis of 6-Month Rainfall (9)

Station code 7292

	6months rainfall series (number of sumple N=44)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.950	0.990	0.978	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.997	0.997
P-COR(99%)	0.895	0.996	0.994	0.999	0.999	0.999	0.998	0.999	0.998	0.999	0.998	0.998
SLSC(99%)	0.064	0.028	0.046	0.013	0.014	0.013	0.014	0.013	0.014	0.013	0.016	0.017
log likelihood	-282.400	-294.900	-296.000	-293.800	-293.800	-293.800	-293.900	-293.900	-293.900	-293.900	-294.000	-294.000
pAIC	568.900	593.900	595.900	593.600	593.700	593.700	593.800	593.800	593.800	593.800	592.000	592.000
X-COR(50%)	0.989	0.993	0.988	0.995	0.995	0.998	0.995	0.995	0.995	0.995	0.995	0.995
P-COR(50%)	0.994	0.995	0.995	0.996	0.996	0.999	0.996	0.996	0.996	0.996	0.995	0.995
SLSC(50%)	0.086	0.049	0.088	0.024	0.028	0.025	0.026	0.026	0.027	0.026	0.031	0.030

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	815	850	846	869	874	870	867	871	870	871	863	863
	1/3	907	937	945	959	961	957	954	957	955	957	953	951
	1/5	1,022	1,035	1,061	1,050	1,048	1,046	1,044	1,044	1,043	1,045	1,047	1,044
	1/10	1,178	1,157	1,216	1,153	1,144	1,147	1,148	1,144	1,142	1,144	1,158	1,153
	1/20	1,335	1,274	1,374	1,240	1,226	1,235	1,241	1,231	1,229	1,231	1,259	1,252
	1/30	1,426	1,341	1,468	1,286	1,269	1,282	1,292	1,278	1,277	1,278	1,315	1,307
	1/50	1,542	1,426	1,591	1,340	1,320	1,338	1,353	1,335	1,333	1,334	1,383	1,373
	1/80	1,648	1,503	1,707	1,385	1,364	1,388	1,408	1,384	1,383	1,383	1,444	1,433
	1/100	1,698	1,539	1,763	1,405	1,383	1,410	1,433	1,407	1,406	1,406	1,473	1,461
	1/150	1,790	1,606	1,868	1,440	1,418	1,451	1,478	1,448	1,448	1,446	1,524	1,510
	1/200	1,854	1,653	1,943	1,463	1,442	1,478	1,509	1,476	1,476	1,474	1,560	1,545
	1/300	1,946	1,719	2,052	1,494	1,474	1,517	1,553	1,515	1,515	1,513	1,610	1,594
	1/400	2,011	1,766	2,131	1,515	1,497	1,543	1,583	1,542	1,543	1,540	1,645	1,628
	1/500	2,061	1,802	2,193	1,530	1,513	1,563	1,607	1,562	1,564	1,560	1,672	1,655
	1/700	2,137	1,857	2,288	1,553	1,538	1,593	1,642	1,593	1,595	1,591	1,713	1,694
	1/1000	2,218	1,915	2,392	1,575	1,564	1,624	1,678	1,626	1,628	1,623	1,756	1,736
jackknife	1/2	29	29	29	33	33	33	32	33	30	33	29	29
error estimates	1/3	31	32	34	36	36	35	34	35	33	35	33	32
	1/5	37	38	44	40	39	39	38	39	38	39	39	38
	1/10	49	47	62	48	47	47	49	47	48	47	49	48
	1/20	63	58	83	62	58	60	64	57	60	57	61	59
	1/30	72	64	96	73	66	69	74	65	68	65	68	66
	1/50	84	72	113	88	77	83	88	76	79	76	77	75
	1/80	95	80	130	104	89	97	102	87	91	86	85	83
	1/100	100	84	138	112	95	105	109	93	97	92	89	87
	1/150	109	90	154	127	106	118	122	103	107	102	97	94
	1/200	116	95	166	138	115	129	131	111	115	109	102	99
	1/300	125	102	183	154	127	144	145	122	127	120	110	107
	1/400	132	107	195	166	136	156	155	130	135	128	116	112
	1/500	137	110	205	175	144	165	163	137	142	135	120	116
	1/700	145	116	220	189	155	179	175	147	153	144	127	122
	1/1000	154	122	236	203	167	194	188	158	164	155	134	129

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7341

	6months rainfall series (number of sumple N=43)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.942	0.984	0.974	0.993	0.993	—	0.992	0.993	0.993	0.993	0.993	0.993
P-COR(99%)	0.917	0.987	0.984	0.994	0.994	—	0.993	0.994	0.994	0.994	0.993	0.993
SLSC(99%)	0.068	0.035	0.047	0.025	0.027	—	0.027	0.026	0.027	0.026	0.026	0.026
log likelihood	-279.000	-291.200	-291.900	-290.200	-290.300	—	-290.300	-290.300	-290.300	-290.300	-290.300	-290.300
pAIC	562.000	586.500	587.700	586.500	586.600	—	586.600	586.700	586.700	586.700	584.700	584.600
X-COR(50%)	0.983	0.985	0.982	0.982	0.983	—	0.985	0.984	0.984	0.984	0.985	0.985
P-COR(50%)	0.979	0.981	0.978	0.976	0.977	—	0.978	0.978	0.978	0.978	0.978	0.978
SLSC(50%)	0.090	0.057	0.086	0.043	0.050	—	0.047	0.046	0.048	0.046	0.047	0.046

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,059	1,096	1,092	1,121	1,123	—	1,113	1,119	1,120	1,120	1,114	1,114
	1/3	1,157	1,190	1,195	1,217	1,216	—	1,207	1,212	1,212	1,212	1,209	1,208
	1/5	1,280	1,294	1,315	1,313	1,309	—	1,304	1,305	1,304	1,306	1,308	1,305
	1/10	1,448	1,425	1,474	1,419	1,411	—	1,418	1,411	1,407	1,411	1,423	1,417
	1/20	1,615	1,550	1,635	1,507	1,498	—	1,519	1,503	1,497	1,503	1,525	1,517
	1/30	1,714	1,623	1,730	1,552	1,544	—	1,574	1,552	1,546	1,552	1,581	1,572
	1/50	1,837	1,713	1,854	1,604	1,599	—	1,641	1,611	1,604	1,611	1,649	1,639
	1/80	1,951	1,795	1,970	1,647	1,646	—	1,701	1,663	1,654	1,662	1,709	1,697
	1/100	2,005	1,835	2,026	1,666	1,667	—	1,729	1,687	1,678	1,686	1,737	1,725
	1/150	2,103	1,906	2,130	1,699	1,705	—	1,778	1,729	1,719	1,728	1,787	1,774
	1/200	2,172	1,956	2,205	1,721	1,730	—	1,813	1,759	1,747	1,757	1,822	1,808
	1/300	2,270	2,027	2,313	1,749	1,766	—	1,861	1,799	1,787	1,797	1,871	1,855
	1/400	2,340	2,077	2,391	1,768	1,790	—	1,895	1,827	1,814	1,825	1,905	1,888
	1/500	2,394	2,116	2,452	1,782	1,808	—	1,920	1,849	1,835	1,847	1,931	1,913
	1/700	2,475	2,175	2,546	1,802	1,835	—	1,959	1,880	1,866	1,878	1,970	1,951
	1/1000	2,561	2,237	2,648	1,821	1,863	—	2,000	1,914	1,898	1,911	2,011	1,991
jackknife	1/2	31	32	33	35	35	—	36	36	41	36	32	32
error estimates	1/3	33	34	38	37	38	—	37	38	41	38	35	35
	1/5	39	40	46	41	42	—	41	42	42	42	41	41
	1/10	52	50	59	52	50	—	51	49	50	49	51	50
	1/20	68	62	74	68	60	—	64	61	68	60	62	60
	1/30	77	68	83	80	68	—	73	68	82	68	68	66
	1/50	90	77	96	96	79	—	86	79	101	79	77	73
	1/80	101	85	108	111	90	—	99	90	121	89	85	80
	1/100	107	89	114	119	96	—	106	95	131	94	88	84
	1/150	117	97	125	133	106	—	118	105	149	104	95	90
	1/200	124	102	133	143	114	—	127	112	163	111	100	94
	1/300	135	109	145	157	125	—	140	123	182	122	107	100
	1/400	142	114	154	167	134	—	149	131	196	129	112	105
	1/500	148	118	161	174	140	—	157	137	207	135	116	108
	1/700	156	125	172	186	150	—	168	146	225	145	122	114
	1/1000	165	131	184	198	161	—	181	157	243	154	128	119

less than 0.04(SLSC)
minimum value(SLSC)

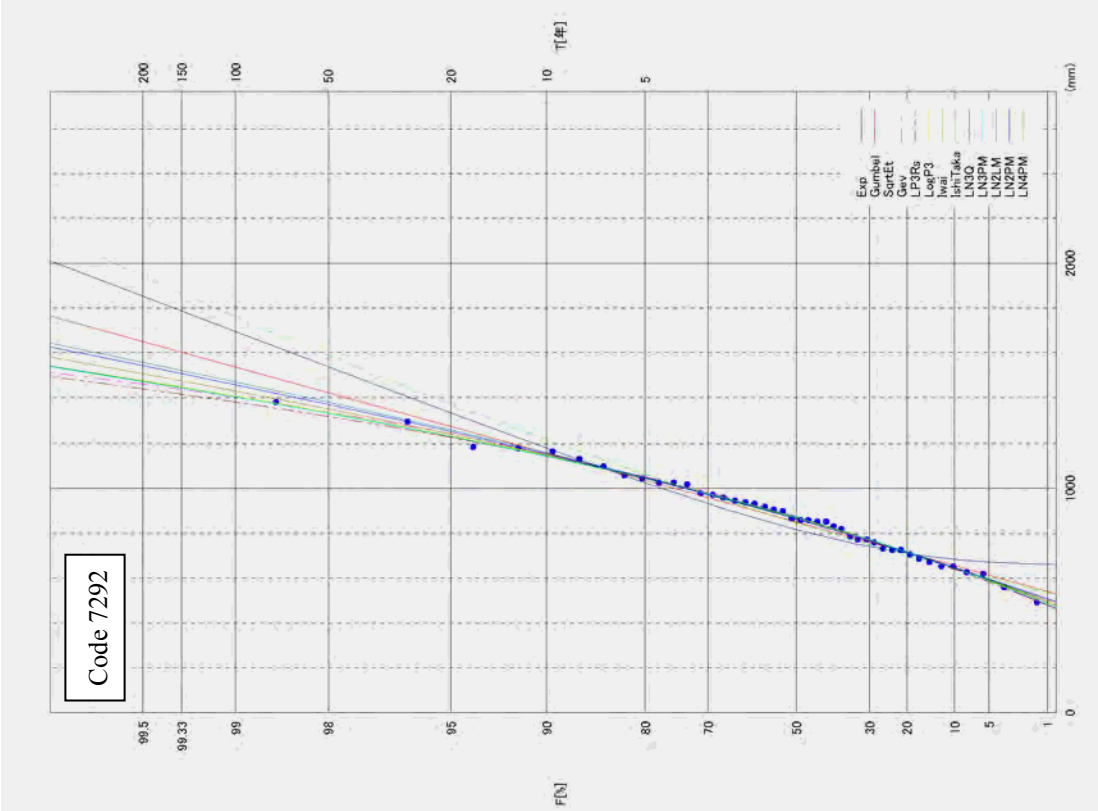

Figure C6.3.42 Probability Distribution on Gumbel Probability Paper (Station code 7292)

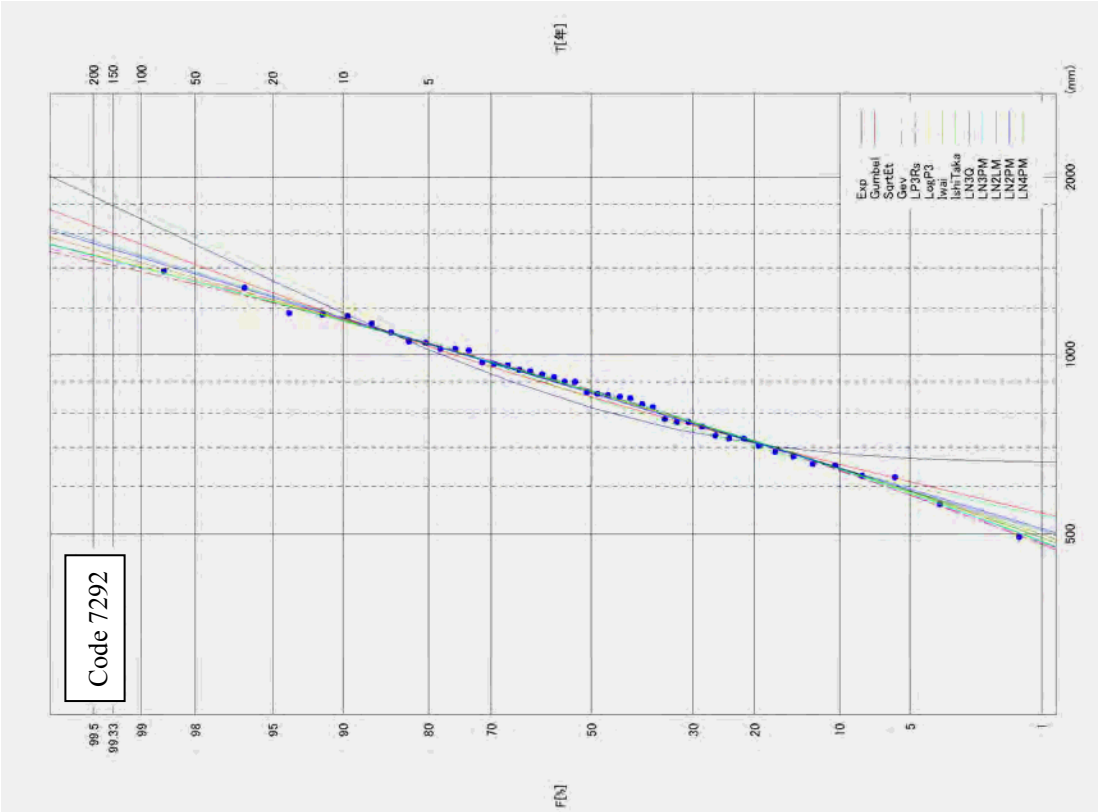

Figure C6.3.43 Probability Distribution on Log-normal Probability Paper (Station code 7292)

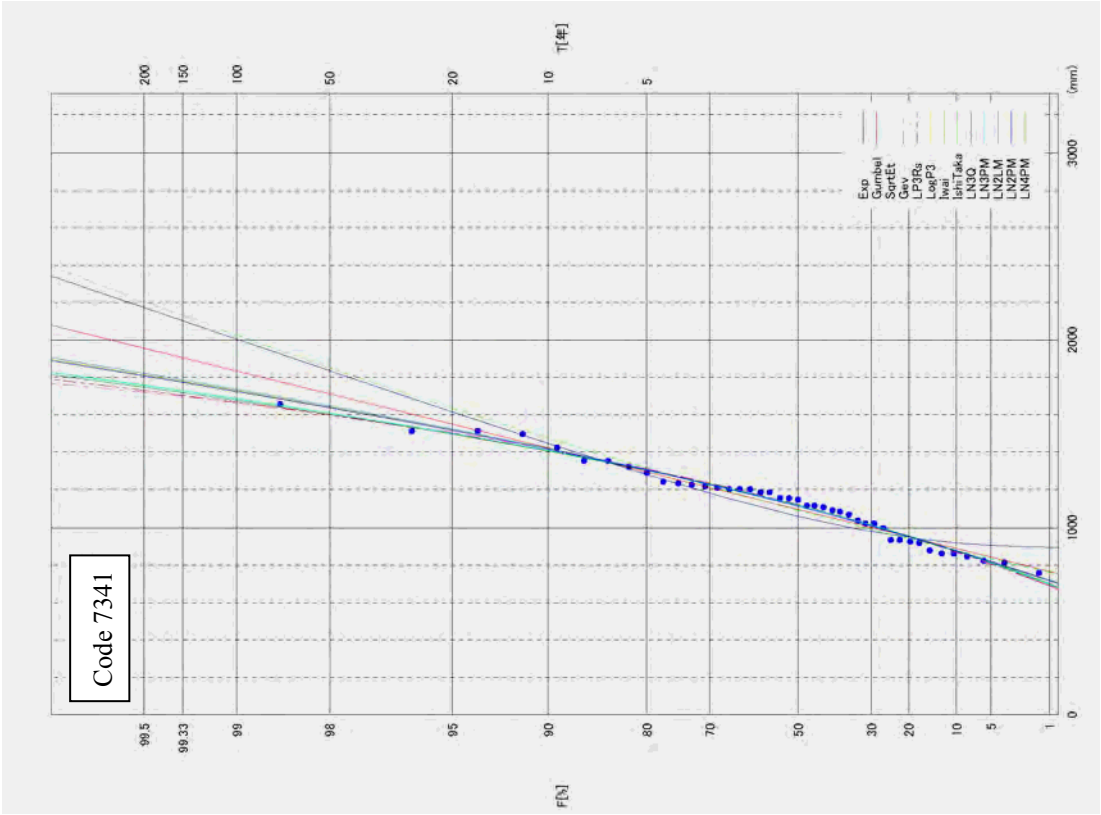

Figure C6.3.44 Probability Distribution on Gumbel Probability Paper (Station code 7341)

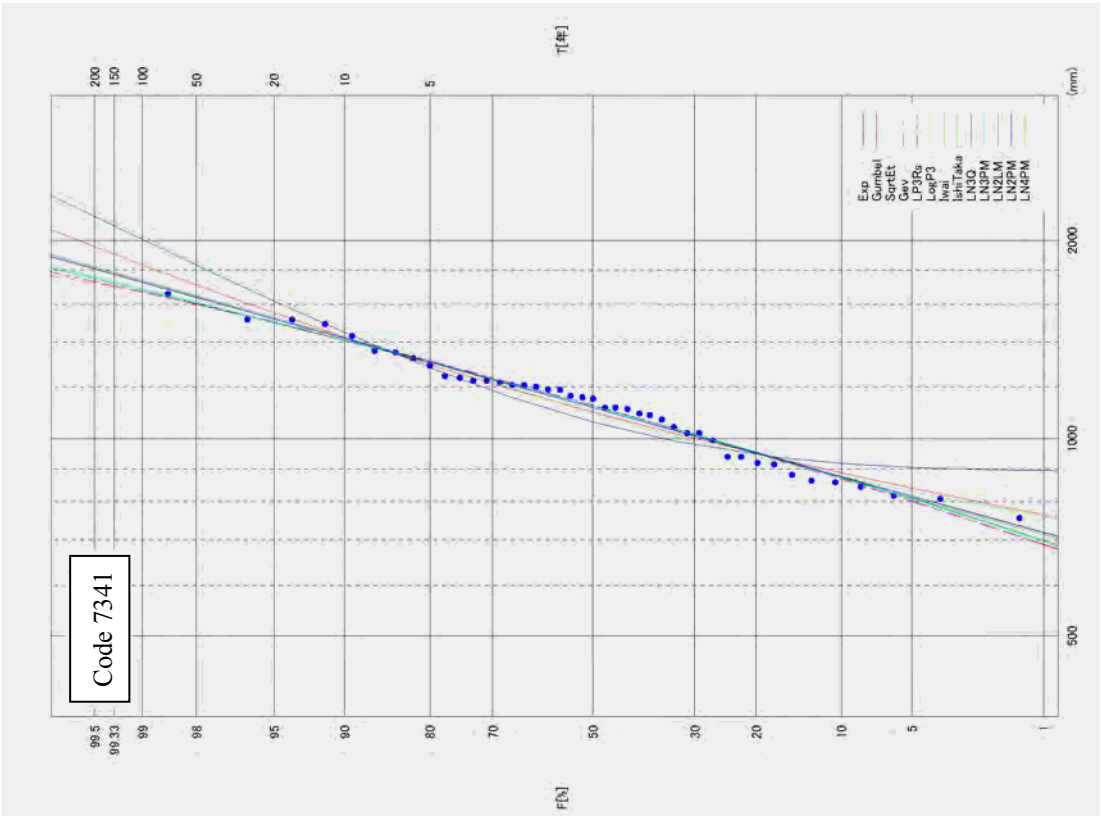

Figure C6.3.45 Probability Distribution on Log-normal Probability Paper (Station code 7341)

Table C 6.3.19 Result of Frequency Analysis of 6-Month Rainfall (10)

Station code 7430

	6months rainfall series (number of sumple N=40)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.972	0.993	0.985	0.993	0.993	—	0.993	0.993	0.993	0.993	0.993	0.993
P-COR(99%)	0.959	0.996	0.995	0.996	0.996	—	0.996	0.996	0.996	0.996	0.996	0.996
SLSC(99%)	0.049	0.024	0.031	0.024	0.026	—	0.021	0.023	0.024	0.023	0.021	0.022
log likelihood	-276.600	-285.500	-285.700	-285.500	-285.700	—	-285.300	-285.500	-285.600	-285.500	-285.500	-285.400
pAIC	557.100	575.000	575.400	577.100	577.400	—	576.700	577.000	577.100	577.100	574.900	574.800
X-COR(50%)	0.977	0.980	0.973	0.981	0.984	—	0.981	0.982	0.982	0.982	0.981	0.982
P-COR(50%)	0.985	0.985	0.986	0.985	0.983	—	0.985	0.984	0.984	0.984	0.984	0.984
SLSC(50%)	0.068	0.046	0.058	0.045	0.052	—	0.044	0.047	0.051	0.048	0.044	0.046

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	903	960	943	963	980	—	962	970	973	971	967	967
	1/3	1,053	1,103	1,088	1,107	1,125	—	1,105	1,112	1,113	1,113	1,112	1,109
	1/5	1,242	1,263	1,261	1,266	1,276	—	1,263	1,265	1,262	1,266	1,271	1,264
	1/10	1,498	1,463	1,495	1,463	1,454	—	1,459	1,450	1,441	1,450	1,467	1,454
	1/20	1,755	1,655	1,736	1,650	1,613	—	1,646	1,622	1,607	1,621	1,651	1,632
	1/30	1,905	1,766	1,882	1,756	1,700	—	1,753	1,719	1,699	1,717	1,755	1,733
	1/50	2,094	1,904	2,072	1,889	1,805	—	1,886	1,838	1,814	1,835	1,885	1,859
	1/80	2,268	2,031	2,254	2,009	1,897	—	2,008	1,947	1,917	1,942	2,004	1,973
	1/100	2,351	2,091	2,342	2,065	1,940	—	2,067	1,998	1,965	1,993	2,060	2,027
	1/150	2,501	2,199	2,506	2,167	2,016	—	2,172	2,090	2,052	2,084	2,162	2,125
	1/200	2,608	2,276	2,626	2,239	2,069	—	2,248	2,155	2,114	2,148	2,234	2,194
	1/300	2,758	2,385	2,799	2,340	2,142	—	2,354	2,246	2,200	2,238	2,336	2,292
	1/400	2,864	2,462	2,924	2,411	2,193	—	2,430	2,311	2,261	2,302	2,408	2,362
	1/500	2,947	2,521	3,024	2,465	2,232	—	2,489	2,361	2,308	2,351	2,465	2,416
	1/700	3,071	2,611	3,176	2,548	2,291	—	2,579	2,437	2,380	2,425	2,550	2,498
	1/1000	3,203	2,707	3,341	2,634	2,351	—	2,675	2,517	2,455	2,504	2,641	2,585
jackknife	1/2	46	49	48	54	56	—	50	57	53	57	49	49
error estimates	1/3	55	59	60	64	67	—	58	67	62	67	59	59
	1/5	72	74	77	75	78	—	73	78	74	78	75	73
	1/10	98	95	104	95	91	—	101	91	93	91	99	95
	1/20	128	116	134	123	104	—	138	106	118	106	126	120
	1/30	145	129	153	144	112	—	163	116	136	116	143	135
	1/50	167	145	178	177	124	—	198	131	161	130	164	154
	1/80	188	160	202	211	137	—	233	146	188	145	185	173
	1/100	198	167	214	230	144	—	250	154	201	153	195	182
	1/150	216	180	237	266	157	—	283	170	227	168	214	199
	1/200	229	189	254	294	168	—	308	182	247	180	228	211
	1/300	247	202	279	336	184	—	345	200	276	197	247	229
	1/400	260	211	297	368	196	—	372	213	298	210	261	241
	1/500	270	218	311	394	206	—	393	224	316	221	273	251
	1/700	285	229	333	435	222	—	427	242	343	238	290	267
	1/1000	301	241	358	481	240	—	464	261	374	256	309	284

less than 0.04(SLSC)
minimum value(SLSC)

Station code 7480

	6months rainfall series (number of sumple N=58)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.891	0.959	0.938	0.997	0.997	0.996	0.994	—	—	—	—	—
P-COR(99%)	0.841	0.988	0.985	0.998	0.997	0.997	0.997	—	—	—	—	—
SLSC(99%)	0.094	0.057	0.073	0.021	0.019	0.019	0.023	—	—	—	—	—
log likelihood	-370.000	-392.300	-392.400	-385.000	-385.000	-385.300	-385.900	—	—	—	—	—
pAIC	744.000	788.500	788.800	775.900	776.000	776.600	777.700	—	—	—	—	—
X-COR(50%)	0.954	0.965	0.953	0.990	0.989	0.996	0.984	—	—	—	—	—
P-COR(50%)	0.989	0.988	0.990	0.990	0.990	0.997	0.989	—	—	—	—	—
SLSC(50%)	0.129	0.101	0.142	0.040	0.039	0.042	0.052	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,020	1,054	1,053	1,093	1,095	1,090	1,085	—	—	—	—	—
	1/3	1,108	1,138	1,159	1,178	1,177	1,172	1,167	—	—	—	—	—
	1/5	1,219	1,231	1,281	1,256	1,251	1,250	1,246	—	—	—	—	—
	1/10	1,370	1,349	1,443	1,334	1,325	1,330	1,331	—	—	—	—	—
	1/20	1,520	1,462	1,607	1,391	1,381	1,394	1,402	—	—	—	—	—
	1/30	1,608	1,526	1,705	1,418	1,409	1,426	1,440	—	—	—	—	—
	1/50	1,719	1,607	1,831	1,447	1,439	1,463	1,483	—	—	—	—	—
	1/80	1,821	1,682	1,951	1,470	1,463	1,493	1,521	—	—	—	—	—
	1/100	1,869	1,717	2,009	1,479	1,473	1,506	1,538	—	—	—	—	—
	1/150	1,957	1,780	2,115	1,494	1,491	1,529	1,568	—	—	—	—	—
	1/200	2,020	1,826	2,193	1,504	1,503	1,545	1,588	—	—	—	—	—
	1/300	2,108	1,889	2,304	1,516	1,518	1,565	1,616	—	—	—	—	—
	1/400	2,170	1,934	2,384	1,523	1,527	1,579	1,635	—	—	—	—	—
	1/500	2,218	1,969	2,447	1,528	1,535	1,589	1,649	—	—	—	—	—
	1/700	2,291	2,022	2,544	1,536	1,545	1,603	1,671	—	—	—	—	—
	1/1000	2,369	2,078	2,648	1,542	1,555	1,618	1,693	—	—	—	—	—
jackknife	1/2	26	25	26	29	29	29	74,037	—	—	—	—	—
error estimates	1/3	25	25	29	29	28	28	73,879	—	—	—	—	—
	1/5	26	26	35	28	28	28	73,724	—	—	—	—	—
	1/10	32	31	47	29	28	29	73,545	—	—	—	—	—
	1/20	41	37	62	34	31	34	73,360	—	—	—	—	—
	1/30	47	41	72	38	34	39	73,253	—	—	—	—	—
	1/50	55	47	85	44	39	45	73,351	—	—	—	—	—
	1/80	63	52	97	50	45	52	74,950	—	—	—	—	—
	1/100	67	55	104	53	47	55	77,465	—	—	—	—	—
	1/150	74	60	115	58	53	62	90,100	—	—	—	—	—
	1/200	79	63	124	61	56	66	111,551	—	—	—	—	—
	1/300	86	68	137	66	62	73	173,275	—	—	—	—	—
	1/400	91	72	146	70	66	78	250,201	—	—	—	—	—
	1/500	95	75	153	72	69	82	336,403	—	—	—	—	—
	1/700	100	79	164	76	74	87	526,860	—	—	—	—	—
	1/1000	107	83	177	79	78	94	841,889	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

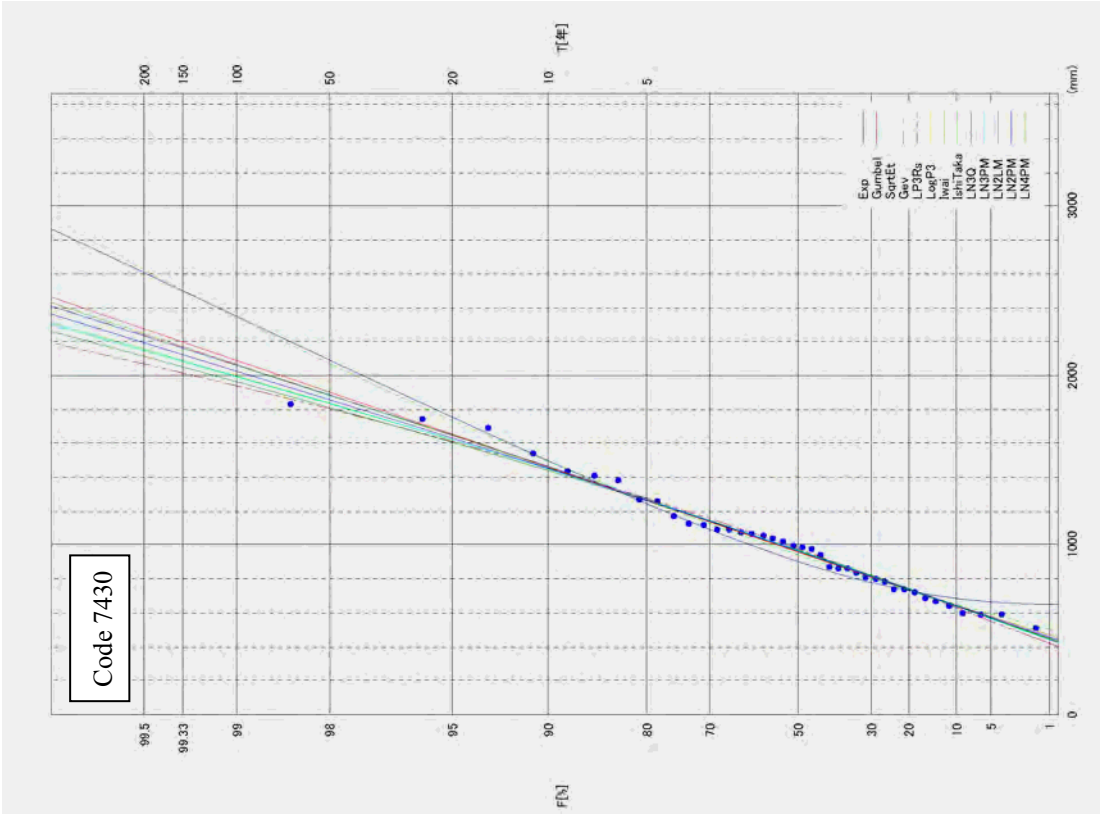

Figure C6.3.46 Probability Distribution on Gumbel Probability Paper (Station code 7430)

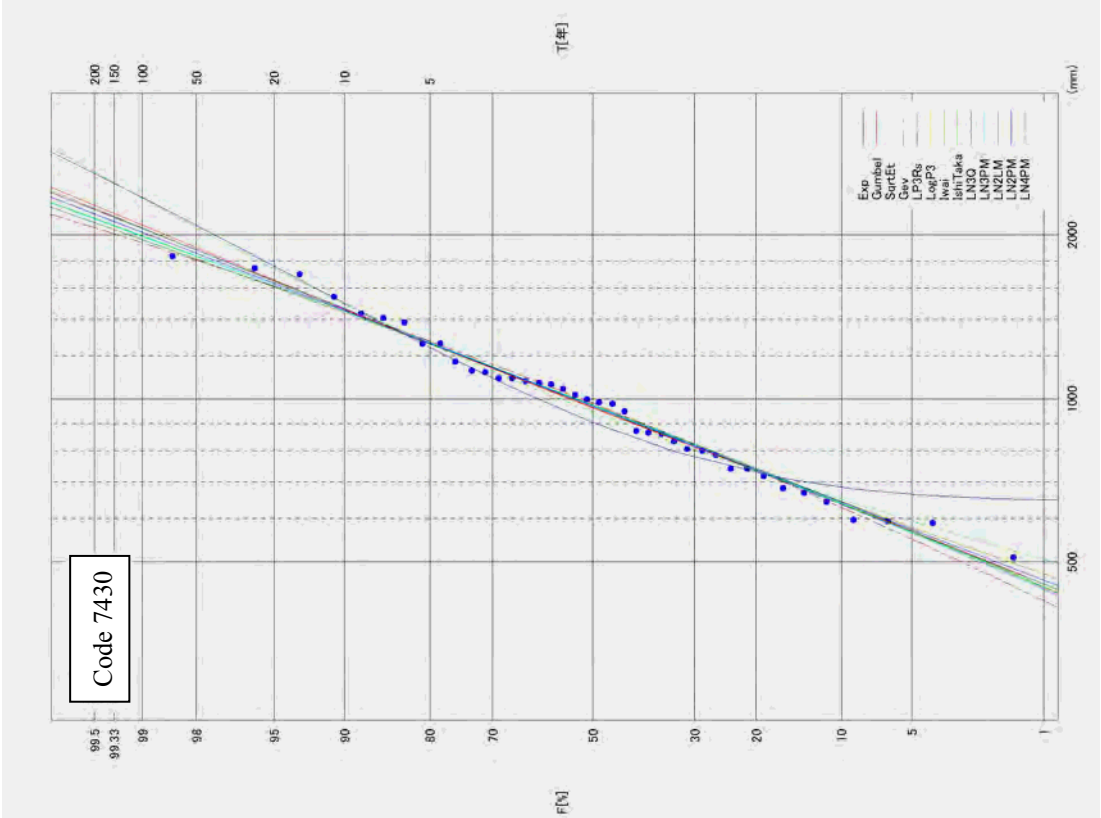

Figure C6.3.47 Probability Distribution on Log-normal Probability Paper (Station code 7430)

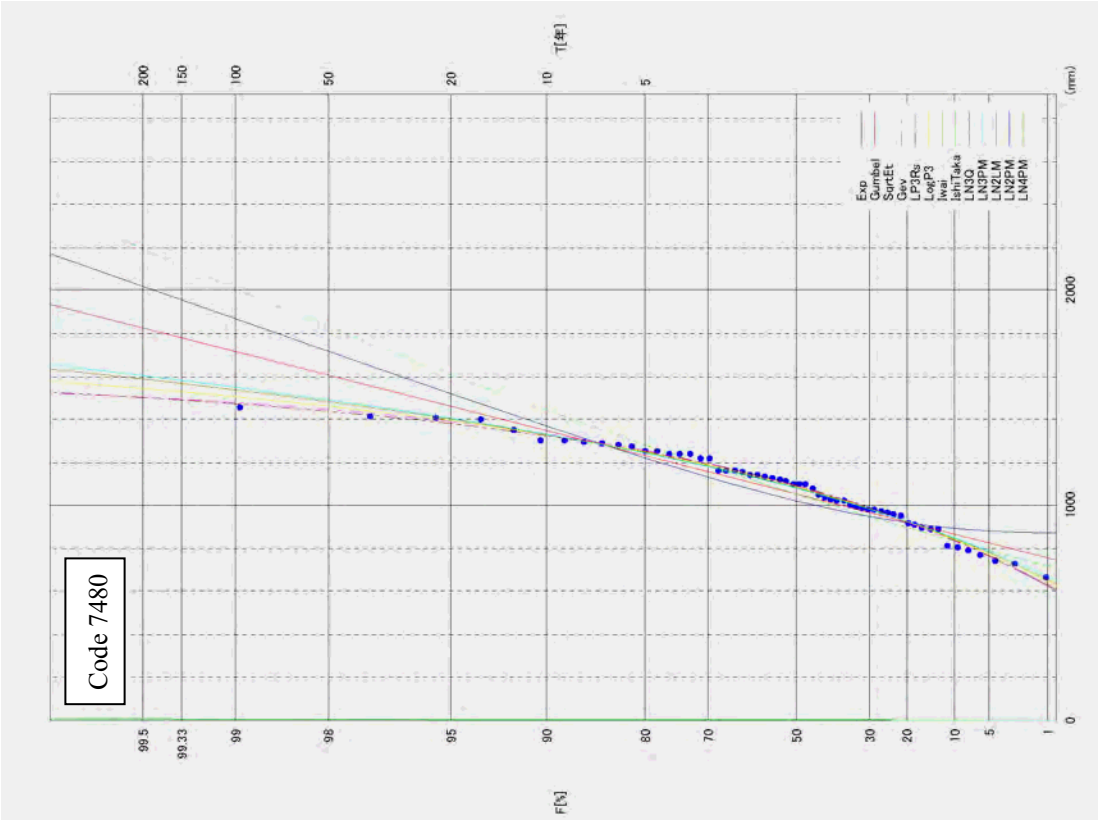

Figure C6.3.48 Probability Distribution on Gumbel Probability Paper (Station code 7480)

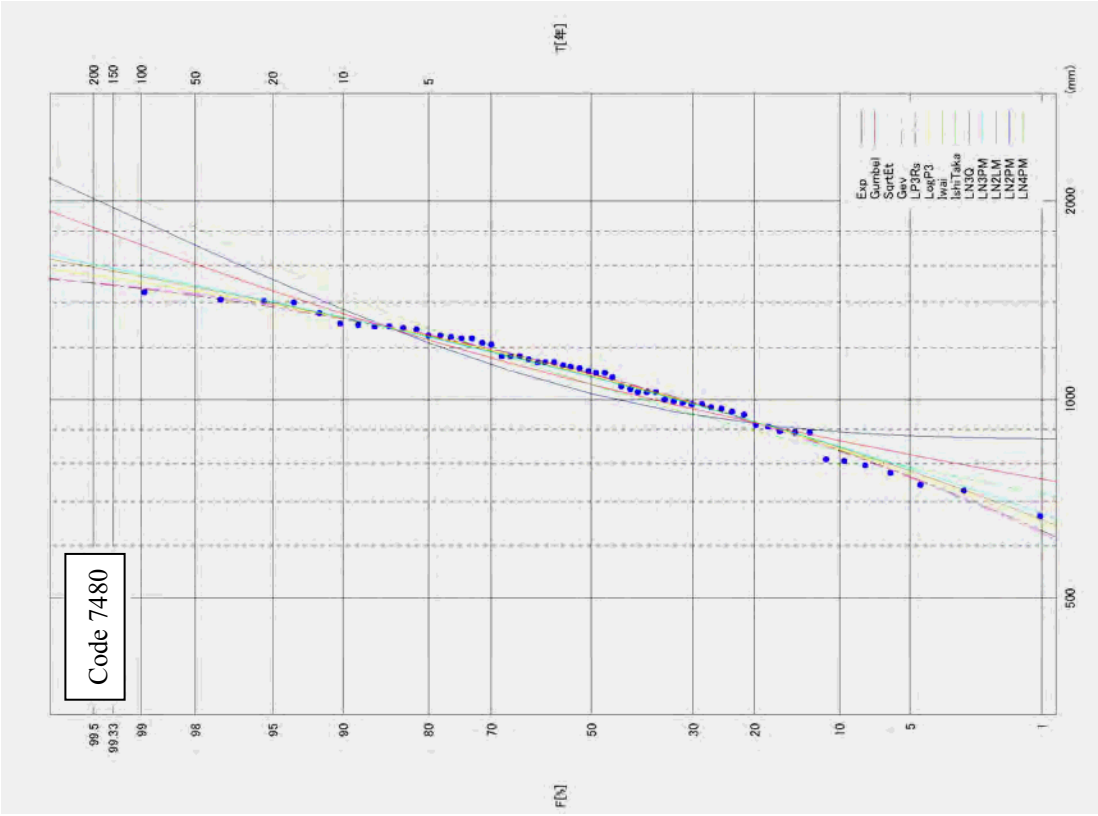

Figure C6.3.49 Probability Distribution on Log-normal Probability Paper (Station code 7480)

Table C 6.3.20 Result of Frequency Analysis of 6-Month Rainfall (11)

Station code 16013

	6months rainfall series (number of sumple N=55)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.968	0.991	0.989	0.988	—	0.991	0.988	0.991	0.991	0.991	0.988	0.988
P-COR(99%)	0.924	0.991	0.987	0.994	—	0.993	0.995	0.991	0.991	0.991	0.994	0.994
SLSC(99%)	0.052	0.027	0.034	0.040	—	0.028	0.030	0.032	0.030	0.031	0.029	0.029
log likelihood	-355.900	-370.500	-371.200	-370.500	—	-370.300	-370.500	-370.400	-370.300	-370.300	-370.400	-370.400
pAIC	715.900	745.000	746.300	746.900	—	746.500	747.000	746.800	746.700	746.700	744.800	744.800
X-COR(50%)	0.990	0.985	0.990	0.975	—	0.991	0.975	0.983	0.983	0.983	0.976	0.976
P-COR(50%)	0.981	0.985	0.982	0.983	—	0.993	0.983	0.984	0.983	0.984	0.983	0.983
SLSC(50%)	0.057	0.042	0.055	0.076	—	0.048	0.062	0.044	0.045	0.045	0.059	0.059

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	904	941	934	952	—	948	956	942	941	943	955	955
	1/3	1,000	1,033	1,033	1,046	—	1,041	1,049	1,034	1,036	1,035	1,047	1,047
	1/5	1,122	1,135	1,148	1,145	—	1,141	1,145	1,136	1,140	1,137	1,144	1,144
	1/10	1,287	1,264	1,301	1,263	—	1,263	1,257	1,262	1,269	1,262	1,258	1,258
	1/20	1,452	1,388	1,456	1,368	—	1,377	1,357	1,381	1,392	1,380	1,360	1,360
	1/30	1,548	1,459	1,549	1,425	—	1,441	1,413	1,449	1,462	1,448	1,417	1,417
	1/50	1,670	1,547	1,668	1,494	—	1,520	1,480	1,535	1,550	1,532	1,485	1,485
	1/80	1,781	1,629	1,782	1,555	—	1,592	1,539	1,613	1,630	1,608	1,547	1,546
	1/100	1,835	1,667	1,836	1,582	—	1,626	1,567	1,650	1,668	1,645	1,575	1,575
	1/150	1,931	1,737	1,938	1,631	—	1,688	1,617	1,717	1,738	1,711	1,626	1,626
	1/200	1,999	1,787	2,012	1,664	—	1,732	1,651	1,765	1,787	1,757	1,662	1,662
	1/300	2,096	1,856	2,117	1,710	—	1,793	1,700	1,833	1,857	1,824	1,712	1,711
	1/400	2,164	1,906	2,194	1,741	—	1,837	1,733	1,881	1,906	1,871	1,747	1,746
	1/500	2,217	1,944	2,254	1,765	—	1,871	1,759	1,918	1,945	1,907	1,774	1,773
	1/700	2,297	2,002	2,346	1,800	—	1,923	1,798	1,975	2,004	1,963	1,814	1,814
	1/1000	2,382	2,063	2,446	1,836	—	1,978	1,839	2,036	2,066	2,022	1,857	1,856
jackknife	1/2	26	28	28	28	—	29	27	31	28	31	28	28
error estimates	1/3	31	33	33	30	—	32	29	33	29	33	33	33
	1/5	41	42	40	38	—	40	39	40	40	40	41	41
	1/10	58	55	52	58	—	59	61	60	68	60	53	53
	1/20	76	69	66	86	—	85	89	91	105	91	65	66
	1/30	87	77	74	105	—	103	108	113	130	112	73	73
	1/50	102	87	86	131	—	128	133	143	164	141	82	83
	1/80	115	97	97	157	—	153	157	173	196	170	91	91
	1/100	121	101	102	170	—	165	170	189	213	185	95	95
	1/150	133	110	112	194	—	189	192	218	244	213	103	103
	1/200	141	116	120	212	—	207	209	239	266	233	109	108
	1/300	153	124	131	237	—	233	233	270	299	263	117	116
	1/400	161	130	139	256	—	252	250	294	324	286	122	122
	1/500	167	134	145	270	—	268	264	312	343	303	127	126
	1/700	177	141	155	292	—	292	286	341	373	331	133	133
	1/1000	187	149	166	316	—	318	309	372	405	361	140	140

less than 0.04(SLSC)
minimum value(SLSC)

Station code 16022

	6months rainfall series (number of sumple N=50)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.941	0.979	0.962	0.985	0.986	0.985	0.986	0.986	0.986	0.986	—	—
P-COR(99%)	0.813	0.992	0.990	0.990	0.985	0.984	0.986	0.986	0.985	0.986	—	—
SLSC(99%)	0.069	0.041	0.061	0.037	0.040	0.040	0.037	0.037	0.037	0.037	—	—
log likelihood	-332.100	-347.900	-349.900	-346.400	-346.000	-346.100	-346.000	-346.000	-346.000	-346.000	—	—
pAIC	668.200	699.800	703.800	698.900	698.100	698.200	698.000	698.000	698.100	698.000	—	—
X-COR(50%)	0.942	0.955	0.936	0.966	0.978	0.985	0.974	0.973	0.975	0.973	—	—
P-COR(50%)	0.981	0.980	0.987	0.983	0.986	0.984	0.985	0.984	0.984	0.984	—	—
SLSC(50%)	0.091	0.070	0.112	0.064	0.080	0.087	0.074	0.072	0.076	0.072	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	858	902	899	912	930	933	928	926	929	926	—	—
	1/3	973	1,011	1,034	1,023	1,042	1,045	1,038	1,036	1,038	1,036	—	—
	1/5	1,117	1,132	1,195	1,142	1,153	1,154	1,149	1,147	1,147	1,148	—	—
	1/10	1,312	1,285	1,411	1,284	1,277	1,273	1,275	1,275	1,270	1,275	—	—
	1/20	1,507	1,431	1,634	1,414	1,381	1,372	1,385	1,388	1,377	1,387	—	—
	1/30	1,622	1,516	1,769	1,485	1,436	1,424	1,444	1,449	1,435	1,448	—	—
	1/50	1,766	1,621	1,945	1,572	1,501	1,484	1,515	1,522	1,504	1,521	—	—
	1/80	1,898	1,717	2,113	1,649	1,556	1,535	1,577	1,586	1,564	1,585	—	—
	1/100	1,961	1,763	2,194	1,684	1,580	1,557	1,606	1,616	1,592	1,614	—	—
	1/150	2,075	1,846	2,346	1,747	1,624	1,597	1,657	1,669	1,642	1,667	—	—
	1/200	2,157	1,904	2,456	1,791	1,654	1,624	1,692	1,706	1,676	1,704	—	—
	1/300	2,271	1,987	2,616	1,851	1,694	1,660	1,741	1,757	1,723	1,754	—	—
	1/400	2,352	2,046	2,732	1,892	1,721	1,685	1,775	1,792	1,755	1,789	—	—
	1/500	2,415	2,091	2,823	1,924	1,742	1,703	1,801	1,820	1,780	1,816	—	—
	1/700	2,510	2,159	2,964	1,970	1,773	1,730	1,839	1,860	1,818	1,857	—	—
	1/1000	2,610	2,232	3,116	2,019	1,804	1,758	1,879	1,903	1,856	1,899	—	—
jackknife	1/2	33	34	33	38	39	38	42	39	32	39	—	—
error estimates	1/3	37	39	41	46	45	44	46	45	38	44	—	—
	1/5	46	47	64	53	50	49	49	49	46	49	—	—
	1/10	62	60	102	59	54	57	51	54	57	54	—	—
	1/20	81	74	145	67	58	75	58	59	68	59	—	—
	1/30	92	82	172	75	62	90	64	64	76	64	—	—
	1/50	107	92	209	90	69	113	75	71	86	70	—	—
	1/80	121	102	244	109	78	139	88	78	96	78	—	—
	1/100	127	107	262	120	84	152	95	83	101	82	—	—
	1/150	139	115	295	141	94	178	108	91	111	90	—	—
	1/200	148	121	319	158	103	197	118	98	118	96	—	—
	1/300	160	130	354	184	116	226	134	108	129	106	—	—
	1/400	168	136	380	204	126	248	145	115	137	113	—	—
	1/500	175	141	401	221	134	265	155	121	144	119	—	—
	1/700	185	148	433	247	147	292	169	131	154	128	—	—
	1/1000	196	156	468	276	162	321	185	142	165	138	—	—

less than 0.04(SLSC)
minimum value(SLSC)

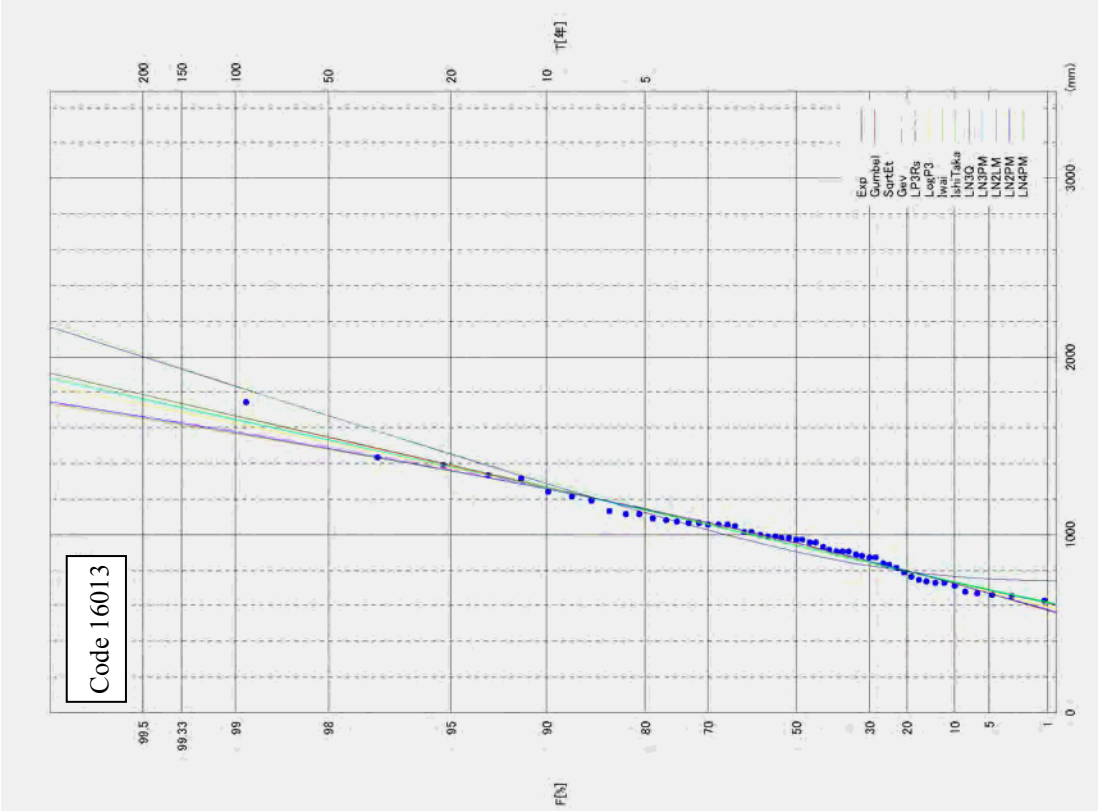

Figure C6.3.50 Probability Distribution on Gumbel Probability Paper (Station code 16013)

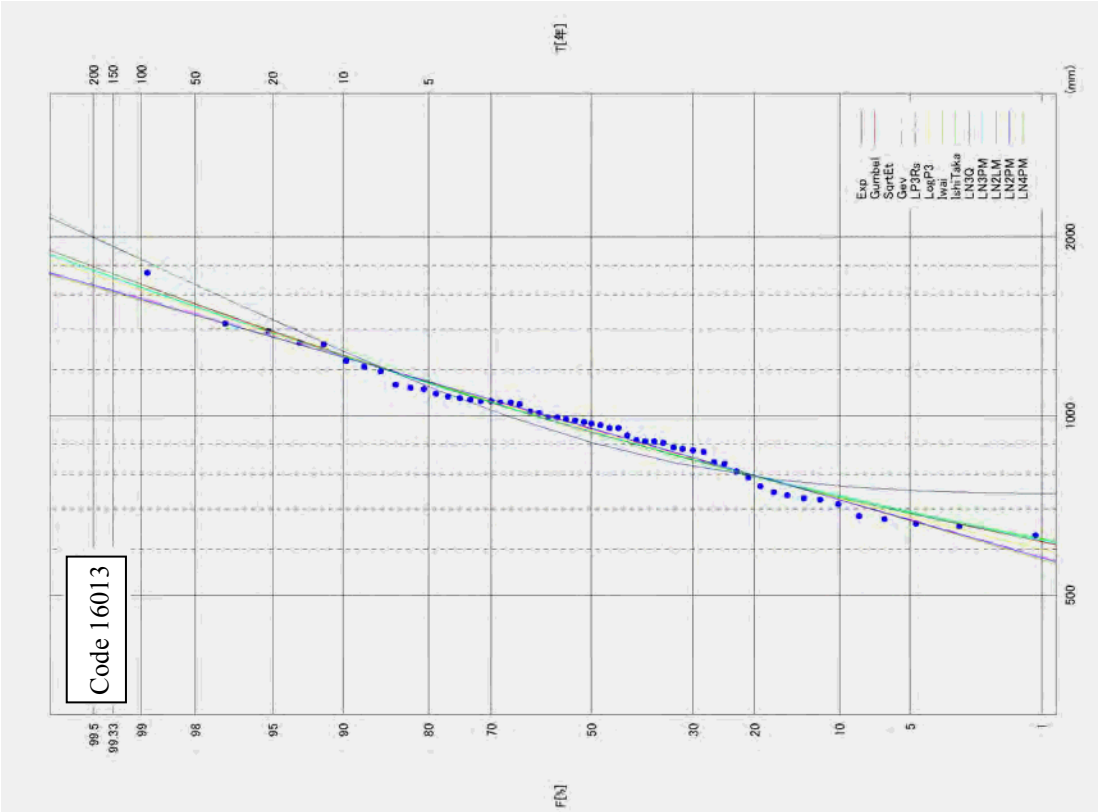

Figure C6.3.51 Probability Distribution on Log-normal Probability Paper (Station code 16013)

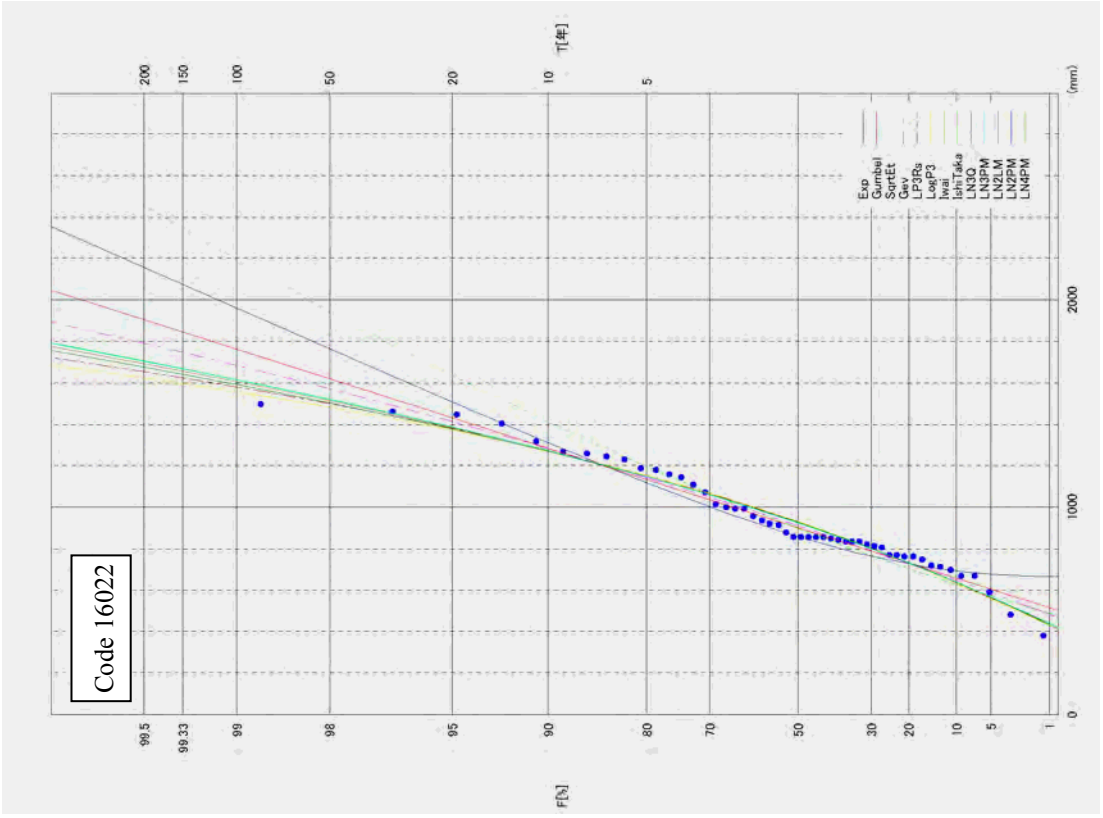

Figure C6.3.52 Probability Distribution on Gumbel Probability Paper (Station code 16022)

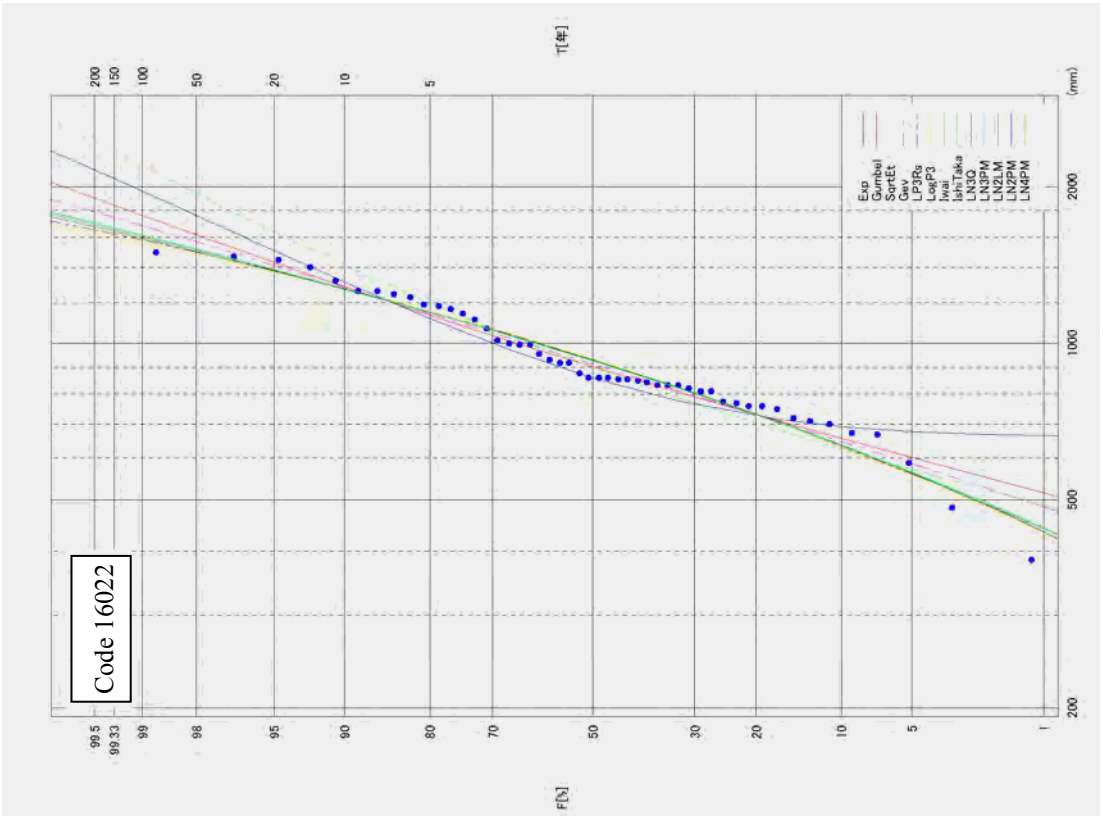

Figure C6.3.53 Probability Distribution on Log-normal Probability Paper (Station code 16022)

Table C 6.3.21 Result of Frequency Analysis of 6-Month Rainfall (12)

Station code 16032

6months rainfall series (number of sumple N=44)

	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.941	0.982	0.962	0.989	0.985	—	0.989	0.989	0.988	0.989	—	—
P-COR(99%)	0.744	0.992	0.981	0.993	0.990	—	0.992	0.992	0.991	0.992	—	—
SLSC(99%)	0.069	0.038	0.077	0.029	0.061	—	0.037	0.034	0.034	0.034	—	—
log likelihood	-305.300	-323.000	-325.600	-318.800	-319.300	—	-318.700	-318.500	-318.500	-318.500	—	—
pAIC	614.700	650.000	655.200	643.500	644.600	—	643.400	643.000	642.900	643.000	—	—
X-COR(50%)	0.986	0.990	0.982	0.993	0.990	—	0.992	0.992	0.991	0.992	—	—
P-COR(50%)	0.993	0.992	0.987	0.990	0.987	—	0.990	0.989	0.988	0.989	—	—
SLSC(50%)	0.067	0.035	0.140	0.046	0.081	—	0.049	0.055	0.075	0.056	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	949	1,008	1,008	1,039	1,053	—	1,039	1,045	1,058	1,045	—	—
	1/3	1,103	1,155	1,222	1,189	1,208	—	1,192	1,195	1,204	1,195	—	—
	1/5	1,297	1,318	1,482	1,343	1,358	—	1,347	1,345	1,347	1,345	—	—
	1/10	1,560	1,524	1,839	1,517	1,516	—	1,525	1,514	1,502	1,514	—	—
	1/20	1,823	1,721	2,214	1,667	1,644	—	1,682	1,661	1,633	1,660	—	—
	1/30	1,977	1,834	2,443	1,745	1,708	—	1,767	1,740	1,702	1,739	—	—
	1/50	2,171	1,976	2,744	1,837	1,780	—	1,869	1,834	1,783	1,833	—	—
	1/80	2,349	2,106	3,034	1,915	1,840	—	1,959	1,916	1,853	1,915	—	—
	1/100	2,434	2,167	3,175	1,949	1,866	—	2,000	1,954	1,885	1,953	—	—
	1/150	2,588	2,279	3,440	2,010	1,910	—	2,074	2,021	1,940	2,019	—	—
	1/200	2,697	2,358	3,633	2,050	1,940	—	2,126	2,068	1,979	2,066	—	—
	1/300	2,851	2,469	3,914	2,104	1,979	—	2,197	2,132	2,031	2,129	—	—
	1/400	2,961	2,548	4,119	2,140	2,005	—	2,247	2,176	2,067	2,173	—	—
	1/500	3,045	2,609	4,281	2,167	2,024	—	2,285	2,210	2,094	2,207	—	—
	1/700	3,173	2,701	4,531	2,206	2,052	—	2,341	2,260	2,135	2,257	—	—
	1/1000	3,308	2,799	4,803	2,245	2,079	—	2,401	2,313	2,176	2,310	—	—
jackknife	1/2	51	51	49	46	52	—	6,454	52	—	51	—	—
error estimates	1/3	53	55	69	54	61	—	6,305	58	—	58	—	—
	1/5	66	68	126	68	71	—	6,153	69	—	69	—	—
	1/10	92	88	219	91	89	—	5,978	87	—	86	—	—
	1/20	123	111	324	122	116	—	5,824	110	—	110	—	—
	1/30	142	125	390	144	137	—	5,740	127	—	126	—	—
	1/50	167	142	479	175	168	—	5,640	150	—	149	—	—
	1/80	189	158	566	207	199	—	5,551	174	—	172	—	—
	1/100	200	166	609	223	215	—	5,510	186	—	184	—	—
	1/150	220	180	690	254	246	—	5,437	208	—	206	—	—
	1/200	235	191	750	277	268	—	5,387	225	—	222	—	—
	1/300	255	205	838	310	300	—	5,316	250	—	246	—	—
	1/400	269	215	903	334	324	—	5,268	268	—	263	—	—
	1/500	280	223	954	353	343	—	5,230	282	—	277	—	—
	1/700	297	235	1,034	382	371	—	5,174	304	—	298	—	—
	1/1000	315	248	1,121	414	402	—	5,116	328	—	322	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 16042

6months rainfall series (number of sumple N=50)

	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.907	0.968	0.946	0.994	0.993	0.994	0.994	—	—	—	—	—
P-COR(99%)	0.790	0.989	0.984	0.997	0.997	0.997	0.997	—	—	—	—	—
SLSC(99%)	0.087	0.050	0.075	0.035	0.027	0.027	0.024	—	—	—	—	—
log likelihood	-321.700	-342.600	-342.900	-335.700	-335.900	-336.000	-335.900	—	—	—	—	—
pAIC	647.300	689.200	689.700	677.400	677.800	677.900	677.700	—	—	—	—	—
X-COR(50%)	0.985	0.989	0.984	0.986	0.985	0.994	0.991	—	—	—	—	—
P-COR(50%)	0.994	0.995	0.991	0.995	0.995	0.997	0.996	—	—	—	—	—
SLSC(50%)	0.108	0.076	0.141	0.068	0.047	0.047	0.034	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	856	891	891	928	933	934	922	—	—	—	—	—
	1/3	948	980	1,009	1,019	1,022	1,022	1,009	—	—	—	—	—
	1/5	1,065	1,078	1,149	1,103	1,102	1,102	1,095	—	—	—	—	—
	1/10	1,224	1,202	1,336	1,189	1,181	1,181	1,188	—	—	—	—	—
	1/20	1,383	1,321	1,528	1,254	1,241	1,241	1,265	—	—	—	—	—
	1/30	1,475	1,389	1,643	1,285	1,270	1,270	1,307	—	—	—	—	—
	1/50	1,592	1,475	1,793	1,319	1,301	1,301	1,355	—	—	—	—	—
	1/80	1,700	1,553	1,936	1,346	1,326	1,327	1,396	—	—	—	—	—
	1/100	1,751	1,590	2,005	1,357	1,337	1,338	1,415	—	—	—	—	—
	1/150	1,844	1,657	2,134	1,376	1,354	1,356	1,448	—	—	—	—	—
	1/200	1,910	1,705	2,228	1,388	1,366	1,368	1,471	—	—	—	—	—
	1/300	2,002	1,772	2,362	1,403	1,381	1,383	1,502	—	—	—	—	—
	1/400	2,068	1,819	2,460	1,412	1,391	1,393	1,523	—	—	—	—	—
	1/500	2,119	1,856	2,537	1,419	1,398	1,400	1,539	—	—	—	—	—
	1/700	2,196	1,912	2,656	1,428	1,408	1,410	1,563	—	—	—	—	—
	1/1000	2,278	1,971	2,784	1,437	1,417	1,420	1,587	—	—	—	—	—
jackknife	1/2	30	29	30	31	31	32	35,143	—	—	—	—	—
error estimates	1/3	28	29	32	32	32	32	35,023	—	—	—	—	—
	1/5	31	32	40	33	33	33	34,906	—	—	—	—	—
	1/10	41	39	58	40	40	40	34,778	—	—	—	—	—
	1/20	54	49	81	51	52	51	34,670	—	—	—	—	—
	1/30	62	55	95	58	60	58	34,614	—	—	—	—	—
	1/50	74	62	115	69	72	69	34,547	—	—	—	—	—
	1/80	84	70	134	79	83	79	34,490	—	—	—	—	—
	1/100	89	73	144	84	88	84	34,463	—	—	—	—	—
	1/150	98	80	162	93	98	93	34,417	—	—	—	—	—
	1/200	105	85	175	99	106	99	34,386	—	—	—	—	—
	1/300	114	91	194	107	116	108	34,343	—	—	—	—	—
	1/400	121	96	209	113	123	115	34,313	—	—	—	—	—
	1/500	126	100	220	117	128	120	34,291	—	—	—	—	—
	1/700	134	105	238	123	136	127	34,258	—	—	—	—	—
	1/1000	142	111	257	129	145	135	34,223	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

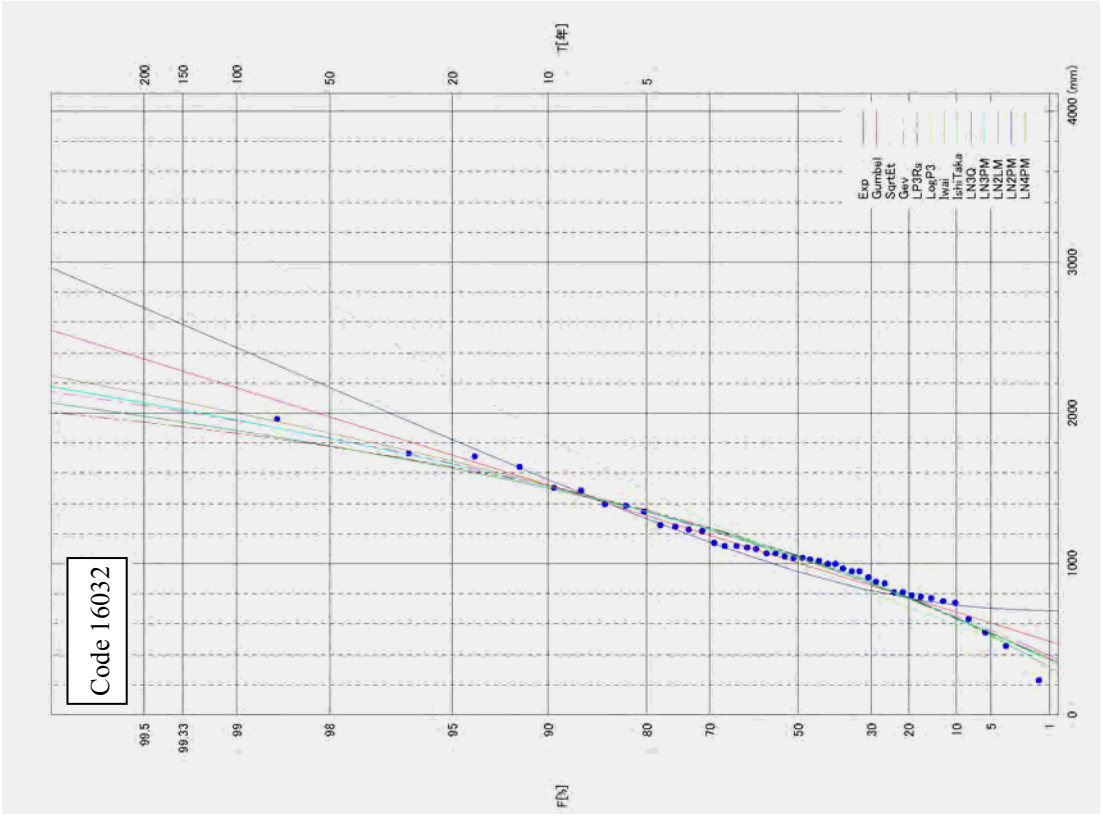

Figure C6.3.54 Probability Distribution on Gumbel Probability Paper (Station code 16032)

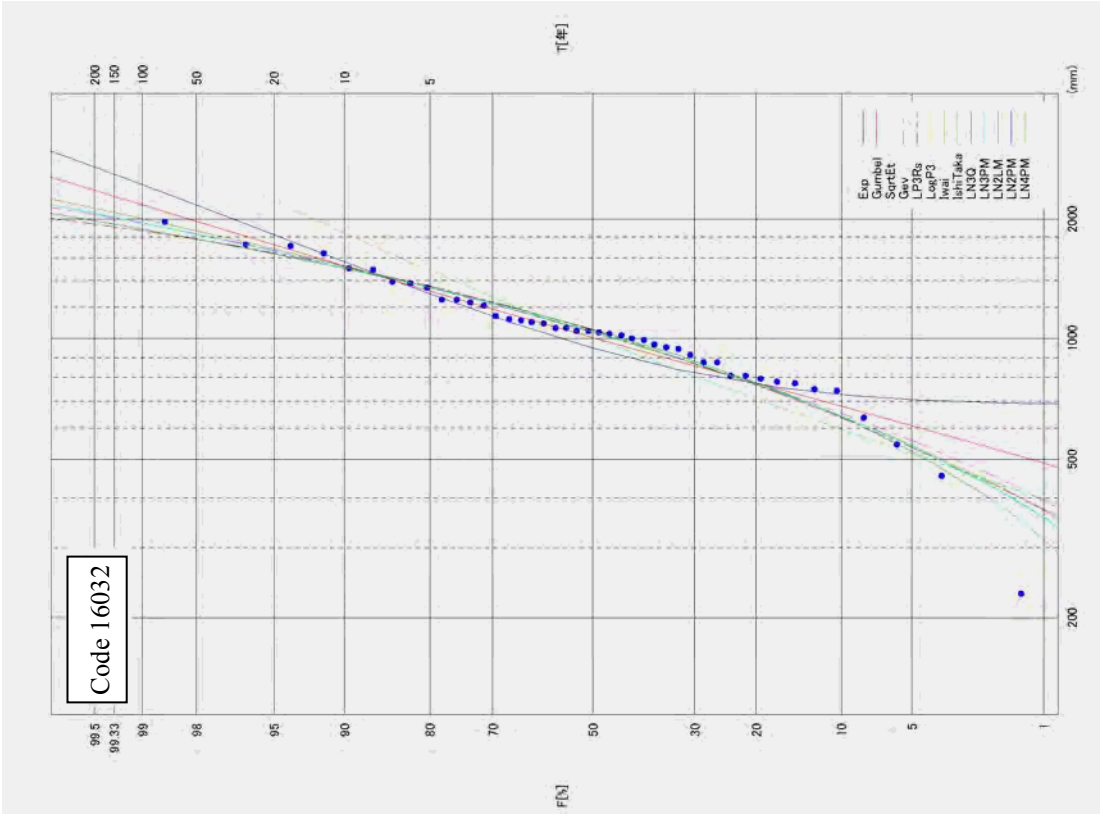

Figure C6.3.55 Probability Distribution on Log-normal Probability Paper (Station code 16032)

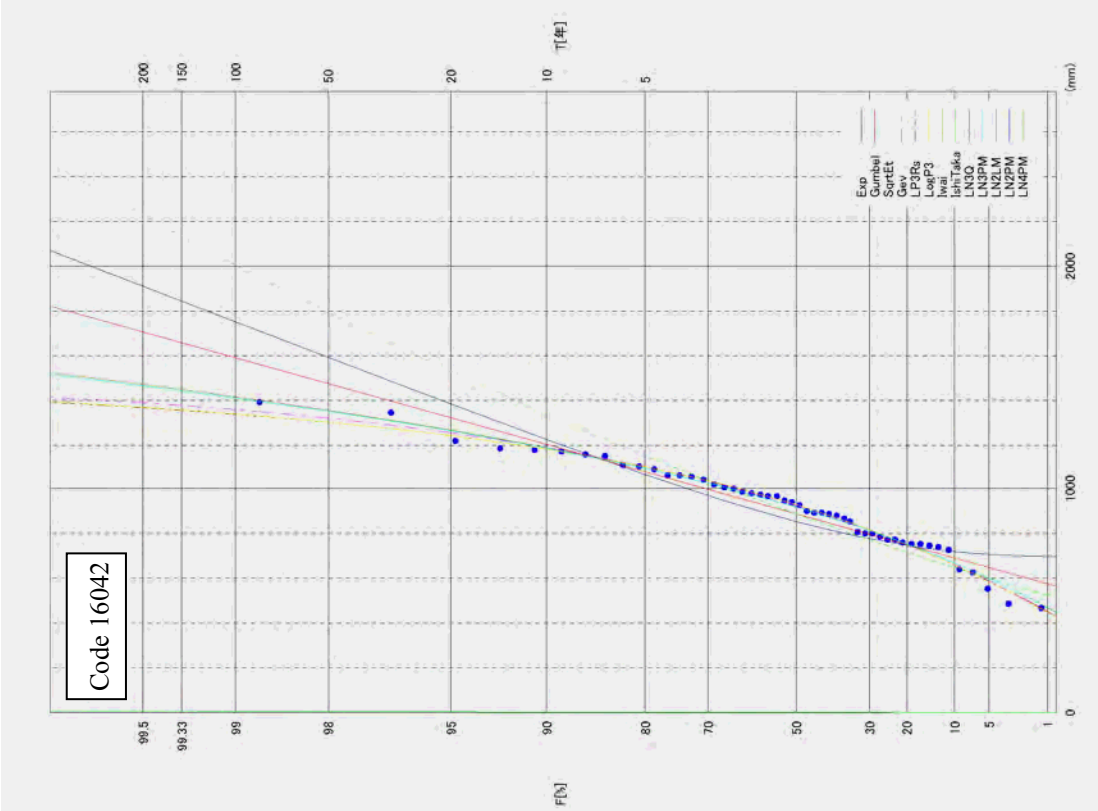

Figure C6.3.56 Probability Distribution on Gumbel Probability Paper (Station code 16042)

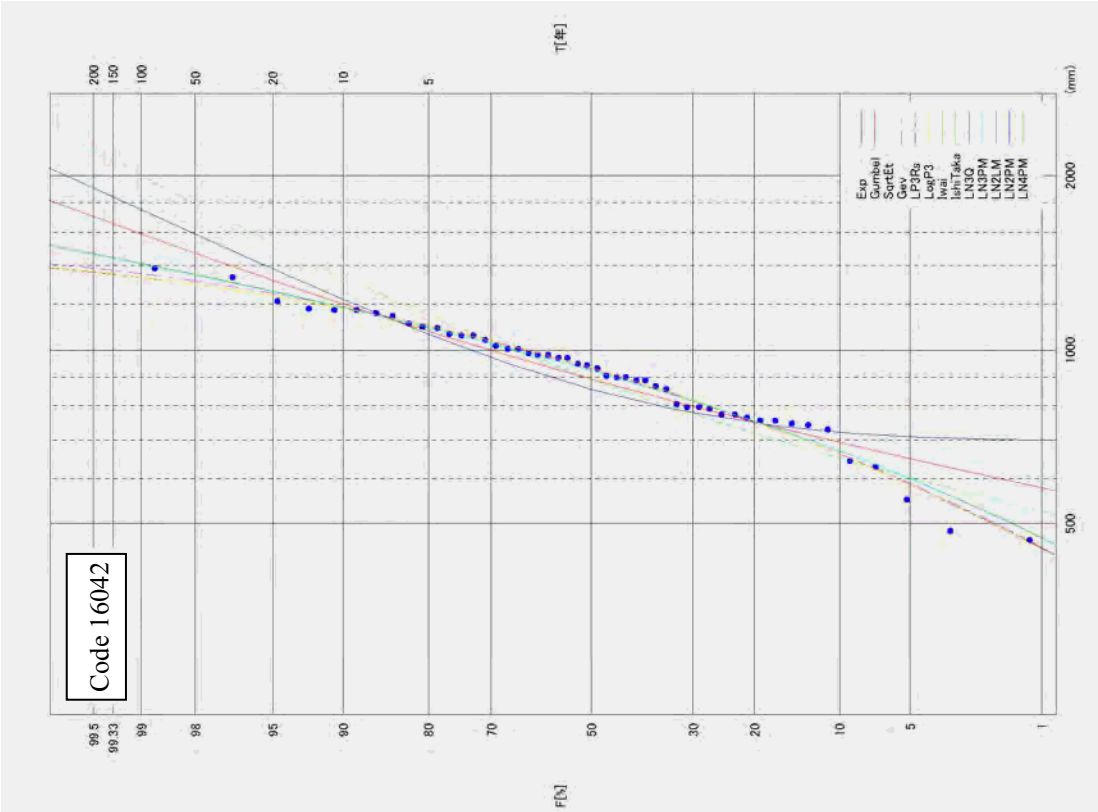

Figure C6.3.57 Probability Distribution on Log-normal Probability Paper (Station code 16042)

Table C 6.3.22 Result of Frequency Analysis of 6-Month Rainfall (13)

Station code 16052

	6months rainfall series (number of sumple N=54)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.948	0.988	0.977	0.995	0.995	—	0.995	0.995	0.995	0.995	0.995	0.995
P-COR(99%)	0.899	0.995	0.993	0.997	0.997	—	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(99%)	0.066	0.031	0.045	0.024	0.019	—	0.019	0.019	0.020	0.019	0.019	0.019
log likelihood	-344.000	-359.400	-360.300	-358.200	-358.300	—	-358.300	-358.300	-358.400	-358.300	-358.300	-358.300
pAIC	692.000	722.700	724.700	722.500	722.700	—	722.700	722.600	722.800	722.700	720.700	720.600
X-COR(50%)	0.976	0.979	0.974	0.984	0.983	—	0.983	0.983	0.983	0.983	0.983	0.983
P-COR(50%)	0.986	0.988	0.986	0.988	0.988	—	0.988	0.988	0.989	0.988	0.988	0.988
SLSC(50%)	0.090	0.058	0.088	0.047	0.045	—	0.043	0.044	0.048	0.044	0.043	0.043

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	879	913	909	929	933	—	926	930	933	930	927	927
	1/3	966	996	1,002	1,014	1,016	—	1,010	1,013	1,015	1,013	1,012	1,011
	1/5	1,076	1,088	1,111	1,102	1,100	—	1,097	1,098	1,097	1,098	1,100	1,097
	1/10	1,225	1,205	1,254	1,202	1,195	—	1,199	1,195	1,191	1,195	1,202	1,199
	1/20	1,374	1,316	1,400	1,288	1,277	—	1,291	1,281	1,272	1,280	1,295	1,289
	1/30	1,462	1,381	1,487	1,334	1,321	—	1,341	1,327	1,316	1,327	1,345	1,339
	1/50	1,571	1,461	1,599	1,388	1,374	—	1,402	1,383	1,368	1,382	1,407	1,400
	1/80	1,672	1,534	1,706	1,434	1,420	—	1,457	1,433	1,414	1,432	1,461	1,453
	1/100	1,720	1,569	1,757	1,454	1,441	—	1,482	1,456	1,435	1,454	1,487	1,478
	1/150	1,808	1,632	1,852	1,490	1,478	—	1,527	1,497	1,473	1,495	1,532	1,523
	1/200	1,869	1,677	1,921	1,514	1,504	—	1,559	1,525	1,499	1,523	1,564	1,554
	1/300	1,957	1,740	2,020	1,546	1,539	—	1,603	1,564	1,535	1,562	1,608	1,598
	1/400	2,018	1,785	2,091	1,568	1,563	—	1,634	1,592	1,560	1,589	1,639	1,628
	1/500	2,066	1,819	2,148	1,585	1,582	—	1,658	1,613	1,579	1,610	1,663	1,652
	1/700	2,139	1,872	2,234	1,608	1,609	—	1,693	1,644	1,607	1,641	1,699	1,687
	1/1000	2,215	1,927	2,327	1,632	1,638	—	1,731	1,677	1,637	1,673	1,737	1,723
jackknife	1/2	25	25	25	28	28	—	27	28	29	28	25	25
error estimates	1/3	27	28	29	31	31	—	29	31	32	31	28	28
	1/5	33	33	37	34	35	—	34	34	35	34	34	34
	1/10	44	42	50	43	41	—	43	41	39	41	43	42
	1/20	57	52	65	55	48	—	55	48	44	48	53	51
	1/30	65	57	74	65	53	—	64	54	48	54	59	56
	1/50	75	65	87	79	61	—	75	61	54	61	66	63
	1/80	85	72	99	93	68	—	86	69	60	69	73	70
	1/100	89	75	105	100	72	—	92	73	63	72	76	73
	1/150	98	81	116	113	80	—	102	80	69	80	82	78
	1/200	104	85	124	123	85	—	110	86	73	85	87	82
	1/300	112	91	137	138	94	—	121	94	80	93	93	88
	1/400	118	96	145	148	100	—	129	100	85	98	97	92
	1/500	123	99	152	157	105	—	135	105	89	103	101	95
	1/700	130	104	163	169	113	—	145	112	95	110	106	100
	1/1000	138	109	175	183	121	—	155	120	101	118	112	105

less than 0.04(SLSC)
minimum value(SLSC)

Station code 16062

	6months rainfall series (number of sumple N=48)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.951	0.985	0.973	0.989	0.989	0.987	0.989	0.989	0.987	0.989	—	—
P-COR(99%)	0.789	0.995	0.996	0.995	0.992	0.991	0.993	0.993	0.991	0.993	—	—
SLSC(99%)	0.063	0.035	0.059	0.029	0.043	0.044	0.037	0.038	0.037	0.038	—	—
log likelihood	-315.700	-330.900	-332.800	-329.300	-328.900	-329.000	-328.900	-328.900	-329.000	-328.900	—	—
pAIC	635.300	665.800	669.500	664.600	663.800	664.000	663.700	663.800	664.000	663.700	—	—
X-COR(50%)	0.975	0.981	0.972	0.986	0.989	0.987	0.989	0.988	0.990	0.988	—	—
P-COR(50%)	0.982	0.983	0.987	0.985	0.988	0.991	0.987	0.987	0.988	0.987	—	—
SLSC(50%)	0.085	0.053	0.107	0.042	0.043	0.051	0.041	0.041	0.053	0.041	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	918	959	959	969	983	988	982	979	989	980	—	—
	1/3	1,025	1,061	1,086	1,072	1,087	1,092	1,084	1,082	1,090	1,082	—	—
	1/5	1,160	1,174	1,236	1,184	1,191	1,193	1,189	1,187	1,189	1,187	—	—
	1/10	1,343	1,317	1,437	1,316	1,309	1,304	1,308	1,308	1,299	1,308	—	—
	1/20	1,526	1,455	1,643	1,437	1,409	1,397	1,413	1,415	1,393	1,414	—	—
	1/30	1,633	1,534	1,767	1,504	1,463	1,446	1,470	1,473	1,443	1,472	—	—
	1/50	1,768	1,632	1,929	1,585	1,527	1,503	1,538	1,543	1,502	1,542	—	—
	1/80	1,892	1,722	2,082	1,656	1,582	1,552	1,598	1,605	1,553	1,603	—	—
	1/100	1,951	1,765	2,156	1,689	1,607	1,573	1,625	1,633	1,576	1,631	—	—
	1/150	2,058	1,843	2,294	1,747	1,651	1,612	1,675	1,684	1,618	1,682	—	—
	1/200	2,134	1,898	2,395	1,787	1,682	1,638	1,709	1,720	1,646	1,717	—	—
	1/300	2,241	1,975	2,539	1,843	1,723	1,673	1,756	1,769	1,685	1,766	—	—
	1/400	2,317	2,030	2,644	1,881	1,752	1,697	1,789	1,803	1,712	1,800	—	—
	1/500	2,376	2,073	2,727	1,910	1,774	1,715	1,814	1,829	1,733	1,826	—	—
	1/700	2,465	2,137	2,854	1,953	1,806	1,742	1,852	1,869	1,763	1,865	—	—
	1/1000	2,559	2,205	2,992	1,998	1,839	1,769	1,891	1,910	1,795	1,906	—	—
jackknife	1/2	32	32	30	38	963	39	40	37	48	37	—	—
error estimates	1/3	35	37	48	44	1,064	47	45	42	55	42	—	—
	1/5	44	45	86	50	1,167	49	48	47	51	47	—	—
	1/10	59	57	143	57	1,281	56	51	54	53	54	—	—
	1/20	77	70	205	70	1,380	78	60	63	87	63	—	—
	1/30	88	78	244	83	1,433	100	71	71	118	70	—	—
	1/50	102	88	294	104	1,495	133	88	82	165	81	—	—
	1/80	115	97	344	129	1,549	169	108	94	215	93	—	—
	1/100	121	102	368	142	1,574	188	119	100	241	99	—	—
	1/150	132	110	413	168	1,617	224	139	113	290	111	—	—
	1/200	140	115	446	189	1,647	252	155	122	327	120	—	—
	1/300	152	123	494	220	1,689	293	178	137	383	134	—	—
	1/400	160	129	529	243	1,717	324	195	147	424	144	—	—
	1/500	166	134	557	262	1,739	349	209	156	457	152	—	—
	1/700	176	141	601	292	1,771	388	231	169	509	165	—	—
	1/1000	186	148	648	325	1,804	431	256	184	567	179	—	—

less than 0.04(SLSC)
minimum value(SLSC)

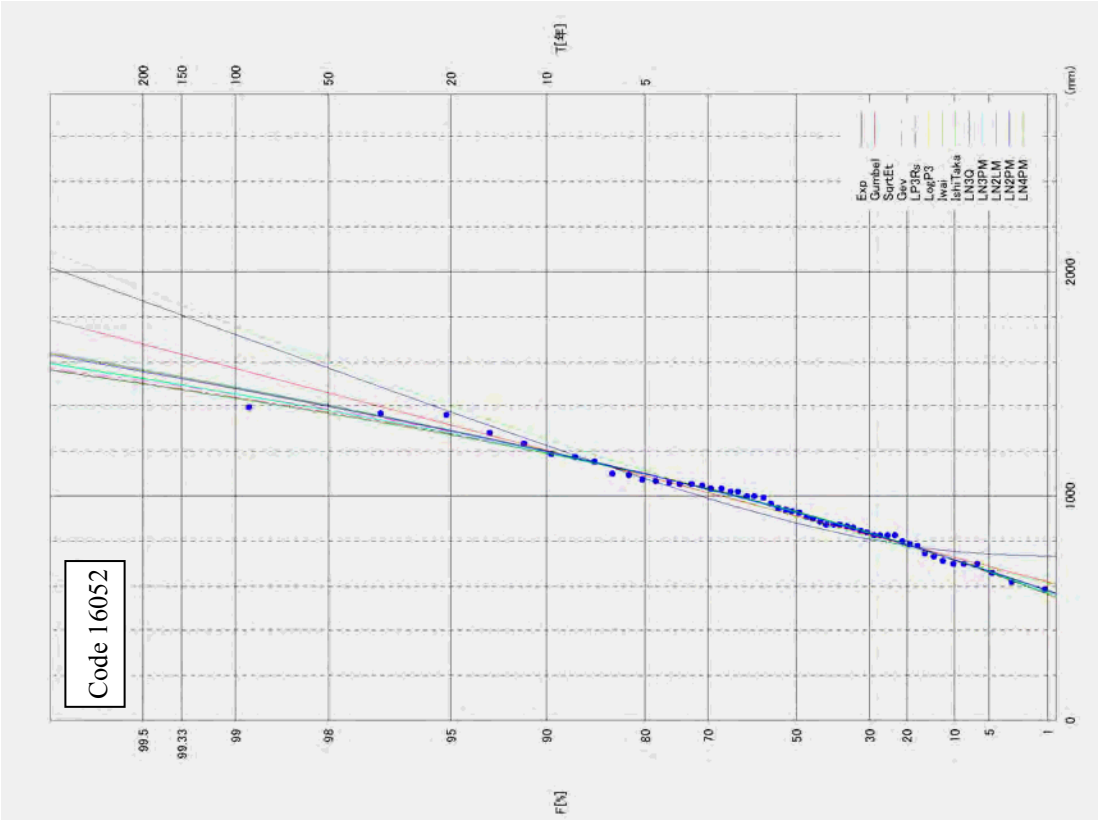

Figure C6.3.58 Probability Distribution on Gumbel Probability Paper (Station code 16052)

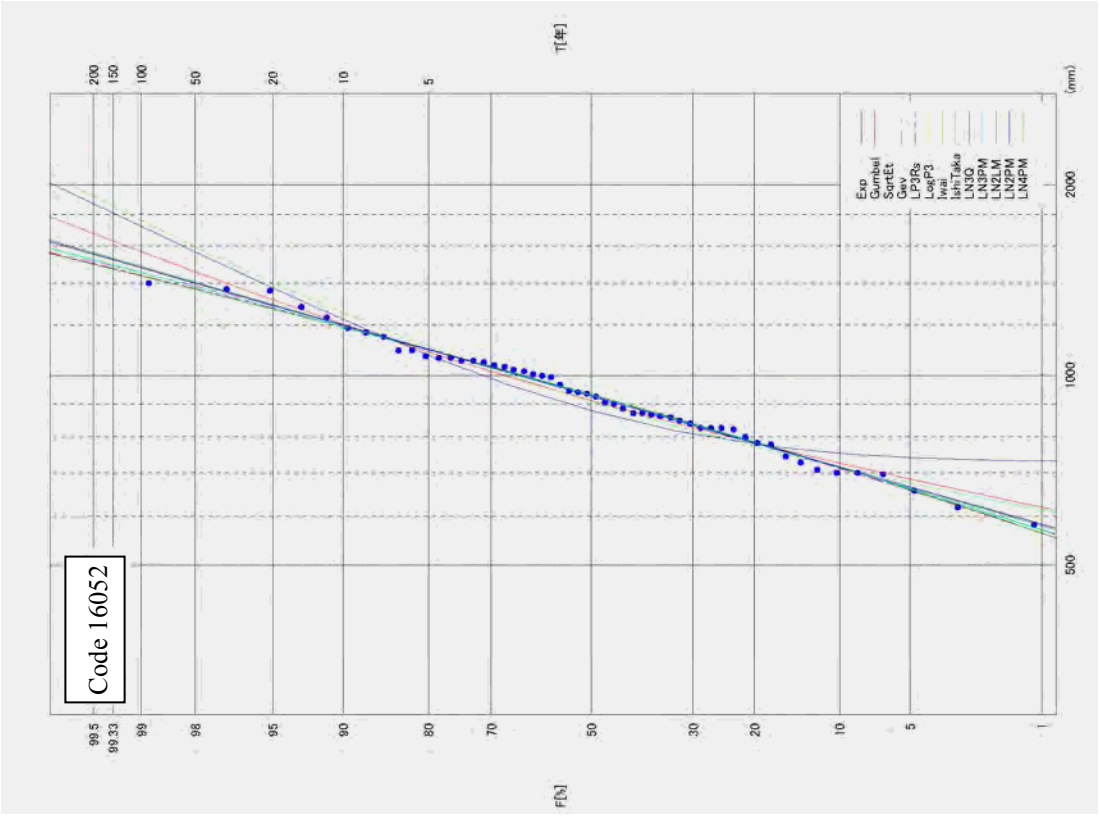

Figure C6.3.59 Probability Distribution on Log-normal Probability Paper (Station code 16052)

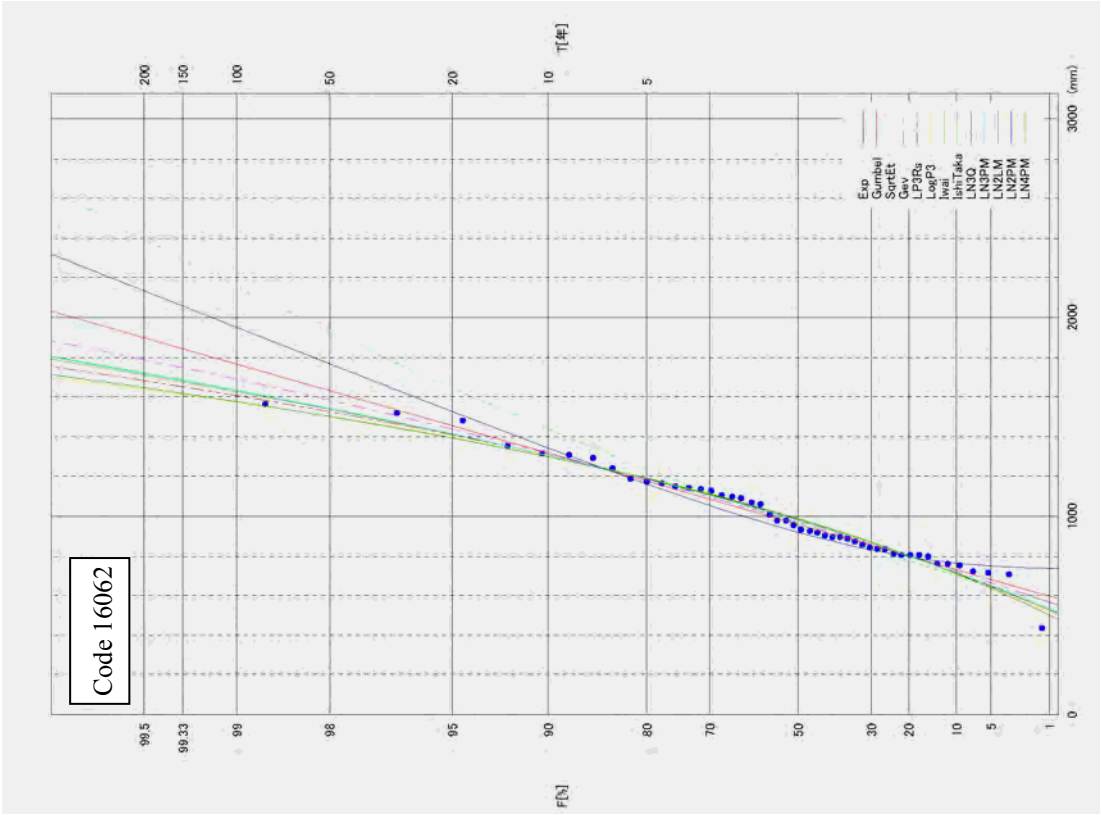

Figure C6.3.60 Probability Distribution on Gumbel Probability Paper (Station code 16062)

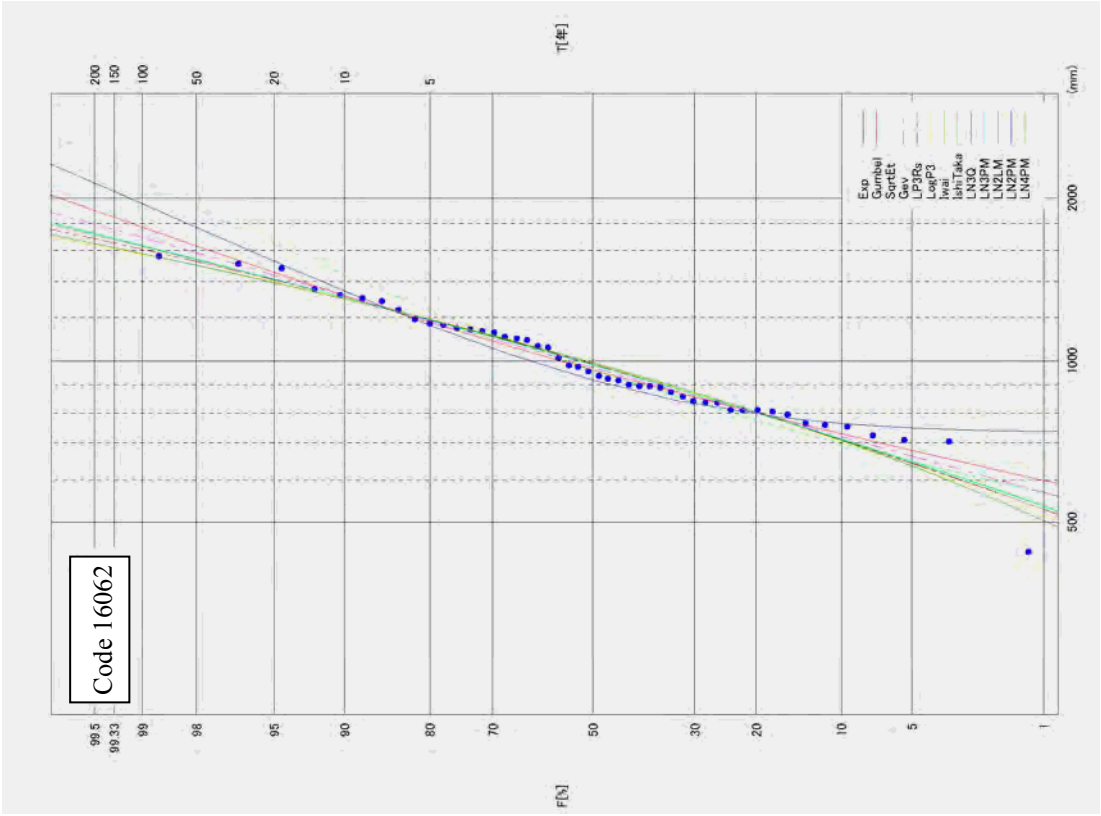

Figure C6.3.61 Probability Distribution on Log-normal Probability Paper (Station code 16062)

Table C 6.3.23 Result of Frequency Analysis of 6-Month Rainfall (14)

Station code 16072

	6months rainfall series (number of sumple N=51)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.928	0.972	0.957	0.984	0.985	—	0.984	0.985	0.984	0.985	0.983	0.983
P-COR(99%)	0.879	0.994	0.994	0.992	0.989	—	0.988	0.990	0.987	0.990	0.992	0.992
SLSC(99%)	0.077	0.047	0.056	0.042	0.033	—	0.036	0.034	0.037	0.034	0.033	0.033
log likelihood	-323.700	-338.100	-339.100	-337.000	-337.100	—	-337.400	-337.200	-337.400	-337.200	-337.100	-337.100
pAIC	651.400	680.300	682.300	680.000	680.300	—	680.800	680.300	680.800	680.400	678.300	678.200
X-COR(50%)	0.904	0.921	0.904	0.944	0.953	—	0.954	0.949	0.954	0.949	0.942	0.942
P-COR(50%)	0.975	0.973	0.977	0.976	0.976	—	0.976	0.975	0.975	0.975	0.975	0.975
SLSC(50%)	0.112	0.092	0.109	0.084	0.090	—	0.091	0.087	0.093	0.087	0.083	0.084

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	895	927	924	940	950	—	953	948	953	948	942	942
	1/3	980	1,008	1,016	1,023	1,031	—	1,033	1,028	1,032	1,028	1,024	1,023
	1/5	1,087	1,099	1,122	1,110	1,112	—	1,111	1,109	1,110	1,109	1,110	1,108
	1/10	1,232	1,212	1,263	1,210	1,201	—	1,197	1,200	1,195	1,200	1,209	1,206
	1/20	1,378	1,321	1,405	1,299	1,276	—	1,270	1,280	1,266	1,279	1,298	1,293
	1/30	1,463	1,384	1,490	1,347	1,316	—	1,309	1,322	1,305	1,322	1,347	1,341
	1/50	1,570	1,462	1,600	1,404	1,363	—	1,355	1,373	1,349	1,373	1,406	1,399
	1/80	1,669	1,534	1,703	1,453	1,404	—	1,394	1,418	1,388	1,417	1,458	1,450
	1/100	1,716	1,568	1,753	1,476	1,422	—	1,412	1,438	1,406	1,437	1,482	1,474
	1/150	1,801	1,630	1,846	1,515	1,455	—	1,444	1,475	1,437	1,474	1,526	1,517
	1/200	1,861	1,674	1,913	1,541	1,477	—	1,466	1,500	1,459	1,499	1,556	1,547
	1/300	1,946	1,735	2,009	1,577	1,508	—	1,496	1,535	1,488	1,533	1,598	1,588
	1/400	2,007	1,779	2,079	1,602	1,528	—	1,516	1,559	1,508	1,557	1,628	1,617
	1/500	2,054	1,813	2,134	1,621	1,544	—	1,532	1,577	1,523	1,575	1,651	1,640
	1/700	2,124	1,864	2,217	1,648	1,568	—	1,555	1,604	1,546	1,603	1,685	1,673
	1/1000	2,199	1,918	2,308	1,675	1,592	—	1,579	1,633	1,570	1,631	1,720	1,708
jackknife error estimates	1/2	24	25	25	31	30	—	39	30	28	30	25	25
	1/3	27	28	30	35	33	—	41	33	31	33	29	28
	1/5	32	32	42	38	35	—	38	35	34	34	34	33
	1/10	42	40	61	38	35	—	33	35	37	35	43	41
	1/20	53	48	83	39	35	—	38	36	44	36	52	49
	1/30	60	53	96	41	36	—	46	37	50	37	57	54
	1/50	69	60	114	46	37	—	60	39	59	39	64	61
	1/80	77	66	131	53	40	—	75	41	69	41	71	67
	1/100	81	68	140	58	42	—	83	43	75	42	74	70
	1/150	88	74	156	68	46	—	99	46	85	46	79	75
	1/200	94	77	167	75	49	—	110	49	93	48	84	79
	1/300	101	83	184	88	55	—	126	53	105	53	89	84
	1/400	106	87	197	97	59	—	138	57	113	56	93	88
	1/500	111	89	206	105	63	—	148	60	120	59	96	91
	1/700	117	94	222	117	69	—	163	64	131	63	101	96
	1/1000	123	99	238	130	76	—	179	70	143	68	106	100

less than 0.04(SLSC)
minimum value(SLSC)

Station code 16082

	6months rainfall series (number of sumple N=46)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.966	0.993	0.987	0.994	0.994	—	0.994	0.994	0.993	0.994	0.994	0.994
P-COR(99%)	0.891	0.996	0.996	0.996	0.995	—	0.995	0.995	0.994	0.995	0.995	0.995
SLSC(99%)	0.053	0.024	0.037	0.021	0.027	—	0.027	0.028	0.027	0.027	0.026	0.026
log likelihood	-298.700	-310.600	-311.600	-310.300	—	—	-310.300	-310.300	-310.400	-310.300	-310.300	-310.300
pAIC	601.300	625.300	627.300	626.600	0.000	—	626.600	626.700	626.800	626.600	624.700	624.700
X-COR(50%)	0.988	0.991	0.989	0.991	0.991	—	0.991	0.991	0.990	0.991	0.991	0.991
P-COR(50%)	0.989	0.990	0.990	0.991	0.992	—	0.992	0.992	0.992	0.992	0.992	0.992
SLSC(50%)	0.072	0.038	0.068	0.033	0.036	—	0.035	0.035	0.041	0.035	0.034	0.035

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	870	908	903	915	923	—	920	918	925	919	921	921
	1/3	969	1,002	1,007	1,010	1,017	—	1,015	1,012	1,017	1,013	1,016	1,016
	1/5	1,093	1,106	1,128	1,113	1,116	—	1,114	1,112	1,113	1,112	1,116	1,114
	1/10	1,261	1,238	1,289	1,237	1,231	—	1,232	1,230	1,224	1,230	1,234	1,231
	1/20	1,429	1,364	1,453	1,352	1,335	—	1,339	1,339	1,323	1,338	1,340	1,336
	1/30	1,528	1,437	1,551	1,416	1,392	—	1,398	1,400	1,377	1,398	1,399	1,394
	1/50	1,652	1,527	1,679	1,495	1,461	—	1,470	1,474	1,443	1,472	1,471	1,465
	1/80	1,766	1,610	1,799	1,564	1,522	—	1,535	1,541	1,502	1,538	1,535	1,529
	1/100	1,820	1,650	1,858	1,597	1,551	—	1,565	1,572	1,529	1,569	1,565	1,558
	1/150	1,919	1,721	1,966	1,655	1,602	—	1,620	1,628	1,577	1,624	1,619	1,611
	1/200	1,989	1,771	2,045	1,695	1,638	—	1,658	1,668	1,611	1,663	1,657	1,649
	1/300	2,087	1,843	2,158	1,750	1,688	—	1,711	1,723	1,658	1,718	1,709	1,701
	1/400	2,157	1,893	2,239	1,789	1,722	—	1,749	1,762	1,691	1,756	1,746	1,737
	1/500	2,211	1,932	2,304	1,819	1,749	—	1,778	1,792	1,716	1,786	1,775	1,765
	1/700	2,293	1,991	2,403	1,863	1,789	—	1,821	1,837	1,754	1,830	1,817	1,807
	1/1000	2,380	2,054	2,510	1,908	1,832	—	1,867	1,885	1,793	1,877	1,863	1,852
jackknife error estimates	1/2	29	30	29	35	2,351	—	33	34	33	34	31	31
	1/3	33	36	37	41	2,592	—	38	39	39	39	36	36
	1/5	43	44	53	46	2,843	—	44	45	44	45	45	44
	1/10	59	56	80	57	3,135	—	57	57	58	56	58	56
	1/20	76	69	110	76	3,397	—	72	73	85	72	71	70
	1/30	87	77	128	91	3,541	—	82	84	107	84	79	78
	1/50	100	87	153	115	3,715	—	96	101	140	100	90	88
	1/80	113	96	177	141	3,870	—	110	118	174	116	99	98
	1/100	119	100	189	155	3,942	—	117	127	192	125	104	102
	1/150	130	108	211	182	4,071	—	131	143	227	141	113	111
	1/200	138	114	227	202	4,161	—	140	156	253	153	119	117
	1/300	149	121	250	233	4,286	—	155	174	292	170	127	126
	1/400	157	127	268	256	4,373	—	165	188	321	183	134	132
	1/500	163	131	281	275	4,440	—	174	199	345	194	139	137
	1/700	172	138	302	304	4,541	—	187	216	382	210	146	144
	1/1000	182	145	325	337	4,647	—	201	234	423	228	154	152

less than 0.04(SLSC)
minimum value(SLSC)

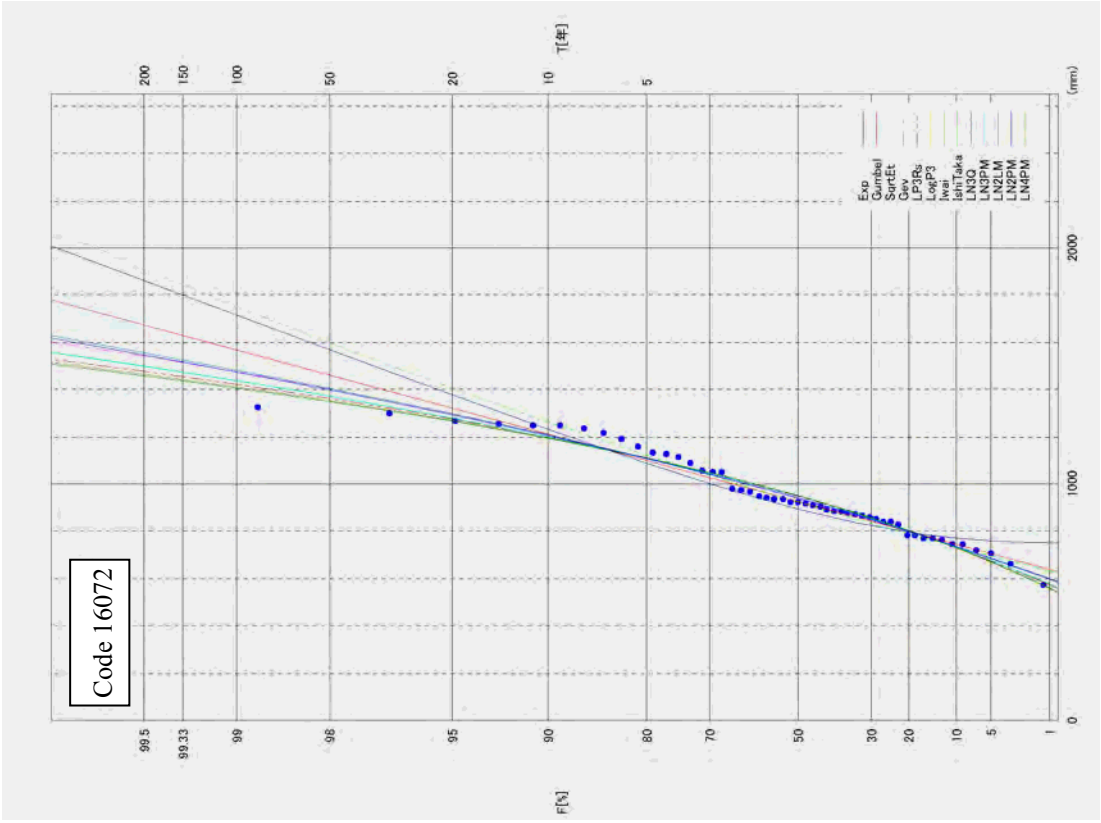

Figure C6.3.62 Probability Distribution on Gumbel Probability Paper (Station code 16072)

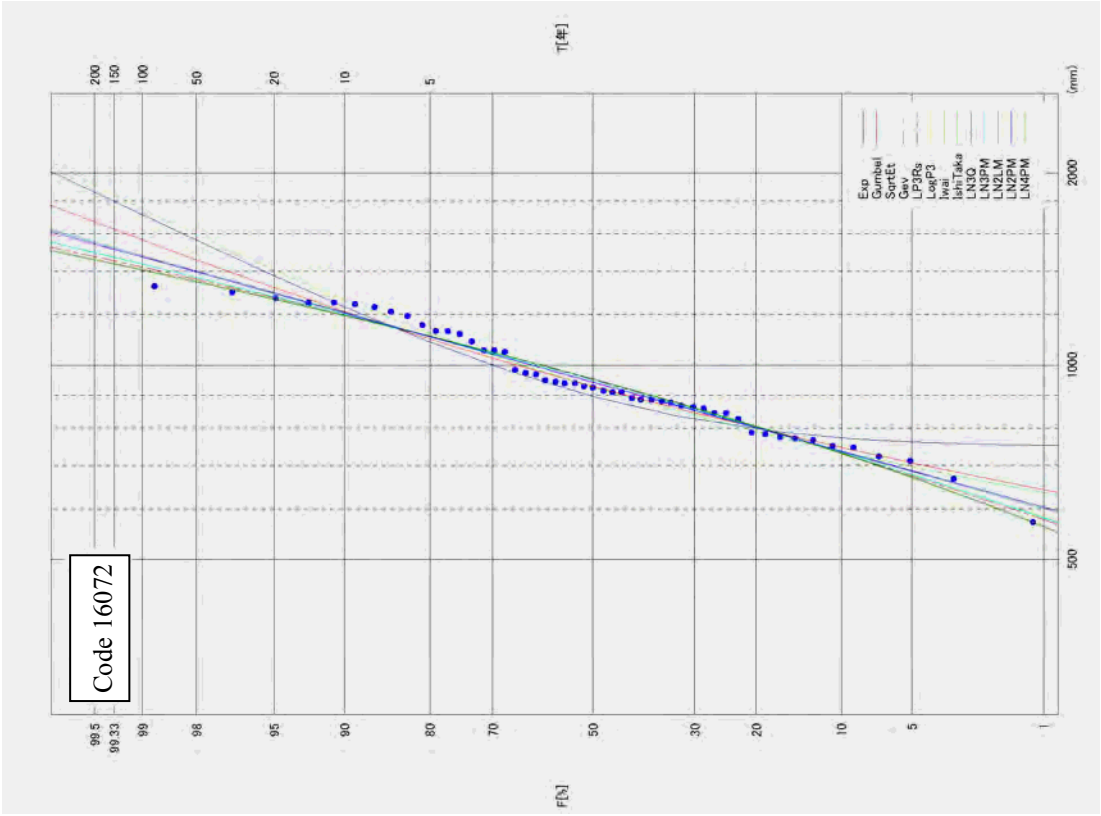

Figure C6.3.63 Probability Distribution on Log-normal Probability Paper (Station code 16072)

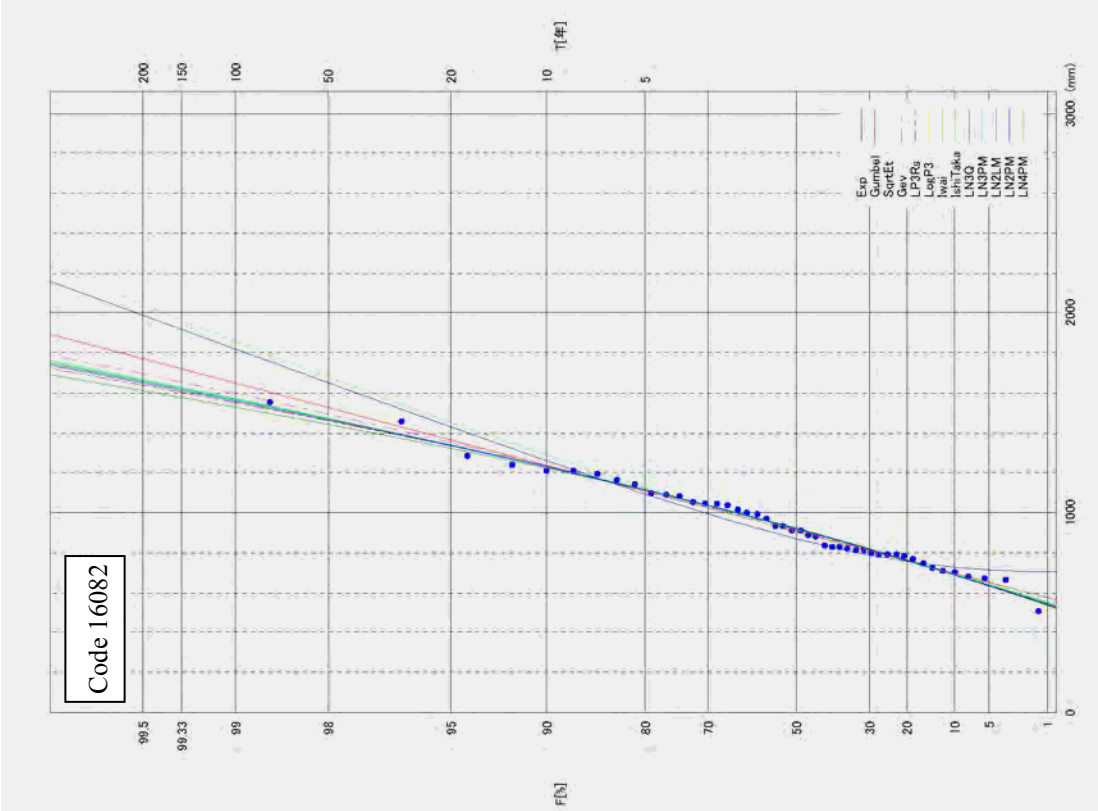

Figure C6.3.64 Probability Distribution on Gumbel Probability Paper (Station code 16082)

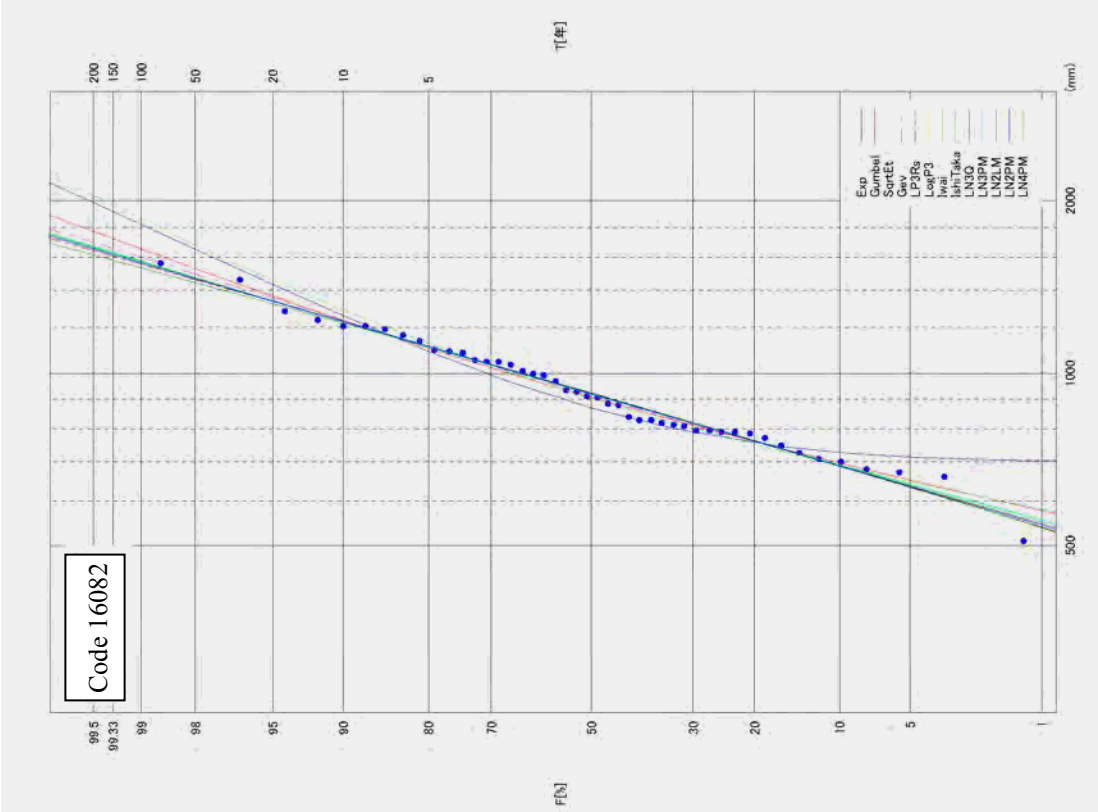

Figure C6.3.65 Probability Distribution on Log-normal Probability Paper (Station code 16082)

Table C 6.3.24 Result of Frequency Analysis of 6-Month Rainfall (15)

Station code 16092

	6months rainfall series (number of sumple N=52)											
	Exponential distribution	Gumbel Distribution	squre-root exponential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.946	0.983	0.975	0.983	0.986	0.985	0.985	0.986	0.984	0.986	0.986	0.986
P-COR(99%)	0.844	0.987	0.985	0.992	0.991	0.992	0.992	0.991	0.993	0.991	0.991	0.991
SLSC(99%)	0.067	0.038	0.053	0.063	0.033	0.031	0.032	0.035	0.034	0.035	0.034	0.033
log likelihood	-341.000	-358.100	-359.100	-356.400	—	-356.100	-356.000	-356.300	-356.100	-356.200	-356.200	-356.200
pAIC	686.000	720.100	722.300	718.800	0.000	718.200	718.100	718.600	718.300	718.500	716.400	716.400
X-COR(50%)	0.973	0.965	0.974	0.937	0.951	0.985	0.947	0.954	0.943	0.953	0.953	0.953
P-COR(50%)	0.951	0.961	0.943	0.957	0.959	0.992	0.959	0.960	0.961	0.960	0.959	0.958
SLSC(50%)	0.083	0.064	0.102	0.127	0.078	0.084	0.082	0.076	0.090	0.076	0.077	0.077

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,011	1,051	1,048	1,076	1,069	1,074	1,074	1,065	1,078	1,065	1,066	1,066
	1/3	1,116	1,151	1,169	1,179	1,172	1,177	1,176	1,167	1,179	1,168	1,169	1,170
	1/5	1,249	1,263	1,310	1,283	1,278	1,281	1,280	1,274	1,279	1,275	1,276	1,279
	1/10	1,428	1,403	1,498	1,398	1,401	1,399	1,398	1,401	1,391	1,401	1,402	1,407
	1/20	1,608	1,538	1,689	1,494	1,511	1,501	1,502	1,515	1,488	1,515	1,516	1,521
	1/30	1,713	1,615	1,804	1,544	1,571	1,556	1,558	1,579	1,540	1,578	1,578	1,585
	1/50	1,845	1,712	1,953	1,601	1,644	1,621	1,626	1,656	1,601	1,654	1,654	1,662
	1/80	1,967	1,801	2,093	1,649	1,708	1,678	1,685	1,725	1,655	1,722	1,722	1,731
	1/100	2,025	1,843	2,162	1,670	1,738	1,704	1,712	1,757	1,680	1,754	1,753	1,763
	1/150	2,130	1,919	2,288	1,707	1,791	1,750	1,761	1,815	1,723	1,812	1,810	1,821
	1/200	2,205	1,973	2,380	1,731	1,829	1,782	1,795	1,856	1,753	1,852	1,849	1,861
	1/300	2,310	2,049	2,512	1,763	1,880	1,826	1,842	1,912	1,795	1,907	1,904	1,917
	1/400	2,385	2,103	2,607	1,784	1,916	1,856	1,874	1,952	1,823	1,947	1,943	1,956
	1/500	2,442	2,145	2,683	1,800	1,944	1,879	1,899	1,983	1,845	1,977	1,973	1,986
	1/700	2,530	2,208	2,798	1,823	1,985	1,914	1,937	2,029	1,878	2,022	2,018	2,032
	1/1000	2,622	2,274	2,923	1,845	2,028	1,949	1,975	2,077	1,911	2,070	2,064	2,080
jackknife	1/2	31	32	31	33	1,467	33	4,511	33	50,270	32	32	32
error estimates	1/3	34	36	37	35	1,609	36	4,381	35	35,960	35	35	36
	1/5	42	44	50	42	1,755	44	4,252	43	35,861	43	43	44
	1/10	60	57	74	62	1,925	62	4,109	62	35,751	62	56	57
	1/20	79	71	101	91	2,076	87	3,987	89	35,656	88	70	71
	1/30	91	80	118	110	2,159	105	3,923	106	35,605	106	78	80
	1/50	106	91	141	136	2,260	129	3,847	131	35,544	129	89	91
	1/80	120	101	163	160	2,349	153	3,782	155	35,491	152	99	101
	1/100	127	106	174	172	2,391	165	3,753	167	35,467	164	104	106
	1/150	140	115	195	194	2,465	188	3,702	189	35,424	185	113	116
	1/200	148	121	210	210	2,517	205	3,667	205	35,395	201	120	122
	1/300	161	130	232	232	2,589	229	3,619	229	35,354	224	129	132
	1/400	170	136	248	248	2,639	247	3,587	246	35,326	241	135	138
	1/500	177	141	261	260	2,678	261	3,563	260	35,304	254	141	143
	1/700	187	149	281	278	2,737	283	3,527	281	35,272	274	148	151
	1/1000	198	157	303	297	2,798	307	3,491	304	35,239	296	157	160

less than 0.04(SLSC)
minimum value(SLSC)

Station code 16102

	6months rainfall series (number of sumple N=46)											
	Exponential distribution	Gumbel Distribution	squre-root exponential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.954	0.992	0.982	0.996	0.996	—	0.997	0.997	0.997	0.997	0.997	0.997
P-COR(99%)	0.872	0.993	0.991	0.996	0.996	—	0.996	0.996	0.996	0.996	0.996	0.996
SLSC(99%)	0.062	0.026	0.045	0.020	0.018	—	0.018	0.018	0.018	0.018	0.019	0.019
log likelihood	-302.600	-316.300	-317.300	-315.000	-315.000	—	-315.000	-315.000	-315.000	-315.000	-315.100	-315.000
pAIC	609.200	636.600	638.600	635.900	635.900	—	636.000	636.000	635.900	635.900	634.100	634.100
X-COR(50%)	0.992	0.995	0.992	0.994	0.994	—	0.995	0.995	0.995	0.995	0.995	0.995
P-COR(50%)	0.992	0.992	0.991	0.992	0.991	—	0.991	0.991	0.991	0.991	0.992	0.992
SLSC(50%)	0.073	0.034	0.083	0.034	0.036	—	0.028	0.029	0.033	0.030	0.027	0.026

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,049	1,090	1,087	1,111	1,114	—	1,110	1,110	1,113	1,111	1,107	1,107
	1/3	1,157	1,193	1,205	1,216	1,217	—	1,213	1,213	1,214	1,213	1,212	1,211
	1/5	1,292	1,307	1,343	1,323	1,322	—	1,319	1,318	1,317	1,318	1,321	1,319
	1/10	1,475	1,450	1,526	1,446	1,439	—	1,442	1,439	1,435	1,439	1,448	1,446
	1/20	1,659	1,587	1,712	1,551	1,542	—	1,551	1,547	1,539	1,546	1,563	1,559
	1/30	1,766	1,666	1,824	1,607	1,597	—	1,611	1,605	1,596	1,604	1,626	1,622
	1/50	1,901	1,765	1,968	1,673	1,662	—	1,683	1,676	1,663	1,675	1,703	1,698
	1/80	2,025	1,856	2,104	1,728	1,719	—	1,747	1,738	1,723	1,737	1,771	1,766
	1/100	2,084	1,898	2,170	1,753	1,745	—	1,776	1,767	1,750	1,765	1,803	1,797
	1/150	2,192	1,976	2,292	1,796	1,792	—	1,829	1,819	1,799	1,817	1,860	1,854
	1/200	2,268	2,031	2,381	1,825	1,824	—	1,866	1,855	1,833	1,852	1,900	1,893
	1/300	2,375	2,109	2,508	1,864	1,868	—	1,917	1,905	1,880	1,902	1,956	1,948
	1/400	2,451	2,164	2,601	1,891	1,898	—	1,952	1,939	1,913	1,936	1,995	1,987
	1/500	2,510	2,206	2,673	1,910	1,921	—	1,980	1,966	1,938	1,963	2,025	2,016
	1/700	2,599	2,271	2,784	1,939	1,956	—	2,021	2,006	1,976	2,002	2,069	2,061
	1/1000	2,694	2,339	2,905	1,967	1,992	—	2,063	2,048	2,015	2,043	2,117	2,107
jackknife	1/2	33	33	33	36	37	—	36	37	29	37	34	34
error estimates	1/3	36	37	39	40	40	—	38	40	34	40	38	38
	1/5	44	45	52	46	46	—	45	46	44	46	46	45
	1/10	60	58	75	59	59	—	60	59	63	59	58	57
	1/20	78	71	101	80	77	—	79	77	86	77	72	71
	1/30	90	79	118	94	90	—	92	89	102	89	81	79
	1/50	104	90	140	115	109	—	109	107	124	106	91	89
	1/80	118	99	162	135	127	—	126	124	145	123	101	99
	1/100	124	104	172	146	136	—	134	133	155	131	106	103
	1/150	136	112	192	165	154	—	149	149	175	147	115	112
	1/200	145	118	207	179	166	—	160	161	189	159	121	118
	1/300	157	127	228	200	185	—	176	178	210	175	130	127
	1/400	165	133	243	215	199	—	188	191	225	188	137	133
	1/500	172	138	256	226	210	—	197	201	237	197	142	138
	1/700	182	145	275	244	227	—	211	217	256	212	149	145
	1/1000	192	153	295	263	245	—	226	233	276	229	158	153

less than 0.04(SLSC)
minimum value(SLSC)

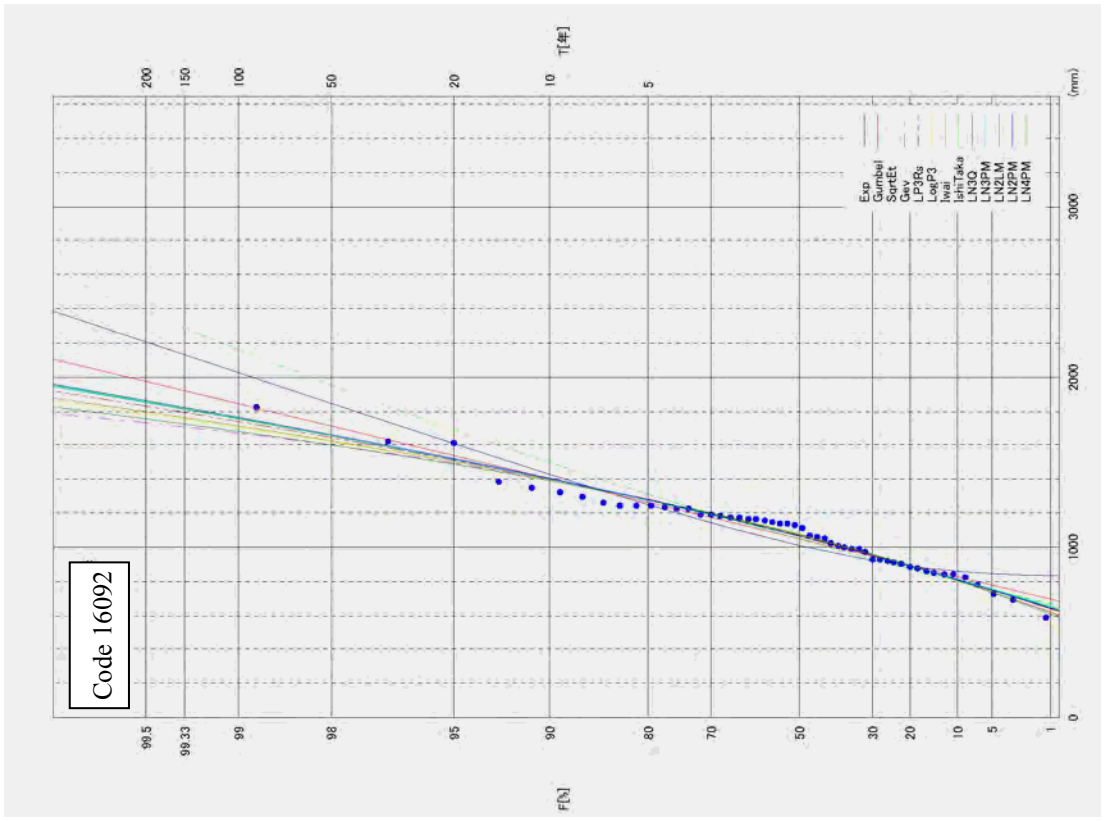

Figure C6.3.66 Probability Distribution on Gumbel Probability Paper (Station code 16092)

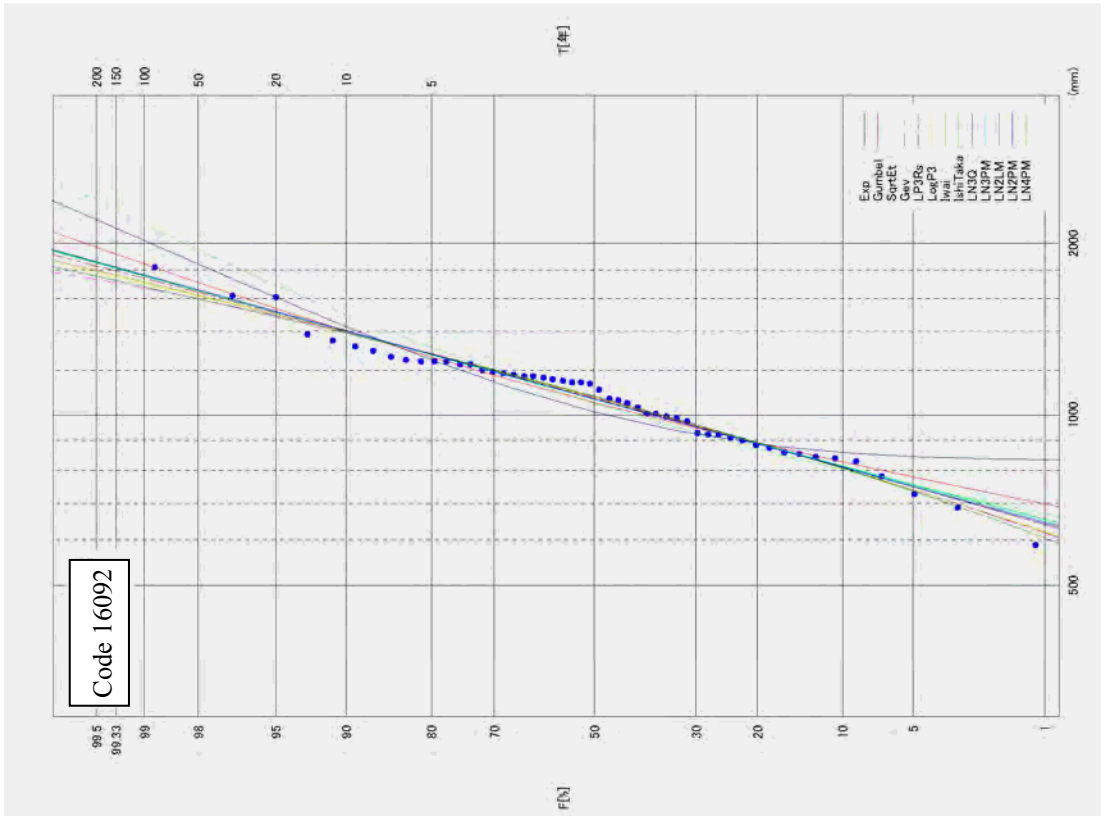

Figure C6.3.67 Probability Distribution on Log-normal Probability Paper (Station code 16092)

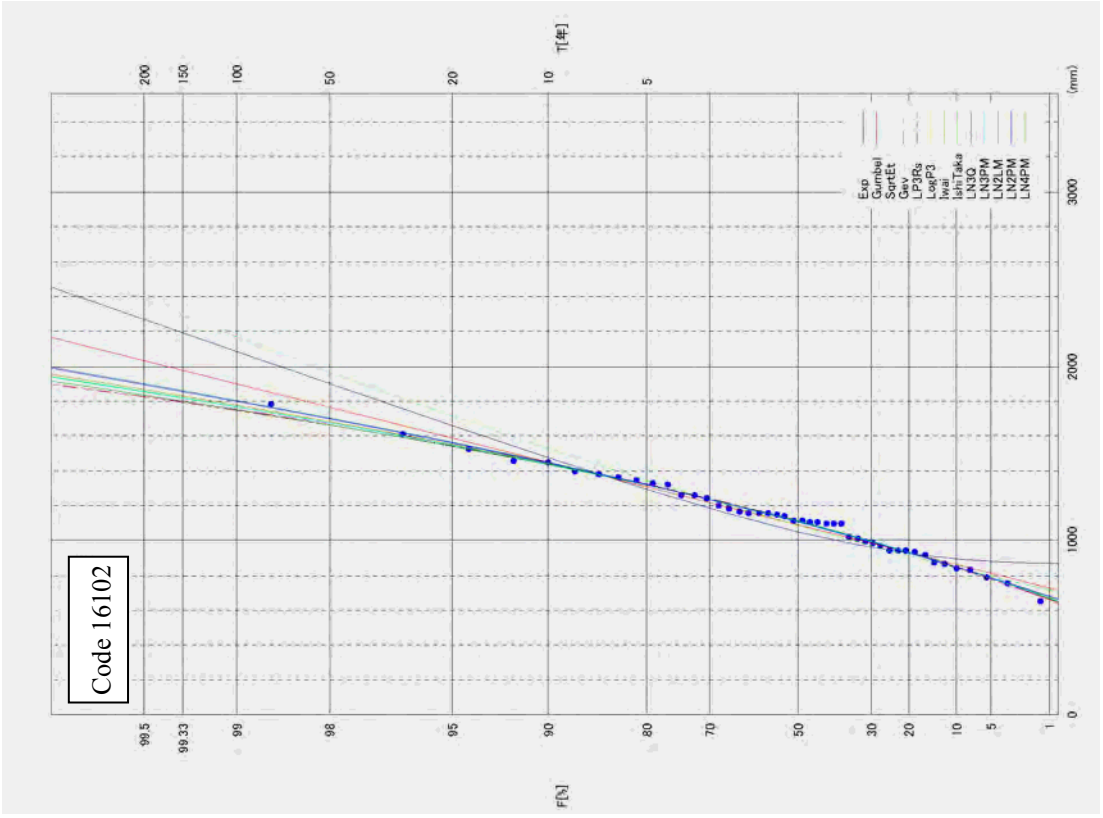

Figure C6.3.68 Probability Distribution on Gumbel Probability Paper (Station code 16102)

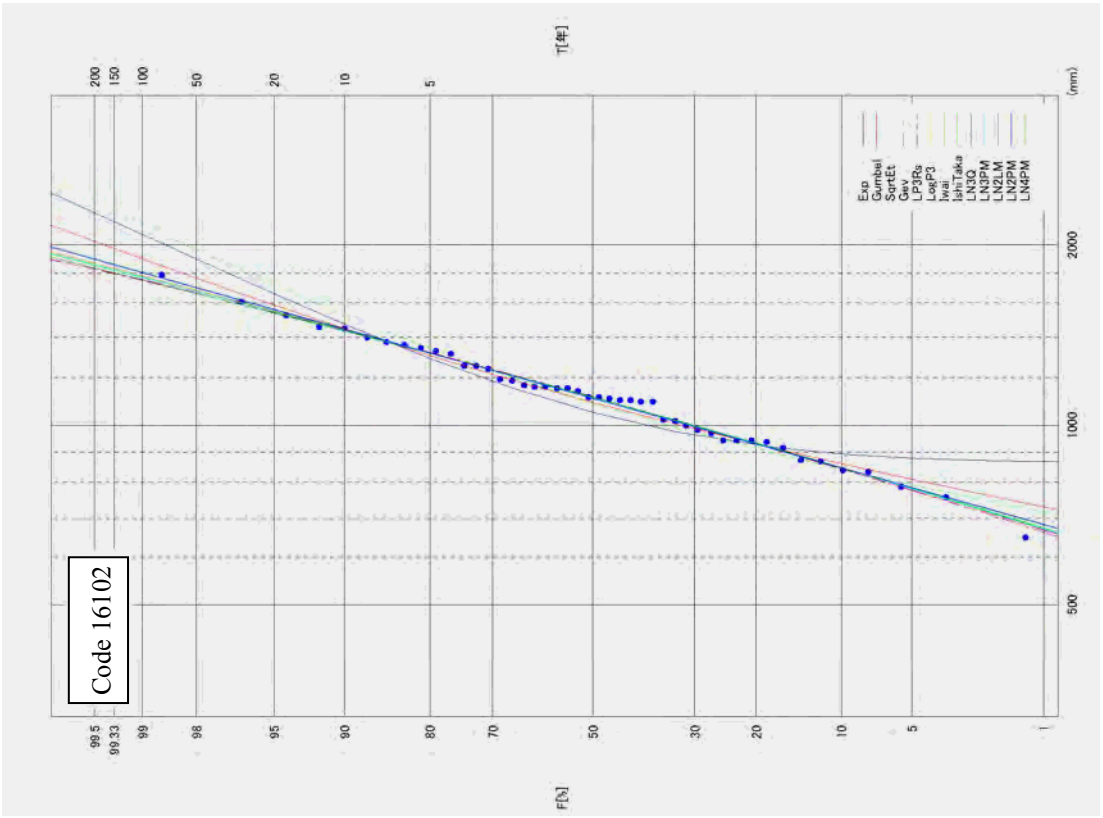

Figure C6.3.69 Probability Distribution on Log-normal Probability Paper (Station code 16102)

Table C 6.3.25 Result of Frequency Analysis of 6-Month Rainfall (16)

Station code 16112

	6months rainfall series (number of sumple N=46)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.942	0.986	0.972	0.998	0.997	0.997	0.997	0.997	0.997	0.997	0.995	0.995
P-COR(99%)	0.904	0.995	0.992	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998
SLSC(99%)	0.069	0.033	0.049	0.016	0.017	0.016	0.016	0.016	0.017	0.016	0.019	0.020
log likelihood	-305.600	-318.800	-319.800	-317.500	-317.500	-317.500	-317.600	-317.600	-317.700	-317.600	-317.800	-317.800
pAIC	615.200	641.600	643.600	641.000	641.100	641.100	641.300	641.300	641.300	641.300	639.600	639.600
X-COR(50%)	0.979	0.985	0.977	0.995	0.994	0.997	0.992	0.993	0.994	0.993	0.990	0.991
P-COR(50%)	0.998	0.998	0.997	0.997	0.997	0.998	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(50%)	0.093	0.058	0.094	0.029	0.030	0.027	0.029	0.029	0.032	0.029	0.037	0.035

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,005	1,049	1,043	1,075	1,082	1,074	1,072	1,078	1,080	1,078	1,064	1,064
	1/3	1,120	1,158	1,167	1,187	1,191	1,184	1,181	1,186	1,186	1,186	1,177	1,175
	1/5	1,264	1,280	1,312	1,300	1,298	1,294	1,292	1,293	1,292	1,293	1,296	1,292
	1/10	1,460	1,433	1,506	1,427	1,415	1,420	1,420	1,415	1,410	1,415	1,436	1,429
	1/20	1,656	1,580	1,703	1,534	1,513	1,528	1,533	1,519	1,511	1,519	1,564	1,554
	1/30	1,770	1,664	1,822	1,589	1,564	1,587	1,594	1,576	1,565	1,575	1,635	1,623
	1/50	1,915	1,769	1,975	1,653	1,623	1,656	1,668	1,643	1,629	1,642	1,721	1,707
	1/80	2,047	1,866	2,121	1,707	1,674	1,717	1,733	1,701	1,685	1,700	1,798	1,782
	1/100	2,110	1,912	2,191	1,731	1,696	1,744	1,763	1,728	1,710	1,727	1,834	1,817
	1/150	2,225	1,995	2,322	1,772	1,736	1,793	1,816	1,776	1,756	1,775	1,899	1,880
	1/200	2,306	2,054	2,417	1,799	1,763	1,827	1,854	1,809	1,787	1,807	1,944	1,924
	1/300	2,421	2,136	2,554	1,836	1,800	1,874	1,905	1,854	1,830	1,852	2,008	1,986
	1/400	2,502	2,195	2,653	1,860	1,824	1,906	1,941	1,886	1,859	1,884	2,052	2,030
	1/500	2,565	2,241	2,731	1,878	1,843	1,930	1,969	1,910	1,882	1,908	2,087	2,063
	1/700	2,660	2,309	2,850	1,904	1,871	1,967	2,010	1,945	1,915	1,943	2,138	2,113
	1/1000	2,761	2,382	2,980	1,929	1,899	2,004	2,053	1,982	1,950	1,980	2,193	2,166
jackknife	1/2	35	36	37	40	41	41	39	41	34	40	36	36
error estimates	1/3	37	39	42	43	44	43	41	43	37	43	40	39
	1/5	44	45	52	48	48	47	46	47	44	47	47	46
	1/10	58	56	69	56	53	55	56	53	56	53	59	57
	1/20	75	68	89	69	61	67	70	61	68	61	73	70
	1/30	85	76	101	80	67	76	79	68	76	67	81	77
	1/50	99	85	118	94	76	89	92	76	86	76	92	88
	1/80	112	94	135	110	85	102	104	85	95	85	103	97
	1/100	118	99	143	118	90	109	111	90	100	89	108	102
	1/150	129	107	159	132	99	123	122	99	108	98	117	110
	1/200	137	112	170	143	107	132	131	105	114	104	124	116
	1/300	148	120	187	158	117	147	144	115	123	113	133	125
	1/400	156	126	199	169	125	158	153	122	129	120	140	131
	1/500	162	130	209	178	131	166	160	127	134	126	145	136
	1/700	172	137	224	191	141	180	172	136	142	134	154	144
	1/1000	182	144	240	205	152	194	184	145	150	143	162	152

less than 0.04(SLSC)
minimum value(SLSC)

Station code 17012

	6months rainfall series (number of sumple N=48)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.963	0.989	0.983	0.989	—	—	0.987	0.989	0.989	0.989	0.989	0.989
P-COR(99%)	0.920	0.997	0.995	0.997	—	—	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(99%)	0.056	0.030	0.037	0.035	—	—	0.029	0.026	0.025	0.025	0.025	0.025
log likelihood	-312.400	-324.600	-325.400	-324.500	—	—	-324.800	-324.500	-324.400	-324.500	-324.500	-324.500
pAIC	628.800	653.300	654.800	655.000	—	—	655.700	655.000	654.900	654.900	653.000	653.000
X-COR(50%)	0.967	0.968	0.968	0.966	—	—	0.965	0.967	0.967	0.967	0.966	0.966
P-COR(50%)	0.985	0.986	0.986	0.987	—	—	0.988	0.987	0.987	0.987	0.988	0.988
SLSC(50%)	0.075	0.059	0.071	0.069	—	—	0.074	0.057	0.060	0.058	0.062	0.062

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	849	887	880	896	—	—	907	892	896	893	899	899
	1/3	949	982	983	993	—	—	1,001	987	991	988	996	995
	1/5	1,075	1,088	1,103	1,097	—	—	1,099	1,090	1,093	1,091	1,098	1,096
	1/10	1,246	1,222	1,263	1,221	—	—	1,210	1,217	1,214	1,217	1,218	1,215
	1/20	1,417	1,350	1,426	1,334	—	—	1,308	1,334	1,326	1,334	1,327	1,323
	1/30	1,517	1,424	1,524	1,396	—	—	1,362	1,401	1,388	1,400	1,388	1,383
	1/50	1,643	1,516	1,651	1,471	—	—	1,426	1,484	1,464	1,481	1,462	1,456
	1/80	1,759	1,600	1,771	1,537	—	—	1,483	1,559	1,533	1,555	1,528	1,522
	1/100	1,814	1,640	1,829	1,568	—	—	1,510	1,594	1,566	1,590	1,559	1,552
	1/150	1,914	1,713	1,937	1,622	—	—	1,557	1,658	1,624	1,653	1,615	1,607
	1/200	1,985	1,764	2,015	1,660	—	—	1,589	1,704	1,665	1,698	1,654	1,646
	1/300	2,085	1,836	2,128	1,711	—	—	1,634	1,768	1,722	1,761	1,709	1,700
	1/400	2,156	1,887	2,209	1,747	—	—	1,666	1,813	1,763	1,805	1,747	1,738
	1/500	2,211	1,927	2,273	1,774	—	—	1,690	1,848	1,794	1,839	1,777	1,767
	1/700	2,294	1,987	2,372	1,814	—	—	1,726	1,901	1,841	1,892	1,821	1,811
	1/1000	2,382	2,051	2,479	1,855	—	—	1,764	1,958	1,891	1,947	1,868	1,857
jackknife	1/2	29	30	30	34	—	—	40	33	35	33	30	30
error estimates	1/3	34	36	36	38	—	—	43	37	40	37	36	36
	1/5	44	45	47	45	—	—	47	45	45	45	45	45
	1/10	61	58	65	60	—	—	58	60	55	60	58	58
	1/20	80	72	86	85	—	—	74	83	69	82	72	72
	1/30	91	81	99	103	—	—	85	98	81	97	80	80
	1/50	106	91	116	130	—	—	101	120	98	119	91	90
	1/80	119	101	133	158	—	—	118	142	116	140	101	100
	1/100	126	105	141	172	—	—	126	153	125	151	106	105
	1/150	137	114	157	199	—	—	141	175	143	172	115	114
	1/200	146	120	168	219	—	—	153	191	157	187	121	120
	1/300	158	128	185	248	—	—	169	214	178	209	130	129
	1/400	166	134	197	270	—	—	182	231	193	226	136	135
	1/500	172	139	206	287	—	—	191	245	206	239	142	140
	1/700	182	146	221	314	—	—	206	267	226	260	149	148
	1/1000	193	154	238	344	—	—	222	291	247	283	158	156

less than 0.04(SLSC)
minimum value(SLSC)

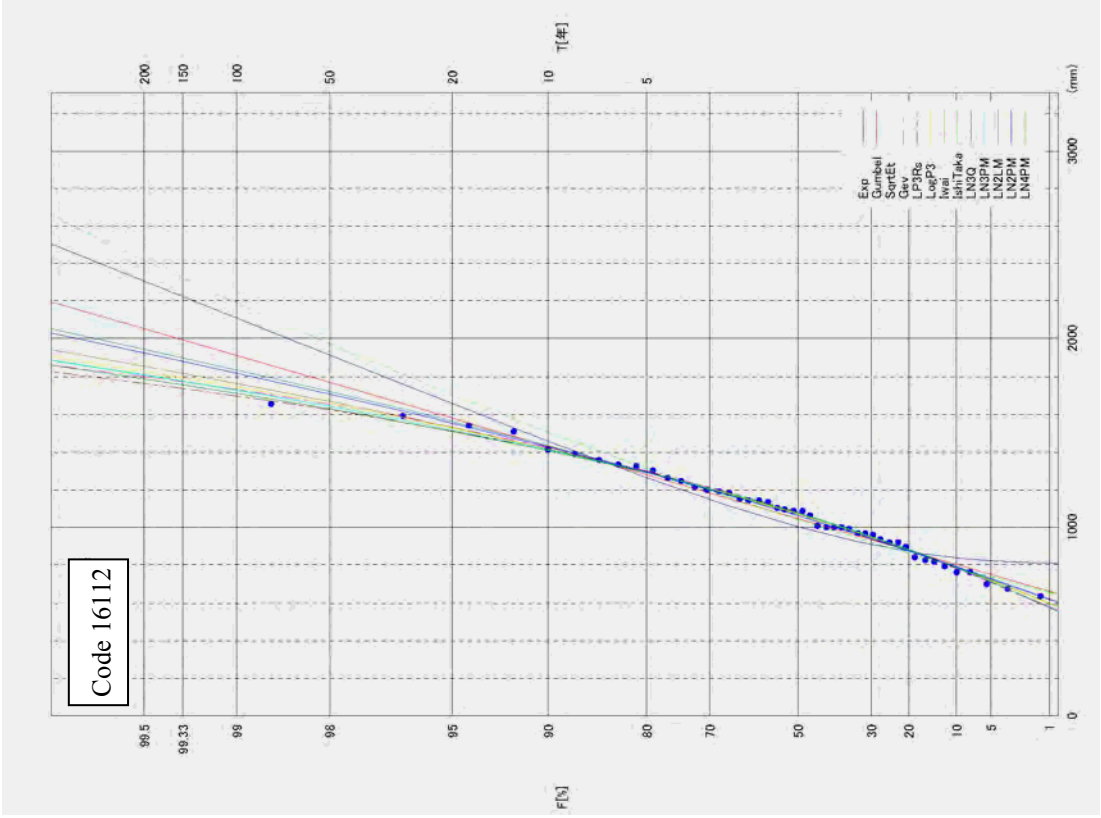

Figure C6.3.70 Probability Distribution on Gumbel Probability Paper (Station code 16112)

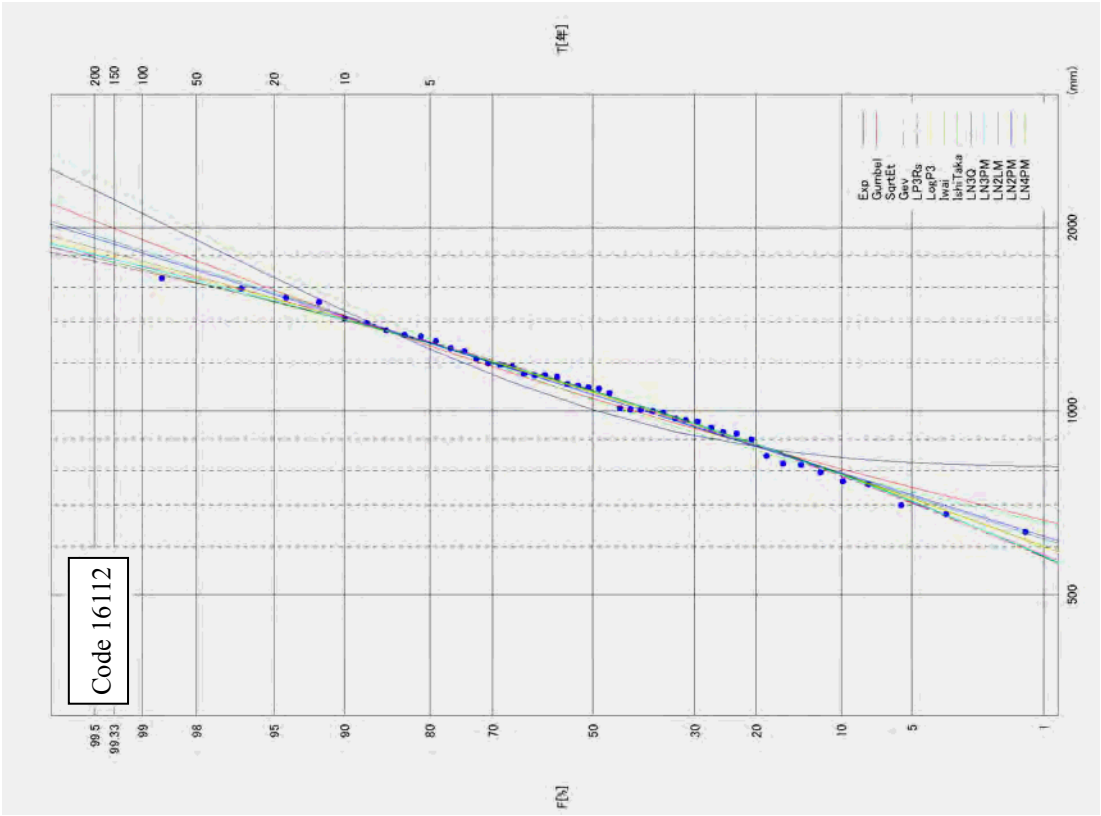

Figure C6.3.71 Probability Distribution on Log-normal Probability Paper (Station code 16112)

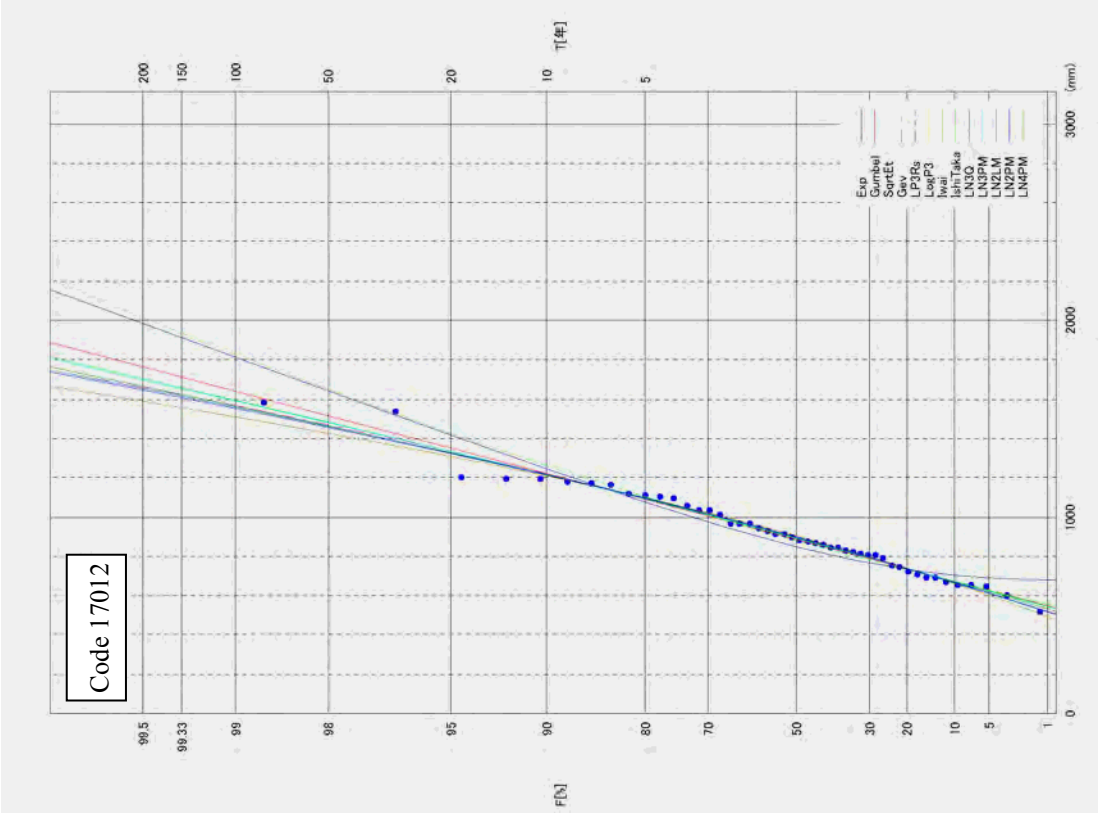

Figure C6.3.72 Probability Distribution on Gumbel Probability Paper (Station code 17012)

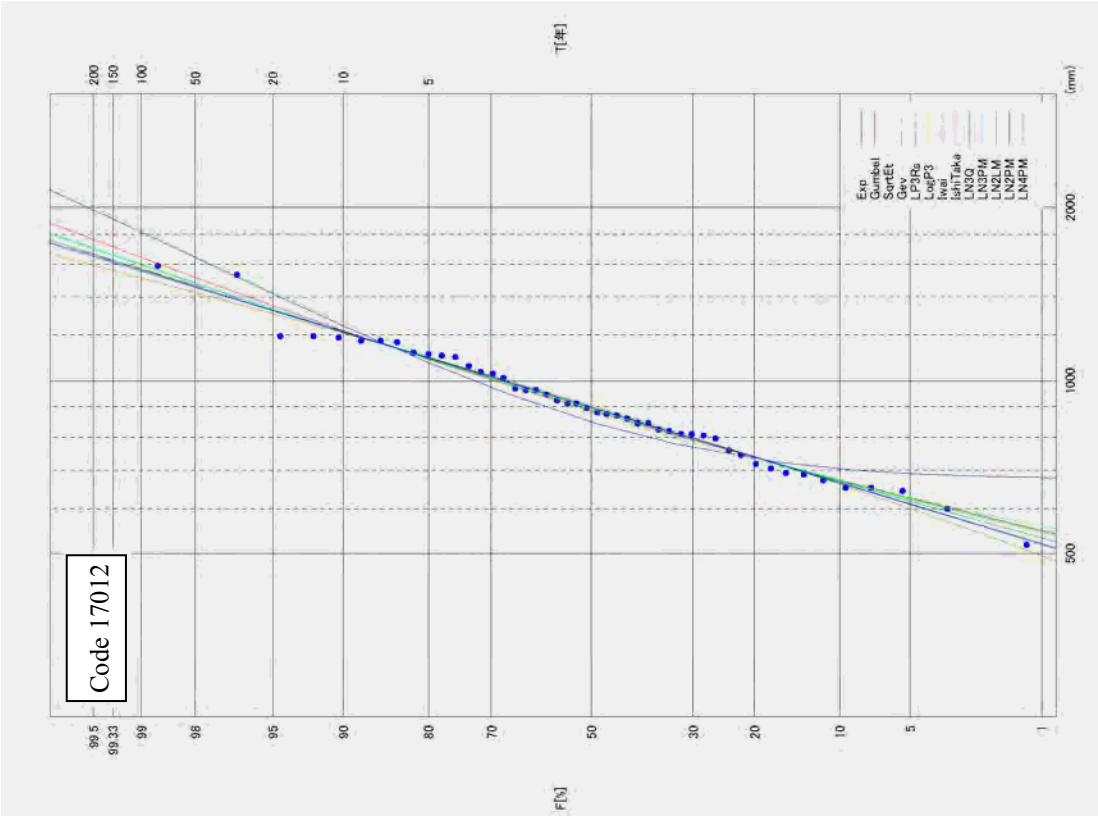

Figure C6.3.73 Probability Distribution on Log-normal Probability Paper (Station code 17012)

Table C 6.3.26 Result of Frequency Analysis of 6-Month Rainfall (17)

Station code 17032

	6months rainfall series (number of sumple N=49)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.909	0.964	0.947	0.989	0.988	0.986	0.986	0.987	0.986	0.987	0.981	0.982
P-COR(99%)	0.920	0.989	0.988	0.993	0.992	0.993	0.992	0.992	0.992	0.992	0.993	0.992
SLSC(99%)	0.085	0.053	0.061	0.036	0.035	0.034	0.035	0.035	0.035	0.035	0.035	0.036
log likelihood	-307.300	-321.600	-322.300	-319.700	-319.700	-319.900	-320.100	-320.100	-320.100	-320.100	-320.300	-320.200
pAIC	618.700	647.100	648.600	645.300	645.300	645.900	646.100	646.200	646.100	646.200	644.600	644.500
X-COR(50%)	0.916	0.933	0.919	0.969	0.971	0.986	0.959	0.965	0.960	0.965	0.951	0.951
P-COR(50%)	0.958	0.958	0.962	0.971	0.970	0.993	0.965	0.967	0.965	0.967	0.965	0.963
SLSC(50%)	0.127	0.102	0.120	0.067	0.068	0.074	0.074	0.069	0.074	0.069	0.082	0.081

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	839	869	866	894	899	890	890	896	891	896	883	883
	1/3	918	945	950	971	973	964	964	969	964	969	961	959
	1/5	1,018	1,029	1,048	1,046	1,043	1,039	1,038	1,040	1,037	1,040	1,041	1,037
	1/10	1,153	1,134	1,177	1,127	1,116	1,122	1,121	1,116	1,117	1,116	1,135	1,128
	1/20	1,288	1,235	1,307	1,192	1,176	1,194	1,193	1,180	1,186	1,180	1,218	1,209
	1/30	1,367	1,294	1,385	1,225	1,206	1,232	1,231	1,214	1,223	1,214	1,264	1,253
	1/50	1,466	1,366	1,486	1,262	1,240	1,277	1,277	1,253	1,267	1,253	1,320	1,307
	1/80	1,558	1,433	1,580	1,292	1,269	1,316	1,317	1,287	1,304	1,287	1,369	1,355
	1/100	1,602	1,464	1,626	1,305	1,282	1,334	1,335	1,303	1,322	1,302	1,392	1,377
	1/150	1,681	1,522	1,711	1,327	1,304	1,366	1,367	1,330	1,353	1,329	1,433	1,416
	1/200	1,737	1,562	1,772	1,341	1,319	1,387	1,390	1,348	1,374	1,348	1,461	1,444
	1/300	1,816	1,619	1,861	1,360	1,339	1,417	1,420	1,373	1,403	1,373	1,501	1,482
	1/400	1,872	1,660	1,924	1,372	1,352	1,438	1,442	1,390	1,423	1,390	1,529	1,509
	1/500	1,915	1,691	1,974	1,381	1,362	1,453	1,458	1,404	1,438	1,403	1,550	1,529
	1/700	1,981	1,739	2,051	1,393	1,376	1,476	1,482	1,423	1,461	1,423	1,582	1,560
	1/1000	2,050	1,789	2,134	1,405	1,391	1,500	1,507	1,443	1,484	1,443	1,616	1,593
jackknife	1/2	24	24	25	32	29	29	31	29	25	29	24	24
error estimates	1/3	24	25	29	33	30	30	30	29	26	29	26	26
	1/5	27	27	36	31	29	30	29	29	28	29	29	29
	1/10	32	31	47	28	28	30	29	28	34	28	34	34
	1/20	40	37	59	29	28	32	33	29	46	29	40	40
	1/30	45	40	67	32	29	35	37	30	55	30	44	43
	1/50	51	45	78	39	32	40	44	32	68	32	48	48
	1/80	57	49	88	47	36	45	52	36	82	36	53	52
	1/100	60	51	93	52	38	49	55	37	89	37	55	54
	1/150	66	55	103	60	43	55	63	41	102	41	59	58
	1/200	70	58	110	66	46	60	69	44	111	44	62	61
	1/300	75	62	120	74	52	67	77	48	125	48	66	65
	1/400	79	64	128	80	56	73	83	51	135	51	69	67
	1/500	83	67	133	85	60	78	88	54	144	53	72	70
	1/700	87	70	143	92	65	84	95	58	156	57	75	73
	1/1000	92	74	152	99	70	92	103	62	170	61	79	76

less than 0.04(SLSC)
minimum value(SLSC)

Station code 17042

	6months rainfall series (number of sumple N=52)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.933	0.947	0.952	0.936	—	0.947	—	—	—	—	—	—
P-COR(99%)	0.844	0.985	0.979	0.990	—	0.983	—	—	—	—	—	—
SLSC(99%)	0.078	0.073	0.058	0.135	—	0.055	—	—	—	—	—	—
log likelihood	-336.100	-352.600	-353.200	-352.900	—	-352.500	—	—	—	—	—	—
pAIC	676.100	709.200	710.500	711.800	—	710.900	—	—	—	—	—	—
X-COR(50%)	0.911	0.899	0.915	0.878	—	0.947	—	—	—	—	—	—
P-COR(50%)	0.983	0.989	0.980	0.989	—	0.983	—	—	—	—	—	—
SLSC(50%)	0.099	0.139	0.105	0.274	—	0.102	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	987	1,024	1,019	1,035	—	1,021	—	—	—	—	—	—
	1/3	1,083	1,115	1,126	1,129	—	1,118	—	—	—	—	—	—
	1/5	1,203	1,217	1,250	1,227	—	1,225	—	—	—	—	—	—
	1/10	1,367	1,344	1,414	1,343	—	1,359	—	—	—	—	—	—
	1/20	1,530	1,467	1,580	1,447	—	1,489	—	—	—	—	—	—
	1/30	1,626	1,537	1,680	1,503	—	1,564	—	—	—	—	—	—
	1/50	1,746	1,625	1,808	1,571	—	1,659	—	—	—	—	—	—
	1/80	1,857	1,706	1,930	1,630	—	1,747	—	—	—	—	—	—
	1/100	1,910	1,744	1,989	1,657	—	1,789	—	—	—	—	—	—
	1/150	2,005	1,813	2,098	1,705	—	1,866	—	—	—	—	—	—
	1/200	2,073	1,862	2,177	1,738	—	1,921	—	—	—	—	—	—
	1/300	2,169	1,931	2,290	1,782	—	2,000	—	—	—	—	—	—
	1/400	2,237	1,980	2,372	1,813	—	2,057	—	—	—	—	—	—
	1/500	2,289	2,018	2,436	1,836	—	2,101	—	—	—	—	—	—
	1/700	2,369	2,076	2,535	1,870	—	2,169	—	—	—	—	—	—
	1/1000	2,453	2,136	2,642	1,905	—	2,242	—	—	—	—	—	—
jackknife	1/2	28	30	28	26	—	35	—	—	—	—	—	—
error estimates	1/3	35	39	33	26	—	30	—	—	—	—	—	—
	1/5	51	53	43	43	—	46	—	—	—	—	—	—
	1/10	77	73	60	84	—	101	—	—	—	—	—	—
	1/20	104	94	81	135	—	172	—	—	—	—	—	—
	1/30	121	106	94	167	—	219	—	—	—	—	—	—
	1/50	142	121	111	210	—	283	—	—	—	—	—	—
	1/80	161	135	128	250	—	347	—	—	—	—	—	—
	1/100	170	141	136	270	—	378	—	—	—	—	—	—
	1/150	187	153	152	306	—	438	—	—	—	—	—	—
	1/200	199	162	163	332	—	482	—	—	—	—	—	—
	1/300	216	174	180	369	—	547	—	—	—	—	—	—
	1/400	228	183	192	395	—	595	—	—	—	—	—	—
	1/500	237	189	201	416	—	633	—	—	—	—	—	—
	1/700	251	199	216	447	—	693	—	—	—	—	—	—
	1/1000	266	210	232	479	—	758	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

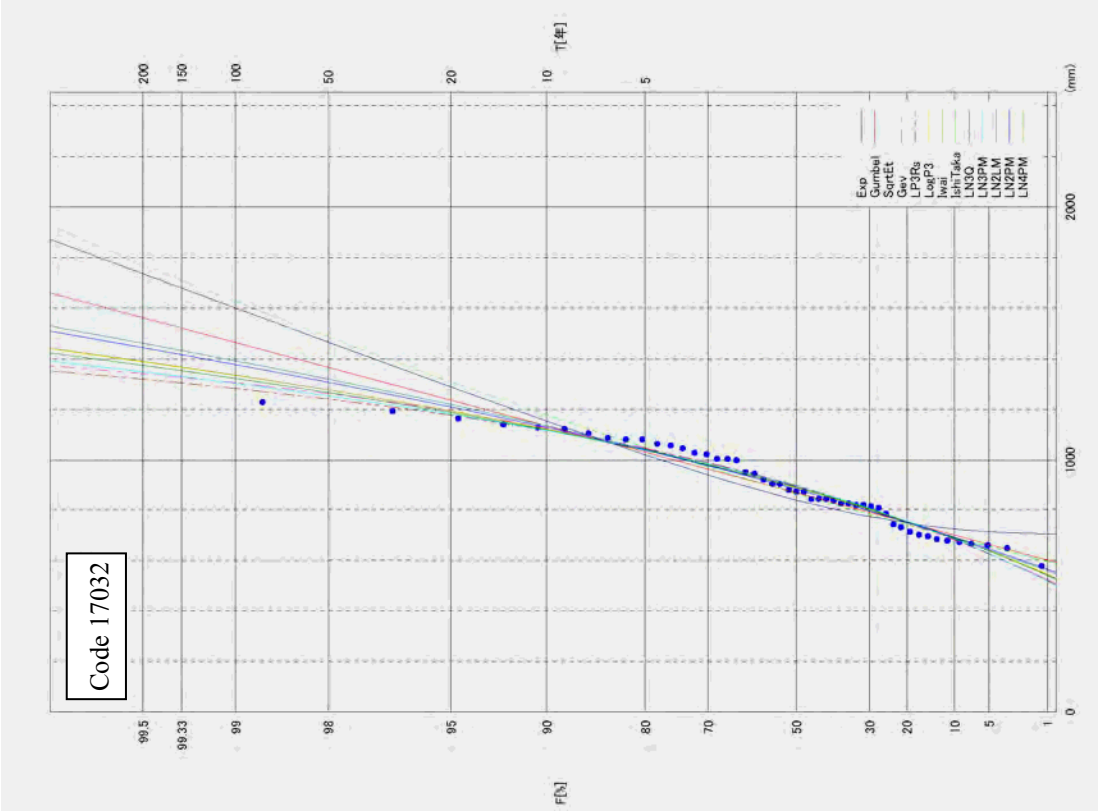

Figure C6.3.74 Probability Distribution on Gumbel Probability Paper (Station code 17032)

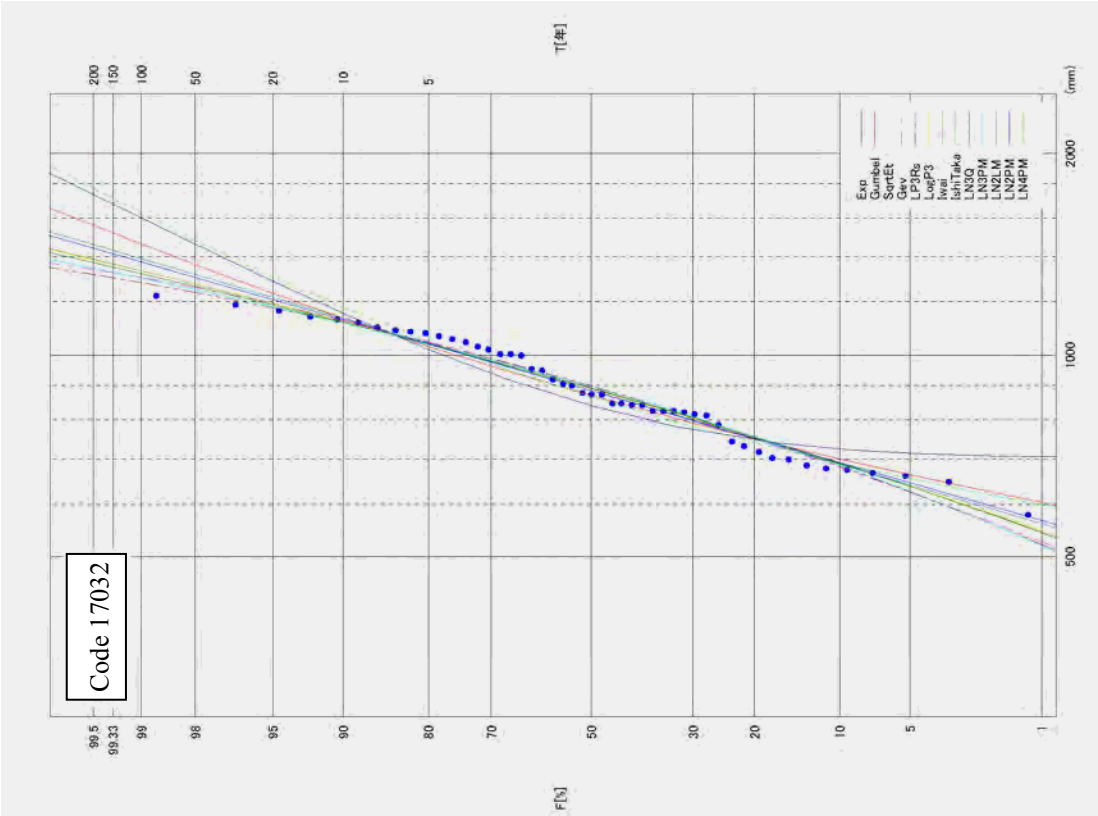

Figure C6.3.75 Probability Distribution on Log-normal Probability Paper (Station code 17032)

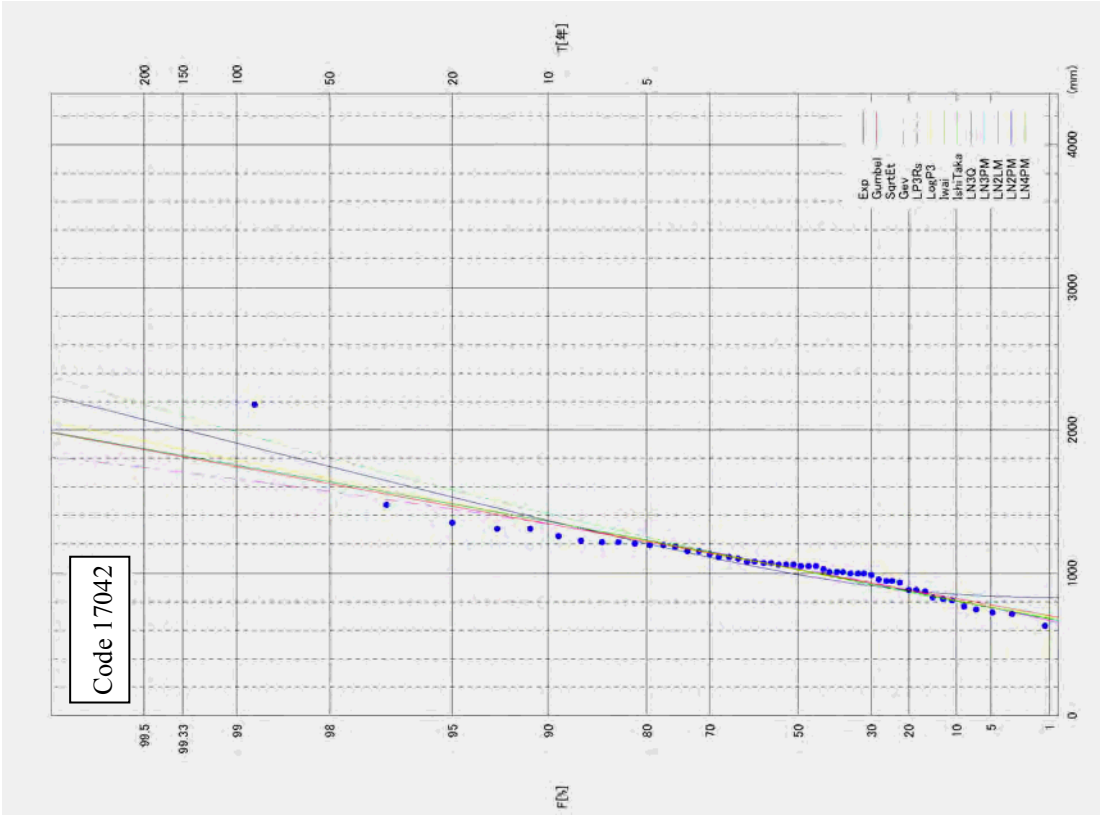

Figure C6.3.76 Probability Distribution on Gumbel Probability Paper (Station code 17042)

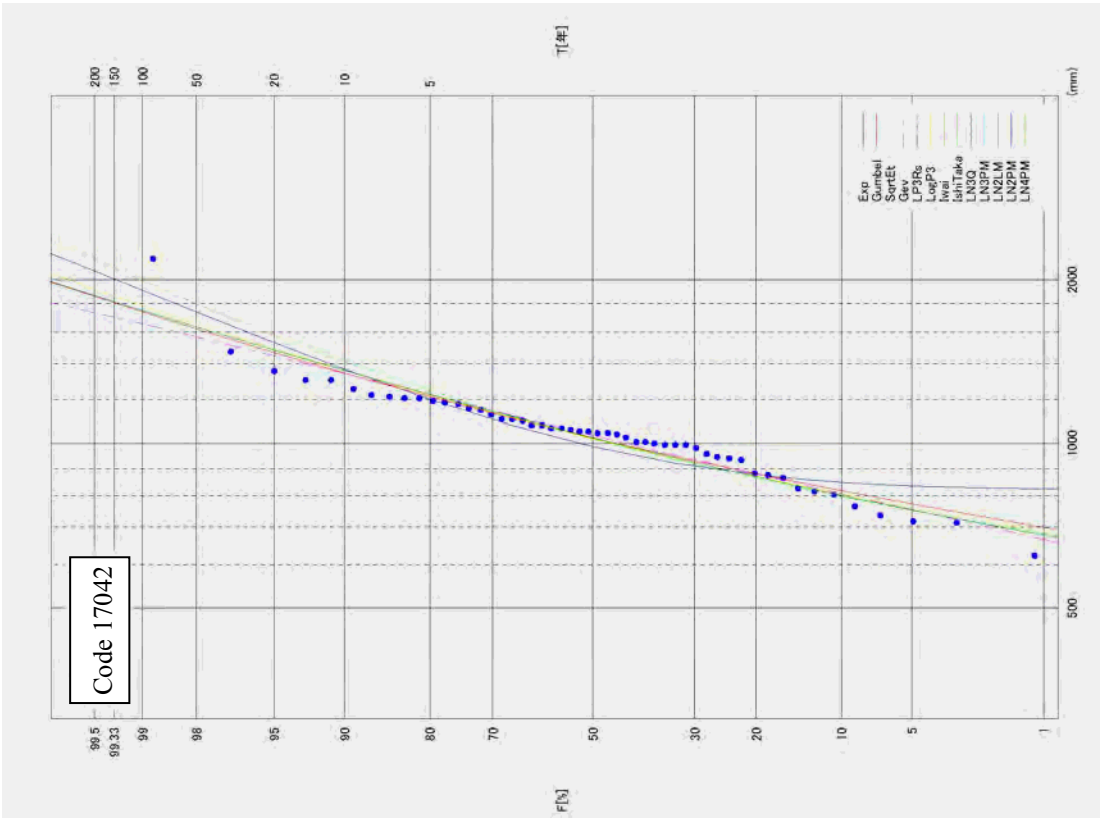

Figure C6.3.77 Probability Distribution on Log-normal Probability Paper (Station code 17042)

Table C 6.3.27 Result of Frequency Analysis of 6-Month Rainfall (18)

Station code 17052

	6months rainfall series (number of sumple N=45)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.947	0.975	0.972	0.972	—	—	—	—	0.974	—	0.974	0.974
P-COR(99%)	0.884	0.991	0.990	0.994	—	—	—	—	0.993	—	0.993	0.993
SLSC(99%)	0.066	0.046	0.048	0.087	—	—	—	—	0.036	—	0.036	0.036
log likelihood	-284.300	-297.200	-297.900	-297.100	—	—	—	—	-296.500	—	-296.600	-296.600
pAIC	572.600	598.300	599.900	600.200	—	—	—	—	599.100	—	597.100	597.200
X-COR(50%)	0.935	0.927	0.938	0.903	—	—	—	—	0.914	—	0.911	0.911
P-COR(50%)	0.978	0.986	0.979	0.988	—	—	—	—	0.988	—	0.989	0.988
SLSC(50%)	0.093	0.089	0.093	0.175	—	—	—	—	0.091	—	0.094	0.094

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	848	880	876	894	—	—	—	—	890	—	893	893
	1/3	931	958	965	975	—	—	—	—	970	—	972	973
	1/5	1,035	1,046	1,068	1,058	—	—	—	—	1,054	—	1,055	1,056
	1/10	1,176	1,157	1,205	1,154	—	—	—	—	1,152	—	1,151	1,153
	1/20	1,317	1,262	1,343	1,237	—	—	—	—	1,241	—	1,238	1,240
	1/30	1,400	1,323	1,426	1,281	—	—	—	—	1,290	—	1,285	1,287
	1/50	1,504	1,399	1,532	1,332	—	—	—	—	1,350	—	1,342	1,345
	1/80	1,600	1,469	1,633	1,376	—	—	—	—	1,403	—	1,393	1,396
	1/100	1,645	1,502	1,682	1,396	—	—	—	—	1,428	—	1,417	1,420
	1/150	1,728	1,562	1,772	1,431	—	—	—	—	1,473	—	1,459	1,463
	1/200	1,787	1,604	1,837	1,454	—	—	—	—	1,504	—	1,489	1,493
	1/300	1,869	1,664	1,931	1,485	—	—	—	—	1,548	—	1,530	1,534
	1/400	1,928	1,707	1,999	1,507	—	—	—	—	1,579	—	1,559	1,563
	1/500	1,974	1,739	2,052	1,523	—	—	—	—	1,603	—	1,581	1,586
	1/700	2,042	1,789	2,134	1,546	—	—	—	—	1,638	—	1,614	1,619
	1/1000	2,115	1,841	2,222	1,569	—	—	—	—	1,676	—	1,649	1,654
jackknife	1/2	26	26	26	30	—	—	—	—	—	—	27	27
error estimates	1/3	29	31	31	32	—	—	—	—	—	—	31	32
	1/5	38	40	41	38	—	—	—	—	—	—	38	40
	1/10	55	52	58	58	—	—	—	—	—	—	48	52
	1/20	72	65	78	88	—	—	—	—	—	—	60	65
	1/30	83	73	90	108	—	—	—	—	—	—	67	73
	1/50	97	83	107	135	—	—	—	—	—	—	75	82
	1/80	110	92	123	161	—	—	—	—	—	—	83	91
	1/100	116	97	130	174	—	—	—	—	—	—	87	95
	1/150	127	105	145	198	—	—	—	—	—	—	94	103
	1/200	135	110	156	215	—	—	—	—	—	—	99	108
	1/300	146	118	171	240	—	—	—	—	—	—	106	116
	1/400	154	124	183	257	—	—	—	—	—	—	111	122
	1/500	160	129	192	271	—	—	—	—	—	—	114	126
	1/700	170	135	206	291	—	—	—	—	—	—	120	132
	1/1000	180	142	221	313	—	—	—	—	—	—	127	139

less than 0.04(SLSC)
minimum value(SLSC)

Station code 17062

	6months rainfall series (number of sumple N=50)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.936	0.977	0.966	0.988	0.988	—	0.987	0.988	0.986	0.988	0.988	0.988
P-COR(99%)	0.959	0.993	0.993	0.994	0.993	—	0.994	0.993	0.994	0.993	0.994	0.993
SLSC(99%)	0.073	0.043	0.048	0.034	0.036	—	0.033	0.035	0.033	0.035	0.033	0.034
log likelihood	-306.600	-318.900	-319.300	-318.700	-319.100	—	-318.800	-319.100	-318.700	-319.100	-318.900	-318.900
pAIC	617.200	641.900	642.600	643.500	644.100	—	643.500	644.100	643.400	644.100	641.900	641.800
X-COR(50%)	0.945	0.958	0.948	0.975	0.979	—	0.971	0.976	0.969	0.976	0.973	0.974
P-COR(50%)	0.977	0.976	0.976	0.981	0.981	—	0.978	0.980	0.977	0.980	0.981	0.979
SLSC(50%)	0.113	0.085	0.095	0.063	0.057	—	0.065	0.059	0.068	0.058	0.059	0.062

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	832	858	854	870	877	—	870	875	868	875	872	872
	1/3	901	924	922	937	941	—	934	939	932	939	938	936
	1/5	987	997	999	1,006	1,005	—	1,001	1,004	999	1,004	1,006	1,002
	1/10	1,105	1,088	1,101	1,086	1,076	—	1,080	1,076	1,079	1,076	1,084	1,078
	1/20	1,222	1,176	1,204	1,156	1,137	—	1,150	1,139	1,150	1,139	1,153	1,144
	1/30	1,291	1,227	1,264	1,193	1,169	—	1,189	1,173	1,190	1,173	1,191	1,180
	1/50	1,377	1,290	1,342	1,237	1,207	—	1,235	1,214	1,238	1,213	1,236	1,224
	1/80	1,457	1,348	1,415	1,274	1,240	—	1,277	1,249	1,281	1,249	1,276	1,262
	1/100	1,495	1,375	1,451	1,291	1,255	—	1,297	1,266	1,302	1,265	1,295	1,280
	1/150	1,563	1,425	1,516	1,321	1,282	—	1,331	1,294	1,338	1,294	1,328	1,312
	1/200	1,612	1,460	1,563	1,341	1,300	—	1,356	1,314	1,363	1,313	1,351	1,334
	1/300	1,681	1,510	1,630	1,367	1,325	—	1,389	1,342	1,398	1,341	1,383	1,364
	1/400	1,729	1,545	1,679	1,386	1,342	—	1,413	1,361	1,423	1,360	1,405	1,386
	1/500	1,767	1,573	1,717	1,399	1,355	—	1,431	1,376	1,442	1,374	1,422	1,402
	1/700	1,824	1,614	1,775	1,419	1,375	—	1,458	1,398	1,471	1,396	1,447	1,426
	1/1000	1,884	1,657	1,838	1,439	1,395	—	1,487	1,420	1,501	1,419	1,474	1,452
jackknife	1/2	20	20	21	27	25	—	26	25	30	25	20	20
error estimates	1/3	21	22	25	30	27	—	27	27	31	27	23	23
	1/5	25	25	31	30	27	—	28	27	29	27	27	26
	1/10	31	30	40	29	28	—	28	28	28	28	32	31
	1/20	39	36	50	31	29	—	31	29	38	29	37	36
	1/30	44	39	56	35	30	—	34	31	47	31	41	39
	1/50	50	44	64	43	33	—	39	34	63	34	45	43
	1/80	55	48	72	53	37	—	44	37	80	37	48	46
	1/100	58	50	75	58	39	—	47	39	88	39	50	48
	1/150	63	53	82	69	43	—	53	43	105	43	53	51
	1/200	67	56	88	77	46	—	58	46	117	46	56	53
	1/300	72	59	95	89	51	—	65	51	135	50	59	56
	1/400	75	62	100	98	55	—	71	54	148	53	61	58
	1/500	78	64	105	105	58	—	75	57	159	56	63	60
	1/700	82	67	111	115	63	—	82	61	176	60	65	62
	1/1000	87	70	118	127	68	—	89	66	194	65	68	65

less than 0.04(SLSC)
minimum value(SLSC)

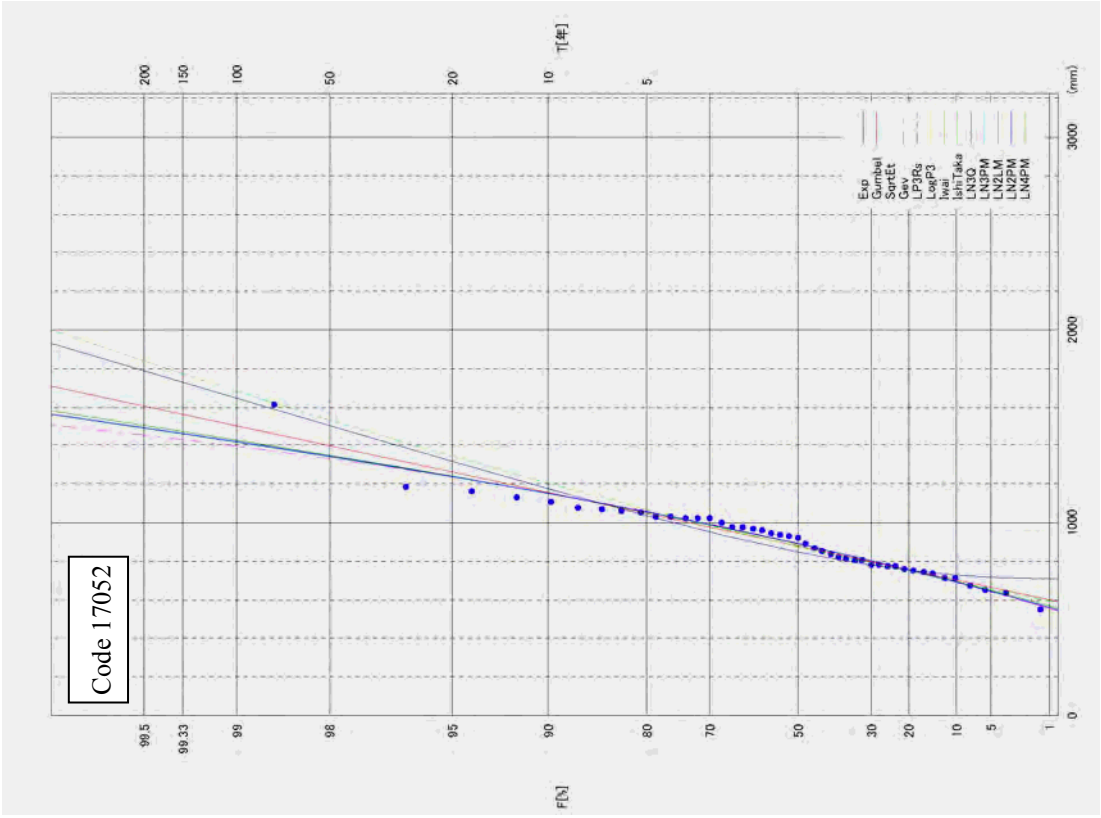

Figure C6.3.78 Probability Distribution on Gumbel Probability Paper (Station code 17052)

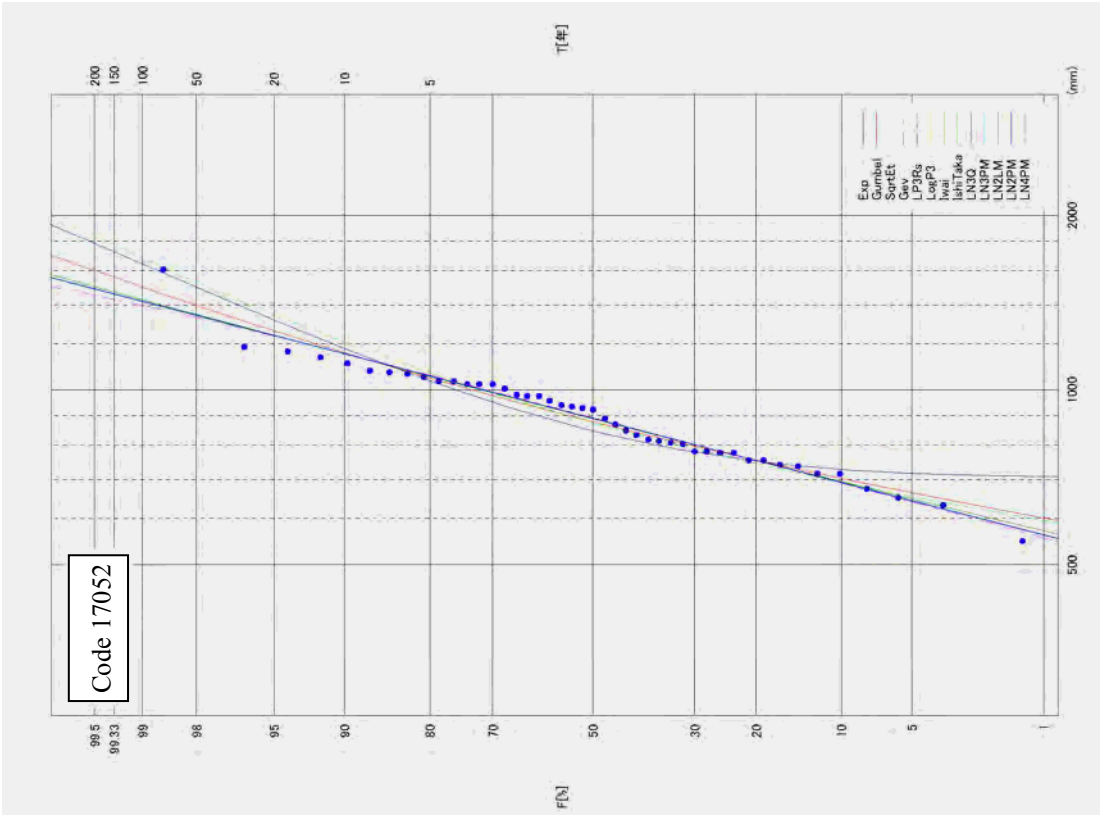

Figure C6.3.79 Probability Distribution on Log-normal Probability Paper (Station code 17052)

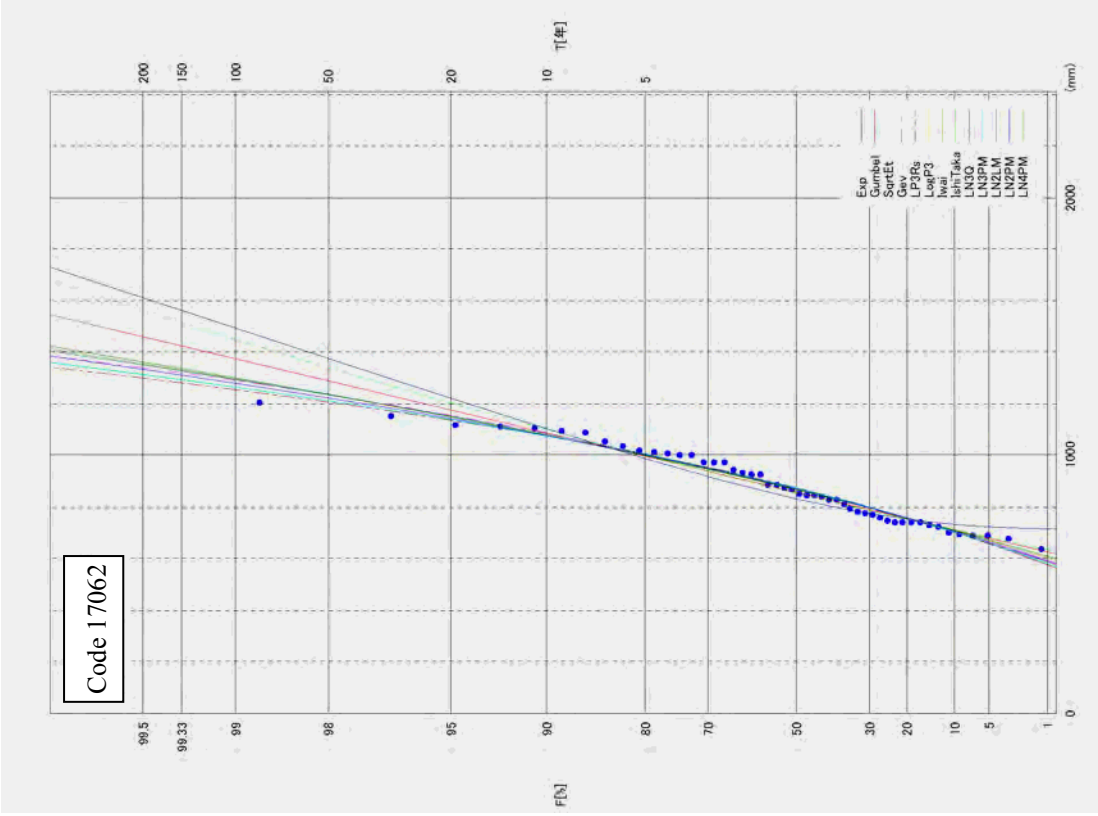

Figure C6.3.80 Probability Distribution on Gumbel Probability Paper (Station code 17062)

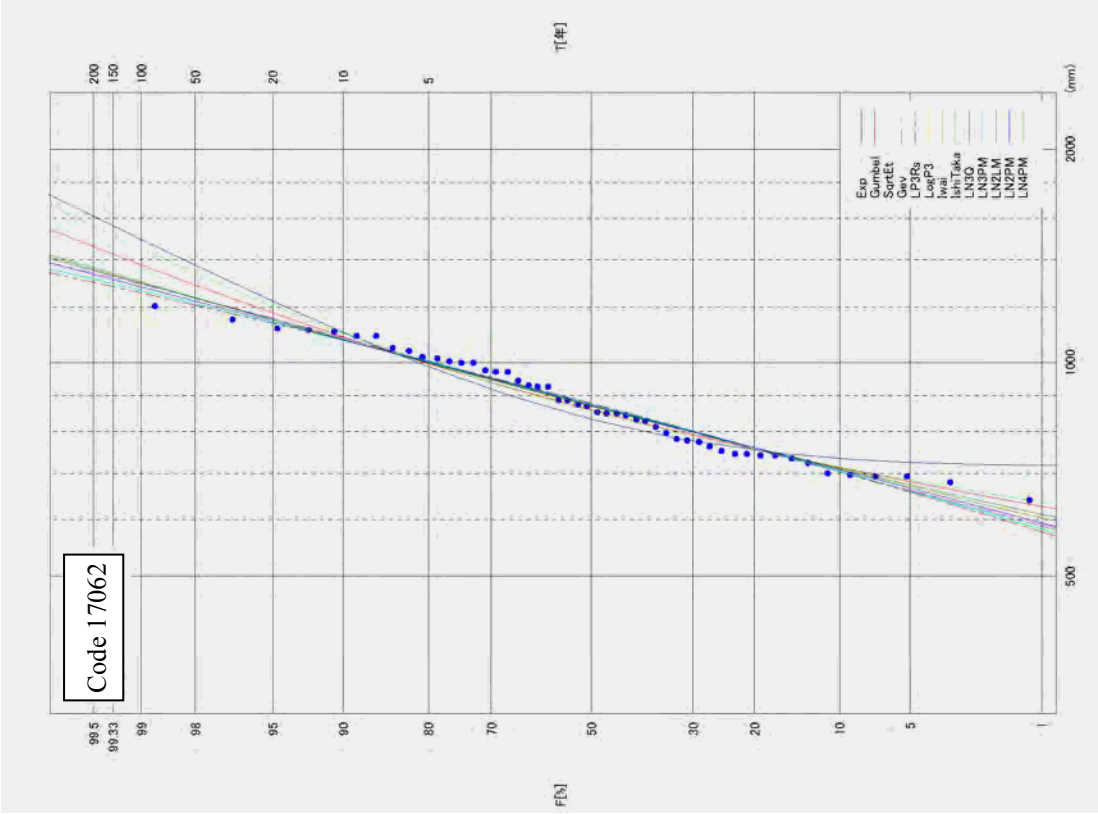

Figure C6.3.81 Probability Distribution on Log-normal Probability Paper (Station code 17062)

Table C 6.3.28 Result of Frequency Analysis of 6-Month Rainfall (19)

Station code 28022

	6months rainfall series (number of sumple N=56)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.934	0.978	0.964	0.986	0.985	—	0.986	0.987	—	0.987	—	—
P-COR(99%)	0.612	0.998	0.995	0.999	0.997	—	0.997	0.998	—	0.998	—	—
SLSC(99%)	0.074	0.042	0.083	0.029	0.059	—	0.038	0.039	—	0.039	—	—
log likelihood	-361.900	-390.800	-389.400	-380.100	-379.500	—	-378.900	-378.900	—	-378.900	—	—
pAIC	727.900	785.600	782.900	766.100	765.100	—	763.800	763.900	—	763.900	—	—
X-COR(50%)	0.991	0.994	0.990	0.993	0.991	—	0.992	0.993	—	0.993	—	—
P-COR(50%)	0.996	0.997	0.989	0.996	0.995	—	0.996	0.996	—	0.996	—	—
SLSC(50%)	0.081	0.042	0.153	0.042	0.048	—	0.043	0.039	—	0.040	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	953	990	999	1,010	1,021	—	1,020	1,018	—	1,018	—	—
	1/3	1,049	1,081	1,137	1,104	1,115	—	1,112	1,111	—	1,111	—	—
	1/5	1,169	1,182	1,300	1,199	1,205	—	1,202	1,201	—	1,201	—	—
	1/10	1,333	1,310	1,519	1,306	1,302	—	1,301	1,301	—	1,301	—	—
	1/20	1,496	1,433	1,743	1,397	1,382	—	1,384	1,386	—	1,386	—	—
	1/30	1,592	1,503	1,879	1,445	1,423	—	1,428	1,431	—	1,431	—	—
	1/50	1,712	1,591	2,055	1,500	1,470	—	1,479	1,485	—	1,484	—	—
	1/80	1,823	1,672	2,222	1,547	1,510	—	1,524	1,531	—	1,530	—	—
	1/100	1,876	1,710	2,304	1,568	1,527	—	1,544	1,552	—	1,551	—	—
	1/150	1,971	1,779	2,455	1,604	1,558	—	1,580	1,589	—	1,588	—	—
	1/200	2,039	1,828	2,565	1,628	1,579	—	1,604	1,614	—	1,613	—	—
	1/300	2,135	1,897	2,723	1,660	1,607	—	1,638	1,649	—	1,648	—	—
	1/400	2,202	1,946	2,838	1,682	1,626	—	1,661	1,673	—	1,672	—	—
	1/500	2,255	1,984	2,929	1,698	1,640	—	1,678	1,691	—	1,690	—	—
	1/700	2,334	2,041	3,069	1,721	1,661	—	1,704	1,718	—	1,717	—	—
	1/1000	2,419	2,102	3,220	1,744	1,682	—	1,731	1,746	—	1,745	—	—
jackknife	1/2	28	28	25	29	1,002	—	—	998	—	32	—	—
error estimates	1/3	29	30	60	33	1,095	—	—	1,089	—	37	—	—
	1/5	35	36	120	38	1,184	—	—	1,178	—	41	—	—
	1/10	49	46	205	47	1,279	—	—	1,276	—	44	—	—
	1/20	65	58	296	63	1,357	—	—	1,359	—	50	—	—
	1/30	74	65	352	75	1,398	—	—	1,403	—	56	—	—
	1/50	87	74	426	94	1,445	—	—	1,455	—	67	—	—
	1/80	99	83	497	113	1,484	—	—	1,500	—	79	—	—
	1/100	105	87	532	123	1,502	—	—	1,521	—	85	—	—
	1/150	115	94	598	143	1,533	—	—	1,558	—	98	—	—
	1/200	123	100	646	157	1,554	—	—	1,583	—	108	—	—
	1/300	133	107	716	178	1,583	—	—	1,618	—	123	—	—
	1/400	141	113	767	194	1,602	—	—	1,642	—	134	—	—
	1/500	147	117	807	206	1,617	—	—	1,661	—	143	—	—
	1/700	155	123	869	225	1,638	—	—	1,688	—	157	—	—
	1/1000	165	130	938	245	1,659	—	—	1,717	—	173	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 28032

	6months rainfall series (number of sumple N=53)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.942	0.985	0.969	0.995	0.995	—	0.994	0.995	0.994	0.995	0.992	0.992
P-COR(99%)	0.927	0.993	0.992	0.996	0.995	—	0.995	0.995	0.995	0.995	0.995	0.995
SLSC(99%)	0.069	0.035	0.049	0.019	0.025	—	0.023	0.023	0.023	0.023	0.023	0.024
log likelihood	-346.800	-361.200	-362.200	-360.300	-360.300	—	-360.400	-360.500	-360.400	-360.500	-360.500	-360.400
pAIC	697.700	726.400	728.400	726.600	726.600	—	726.800	727.000	726.800	727.000	725.000	724.900
X-COR(50%)	0.984	0.990	0.983	0.995	0.994	—	0.994	0.994	0.994	0.994	0.993	0.993
P-COR(50%)	0.987	0.989	0.989	0.991	0.992	—	0.991	0.992	0.991	0.992	0.991	0.991
SLSC(50%)	0.103	0.069	0.097	0.033	0.036	—	0.046	0.038	0.046	0.038	0.055	0.054

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	847	886	879	908	915	—	905	912	905	912	899	899
	1/3	950	985	988	1,010	1,014	—	1,003	1,009	1,002	1,009	1,001	999
	1/5	1,081	1,095	1,116	1,113	1,111	—	1,105	1,107	1,103	1,107	1,109	1,104
	1/10	1,258	1,234	1,287	1,229	1,218	—	1,223	1,217	1,219	1,217	1,238	1,229
	1/20	1,435	1,366	1,461	1,328	1,307	—	1,328	1,313	1,323	1,312	1,355	1,343
	1/30	1,539	1,443	1,566	1,380	1,354	—	1,385	1,364	1,379	1,364	1,420	1,407
	1/50	1,670	1,538	1,702	1,440	1,409	—	1,455	1,425	1,448	1,425	1,501	1,484
	1/80	1,790	1,626	1,831	1,491	1,455	—	1,517	1,479	1,508	1,478	1,572	1,554
	1/100	1,847	1,667	1,894	1,513	1,476	—	1,546	1,504	1,536	1,503	1,606	1,586
	1/150	1,951	1,742	2,010	1,552	1,512	—	1,597	1,548	1,587	1,546	1,667	1,645
	1/200	2,024	1,795	2,094	1,579	1,537	—	1,633	1,578	1,622	1,576	1,709	1,686
	1/300	2,128	1,870	2,216	1,613	1,571	—	1,682	1,620	1,670	1,618	1,769	1,744
	1/400	2,201	1,923	2,304	1,637	1,593	—	1,717	1,649	1,704	1,647	1,811	1,784
	1/500	2,258	1,965	2,373	1,654	1,611	—	1,744	1,671	1,730	1,669	1,843	1,815
	1/700	2,344	2,027	2,480	1,679	1,636	—	1,784	1,704	1,769	1,702	1,892	1,862
	1/1000	2,436	2,093	2,595	1,704	1,662	—	1,826	1,738	1,810	1,736	1,943	1,912
jackknife	1/2	29	30	30	37	35	—	35	35	49	35	30	30
error estimates	1/3	31	33	36	40	38	—	37	37	48	37	33	33
	1/5	37	38	45	41	40	—	40	40	42	40	39	39
	1/10	48	46	60	45	44	—	45	44	39	44	49	48
	1/20	61	55	77	56	51	—	54	51	51	51	60	59
	1/30	69	61	88	66	57	—	62	57	66	57	67	65
	1/50	79	69	103	81	65	—	74	65	88	65	75	73
	1/80	89	75	117	96	74	—	86	73	111	73	83	81
	1/100	93	79	124	104	79	—	93	78	123	77	87	85
	1/150	102	85	137	120	88	—	105	86	146	85	95	92
	1/200	108	89	147	131	95	—	114	92	163	91	100	97
	1/300	117	95	161	147	105	—	128	101	187	99	108	104
	1/400	123	100	171	159	112	—	138	107	205	106	113	109
	1/500	127	103	179	169	118	—	147	113	219	111	118	113
	1/700	135	108	192	183	128	—	159	121	241	119	124	119
	1/1000	142	114	206	198	138	—	173	130	265	127	131	126

less than 0.04(SLSC)
minimum value(SLSC)

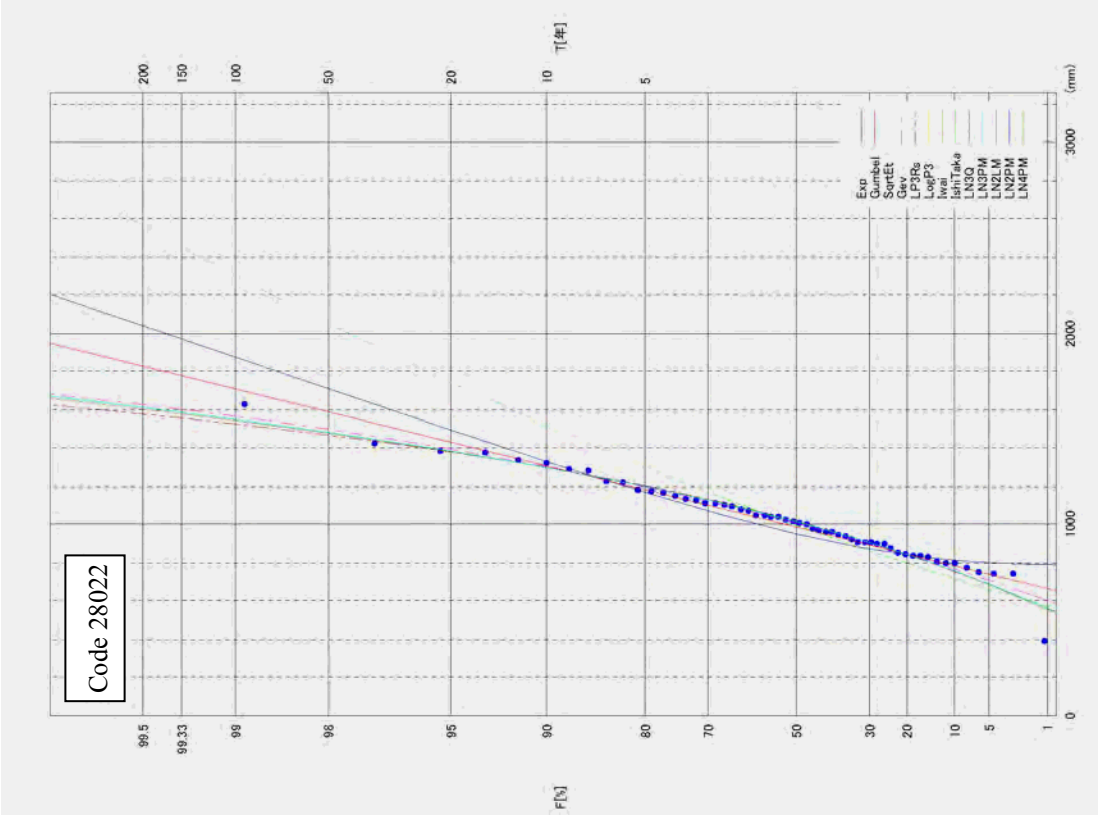

Figure C6.3.82 Probability Distribution on Gumbel Probability Paper (Station code 28022)

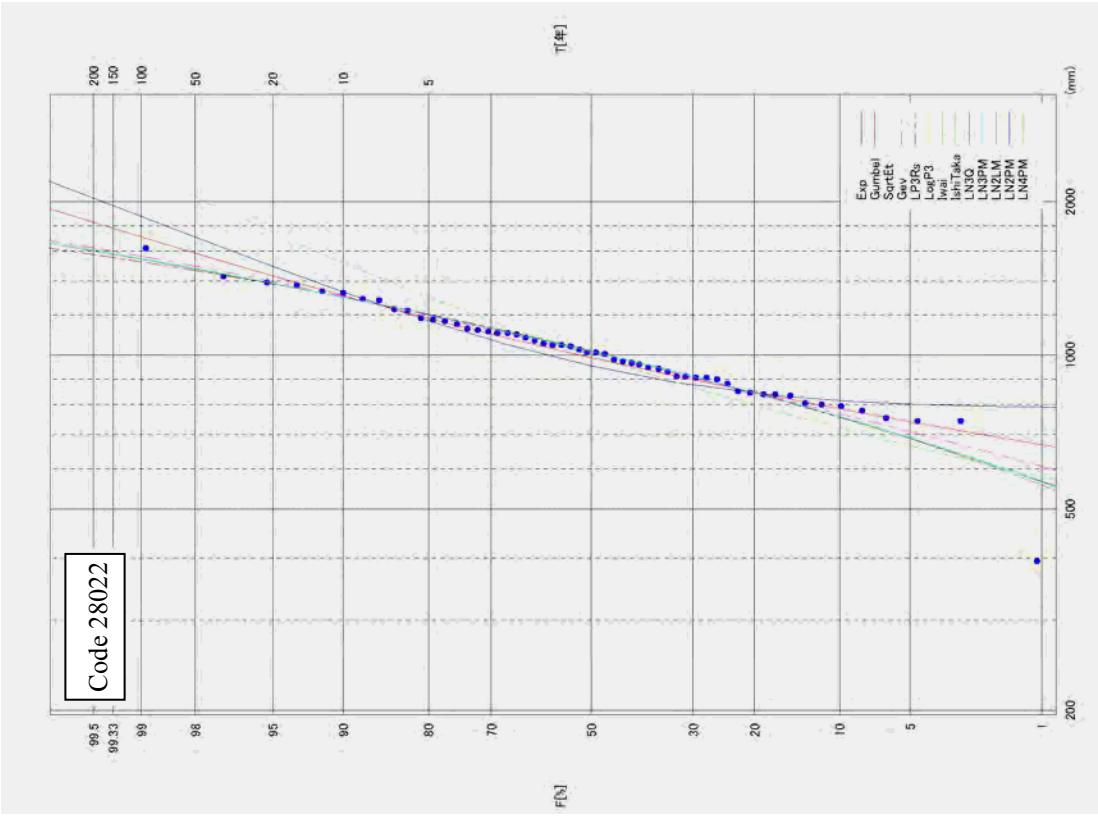

Figure C6.3.83 Probability Distribution on Log-normal Probability Paper (Station code 28022)

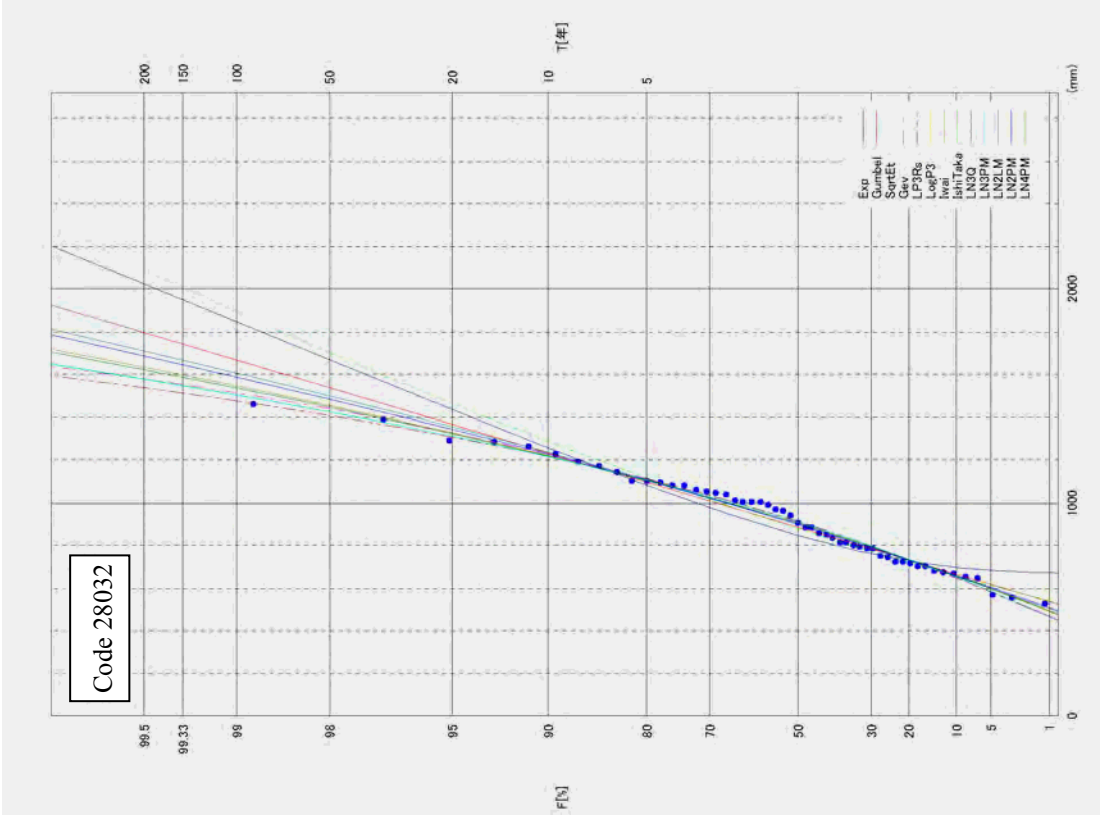

Figure C6.3.84 Probability Distribution on Gumbel Probability Paper (Station code 28032)

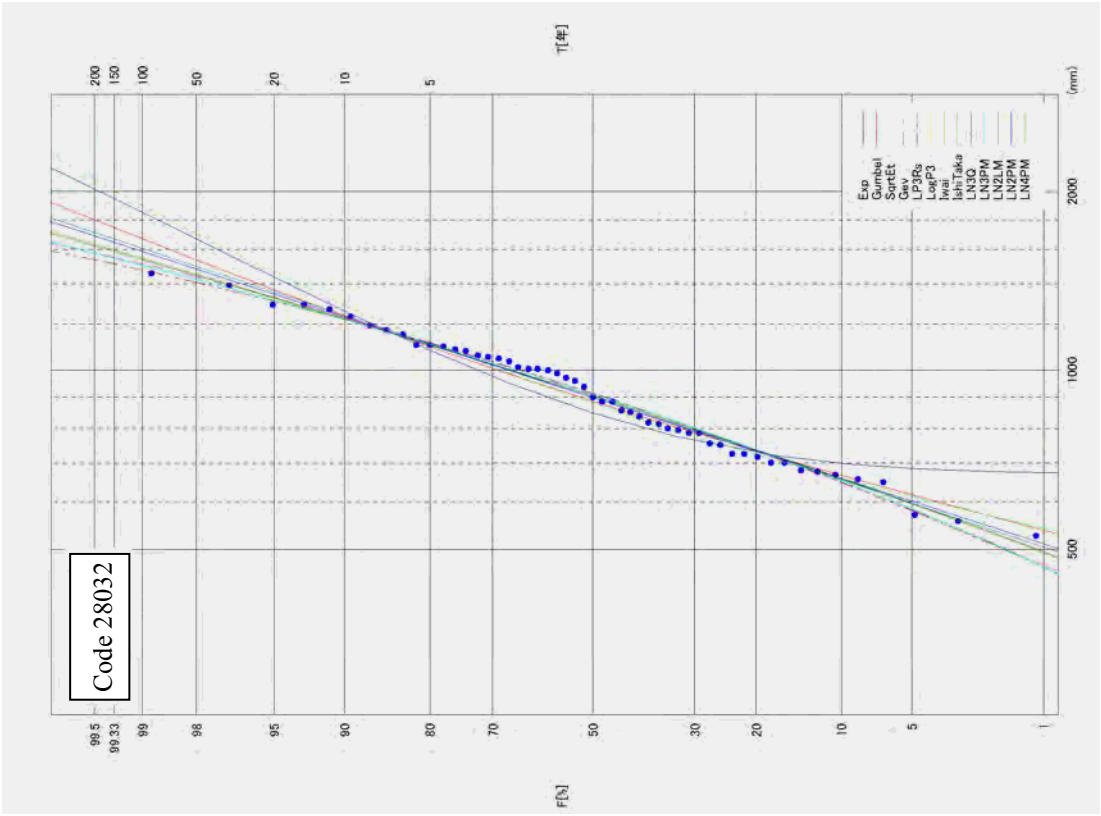

Figure C6.3.85 Probability Distribution on Log-normal Probability Paper (Station code 28032)

Table C 6.3.29 Result of Frequency Analysis of 6-Month Rainfall (20)

Station code 28042

6months rainfall series (number of sumple N=52)

	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.899	0.964	0.941	0.996	0.996	0.996	0.995	—	—	—	—	—
P-COR(99%)	0.798	0.989	0.982	0.997	0.997	0.997	0.997	—	—	—	—	—
SLSC(99%)	0.090	0.053	0.076	0.026	0.020	0.020	0.020	—	—	—	—	—
log likelihood	-346.000	-367.800	-367.900	-360.100	-360.300	-360.200	-360.500	—	—	—	—	—
pAIC	695.900	739.700	739.900	726.300	726.500	726.400	727.000	—	—	—	—	—
X-COR(50%)	0.972	0.979	0.970	0.989	0.988	0.996	0.990	—	—	—	—	—
P-COR(50%)	0.992	0.992	0.990	0.990	0.990	0.997	0.991	—	—	—	—	—
SLSC(50%)	0.115	0.085	0.145	0.050	0.048	0.042	0.037	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,098	1,142	1,142	1,192	1,198	1,196	1,184	—	—	—	—	—
	1/3	1,214	1,253	1,289	1,304	1,308	1,305	1,292	—	—	—	—	—
	1/5	1,360	1,376	1,462	1,407	1,406	1,405	1,396	—	—	—	—	—
	1/10	1,557	1,530	1,693	1,511	1,501	1,504	1,508	—	—	—	—	—
	1/20	1,755	1,678	1,930	1,590	1,572	1,578	1,601	—	—	—	—	—
	1/30	1,871	1,763	2,072	1,627	1,605	1,615	1,650	—	—	—	—	—
	1/50	2,016	1,870	2,257	1,667	1,642	1,654	1,707	—	—	—	—	—
	1/80	2,150	1,967	2,433	1,698	1,670	1,686	1,756	—	—	—	—	—
	1/100	2,214	2,013	2,518	1,711	1,682	1,700	1,778	—	—	—	—	—
	1/150	2,330	2,097	2,677	1,732	1,703	1,723	1,816	—	—	—	—	—
	1/200	2,412	2,156	2,791	1,746	1,716	1,738	1,843	—	—	—	—	—
	1/300	2,527	2,240	2,957	1,763	1,733	1,757	1,879	—	—	—	—	—
	1/400	2,609	2,299	3,077	1,773	1,743	1,770	1,903	—	—	—	—	—
	1/500	2,673	2,345	3,172	1,781	1,751	1,779	1,922	—	—	—	—	—
	1/700	2,769	2,415	3,317	1,792	1,762	1,792	1,949	—	—	—	—	—
	1/1000	2,871	2,488	3,475	1,801	1,773	1,805	1,978	—	—	—	—	—
jackknife	1/2	37	35	37	37	39	40	—	—	—	—	—	—
error estimates	1/3	35	35	39	38	39	39	—	—	—	—	—	—
	1/5	37	38	49	40	40	39	—	—	—	—	—	—
	1/10	48	46	70	46	44	46	—	—	—	—	—	—
	1/20	64	57	96	56	54	57	—	—	—	—	—	—
	1/30	74	64	113	63	62	65	—	—	—	—	—	—
	1/50	87	74	136	73	73	77	—	—	—	—	—	—
	1/80	99	82	158	83	83	88	—	—	—	—	—	—
	1/100	105	87	169	87	89	94	—	—	—	—	—	—
	1/150	116	94	190	95	98	104	—	—	—	—	—	—
	1/200	124	100	206	101	105	111	—	—	—	—	—	—
	1/300	135	108	228	109	115	121	—	—	—	—	—	—
	1/400	143	113	245	114	122	128	—	—	—	—	—	—
	1/500	150	118	258	118	127	134	—	—	—	—	—	—
	1/700	159	125	278	124	135	142	—	—	—	—	—	—
	1/1000	169	132	301	130	143	151	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 28053

6months rainfall series (number of sumple N=55)

	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.878	0.951	0.922	0.995	0.993	—	—	—	—	—	—	—
P-COR(99%)	0.694	0.988	0.980	0.997	0.652	—	—	—	—	—	—	—
SLSC(99%)	0.099	0.063	0.091	0.049	0.029	—	—	—	—	—	—	—
log likelihood	-377.100	-407.600	-404.900	-392.500	—	—	—	—	—	—	—	—
pAIC	758.100	819.200	813.700	791.100	0.000	—	—	—	—	—	—	—
X-COR(50%)	0.969	0.977	0.967	0.986	0.981	—	—	—	—	—	—	—
P-COR(50%)	0.991	0.991	0.987	0.988	0.113	—	—	—	—	—	—	—
SLSC(50%)	0.122	0.093	0.172	0.098	0.074	—	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,363	1,417	1,423	1,487	1,502	—	—	—	—	—	—	—
	1/3	1,505	1,552	1,627	1,623	1,635	—	—	—	—	—	—	—
	1/5	1,683	1,703	1,867	1,745	1,745	—	—	—	—	—	—	—
	1/10	1,925	1,892	2,191	1,863	1,845	—	—	—	—	—	—	—
	1/20	2,167	2,073	2,523	1,948	1,911	—	—	—	—	—	—	—
	1/30	2,309	2,177	2,724	1,987	1,941	—	—	—	—	—	—	—
	1/50	2,487	2,308	2,985	2,028	1,971	—	—	—	—	—	—	—
	1/80	2,651	2,427	3,234	2,059	1,993	—	—	—	—	—	—	—
	1/100	2,729	2,484	3,355	2,072	2,002	—	—	—	—	—	—	—
	1/150	2,871	2,586	3,580	2,093	2,016	—	—	—	—	—	—	—
	1/200	2,971	2,659	3,743	2,106	2,025	—	—	—	—	—	—	—
	1/300	3,113	2,761	3,979	2,122	2,035	—	—	—	—	—	—	—
	1/400	3,213	2,834	4,150	2,131	2,042	—	—	—	—	—	—	—
	1/500	3,291	2,890	4,286	2,138	2,046	—	—	—	—	—	—	—
	1/700	3,409	2,975	4,493	2,147	2,053	—	—	—	—	—	—	—
	1/1000	3,534	3,065	4,718	2,156	2,058	—	—	—	—	—	—	—
jackknife	1/2	46	43	44	45	48	—	—	—	—	—	—	—
error estimates	1/3	41	41	53	45	47	—	—	—	—	—	—	—
	1/5	42	43	88	46	46	—	—	—	—	—	—	—
	1/10	55	53	148	51	52	—	—	—	—	—	—	—
	1/20	74	66	216	61	71	—	—	—	—	—	—	—
	1/30	87	75	258	70	85	—	—	—	—	—	—	—
	1/50	104	87	315	81	104	—	—	—	—	—	—	—
	1/80	119	98	370	92	121	—	—	—	—	—	—	—
	1/100	127	103	397	97	130	—	—	—	—	—	—	—
	1/150	141	113	448	106	144	—	—	—	—	—	—	—
	1/200	151	120	485	112	155	—	—	—	—	—	—	—
	1/300	165	130	540	120	168	—	—	—	—	—	—	—
	1/400	175	137	579	126	178	—	—	—	—	—	—	—
	1/500	183	143	611	130	185	—	—	—	—	—	—	—
	1/700	195	151	660	136	195	—	—	—	—	—	—	—
	1/1000	208	160	714	142	206	—	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

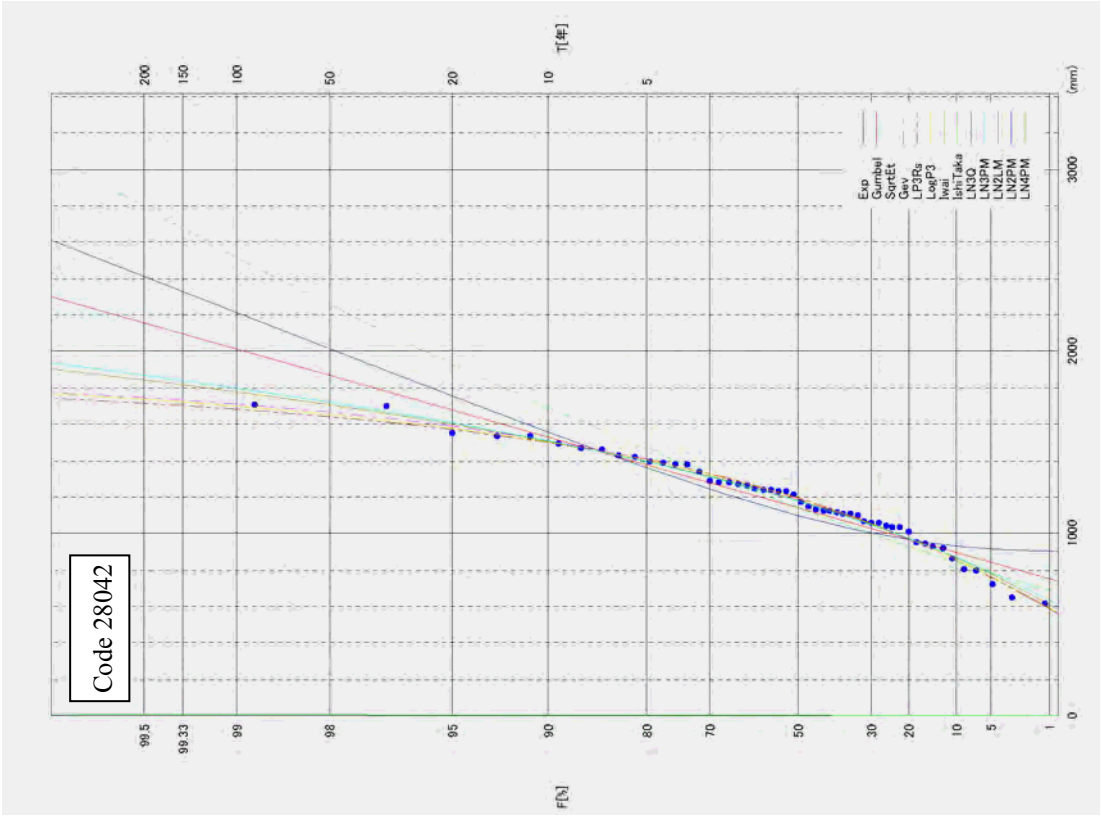

Figure C6.3.86 Probability Distribution on Gumbel Probability Paper (Station code 28042)

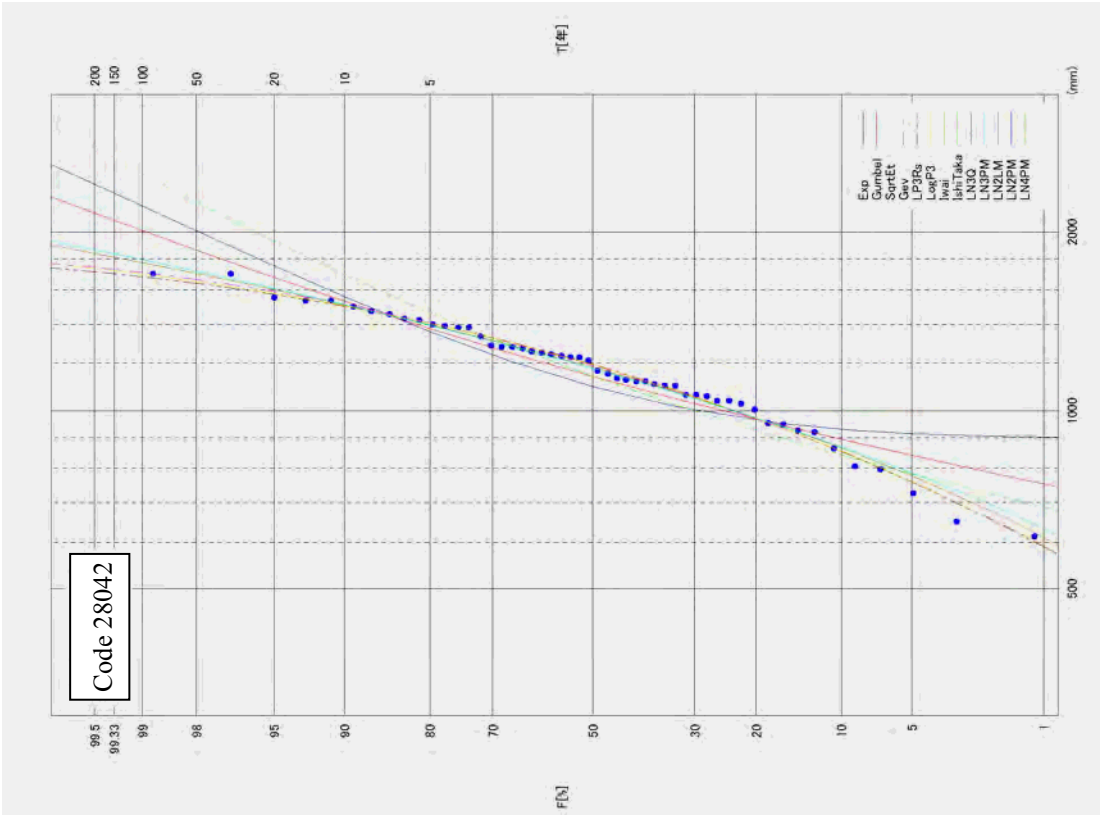

Figure C6.3.87 Probability Distribution on Log-normal Probability Paper (Station code 28042)

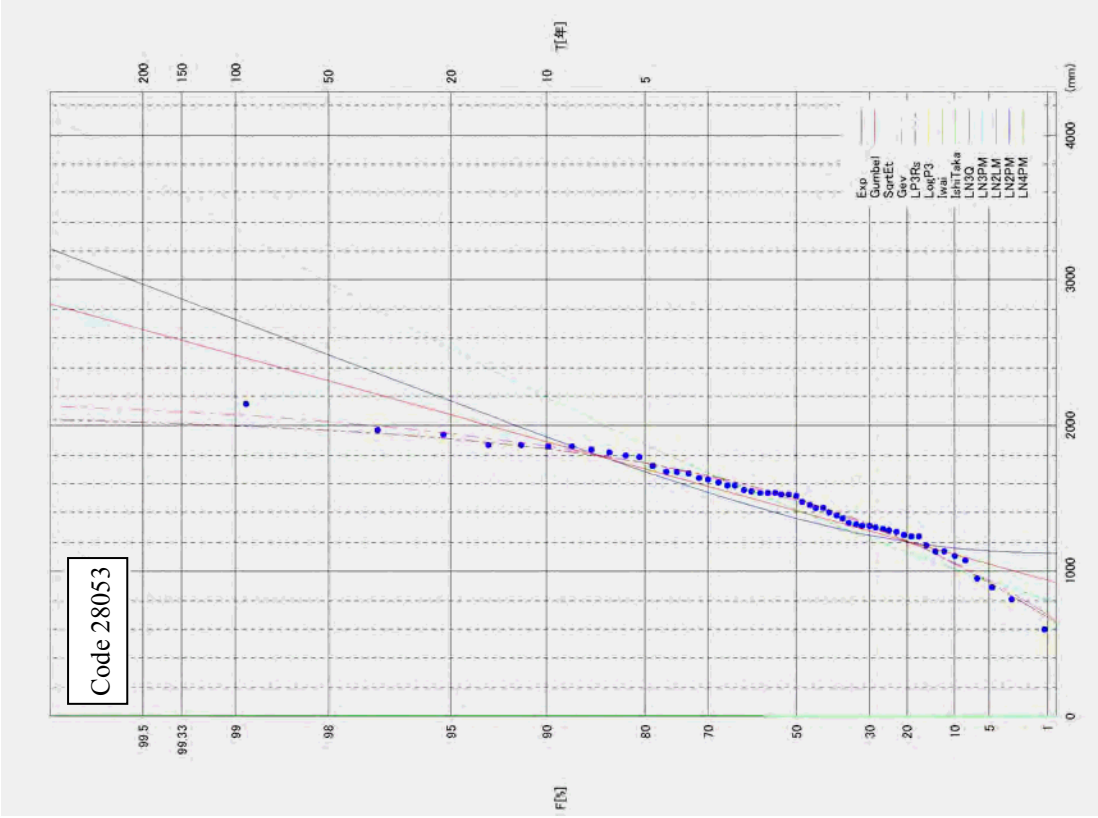

Figure C6.3.88 Probability Distribution on Gumbel Probability Paper (Station code 28053)

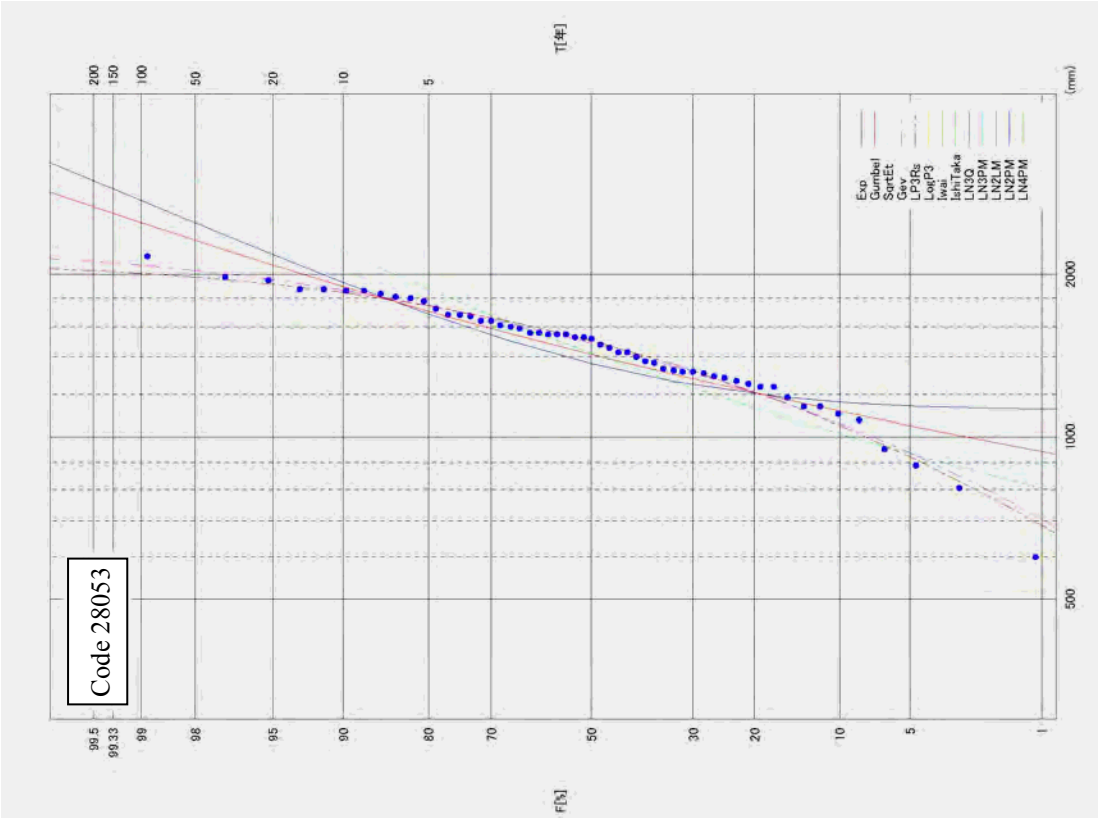

Figure C6.3.89 Probability Distribution on Log-normal Probability Paper (Station code 28053)

Table C 6.3.30 Result of Frequency Analysis of 6-Month Rainfall (21)

Station code 28073

	6months rainfall series (number of sumple N=41)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.926	0.974	0.960	0.991	0.990	—	0.989	0.990	0.985	0.990	0.987	0.987
P-COR(99%)	0.932	0.990	0.989	0.993	0.993	—	0.993	0.992	0.992	0.992	0.993	0.992
SLSC(99%)	0.077	0.045	0.053	0.030	0.033	—	0.031	0.031	0.033	0.031	0.031	0.032
log likelihood	-271.200	-282.400	-282.900	-281.400	-281.500	—	-281.600	-281.600	-281.700	-281.600	-281.600	-281.600
pAIC	546.300	568.700	569.900	568.800	568.900	—	569.200	569.300	569.300	569.300	567.300	567.200
X-COR(50%)	0.951	0.962	0.952	0.981	0.981	—	0.977	0.979	0.971	0.979	0.973	0.973
P-COR(50%)	0.957	0.961	0.963	0.975	0.975	—	0.971	0.972	0.966	0.972	0.970	0.968
SLSC(50%)	0.114	0.086	0.104	0.054	0.056	—	0.059	0.057	0.072	0.057	0.067	0.067

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,194	1,237	1,231	1,266	1,273	—	1,266	1,270	1,252	1,270	1,257	1,257
	1/3	1,305	1,343	1,346	1,375	1,378	—	1,369	1,373	1,357	1,373	1,365	1,362
	1/5	1,445	1,461	1,480	1,483	1,478	—	1,473	1,474	1,468	1,474	1,478	1,471
	1/10	1,635	1,609	1,657	1,602	1,586	—	1,589	1,587	1,599	1,587	1,608	1,598
	1/20	1,825	1,752	1,835	1,700	1,675	—	1,690	1,682	1,717	1,682	1,725	1,710
	1/30	1,937	1,833	1,941	1,751	1,722	—	1,744	1,733	1,783	1,732	1,788	1,772
	1/50	2,077	1,936	2,078	1,808	1,775	—	1,808	1,793	1,863	1,792	1,866	1,846
	1/80	2,206	2,030	2,207	1,856	1,820	—	1,864	1,844	1,934	1,844	1,934	1,912
	1/100	2,267	2,074	2,270	1,877	1,841	—	1,889	1,868	1,968	1,868	1,966	1,943
	1/150	2,378	2,154	2,385	1,912	1,876	—	1,935	1,910	2,028	1,909	2,023	1,998
	1/200	2,457	2,212	2,469	1,936	1,900	—	1,966	1,939	2,070	1,938	2,063	2,036
	1/300	2,568	2,292	2,588	1,967	1,932	—	2,009	1,978	2,129	1,977	2,118	2,089
	1/400	2,647	2,349	2,675	1,987	1,954	—	2,039	2,005	2,170	2,004	2,157	2,126
	1/500	2,708	2,393	2,743	2,002	1,971	—	2,062	2,026	2,202	2,025	2,186	2,155
	1/700	2,800	2,460	2,847	2,024	1,995	—	2,096	2,056	2,249	2,056	2,231	2,197
	1/1000	2,898	2,530	2,960	2,045	2,019	—	2,131	2,088	2,300	2,087	2,278	2,242
jackknife	1/2	36	36	38	47	44	—	52	44	55	44	37	37
error estimates	1/3	38	39	44	50	46	—	51	45	54	45	40	40
	1/5	43	43	54	49	47	—	47	46	47	46	46	45
	1/10	54	52	69	49	48	—	48	48	40	48	55	54
	1/20	67	62	85	56	51	—	59	52	49	52	65	63
	1/30	75	68	96	64	55	—	71	56	62	56	71	69
	1/50	87	75	110	78	61	—	88	62	84	62	79	76
	1/80	97	83	124	94	69	—	106	70	107	69	86	83
	1/100	102	86	131	101	73	—	115	73	119	73	90	86
	1/150	112	93	143	116	82	—	132	81	143	80	97	92
	1/200	118	98	153	127	88	—	145	86	160	85	101	97
	1/300	128	104	166	143	98	—	163	94	186	93	108	103
	1/400	134	109	176	155	105	—	177	100	205	99	113	107
	1/500	140	113	184	163	110	—	188	105	220	104	117	110
	1/700	148	118	196	177	119	—	204	113	243	112	122	116
	1/1000	156	124	209	191	129	—	222	121	269	120	128	121

less than 0.04(SLSC)
minimum value(SLSC)

Station code 39101

	6months rainfall series (number of sumple N=41)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.940	0.979	0.966	0.988	0.988	—	0.988	0.988	0.988	0.988	0.987	0.987
P-COR(99%)	0.914	0.996	0.995	0.995	0.993	—	0.994	0.994	0.994	0.994	0.995	0.995
SLSC(99%)	0.069	0.041	0.048	0.036	0.029	—	0.029	0.029	0.029	0.030	0.028	0.028
log likelihood	-275.000	-285.700	-286.400	-285.200	-285.400	—	-285.400	-285.400	-285.300	-285.400	-285.300	-285.300
pAIC	554.100	575.400	576.800	576.500	576.800	—	576.700	576.800	576.600	576.800	574.700	574.600
X-COR(50%)	0.929	0.942	0.928	0.958	0.964	—	0.959	0.960	0.958	0.960	0.956	0.956
P-COR(50%)	0.983	0.982	0.983	0.982	0.982	—	0.982	0.982	0.982	0.982	0.982	0.982
SLSC(50%)	0.100	0.079	0.093	0.072	0.076	—	0.073	0.073	0.074	0.074	0.069	0.071

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,164	1,211	1,205	1,227	1,242	—	1,235	1,237	1,233	1,237	1,230	1,230
	1/3	1,287	1,328	1,331	1,346	1,358	—	1,351	1,352	1,347	1,352	1,349	1,346
	1/5	1,440	1,457	1,478	1,471	1,474	—	1,469	1,469	1,465	1,470	1,472	1,467
	1/10	1,649	1,621	1,673	1,618	1,604	—	1,605	1,604	1,601	1,604	1,617	1,609
	1/20	1,858	1,777	1,871	1,749	1,715	—	1,724	1,722	1,722	1,721	1,748	1,736
	1/30	1,980	1,867	1,989	1,820	1,775	—	1,790	1,786	1,788	1,785	1,820	1,806
	1/50	2,134	1,979	2,142	1,905	1,845	—	1,868	1,863	1,868	1,862	1,907	1,892
	1/80	2,276	2,082	2,286	1,978	1,905	—	1,938	1,931	1,939	1,929	1,985	1,967
	1/100	2,343	2,131	2,356	2,012	1,933	—	1,970	1,962	1,972	1,960	2,021	2,003
	1/150	2,465	2,220	2,486	2,071	1,982	—	2,027	2,018	2,031	2,016	2,086	2,066
	1/200	2,552	2,282	2,580	2,111	2,016	—	2,067	2,057	2,071	2,054	2,132	2,110
	1/300	2,674	2,371	2,714	2,166	2,062	—	2,123	2,110	2,128	2,108	2,195	2,172
	1/400	2,761	2,433	2,812	2,204	2,093	—	2,161	2,148	2,168	2,145	2,240	2,215
	1/500	2,828	2,482	2,888	2,232	2,117	—	2,191	2,176	2,198	2,173	2,274	2,248
	1/700	2,929	2,555	3,006	2,274	2,153	—	2,235	2,219	2,244	2,216	2,325	2,298
	1/1000	3,037	2,633	3,133	2,317	2,190	—	2,281	2,264	2,292	2,260	2,379	2,350
jackknife	1/2	38	40	40	48	48	—	46	48	45	48	40	40
error estimates	1/3	43	45	47	54	53	—	51	53	49	53	46	45
	1/5	52	53	60	60	57	—	55	56	54	56	56	54
	1/10	68	66	82	64	59	—	60	59	62	59	70	67
	1/20	87	80	106	69	60	—	65	62	71	62	85	80
	1/30	98	88	122	75	62	—	69	64	78	64	94	89
	1/50	113	98	142	86	65	—	76	68	87	68	106	99
	1/80	127	108	163	100	70	—	83	73	97	73	117	109
	1/100	134	113	173	108	72	—	86	76	101	76	122	114
	1/150	146	122	191	124	79	—	94	82	111	81	132	122
	1/200	155	128	205	136	84	—	99	86	118	86	139	129
	1/300	167	137	225	156	93	—	108	94	128	93	149	137
	1/400	176	143	239	170	100	—	115	100	135	98	156	144
	1/500	182	148	251	182	105	—	120	104	141	103	161	149
	1/700	193	155	269	201	114	—	129	112	151	110	169	156
	1/1000	203	163	288	222	125	—	139	120	161	118	178	164

less than 0.04(SLSC)
minimum value(SLSC)

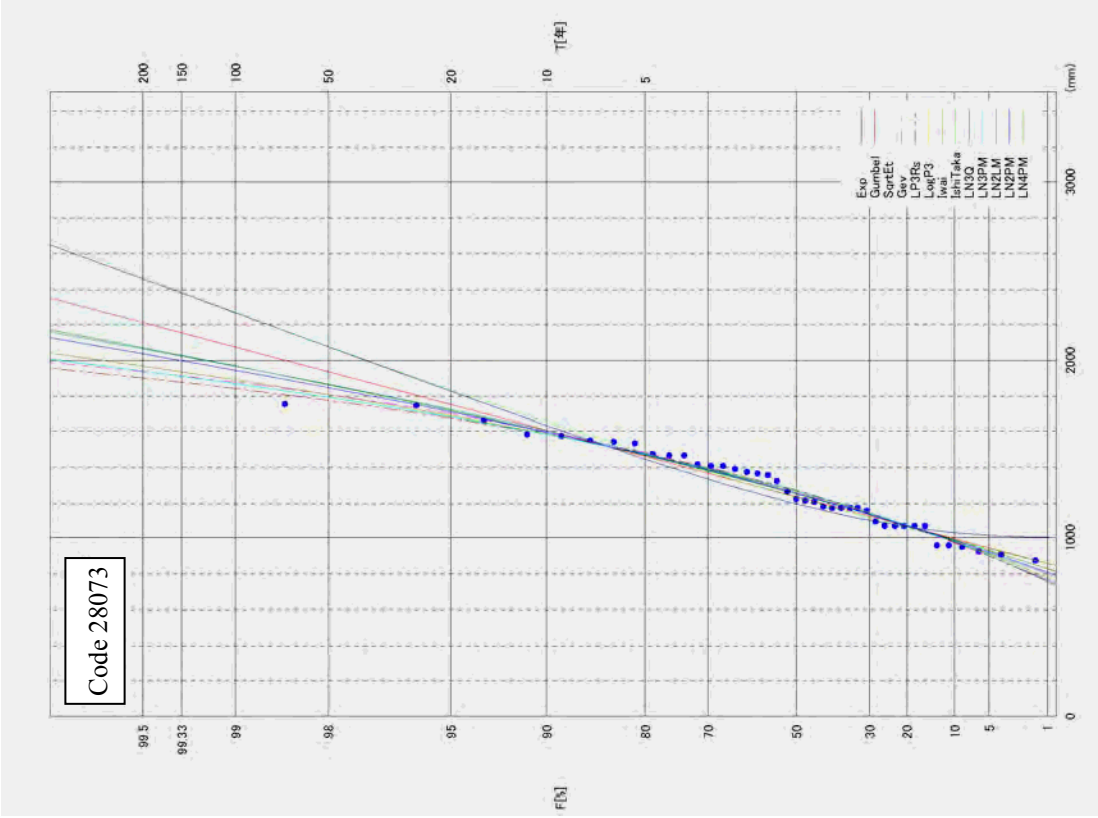

Figure C6.3.90 Probability Distribution on Gumbel Probability Paper (Station code 28073)

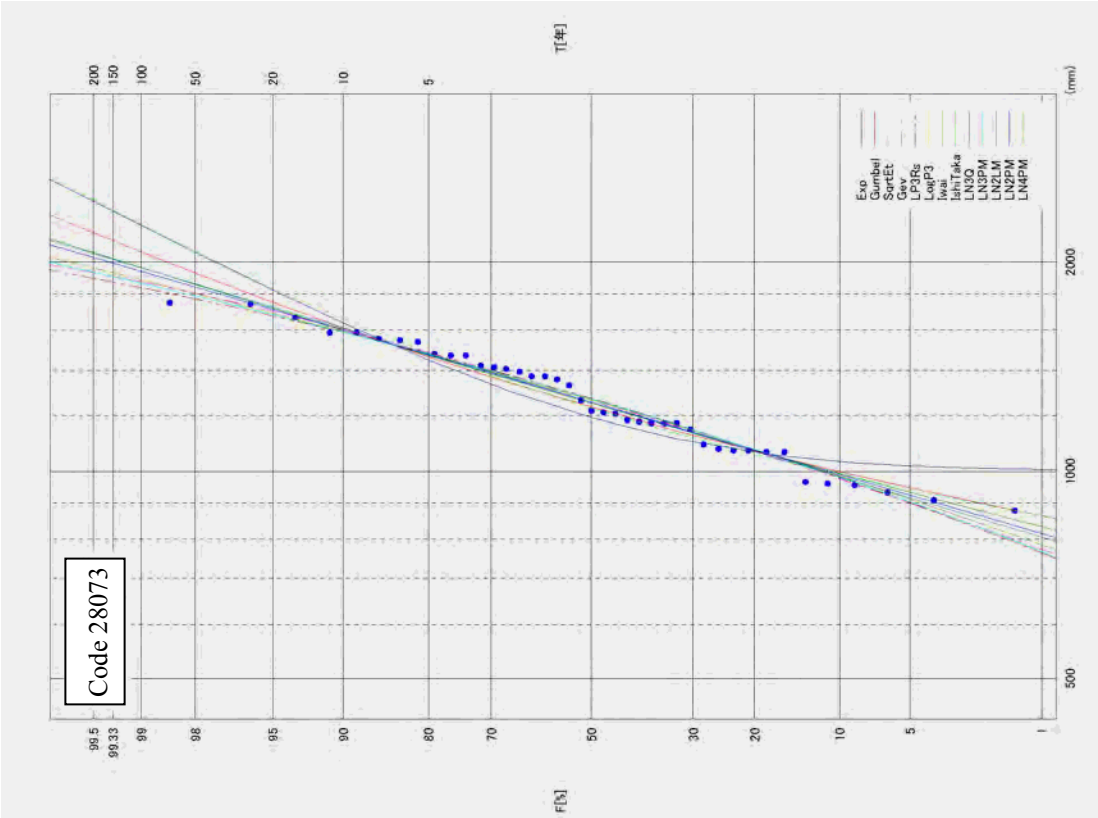

Figure C6.3.91 Probability Distribution on Log-normal Probability Paper (Station code 28073)

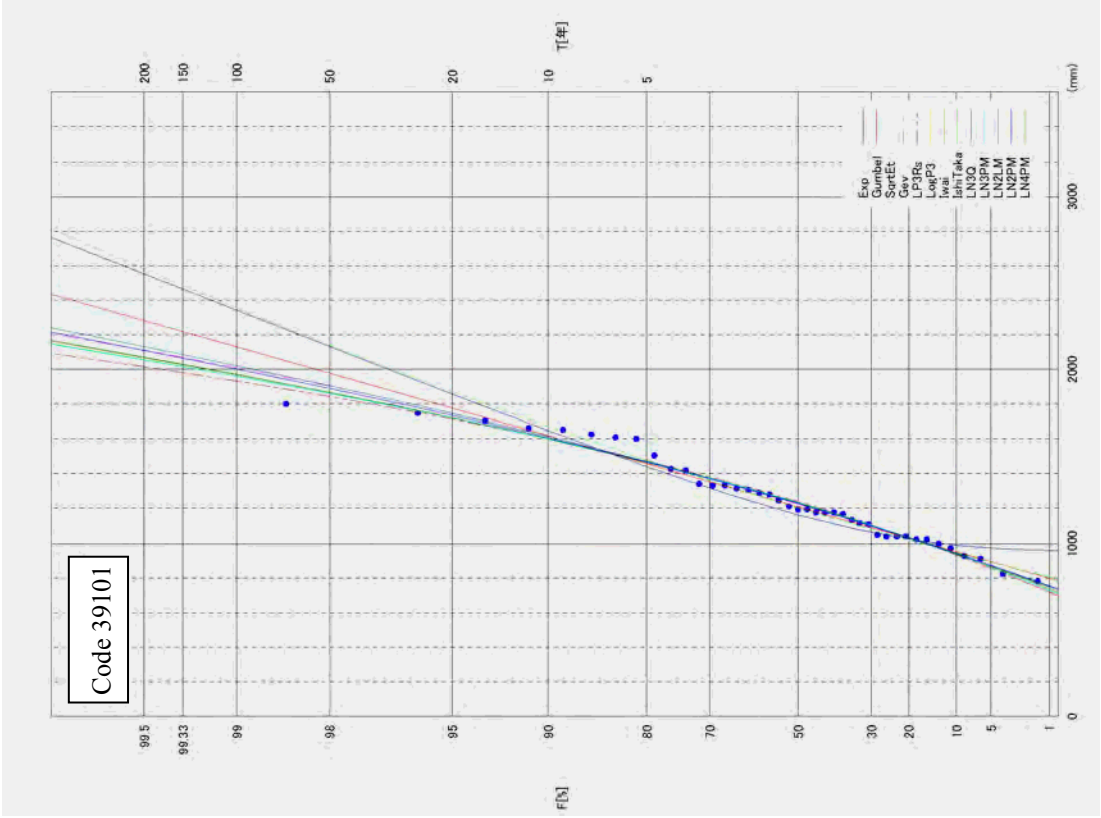

Figure C6.3.92 Probability Distribution on Gumbel Probability Paper (Station code 39101)

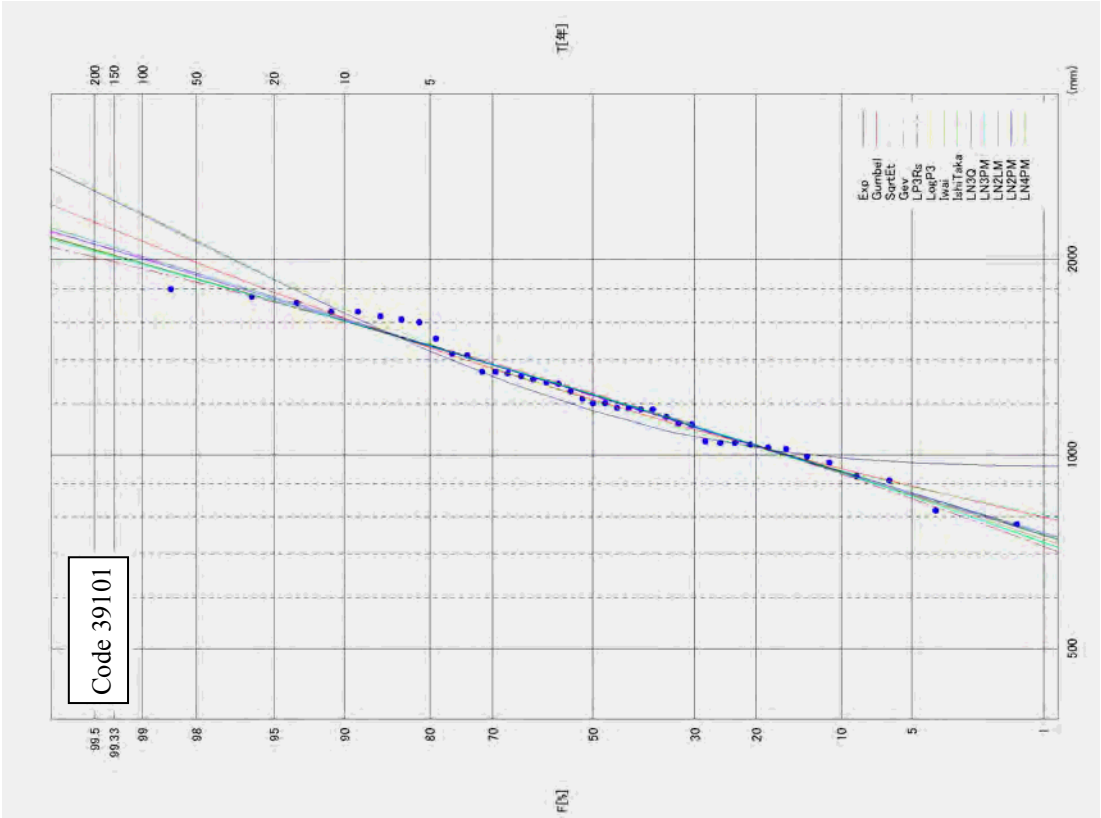

Figure C6.3.93 Probability Distribution on Log-normal Probability Paper (Station code 39101)

Table C 6.3.31 Result of Frequency Analysis of 6-Month Rainfall (22)

Station code 40013

	6months rainfall series (number of sumple N=64)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.896	0.958	0.932	0.985	0.981	—	—	—	—	—	—	—
P-COR(99%)	0.536	0.992	0.985	0.997	0.993	—	—	—	—	—	—	—
SLSC(99%)	0.092	0.058	0.101	0.028	0.065	—	—	—	—	—	—	—
log likelihood	-413.300	-461.200	-451.100	-433.500	-436.600	—	—	—	—	—	—	—
pAIC	830.500	926.500	906.100	873.000	879.200	—	—	—	—	—	—	—
X-COR(50%)	0.978	0.984	0.973	0.992	0.986	—	—	—	—	—	—	—
P-COR(50%)	0.992	0.992	0.985	0.991	0.989	—	—	—	—	—	—	—
SLSC(50%)	0.102	0.067	0.190	0.044	0.094	—	—	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	954	990	1,004	1,025	1,042	—	—	—	—	—	—	—
	1/3	1,049	1,081	1,160	1,118	1,134	—	—	—	—	—	—	—
	1/5	1,169	1,182	1,345	1,206	1,213	—	—	—	—	—	—	—
	1/10	1,331	1,309	1,596	1,297	1,288	—	—	—	—	—	—	—
	1/20	1,494	1,431	1,854	1,368	1,341	—	—	—	—	—	—	—
	1/30	1,589	1,501	2,011	1,403	1,365	—	—	—	—	—	—	—
	1/50	1,709	1,588	2,215	1,441	1,391	—	—	—	—	—	—	—
	1/80	1,819	1,668	2,410	1,471	1,411	—	—	—	—	—	—	—
	1/100	1,871	1,706	2,505	1,484	1,419	—	—	—	—	—	—	—
	1/150	1,966	1,775	2,682	1,506	1,432	—	—	—	—	—	—	—
	1/200	2,034	1,824	2,810	1,520	1,441	—	—	—	—	—	—	—
	1/300	2,129	1,893	2,996	1,537	1,451	—	—	—	—	—	—	—
	1/400	2,196	1,941	3,131	1,549	1,458	—	—	—	—	—	—	—
	1/500	2,248	1,979	3,237	1,557	1,463	—	—	—	—	—	—	—
	1/700	2,327	2,036	3,401	1,568	1,469	—	—	—	—	—	—	—
	1/1000	2,411	2,096	3,579	1,579	1,476	—	—	—	—	—	—	—
jackknife	1/2	28	27	25	27	31	—	—	—	—	—	—	—
error estimates	1/3	26	27	61	29	35	—	—	—	—	—	—	—
	1/5	29	30	125	32	35	—	—	—	—	—	—	—
	1/10	40	38	217	38	38	—	—	—	—	—	—	—
	1/20	54	49	315	49	55	—	—	—	—	—	—	—
	1/30	63	55	376	57	70	—	—	—	—	—	—	—
	1/50	75	63	457	70	91	—	—	—	—	—	—	—
	1/80	86	71	535	82	112	—	—	—	—	—	—	—
	1/100	92	75	574	88	122	—	—	—	—	—	—	—
	1/150	101	82	646	100	142	—	—	—	—	—	—	—
	1/200	108	87	699	108	155	—	—	—	—	—	—	—
	1/300	118	94	776	119	175	—	—	—	—	—	—	—
	1/400	125	99	833	127	189	—	—	—	—	—	—	—
	1/500	131	103	878	133	200	—	—	—	—	—	—	—
	1/700	139	109	947	143	216	—	—	—	—	—	—	—
	1/1000	148	115	1,023	152	234	—	—	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 40022

	6months rainfall series (number of sumple N=53)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.969	0.995	0.988	0.996	0.995	0.996	0.996	0.996	0.996	0.996	0.995	0.995
P-COR(99%)	0.941	0.997	0.995	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
SLSC(99%)	0.052	0.021	0.030	0.019	0.021	0.019	0.019	0.019	0.019	0.020	0.020	0.021
log likelihood	-347.500	-360.300	-360.900	-360.300	—	-360.300	-360.200	-360.300	-360.200	-360.300	-360.400	-360.400
pAIC	698.900	724.700	725.700	726.600	0.000	726.500	726.400	726.500	726.400	726.600	724.900	724.800
X-COR(50%)	0.983	0.987	0.982	0.990	0.991	0.996	0.989	0.990	0.989	0.990	0.990	0.990
P-COR(50%)	0.991	0.990	0.990	0.990	0.990	0.997	0.990	0.990	0.990	0.990	0.990	0.990
SLSC(50%)	0.068	0.038	0.056	0.035	0.043	0.037	0.038	0.040	0.037	0.040	0.042	0.044

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	895	935	927	941	949	942	943	945	940	945	948	948
	1/3	999	1,035	1,031	1,043	1,050	1,042	1,043	1,044	1,039	1,045	1,049	1,048
	1/5	1,132	1,146	1,153	1,152	1,155	1,150	1,151	1,151	1,148	1,151	1,156	1,152
	1/10	1,311	1,286	1,315	1,286	1,279	1,281	1,281	1,278	1,280	1,278	1,281	1,276
	1/20	1,490	1,421	1,480	1,409	1,391	1,403	1,402	1,395	1,405	1,394	1,395	1,387
	1/30	1,595	1,498	1,579	1,478	1,453	1,472	1,470	1,461	1,475	1,459	1,459	1,449
	1/50	1,727	1,594	1,707	1,562	1,528	1,557	1,554	1,541	1,562	1,539	1,536	1,525
	1/80	1,849	1,683	1,828	1,637	1,595	1,635	1,630	1,613	1,641	1,610	1,605	1,593
	1/100	1,907	1,725	1,887	1,672	1,627	1,672	1,666	1,647	1,679	1,644	1,637	1,624
	1/150	2,012	1,801	1,995	1,734	1,683	1,739	1,730	1,709	1,747	1,704	1,695	1,681
	1/200	2,086	1,855	2,074	1,778	1,722	1,786	1,776	1,752	1,795	1,746	1,736	1,721
	1/300	2,191	1,930	2,188	1,838	1,777	1,853	1,840	1,812	1,862	1,806	1,793	1,776
	1/400	2,265	1,984	2,270	1,880	1,815	1,900	1,885	1,855	1,910	1,848	1,833	1,815
	1/500	2,323	2,026	2,334	1,912	1,845	1,937	1,920	1,888	1,948	1,880	1,864	1,845
	1/700	2,410	2,089	2,433	1,960	1,889	1,993	1,973	1,937	2,004	1,929	1,910	1,890
	1/1000	2,502	2,155	2,541	2,009	1,936	2,052	2,029	1,990	2,064	1,980	1,959	1,938
jackknife	1/2	28	30	30	33	—	33	30	34	32	34	30	30
error estimates	1/3	33	35	36	38	—	38	32	39	36	39	36	36
	1/5	43	44	46	45	—	44	41	46	43	45	45	44
	1/10	59	56	60	57	—	56	66	55	59	55	57	55
	1/20	76	69	77	75	—	71	101	67	80	67	71	68
	1/30	87	77	87	88	—	82	123	76	94	76	79	75
	1/50	100	87	101	108	—	98	155	88	113	88	89	85
	1/80	113	96	115	130	—	114	185	101	132	100	99	93
	1/100	119	100	121	141	—	123	201	107	142	106	103	98
	1/150	130	108	134	162	—	139	230	120	160	118	112	105
	1/200	138	113	143	178	—	151	251	129	173	127	118	111
	1/300	149	121	156	203	—	170	282	143	193	140	126	119
	1/400	156	127	166	221	—	184	305	153	207	150	133	125
	1/500	163	131	174	235	—	195	323	161	218	158	138	129
	1/700	172	138	186	258	—	213	351	174	236	170	145	136
	1/1000	181	145	199	284	—	232	382	188	255	183	153	143

less than 0.04(SLSC)
minimum value(SLSC)

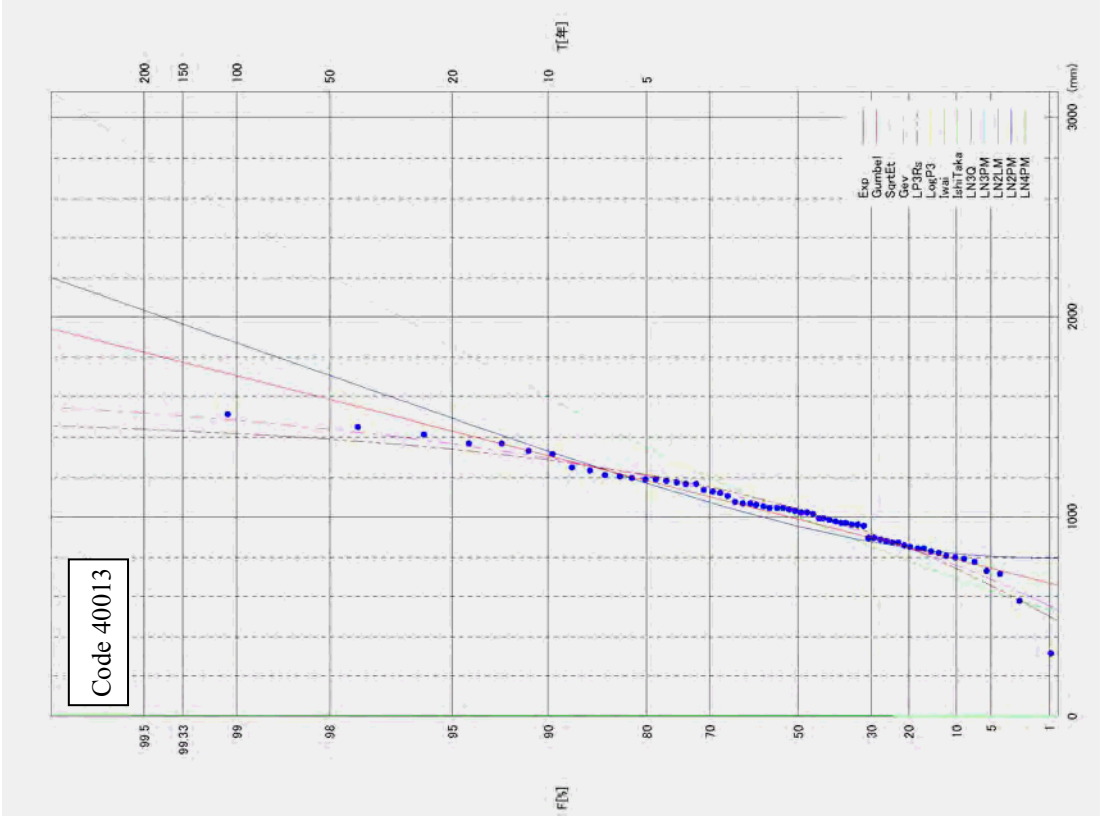

Figure C6.3.94 Probability Distribution on Gumbel Probability Paper (Station code 40013)

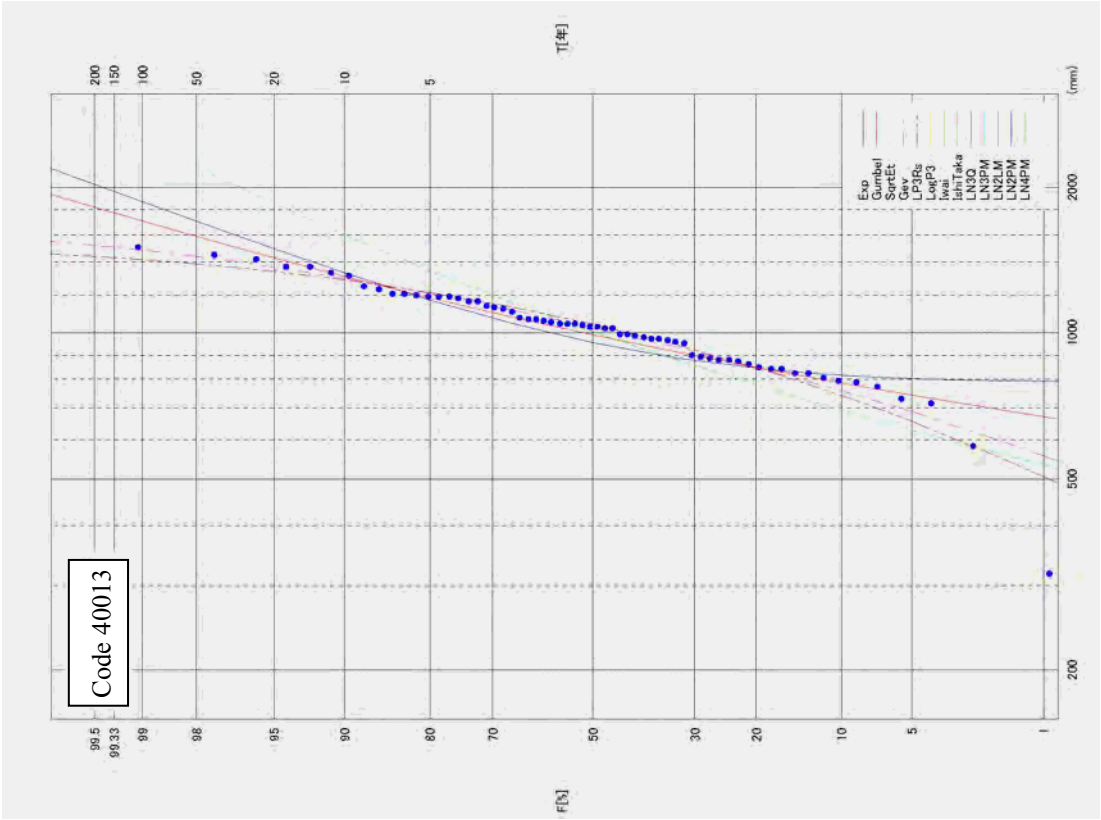

Figure C6.3.95 Probability Distribution on Log-normal Probability Paper (Station code 40013)

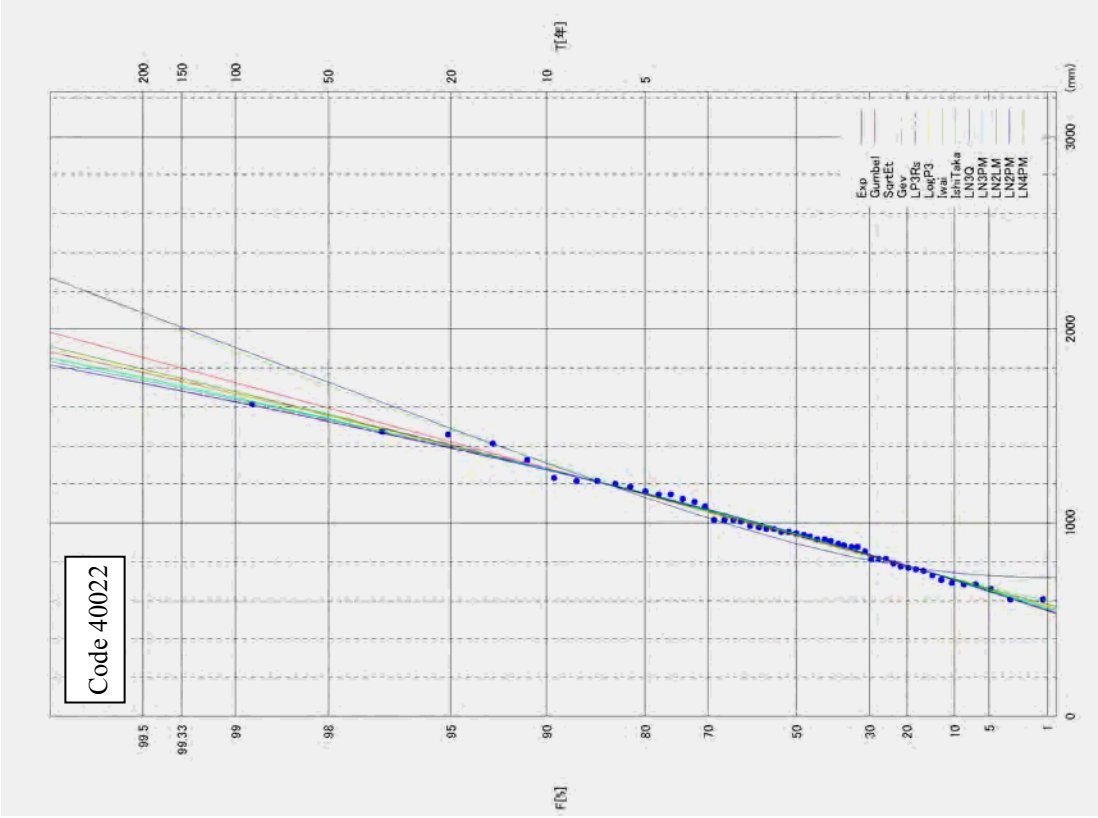

Figure C6.3.96 Probability Distribution on Gumbel Probability Paper (Station code 40022)

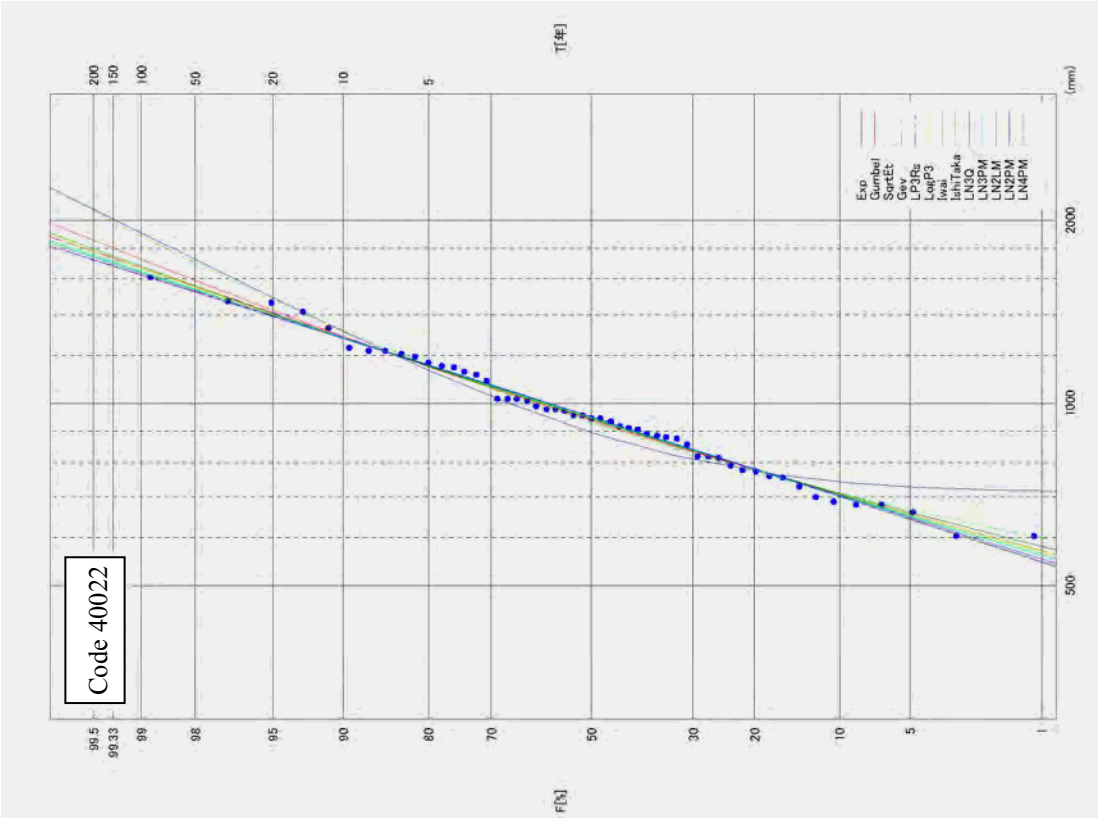

Figure C6.3.97 Probability Distribution on Log-normal Probability Paper (Station code 40022)

Table C 6.3.32 Result of Frequency Analysis of 6-Month Rainfall (23)

Station code 40032

	6months rainfall series (number of sumple N=53)											
	Exponential distribution	Gumbel Distribution	squre-root exponential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.991	0.988	0.994	0.994	—	0.994	0.991	0.994	0.994	0.994	—	—
P-COR(99%)	0.954	0.992	0.996	0.997	—	0.996	0.994	0.996	0.995	0.996	—	—
SLSC(99%)	0.028	0.034	0.023	0.022	—	0.023	0.026	0.032	0.027	0.030	—	—
log likelihood	-369.300	-380.300	-379.500	-379.600	—	-379.600	-379.700	-379.900	-379.600	-379.700	—	—
pAIC	742.700	764.600	763.000	765.200	—	765.200	765.400	765.700	765.300	765.400	—	—
X-COR(50%)	0.993	0.993	0.991	0.989	—	0.994	0.993	0.992	0.992	0.992	—	—
P-COR(50%)	0.993	0.992	0.993	0.993	—	0.996	0.992	0.993	0.993	0.993	—	—
SLSC(50%)	0.028	0.064	0.041	0.036	—	0.040	0.059	0.043	0.043	0.044	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,035	1,095	1,075	1,066	—	1,073	1,087	1,072	1,074	1,073	—	—
	1/3	1,193	1,246	1,220	1,209	—	1,220	1,235	1,218	1,224	1,220	—	—
	1/5	1,393	1,415	1,391	1,381	—	1,394	1,404	1,392	1,399	1,394	—	—
	1/10	1,664	1,626	1,621	1,619	—	1,628	1,619	1,622	1,632	1,624	—	—
	1/20	1,935	1,829	1,856	1,873	—	1,867	1,828	1,856	1,865	1,856	—	—
	1/30	2,093	1,946	1,998	2,031	—	2,013	1,950	1,995	2,005	1,994	—	—
	1/50	2,293	2,092	2,182	2,242	—	2,203	2,104	2,176	2,184	2,172	—	—
	1/80	2,477	2,226	2,357	2,450	—	2,386	2,247	2,347	2,353	2,340	—	—
	1/100	2,564	2,289	2,442	2,553	—	2,476	2,316	2,430	2,434	2,422	—	—
	1/150	2,723	2,404	2,600	2,749	—	2,644	2,441	2,583	2,586	2,573	—	—
	1/200	2,835	2,485	2,715	2,895	—	2,768	2,531	2,695	2,695	2,682	—	—
	1/300	2,994	2,600	2,880	3,111	—	2,949	2,660	2,856	2,853	2,840	—	—
	1/400	3,106	2,681	3,000	3,272	—	3,082	2,752	2,973	2,967	2,954	—	—
	1/500	3,193	2,744	3,095	3,401	—	3,189	2,824	3,065	3,058	3,044	—	—
	1/700	3,325	2,839	3,240	3,605	—	3,354	2,934	3,207	3,196	3,183	—	—
	1/1000	3,464	2,940	3,398	3,831	—	3,536	3,052	3,361	3,346	3,333	—	—
jackknife	1/2	40	45	42	43	—	45	41	50	41	50	—	—
error estimates	1/3	55	61	54	56	—	58	56	67	53	68	—	—
	1/5	80	82	72	75	—	77	76	86	76	87	—	—
	1/10	116	111	99	108	—	109	109	112	118	113	—	—
	1/20	153	138	129	154	—	152	148	144	170	144	—	—
	1/30	175	155	148	190	—	183	174	166	204	166	—	—
	1/50	203	175	173	245	—	228	210	198	252	198	—	—
	1/80	229	194	198	307	—	277	246	233	300	233	—	—
	1/100	241	203	210	341	—	303	265	251	324	251	—	—
	1/150	264	219	232	411	—	354	300	288	371	287	—	—
	1/200	280	230	249	467	—	394	326	316	405	316	—	—
	1/300	302	247	273	556	—	455	366	359	457	359	—	—
	1/400	318	258	291	626	—	503	395	392	495	392	—	—
	1/500	331	267	305	686	—	542	419	419	526	419	—	—
	1/700	349	280	327	784	—	606	456	462	574	462	—	—
	1/1000	369	295	351	899	—	679	497	511	627	511	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 40052

	6months rainfall series (number of sumple N=47)											
	Exponential distribution	Gumbel Distribution	squre-root exponential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.957	0.985	0.980	0.983	0.984	0.974	0.982	—	0.983	—	—	—
P-COR(99%)	0.779	0.996	0.991	0.996	0.996	0.994	0.996	—	0.996	—	—	—
SLSC(99%)	0.060	0.036	0.059	0.048	0.049	0.044	0.040	—	0.041	—	—	—
log likelihood	-315.000	-331.500	-333.200	-329.400	—	-330.400	-329.000	—	-329.100	—	—	—
pAIC	634.000	667.000	670.300	664.800	0.000	666.900	664.100	—	664.300	—	—	—
X-COR(50%)	0.982	0.979	0.986	0.969	0.973	0.974	0.969	—	0.970	—	—	—
P-COR(50%)	0.979	0.983	0.979	0.985	0.985	0.994	0.986	—	0.986	—	—	—
SLSC(50%)	0.060	0.049	0.103	0.090	0.054	0.096	0.065	—	0.062	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	962	1,009	1,007	1,024	1,020	1,045	1,029	—	1,027	—	—	—
	1/3	1,084	1,124	1,157	1,142	1,140	1,164	1,150	—	1,146	—	—	—
	1/5	1,237	1,253	1,334	1,267	1,268	1,281	1,274	—	1,271	—	—	—
	1/10	1,444	1,416	1,574	1,414	1,420	1,407	1,418	—	1,417	—	—	—
	1/20	1,652	1,571	1,820	1,545	1,559	1,510	1,547	—	1,548	—	—	—
	1/30	1,773	1,661	1,969	1,616	1,637	1,564	1,617	—	1,620	—	—	—
	1/50	1,926	1,772	2,163	1,701	1,732	1,625	1,703	—	1,707	—	—	—
	1/80	2,067	1,875	2,348	1,776	1,818	1,677	1,778	—	1,785	—	—	—
	1/100	2,134	1,923	2,438	1,810	1,858	1,700	1,813	—	1,821	—	—	—
	1/150	2,255	2,011	2,606	1,870	1,931	1,740	1,876	—	1,886	—	—	—
	1/200	2,342	2,074	2,728	1,911	1,982	1,767	1,920	—	1,931	—	—	—
	1/300	2,463	2,161	2,903	1,967	2,053	1,804	1,981	—	1,994	—	—	—
	1/400	2,549	2,224	3,031	2,006	2,103	1,828	2,023	—	2,038	—	—	—
	1/500	2,616	2,272	3,132	2,035	2,142	1,847	2,056	—	2,072	—	—	—
	1/700	2,717	2,345	3,287	2,077	2,201	1,873	2,105	—	2,123	—	—	—
	1/1000	2,824	2,422	3,455	2,121	2,263	1,901	2,156	—	2,177	—	—	—
jackknife	1/2	37	38	38	38	—	40	35	—	35	—	—	—
error estimates	1/3	42	45	44	43	—	46	41	—	39	—	—	—
	1/5	56	57	66	55	—	60	57	—	57	—	—	—
	1/10	80	76	107	81	—	91	93	—	93	—	—	—
	1/20	107	96	153	120	—	134	137	—	133	—	—	—
	1/30	123	108	183	148	—	163	167	—	159	—	—	—
	1/50	144	123	222	187	—	204	207	—	191	—	—	—
	1/80	163	137	261	227	—	243	246	—	222	—	—	—
	1/100	173	144	280	247	—	263	265	—	237	—	—	—
	1/150	190	156	315	284	—	299	302	—	265	—	—	—
	1/200	202	164	342	312	—	326	329	—	285	—	—	—
	1/300	219	177	380	353	—	365	367	—	314	—	—	—
	1/400	231	185	408	384	—	394	396	—	334	—	—	—
	1/500	240	192	430	407	—	416	418	—	350	—	—	—
	1/700	254	202	465	444	—	451	453	—	375	—	—	—
	1/1000	269	213	503	484	—	488	491	—	402	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

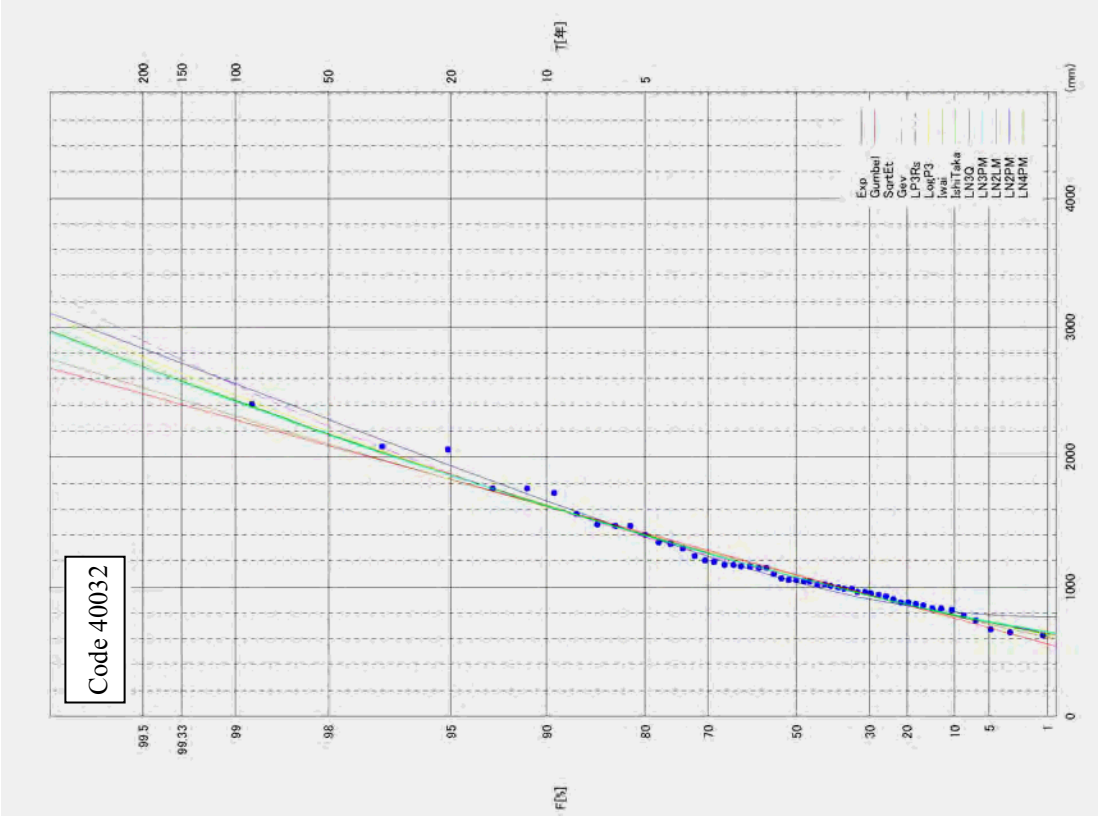

Figure C6.3.98 Probability Distribution on Gumbel Probability Paper (Station code 40032)

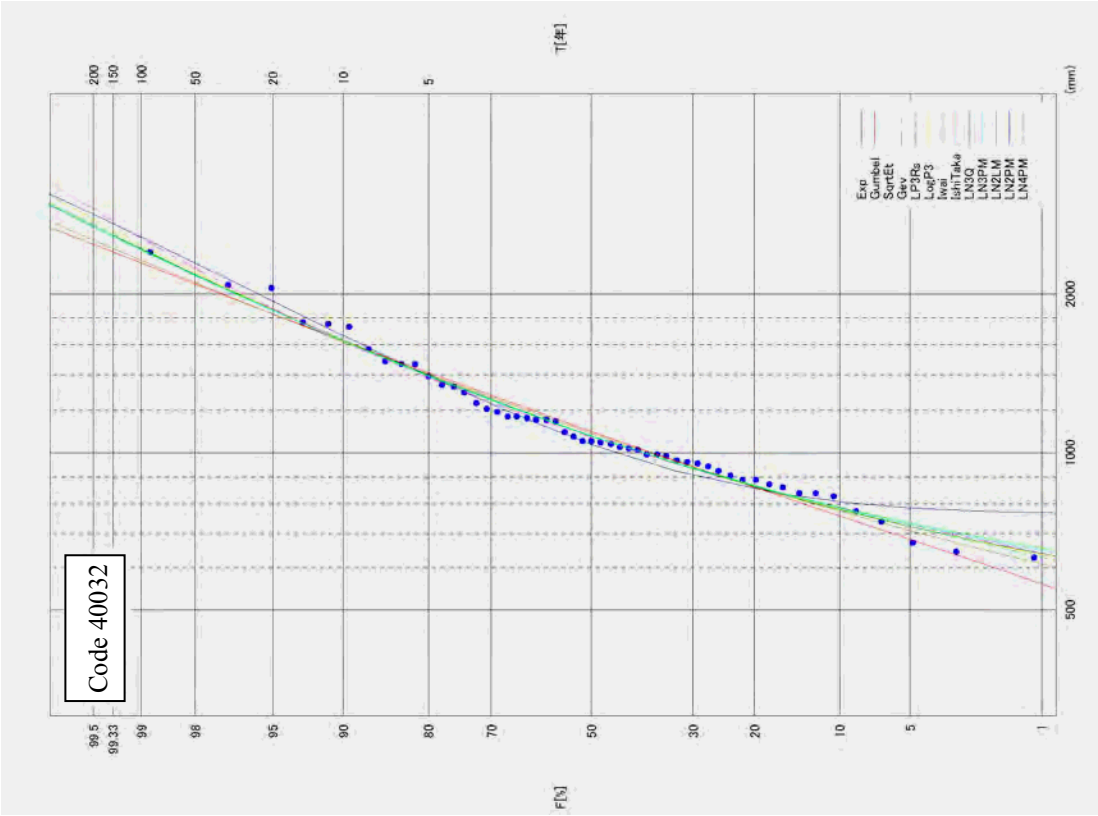

Figure C6.3.99 Probability Distribution on Log-normal Probability Paper (Station code 40032)

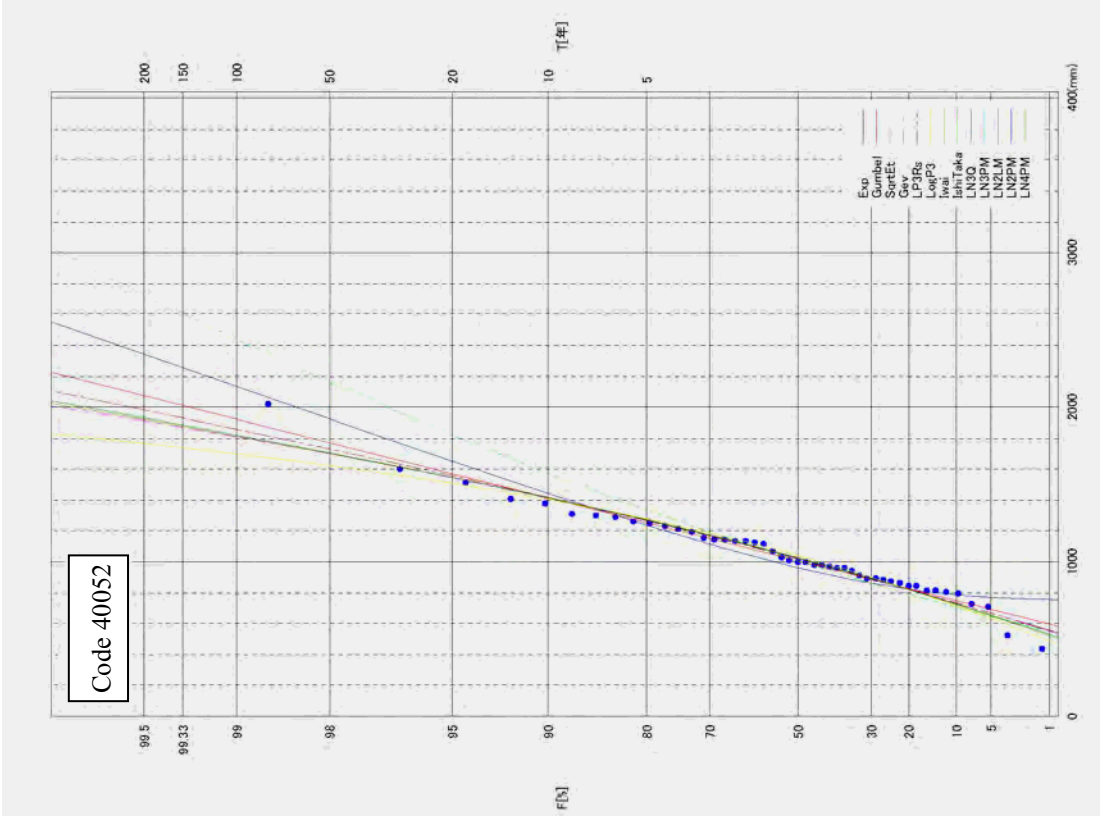

Figure C6.3.100 Probability Distribution on Gumbel Probability Paper (Station code 40052)

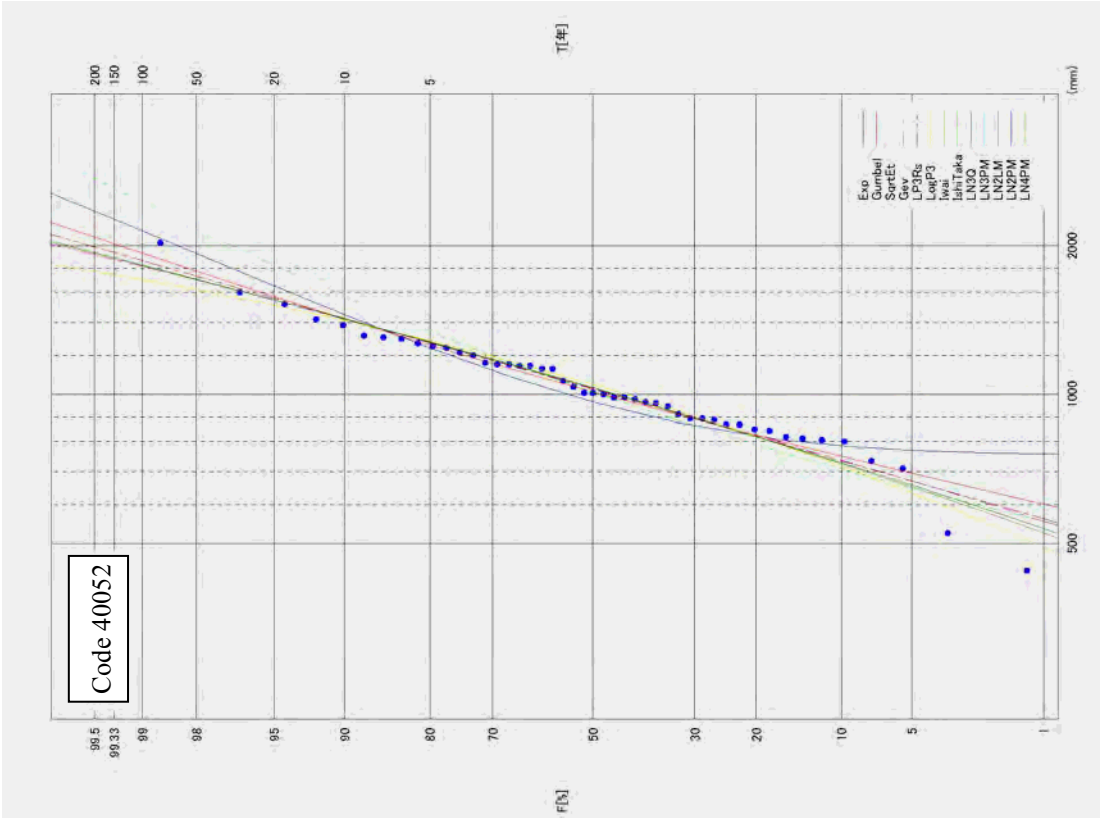

Figure C6.3.101 Probability Distribution on Log-normal Probability Paper (Station code 40052)

Table C 6.3.33 Result of Frequency Analysis of 6-Month Rainfall (24)

Station code 40062

6months rainfall series (number of sumple N=47)

	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.959	0.985	0.977	0.985	0.984	0.976	—	—	0.982	—	—	—
P-COR(99%)	0.818	0.994	0.991	0.994	0.994	0.993	—	—	0.994	—	—	—
SLSC(99%)	0.058	0.035	0.057	0.039	0.047	0.044	—	—	0.038	—	—	—
log likelihood	-336.700	-351.200	-353.500	-350.000	—	-351.000	—	—	-350.000	—	—	—
pAIC	677.400	706.300	711.000	706.000	0.000	708.000	—	—	705.900	—	—	—
X-COR(50%)	0.971	0.968	0.971	0.962	0.962	0.976	—	—	0.959	—	—	—
P-COR(50%)	0.957	0.963	0.956	0.964	0.964	0.993	—	—	0.966	—	—	—
SLSC(50%)	0.071	0.060	0.104	0.073	0.071	0.101	—	—	0.084	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,278	1,352	1,346	1,372	1,374	1,404	—	—	1,391	—	—	—
	1/3	1,471	1,536	1,577	1,559	1,563	1,593	—	—	1,575	—	—	—
	1/5	1,714	1,740	1,853	1,758	1,764	1,779	—	—	1,764	—	—	—
	1/10	2,043	1,998	2,228	1,995	2,001	1,980	—	—	1,980	—	—	—
	1/20	2,372	2,244	2,616	2,210	2,214	2,145	—	—	2,170	—	—	—
	1/30	2,565	2,386	2,853	2,329	2,333	2,231	—	—	2,273	—	—	—
	1/50	2,808	2,563	3,161	2,471	2,476	2,329	—	—	2,398	—	—	—
	1/80	3,031	2,726	3,457	2,596	2,604	2,411	—	—	2,507	—	—	—
	1/100	3,137	2,803	3,601	2,654	2,663	2,448	—	—	2,558	—	—	—
	1/150	3,329	2,942	3,869	2,756	2,770	2,512	—	—	2,648	—	—	—
	1/200	3,466	3,041	4,064	2,827	2,844	2,555	—	—	2,710	—	—	—
	1/300	3,659	3,180	4,347	2,924	2,948	2,612	—	—	2,797	—	—	—
	1/400	3,795	3,279	4,553	2,990	3,020	2,651	—	—	2,858	—	—	—
	1/500	3,901	3,356	4,716	3,041	3,076	2,680	—	—	2,904	—	—	—
	1/700	4,061	3,471	4,966	3,116	3,159	2,722	—	—	2,973	—	—	—
	1/1000	4,231	3,593	5,238	3,193	3,246	2,764	—	—	3,045	—	—	—
jackknife	1/2	58	60	56	62	1,345	72	—	—	68	—	—	—
error estimates	1/3	66	71	81	70	1,531	86	—	—	82	—	—	—
	1/5	87	90	140	86	1,728	97	—	—	94	—	—	—
	1/10	124	119	234	123	1,961	129	—	—	111	—	—	—
	1/20	164	148	337	179	2,172	197	—	—	139	—	—	—
	1/30	188	166	402	220	2,289	252	—	—	162	—	—	—
	1/50	219	188	489	279	2,431	333	—	—	199	—	—	—
	1/80	248	209	574	339	2,558	418	—	—	239	—	—	—
	1/100	262	219	616	370	2,618	462	—	—	259	—	—	—
	1/150	287	237	694	430	2,724	546	—	—	300	—	—	—
	1/200	305	250	752	474	2,799	610	—	—	331	—	—	—
	1/300	330	268	837	540	2,903	705	—	—	378	—	—	—
	1/400	348	281	899	588	2,977	775	—	—	412	—	—	—
	1/500	362	291	948	627	3,033	832	—	—	441	—	—	—
	1/700	383	306	1,024	687	3,118	921	—	—	485	—	—	—
	1/1000	406	322	1,108	752	3,208	1,019	—	—	534	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

Station code 40082

6months rainfall series (number of sumple N=40)

	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extreme value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.906	0.965	0.933	0.995	0.996	0.994	0.990	—	—	—	—	—
P-COR(99%)	0.897	0.991	0.988	0.997	0.997	0.997	0.996	—	—	—	—	—
SLSC(99%)	0.086	0.052	0.068	0.031	0.023	0.020	0.027	—	—	—	—	—
log likelihood	-269.000	-281.300	-282.800	-278.800	-277.900	-278.700	-279.300	—	—	—	—	—
pAIC	542.000	566.700	569.600	563.700	561.800	563.400	564.700	—	—	—	—	—
X-COR(50%)	0.937	0.951	0.929	0.985	0.993	0.994	0.973	—	—	—	—	—
P-COR(50%)	0.986	0.985	0.989	0.992	0.994	0.997	0.988	—	—	—	—	—
SLSC(50%)	0.126	0.100	0.134	0.060	0.044	0.053	0.065	—	—	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	761	809	799	853	865	845	843	—	—	—	—	—
	1/3	886	927	943	975	984	966	959	—	—	—	—	—
	1/5	1,042	1,059	1,114	1,090	1,089	1,084	1,075	—	—	—	—	—
	1/10	1,254	1,225	1,348	1,210	1,188	1,209	1,204	—	—	—	—	—
	1/20	1,467	1,384	1,591	1,304	1,259	1,311	1,315	—	—	—	—	—
	1/30	1,591	1,476	1,739	1,351	1,291	1,362	1,374	—	—	—	—	—
	1/50	1,747	1,590	1,933	1,401	1,325	1,421	1,444	—	—	—	—	—
	1/80	1,891	1,695	2,118	1,442	1,350	1,469	1,506	—	—	—	—	—
	1/100	1,960	1,744	2,208	1,459	1,361	1,491	1,534	—	—	—	—	—
	1/150	2,084	1,834	2,377	1,488	1,378	1,528	1,583	—	—	—	—	—
	1/200	2,172	1,898	2,500	1,506	1,388	1,552	1,618	—	—	—	—	—
	1/300	2,296	1,988	2,678	1,530	1,401	1,585	1,665	—	—	—	—	—
	1/400	2,384	2,051	2,807	1,545	1,410	1,606	1,697	—	—	—	—	—
	1/500	2,453	2,101	2,910	1,556	1,415	1,622	1,722	—	—	—	—	—
	1/700	2,556	2,175	3,067	1,572	1,423	1,646	1,759	—	—	—	—	—
	1/1000	2,665	2,254	3,239	1,587	1,431	1,669	1,798	—	—	—	—	—
jackknife	1/2	42	42	44	53	53	52	53	—	—	—	—	—
error estimates	1/3	42	42	50	53	53	52	51	—	—	—	—	—
	1/5	45	46	63	51	49	51	48	—	—	—	—	—
	1/10	55	53	86	48	44	52	47	—	—	—	—	—
	1/20	69	63	113	52	46	62	52	—	—	—	—	—
	1/30	78	70	131	58	51	71	58	—	—	—	—	—
	1/50	90	78	156	68	60	86	69	—	—	—	—	—
	1/80	102	86	180	80	70	102	81	—	—	—	—	—
	1/100	107	90	192	86	76	110	87	—	—	—	—	—
	1/150	118	97	215	97	85	126	99	—	—	—	—	—
	1/200	125	102	232	105	92	137	108	—	—	—	—	—
	1/300	135	110	257	117	101	153	121	—	—	—	—	—
	1/400	143	115	275	125	107	165	130	—	—	—	—	—
	1/500	149	119	290	131	112	174	138	—	—	—	—	—
	1/700	158	125	312	140	119	188	150	—	—	—	—	—
	1/1000	167	132	337	150	126	203	162	—	—	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

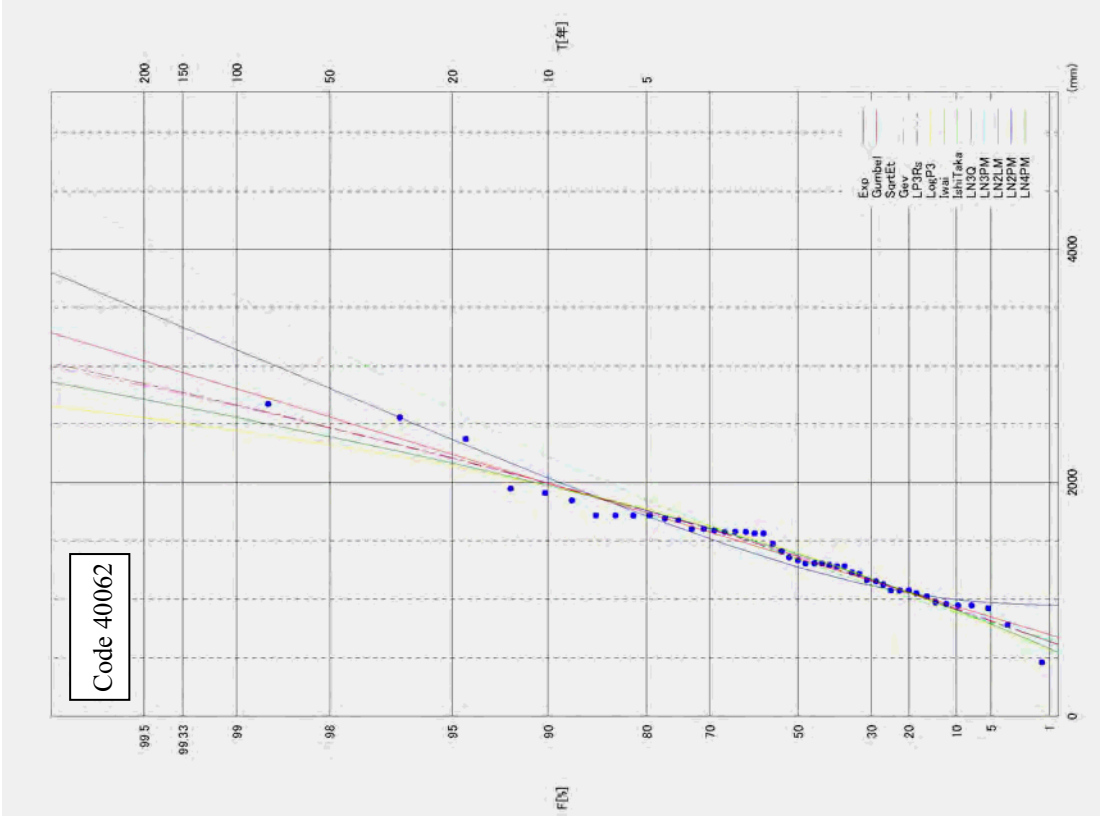

Figure C6.3.102 Probability Distribution on Gumbel Probability Paper (Station code 40062)

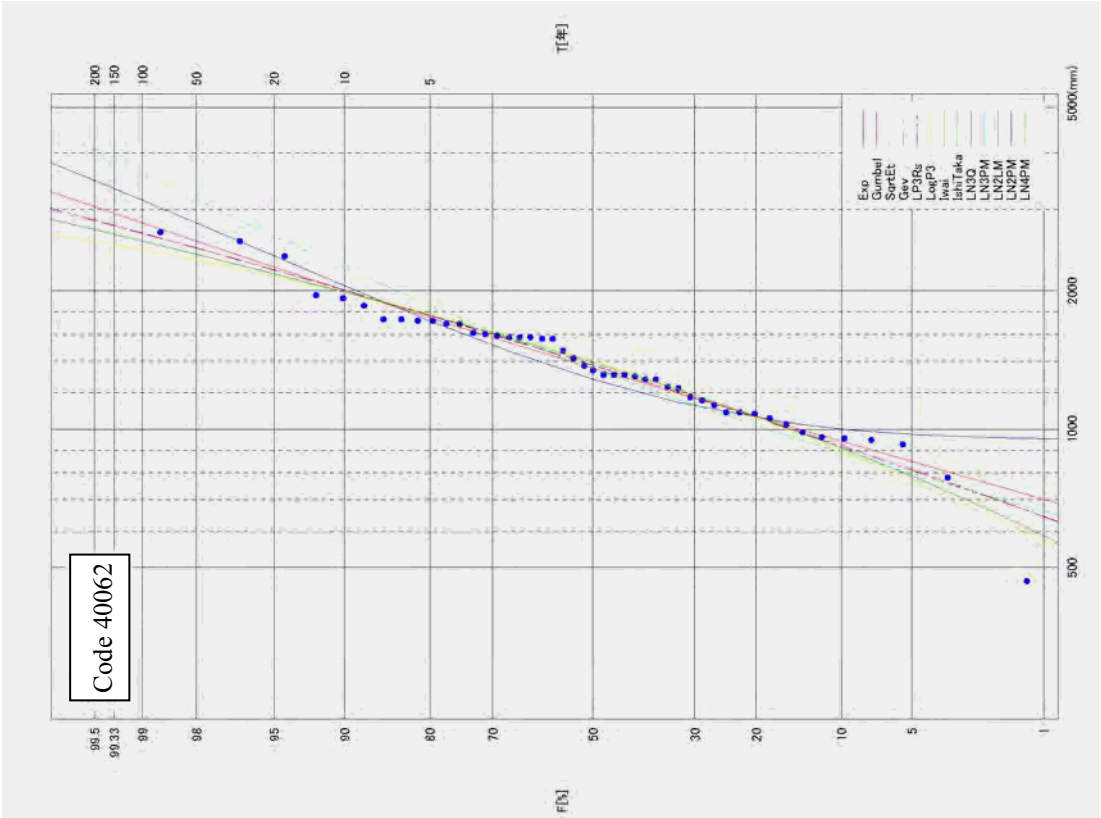

Figure C6.3.103 Probability Distribution on Log-normal Probability Paper (Station code 40062)

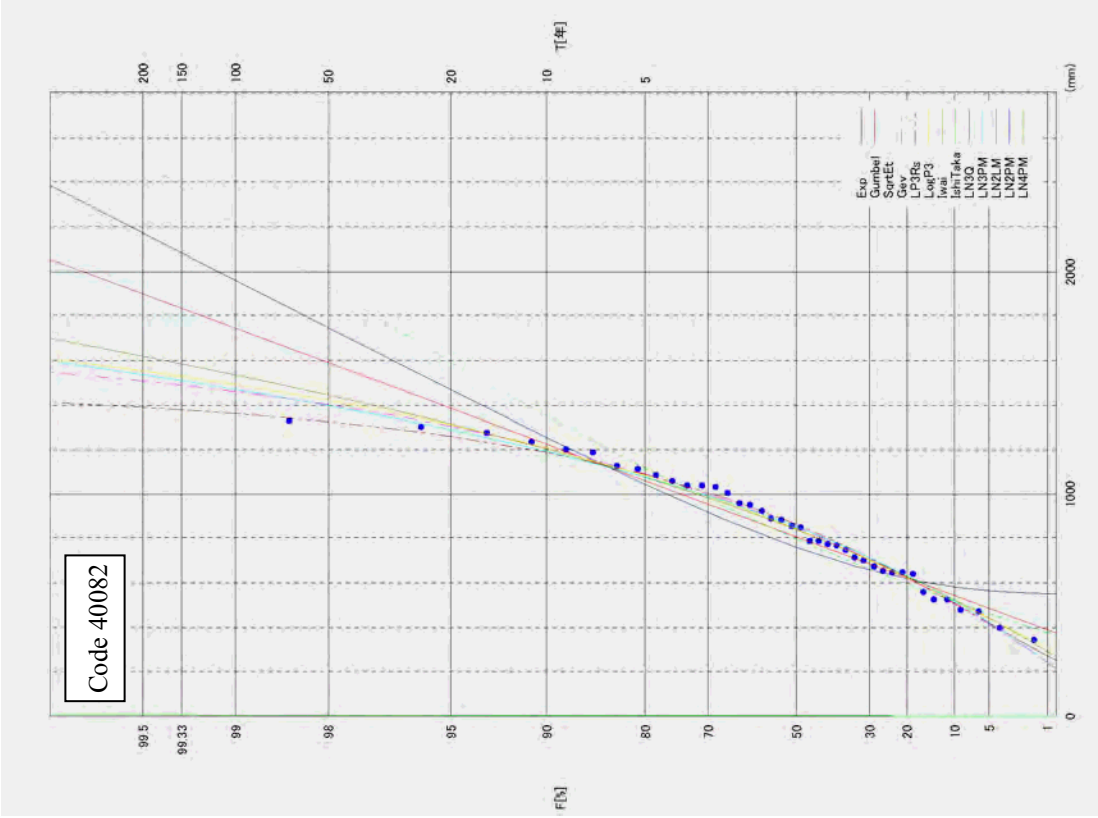

Figure C6.3.104 Probability Distribution on Gumbel Probability Paper (Station code 40082)

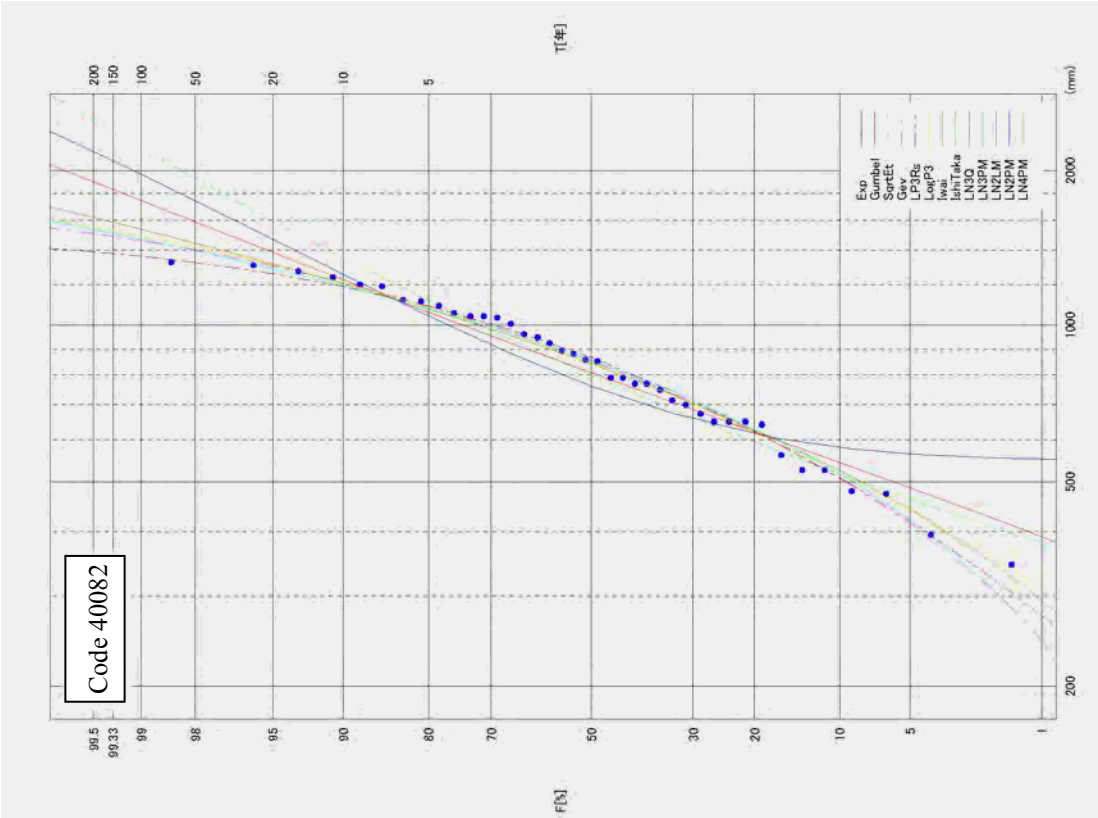

Figure C6.3.105 Probability Distribution on Log-normal Probability Paper (Station code 40082)

Table C 6.3.34 Result of Frequency Analysis of 6-Month Rainfall (25)

Station code 59121

	6months rainfall series (number of sumple N=49)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.941	0.978	0.965	0.984	0.985	—	0.985	0.985	—	0.985	0.984	0.984
P-COR(99%)	0.875	0.995	0.995	0.994	0.992	—	0.992	0.993	—	0.993	0.993	0.993
SLSC(99%)	0.069	0.042	0.051	0.040	0.034	—	0.035	0.034	—	0.034	0.034	0.034
log likelihood	-322.100	-335.600	-336.700	-334.900	-335.000	—	-335.000	-334.900	—	-334.900	-334.900	-334.900
pAIC	648.200	675.200	677.400	675.800	676.000	—	676.000	675.900	—	675.900	673.900	673.800
X-COR(50%)	0.929	0.939	0.926	0.949	0.954	—	0.953	0.951	—	0.952	0.950	0.950
P-COR(50%)	0.971	0.969	0.969	0.967	0.965	—	0.965	0.966	—	0.965	0.966	0.966
SLSC(50%)	0.099	0.081	0.098	0.078	0.083	—	0.083	0.080	—	0.081	0.077	0.078

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,009	1,050	1,046	1,061	1,073	—	1,073	1,069	—	1,070	1,066	1,066
	1/3	1,116	1,152	1,161	1,164	1,176	—	1,174	1,171	—	1,172	1,170	1,169
	1/5	1,251	1,265	1,295	1,275	1,280	—	1,278	1,276	—	1,277	1,277	1,276
	1/10	1,433	1,408	1,472	1,407	1,398	—	1,395	1,398	—	1,398	1,404	1,401
	1/20	1,616	1,545	1,653	1,526	1,501	—	1,499	1,506	—	1,505	1,517	1,514
	1/30	1,722	1,623	1,761	1,592	1,557	—	1,555	1,565	—	1,564	1,580	1,577
	1/50	1,857	1,722	1,901	1,672	1,623	—	1,622	1,636	—	1,635	1,656	1,652
	1/80	1,980	1,812	2,033	1,742	1,681	—	1,682	1,700	—	1,698	1,725	1,720
	1/100	2,039	1,854	2,097	1,774	1,708	—	1,709	1,729	—	1,727	1,756	1,751
	1/150	2,146	1,931	2,216	1,831	1,755	—	1,758	1,781	—	1,779	1,813	1,807
	1/200	2,222	1,986	2,302	1,871	1,788	—	1,792	1,818	—	1,815	1,853	1,847
	1/300	2,328	2,063	2,426	1,925	1,832	—	1,839	1,869	—	1,865	1,908	1,902
	1/400	2,404	2,118	2,515	1,962	1,864	—	1,871	1,904	—	1,900	1,947	1,940
	1/500	2,463	2,160	2,586	1,990	1,887	—	1,896	1,931	—	1,927	1,977	1,970
	1/700	2,551	2,224	2,694	2,032	1,923	—	1,933	1,972	—	1,967	2,022	2,014
	1/1000	2,645	2,292	2,810	2,076	1,959	—	1,972	2,015	—	2,010	2,069	2,061
jackknife	1/2	31	32	31	36	1,052	—	43	38	—	38	33	33
error estimates	1/3	35	37	39	42	1,153	—	48	43	—	43	38	37
	1/5	43	44	56	48	1,255	—	48	47	—	47	46	45
	1/10	58	56	85	55	1,371	—	47	51	—	51	59	57
	1/20	75	68	117	64	1,471	—	51	54	—	54	73	69
	1/30	85	76	136	71	1,526	—	57	57	—	57	81	77
	1/50	98	85	163	83	1,591	—	69	61	—	61	91	87
	1/80	111	94	188	96	1,647	—	84	65	—	65	101	96
	1/100	117	98	201	104	1,673	—	93	68	—	67	106	101
	1/150	127	106	224	119	1,720	—	109	73	—	72	114	109
	1/200	135	111	241	131	1,752	—	122	77	—	77	120	115
	1/300	146	119	266	150	1,796	—	140	84	—	83	129	123
	1/400	153	124	285	164	1,826	—	155	89	—	88	135	129
	1/500	159	129	299	175	1,849	—	166	94	—	92	140	133
	1/700	168	135	321	194	1,884	—	184	101	—	98	147	140
	1/1000	178	142	346	214	1,920	—	203	109	—	106	155	148

less than 0.04(SLSC)
minimum value(SLSC)

Station code 59131

	6months rainfall series (number of sumple N=40)											
	Exponential distribution	Gumbel Distribution	squre-root expotential type maximum distribution	extrame value distribution	Peason type III distribution(real-space)	Peason type III distribution	log-nomal distribution				two-parameter log-nomal distribution	
							Iwai	Ishihara・takase	quantile	product moment	L-moments	product moment
	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
X-COR(99%)	0.980	0.988	0.988	0.987	—	0.988	0.988	—	0.984	—	—	—
P-COR(99%)	0.919	0.996	0.998	0.998	—	0.997	0.996	—	0.994	—	—	—
SLSC(99%)	0.041	0.033	0.029	0.029	—	0.030	0.034	—	0.035	—	—	—
log likelihood	-262.500	-271.400	-271.500	-271.600	—	-271.800	-271.500	—	-271.700	—	—	—
pAIC	529.100	546.800	547.000	549.300	—	549.600	549.100	—	549.400	—	—	—
X-COR(50%)	0.975	0.978	0.974	0.972	—	0.988	0.978	—	0.979	—	—	—
P-COR(50%)	0.995	0.995	0.995	0.995	—	0.997	0.995	—	0.994	—	—	—
SLSC(50%)	0.053	0.062	0.051	0.051	—	0.053	0.057	—	0.079	—	—	—

Probable Value	return period (year)	Exp	Gumbel	SqrtEt	Gev	LP3Rs	LogP3	Iwai	IshiTaka	LN3Q	LN3PM	LN2LM	LN2PM
	1/2	1,150	1,190	1,184	1,178	—	1,184	1,189	—	1,199	—	—	—
	1/3	1,256	1,291	1,285	1,276	—	1,284	1,291	—	1,298	—	—	—
	1/5	1,389	1,403	1,401	1,390	—	1,398	1,404	—	1,403	—	—	—
	1/10	1,569	1,544	1,555	1,543	—	1,545	1,546	—	1,530	—	—	—
	1/20	1,750	1,680	1,709	1,699	—	1,689	1,682	—	1,647	—	—	—
	1/30	1,856	1,758	1,800	1,794	—	1,773	1,760	—	1,713	—	—	—
	1/50	1,989	1,855	1,918	1,917	—	1,881	1,858	—	1,793	—	—	—
	1/80	2,111	1,944	2,029	2,035	—	1,983	1,948	—	1,866	—	—	—
	1/100	2,170	1,986	2,083	2,093	—	2,031	1,991	—	1,900	—	—	—
	1/150	2,275	2,063	2,182	2,201	—	2,122	2,070	—	1,962	—	—	—
	1/200	2,350	2,117	2,253	2,280	—	2,187	2,126	—	2,006	—	—	—
	1/300	2,456	2,194	2,356	2,394	—	2,280	2,205	—	2,067	—	—	—
	1/400	2,531	2,248	2,430	2,478	—	2,348	2,262	—	2,110	—	—	—
	1/500	2,589	2,290	2,488	2,544	—	2,402	2,306	—	2,143	—	—	—
	1/700	2,677	2,353	2,577	2,647	—	2,484	2,373	—	2,193	—	—	—
	1/1000	2,770	2,420	2,672	2,760	—	2,573	2,445	—	2,246	—	—	—
jackknife	1/2	31	34	32	34	—	36	36	—	35	—	—	—
error estimates	1/3	41	45	41	44	—	46	44	—	47	—	—	—
	1/5	57	59	58	57	—	58	57	—	58	—	—	—
	1/10	81	78	83	77	—	76	75	—	75	—	—	—
	1/20	107	97	111	106	—	99	95	—	104	—	—	—
	1/30	123	108	129	127	—	115	108	—	128	—	—	—
	1/50	142	122	151	161	—	139	126	—	165	—	—	—
	1/80	160	135	173	199	—	165	144	—	205	—	—	—
	1/100	169	142	184	220	—	178	154	—	226	—	—	—
	1/150	184	153	204	263	—	205	172	—	268	—	—	—
	1/200	195	161	219	297	—	226	185	—	300	—	—	—
	1/300	211	172	240	351	—	257	205	—	349	—	—	—
	1/400	222	180	256	394	—	281	220	—	386	—	—	—
	1/500	231	186	268	430	—	301	232	—	416	—	—	—
	1/700	244	196	287	489	—	333	251	—	464	—	—	—
	1/1000	257	206	307	557	—	370	273	—	517	—	—	—

less than 0.04(SLSC)
minimum value(SLSC)

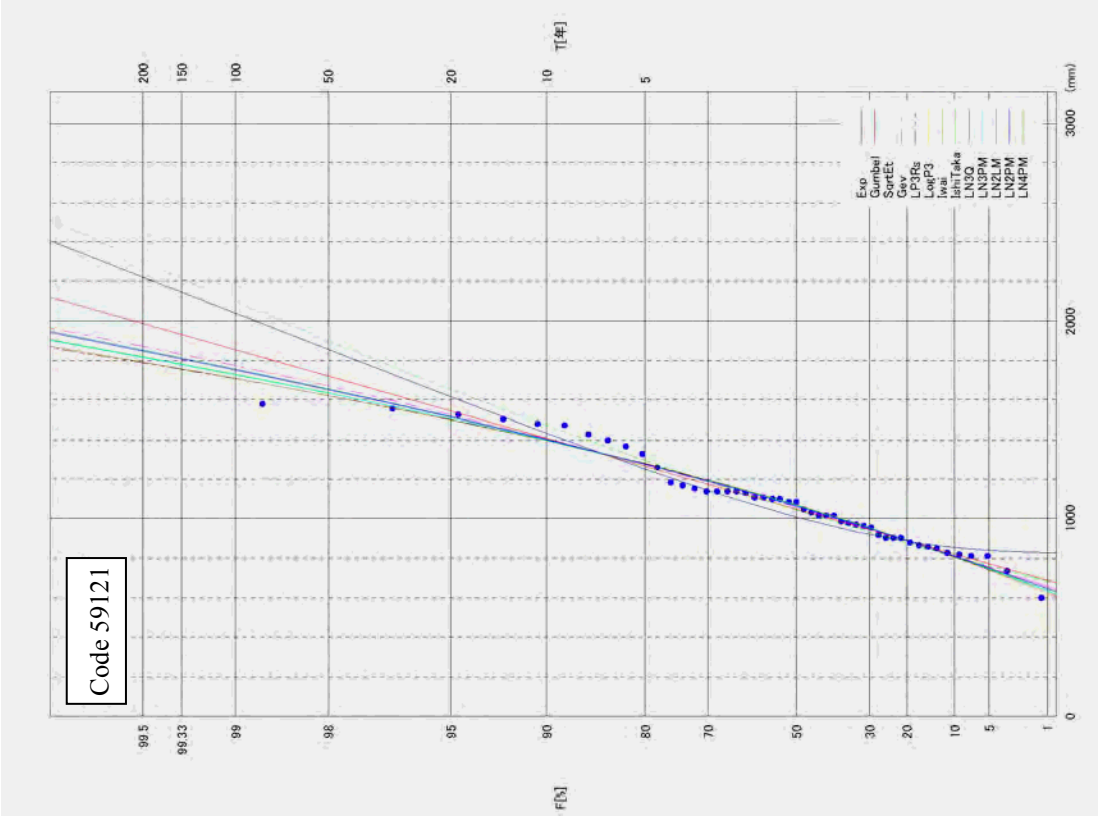

Figure C6.3.106 Probability Distribution on Gumbel Probability Paper (Station code 59121)

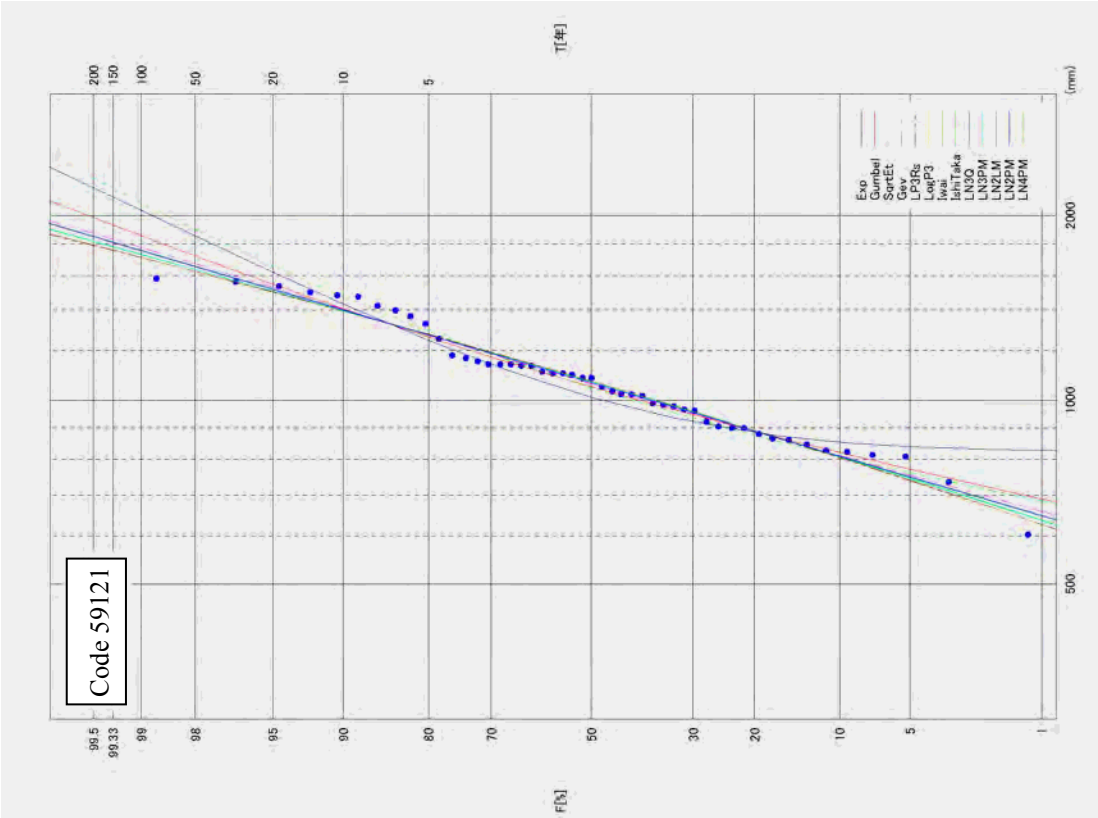

Figure C6.3.107 Probability Distribution on Log-normal Probability Paper (Station code 59121)

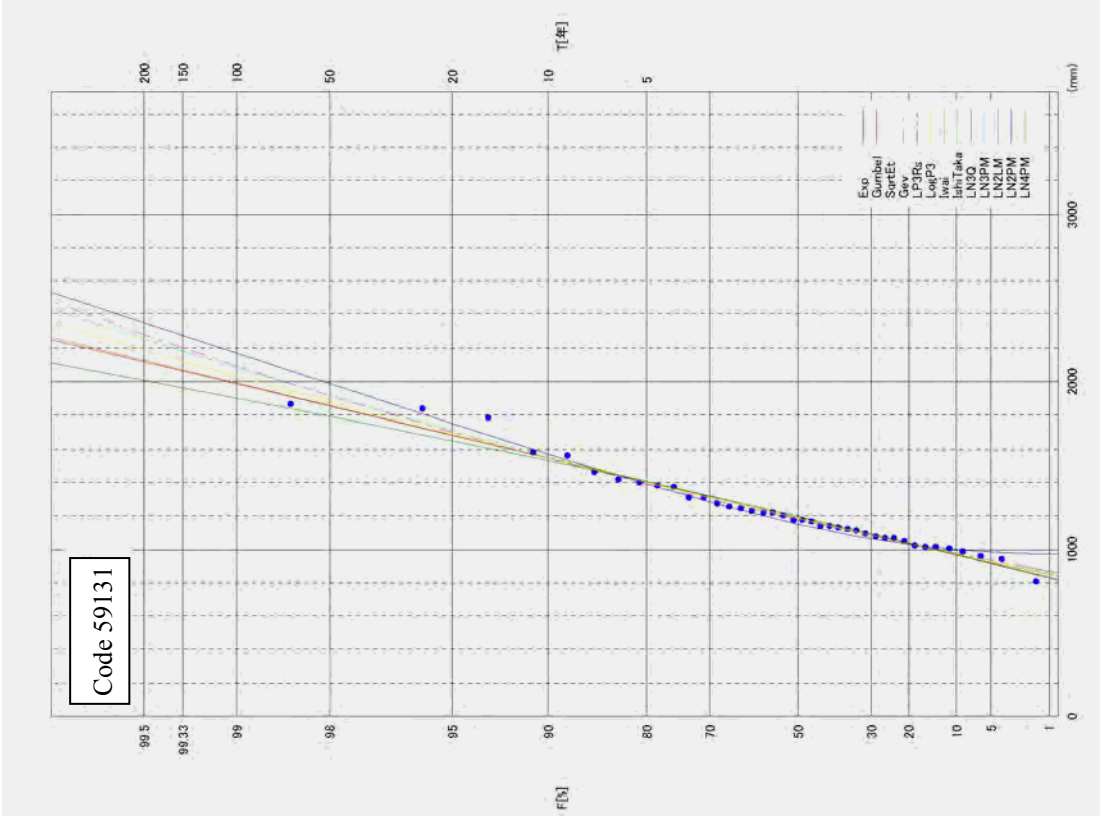

Figure C6.3.108 Probability Distribution on Gumbel Probability Paper (Station code 59131)

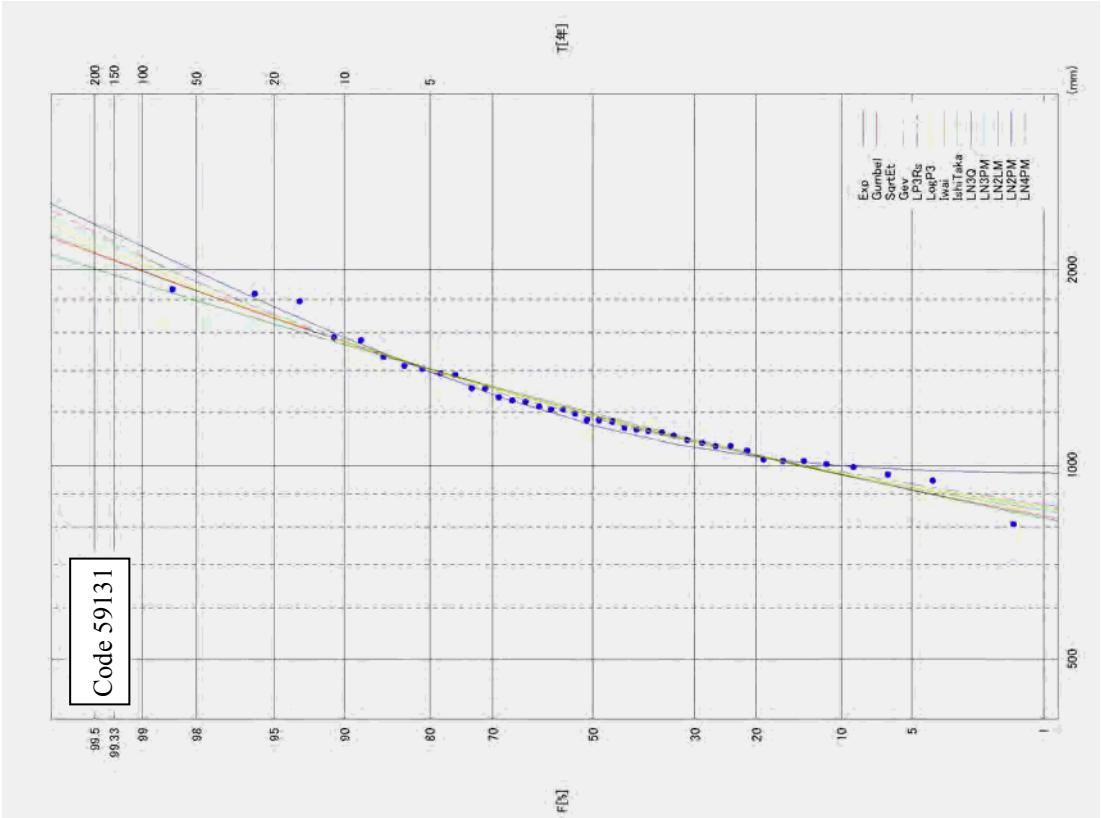

Figure C6.3.109 Probability Distribution on Log-normal Probability Paper (Station code 59131)