Coconuts are planted on 21,200 ha, from which about 20,000 tons of copra are produced annually. Average yield is about 40 nuts per tree per year. The planting density is around 120 trees per hectare. About 88% of trees are fruit bearing. Around 350 to 400 nuts produce 100 kg of dried copra. Major pest and disease of coconut in the project area are Asiatic palm weevils and Cadang-cadang disease.

Abaca is planted on 131 ha in the project area. Average yield of abaca is 0.7 ton/ha/year. Historical record of the planted area of Abaca in the project area is not available. But, on the analogy of the trend in the planted area in Albay Province, the planted area of abaca in the project area seems to be decreasing. The planted area of abaca in Albay Province in 1979 decreased to 48% of the area in 1970 due to the expansion of the bunchy top disease and a low rate of rehabilitation of old trees.

Corn is not so important for staple food in the project area. Information on the planted area and production of corn in the project area is not available. Average yield of corn in Albay Province in the phase 6 (January to June, 1980) of Masagana Maisan was 1.9 tons/ha according to the information from BPI (Bureau of Plant Industry) in Daraga. Expansion of the planted area of corn is much restricted by the prevalence of the downy mildew disease.

Leafy vegetables and rootcrops are grown for the home consumption, for most cases. The data on planted area and the production of them are not available. The average yield of the vegetables in 1976 was 4.9 tons/ha and that of rootcrops was 7.6 tons/ha.

6.4.6 Animal Husbandry

The animal husbandry in the project area is much primitive. Farms specialized in animal industry are rare. Most livestocks are raised on wild grasses or farm residue. The information on the number of heads of animal in recent years in the project area is not available. According to the information from Bureau of Animal Industry in Legazpi City, the number of livestocks in Albay Province in 1976 is about 43,400 for carabao, 24,900 for cattle and 142,400 for swine.

Livestock meat production sufficiency analysis for Albay Province, which was carried out by the provincial development staff in 1976, revealed that the total requirement for Albay province was 9,390 tons among which 5,540 tons or 59% were deficient. The analysis also revealed that the poultry meat production in Albay Province in 1976 was 245 tons which was 7% of the total requirement.

Constraints in the development of the animal husbandry in the project area are considered to be insufficient supply of the feedstuff, poor credit service, technical inadequency including extension service and lack of modern market system such as cold storage, auction markets, processing facilities, etc.

6.5 Market and Prices

Agricultural inputs such as fertilizers and agro-chemicals are handled mostly by private enterprises and are obtainable at the shops in large towns. The supply of the agricultural inputs to individual farmer seems to be smooth and to have no restriction on the agricultural development judging from the results of the field survey.

BPI is responsible for the production and distribution of improved seeds and plant materials. As for rice seeds, BPI supplies the foundation seeds or registered seeds to private seed growers and analyzes and certifies the seeds produced in grower's field. Amount of certified seeds produced in seed grower's field is not sufficient for farmers in the project area. In 1979, the Albay Seed Growers Inc. which is producer of certified seeds in Albay Province produced 866 cavans (3.8 tons) of certified seeds of which about 60% was IR-36 and about 40% was IR-42. Rice seeds are usually spread through farmers. The price of seeds in 1980 is P 105/cavan for registered seeds and P 95/cavan for certified seeds.

The details of the farm gate prices of the agricultural products and the retail prices of the agricultural commodities in Albay Province in 1980 are shown in TABLE-VI.10 and VI.11. The farm gate price of palay has been stable since 1975 as shown in TABLE-VI.12. While, the

consumer's price index, the price of wage of hired labourer and the price of urea raised 60% within the last 5 years, 140% within the last 6 years and 34% within the last 6 years, respectively.

6.6 Agricultural Support System

6.6.1 Agricultural Research

Most of the agricultural researches except these in coconut, abaca and animal husbandry are carried out by BPI. BPI has two research stations in Bicol regions, i,e, the Bicol Rice and Corn Experiment Station at Pili, and the Albay Experiment Station in Tabaco. The former is responsible for the research in rice and is conducting varietal tests, fertilizer response tests, pest control test, etc. TABLE-VI.13 and VI.14 show experimental results obtained in this station.

The Albay Experiment Station in Tabaco is responsible for the research in vegetables, rootcrops, and cereal crops. Corn research was transfered in 1980 to this station from the Albay Rice and Corn Experiment Station in Pili.

The Food and Agricultural Organization (FAO) and the United Nations Development Programme (UNDP) have been conducting the fertilizer field trials in the project area as part of the soil and land resources appraisal and training project for the Bicol River basin since 1975. About 560 trials have been carried out in the farmer's fields. The average yields for each treatment in the dry season and the wet season in 1979 are shown in TABLE-VI.15. The results show the high yield potentiality of the project area at the experimental level.

6.6.2 Agricultural Extension

A number of Government agencies provide extension services. Among them, the extension services for creal crops are provided mainly by BAEx and BPI. Major work of the extension is to promote comprehensive agricultural extension programs relating to crop production, poultry and livestock on farms, farm organization, farm credits, home economics and family life, home industries, rural youth development, and extension information. Among the programs, the supervision of credit

schemes such as the Masagana 99 and the Masagana Maizan plays an important part in the extension work. The number of extension worker in 1980 for Albay Province is 118 in BAEx and 56 in BPI. The average area for food crops served by one extension worker is 347 ha for Albay Province. While the average rice field served by one BAEx extension worker is 243 ha.

The transfer of the technical information from the agricultural research station to the extension worker is not enough. The integration of the extension and research organization is necessary for increasing the technical knowledge of extension workers.

Most of the extension workers are provided with motor bicycles, which is very effective for the execution of the extension work. The number of the extension workers in the project area is sufficient judging from the service area per one extension worker and the mobility of the worker.

6.6.3 Agricultural Credit

Various agricultural credits are available in the Philippines. The Masagana 99 program is for rice production, the Masagana Maizan program is for maize, sorghum and soybean productions, and the Gulayan Sa Kalusugan program is for vegetables.

The Masagana 99 program was introduced in 1973 as nationwide scheme for rice production. Farmers are organized into liability groups consisting of 5 to 15 farmers. Under the joint responsibility of the groups, farmers are furnished with a package of technology under the guidance of extension workers. The loan is made up of a cash portion and portion in cheques or coupons for material inputs. The cash portion covers the cost for land preparation and seed. The coupon issued can be exchanged for fertilizers or agro-chemicals. The maximum loan allowed was about 1,350 pesos per hectare in 1979. The interest of the loan is 12% per year. The repayment period is within 6 months from the harvest.

Historical trend of the loan operation in Albay Province is presented in TABLE-VI.16. The rapid increase of the loan released in 1978 can be attribute to softening of the qualification of applicants. Before 1978, the loan were allowed only to the farmers who had repayed total amount of the previous loan. In 1978, the farmer who had repayed at least 20% of previous loan could get the loan. The average amount of loan provided to one farmer was about 2,600 pesos in 1979. The percentage at the repayment was 94% for 1978 and 85% for 1979.

VII. IRRIGATION AND DRAINAGE PLAN

7.1 Basic Engineering Consideration

The facilities required for the irrigation and drainage development in the project area include headworks, irrigation canals and their relevant structures, drainage facilities and farm roads. The principle for determining the facility requirements for each function is that the project facilities is provided in the most effective and economical manner so that each function can be combined with and fully compatible with the other farming operations at the respective stages of development. Based on the above requirements, the following basic engineering considerations are given to the present study.

7.1.1 Integration of Existing Irrigation Facilities

The major rivers and their tributaries crisscross in the project area. A large number of temporary brush dams and permanent headworks have been built on these rivers for the purpose of irrigation water intake. Most of these structures have inadequate flow capacities and cause flood problems in the paddy fields along the rivers. In the flood control plan for the major rivers, the temporary brush dams and some of the headworks are to be removed and integration of existing canal systems is proposed for their practical and efficient operation through construction of new headworks at the suitable locations. Investory of the existing irrigation systems is summarized in Tables VII.1 to VII.5.

7.1.2 Headworks

Most of the existing headworks have two intake structures on both right and left banks. On the meandered rivers in the project area, however, this type of headworks can not divert water sufficiently to both sides. Considering this difficulty in intake of water, existing headworks should be modified so as to have one-side intake. For the irrigation of the areas excluded due to the modification, the construction of new headworks or extension of existing canal systems is required in proper way.

In selecting the location of new headworks sites, the following items are checked and surveyed on the preliminary basis.

(a) Flood control plan and configuration of existing canal system:
The location of the headworks sites should not hamper the flood control plan of the rivers and should be suitable for the configulation of existing canal network.

(b) Relation between the height of weir crest and the length of headreach:
In order to attain the designed intake water level, if the headworks site is selected upstream, the weir crest will become low, but the headreach will become long. If the headworks site is selected downstream, the crest become high but the headreach become short. For the selection, therefore, rough cost comparison will be required.

(c) Topography and geology of the site:
i) Narrow portion of river course will first be selected.
ii) The stable rock foundation is preferable.
iii) The river course at the site should be stable.

(d) Affection of structure to sediment transport in the river:
Due to construction of weir, sediment transport in the river will be checked to great extent, which will result in the river bed erosion in the downstream from the weir and may give damage to the existing bridges and intake structure in the downstream reach of the river. Careful survey and study are required on this matter.

(e) Construction:
The site should provide an easy and cheap construction work.

(f) Operation and maintenance:
The site should provide a good access for operation and maintenance.

7.1.3 Irrigation Canal System

Irrigation canal system in the project area includes main canal, secondary canal, tertiary canal and quarternary canal. The layout planning of these canals is done after understanding their respective function and requirement mentioned below:

- Main Canal

  The function of the main canals is to deliver irrigation water from river to the development area in the shortest or in the most economical way. The canal will basically be of unlined and trapezoidal type.

- Secondary canal

  The secondary canal is branched off from the main canal to distribute water to the secondary unit areas. The size of the irrigation area varies from 250 ha to 150 ha which are divided into 5 to 3 tertiary unit areas in consideration of present terminal irrigation system in the project area. The canal will be unlined and trapezoidal.

- Tertiary and Quarternary canals

  These canals are branched off from the secondary canal to distribute water up to tertiary unit areas. This terminal canal network has been developed in the existing irrigation system areas. Thus, these canal networks are used in the new canal system.

7.1.4 Drainage Canal System

The drainage canals are classified by function as follows:

i) Field drain is provided to remove excess water from the fields and to lower or control the subsurface water level.

ii) Main and secondary drains are provided to transport water from field drain to outlet or disposal points.

- Field drain

  In flat land areas, all field drains are laid out in a grid system. Straight ditches are proposed to raise hydraulic efficiency and to attain efficient farming.

- Secondary drain

  This drain is designed to collect water from field drains and to convey to main drains. Depressed area or old stream beds will be used for location of the secondary drain.

- Main drain

  The location of main drain is dominated by natural streams and rivers traversing the development areas. These natural streams and rivers will be used as the main drain.

7.1.5 Road Network

There exists a National Highway and Provincial roads linking 6 municipalities, namely, Malinao, Tabaco, Guinobatan, Oas, Polangui, Libon with Legaspi and Naga cities, which will become the most important marketing and transportation centers for the agricultural products and required inputs. In addition, adequate communications are essential throughout the project area for successful operation. In this regard, the following 2 kinds of farm roads are proposed to be constructed.

- Main farm road

  The main farm roads are required for inspection and operation of the canals, the movement of agricultural products and equipment and for the day-to-day services between Barangays and therefrom to the National Highway and railway stations. These roads are to be constructed mainly along the main canals. Existing roads are also utilized for this purpose as much as possible. All the main farm roads are designed as earth road with an effective width of 3 m.

- Secondary farm road

The secondary farm roads are required to link the cultivable areas with population centers in the area. The secondary farm roads are to be constructed on one side of all the secondary canals. These roads will have an effective width of 1.0 m and will be of earth type without any metalling.

7.2 Irrigation Water Requirements

7.2.1 General

In planning of irrigation project, sufficient information on water consumption by crops from seeding time until harvest is needed. Since field measurement of consumptive use of water by crop was not carried out in the survey period, this study is mainly depending on the study results in the report on Soil and Land Resources Appraisal and Training Project on Bicol River Basin/1 and Feasibility Studies of Quinali Integrated Development Area/2. The empirical and theoretical formulas developed in the past by various experts are also used in this study.

The calculation procedure adopted in this study is shown in the following equation:

$$IDR = (KC \times PET + P + N + LP - RE)/IE$$

where,

IDR = Irrigation diversion requrement,
KC = Crop growth stage coefficient,
PET = Potential evapotranspiration,
P = Percolation rate,
N = Nursery requirement,
LP = Land preparation requirement,
RE = Effective rainfall, and
IE = Overall irrigation efficiency.

/1; Bureau of Soil, Department of Agriculture, UNDP/FAO, 1976.
/2; Bicol River Basin Development Program, 1980.

The following terms and their abbreviations are used in this study.

a) Consumptive use (CU) : CU = KC x PET
b) Field crop requirement (FC) : FC = CU + P
c) Crop water requirement (CWR) : CWR = FC + N + LP
d) Crop irrigation requirement (CIR) : CIR = CWR - RE
e) Irrigation diversion requirement (IDR): IDR = CIR/IE

7.2.2 Consumptive use of water by crop

The consumptive use of water by crop can be estimated as a product of potential evapotranspiration (PET) calculated from climatic data and crop coefficients (KC) which depend on growing season and stage of the crop.

Since meteorological conditions between the Quinali (A) River basin and the Quinali (B) River basin are rather different, the potential evapotranspiration for these two areas is separately estimated. For the Quinali (A) River basin, the monthly potential evapotranspiration is estimated by using modified Penman method based on meteorological records observed at Legaspi. On the other hand, monthly class-A pan evaporation records (1972-1980) observed at Paraputo Agro-meteorological station near Malinao are used for estimation of the potential evapotranspiration for the Quinali (B) River basin. Results of calculation are shown in Table-VII.6.

Crop growth stage coefficients (KC) used in this study are shown in Table-VII.7, which were proposed in the "Soil and Land Resources Appraisal and Training Project" by FAO/UNDP in 1976.

Calculation results of the consumptive use of water by crop are shown in Tables VII.8 to VII.10.

7.2.3 Percolation rate

The rate of deep percolation loss was measured and discussed in the report on "the Feasibility Studies of Quinali Integrated Development Area" in 1980. According to the report, the results of

actual field tests at 5 sites located in the Quinali (A) River basin ranged from 2 mm/day to 5 mm/day for the various soil types. During the wet season when the ground water table is high, the rate was slow and increases to a maximum of 5 mm/day during the dry season when the water table recorded to its lowest level.

Taking account of the above report, soil and topographic conditions in the project area, the following figures are adopted in this study.

Area	Name of Scheme	Percolation Rate (mm/day)
Quinali (A)		
Lower area	Agos Sta. Crus-South Quinali Scheme	2
Upper area	Cabilogan Scheme, Quinali Scheme	4
Quinali (B)	Bantayan Scheme	4

7.2.4 Nursery requirement

The nursery requirement is calculated by the following equation:

$$N = (LP + (KC \times PET + P) \times T) \times A$$

where,

N = Nursery requirement (mm),

LP = Land preparation requirement for nursery bed (mm),

KC = Crop growth stage coefficient,

PET = Potential evapotranspiration (mm/day),

T = Period of nursery (days), and

A = Area factor.

The area required for nursery bed and the period of nursery are assumed to be 5% of the total paddy land to be transplanted and 20 days respectively. In addition, the land preparation requirement and the crop growth stage coefficient are assumed to be 150 mm and 0.8 respectively. Results of calculation are shown in Tables VII.8 to VII.10.

7.2.5 Land preparation requirement

In general, the land preparation requirement for paddy fields can be defined as the supply of water, either by irrigation or rainfall, to a group of farms so as to wet the ground to saturation and to provide a water layer to facilitate ploughing and transplanting.

The present irrigation system in the project area relies on field-to-field flooding. In order to supply required amount of water to each plot, it may take for the period of two weeks on an average. Hence, replenishment for evaporation and percolation losses during the land preparation period is needed. Taking account of the amount of replenishment, the land preparation requirement is calculated by the following equation:

$$LP = SS + (KE \times EP + P) \times T + SP$$

where,

LP = Land preparation requirement (mm),

SS = Water depth required for land soaking (120 mm),

KE = Coefficient for evaporation from saturated soil or shallow water layer (= 0.8),

EP = Pan evaporation (mm/day),

P = Percolation rate (refer to 7.2.3),

T = Period for land preparation (15 days), and

ST = Water depth required for transplanting (25 mm).

Results of calculation are shown in Tables VII.8 to VII.10 and summarized below.

Area		Land Preparation requirement Wet (mm)	Dry (mm)
Quinali (A):	Lower area	237	221
	Upper area	268	251
Quinali (B):		257	236

7.2.6 Effective rainfall

(1) Rainfall data for the Quinali (A) River basin

In the Quinali (A) River basin, monthly rainfall data are available from three rainfall gauging stations, i.e. Guinobatan, Polangui and Libon. Among them, Libon rainfall gauging station is regarded as the key station for estimation of effective rainfall in the Quinali (A) River basin because it locates almost in the center of the proposed irrigation schemes.

Since duration of rainfall data available at Libon rainfall gauging station is insufficient for the study, rainfall data at Libon are supplemented by the long-term rainfall records available at Guinobatan rainfall gauging station. Figure VII.1 shows correlation of monthly rainfall between Guinobatan and Libon rainfall gauging stations. As shown in this fugure, the monthly rainfall at Libon can be regarded as 75% of that observed at Guinobatan rainfall gauging station with a correlation coefficient of 0.842. Since monthly rainfall records from 1972 to 1977 are available at Libon rainfall gauging station, rainfall data for other periods, i.e. 1956-1971 and 1978-1979, are supplemented by using the above conversion ratio.

(2) Rainfall data for the Quinali (B) River basin

In the Quinali (B) River basin, monthly rainfall data are available from Malinao rainfall gauging station for 8 years from 1972 to 1979. Since duration of available rainfall record at Malinao is insufficient for the present study, it is supplemented by the rainfall records observed at Sto. Domingo rainfall gauging station. Figure VII.1 shows correlation of monthly rainfall between the above two stations. The monthly rainfall at Malinao can be regarded as 110% of that observed at Sto. Domingo rainfall gauging station with a correlation coefficient of 0.908 and then, monthly rainfall records at Malinao are supplemented by using the aboe conversion ratio.

(3) Estimation of effective rainfall

The potential effective rainfall on paddy land in the project area can be estimated by using a conversion curve shown in Fig. VII.2 which was proposed in the report on the Upper Pampanga River Project in 1975. The monthly potential effective rainfalls thus estimated are shown in Tables VII.11 and VII.12 for Libon (Quinali A) and Malinao (Quinali B) respectively.

7.2.7 Irrigation efficiency

Irrigation efficiency is estimated by the following equation:

$$IE = Ea \times Ec$$

where,

IE = Overall irrigation efficiency,

Ea = Application efficiency, and

Ec = Conveyance and operation efficiencies.

Taking into account the soil characteristics, topography, climate, irrigation practice, etc, in the project area, the application efficiency is assumed to be 75% of the crop irrigation requirement on an average over the whole project area. In addition, the canal conveyance and operation efficiencies are estimated to be 80% of the crop irrigation requirement in total. Overall irrigation efficiency is, therefore, estimated at 60%.

7.2.8 Irrigation diversion requirement

The irrigation diversion requirement is defined by the following equation:

$$IDR = (CWR - RE)/IE$$

where,

IDR = Irrigation diversion requirement,

CWR = Crop water requirement (Tables VII.8 to VII.10),

RE = Effective rainfall (Tables VII.11 and VII.12), and

IE = Overall irrigation efficiency (60%).

The irrigation diversion requirement for unit area is estimated on monthly basis in 24-year period of 1956-1979. Results are shown in Tables VII.13 to VII.15 taking the unit of l/sec/ha.

The unit irrigation diversion requirement for the design of irrigation facilities, or the design intake discharge, for each area is determined to be equivalent to 20% probability of occurrence for the annual maximum monthly mean requirements taken from Tables VII.13 to VII.15. Following figures thus estimated are adopted to the design of irrigation facilities.

Area	Design Discharge (l/sec/ha)
Quinali (A) River basin	
Lower area	1.28
Upper area	1.67
Quinali (B) River basin	1.14

7.3 Scale of Irrigation Area

7.3.1 Water sources in the Quinali (A) River basin

Reliable water sources in the Quinali (A) River basin are the Cabilogan, Ogsong, Nasisi, Salog and Polangui Rivers. Except for the Quinali (A) river, stream flow records are available at 3 gauging stations as shown below.

Gauging Station	River	Drainage Area (km2)	Period of Record
Bobongsuran	Cabilogan	131	1956 - 1978
Benanuan	Ogsong	11	1956 - 1978
Nasisi	Nasisi	39	1951 - 1978

The stream runoff for the Salog and Polangui Rivers can be estimated by extrapolation from flow records observed at Nasisi gauging station. The extrapolation is carried out based on relationship between drainage area and annual mean runoff as shown in Fig.-I.30.

A certain portion of runoff from the Ogsong, Nasisi, Salog and Polangui Rivers has been diverted by existing intake facilities of the 4 National Irrigation Systems. Available discharge for the new development should, therefore, be calculated by deducting irrigation diversion requirements of the National Irrigation Systems fro river runoff. Water sources for the proposed irrigation schemes can be evaluated as follows:

(1) Water source for the Cabilogan Scheme:

Cabilogan River (Drainage area = 122 km^2)

(2) Water sources for the Agos Sta. Cruz - South Quinali Scheme:

i) Remaining discharge on the Cabilogan River after diversion by the Cabilogan National Irrigation System,

ii) Remaining discharge on the Ogsong River after diversion by the Ogsong National Irrigation System, and

iii) Remaining discharge on the Nasisi River after diversion by the Nasisi National Irrigation System.

(3) Water sources for the Quinali Scheme:

i) Remaining discharge on the Salog River after diversion by the Mahaba National Irrigation System,

ii) Remaining discharge at the Hibiga Headworks after diversion by the Hibiga National Irrigation System, and

iii) Stream runoff from the drainage area of the Polangui River (excluding the drainage area at the Hibiga Headworks).

Irrigation diversion requirements for the National Irrigation System are calculated taking the future irrigable area into account as shown in Table-VII.16. Based on the unit irrigation diversion requirement for the upper area in the Quinali (A) area (Table-VII.14) and the future irrigable areas, irrigation diversion requirements are calculated as shown in Tables VII.17 to VII.20.

The monthly mean discharge at the proposed Cabilogan Headworks, the existing headworks for the National Irrigation Systems and for the Polangui River are calculated by using available records and conversion ratio as shown in Table-VII.21. Results of calculation are shown in Tables-VII.22 to VII.27.

Available discharge at the proposed Agos Sta. Cruz - South Quinali Headworks and at the Quinali Headworks are calculated as shown in Tables VII.28 and VII.29.

7.3.2 Water sources in the Quinali (B) River basin

The Quinali (B) River is the most reliable water source for irrigation. Since stream flow records for this river are not available, the stream runoff at the proposed Bantayan Headworks is extrapolated from flow records observed at Bobongsuran gauging station using conversion ratio of 0.715 (refer to Table-I.30). The result of calculation is summarized in Table-VII.30.

7.3.3 Scale of irrigation area

The following criteria 1/ concerning limitations for water shortages are utilized in determining the adequacy of project water supplies.

(1) Maximum annual shortages should not be greater than 50% of the annual irrigation diversion requirement.

(2) Maximum combined shortages in any two consecutive years should not be greater than 37.5% of the irrigation diversion requirements, and

(3) The average annual shortage over the 1956-1978 period should not be greater than 7%.

1/: Irrigation Development Plan for Central Luson, NIA/ECI, 1977

First, physically maximum irrigable areas by gravity irrigation are delineated on the available topographic map with a scale of 1 to 25,000 and a contour interval of 10 m as shown in Table-VII.35.

Irrigation diversion requirements for the delineated schemes are calculated as shown in Tables VII.31 to VII.34. In order to confirm the availability of water source for irrigation, water balance calculations are carried out based on the criteria mentioned above. Figures VII.3 to VII.10 shows the monthly water balance between available mean discharge and irrigation diversion requirement for 24 years from 1956 to 1979.

The amount of irrigation water shortage is calculated for each scheme as shown in Table-VII.36. Irrigation water for envisaged irrigation areas can be supplied by stream flow within the limitation of shortage mentioned above. Hence, the scale of irrigation area for each scheme is proposed as follows.

	Name of Scheme	Net Irrigation Area (ha)
Quinali (A) River basin		
i)	Cabilogan	1,400
ii)	Agos Sta. Cruz-South Quinali	4,350
iii)	Quinali	600
	Sub-total	6,350
Quinali (B) River basin		
iv)	Bantayan	2,400
	Total	8,750

7.4 Drainage Requirement

7.4.1 General

The drainage facilities are to be provided to remove the excess water in the fields taken place due to the heavy rainfall during storm and to create adequate conditions of drawdown in a harvesting period.

The unit drainage requirement is estimated referring the NIA design criteria 1/. Surface drains are designed so as to handle flows generated from 10-year storm frequencies.

7.4.2 Design rainfall

The 10-year, 1-day storm rainfall in the project area is calculated in Figs. VII.13 and VII.14 as follows.

Area	10-year, 1-day storm rainfall (mm/day)
Quinali (A) River basin	250
Quinali (B) River basin	300

These figures are used as a design rainfall for estimation of unit drainage requirement.

7.4.3 Unit drainage requirement

The unit drainage requirement is calculated by the following equation.

$$R = \frac{I - 100}{T} \times 10^4$$

where, R : Unit drainage requirement (l/sec/ha)
I : Design rainfall (mm/day) and
T : Drainage period (86,400 sec)

Using design rainfalls for both basins, unit drainage requirements for the Quinali (A) and Quinali (B) River basins are estimated at 17.4 l/sec/ha and 23.1 l/sec/ha, respectively.

1/: Design Criteria for Irrigation Canals, Drainage Channels and Appurtenant Structures, G.N. Iglesia.

VIII. FLOOD DAMAGE ANALYSIS

8.1 Damage to Infrastructure

8.1.1 Damage to Houses

8.1.1.1 Value of House

Houses in the project area are divided into three classes such as Type A, B and C considering the construction materials of roof and wall as shown in Municipal Socio-Economic and Physical Profile Document. 'Type A' houses are made of concrete and F.I./Aluminium. 'Type B' houses are made of wood. 'Type C' houses are made of bamboo slate and nipa.

House value of each type is assessed the average value estimated with construction cost on the basis of interview with the barangay captains. The values are estimated at P 80,000, P 20,000 and P 2,000 for 'Type A', 'Type B' and 'Type C' respectively.

8.1.1.2 Flood Damage Rate to Houses

Since there is no flood damage rate to be applicable in the Philippines, the damage rate on the basis of Japanese Standard is applied. The damage rate in relation to inundation depth is listed below.

Situation	Depth above floor level	Damage rate
Inundation below floor level	-	0.03
Inundation above floor level	0 - 0.5 m	0.053
	0.5 - 1.0 m	0.072
	1.0 - 2.0 m	0.109
	2.0 - 3.0 m	0.152
	Over 3.0 m	0.220

Source: The Ministry of Construction, Japan

8.1.1.3 The Number of Houses Inundated due to Flood

In counting the number of houses inundated due to flood, the following criteria are considered:

i) Distribution of the different type houses is assessed by the proportion obtained from the Socio-Economic & Physical Profile of Municipalities and the field interview with the barangay captains. The proportion is referred in TABLE-VII.1.

ii) Inundated barangays are obtained from the field survey and maps. The number of inundated barangays in 1979 is estimated at 49 in the Quinali (A) River Basin, 4 in the Yawa River Basin and 6 in the Quinali (B) River Basin respectively as shown in TABLE-VIII.2. The East and north-East Area is assumed to have no inundation.

iii) The total number of houses in the inundated barangays is estimated as household by the Socio-Economic & Physical Municipalities in 1977 and the data in 1980 collected by this survey.

iv) The number of inundated houses by typhoon "Pepang" in 1979 is estimated by the field survey of inundation depth, inundation area and flood damages, etc. The number of houses inundated for 10-year, 20-year, 50-year and 100-year probable flood is estimated based on the informations of the field survey and map.

8.1.1.4 Damage to Houses

In this study, the damage to houses is estimated on the dwelling units excluding the damages to public buildings such as schools, churches, factories, etc. TABLE-VIII.4 summarizes the damage to houses.

The damage to Houses by typhoon "Pepang" in 1979 is estimated at P 12.94 million at 1979 price level and the damage in each river basin is shown in TABLE-VIII.5. TABLE-VIII.4 includes the direct damage sustained by commercial establishments. This damage is estimated at about 10 percent of the damage to houses used by the Bureau of Public Works in their damage estimates.

The damages for 10-year, 20-year, 50-year and 100-year probable flood are estimated simultaneously as shown in TABLE-VIII.4 and TABLE-VIII.6 to TABLE-VIII.9. These damage costs are P 24.62 million, P 32.33 million, P 43.77 million and P 52.00 million respectively.

8.1.2 Damage to Government Infrastructure

8.1.2.1 Damage to Road Structures

Due to flood water and sand sedimentation brought by the flood, the various kinds of roads such as national road, provincial road, municipal road, city road and barangay road, have been damaged every year. In the extreme case, roads and bridges were washed away by rushing flood water. Besides, travel time or transportation cost increased during the flood time, which gave adverse effect on the province economy.

Flood damages to roads are classified into the following three categories:

i) Damage to bridges, culverts, pipes, ditches and reconstruction of embankment, surfacing, riprapping, etc.
ii) Increase of travel cost for the detouring.
iii) Decrease of regional product such as gross regional product resulting from temporary closure of major transportation arteries.

The detailed damage to roads by each typhoon during the period of 1975 - 1979 are listed in TABLE-VIII.10 to TABLE-VIII.13.

Damage to bridges and roads can be approximately measured by the estimated damage costs, since the estimated damage costs due to each typhoon and heavy rain are submitted as the calamity fund to the Government from the Ministry of Public Highway, the Provincial Engineering Office, the City Engineering Office and the Municipalities. While, the rehabilitation costs in each year are not sufficiently released to reconstruct the damaged bridges and roads.

For the damages in categories ii) and iii), these indirect damages are assumed to be 15 percent of the direct estimated damage costs. This value is used by the Bureau of Public Works in their damage estimate.

8.1.2.2 Damage to Railway Structures

Railway located at the east area of Mayon Volcano from Legazpi City to Tabaco was destroyed and dismantled by the eruptionin 1938. The railway from Daraga to Camalig was damaged by debris flow in 1969 after the eruption of 1968 and many bridges were damaged heavily in 1975 by flood and debris flow from Mayon Volcano. The railway system in Albay Province has been dismantled between Camalig and Legazpi City at present.

In estimating the damage costs, the dismantled railway from Daraga to Tabaco is excluded and the estimated damage cost from 1975 to 1979 are obtained from the Philippine National Railway. The railway of the project area is located only in the Quinali (A) River basin.

The detailed damage to railway trucks and bridges caused by flood is summarized in TABLE-VIII.14. The damage in 1975 from Daraga to Camalig is considered in this study.

These estimated damage costs are revalued at 1979 price level, which are P 6.11 million and P 0.32 million for the flood in 1975 and 1979 respectively.

8.1.2.3 Damage to River Facilities

In the project area, flooding of the main rivers such as the Quinali (A) River, the Yawa River and the Quinali (B) River has done damages to river structures. These damages are caused by washing out and eroding dikes and scouring boulder riprap.

The detailed damage to river facilities by each typhoon during 1975 - 1979 is listed in TABLE-VIII.15 to TABLE-VIII.18. These damage costs are measured by the estimated damage costs submitted as the calamity fund to the Government from the Ministry of Public Works and the City Engineering Office.

8.2 Damages to Irrigation Facilities

8.2.1 Past Damages

The flood damages to the irrigation facilities in both National and Communal Irrigation Systems had been investigated by NIA staffs just often every flood in the past 5 years from 1975 to 1979. These damages are summarized in TABLE-VIII.20 through TABLE-VIII.25. In addition, the damages on the temporary irrigation facilities constructed by farmers themselves are also included in the above tables, which are estimated to be around 30% of the total damages on the National and Communal Systems based on the result of field investigation.

8.2.2 Forecast of Damages to Irrigation Facilities

Major floods which occurred during 5 years from 1976 to 1979 almost correspond to the probable flood with 2-year return period. The amounts of damage to irrigation facilities due to the floods are ranging from P 104,000 to P 494,000 in the said period. On the other hand, the flood due to Typhoon "Sisang" in 1975 corresponds to the probable flood with a return period of more than 20-year. However, the amount of flood damages is only P 156,500 which does not exceed the above maximum of P 494,000. This indicates that the flood damage does not increase in proportion to the magnitude of flood and therefore it is difficult to establish the relation between the flood damage and flood magnitude. For the estimation of the flood damages, the biggest damages during the said 5 years which was caused by typhoon "Pepang" in 1979 is adopted as the flood damage to be caused by the probable flood with a return period of 2-year.

The damages to be caused by the probable floods with return periods of more than 2-year are estimated by employing the damage increase rates applied for forecast of the damage to infrastructure assuming that the damage to irrigation facilities is qualitatively the same as that to infrastructure.

8.3 Damage to Crop

Flood damage to crops in the project area is estimated by the analytical method in the with- and without project conditions. Past records on the crop damage are used subsidiary. Crop damage by floods is made majorly on palay. Damage to the upland crops such as coconut, abaca maize, sweet potato, taro is negligibly small because these crops are planted, for the most cases, on the flood-free areas. Parameters of the flood damage to palay are the area of standing crop, expected net income by the farming, production cost already spend by the date when flood occurred, growth stage of the crop (cropping pattern), inundation depth, inundation duration, flood velocity, monthly occurrence frequency of floods and sediment flows and debris flows.

Crop damage by flood can be expressed as

$$D = (I + C) \times R$$

where, D is the crop damage, I is the net income in without-flood condition, C is the production cost already spent by the date when flood occurred and R is the crop damage rate. The net income in without-flood condition and the production cost already spent by the date when flood occurred are estimated from the typical farm budget. The crop damage rate is determined following the standard table for the palay damage prepared by the Ministry of Agriculture, Forestry and Fisheries of Japan. The damage rate is the sum of the rates for the inundation damage and the lodging damage in which inundation damage rate is the product of the interaction among the growth stage, inundation depth, inundation duration and debris content, and the lodging damage rate is the product of the interaction among the growth stage, flood depth and flood velocity. The complete lodging is caused in maturing stage if the flood depth is above around knee high and that the flood velocity becomes around 2 m/sec or more.

The area of standing crop is estimated based on the cropping pattern and is expressed reflecting the ratio of area of standing crop to the total planted area.

The monthly frequency of floods is expressed in terms of the monthly frequency of occurrence of typhoons in the project area, which is obtained from the Meteological Agency of Japan.

IX. COST ESTIMATE

9.1 Detailed Estimate

The detailed estimate of construction cost including physical contingency of each works of this project is made considering the previous design report for the Mayon Volcano Sabo and Flood Control Project in 1979. Work items are as follows.

(1) Sabo Works

The Quinali (A) River Basin: 6 tributaries (TABLE-IX.2 to TABLE-IX.7)

The Quirangay River, The Tumpa River, The Maninila River, The Masarawag River, The Ogsong River, The Nasisi River

The Quinali (B) River Basin: 1 tributary (TABLE-IX.8)

The Buang River

The Yawa River Basin: 3 tributaries (TABLE-IX.9 to TABLE-IX.11)

The Anuling River, The Budiao River, The Pawa-Burabod River

(2) River improvement Works

The Quinali (A) River: 3 major rivers (TABLE-IX.12)

The Quinali (A) River, The Nasisi River, The Talisay River

The Quinali (B) River: 2 major rivers (TABLE-IX.13)

The Quinali (B) River, The San Francisco River, The San Vicente River

The Yawa River: (TABLE-IX.14)

The Quinali (A) River: Diversion to the Talisay River (TABLE-IX.15)

(3) Irrigation Works

The Quinali (A) River Basin (TABLE-IX.16)

The Quinali (B) River Basin (TABLE-IX.17)

9.2 Financial Cost

The financial cost of each river basin is described in the MAIN REPORT. The foreign and local currency portion of the construction cost is roughly estimated on the following conditions. These estimates are shown in the TABLE-IX.18 to TABLE-IX.20.

i) Only the machinery cost, the cost of steel products and cement are included in the foreign currency portion, while most of the materials and laborer are assumed to be procured locally.

ii) The local currency portion includes the costs for general contractor's profit, contractor's tax, surcharges, land acquisition, resettlement, engineering and administration.

TABLES

TABLE-I.1 RECORDED ANNUAL MAXIMUM RAINFALL AT BACACAY

Duration	1 - day		3 - day		Remarks
Year	Occurrence date	Amount	Occurrence date	Amount	(No record period)
1971	Dec. 11	121.6	Dec. 10-12	311.6	Jan. - June
1972	June 25	129.5	June 24-26	152.8	
1973	Dec. 17	153.6	Dec. 17-19	234.4	
1974	June 8	156.6	June 7- 9	453.8	
1975	Apr. 23	127.4	Dec. 18-20	239.8	
1976	Jan. 9	127.0	May 18-20	224.3	Dec.
1977	Nov. 4	99.4	Nov. 3- 5	189.5	Dec.
1978	Nov. 20	88.1	Dec. 23-25	134.1	
1979	Sept.19	146.3	Apr. 14-16	123.1	Nov. - Dec.

TABLE-I.2 RECORDED ANNUAL MAXIMUM RAINFALL AT GUINOBATAN

Duration / Year	1 - day Occurrence date	1 - day Amount	3 - day Occurrence date	3 - day Amount	Remarks (No record period)
1956	Dec. 9	194.3	Dec. 7- 9	282.4	
1957	Nov. 11	99.6	Aug. 8-10	164.1	
1958	Oct. 28	258.3	Oct. 27-29	485.1	
1959	Nov. 16	295.9	Nov. 14-16	363.0	
1960					No Record
1961	July 4	122.9	July 3- 5	122.9	
1962	May 17	133.1	May 16-18	200.6	
1963	Aug. 13	135.4	Aug. 11-13	270.0	
1964	Dec. 13	126.5	Dec. 12-14	184.9	
1965	July 12	73.5	July 11-13	101.9	
1966	Dec. 18	172.7	Dec. 25-27	288.0	
1967	Sept. 2	179.9	Sept. 2- 4	222.8	
1968	Dec. 22	301.8	Dec. 21-23	335.8	May-Aug., Nov.
1969	Dec. 11	84.6	Dec. 9 -11	195.7	Jan., June
1970	Feb. 5	112.2	Nov. 22-24	560.1	
1971	Dec. 28	146.9	Dec. 27-29	206.3	Feb.
1972	June 24	189.3	Jun. 23-25	200.7	
1973	Nov. 19	145.3	Nov. 19-21	281.8	
1974	Dec. 20	250.9	June 8-10	400.5	Sept.
1975	Nov. 25	214.3	Nov. 24-26	456.7	
1976	Dec. 4	292.1	Dec. 3- 5	366.8	
1977	July 22	86.8	Nov. 2- 4	140.2	
1978	Oct. 6	84.3	Oct. 22-24	111.7	
1979	Apr. 18	160.1	Apr. 17-19	197.5	Aug. - Dec.

TABLE-I.3 RECORDED ANNUAL MAXIMUM RAINFALL AT LEGASPI

Duration	1 - day		3 - day		Remarks
Year	Occurrence date	Amount	Occurrence date	Amount	(No record period)
1956	Sept. 19	169.7	Apr. 7- 9	251.4	
1957	Oct. 12	90.7	Nov. 10-12	149.2	
1958	Oct. 28	263.9	Oct. 28-30	449.1	
1959	Nov. 16	150.1	Nov. 14-16	270.7	
1960	June 25	294.1	Apr. 21-23	347.5	Jan. - Mar.
1961	Aug. 31	83.8	June 17-.9	116.6	
1962	Apr. 17	189.7	May 16- 18	207.5	
1963	Aug. 13	178.3	Aug. 12-14	313.5	
1964	Dec. 13	172.5	Apr. 27-29	220.2	
1965	July 12	174.0	July 11-13	217.0	
1966	Jan. 2	236.3	Jan. 2- 4	319.3	
1967	Nov. 3	484.8	Nov. 1- 3	578.0	
1968	Jan. 28	173.5	Jan. 27-29	264.8	
1969	Dec. 11	116.2	Dec. 9-11	244.3	
1970	Dec. 13	130.9	Nov. 22-24	235.9	
1971	Mar. 11	209.2	Mar. 10-12	337.4	
1972	June 24	236.6	June 22-24	268.9	
1973	Nov. 20	190.8	Dec. 12-14	319.5	
1974	June 9	247.6	June 8-10	421.7	
1975	Dec. 26	458.6	Dec. 24-26	744.9	
1976	May 18	155.8	Jan. 1- 3	274.5	
1977	Nov. 4	137.2	Nov. 2- 4	173.5	Mar. - Apr.
1978	Oct. 26	171.5	Oct. 24-26	193.2	Jan.
1979	Sept. 18	161.2	Sept.16-18	237.8	Oct.

TABLE-I.4 RECORDED ANNUAL MAXIMUM RAINFALL AT MALAMA

Duration / Year	1 - day Occurrence date	1 - day Amount	3 - day Occurrence date	3 - day Amount	Remarks (No record period)
1971	Aur. 3	85.9	Oct. 2-4	115.8	Jan. - June, Sept.
1972	June 24	69.4	Aug. 12-14	149.2	
1973	Dec. 18	101.2	Oct. 5- 7	253.6	
1974	June 8	70.3	June 7- 9	120.9	Apr., Dec.
1975					No Record
1976	Nov. 29	55.4	Nov. 27-29	113.6	Jan.-July., Dec.
1977	July 17	92.0	July 16-18	129.6	Jan.
1978	Oct. 26	84.1	Sept.25-27	162.8	
1979	Apr. 17	100.7	Apr. 16-18	217.8	June - Dec.

TABLE-I.5 RECORDED ANNUAL MAXIMUM RAINGALL AT ALLANG

Duration / Year	1 - day Occurrence date	1 - day Amount	3 - day Occurrence date	3 - day Amount	(No record period)
1975	Jan. 7	231.1	Jan. 5- 7	424.1	Mar.
1976	Nov. 28	82.6	Nov. 27-29	191.8	Dec.
1977	July 22	204.3	July 1- 3	310.8	
1978	Sept. 4	154.9	Sept. 4- 6	307.1	
1979	Sept.18	174.3	Aug. 14-16	360.8	

TABLE-I.6 RECORDED ANNUAL MAXIMUM RAINFALL AT STO. DOMINGO

Duration	1 - day		3 - day		
Year	Occurrence date	Amount	Occurrence date	Amount	(No record period)
1956	Sept.19	218.7	Apr. 7- 9	340.9	
1957	Nov. 10	142.7	Nov. 10-12	235.4	
1958	Oct. 28	207.5	Oct. 27-29	339.3	
1959	Nov. 16	191.5	Nov. 14-16	364.2	
1960	Oct. 5	126.0	Oct. 4- 6	285.7	
1961	June 19	80.0	Nov. 7- 9	143.8	
1962	May 17	154.4	Nov. 5- 7	198.6	
1963	Aug. 12	141.0	Aug. 12-14	287.3	
1964	Sept.28	215.4	Sept.28-30	223.5	
1965	July 12	129.8	Jan. 16-18	201.6	
1966	Nov. 19	254.0	Nov. 17-19	289.6	
1967	Nov. 3	362.7	Nov. 1- 3	472.5	
1968	Jan. 28	145.3	Jan. 27-29	239.3	
1969	Dec. 11	159.5	Dec. 10-12	268.0	
1970	Oct. 12	163.6	Oct. 12-14	331.0	
1971	Jan. 28	141.2	Mar. 10-12	269.0	
1972	June 24	161.6	Jan. 28-30	222.1	
1973	Dec. 17	163.9	Dec. 17-19	311.2	
1974	June 9	210.9	June 8-10	308.7	Jan.
1975	Dec. 25	196.6	Dec. 23-25	390.8	
1976	Dec. 4	204.0	Dec. 3- 5	309.8	
1977	Nov. 13	182.8	Nov. 2-4	270.7	
1978	Sept.26	171.9	Dec. 23-25	195.4	Jan.
1979	Sept.18	149.0	Sept.16-18	241.0	

TABLE-I.7 RECORDED ANNUAL MAXIMUM RAINFALL AT TABACO

Duration / Year	1 - day Occurrence date	1 - day Amount	3 - day Occurrence date	3 - day Amount	Remarks (No record period)
1971	July 8	96.5	July 7- 9	188.0	Jan. - June, Dec.
1972	Aug. 13	193.0	Aug.12-14	281.9	Jan. - May
1973	Nov. 20	205.7	Nov.18-20	391.2	July - Aug.
1974	June 9	335.3	June 7- 9	419.1	
1975	Dec. 18	294.6	Dec.17-19	386.1	
1976	Dec. 4	322.6	Dec. 3- 5	833.1	Feb.
1977	Apr. 12	63.5	Dec.-Jan.30-1	231.1	May - Dec.
1978	Oct. 18	271.8	Oct. 17-19	546.1	Jan.-Sept., Dec.

TABLE-1.8 RECORDED ANNUAL MAXIMUM RAINFALL AT MALINAO

Duration / Year	1 - day Occurrence date	1 - day Amount	3 - day Occurrence date	3 - day Amount	Remarks (No record period)
1972	Jan. 30	226.4	Jan.29-31	341.4	
1973	Oct. 6	191.7	Dec. 16-18	271.4	Nov.
1974	Dec. 20	211.5	Dec. 14-16	248.3	
1975	Apr. 23	164.9	Dec. 18-20	485.5	
1976	Dec. 4	263.9	Dec. 29-31	385.4	
1977	Nov. 13	236.2	Nov. 11-13	277.3	Apr.
1978	Sept. 26	164.4	June 27-29	287.4	
1979	Sept. 18	94.8	Nov. 28-30	186.0	

TABLE-I.9 RECORDED ANNUAL MAXIMUM HOURLY RAINFALL AT LEGASPI

Duration	6 - hours		12 - hours		Remarks
Year	Occurrence date	Amount	Occurrence date	Amount	(No record period)
1970	Oct. 13	77.0	Oct. 13	113.8	
1971	Dec. 29	139.4	Mar. 17-18	181.9	
1972	June 24	165.0	June 24-25	192.7	
1973	Nov. 20	90.2	Dec. 18	154.7	
1974	Nov. 12	163.6	Nov. 12	204.8	
1975	Dec. 25	250.5	Dec. 24-25	252.5	
1976	Dec. 4	119.9	Dec. 4	214.1	
1977	Dec. 1	111.2	Nov. 4	141.2	
1978	Oct. 6	149.2	Oct. 26	164.8	
1979	Sept.18	96.0	Sept.18	129.2	
1980	Mar. 23	100.8	Mar. 23	148.6	July-Dec.

Duration	18 - hours		24 - hours		
Year	Occurrence date	Amount	Occurrence date	Amount	(No record period)
1970	Oct. 13	138.7	Feb, 5- 6	161.6	
1971	Mar. 17-18	245.7	Mar. 17-18	276.7	
1972	June 24	208.9	June 24-25	236.6	
1973	Nov. 20-21	175.6	Nov. 20	198.1	
1974	Nov. 12	205.8	June 9-10	233.5	
1975	Dec. 24-25	258.3	Dec. 24-25	357.6	
1976	Dec. 4- 5	248.9	Dec. 24-25	279.9	
1977	Nov. 4	160.3	Nov. 4	181.1	
1978	Oct. 26	168.4	Oct. 26	171.5	
1979	Sept.18	160.6	Sept.18	186.6	
1980	Mar. 23	161.6	Mar. 23	161.6	July - Dec.

TABLE-I.10 ANNUAL MAXIMUM BASIN AVERAGE 1-DAY RAINFALL OF THE QUINALI (A) RIVER BASIN INCLUDING THE TALISAY RIVER

Year	Occurrence date	Name of Station					Basin Average
		Guinobatan	Malama	Allang	Polangui	Bato	
1972	July 24	189.3 (0.55)	69.4 (0.36)	- -	- -	198.9 (0.09)	147.0
1973	Oct. 14	137.2 (0.55)	50.6 (0.36)	-	-	159.8 (0.09)	108.1
1974	June 9	250.9 (0.55)	70.3 (0.36)	-	-	135.2 (0.09)	175.5
1975	Nov. 25	214.3 (0.55)	*136.5 (0.36)	-	-	*149.6 (0.09)	180.5
1976	Dec. 4	292.1 (0.55)	*186.1 (0.36)	-	-	*203.9 (0.09)	264.4
1977	July 22	86.8 (0.40)	61.3	204.3 (0.32)	19.0 (0.28)	84.3	105.4
1978	Oct. 26	22.8 (0.40)	84.1	114.3 (0.32)	106.6 (0.28)	-	75.5
1979	Apr. 18	160.1 (0.40)	36.9	103.9 (0.32)	58.0 (0.28)	-	113.5

Note; (1) The drainage area of the subject basin is 523 km^2

(2) The parenthesized figures are Thissen's weights.

(3) The astarisked figures were estimated by simple regression analysis.

TABLE-I.11 COEFFICIENT OF CORRELATION AMONG STATIONS IN THE QUINALI (A) RIVER BASIN INCLUDING THE TALISAY RIVER

	Guinobatan	Malama	Allang	Polangui	Bato
Guinobatan		0.45 (90)	0.11 (28)	0.17 (17)	0.59 (62)
Malama	0.45 (90)		0.50 (22)	0.45 (14)	0.20 (42)
Allang	0.11 (28)	0.50 (22)		0.75 (11)	-
Polangui	0.17 (17)	0.45 (14)	0.75 (11)		-
Bato	0.59 (62)	0.20 (42)	-	-	

Note; The parenthesized figures mean number of samples.

TABLE-I.12 REPRESENTATIVE RAINFALL STATIONS

Base point No. concerned to basin	Representative station	Remarks
A-1 - A-48, A-58 - A-59	Guinobatan	Quinali (A) River basin
A-49 - A-57	Allang	Talisay River basin
Y-1 - Y-14	Legaspi	Yawa River basin
O-1 - O-9	Sto. Domingo	Northeast - Southeast torrents' basins
O-10 - O-15, B-1 - B-21	Malinao	Part of northeast-southeast torrents' basins Quinali (B) River basin

Note; A means the Quinali (A) River

Y means the Yawa River

O means the northeast - southeast torrents

B means the Quinali (B) River

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A- 1	QUIRANGAY RIVER	9.3	110-2400	9.75	0.2349- 0.235	46.	0.70	1	73.8	15.2	27.
								2	203.4	37.3	67.
								5	299.2	67.4	122.
								10	361.4	92.0	166.
								20	422.3	118.2	214.
								50	500.0	153.3	277.
								100	558.3	184.4	333.
A- 2	TRIBUTARY	5.6	110- 510	5.38	0.0743- 0.074	26.	0.70	1	75.4	16.5	18.
								2	207.6	40.1	44.
								5	305.5	73.6	80.
								10	368.9	104.7	111.
								20	431.1	131.9	144.
								50	510.4	172.9	188.
								100	569.9	209.9	229.
A- 3	IRAYA RIVER	14.9	110-2400	9.75	0.2349- 0.235	46.	0.70	1	72.2	14.8	43.
								2	198.9	36.5	106.
								5	292.6	65.9	191.
								10	353.4	90.0	261.
								20	413.0	115.5	335.
								50	489.0	149.9	434.
								100	546.0	180.3	522.
A- 4	TAGAYTAY RIVER	26.7	100-2400	15.00	0.0019- 0.235	88.	0.70	1	69.9	12.9	67.
								2	192.5	32.1	166.
								5	283.3	56.4	293.
								10	342.2	75.6	392.
								20	399.8	95.5	496.
								50	473.4	121.9	633.
								100	528.6	144.6	751.
A- 5	TRIBUTARY	16.4	100- 160	6.90	0.0087- 0.009	38.	0.70	1	71.8	15.1	48.
								2	197.9	37.0	118.
								5	291.2	67.3	215.
								10	351.7	92.3	296.
								20	410.9	118.9	379.
								50	486.5	154.9	494.
								100	543.3	186.9	596.
A- 6	TAGAYTAY RIVER	43.1	100-2400	15.00	0.0019- 0.235	88.	0.70	1	67.8	12.5	104.
								2	186.7	31.1	261.
								5	274.6	54.6	458.
								10	331.7	73.3	614.
								20	387.6	92.6	776.
								50	458.9	118.2	991.
								100	512.4	140.2	1175.

NOTE: CONCE. --- CONCENTRATION SQ.KM --- SQUARE KILOMETERS MMSL --- METERS ABOVE MEAN SEA LEVEL
MIN --- MINUTES MM/D --- MILLIMETERS PER DAY MM/H --- MILLIMETERS PER HOUR
CMS --- CUBIC METERS PER SECOND KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A- 7	TAGAYTAY RIVER	44.0	95-2400	16.73	0.0029- 0.235	102.	0.70	1	67.7	12.0	103.
								2	186.4	30.1	258.
								5	274.2	52.5	450.
								10	331.2	70.1	600.
								20	387.0	88.2	755.
								50	458.2	112.1	959.
								100	511.7	132.5	1134.
A- 8	TUMPA RIVER	5.7	95- 525	7.75	0.0555- 0.055	37.	0.70	1	75.3	15.9	18.
								2	207.5	39.0	43.
								5	305.3	70.9	79.
								10	368.7	97.3	106.
								20	430.8	125.4	139.
								50	510.1	163.5	181.
								100	569.6	197.4	219.
A- 9	TAGAYTAY RIVER	49.7	95-2400	16.73	0.0029- 0.235	102.	0.70	1	67.1	11.9	115.
								2	184.8	29.9	289.
								5	271.9	52.1	503.
								10	328.3	69.5	672.
								20	383.7	87.5	845.
								50	454.3	111.2	1074.
								100	507.2	131.3	1269.
A-10	CABILOGAN RIVER	52.1	94-2400	17.61	0.0020- 0.235	109.	0.70	1	66.8	11.7	118.
								2	184.1	29.3	297.
								5	270.9	51.0	516.
								10	327.2	67.8	687.
								20	382.3	85.2	863.
								50	452.7	108.0	1094.
								100	505.5	127.4	1291.
A-11	MANINILA RIVER	4.9	94-2400	10.65	0.2165- 0.217	51.	0.70	1	75.7	15.4	15.
								2	208.6	37.9	36.
								5	307.0	68.2	65.
								10	370.8	93.0	89.
								20	433.2	119.1	114.
								50	513.0	154.2	147.
								100	572.8	185.2	176.
A-12	CABILOGAN RIVER	57.0	94-2400	17.61	0.0020- 0.235	109.	0.70	1	66.4	11.6	129.
								2	182.9	29.1	323.
								5	269.1	50.6	561.
								10	325.0	67.4	747.
								20	379.8	84.6	938.
								50	449.7	107.3	1189.
								100	502.1	126.6	1403.

NOTE: CONCE. --- CONCENTRATION; MIN --- MINUTES; CMS --- CUBIC METERS PER SECOND; SQ.KM --- SQUARE KILOMETERS; MM/D --- MILLIMETERS PER DAY; MMSL --- METERS ABOVE MEAN SEA LEVEL; MM/H --- MILLIMETERS PER HOUR; KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFFICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-13	CABILOGAN RIVER	58.1	30-2400	19.31	0.0082- 0.235	118.	0.70	1	66.3	11.3	128.
								2	182.6	28.5	322.
								5	268.7	49.3	557.
								10	324.5	65.4	739.
								20	379.2	82.0	926.
								50	449.0	103.7	1171.
								100	501.4	122.0	1378.
A-14	TRAPICIA RIVER	4.9	80- 823	8.80	0.0844- 0.084	42.	0.70	1	75.7	15.8	15.
								2	208.6	38.7	37.
								5	307.0	70.1	67.
								10	370.8	96.0	91.
								20	433.2	123.5	118.
								50	513.0	160.6	153.
								100	572.8	193.5	184.
A-15	CABILOGAN RIVER	63.0	80-2400	19.31	0.0082- 0.235	118.	0.70	1	65.9	11.3	138.
								2	181.5	28.3	347.
								5	267.0	49.0	600.
								10	322.5	65.0	796.
								20	376.9	81.5	998.
								50	446.2	103.0	1262.
								100	498.2	121.2	1485.
A-16	CABILOGAN RIVER	73.4	68-2400	21.34	0.0070- 0.235	130.	0.70	1	65.1	10.8	155.
								2	179.3	27.3	390.
								5	263.8	47.0	671.
								10	318.6	62.2	887.
								20	372.3	77.7	1109.
								50	440.8	98.0	1398.
								100	492.2	115.0	1642.
A-17	MASARAWAG RIVER	10.5	68-2400	12.23	0.1907- 0.191	58.	0.70	1	73.4	14.6	30.
								2	202.3	36.1	74.
								5	297.6	64.6	132.
								10	359.4	87.7	179.
								20	420.0	112.1	229.
								50	497.3	144.6	295.
								100	555.2	173.2	354.
A-18	SAN FRANCISCO R.	83.9	68-2400	21.34	0.0070- 0.235	130.	0.70	1	64.4	10.7	175.
								2	177.3	27.0	441.
								5	260.9	46.5	759.
								10	315.1	61.5	1003.
								20	368.1	76.8	1253.
								50	435.9	96.9	1581.
								100	486.7	113.7	1856.

NOTE: CONCE. --- CONCENTRATION; SQ.KM --- SQUARE KILOMETERS; MMSL --- METERS ABOVE MEAN SEA LEVEL
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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-19	SAN FRANCISCO R.	91.4	60-2400	24.79	0.0023- 0.235	157.	0.70	1	63.9	10.0	178.
								2	176.0	25.4	452.
								5	258.9	43.2	768.
								10	312.8	56.7	1007.
								20	365.4	70.6	1251.
								50	432.7	88.2	1567.
								100	483.1	103.0	1830.
A-20	CABILOGAN RIVER	128.8	38-2400	34.79	0.0022- 0.235	236.	0.70	1	61.9	8.3	208.
								2	170.5	21.4	535.
								5	250.9	35.3	884.
								10	303.0	45.5	1139.
								20	354.1	55.7	1395.
								50	419.2	68.9	1725.
								100	468.1	79.5	1992.
A-21	BUBLUSAN CREEK	18.9	60-1070	13.75	0.0188- 0.135	68.	0.70	1	71.3	13.8	51.
								2	196.4	34.3	126.
								5	289.0	61.0	224.
								10	349.0	82.5	303.
								20	407.8	105.0	386.
								50	482.9	134.9	496.
								100	539.2	161.1	592.
A-22	NABONTON CREEK	8.3	60-2400	13.45	0.1740- 0.174	64.	0.70	1	74.2	14.5	23.
								2	204.4	36.0	58.
								5	300.7	64.1	104.
								10	363.2	86.9	140.
								20	424.3	110.7	179.
								50	502.4	142.6	230.
								100	561.0	170.3	275.
A-23	OGSONG RIVER	27.2	60-1070	13.75	0.0188- 0.135	68.	0.70	1	69.8	13.5	72.
								2	192.3	33.6	177.
								5	283.0	59.7	316.
								10	341.8	80.7	427.
								20	399.4	102.8	544.
								50	472.9	132.2	699.
								100	528.0	157.7	834.
A-24	OGSONG RIVER	38.1	38-1070	21.35	0.0029- 0.135	128.	0.70	1	68.3	11.4	85.
								2	188.2	28.8	213.
								5	277.0	49.6	367.
								10	334.5	65.6	486.
								20	390.9	82.0	607.
								50	462.8	103.4	766.
								100	516.7	121.4	900.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-25	NASISI RIVER	11.0	190-2400	9.25	0.2389- 0.239	44.	0.70	1	73.3	15.2	52.
								2	201.8	37.2	80.
								5	296.9	67.4	144.
								10	358.7	92.1	197.
								20	419.1	118.4	253.
								50	496.2	153.8	329.
								100	554.0	185.1	396.
A-26	NASISI RIVER	7.7	190-1328	4.95	0.2299- 0.230	24.	0.70	1	74.4	16.4	24.
								2	205.0	39.8	60.
								5	301.6	73.2	110.
								10	364.3	101.3	152.
								20	425.7	131.4	197.
								50	504.0	172.5	258.
								100	562.8	209.7	314.
A-27	NASISI RIVER	18.7	190-2400	9.25	0.2389- 0.239	44.	0.70	1	77.3	14.8	54.
								2	196.5	36.3	132.
								5	289.1	65.6	239.
								10	349.2	89.7	326.
								20	408.1	115.3	419.
								50	483.2	149.7	544.
								100	539.5	180.3	656.
A-28	NASISI RIVER	26.7	100-2400	12.25	0.1878- 0.188	58.	0.70	1	69.9	13.9	72.
								2	192.5	34.3	178.
								5	283.3	61.5	319.
								10	342.2	83.5	433.
								20	399.8	106.7	554.
								50	473.4	137.6	715.
								100	528.6	164.8	856.
A-29	BUGA RIVER	7.7	100-2400	11.13	0.2066- 0.207	53.	0.70	1	74.4	15.0	22.
								2	205.0	37.0	55.
								5	301.6	66.5	100.
								10	364.3	90.6	136.
								20	425.7	116.0	174.
								50	504.0	150.0	225.
								100	562.8	180.0	269.
A-30	NASISI RIVER	34.4	100-2400	12.25	0.1878- 0.188	58.	0.70	1	68.8	13.7	92.
								2	189.5	33.8	226.
								5	278.8	60.5	405.
								10	336.8	82.2	550.
								20	393.5	105.0	702.
								50	465.9	135.5	906.
								100	520.3	162.2	1085.

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TABLE-I.13

PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-31	NASISI RIVER	35.7	80-2400	13.33	0.1740- 0.176	63	0.70	1	68.6	13.5	93.
								2	189.1	33.3	231.
								5	278.2	59.4	413.
								10	336.0	80.5	559.
								20	392.6	102.7	713.
								50	464.8	132.2	918.
								100	519.0	158.0	1097.
A-32	NASISI RIVER	39.2	40-2400	19.91	0.0046- 0.151	109.	0.70	1	68.2	11.9	91.
								2	187.9	29.9	228.
								5	276.4	52.0	396.
								10	333.9	69.2	528.
								20	390.1	86.9	663.
								50	461.9	110.3	840.
								100	515.8	130.1	991.
A-33	NASISI RIVER	6.6	40- 82	6.00	0.0033- 0.011	38.	0.70	1	74.9	15.8	20.
								2	206.3	38.6	50.
								5	303.5	70.2	90.
								10	366.6	96.3	124.
								20	428.4	124.1	159.
								50	507.2	161.6	207.
								100	566.3	195.1	250.
A-34	NASISI RIVER	84.2	38-2400	20.91	0.0061- 0.151	117.	0.70	1	64.3	11.0	181.
								2	177.2	27.8	455.
								5	260.8	48.1	787.
								10	315.0	63.8	1044.
								20	368.0	80.0	1309.
								50	435.8	101.2	1656.
								100	486.6	119.1	1950.
A-35	QUINALI(A) RIVER	213.0	38-2400	34.79	0.0022- 0.235	236.	0.70	1	58.7	7.9	326.
								2	161.8	20.3	840.
								5	238.0	33.5	1387.
								10	287.5	43.2	1788.
								20	335.9	52.8	2189.
								50	397.8	65.3	2706.
								100	444.1	75.5	3126.
A-36	QUINALI(A) RIVER	216.1	20-2400	45.04	0.0020- 0.235	318.	0.70	1	58.6	6.8	287.
								2	161.5	17.8	749.
								5	237.7	28.8	1211.
								10	287.0	36.6	1540.
								20	335.4	44.4	1867.
								50	397.1	54.4	2286.
								100	443.4	62.4	2621.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-37	SALOG RIVER	30.3	22-1328	17.90	0.0042- 0.301	129.	0.70	1	69.4	11.6	68.
								2	191.1	29.2	172.
								5	281.1	50.2	296.
								10	339.5	66.4	391.
								20	396.2	83.0	489.
								50	469.7	104.6	616.
								100	524.5	122.9	724.
A-38	MAGKASLA RIVER	17.3	22- 367	16.50	0.0035- 0.037	104.	0.70	1	71.6	12.7	43.
								2	197.3	31.7	107.
								5	290.4	55.3	186.
								10	350.7	73.7	248.
								20	409.8	92.8	312.
								50	485.2	117.8	396.
								100	541.7	139.1	468.
A-39	SALOG RIVER	47.6	22-1328	17.90	0.0042- 0.301	129.	0.70	1	67.3	11.2	104.
								2	185.3	28.3	262.
								5	272.7	48.7	453.
								10	329.4	64.4	596.
								20	384.9	80.5	745.
								50	455.7	101.5	939.
								100	508.8	119.2	1103.
A-40	MAGKASLU RIVER	13.9	40-1328	7.50	0.0045- 0.241	43.	0.70	1	72.5	15.1	41.
								2	199.6	37.0	100.
								5	293.6	66.9	181.
								10	354.7	91.6	247.
								20	414.4	117.8	318.
								50	490.7	153.0	414.
								100	547.9	186.3	498.
A-41	TRIBUTARY	11.2	40- 800	5.10	0.1490- 0.149	24.	0.70	1	73.2	16.1	35.
								2	201.7	39.1	85.
								5	296.7	71.8	156.
								10	358.4	99.3	216.
								20	418.7	128.9	281.
								50	495.8	169.0	368.
								100	553.6	205.4	447.
A-42	TRIBUTARY	25.1	40-1328	7.50	0.0045- 0.241	43.	0.70	1	70.2	14.6	71.
								2	193.3	35.8	175.
								5	284.4	64.8	316.
								10	343.4	88.7	433.
								20	401.3	114.0	557.
								50	475.2	148.2	723.
								100	530.6	178.5	871.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-43	POLANGUI RIVER	79.1	20-1328	19.40	0.0039- 0.301	141.	0.70	1	64.7	10.5	162.
								2	178.2	26.6	409.
								5	262.2	45.5	599.
								10	316.6	59.9	921.
								20	370.0	74.6	1148.
								50	438.1	93.9	1464.
								100	489.1	110.0	1691.
A-44	QUINALI(A) RIVER	295.2	20-2400	45.04	0.0020- 0.235	318.	0.70	1	56.5	6.6	378.
								2	155.7	17.2	986.
								5	229.0	27.8	1594.
								10	276.6	35.3	2027.
								20	323.2	42.8	2458.
								50	382.7	52.4	3010.
								100	427.3	60.1	3450.
A-45	QUINALI(A) RIVER	297.3	15-2400	50.44	0.0018- 0.235	360.	0.70	1	56.5	6.2	356.
								2	155.5	16.1	954.
								5	228.8	25.9	1495.
								10	276.4	32.7	1891.
								20	322.9	39.5	2283.
								50	382.4	48.2	2785.
								100	426.9	55.1	3183.
A-46	SUGTAO CREEK	28.0	15- 213	9.90	0.0026- 0.045	66.	0.70	1	69.7	13.6	74.
								2	192.0	33.7	183.
								5	282.5	60.0	327.
								10	341.2	81.2	442.
								20	398.7	103.4	563.
								50	472.0	133.1	725.
								100	527.1	158.9	865.
A-47	QUINALI(A) RIVER	325.3	15-2400	50.44	0.0018- 0.235	360.	0.70	1	55.8	6.1	385.
								2	153.8	16.0	1010.
								5	226.2	25.6	1617.
								10	273.3	32.3	2065.
								20	319.3	39.0	2470.
								50	378.0	47.6	3013.
								100	422.1	54.4	3443.
A-48	QUINALI(A) RIVER	330.6	8-2400	54.97	0.0018- 0.235	396.	0.70	1	55.7	5.8	370.
								2	153.4	15.2	976.
								5	225.8	24.1	1552.
								10	272.7	30.4	1955.
								20	318.6	36.6	2353.
								50	377.3	44.5	2863.
								100	421.2	50.8	3264.

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CMS --- CUBIC METERS PER SECOND KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-49	TALISAY RIVER	96.5	50- 507	24.70	0.0026- 0.074	179.	0.70	1	87.0	13.0	244.
								2	195.2	27.1	508.
								5	282.3	44.8	841.
								10	340.3	58.4	1095.
								20	394.9	71.2	1345.
								50	466.3	89.2	1673.
								100	519.9	103.6	1944.
A-50	TALISAY RIVER	132.0	30- 507	37.20	0.0021- 0.074	278.	0.70	1	84.5	10.5	270.
								2	189.6	22.2	571.
								5	274.1	35.7	915.
								10	330.5	45.5	1168.
								20	383.6	55.1	1414.
								50	452.9	67.5	1734.
								100	504.9	77.6	1991.
A-51	TALISAY RIVER	19.5	20- 400	8.65	0.0042- 0.092	56.	0.70	1	97.4	19.5	74.
								2	218.5	39.2	148.
								5	316.0	69.0	262.
								10	380.9	93.6	355.
								20	442.1	118.9	451.
								50	522.0	153.1	581.
								100	582.0	183.2	695.
A-52	TALISAY RIVER	151.5	30- 507	37.20	0.0021- 0.074	278.	0.70	1	83.4	10.4	305.
								2	187.0	21.9	646.
								5	270.4	35.2	1036.
								10	326.0	44.9	1323.
								20	378.3	54.3	1600.
								50	446.7	66.6	1963.
								100	498.1	76.5	2254.
A-53	TALISAY RIVER	163.8	19- 507	42.28	0.0021- 0.074	318.	0.70	1	82.7	9.6	306.
								2	185.5	20.5	652.
								5	268.2	32.5	1035.
								10	323.4	41.2	1314.
								20	375.3	49.7	1582.
								50	443.2	60.7	1932.
								100	494.1	69.4	2211.
A-54	TALISAY RIVER	174.8	11- 507	47.06	0.0020- 0.074	356.	0.70	1	82.1	9.0	306.
								2	184.3	19.3	654.
								5	266.4	30.3	1031.
								10	321.2	38.3	1302.
								20	372.8	46.0	1562.
								50	440.2	55.9	1901.
								100	490.7	63.8	2170.

NOTE: CONCE. --- CONCENTRATION SQ.KM --- SQUARE KILOMETERS MMSL --- METERS ABOVE MEAN SEA LEVEL
MIN --- MINUTES MM/D --- MILLIMETERS PER DAY MM/H --- MILLIMETERS PER HOUR
CMS --- CUBIC METERS PER SECOND KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
A-55	SAN MIGUEL RIVER	3.8	11- 22	6.75	0.0016- 0.002	54.	0.70	1	104.6	21.1	16.
								2	234.6	42.3	31.
								5	339.2	74.7	55.
								10	408.9	101.5	75.
								20	474.6	129.0	95.
								50	560.5	166.4	123.
								100	624.8	199.3	147.
A-56	TALISAY RIVER	178.6	11- 507	42.06	0.0020- 0.074	356.	0.70	1	81.9	9.0	312.
								2	183.9	19.2	667.
								5	265.8	30.3	1051.
								10	320.4	38.2	1327.
								20	371.9	45.8	1592.
								50	439.2	55.8	1938.
								100	489.6	63.7	2212.
A-57	TALISAY RIVER	192.4	8- 507	50.16	0.0020- 0.074	381.	0.70	1	81.3	8.6	322.
								2	182.4	18.4	689.
								5	263.7	28.9	1080.
								10	317.9	36.4	1360.
								20	368.9	43.5	1629.
								50	435.6	52.9	1979.
								100	485.7	60.3	2255.
A-58	QUINALI(A) RIVER	523.0	8-2400	54.97	0.0018- 0.235	396.	0.70	1	52.3	5.4	550.
								2	144.1	14.2	1469.
								5	211.9	22.7	2304.
								10	256.0	28.5	2903.
								20	299.1	34.4	3495.
								50	354.2	41.8	4252.
								100	395.5	47.7	4848.
A-59	QUINALI(A) RIVER	524.2	7-2400	56.52	0.0017- 0.235	409.	0.70	1	52.3	5.3	542.
								2	144.0	14.0	1429.
								5	211.9	22.2	2267.
								10	255.9	28.0	2852.
								20	299.0	33.7	3430.
								50	354.0	40.9	4170.
								100	395.3	46.6	4751.
Y- 1	ANULING RIVER	9.4	85-2400	10.23	0.2263- 0.226	49.	0.70	1	111.3	22.7	42.
								2	225.3	41.7	75.
								5	335.3	75.0	137.
								10	423.4	106.9	195.
								20	521.7	144.6	264.
								50	671.9	203.8	373.
								100	802.7	262.1	479.

NOTE: CONCE. --- CONCENTRATION
MIN --- MINUTES
CMS --- CUBIC METERS PER SECOND
SQ.KM --- SQUARE KILOMETERS
MM/D --- MILLIMETERS PER DAY
MMSL --- METERS ABOVE MEAN SEA LEVEL
MM/H --- MILLIMETERS PER HOUR
KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
Y- 2	RIGHT TRIBUTARY	4.8	85- 340	5.13	0.0497- 0.050	24.	0.70	1	114.4	25.1	23.
								2	231.4	44.9	62.
								5	344.5	83.4	78.
								10	434.9	120.5	112.
								20	536.0	164.8	154.
								50	690.2	235.2	220.
								100	824.6	305.7	285.
Y- 3	YAWA RIVER	14.2	85-2400	10.23	0.2263- 0.226	49.	0.70	1	109.2	22.3	62.
								2	220.9	40.3	111.
								5	328.9	73.5	203.
								10	415.2	104.9	290.
								20	511.7	141.9	392.
								50	659.0	199.9	552.
								100	787.3	257.1	710.
Y- 4	LEFT TRIBUTARY	4.0	68-2400	10.08	0.2313- 0.231	48.	0.70	1	115.1	23.6	18.
								2	232.9	42.6	33.
								5	346.7	77.7	60.
								10	437.7	110.8	86.
								20	539.4	150.0	117.
								50	694.7	211.4	164.
								100	829.9	271.9	211.
Y- 5	YAWA RIVER	19.0	40-2400	11.68	0.2021- 0.202	56.	0.70	1	107.6	21.6	80.
								2	217.6	39.1	144.
								5	323.9	70.9	262.
								10	409.0	100.7	372.
								20	504.0	133.9	502.
								50	649.1	191.0	705.
								100	775.4	244.9	905.
Y- 6	RIGHT TRIBUTARY	19.0	40- 126	8.05	0.0107- 0.011	38.	0.70	1	107.6	22.6	84.
								2	217.6	40.7	150.
								5	323.9	74.9	277.
								10	409.0	107.3	397.
								20	504.0	145.9	539.
								50	649.1	206.6	763.
								100	775.4	266.8	986.
Y- 7	YAWA RIVER	38.0	40-2400	11.68	0.2021- 0.202	56.	0.70	1	103.1	20.7	153.
								2	208.7	37.4	277.
								5	310.6	68.0	502.
								10	392.1	96.6	714.
								20	483.3	130.3	963.
								50	622.4	183.1	1353.
								100	743.5	234.8	1735.

NOTE: CONCE. --- CONCENTRATION SQ.KM --- SQUARE KILOMETERS MMSL --- METERS ABOVE MEAN SEA LEVEL
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TABLE- I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
Y- 8	YAWA RIVER	40.0	20-2400	12.98	0.1834- 0.183	62.	0.70	1	102.8	20.2	157.
								2	207.9	36.8	286.
								5	309.5	66.5	517.
								10	390.8	94.2	733.
								20	481.0	126.8	986.
								50	620.2	177.6	1382.
								100	740.9	227.3	1768.
Y- 9	BUDIAO RIVER	7.5	20-2400	11.28	0.2020- 0.202	56.	0.70	1	112.4	22.5	33.
								2	227.5	40.8	59.
								5	338.6	74.0	108.
								10	427.5	105.1	153.
								20	526.8	141.8	207.
								50	678.4	199.2	290.
								100	810.5	255.4	372.
Y-10	YAWA RIVER	47.5	20-2400	12.98	0.1834- 0.183	62.	0.70	1	101.5	20.0	185.
								2	205.4	36.3	336.
								5	305.8	65.7	607.
								10	386.1	93.1	860.
								20	475.8	125.2	1157.
								50	612.8	175.5	1621.
								100	732.0	224.6	2074.
Y-11	YAWA RIVER	58.5	10-2400	15.53	0.0039- 0.183	82.	0.70	1	100.0	18.7	212.
								2	202.3	34.1	388.
								5	301.1	60.9	693.
								10	380.2	85.6	974.
								20	468.5	114.4	1301.
								50	603.4	159.1	1810.
								100	720.8	202.2	2300.
Y-12	PAWA-BURABOO R.	7.6	10-2400	11.55	0.2069- 0.207	55.	0.70	1	112.4	22.6	33.
								2	227.3	40.9	60.
								5	338.4	74.2	110.
								10	427.2	105.5	156.
								20	526.5	142.3	210.
								50	678.1	200.0	296.
								100	810.0	256.6	379.
Y-13	YAWA RIVER	66.7	10-2400	15.53	0.0039- 0.183	82.	0.70	1	99.0	18.5	238.
								2	200.4	33.8	435.
								5	298.3	60.4	776.
								10	376.6	84.8	1090.
								20	464.1	113.3	1456.
								50	597.7	157.6	2026.
								100	714.0	200.3	2575.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
Y-14	YAWA RIVER	74.4	4-2400	17.78	0.0030- 0.183	96.	0.70	1	98.1	17.7	256.
								2	198.5	32.5	470.
								5	295.4	57.5	832.
								10	373.0	80.4	1163.
								20	459.7	106.9	1547.
								50	592.0	148.0	2142.
								100	707.2	187.6	2711.
O- 1	BUYUMAN(A) RIVER	5.3	0-1300	9.38	0.1386- 0.139	45.	0.70	1	147.1	30.4	31.
								2	216.0	39.8	41.
								5	280.9	63.6	66.
								10	331.3	84.9	88.
								20	385.6	108.7	112.
								50	463.8	143.3	148.
								100	528.7	176.1	182.
O- 2	BUYUMAN(B) RIVER	3.7	0-1700	9.25	0.1838- 0.184	44.	0.70	1	149.0	30.8	22.
								2	218.7	40.4	29.
								5	284.5	64.5	46.
								10	335.5	86.2	62.
								20	390.5	110.3	79.
								50	469.7	145.6	105.
								100	535.5	178.9	129.
O- 3	UNKNOWN	3.2	0-2400	10.25	0.2341- 0.234	49.	0.70	1	149.7	30.6	19.
								2	219.8	40.1	25.
								5	285.9	63.9	40.
								10	337.1	85.1	53.
								20	392.4	108.7	68.
								50	471.9	143.1	89.
								100	538.0	175.6	109.
O- 4	MATANG RIVER	5.6	0-2400	10.13	0.2369- 0.237	48.	0.70	1	146.8	30.0	33.
								2	215.5	39.4	43.
								5	280.3	62.8	68.
								10	330.6	83.6	91.
								20	384.8	106.9	116.
								50	462.8	140.7	153.
								100	527.6	172.7	188.
O- 5	BASUD RIVER	14.0	0-2400	11.00	0.2182- 0.218	52.	0.70	1	141.0	28.5	78.
								2	207.1	37.5	102.
								5	269.4	59.5	162.
								10	317.7	79.2	216.
								20	369.8	101.0	275.
								50	444.7	132.7	361.
								100	507.0	162.6	443.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MNSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
0- 6	BACACAY RIVER	23.3	10-1500	14.38	0.0043- 0.141	76.	0.70	1	137.2	26.1	118.
								2	201.5	34.5	156.
								5	262.1	54.0	245.
								10	309.1	71.0	322.
								20	359.8	89.8	407.
								50	432.7	117.0	530.
								100	493.3	142.1	644.
0- 7	BULAWAN RIVER	5.2	220-2400	7.25	0.3007- 0.301	35.	0.70	1	146.7	31.2	35.
								2	215.4	40.7	45.
								5	280.2	65.5	73.
								10	330.4	88.0	98.
								20	384.6	113.1	125.
								50	462.5	149.9	166.
								100	527.3	185.1	205.
0- 8	BULAWAN RIVER	7.3	220-2400	9.00	0.2422- 0.242	43.	0.70	1	145.3	30.2	43.
								2	213.3	39.5	56.
								5	277.4	63.2	90.
								10	327.2	84.4	120.
								20	380.8	108.1	153.
								50	458.0	142.7	203.
								100	522.2	175.5	249.
0- 9	BULAWAN RIVER	15.4	90-2400	11.48	0.2012- 0.201	55.	0.70	1	140.4	28.2	84.
								2	206.1	37.1	111.
								5	268.1	58.8	176.
								10	316.1	78.1	234.
								20	368.0	99.6	298.
								50	442.6	130.8	392.
								100	504.6	160.3	479.
0-10	TIAGAO RIVER	5.7	0- 493	4.25	0.0059- 0.189	22.	0.70	1	130.8	28.9	32.
								2	248.4	48.5	54.
								5	330.4	80.7	89.
								10	384.6	107.7	119.
								20	436.1	135.9	151.
								50	503.5	174.1	193.
								100	553.7	208.6	231.
0-11	TIAGAO RIVER	7.7	0-2400	10.05	0.0100- 0.264	48.	0.70	1	129.3	26.5	40.
								2	245.5	44.9	67.
								5	326.4	73.2	110.
								10	380.0	96.3	144.
								20	430.9	119.9	179.
								50	497.5	151.5	227.
								100	547.1	179.4	269.

NOTE: CONCE. --- CONCENTRATION SQ.KM --- SQUARE KILOMETERS MNSL --- METERS ABOVE MEAN SEA LEVEL
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TABLE- I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
0-12	TIAGAO RIVER	13.4	0-2400	10.05	0.0100- 0.264	48	0.70	1	126.1	25.8	67.
								2	239.4	43.8	114.
								5	318.4	71.4	186.
								10	370.6	93.9	245.
								20	420.2	116.9	305.
								50	485.2	147.8	385.
								100	533.0	175.0	456.
0-13	TAGAS RIVER	8.3	0-2400	13.64	0.1760- 0.176	65.	0.70	1	128.9	25.2	41.
								2	244.7	43.0	69.
								5	325.4	69.2	112.
								10	378.8	90.3	146.
								20	429.6	111.7	180.
								50	495.9	140.2	226.
								100	545.4	164.9	266.
0-14	BONBON RIVER	6.6	0- 880	11.78	0.0102- 0.088	56.	0.70	1	130.1	26.0	33.
								2	247.0	44.3	57.
								5	328.5	71.8	92.
								10	382.4	94.0	121.
								20	433.6	116.7	150.
								50	500.6	147.0	189.
								100	550.6	173.5	223.
0-15	SAWANG RIVER	9.9	20-2400	13.25	0.1796- 0.180	63.	0.70	1	127.9	25.7	48.
								2	242.8	42.8	82.
								5	322.9	69.1	133.
								10	375.9	90.2	174.
								20	426.3	111.6	215.
								50	492.1	140.2	270.
								100	541.2	165.1	318.
8- 1	AMTIC(B) RIVER	8.1	240-1140	7.13	0.1262- 0.126	34.	0.70	1	129.0	27.5	43.
								2	245.0	46.4	73.
								5	325.8	76.4	120.
								10	379.2	101.2	159.
								20	430.0	126.8	200.
								50	496.4	161.4	254.
								100	546.0	192.2	303.
8- 2	BUANG RIVER	4.5	240-2400	8.25	0.2618- 0.262	39.	0.70	1	132.0	27.7	24.
								2	250.6	46.8	41.
								5	333.3	70.8	67.
								10	387.9	101.4	89.
								20	439.9	126.8	111.
								50	507.9	160.9	141.
								100	558.5	191.2	167.

NOTE: CONCE. --- CONCENTRATION; SQ.KM --- SQUARE KILOMETERS; MMSL --- METERS ABOVE MEAN SEA LEVEL
MIN --- MINUTES; MM/D --- MILLIMETERS PER DAY; MM/H --- MILLIMETERS PER HOUR
CMS --- CUBIC METERS PER SECOND; KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
B-3	QUINALI(B) RIVER	12.6	240-2400	8.25	0.2618-0.262	39.	0.70	1	120.4	26.5	65.
								2	240.1	44.8	110.
								5	319.3	75.6	180.
								10	371.7	97.2	238.
								20	421.5	121.5	298.
								50	486.6	154.2	378.
								100	535.2	183.2	449.
B-4	QUINALI(B) RIVER	19.2	180-2400	9.13	0.2432-0.243	43.	0.70	1	123.7	25.7	96.
								2	235.0	43.4	162.
								5	312.5	71.0	265.
								10	363.7	93.6	350.
								20	412.5	116.8	436.
								50	476.2	148.0	552.
								100	523.7	175.5	655.
B-5	QUINALI(B) RIVER	30.8	100-2400	12.80	0.0308-0.262	61.	0.70	1	120.4	23.8	142.
								2	228.5	40.5	243.
								5	303.9	65.4	392.
								10	353.8	85.5	512.
								20	407.2	105.9	634.
								50	463.2	133.2	797.
								100	509.4	156.9	940.
B-6	TABIGYAN RIVER	4.7	90-1180	7.75	0.3406-0.341	37.	0.70	1	131.8	27.8	25.
								2	250.2	47.0	43.
								5	332.7	77.2	71.
								10	387.3	102.2	93.
								20	439.2	127.9	117.
								50	507.1	162.5	149.
								100	557.7	193.3	177.
B-7	LEFT TRIBUTARY	44.7	90-1548	15.90	0.0917-0.092	76.	0.70	1	117.4	22.3	194.
								2	222.9	38.2	332.
								5	296.5	61.1	531.
								10	345.1	79.4	690.
								20	391.3	97.8	850.
								50	451.8	122.2	1062.
								100	496.9	143.2	1245.
B-8	QUINALI(B) RIVER	80.2	90-1548	15.90	0.0917-0.092	76.	0.70	1	112.2	21.3	332.
								2	213.1	36.3	569.
								5	283.4	58.4	911.
								10	329.9	75.9	1183.
								20	374.1	93.4	1457.
								50	431.9	116.8	1821.
								100	475.0	136.9	2135.

NOTE: CONCE. --- CONCENTRATION
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SQ.KM --- SQUARE KILOMETERS
MM/D --- MILLIMETERS PER DAY
MMSL --- METERS ABOVE MEAN SEA LEVEL
MM/H --- MILLIMETERS PER HOUR
KM --- KILOMETERS

TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFFICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
B-9	QUINALI(B) RIVER	84.1	75-1548	17.70	0.0083- 0.092	86.	0.70	1	111.8	20.7	338.
								2	212.3	35.5	581.
								5	282.3	56.5	925.
								10	328.6	73.1	1196.
								20	372.6	89.8	1468.
								50	430.2	111.8	1829.
								100	473.1	130.7	2137.
B-10	NAMOINGA RIVER	5.0	75-1960	9.25	0.2038- 0.204	44.	0.70	1	131.5	27.2	20.
								2	249.7	46.1	45.
								5	332.0	75.5	73.
								10	386.4	99.3	97.
								20	438.2	123.8	120.
								50	506.0	156.8	152.
								100	556.4	185.9	181.
B-11	QUINALI(B) RIVER	89.1	75-1548	17.70	0.0083- 0.092	86.	0.70	1	111.2	20.6	357.
								2	211.2	35.4	613.
								5	280.9	56.3	975.
								10	326.9	72.8	1261.
								20	370.7	89.3	1548.
								50	428.0	111.3	1928.
								100	470.7	130.1	2253.
B-12	QUINALI(B) RIVER	93.9	20-1548	22.20	0.0122- 0.092	107.	0.70	1	110.7	19.6	355.
								2	210.2	33.6	613.
								5	279.6	52.8	964.
								10	325.4	67.8	1238.
								20	369.0	82.7	1510.
								50	426.1	102.3	1867.
								100	468.6	118.9	2170.
B-13	LEFT TRIBUTARY	15.3	20-1548	11.50	0.1329- 0.133	55.	0.70	1	125.2	25.2	75.
								2	237.8	42.8	127.
								5	316.3	69.4	206.
								10	368.1	91.0	271.
								20	417.5	112.9	336.
								50	482.0	142.3	423.
								100	530.0	168.1	500.
B-14	QUINALI(B) RIVER	109.2	20-1548	22.20	0.0122- 0.092	107.	0.70	1	109.2	19.2	407.
								2	207.4	33.1	704.
								5	275.8	52.1	1106.
								10	321.0	66.9	1420.
								20	364.1	81.6	1732.
								50	420.3	100.9	2142.
								100	462.2	117.3	2490.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
B-15	QUINALI(B) RIVER	123.1	8-1548	27.40	0.0023- 0.092	148.	0.70	1	105.0	17.2	433.
								2	205.1	30.1	721.
								5	272.7	46.4	1192.
								10	317.4	58.8	1408.
								20	360.0	71.0	1700.
								50	415.6	87.0	2081.
								100	457.1	100.2	2398.
B-16	LEFT TRIBUTARY	8.8	8-1548	9.50	0.0048- 0.218	53.	0.70	1	128.5	25.9	44.
								2	244.1	44.1	75.
								5	324.6	71.6	122.
								10	377.8	93.9	161.
								20	428.5	116.7	200.
								50	494.7	147.1	252.
								100	544.0	173.8	297.
B-17	QUINALI(B) RIVER	131.9	8-1548	27.40	0.0023- 0.092	148.	0.70	1	107.3	17.1	439.
								2	203.7	29.9	768.
								5	270.9	46.1	1183.
								10	315.3	58.4	1499.
								20	357.6	70.6	1809.
								50	412.9	86.4	2215.
								100	454.0	99.5	2552.
B-18	QUINALI(B) RIVER	132.8	7-1548	28.84	0.0007- 0.092	160.	0.70	1	107.2	16.7	431.
								2	203.6	29.3	755.
								5	270.7	44.9	1159.
								10	315.1	56.7	1463.
								20	357.4	68.2	1762.
								50	412.6	83.4	2152.
								100	453.7	95.8	2474.
B-19	TULIW CREEK	18.3	7- 700	13.64	0.0031- 0.092	80.	0.70	1	124.1	23.3	83.
								2	235.6	39.9	142.
								5	313.3	63.8	227.
								10	364.7	82.7	294.
								20	413.5	101.7	362.
								50	477.5	126.9	451.
								100	525.1	148.6	529.
B-20	QUINALI(B) RIVER	151.1	7-1548	28.84	0.0007- 0.092	160.	0.70	1	105.8	16.5	464.
								2	201.0	28.9	848.
								5	267.3	44.3	1302.
								10	311.1	55.9	1644.
								20	352.8	67.4	1980.
								50	407.3	82.3	2418.
								100	447.9	94.6	2779.

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TABLE-I.13 PROBABLE FLOOD PEAK RUNOFF CALCULATED BY RATIONAL FORMULA

SITE NO.	NAME OF RIVER	DRAINAGE AREA (SQ.KM)	ELEVATION OF BASIN (MMSL)	RIVER COURSE LENGTH (KM)	AVERAGE RIVER BED SLOPE	FLOOD CONCE. TIME (MIN)	RUNOFF COEFF-ICIENT	RAINFALL RETURN PERIOD (YEARS)	AVERAGE BASIN RAINFALL (MM/D)	AVERAGE RAINFALL INTENSITY (MM/H)	PEAK RUNOFF DISCHARGE (CMS)
B-21	QUINALI(B) RIVER	157.8	0-1548	31.14	0.0030- 0.092	178.	0.70	1	105.4	15.8	485.
								2	200.1	27.8	852.
								5	266.1	42.3	1298.
								10	309.7	53.2	1632.
								20	351.2	63.8	1958.
								50	405.5	77.7	2383.
								100	446.0	89.0	2731.

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