

## **Appendix D**

### **Water Demand for Agriculture**

# Appendix D

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## Appendix D Water Demand for Agriculture

### 1 GENERAL

Agricultural water demand for irrigation, livestock and aquaculture is summarized and tabulated as below. Processes and results of estimate for the respective components of agricultural water demand are briefly mentioned in the succeeding paragraphs hereinafter.

#### (1) Kone and Ha Thanh River Basins

Irrigation Area (Unit: ha)

River Basin	Present (2001)	Future (2010)	Future (2020)
Kone River Basin	20,200	25,100	43,900
Ha Thanh River Basin	1,200	2,400	4,300
<b>Total</b>	<b>21,400</b>	<b>27,500</b>	<b>48,200</b>

Agricultural Water Demand (AWD), **50% Dependability** (m<sup>3</sup>/sec)

Item	Cropping Pattern		
	Present (2001)	Future (2010)	Future (2020)
Year	1995	1994	1992
Irrigation	19.18	20.03	32.75
Livestock	0.07	0.10	0.13
Aquaculture	0.00	0.36	0.36
<b>Total</b>	<b>19.3</b>	<b>20.5</b>	<b>33.2</b>

Agricultural Water Demand (AWD), **75% Dependability** (m<sup>3</sup>/sec)

Item	Cropping Pattern		
	Present (2001)	Future (2010)	Future (2020)
Year	1986	1986	1997
Irrigation	19.85	20.73	34.00
Livestock	0.07	0.10	0.13
Aquaculture	0.00	0.36	0.36
<b>Total</b>	<b>19.9</b>	<b>21.2</b>	<b>34.5</b>

#### (2) La Tinh, Kone and Ha Thanh River Basins

Irrigation Area (Unit: ha)

River Basin	Present (2001)	Future (2010)	Future (2020)
La Tinh River Basin	3,000	3,000	6,300
Kone River Basin	20,200	25,100	43,900
Ha Thanh River Basin	1,200	2,400	4,300
<b>Total</b>	<b>24,400</b>	<b>30,500</b>	<b>54,500</b>

**Agricultural Water Demand (AWD), 50% Dependability (m<sup>3</sup>/sec)**

Item	Cropping Pattern		
	Present (2001)	Future (2010)	Future (2020)
Year	1991	1991	1992
Irrigation	22.15	22.29	37.08
Livestock	0.07	0.10	0.13
Aquaculture	0.00	0.36	0.36
Total	22.2	22.8	37.6

**Agricultural Water Demand (AWD), 75% Dependability (m<sup>3</sup>/sec)**

Item	Cropping Pattern		
	Present (2001)	Future (2010)	Future (2020)
Year	1986	1986	1997
Irrigation	22.87	23.03	38.53
Livestock	0.07	0.10	0.13
Aquaculture	0.00	0.36	0.36
Total	22.9	23.5	39.0

## **2 METHODOLOGY**

The irrigation water demand, the livestock water demand and the aquaculture water demand have been estimated with the method and process explained hereinafter.

Estimation results of the irrigation water demand, the livestock water demand and the aquaculture water demand are presented in the following Sections 3, 4 and 5, respectively.

### **2.1 Irrigation Water Estimation Method**

For estimation of irrigation water demand, future cropping pattern and crop planted area have been assumed according to the basic concept for agricultural development as described in the Main Report Volume IV Section 7.2. The basic concept is formulated based on policies mentioned in the agricultural and rural development plan of the province as well as the conceivable project works.

The main concept in the agricultural and rural development is i) Sustainable development in view of land, water and biological resources, ii) Increase of crop production through crop diversification to meet local food demand and support processing industry, iii) Raising of living standard in the rural area. Particularly, high priority has been given to the water resource development and management for flood mitigation, irrigation water and drainage improvement to facilitate diversification of crops and improved farming technologies in the crop production.

Under the conceivable project works, the future agriculture land will be provided with the following improvement under the project works:

- (i) Irrigation water will be adequately supplied.
- (ii) Cultivated land will be protected from the minor, early and late floods except major floods.
- (iii) Drainage condition will be improved to remove internal excessive water.

The above conditions will enable to expand the cropped area, increase cropping intensity and better quality of products along with technical improvement of farming practices like introduction of improved varieties, efficient farming practices and proper input dosage.

Process and methodology for estimation of irrigation water demand adopted in this Study are as follows:

#### **(A) Collection of Data and Information**

Required data and information for the irrigation water demand forecast have been gathered to some extent in the First Work and this Second Work in Vietnam through both the official and unofficial routes. The major items required are as follows:

- a) General features of existing projects (name, location, area, etc.)

- b) General features of existing water source facilities (dam/reservoir, weirs, etc.)
- c) Present cropping patterns
- d) Present discharges of intakes for existing irrigation systems
- e) Criteria on irrigation water requirement
  - Common formula in Vietnam for potential evapotranspiration
  - Common method in Vietnam for estimation of effective rainfall
  - Common value in Vietnam of irrigation efficiency
  - Common value in Vietnam of unit irrigation water requirement (l/sec/ha)
- f) Latest water source facilities development plans (dam/reservoir, weirs, etc.)
- g) Latest irrigation, drainage and farm road development plans

The water demands presented in this report have been estimated with full use of data and information that have been collected through interviews and investigations.

(B) Field Investigation

Through the field investigation, the collected data and information that were given in documents or heard at the interviews have been examined and confirmed to some extent actually on the site.

(C) Cultivated Land Area and Planted Area

Present and future cultivated land area and crop planted area have been estimated as mentioned in the Main Report Volume IV Section 7.2.

(D) Cropping Pattern

Present and future cropping patterns have been set up as mentioned also in the Main Report Volume IV Section 7.2.

The following three (3) representative patterns have been used for the irrigation water requirement:

Pattern A: Kone upper and middle reaches such as Vinh Thanh, Van Phong proper, Van Phong extension (La Tinh), Tan An extension (Ha Thanh lower reaches), Ha Thanh upper and middle reaches, La Tinh proper, etc.

Pattern B: Tan An Dap Da upper and middle reaches

Pattern C: Tan An – Dap Da lower reaches

(E) Irrigation Area

With reference to the Answers to Questionnaire on Irrigation Development (from Provinces to JICA Study Team), present and future irrigation areas have been estimated. Then, the future irrigation areas have been determined with the water balance calculation as follows:

Irrigation Area, Kone and Ha Thanh River Basins (Unit: ha)

Cropping Pattern	Year 2001	Year 2010	Year 2020
A	8,700	14,800	31,300
B	10,100	10,100	13,600
C	2,600	2,600	3,300
Total	21,400	27,500	48,200

Note. Above irrigation areas are those confirmed with water balance analysis.

Irrigation Area, La Tinh, Kone and Ha Thanh River Basins (Unit: ha)

Cropping Pattern	Year 2001	Year 2010	Year 2020
A	11,700	17,800	37,700
B	10,100	10,100	13,500
C	2,600	2,600	3,300
Total	24,400	30,500	54,500

Note. Above irrigation areas are those confirmed with water balance analysis.

(F) Potential Evapotranspiration (ET<sub>o</sub>)

With reference to the Report "General Explanation No.444C-05-TM, Feasibility Study, Water Resources Project Dinh Binh Reservoir, HEC1, HDECE, May 2000, the following climate data at the Quy Nhon Station have been obtained:

- Mean air temperature (°C)
- Relative humidity (%)
- Wind velocity (m/sec)
- Sunshine hours (hr)

Then, with use of the above climate data, the monthly potential evapotranspiration (ET<sub>o</sub> mm/month) have been estimated.

In addition to the following documents, with reference to a past report for MARD and also in consideration of interview results to MARD's and IWRP's officials or experts, the Modified Penman Method has finally been adopted for the estimation of ET<sub>o</sub>.

- a) ESCAP Water Resources Series No.65 Guidelines for the Preparation of National Master Water Plans, UN, 1989
- b) FAO Irrigation and Drainage Paper 24 revised 1977 Guidelines for Predicting Crop Water Requirements, 1977



- c) REPORT Expert Consultation on Revision of FAO Methodologies for Crop Water Requirements, FAO, 1990
- d) FAO Irrigation and Drainage Paper 46 CROPWAT, A Computer Program for Irrigation Planning and Management, 1992
- e) FAO Irrigation and Drainage Paper 56 Crop Evapotranspiration Guidelines for Computing Crop Water Requirements, 1998

The calculation result of ETo is shown in Table D.1.

The above ETo (mm/month) was divided into three (3) pieces of 10-day ETo (mm/10-day) and used for calculation of crop water requirement to let them suit the variation of crop growing degree or crop coefficient value described hereinafter.

(G) Crop Coefficient (Kc)

The crop coefficients (Kc) of the various crops concerned have been estimated with reference to:

- a) FAO Irrigation and Drainage Paper 33 Yield Response to Water, 1979
- b) FAO Irrigation and Drainage Paper 56 Crop Evapotranspiration Guidelines for Computing Crop Water Requirements, 1998
- c) Report on Irrigation Water Requirement and Water Balance, Binh Dinh Irrigation Project, Directorate of Irrigation and Rural Engineering, Ministry of Agriculture, Republic of Vietnam, 1974

Different Kc values were taken for the respective development stages:

- Initial stage
- Crop development stage
- Mid-season stage
- Late season stage
- Stage at harvest

With use of the Kc values, crop coefficient curves have been drawn for the respective crops as shown in Figure D.1. Value of Kc at each growing time has been read from the curve.

(H) Crop Water Requirement (CWR)

Crop water requirement (CWR) or crop evapotranspiration (ETc) of the various crops concerned have been estimated as follows:

$$CWR = ETc = ETo \times Kc$$

where, CWR: Crop water requirement (mm/10-day)

ETc: Crop evapotranspiration (mm/10-day)

ETo: Potential evapotranspiration (mm/10-day)

Kc: Crop coefficient (see Figure D.1)

This is directly used as consumptive use of water of upland crops that are ones except paddy rice.

(I) Consumptive Use of Water of Crops (CUW)

a) Paddy rice

i) Percolation loss (P)

As for the paddy rice, the percolation loss (P mm/day) has been estimated with reference to the following:

FAO Irrigation and Drainage Paper 46 CROPWAT, A Computer Program for Irrigation Planning and Management, 1992

The percolation loss has been determined as follows:

$$P = 2 \text{ mm/day} \\ = 16 \text{ mm/8 days or } 20 \text{ mm/10 days or } 22 \text{ mm/11days}$$

By the way, it is noted that the past report of MARD also used the percolation loss of 2 mm/day.

ii) Land preparation water requirement (LPW)

Besides, water requirement for the land preparation (LPW) for paddy fields is to be included in CUW for the period before sowing seeds. With reference to the past report of MARD, the following conditions have been applied for estimation of LPW:

$$LPW = (LS + SW) + E_p + P$$

where, LPW: Land preparation water requirement (mm/10-day)

LS: Land soaking water (mm/10-day)

LS=10mm/10-day for winter-spring paddy

LS=110mm/10-day for summer-autumn paddy

LS=55mm/10-day for 3<sup>rd</sup> crop paddy

SW: Standing water requirement (mm/10-day)

SW=50mm/10-day

E<sub>p</sub>: Evaporation from open water surface (mm/10-day)

E<sub>p</sub> = E<sub>To</sub> x 1.1

P: Percolation loss (mm/10-day)

The above-mentioned condition is shown also in Figure D.2.

iii) Consumptive use of water of paddy rice field (CUW)

Then, the consumptive use of water (CUW mm/10-day) of the paddy rice field has been calculated as follows:

$$CUW = CWR + P \text{ for growing period}$$

$$CUW = LPW \quad \text{for land preparation period}$$

where, CUW: Consumptive use of water (mm/10-day)

CWR: Crop water requirement (mm/10-day)

P: Percolation loss (mm/10-day)

LPW: Land preparation water requirement (mm/10-day)

An example of calculation is presented in Table D.2.

b) Upland crops

As for upland crops, the consumptive use of water is expressed as follows:

$$CUW = CWR$$

where, CUW: Consumptive use of water of crop (mm/10-day)

CWR: Crop water requirement (mm/10-day)

An example of the calculation is presented in Table D.3.

(J) Effective Rainfall (Peff)

For estimation of effective rainfall, the following were referred to:

a) FAO Irrigation and Drainage Paper 25 Effective Rainfall, 1974

b) FAO Irrigation and Drainage Paper 46 CROPWAT, A Computer Program for Irrigation Planning and Management, 1992

Finally in consideration of required accuracy, it has been determined to adopt the following methods:

a) Paddy rice

Effective rainfall during a growing period of paddy is estimated by the daily depth balance method based on the recent 24 years rainfall records of the Quy Nhon Station and the Cay Muong (Binh Tuong) from 1978 to 2001. The following assumptions are made prior to the calculation:

- rainfall less than 5 mm/day is ineffective due to evaporation from soil surface,
- rainfall more than 40 mm/day is also ineffective considering the height of ridge in the project area, and
- 80 % of the rainfall which is greater than 5 mm/day and less than 40 mm/day is

effective.

The daily effective rainfalls for paddy rice have been summed up to the 10-day effective rainfall. Its calculation results are shown in Table D.4.

b) Upland crops

United States Department of Agriculture (USDA) Soil Conservation Service (SCS) Method, which is shown in the FAO Irrigation and Drainage Paper 46 mentioned above, have been applied for the upland crops.

In the method, the effective rainfall is calculated on the monthly basis.

$$P_{eff} = P_{tot} \times (125 - 0.2P_{tot}) / 125 \quad \text{for } P_{tot} \leq 250 \text{ mm}$$

$$P_{eff} = 125 + 0.1P_{tot} \quad \text{for } P_{tot} > 250 \text{ mm}$$

where,  $P_{eff}$ : Effective rainfall (mm/month)

$P_{tot}$ : Monthly rainfall (mm/month)

Therefore, the above  $P_{eff}$  (mm/month) has been divided into three (3) 10-day basis effective rainfalls  $P_{eff}$  (mm/10-day) like the  $E_{To}$  (mm/10-day) case.

Calculation results of the effective rainfall for upland crops on the 10-day basis are shown in Table D.5.

(K) Net Irrigation Water Requirement (NIR)

The net irrigation water requirement (NIR mm/10-day) has been calculated as follows:

$$NIR = CUW - P_{eff}$$

where,  $NIR$ : Net irrigation requirement (mm/10-day)

$CUW$ : Consumptive use of water of crop (mm/10-day)

$P_{eff}$ : Effective rainfall (mm/10-day)

A weighted average of NIRs of the respective crops with use of their planted areas has been calculated to obtain an average value for the whole area.

An example of the calculation is presented in Table D.6.

(L) Irrigation Efficiency ( $E_p$ )

For estimation of irrigation efficiency, the following were referred to:

a) FAO Irrigation and Drainage Paper 24 revised 1977 Guidelines for Predicting Crop Water Requirements, 1977

b) FAO Irrigation and Drainage Paper 46 CROPWAT, A Computer Program for Irrigation Planning and Management, 1992

Besides, interviews and discussions were made with many officials and engineers of MARĐ and IWRP for confirmation of the standard values in Vietnam and in the Study Area.

The irrigation efficiency has been determined as follows:

$$E_p = E_a \times E_b \times E_c$$

where,      $E_p$ :     Project efficiency  
                $E_a$ :     Field application efficiency  
                $E_b$ :     Field canal efficiency  
                $E_c$ :     Conveyance efficiency

For Paddy Rice Irrigation

Item	Less-managed System (Year 2000)	Ordinary System (Year 2010)	Well-managed System (Year 2020)
Ea	0.78	0.80	0.83
Eb	0.88	0.89	0.90
Ec	0.88	0.91	0.94
Ep	0.60	0.65	0.70

Ref.     Table 37 of FAO Paper 24

For the paddy rice irrigation,  $E_p$  of 0.60 has been applied for the present water demand, and 0.65 for 2010 and 0.70 for 2020 respectively for the future water demands in this Study.

For Upland Crops Irrigation

Item	Less-managed System (Year 2000)	Ordinary System (Year 2010)	Well-managed System (Year 2020)
Ea	0.70	0.74	0.78
Eb	0.88	0.89	0.90
Ec	0.88	0.91	0.94
Ep	0.54	0.60	0.66

Ref.     Table 37 of FAO Paper 24

For the upland crops irrigation,  $E_p$  of 0.54 has been applied for the present water demand, and 0.60 for 2010 and 0.66 for 2020 respectively for the future water demands in this Study.

(M) Gross Irrigation Requirement (GIR)

The gross irrigation water requirement has been estimated as follows:

$$GIR = NIR / E_p$$

where,     $GIR$  :     Gross irrigation water requirement (mm/10-day)  
                $NIR$  :     Net irrigation water requirement (mm/10-day)

$E_p$  : Irrigation efficiency (project efficiency)

The gross irrigation water requirement GIR (mm-10 day) has been converted into GIR (l/sec/ha) as shown also in Table D.6. Then, the GIRs have been used for the water balance calculation.

The 10-day GIRs for 24 years from 1978 to 2001 of the respective cropping patterns A, B and C for the present (2001) condition are shown in Table D.7. Those for the future (2010) and (2020) are shown in Table D.8 and Table D.9, respectively.

(N) Irrigation Water Demand (IWD)

The irrigation water demand has been estimated as follows:

$$IWD = GIR \times A / 1,000$$

where, IWD: Irrigation water demand (m<sup>3</sup>/sec)  
GIR: Gross irrigation water requirement (lit/sec/ha)  
A: Irrigation area (ha)

## 2.2 Livestock Water Estimation Method

Process and methodology for estimation of livestock water demand adopted in this Study are as follows:

(A) Unit Water Requirement

With reference to the Guidelines for the Preparation of National Master Water Plans, Water Resources Series No.65, ESCAP, 1989, the unit water requirement (lit/head/day) has been estimated as follows:

(Unit: lit/head/day)

Kind of livestock	Water requirement per head per day		
	Drinking	Others	Total
Pig	15	30	45
Ox	35	70	105
Buffalo	35	70	105
Poultry	0.25	0.50	0.75
Goat	25	50	75

(B) Head numbers of various kinds of livestock

With reference to “Review and Supplementary Report on Agricultural and Rural Planning for Binh Dinh Province Towards 2010, Binh Dinh People’s Committee, Department of Agriculture and Rural Development (DARD), 2002” and the statistics by districts of Binh Dinh Province, head numbers of the livestock have been estimated.

(C) Livestock Water Demand (LWD)

Livestock water demand (LWD) has been calculated as follows:

$$LWD = (UP_i \times NP_i + UO \times NO + UB \times NB + UP_o \times NP_o + UG \times NG) / 1,000$$

where,	LWD:	Livestock water demand (m <sup>3</sup> /day)
	UP <sub>i</sub> :	Unit water requirement for pig (lit/head/day)
	NP <sub>i</sub> :	Head number of pig (head)
	UO:	Unit water requirement for ox (lit/head/day)
	NO:	Head number of ox (head)
	UB:	Unit water requirement for buffalo (lit/head/day)
	NB:	Head number of buffalo (head)
	UP <sub>o</sub> :	Unit water requirement for poultry (lit/head/day)
	NP <sub>o</sub> :	Head number of poultry (head)
	UG:	Unit water requirement for goat (lit/head/day)
	NG:	Head number of goat (head)

### 2.3 Aquaculture Water Estimation Method

Process and methodology for estimation of aquaculture water demand (fresh water) adopted in this Study are as follows:

#### (A) Unit Fresh Water Requirement

With reference to the Standard on Fishery Industry in Vietnam, Ministry of Fishery, 2000, the unit fresh water requirement (mm/year) for the coastal brackish water shrimp culture has been estimated as follows:

##### a) Required brackish water for one farming (BWF)

$$BWF = W1 + W2 + W3 + W4 + W5 = 2.30 \text{ m/farming/4months}$$

where, W1: Water filled after farm-bed preparation (0.30 m)

W2: Water for treatment after W1 drained (0.40 m)

W3: Water for cleaning after W2 drained (0.40 m)

W4: Water after nourishment after W3 drained (0.40 m)

W5: Water added to depth 1.20 m for putting larvae (0.80 m)

##### b) Required brackish water per year (BWY) (just for reference)

$$BWY = N \times BWF = 6.90 \text{ m/year (in case } N=3)$$

$$= 4.60 \text{ m/year (in case } N=2)$$

##### c) Required fresh water per year for shrimp culture (FWYS)

$$FWYS = 0.20 BWF = 0.46 \text{ m/ year (for salinity regulation in dry season)}$$

It is noted that all the inland fresh water fish culture in the Study Area is being operated in the reservoirs. There is no fish pond in the field. It means that no

particular water supply is made at present and such a way would continue also to the future in this area. Therefore, the water demand estimation has not been done for the inland fresh water fish culture.

(B) Aquaculture Pond Area

“General Explanation No.444C-05-TM, Feasibility Study, Water Resources Project Dinh Binh Reservoir, HEC1, HDECE, May 2000, ETo has been referred to for estimation of the pond area for the coastal shrimp culture.

(C) Aquaculture Water Demand (AWD)

Aquaculture fresh water demand (AWD) for the coastal brackish water shrimp culture has been calculated as follows:

$$AWD = FWYS \times 10,000AS$$

where,      AWD:      Aquaculture water demand (m<sup>3</sup>/year)  
                 FWYS:      Required freshwater for shrimp culture (m/year)  
                 AS:        Shrimp culture pond area (ha)



### 3 FORECAST OF WATER DEMAND FOR IRRIGATION

#### 3.1 Gross Unit Irrigation Requirement (GIR)

GIRs estimated based on the present and future conditions of cropping patterns are as follows:

- (a) Gross Unit Irrigation Requirement (GIR), P = 50%

Gross Unit Irrigation Water Requirement (GIR), P = 50% calculated from 10-day GIR

Item	Cropping Pattern (Weighted Average)					
	Present (2001)		Future (2010)		Future (2020)	
	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Kone and Ha Thanh River Basins						
Year	1980	1995	1987	1994	1993	1992
Water Requirement	1.79	<b>28,200</b>	1.42	<b>23,000</b>	1.30	<b>21,400</b>
La Tinh, Kone and Ha Thanh River Basins						
Year	1995	1991	1978	1991	1992	1992
Water Requirement	1.78	<b>28,600</b>	1.41	<b>23,100</b>	1.30	<b>21,500</b>

The above annual total GIRs have been calculated as a weighted average of the respective cropping patterns adopted for the respective areas. The annual total GIRs for the respective cropping patterns are as follows:

GIR of **Cropping Pattern A**, P = 50% calculated from 10-day GIR

Item	Cropping Pattern A					
	Present (2001)		Future (2010)		Future (2020)	
	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Year	1996	1983	1998	1984	1998	1984
Water Requirement	2.18	<b>30,900</b>	1.44	<b>23,500</b>	1.32	<b>21,800</b>

GIR of **Cropping Pattern B**, P = 50% calculated from 10-day GIR

Item	Cropping Pattern B					
	Present (2001)		Future (2010)		Future (2020)	
	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Year	1992	1992	1985	1994	1990	2001
Water Requirement	1.90	<b>26,400</b>	1.62	<b>22,300</b>	1.50	<b>21,100</b>

GIR of **Cropping Pattern C**, **P = 50%** calculated from 10-day GIR

Item	Cropping Pattern C					
	Present (2001)		Future (2010)		Future (2020)	
	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Year	1992	1992	1984	1992	1987	1994
Water Requirement	2.32	<b>27,300</b>	1.60	<b>22,300</b>	1.47	<b>20,600</b>

The above GIRs in the average rainfall year (dependability P=50%) are to be used to roughly grasp the water demand condition.

It is noted that not only GIRs in the above table but also all the 10-day basis GIRs for the 24 years from 1978 to 2001 have been calculated for the water balance calculation in order to judge if the planned irrigation development would be possible or not.

The 10-day GIRs for the 24 years of the respective cropping patterns A, B and C for the present (2001) condition are shown in Table D.7. Those for the future (2010) and (2020) are shown in Table D.8 and Table D.9, respectively.

(b) Gross Unit Irrigation Requirement (GIR), P = 75%

Gross Unit Irrigation Water Requirement (GIR), **P = 75%** calculated from 10-day GIR

Item	Cropping Pattern (Weighted Average)					
	Present (2001)		Future (2010)		Future (2020)	
	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	Peak 10-day (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Kone and Ha Thanh River Basins						
Year	1987	1986	1983	1986	1996	1997
Water Requirement	<b>1.89</b>	29,200	<b>1.45</b>	23,800	<b>1.32</b>	22,300
La Tinh, Kone and Ha Thanh River Basins						
Year	1987	1986	1983	1986	1991	1997
Water Requirement	<b>1.88</b>	29,500	<b>1.45</b>	23,800	<b>1.32</b>	22,300

The above peak 10-day GIRs have been calculated as a weighted average of the respective cropping patterns adopted for the respective areas, and are presented here just for reference. The peak 10-day GIRs at the probable drought year for the respective cropping patterns are to be used for the design discharge calculation to determine the capacity of canals and related structures of the irrigation systems. The peak 10-day GIRs for the respective cropping patterns are as follows:

GIR of **Cropping Pattern A**, **P = 75%** calculated from 10-day GIR

Item	Cropping Pattern A					
	Present (2001)		Future (2010)		Future (2020)	
	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Year	1979	1986	1983	1985	1983	1985
Water Requirement	<b>2.18</b>	31,700	<b>1.47</b>	24,300	<b>1.35</b>	22,500

GIR of **Cropping Pattern B**, **P = 75%** calculated from 10-day GIR

Item	Cropping Pattern B					
	Present (2001)		Future (2010)		Future (2020)	
	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Year	1986	1997	1997	1997	1981	1986
Water Requirement	<b>1.90</b>	27,200	<b>1.62</b>	23,100	<b>1.51</b>	21,700

GIR of **Cropping Pattern C**, **P = 75%** calculated from 10-day GIR

Item	Cropping Pattern C					
	Present (2001)		Future (2010)		Future (2020)	
	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)	<b>Peak 10-day</b> (lit/sec/ha)	Annual Total (m <sup>3</sup> /year/ha)
Year	1986	1986	1989	1986	1999	1986
Water Requirement	<b>2.32</b>	28,300	<b>1.62</b>	23,300	<b>1.49</b>	21,500

The above peak 10-day GIRs of the respective cropping patterns A, B and C for the present (2001) condition are found also in Table D.7. Those for the future (2010) and (2020) are shown also in Table D.8 and Table D.9, respectively.

### 3.2 Irrigation Water Demand (IWD)

IWDs estimated based on the present and future conditions of cropping patterns and irrigation areas are as follows:

Irrigation Water Demand (IWD), **P = 50%** calculated from 10-day GIR

Item	Cropping Pattern (Weighted Average)					
	Present (2001)		Future (2010)		Future (2020)	
	Annual Average m <sup>3</sup> /sec	Annual Total 10 <sup>6</sup> m <sup>3</sup> / year	Annual Average m <sup>3</sup> /sec	Annual Total 10 <sup>6</sup> m <sup>3</sup> / year	Annual Average m <sup>3</sup> /sec	Annual Total 10 <sup>6</sup> m <sup>3</sup> / year
Kone and Ha Thanh River Basins						
Irrigation Area (ha)	21,400		27,500		48,200	
Water Demand	19.2	605	20.0	632	32.8	1,033
La Tinh, Kone and Ha Thanh River Basins						
Irrigation Area (ha)	24,400		30,500		54,500	
Water Demand	22.2	698	22.3	703	37.1	1,169

Irrigation Water Demand (IWD), **P = 75%** calculated from 10-day GIR

Item	Cropping Pattern (Weighted Average)					
	Present (2001)		Future (2010)		Future (2020)	
	Annual Average m <sup>3</sup> /sec	Annual Total 10 <sup>6</sup> m <sup>3</sup> / year	Annual Average m <sup>3</sup> /sec	Annual Total 10 <sup>6</sup> m <sup>3</sup> / year	Annual Average m <sup>3</sup> /sec	Annual Total 10 <sup>6</sup> m <sup>3</sup> / year
Kone and Ha Thanh River Basins						
Irrigation Area (ha)	21,400		27,500		48,200	
Water Demand	19.9	626	20.7	654	34.0	1,072
La Tinh, Kone and Ha Thanh River Basins						
Irrigation Area (ha)	24,400		30,500		54,500	
Water Demand	22.9	721	23.0	726	38.5	1,215

#### 4 FORECAST OF WATER DEMAND FOR LIVESTOCK

Water demand for livestock (LWD) estimated based on the present and future numbers of various kinds of livestock in the coastal area where the groundwater is salty is as follows:

**Livestock Water Demand (LWD)**

Kind	Present (2001)		Future (2010)		Future (2020)	
	Heads (nos.)	Demand (m <sup>3</sup> /day)	Heads (nos.)	Demand (m <sup>3</sup> /day)	Heads (nos.)	Demand (m <sup>3</sup> /day)
Cattle & Buffalo	19,600	2,060	32,000	3,360	41,000	4,300
Pig	71,000	3,200	90,000	4,050	117,000	5,260
Poultry	458,000	340	1,500,000	1,130	2,250,000	1,690
Goat	970	70	1,500	110	3,000	230
Total	-	5,670	-	8,650	-	11,480

#### 5 FORECAST OF WATER DEMAND FOR AQUACULTURE

Gross water demands (required fresh water) for the coastal shrimp culture (AWDs) estimated based on the present and future areas of the pond are as follows:

**Coastal Shrimp Culture Water Demand (AWD)**

Kind	Present (2001)		Future (2010)		Future (2020)	
	Area (ha)	Demand (10 <sup>3</sup> m <sup>3</sup> /year)	Area (ha)	Demand (10 <sup>3</sup> m <sup>3</sup> /year)	Area (ha)	Demand (10 <sup>3</sup> m <sup>3</sup> /year)
Coastal Shrimp	1,600	7,360	2,500	11,150	2,500	11,150

**Table D.1 Calculation Sheet of Potential Evapotranspiration (ETo)**

<b>Irrigation Area in River Basin (14°North, 10 m in Altitude)</b>														
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Average
<b>A</b>	Tmean ( °C) (HEC1 F/S)	23.1	23.9	25.4	27.3	28.9	29.7	29.8	29.8	28.4	26.8	25.4	23.7	26.9
<b>B</b>	RHmean (%) (HEC1 F/S)	84	82	83	83	80	74	71	71	78	83	84	83	80
<b>C</b>	ea (mbar)	28.3	29.6	32.5	36.3	39.9	41.7	41.9	41.9	38.7	35.3	32.5	29.3	
<b>D</b>	ed (mbar)	23.7	24.3	26.9	30.2	31.9	30.9	29.8	29.8	30.2	29.3	27.3	24.3	
<b>E</b>	(ea-ed) (mbar)	4.5	5.3	5.5	6.2	8.0	10.8	12.2	12.2	8.5	6.0	5.2	5.0	
<b>F</b>	Wind, Vw (m/s) (HEC1 F/S)	2.3	2.0	2.2	2.0	1.7	2.0	1.8	2.0	1.5	2.2	2.8	2.7	2.1
<b>G</b>	U (km/day)	198.7	172.8	190.1	172.8	146.9	172.8	155.5	172.8	129.6	190.1	241.9	233.3	
<b>H</b>	f(u)	0.81	0.74	0.78	0.74	0.67	0.74	0.69	0.74	0.62	0.78	0.92	0.90	
<b>I</b>	(1-W) of wind & numidity	0.28	0.28	0.26	0.24	0.23	0.23	0.23	0.23	0.23	0.25	0.26	0.28	
<b>J</b>	Sunshine, n (hr) (HEC1 F/S)	5.3	7.2	8.2	8.8	8.9	8.0	8.7	7.6	6.7	5.8	4.2	4.2	7.0
<b>K</b>	W of radiation	0.72	0.72	0.74	0.76	0.77	0.78	0.78	0.78	0.77	0.75	0.74	0.72	
<b>L</b>	Ra (mm/day)	12.40	13.60	14.90	15.70	15.80	15.70	15.70	15.70	15.10	14.10	12.80	12.00	
<b>M</b>	N (hr)	11.30	11.60	12.00	12.50	12.80	13.00	12.90	12.60	12.20	11.80	11.40	11.20	
<b>N</b>	n/N	0.47	0.62	0.68	0.70	0.70	0.62	0.67	0.60	0.55	0.49	0.37	0.38	
<b>O</b>	Rs (mm/day)	6.0	7.6	8.8	9.5	9.4	8.8	9.2	8.7	7.9	7.0	5.6	5.3	
<b>P</b>	Rns (mm/day)	4.5	5.7	6.6	7.1	7.1	6.6	6.9	6.5	5.9	5.2	4.2	3.9	
<b>Q</b>	f(Tmean)	15.2	15.3	15.7	16.1	16.4	16.6	16.6	16.6	16.3	16.0	15.7	15.3	
<b>R</b>	f(ed)	0.13	0.12	0.11	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.11	0.12	
<b>S</b>	f(n/N)	0.52	0.66	0.72	0.73	0.73	0.65	0.71	0.64	0.59	0.54	0.43	0.44	
<b>T</b>	Rnl (mm/day)	1.0	1.2	1.3	1.2	1.1	1.0	1.2	1.1	1.0	0.9	0.7	0.8	
<b>U</b>	Rn (mm/day)	3.5	4.5	5.4	5.9	6.0	5.5	5.7	5.4	5.0	4.4	3.4	3.1	
<b>V</b>	c	0.95	1.00	1.02	1.04	1.05	1.03	1.05	1.03	1.02	0.97	0.92	0.91	
<b>W</b>	<b>ETo (mm/day) for MP &amp; FS</b>	<b>3.38</b>	<b>4.34</b>	<b>5.20</b>	<b>5.82</b>	<b>6.12</b>	<b>6.25</b>	<b>6.63</b>	<b>6.40</b>	<b>5.17</b>	<b>4.31</b>	<b>3.47</b>	<b>3.19</b>	5.02

Source: Meteorological Data in F/S Report, HEC1, 2000

**Table D.2 Crop Water Requirement (CWR) of Paddy Rice**

Planting Date	Cropping Period (unit: mm/10-day)																														Total (mm)						
	January			February			March			April			May			June			July			August			September			October				November			December		
	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d		1st	2nd	3d	1st	2nd	3d
Potential Evapotranspiration (E <sub>o</sub> )	mm/month																														1,835						
Potential Evapotranspiration (E <sub>o</sub> )	mm/10-day																														1,835						
Mar. 21 2nd	a Land Preparation (150mm)																														150						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														57.2						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Prep. Req. (a+b+c)																														227						
	e Crop Water Req. (CWR)																														654						
	f Percolation (2mm/day)																														184						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														1,065						
Mar. 31 3rd	a Land Preparation (150mm)																														150						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														57.2						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Prep. Req. (a+b+c)																														227						
	e Crop Water Req. (CWR)																														666						
	f Percolation (2mm/day)																														184						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														1,077						
Apr. 1st	a Land Preparation (150mm)																														150						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														62.9						
	c Percolation (2mm/day*A%)																														22						
	d Total Land Prep. Req. (a+b+c)																														235						
	e Crop Water Req. (CWR)																														673						
	f Percolation (2mm/day)																														182						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														1,090						
Jul. 1st	a Land Preparation (105mm)																														105						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														68.8						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Prep. Req. (a+b+c)																														194						
	e Crop Water Req. (CWR)																														678						
	f Percolation (2mm/day)																														184						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														1,056						
Jul. 2nd	a Land Preparation (105mm)																														105						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														72.9						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Prep. Req. (a+b+c)																														198						
	e Crop Water Req. (CWR)																														649						
	f Percolation (2mm/day)																														184						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														1,031						
Jul. 3rd	a Land Preparation (105mm)																														105						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														72.9						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Prep. Req. (a+b+c)																														198						
	e Crop Water Req. (CWR)																														618						
	f Percolation (2mm/day)																														184						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														1,000						
Nov. 3rd	a Land Preparation (60 mm)																														60						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														38.2						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Preparation Req. (a+b+c)																														118						
	e Crop Water Req. (CWR)																														395						
	f Percolation (2mm/day)																														184						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														698						
Dec. 1st	a Land Preparation (60 mm)																														60						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														38.2						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Preparation Req. (a+b+c)																														118						
	e Crop Water Req. (CWR)																														398						
	f Percolation (2mm/day)																														180						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														696						
Dec. 2nd	a Land Preparation (60 mm)																														60						
	b Evaporation (E <sub>o</sub> *1.1*A%)																														35.1						
	c Percolation (2mm/day*A%)																														20						
	d Total Land Preparation Req. (a+b+c)																														115						
	e Crop Water Req. (CWR)																														421						
	f Percolation (2mm/day)																														180						
	g Consumptive Use (C <sub>u</sub> ) (d+e+f) mm/10-day																														716						

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**Table D.3 Crop Water Requirement (CWR) of Upland Crops**

Planting Date	Cropping Period (unit: mm/10-day)																														Total (mm)							
	January			February			March			April			May			June			July			August			September			October				November			December			
	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d	1st	2nd	3d		1st	2nd	3d	1st	2nd	3d	
Potential Evapotranspiration (ETo) mm/month		105			122			161			175			190			188			206			198			155			134			104			99		1,835	
Potential Evapotranspiration (ETo) mm/10-day	34	34	37	43	43	35	52	52	57	58	58	58	61	61	67	63	63	63	66	66	73	64	64	70	52	52	52	43	43	47	35	35	35	32	32	35.09	1,835	
<b>Maize</b>																																						
March 2nd 10-day Crop Coefficient (kc)	-	-	-	-	-	-	-	0.43	0.51	0.68	0.93	1.06	1.08	1.06	0.95	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crop Water Req. (CWR)	-	-	-	-	-	-	-	22	29	40	54	62	66	65	64	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	444	
March 3rd 10-day Crop Coefficient (kc)	-	-	-	-	-	-	-	0.43	0.51	0.68	0.93	1.06	1.08	1.06	0.95	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crop Water Req. (CWR)	-	-	-	-	-	-	-	25	30	40	54	65	66	71	59	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	452	
April 1st 10-day Crop Coefficient (kc)	-	-	-	-	-	-	-	0.43	0.51	0.68	0.93	1.06	1.08	1.06	0.95	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crop Water Req. (CWR)	-	-	-	-	-	-	-	25	30	40	57	65	73	66	59	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	457
<b>Soybeans</b>																																						
April 1st 10-day Crop Coefficient (kc)	-	-	-	-	-	-	-	0.43	0.48	0.67	0.90	1.02	1.05	1.04	1.02	0.96	0.84	0.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crop Water Req. (CWR)	-	-	-	-	-	-	-	25	28	39	55	62	71	65	64	60	56	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	564	
April 2nd 10-day Crop Coefficient (kc)	-	-	-	-	-	-	-	0.43	0.48	0.67	0.90	1.02	1.05	1.04	1.02	0.96	0.84	0.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crop Water Req. (CWR)	-	-	-	-	-	-	-	25	28	41	55	69	66	65	64	64	56	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	574	
April 3rd 10-day Crop Coefficient (kc)	-	-	-	-	-	-	-	0.43	0.48	0.67	0.90	1.02	1.05	1.04	1.02	0.96	0.84	0.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Crop Water Req. (CWR)	-	-	-	-	-	-	-	25	29	41	61	64	66	65	68	64	61	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	581	

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**Table D.4 (1/2) 10-day Effective Rainfall for Paddy at Quy Nhon Station (1977-2001)**

(Unit : mm/10-day)

Year	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
1977	6	0	0	0	0	0	14	0	0	0	0	0	0	12	11	8	0	0	20	8	0	0	0	5	80	21	116	64	119	49	175	36	0	14	0	0	758
1978	34	32	0	41	0	0	0	4	0	0	24	0	77	67	0	0	0	50	40	15	17	0	25	17	13	60	38	62	6	87	80	42	10	12	0	23	876
1979	40	0	0	0	7	0	0	0	0	0	0	0	8	16	14	32	34	32	5	0	0	0	0	6	0	66	0	122	62	22	140	27	97	14	0	744	
1980	0	0	0	14	0	0	0	0	7	0	0	0	16	12	46	41	64	31	0	0	0	0	0	31	45	31	73	176	59	110	68	154	0	20	10	7	1,015
1981	0	0	40	5	0	0	9	0	0	0	0	0	0	24	28	0	108	26	0	47	6	5	14	0	0	54	91	64	105	234	112	138	14	131	53	0	1,308
1982	0	36	7	0	13	0	0	0	0	0	0	0	0	6	50	0	12	0	7	0	0	0	80	89	0	34	43	63	43	34	14	55	40	10	0	636	
1983	11	17	0	0	0	0	0	0	0	0	0	0	0	0	10	0	32	0	8	0	43	22	5	14	0	130	61	92	99	88	122	0	0	63	35	852	
1984	22	0	7	5	0	0	0	0	0	0	0	0	28	9	6	74	0	0	29	0	8	6	0	0	35	0	73	45	127	10	140	7	117	7	10	34	799
1985	5	19	15	0	0	0	11	0	17	0	44	64	45	32	0	24	0	0	16	32	0	0	0	33	52	109	65	93	6	81	119	102	156	11	17	1,168	
1986	4	0	0	11	0	47	7	0	0	4	0	0	15	16	0	0	0	0	5	32	9	11	5	22	69	154	0	163	12	41	76	138	0	31	872		
1987	0	0	18	0	0	31	0	0	0	0	0	0	0	5	30	6	0	0	0	0	0	13	14	53	67	6	49	43	99	254	105	64	9	18	0	884	
1988	18	26	0	0	4	9	0	0	0	0	5	0	0	6	0	24	11	0	0	31	0	0	0	8	0	51	62	120	104	0	78	6	0	10	12	9	594
1989	5	0	10	0	0	5	29	66	24	0	0	0	0	6	54	32	0	6	16	0	34	20	20	5	45	39	19	97	73	5	61	64	46	0	49	19	849
1990	4	12	11	0	5	0	5	6	0	0	0	55	0	0	31	5	59	0	0	0	27	0	53	0	82	11	4	112	211	93	24	124	26	30	37	69	1,096
1991	26	0	7	0	0	27	0	37	6	26	0	37	5	0	16	54	0	0	0	5	5	7	0	0	16	103	132	133	6	148	59	28	14	35	44	0	976
1992	32	65	32	0	0	5	0	0	0	32	0	0	0	0	23	6	21	19	0	0	22	0	0	69	10	31	43	105	124	188	45	56	32	0	0	11	971
1993	0	6	0	0	0	0	11	0	0	0	13	0	0	0	6	0	0	0	0	0	0	21	0	39	39	87	96	101	99	115	9	23	172	120	68	35	1,060
1994	0	15	0	0	0	0	0	10	0	0	0	0	5	32	44	0	0	32	10	8	0	0	0	40	33	45	69	113	62	101	47	4	5	92	51	27	845
1995	0	0	0	10	0	0	37	0	0	0	0	0	9	54	0	0	0	0	32	0	0	0	0	27	63	65	89	98	12	83	84	38	87	0	15	51	854
1996	12	32	24	31	0	0	0	10	0	0	15	13	0	66	5	22	30	0	0	5	32	0	5	70	16	125	0	152	127	103	166	106	114	24	60	1,365	
1997	4	0	15	0	0	0	0	0	0	0	41	12	0	0	59	0	5	32	0	7	0	0	0	5	0	91	81	51	82	105	64	10	0	77	6	4	751
1998	0	12	22	0	0	0	0	0	15	0	0	0	25	63	62	16	0	0	44	0	0	37	5	19	11	62	87	116	69	84	160	191	115	96	53	15	1,379
1999	14	32	0	16	44	0	0	0	0	44	0	47	10	0	13	0	0	0	0	0	0	0	0	0	24	81	101	105	213	131	63	52	161	131	10	1,292	
2000	16	40	38	0	0	0	0	0	0	20	6	0	40	96	97	5	21	0	34	0	27	0	17	88	0	22	23	164	138	62	30	142	39	69	56	0	1,290
2001	7	0	0	0	12	0	0	8	57	0	0	17	9	51	6	15	0	0	21	0	0	36	37	5	18	13	55	48	100	123	47	64	11	13	34	7	814
Average	10	14	10	5	3	5	4	6	5	6	4	9	12	23	23	17	15	11	10	6	8	10	9	19	30	39	71	86	87	96	80	76	47	58	31	19	962

Note. Out of the above, results from 1978 to 2001 have been used for the irrigation water requirement calculation.

DT-4

**Table D.4 (2/2) 10-day Effective Rainfall for Paddy at Cay Muong (Binh Tuong) Station (1977-2001)**

(Unit : mm/10-day)

Year	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3				
1977	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0	0	85	0	4	0	76	105	53	156	25	62	11	147	36	0	0	0	0	770		
1978	62	0	0	16	0	0	14	0	0	0	25	55	43	54	0	0	48	31	43	5	10	0	0	21	51	61	12	32	7	87	52	4	0	15	9	21	778
1979	8	6	0	0	7	0	0	4	0	6	20	0	40	85	16	36	25	32	0	0	43	33	0	0	5	32	94	0	87	44	0	157	11	29	0	0	820
1980	0	0	4	0	0	0	12	0	0	0	14	12	30	44	109	51	27	20	18	0	41	0	13	41	75	70	72	144	70	193	110	133	0	22	24	0	1,349
1981	0	0	6	5	0	0	0	0	0	0	46	0	31	34	50	0	112	15	5	76	0	0	25	0	29	51	58	41	102	234	107	111	42	86	20	0	1,286
1982	5	0	8	0	0	0	0	0	29	32	12	29	45	5	0	51	19	8	0	0	0	0	0	78	15	23	61	19	75	28	43	38	24	24	0	0	671
1983	10	0	0	0	0	0	0	0	0	0	0	27	0	69	0	69	0	49	0	0	0	115	8	0	45	29	68	77	101	105	49	106	0	0	76	5	1,008
1984	0	0	0	0	0	0	0	0	0	0	8	44	47	0	61	86	7	0	4	19	38	18	0	0	45	0	133	29	155	0	192	0	95	27	0	21	1,029
1985	0	0	0	0	0	4	0	0	0	0	5	42	40	45	15	0	25	0	20	29	0	0	7	0	58	15	94	32	76	30	94	86	96	17	15	12	857
1986	0	0	0	0	0	0	0	12	0	0	0	0	0	44	8	0	32	0	32	28	32	19	79	0	45	14	37	125	0	137	5	24	36	121	0	57	887
1987	0	5	0	0	0	20	0	0	0	0	0	0	0	41	66	0	5	19	32	7	0	22	48	37	74	15	32	0	48	237	116	67	0	8	0	899	
1988	6	5	0	0	0	39	0	0	0	0	4	12	0	0	12	29	19	0	39	66	35	0	0	42	8	47	78	109	136	32	69	4	5	4	12	0	812
1989	6	4	5	0	0	0	7	56	38	13	0	0	71	14	46	24	0	41	93	25	16	26	47	41	58	78	10	42	54	0	46	38	32	0	24	19	974
1990	11	0	0	0	0	0	0	0	0	0	32	32	19	16	94	11	44	32	41	33	13	44	62	0	49	56	0	66	116	92	59	112	0	21	0	42	1,097
1991	0	0	0	0	0	32	0	41	0	0	18	13	7	0	0	55	0	11	75	0	0	28	0	0	31	57	153	116	15	127	64	12	44	32	51	7	989
1992	20	26	20	0	0	0	0	0	0	11	11	0	24	0	10	58	39	14	0	14	51	0	4	48	0	41	114	67	62	206	31	21	52	4	4	42	994
1993	0	0	0	0	0	0	0	0	0	0	32	0	0	0	52	16	21	22	0	32	5	0	0	7	0	34	56	80	36	115	0	11	155	87	71	0	832
1994	0	30	0	6	0	0	0	0	25	0	0	0	0	79	23	0	0	32	4	5	0	0	0	84	50	87	22	60	66	48	26	0	23	102	27	13	812
1995	13	0	0	9	0	0	0	0	4	0	0	9	6	66	57	6	9	22	18	14	32	56	21	107	31	75	71	104	6	119	95	16	42	0	40	11	1,059
1996	5	14	0	5	8	0	0	0	0	0	13	0	7	90	12	19	32	11	0	8	0	21	0	12	62	33	74	4	108	160	105	177	102	86	34	0	1,202
1997	0	0	0	8	0	0	0	0	0	0	89	0	40	72	53	0	44	0	0	16	7	0	29	0	0	25	100	33	7	57	64	13	0	46	5	0	708
1998	0	38	0	0	0	0	0	0	11	0	7	0	28	17	7	0	12	7	17	32	6	36	12	33	26	56	84	89	24	64	85	154	122	81	108	0	1,156
1999	5	54	8	11	10	23	32	0	0	15	0	56	56	0	105	15	28	14	10	32	0	0	70	30	32	32	101	63	88	163	165	47	86	166	111	0	1,628
2000	0	4	33	0	0	0	0	0	0	20	60	0	0	105	49	6	18	62	70	0	49	23	38	61	0	37	31	117	140	49	0	160	43	75	33	30	1,313
2001	6	14	0	0	0	0	15	19	13	6	0	6	20	62	0	8	6	0	8	0	17	47	5	28	0	17	35	39	50	152	54	32	6	8	77	25	775
Average	6	8	3	2	1	5	3	5	5	4	16	13	22	36	33	24	23	17	21	22	16	19	18	30	34	44	69	62	66	92	76	64	43	42	30	12	988

Note. Out of the above, results from 1978 to 2001 have been used for the irrigation water requirement calculation.

**Table D.5 (1/2) 10-day Effective Rainfall for Upland Crops at Quy Nhon Station (1977-2001)**

(Unit : mm/10-day)

Year	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
1977	9	7	1	2	1	2	21	0	7	0	0	0	1	14	14	10	0	2	24	10	1	5	1	15	63	32	78	60	58	46	96	50	10	20	3	10	673
1978	44	36	0	81	2	6	1	5	0	0	29	0	68	70	4	10	0	74	45	20	21	2	32	24	18	54	40	73	9	74	78	60	17	19	15	29	1,060
1979	47	6	4	1	8	0	6	0	0	1	0	4	11	19	16	35	37	38	7	0	0	5	2	4	14	3	83	8	97	70	34	86	38	75	30	20	809
1980	8	6	1	16	1	2	0	0	10	1	0	0	26	22	74	46	59	39	3	0	13	0	6	41	56	35	64	69	50	60	53	103	3	27	18	20	932
1981	5	6	47	15	0	0	11	0	1	1	5	5	0	31	36	6	89	44	0	56	10	10	23	0	0	63	70	50	62	101	108	76	28	79	66	3	1,107
1982	3	43	14	3	15	0	0	0	5	4	8	0	2	4	12	52	2	20	3	12	1	0	2	100	70	9	49	48	50	62	45	22	51	54	20	1	786
1983	17	28	0	0	0	0	5	0	0	0	0	0	0	2	5	26	0	55	0	15	3	55	31	7	30	2	113	59	53	66	77	80	7	12	60	41	849
1984	31	3	20	12	1	2	0	0	0	0	1	8	32	10	17	96	2	7	34	0	12	9	4	0	49	3	72	55	109	15	108	19	70	14	14	46	875
1985	12	23	27	0	0	0	0	14	2	21	0	46	63	45	47	3	29	8	0	22	43	0	2	0	37	58	64	73	79	14	57	68	72	95	27	32	1,083
1986	12	5	6	18	5	49	10	0	0	7	0	0	9	27	23	0	0	0	0	3	6	35	18	14	15	30	61	89	1	92	20	46	60	114	6	48	829
1987	8	1	29	7	0	35	0	0	1	3	1	2	0	2	7	36	8	0	0	3	3	0	16	20	60	60	13	46	44	60	97	84	58	22	24	8	758
1988	28	36	2	0	7	14	9	0	0	1	9	0	0	8	1	33	22	0	0	37	0	3	0	14	0	71	73	101	115	1	110	18	13	15	29	20	790
1989	9	7	23	5	0	16	37	61	29	0	1	0	0	12	56	55	0	11	23	2	36	26	28	12	48	44	24	73	68	12	51	52	52	2	54	31	960
1990	6	18	17	1	6	0	7	9	0	0	1	64	1	0	38	22	106	0	4	8	30	0	60	1	83	22	18	66	97	56	39	79	39	41	43	63	1,045
1991	34	1	12	3	0	36	0	62	9	31	1	53	6	0	25	68	1	0	2	6	7	12	2	8	22	65	73	84	13	97	90	45	30	41	50	4	993
1992	38	33	37	0	1	7	0	0	0	1	0	0	1	2	27	8	25	22	3	0	33	5	7	100	13	39	57	57	57	107	45	50	35	7	3	15	835
1993	3	8	0	3	0	0	14	4	0	0	16	0	0	3	16	0	2	4	6	0	2	25	2	41	40	56	59	99	57	61	17	40	106	76	55	42	857
1994	10	21	2	7	0	0	0	2	13	0	0	0	11	39	44	4	4	45	12	11	5	6	0	44	37	47	56	56	52	57	60	17	15	66	53	33	829
1995	2	4	15	16	0	0	47	0	4	0	0	4	15	67	0	3	0	0	38	3	7	3	0	38	51	50	65	69	18	76	58	40	57	12	27	52	841
1996	15	36	28	40	1	0	0	13	0	0	21	16	3	91	11	30	34	0	0	1	15	36	1	7	58	29	78	8	93	73	68	83	64	72	36	54	1,115
1997	6	0	21	0	16	3	0	0	1	0	43	20	1	0	69	0	7	43	0	10	3	3	3	9	6	79	80	50	52	70	120	30	4	72	15	10	846
1998	2	15	25	0	0	0	3	0	29	0	6	2	32	58	54	20	0	8	53	0	0	50	11	24	17	60	63	59	59	78	78	99	74	68	67	24	1,138
1999	21	38	7	25	52	1	1	0	5	47	2	50	16	9	17	5	0	0	2	0	6	1	2	0	10	42	70	57	60	79	70	50	62	82	94	19	1,002
2000	21	39	43	5	1	6	3	0	6	25	12	0	41	57	62	19	26	2	41	3	32	4	34	81	1	27	28	74	60	50	36	80	46	65	59	19	1,108
2001	14	9	1	1	15	0	5	20	56	2	0	21	13	51	11	18	0	2	26	1	0	41	39	14	23	19	57	47	58	70	58	67	17	17	39	18	850
Average	16	17	15	10	5	7	7	8	7	6	6	12	14	26	27	24	18	17	13	9	12	13	13	25	33	40	60	61	59	62	67	58	41	47	36	26	919

Note. Out of the above, results from 1978 to 2001 have been used for the irrigation water requirement calculation.

**Table D.5 (2/2) 10-day Effective Rainfall for Upland Crops at Cay Muong (Binh Tuong) Station (1977-2001)**

(Unit : mm/10-day)

Year	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
1977	2	4	0	0	6	1	6	0	2	0	1	2	0	0	4	0	11	4	20	80	5	12	0	80	63	50	91	40	71	20	111	66	7	11	1	1	772
1978	70	3	0	20	0	0	18	4	0	0	34	53	46	56	7	0	51	35	59	13	18	1	3	26	52	60	19	47	10	71	84	24	9	24	15	29	961
1979	12	11	1	0	9	0	0	7	0	7	23	0	46	62	24	36	28	40	6	0	47	39	0	0	18	45	67	3	98	62	3	116	35	37	7	2	891
1980	2	3	6	1	0	4	15	0	3	0	17	14	35	49	74	48	35	28	22	0	43	3	23	43	52	52	68	53	71	104	84	4	27	32	7	1,074	
1981	5	2	16	9	0	1	1	0	0	0	55	3	32	34	45	6	91	29	16	83	6	1	32	0	33	50	56	53	66	105	85	64	41	93	52	0	1,165
1982	6	4	13	1	1	0	0	0	36	56	16	35	50	6	2	48	25	13	0	0	3	6	79	27	33	53	27	60	36	44	40	26	31	0	0	777	
1983	16	9	0	0	0	0	3	0	0	0	0	32	10	84	1	67	3	67	3	0	4	97	27	0	51	34	66	65	55	85	65	88	1	3	72	18	1,026
1984	11	0	9	0	0	0	0	0	0	0	13	48	61	0	68	112	15	7	5	26	42	22	4	0	66	1	90	44	116	9	123	2	81	31	3	31	1,040
1985	3	4	5	3	0	5	1	0	0	2	8	46	40	42	21	8	27	6	27	32	0	1	9	0	60	22	71	63	78	34	57	54	86	31	19	17	882
1986	0	0	3	3	4	6	0	14	0	0	0	0	5	50	17	0	43	2	41	31	45	32	67	11	44	19	42	79	0	83	6	34	43	110	4	62	900
1987	0	6	1	0	0	24	0	0	0	4	2	0	0	2	46	67	0	9	25	39	12	1	33	59	56	60	20	41	3	50	79	81	60	4	13	1	798
1988	18	8	8	0	3	55	1	0	0	0	9	16	0	0	19	35	27	0	46	51	36	7	0	55	17	53	64	66	79	44	107	16	17	8	17	6	888
1989	16	10	10	0	0	7	12	51	41	15	3	0	64	24	51	29	4	44	78	36	29	28	51	48	57	62	16	53	51	10	45	41	46	0	28	24	1,084
1990	14	2	4	0	1	0	0	5	1	0	45	40	28	34	74	19	72	60	40	36	16	50	58	0	69	74	0	62	86	54	64	83	9	24	12	41	1,177
1991	6	0	0	0	0	61	0	63	0	6	20	27	10	0	0	57	0	16	89	2	0	34	0	0	37	56	79	67	21	88	79	20	55	39	51	8	991
1992	24	28	22	0	0	1	0	0	0	12	14	0	27	2	20	50	43	18	3	26	77	0	11	52	0	61	83	50	49	116	39	30	46	7	8	46	965
1993	0	0	0	0	0	0	0	3	0	0	44	0	0	0	89	18	27	29	7	43	10	3	0	15	9	38	57	70	42	61	0	27	131	78	72	0	873
1994	0	36	0	10	0	0	0	4	35	2	0	0	0	80	38	1	0	75	7	13	0	0	0	98	51	59	31	49	66	53	34	8	33	74	40	20	917
1995	16	0	4	13	0	0	2	0	6	1	0	11	14	62	56	10	11	27	21	17	44	58	29	65	38	55	55	77	11	88	63	32	49	1	42	20	998
1996	6	17	4	12	10	0	0	0	0	0	18	0	14	109	24	22	35	13	0	9	0	24	3	15	54	40	54	10	70	84	59	87	58	103	45	16	1,015
1997	5	0	2	9	11	0	0	0	2	3	91	0	40	57	53	0	52	0	5	19	11	1	33	5	3	45	96	48	21	73	124	28	0	56	7	0	900
1998	0	49	11	0	0	0	3	0	14	2	8	5	32	22	17	0	15	12	26	35	7	44	16	39	37	55	60	58	34	83	56	90	79	69	79	11	1,068
1999	8	56	12	12	15	26	45	0	0	24	7	54	70	4	80	22	34	17	18	51	1	0	64	41	44	49	61	50	58	75	89	54	55	92	80	5	1,373
2000	5	7	42	0	0	1	0	2	0	37	73	4	4	81	67	14	30	63	65	0	59	29	39	50	3	51	39	63	65	46	5	96	65	60	42	39	1,246
2001	10	23	0	0	6	0	18	23	24	7	0	7	28	65	0	10	9	5	10	2	20	51	8	38	0	25	41	41	53	78	55	56	8	13	63	41	838
Average	10	11	7	4	3	8	5	7	7	7	20	16	26	37	36	27	28	25	26	26	21	22	21	33	38	46	55	52	53	63	63	53	42	41	32	18	985

Note. Out of the above, results from 1978 to 2001 have been used for the irrigation water requirement calculation.

**Table D.6 Irrigation Water Requirement by Year**

**Present Cropping Pattern A (2001)  
For 24 Years from 1978 to 2001**

**9,500 ha**

Year	Cropping Crop	Land Code No.	Land Area (ha)	Land Area Ratio	Cropping Period												Total																								
					January			February			March			April				May			June			July			August			September			October			November			December		
					1	2	3	1	2	3	1	2	3	1	2	3		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3			
1978	Effective Rainfall for Paddy		mm/10-day		62	0	0	16	0	0	14	0	0	0	25	55	43	54	0	0	48	31	43	5	10	0	0	21	51	61	12	32	7	87	52	4	0	15	9	21	778
1978	Effective Rainfall for Upland Crops		mm/10-day		70	3	0	20	0	0	18	4	0	0	34	53	46	56	7	0	51	35	59	13	18	1	3	26	52	60	19	47	10	71	84	24	9	24	15	29	961
1978	I. Paddy-Paddy	a	5,600	0.59																																					
	1 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		1st 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	2 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		2nd 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	3 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		3rd 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	Total Cropped Area (ha)		1.00																																						
	Total Net Irr. Req. (NIR) mm/10-day																																								
	Irr. Efficiency (Paddy/Upland Crops)		0.60																																						
	Total Gross Irr. Req. (GIR)		mm/10-day																																						
1978	II. Paddy-Paddy	b	2,800	0.29																																					
	1 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		1st 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	2 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		2nd 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	3 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		3rd 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	Total Cropped Area (ha)		1.00																																						
	Total Net Irr. Req. (NIR) mm/10-day																																								
	Irr. Efficiency (Paddy/Upland Crops)		0.60																																						
	Total Gross Irr. Req. (GIR)		mm/10-day																																						
1978	III. Paddy-Soybeans	c	1,100	0.12																																					
	1 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		1st 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	2 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		2nd 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	3 Cropped Area (ha)		0.33																																						
	Consumptive Use of Water		3rd 10-day																																						
	Effective rainfall (ER10-day)		Seeding																																						
	Net Irr. Req. (NIR)		mm/10-day																																						
	Total Cropped Area (ha)		1.00																																						
	Total Net Irr. Req. (NIR) mm/10-day																																								
	Irr. Efficiency (Paddy/Upland Crops)		0.60																																						
	Total Gross Irr. Req. (GIR)		mm/10-day																																						
	Total		9,500	1.00																																					
	Weighted Ave. NIR		mm/10-day																																						
	Weighted Ave. GIR		mm/10-day																																						

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**Table D.7 (1/3) Gross Unit Irrigation Water Requirement by Year, 2001, Cropping Pattern A**

Present Cropping Pattern (2001)

For 24 Years from 1978 to 2001

A-II Kone Upper & Middle Reaches, Van Phong Proper, Van Phong Extension (La Tinh), Ha Thanh  
(using ETo data at Quy Nhon and Rainfall data at Cay Muong (Binh Tuong))

(Unit: l/s/ha)

No.	Year	Cropping Period																								Max. (l/s/ha)	Rank	Ave. (l/s/ha)	Rank													
		Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.							Sept.			Oct.			Nov.			Dec.			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					1	2	3	1	2	3	1	2	3				
1.	1978	0.02	1.24	1.26	1.19	1.42	0.92	1.61	1.71	2.18	1.56	1.08	0.68	1.03	0.86	1.89	1.88	0.55	0.99	0.77	1.40	0.95	1.08	1.13	0.96	0.44	0.31	0.82	0.30	0.23	0.00	0.00	0.73	1.12	1.14	0.89	0.74	2.18	1	0.98	13	
2.	1979	1.04	1.12	1.26	1.50	1.29	0.92	1.79	1.67	2.18	1.43	1.22	1.76	1.06	0.45	1.59	1.15	0.88	0.95	1.15	1.46	0.61	0.70	1.13	1.18	0.96	0.64	0.00	0.54	0.00	0.00	0.00	0.00	0.98	0.87	1.06	1.10	2.18	1	0.99	10	
3.	1980	1.20	1.24	1.19	1.50	1.42	0.92	1.64	1.73	2.16	1.56	1.34	1.50	1.27	1.03	0.24	0.88	0.82	1.08	0.99	1.46	0.63	1.08	0.99	0.76	0.16	0.21	0.14	0.00	0.00	0.00	0.00	0.00	1.12	1.01	0.60	1.10	2.16	18	0.92	22	
4.	1981	1.20	1.24	1.16	1.40	1.42	0.92	1.79	1.73	2.18	1.56	0.68	1.74	1.29	1.28	1.07	1.83	0.02	1.11	1.10	0.57	1.05	1.08	0.85	1.18	0.69	0.43	0.30	0.23	0.00	0.00	0.00	0.05	0.58	0.19	0.67	1.10	2.18	1	0.94	19	
5.	1982	1.10	1.24	1.12	1.50	1.42	0.92	1.79	1.73	1.64	0.77	1.38	1.12	0.97	1.86	1.93	0.88	0.94	1.23	1.16	1.46	1.05	1.08	1.13	0.37	0.85	0.75	0.26	0.39	0.00	0.00	0.00	0.52	0.81	0.97	1.06	1.10	1.93	22	1.01	4	
6.	1983	1.01	1.24	1.26	1.50	1.42	0.92	1.78	1.73	2.18	1.56	1.65	1.17	1.83	0.49	1.94	0.52	1.23	0.75	1.15	1.46	1.05	0.00	1.04	1.18	0.51	0.68	0.18	0.00	0.00	0.00	0.00	0.08	1.12	1.43	0.00	1.02	2.18	1	0.98	12	
7.	1984	1.20	1.24	1.26	1.50	1.42	0.92	1.79	1.73	2.18	1.56	1.45	0.85	0.86	1.97	0.77	0.13	1.10	1.31	1.12	1.23	0.66	0.87	1.13	1.18	0.51	1.01	0.00	0.32	0.00	0.00	0.00	0.76	0.15	0.91	1.06	0.74	2.18	1	0.97	15	
8.	1985	1.20	1.24	1.26	1.50	1.42	0.85	1.79	1.73	2.18	1.54	1.53	0.89	1.12	1.08	1.62	1.81	0.88	1.31	0.97	1.11	1.05	1.08	1.06	1.18	0.36	0.84	0.00	0.30	0.00	0.00	0.00	0.21	0.14	1.10	0.77	0.89	2.18	1	1.00	7	
9.	1986	1.20	1.24	1.26	1.50	1.42	0.92	1.79	1.58	2.18	1.56	1.65	1.76	1.88	1.03	1.73	1.88	0.72	1.33	0.86	1.12	0.72	0.86	0.24	1.18	0.51	0.85	0.54	0.00	0.26	0.00	0.00	0.61	0.66	0.00	1.06	0.10	2.18	1	1.01	6	
10.	1987	1.20	1.14	1.26	1.50	1.42	0.60	1.79	1.73	2.18	1.52	1.64	1.76	1.92	1.95	1.16	0.55	1.26	1.26	0.98	1.07	0.98	1.08	0.88	0.68	0.60	0.17	0.79	0.30	0.26	0.00	0.00	0.01	0.33	1.43	0.91	1.10	2.18	1	1.04	2	
11.	1988	1.08	1.14	1.26	1.50	1.42	0.29	1.79	1.73	2.18	1.56	1.53	1.48	1.92	1.97	1.67	1.24	0.93	1.33	0.80	0.68	0.69	1.08	1.13	0.75	0.93	0.47	0.07	0.00	0.00	0.00	0.73	1.06	1.35	0.83	1.10	2.18	1	1.05	1		
12.	1989	1.08	1.16	1.17	1.50	1.42	0.92	1.69	1.10	1.52	1.28	1.63	1.76	0.56	1.60	1.06	1.35	1.23	0.87	0.40	1.15	0.89	0.78	0.60	0.76	0.36	0.12	0.84	0.22	0.05	0.00	0.00	0.52	0.71	1.43	0.60	0.77	1.76	24	0.92	21	
13.	1990	0.99	1.24	1.26	1.50	1.42	0.92	1.79	1.71	2.18	1.56	0.91	1.05	1.46	1.48	0.39	1.59	0.47	0.89	0.79	1.06	0.92	0.58	0.43	1.18	0.46	0.37	0.96	0.04	0.00	0.00	0.00	0.04	1.12	1.03	1.06	0.37	2.18	16	0.92	20	
14.	1991	1.20	1.24	1.26	1.50	1.42	0.40	1.79	1.16	2.18	1.51	1.27	1.38	1.75	1.97	1.95	0.75	1.26	1.19	0.52	1.46	1.05	0.76	1.13	1.18	0.66	0.36	0.00	0.00	0.20	0.00	0.00	0.68	0.55	0.81	0.08	0.98	2.18	1	1.00	9	
15.	1992	0.81	0.74	0.91	1.50	1.42	0.92	1.79	1.73	2.18	1.33	1.41	1.76	1.41	1.95	1.68	0.78	0.67	1.16	1.15	1.29	0.53	1.08	1.09	0.68	1.02	0.54	0.00	0.03	0.02	0.00	0.00	0.62	0.45	1.35	0.98	0.37	2.18	1	0.98	11	
16.	1993	1.20	1.24	1.26	1.50	1.42	0.92	1.79	1.72	2.18	1.56	0.92	1.76	1.92	1.97	0.74	1.54	0.92	1.06	1.15	1.07	1.00	1.08	1.13	1.11	1.02	0.62	0.32	0.00	0.12	0.00	0.00	0.69	0.00	0.18	0.00	1.10	2.18	1	1.01	5	
17.	1994	1.20	0.66	1.26	1.38	1.42	0.92	1.79	1.71	1.69	1.54	1.65	1.76	1.92	0.40	1.41	1.87	1.26	0.86	1.12	1.40	1.05	1.08	1.13	0.31	0.45	0.02	0.71	0.08	0.01	0.00	0.00	0.76	0.82	0.08	0.54	0.88	1.92	23	0.98	14	
18.	1995	0.95	1.24	1.26	1.32	1.42	0.92	1.78	1.73	2.10	1.55	1.65	1.56	1.73	0.67	0.91	1.72	1.11	1.07	0.99	1.29	0.72	0.44	0.90	0.07	0.66	0.15	0.15	0.00	0.23	0.00	0.00	0.66	0.58	1.43	0.29	0.91	2.10	19	0.95	18	
19.	1996	1.10	0.97	1.26	1.40	1.27	0.92	1.79	1.73	2.18	1.56	1.35	1.76	1.72	0.14	1.63	1.47	0.78	1.20	1.16	1.37	1.05	0.84	1.13	1.06	0.31	0.63	0.11	0.51	0.00	0.00	0.00	0.00	0.10	0.19	0.40	1.10	2.18	1	0.95	16	
20.	1997	1.20	1.24	1.26	1.34	1.42	0.92	1.79	1.73	2.17	1.53	0.02	1.76	1.12	0.65	0.98	1.88	0.57	1.33	1.15	1.27	0.98	1.08	0.80	1.18	1.02	0.72	0.00	0.29	0.23	0.00	0.00	0.68	1.12	0.54	0.96	1.10	2.17	17	1.00	8	
21.	1998	1.20	0.51	1.26	1.50	1.42	0.92	1.78	1.73	1.97	1.54	1.50	1.72	1.32	1.58	1.74	1.88	1.06	1.24	0.99	1.07	0.99	0.67	1.00	0.84	0.72	0.37	0.03	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.22	0.00	1.10	1.97	20	0.95	17
22.	1999	1.10	0.20	1.12	1.28	1.23	0.55	1.38	1.73	2.18	1.18	1.59	0.66	0.69	1.93	0.25	1.52	0.82	1.17	1.06	1.07	1.05	1.08	0.34	0.87	0.65	0.64	0.00	0.06	0.00	0.00	0.00	0.46	0.21	0.00	0.00	1.10	2.18	1	0.81	24	
23.	2000	1.20	1.16	0.68	1.50	1.42	0.92	1.79	1.72	2.18	1.02	0.41	1.73	1.89	0.13	0.90	1.69	0.92	0.66	0.56	1.46	0.55	0.81	0.70	0.55	1.02	0.59	0.60	0.00	0.00	0.00	0.00	0.00	0.57	0.26	0.42	0.58	2.18	1	0.85	23	
24.	2001	1.08	0.97	1.26	1.50	1.42	0.92	1.60	1.48	1.88	1.43	1.65	1.63	1.45	0.69	1.95	1.70	1.15	1.32	1.08	1.46	0.88	0.54	1.08	0.89	1.02	0.81	0.56	0.24	0.07	0.00	0.00	0.55	1.04	1.28	0.00	0.67	1.95	21	1.04	3	
<b>Max.</b>		1.20	1.24	1.26	1.50	1.42	0.92	1.79	1.73	2.18	1.56	1.65	1.76	1.92	1.97	1.95	1.88	1.26	1.33	1.16	1.46	1.05	1.08	1.13	1.18	1.02	1.01	0.96	0.54	0.26	0.00	0.00	0.76	1.12	1.43	1.06	1.10	2.18				
<b>Ave.</b>		1.07	1.08	1.20	1.45	1.40	0.84	1.74	1.66	2.09	1.45	1.30	1.46	1.42	1.21	1.30	1.35	0.90	1.11	0.96	1.23	0.88	0.87	0.93	0.89	0.66	0.51	0.31	0.16	0.08	0.00	0.00	0.39	0.64	0.80	0.59	0.88			0.97		

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**Table D.7 (2/3) Gross Unit Irrigation Water Requirement by Year, 2001, Cropping Pattern B**

Present Cropping Pattern (2001)

For 24 Years from 1978 to 2001

B-1 Tan An - Dap Da Upper & Middle Reaches, Tan An Extension (Ha Thanh Lower Reaches)

(using ETo data at Quy Nhon and Rainfall data at Quy Nhon)

(Unit: l/s/ha)

No.	Year	Cropping Period																								Max. (l/s/ha)	Rank	Ave. (l/s/ha)	Rank													
		Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.							Sept.			Oct.			Nov.			Dec.			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					1	2	3	1	2	3	1	2	3				
1.	1978	0.46	0.54	1.20	0.68	1.49	1.41	1.74	1.55	1.33	1.68	1.21	1.90	0.30	0.37	1.54	1.53	1.58	0.54	0.75	0.77	0.29	0.34	0.25	0.30	0.26	0.10	0.15	0.02	0.07	0.00	0.00	0.09	0.17	0.76	1.08	0.94	1.90	1	0.76	23	
2.	1979	0.34	1.15	1.20	1.47	1.36	1.41	1.74	1.63	1.33	1.68	1.54	1.90	1.29	1.23	1.37	1.10	1.02	1.14	1.23	0.93	0.37	0.33	0.34	0.35	0.28	0.30	0.06	0.16	0.00	0.00	0.00	0.00	0.13	0.12	0.88	1.35	1.90	14	0.85	10	
3.	1980	1.11	1.15	1.20	1.20	1.49	1.41	1.74	1.63	1.24	1.68	1.54	1.90	1.13	1.28	0.84	0.94	0.55	1.15	1.29	0.93	0.35	0.34	0.34	0.25	0.15	0.19	0.04	0.00	0.01	0.00	0.00	0.00	0.19	0.69	0.94	1.22	1.90	1	0.83	13	
4.	1981	1.11	1.15	0.50	1.37	1.49	1.41	1.58	1.63	1.33	1.68	1.54	1.89	1.43	1.08	1.13	1.66	0.00	1.21	1.30	0.50	0.34	0.32	0.29	0.35	0.30	0.12	0.00	0.02	0.00	0.00	0.00	0.16	0.00	0.34	1.35	1.89	16	0.79	19		
5.	1982	1.11	0.46	1.07	1.47	1.24	1.41	1.74	1.63	1.33	1.68	1.53	1.90	1.43	1.50	1.49	0.79	1.58	1.46	1.29	0.86	0.37	0.34	0.34	0.10	0.00	0.30	0.17	0.06	0.00	0.00	0.00	0.12	0.07	0.51	0.94	1.35	1.90	1	0.88	4	
6.	1983	0.90	0.83	1.20	1.47	1.49	1.41	1.74	1.63	1.33	1.68	1.54	1.90	1.43	1.51	1.58	1.46	1.58	1.10	1.30	0.85	0.36	0.17	0.26	0.33	0.25	0.30	0.00	0.02	0.00	0.00	0.00	0.19	0.86	0.28	0.73	1.90	1	0.88	3		
7.	1984	0.69	1.15	1.07	1.37	1.49	1.41	1.74	1.63	1.33	1.68	1.54	1.89	0.94	1.35	1.48	0.40	1.58	1.66	0.93	0.93	0.33	0.31	0.34	0.35	0.18	0.30	0.04	0.06	0.00	0.00	0.00	0.12	0.00	0.80	0.94	0.75	1.89	17	0.85	9	
8.	1985	1.02	0.79	0.93	1.47	1.49	1.41	1.74	1.43	1.33	1.46	1.54	1.20	0.39	0.74	1.06	1.66	1.18	1.65	1.30	0.78	0.22	0.34	0.34	0.35	0.19	0.12	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.92	1.05	1.74	18	0.78	21	
9.	1986	1.04	1.15	1.20	1.26	1.49	0.34	1.61	1.63	1.33	1.62	1.54	1.90	1.41	1.22	1.33	1.67	1.58	1.67	1.30	0.93	0.35	0.21	0.31	0.31	0.28	0.22	0.05	0.00	0.08	0.00	0.00	0.09	0.05	0.00	1.08	0.80	1.90	1	0.86	5	
10.	1987	1.11	1.15	0.88	1.47	1.49	0.71	1.74	1.63	1.33	1.68	1.54	1.90	1.43	1.51	1.51	1.13	1.48	1.67	1.30	0.93	0.36	0.34	0.30	0.31	0.12	0.07	0.26	0.05	0.03	0.00	0.00	0.01	0.06	0.78	0.83	1.35	1.90	12	0.90	1	
11.	1988	0.77	0.65	1.20	1.47	1.41	1.21	1.74	1.63	1.33	1.68	1.48	1.90	1.43	1.40	1.59	1.23	1.38	1.67	1.30	0.64	0.37	0.34	0.34	0.32	0.30	0.13	0.07	0.00	0.00	0.00	0.00	0.13	0.19	0.77	0.91	1.19	1.90	1	0.89	2	
12.	1989	1.02	1.15	1.02	1.47	1.49	1.30	1.21	0.46	1.01	1.68	1.54	1.90	1.43	1.39	0.74	1.06	1.58	1.56	1.08	0.93	0.23	0.26	0.27	0.33	0.15	0.17	0.22	0.00	0.00	0.00	0.00	0.06	0.09	0.86	0.39	1.01	1.90	1	0.80	17	
13.	1990	1.04	0.92	1.00	1.47	1.39	1.41	1.65	1.52	1.33	1.68	1.54	1.03	1.43	1.51	1.09	1.54	0.60	1.67	1.29	0.92	0.25	0.34	0.16	0.35	0.02	0.26	0.27	0.00	0.00	0.00	0.00	0.00	0.14	0.60	0.56	0.25	1.68	24	0.81	16	
14.	1991	0.61	1.15	1.07	1.47	1.49	0.80	1.74	0.97	1.25	1.34	1.54	1.30	1.34	1.51	1.32	0.71	1.58	1.67	1.30	0.88	0.35	0.31	0.34	0.35	0.25	0.00	0.00	0.00	0.07	0.00	0.00	0.10	0.16	0.56	0.46	1.35	1.74	18	0.82	15	
15.	1992	0.50	0.00	0.64	1.47	1.49	1.30	1.74	1.63	1.33	1.26	1.54	1.90	1.43	1.51	1.22	1.56	1.23	1.36	1.29	0.93	0.27	0.33	0.34	0.14	0.27	0.19	0.14	0.00	0.00	0.00	0.00	0.07	0.12	0.86	1.08	1.15	1.90	1	0.84	12	
16.	1993	1.11	1.04	1.20	1.47	1.49	1.41	1.54	1.63	1.33	1.68	1.38	1.90	1.43	1.51	1.48	1.67	1.58	1.66	1.29	0.93	0.37	0.26	0.34	0.23	0.17	0.01	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.25	0.73	1.90	1	0.86	7		
17.	1994	1.11	0.86	1.20	1.47	1.49	1.41	1.74	1.63	1.20	1.68	1.54	1.90	1.33	0.95	0.90	1.66	1.58	1.12	1.17	0.85	0.36	0.33	0.34	0.23	0.19	0.15	0.05	0.00	0.01	0.00	0.00	0.13	0.18	0.15	0.37	0.87	1.90	1	0.83	14	
18.	1995	1.11	1.15	1.20	1.28	1.49	1.41	1.07	1.63	1.33	1.68	1.54	1.90	1.26	0.60	1.59	1.66	1.58	1.67	0.89	0.93	0.36	0.34	0.34	0.27	0.09	0.08	0.00	0.00	0.06	0.00	0.00	0.09	0.03	0.86	0.87	0.45	1.90	14	0.85	8	
19.	1996	0.88	0.54	0.78	0.87	1.49	1.41	1.74	1.45	1.33	1.68	1.36	1.68	1.43	0.42	1.50	1.27	1.09	1.67	1.30	0.93	0.34	0.21	0.34	0.33	0.07	0.24	0.00	0.16	0.00	0.00	0.00	0.00	0.01	0.01	0.74	0.30	1.74	18	0.76	22	
20.	1997	1.04	1.15	0.93	1.47	1.49	1.41	1.74	1.63	1.33	1.68	1.06	1.69	1.43	1.51	0.66	1.67	1.50	1.12	1.30	0.86	0.36	0.34	0.34	0.33	0.30	0.00	0.02	0.04	0.00	0.00	0.00	0.12	0.19	0.24	0.99	1.28	1.74	18	0.86	6	
21.	1998	1.11	0.92	0.81	1.47	1.49	1.41	1.74	1.63	1.13	1.68	1.54	1.90	0.99	0.46	0.63	1.38	1.58	1.65	0.74	0.93	0.37	0.19	0.32	0.29	0.26	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.34	1.08	1.90	12	0.78	20	
22.	1999	0.84	0.54	1.20	1.16	0.64	1.41	1.74	1.63	1.33	1.10	1.54	1.15	1.24	1.49	1.38	1.66	1.58	1.67	1.30	0.93	0.36	0.34	0.34	0.35	0.30	0.22	0.02	0.00	0.00	0.00	0.00	0.06	0.08	0.00	0.00	1.17	1.74	18	0.80	18	
23.	2000	0.81	0.38	0.53	1.47	1.49	1.41	1.74	1.63	1.33	1.42	1.46	1.90	0.75	0.02	0.15	1.55	1.23	1.67	0.86	0.93	0.25	0.33	0.28	0.08	0.30	0.22	0.20	0.00	0.00	0.00	0.00	0.00	0.11	0.30	0.32	1.35	1.90	1	0.73	24	
24.	2001	0.98	1.15	1.20	1.47	1.26	1.41	1.74	1.48	0.56	1.68	1.54	1.61	1.27	0.65	1.49	1.40	1.58	1.67	1.03	0.93	0.37	0.20	0.21	0.33	0.24	0.25	0.10	0.05	0.00	0.00	0.00	0.06	0.17	0.75	0.60	1.22	1.74	18	0.85	11	
<b>Max.</b>		1.11	1.15	1.20	1.47	1.49	1.41	1.74	1.63	1.33	1.68	1.54	1.90	1.43	1.51	1.59	1.67	1.58	1.67	1.30	0.93	0.37	0.34	0.34	0.35	0.30	0.30	0.27	0.16	0.08	0.00	0.00	0.13	0.19	0.86	1.08	1.35	1.90				
<b>Ave.</b>		0.91	0.88	1.02	1.36	1.42	1.29	1.67	1.52	1.27	1.60	1.49	1.75	1.22	1.11	1.21	1.35	1.33	1.46	1.17	0.87	0.33	0.30	0.31	0.29	0.20	0.17	0.08	0.03	0.01	0.00	0.00	0.06	0.11	0.44	0.67	1.01			0.83		

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**Table D.7 (3/3) Gross Unit Irrigation Water Requirement by Year, 2001, Cropping Pattern C**

Present Cropping Pattern (2001)

For 24 Years from 1978 to 2001

C-I Tan An - Dap Da Lower Reaches

(using ETo data at Quy Nhon and Rainfall data at Quy Nhon)

(Unit: l/s/ha)

No.	Year	Cropping Period																								Max. (l/s/ha)	Rank	Ave. (l/s/ha)	Rank													
		Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.							Sept.			Oct.			Nov.			Dec.			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					1	2	3	1	2	3	1	2	3				
1.	1978	0.44	0.52	1.18	0.67	1.50	1.51	1.68	1.50	1.01	1.87	1.53	2.32	0.17	0.42	1.77	1.88	1.94	0.91	1.11	1.03	0.48	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	1.08	0.99	2.32	1	0.78	23	
2.	1979	0.32	1.14	1.18	1.47	1.37	1.51	1.68	1.57	1.01	1.87	1.83	2.32	1.41	1.35	1.53	1.27	1.27	1.28	1.80	1.23	0.60	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.90	1.40	2.32	15	0.87	11
3.	1980	1.10	1.14	1.18	1.20	1.50	1.51	1.68	1.57	0.93	1.87	1.83	2.32	1.24	1.42	0.94	1.09	0.70	1.30	1.90	1.23	0.58	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.95	1.27	2.32	1	0.86	14
4.	1981	1.10	1.14	1.18	1.20	1.50	1.51	1.68	1.57	0.93	1.87	1.83	2.32	1.24	1.42	0.94	1.09	0.70	1.30	1.90	1.23	0.58	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.95	1.27	2.32	1	0.86	14	
5.	1982	1.10	0.44	1.06	1.47	1.25	1.51	1.68	1.57	1.01	1.87	1.82	2.32	1.57	1.66	1.66	0.92	1.94	1.67	1.90	1.13	0.60	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.95	1.40	2.32	1	0.91	4	
6.	1983	0.88	0.81	1.18	1.47	1.50	1.51	1.68	1.57	1.01	1.87	1.83	2.32	1.58	1.67	1.77	1.67	1.94	1.24	1.90	1.12	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.33	0.78	2.32	1	0.91	5	
7.	1984	0.67	1.14	1.06	1.37	1.50	1.51	1.68	1.57	1.01	1.87	1.82	2.31	1.03	1.49	1.65	0.48	1.94	1.90	1.32	1.23	0.54	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.95	0.80	2.31	17	0.87	10	
8.	1985	1.00	0.77	0.92	1.47	1.50	1.51	1.68	1.37	1.01	1.66	1.83	1.52	0.40	0.81	1.18	1.89	1.46	1.90	1.90	1.01	0.38	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	1.10	1.90	24	0.81	21	
9.	1986	1.02	1.14	1.18	1.25	1.50	0.38	1.54	1.57	1.01	1.82	1.83	2.32	1.56	1.35	1.48	1.90	1.94	1.92	1.90	1.23	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.85	2.32	1	0.90	6		
10.	1987	1.10	1.14	0.87	1.47	1.50	0.77	1.68	1.57	1.01	1.87	1.82	2.32	1.58	1.67	1.69	1.30	1.82	1.92	1.90	1.23	0.59	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.85	1.40	2.32	13	0.94	1		
11.	1988	0.75	0.63	1.18	1.47	1.43	1.30	1.68	1.57	1.01	1.87	1.76	2.32	1.58	1.55	1.78	1.41	1.71	1.92	1.90	0.81	0.60	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.93	1.24	2.32	1	0.92	2		
12.	1989	1.00	1.14	1.01	1.47	1.50	1.39	1.12	0.33	0.73	1.87	1.82	2.32	1.58	1.54	0.83	1.22	1.94	1.79	1.57	1.23	0.38	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.45	1.06	2.32	1	0.83	19		
13.	1990	1.02	0.90	0.99	1.47	1.41	1.51	1.58	1.46	1.01	1.87	1.82	1.33	1.57	1.67	1.22	1.76	0.78	1.92	1.89	1.22	0.42	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.61	0.30	1.92	23	0.83	17		
14.	1991	0.59	1.14	1.06	1.47	1.50	0.86	1.68	0.88	0.94	1.56	1.82	1.64	1.48	1.67	1.48	0.82	1.94	1.92	1.90	1.17	0.56	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.52	1.40	1.94	22	0.85	16		
15.	1992	0.48	0.00	0.62	1.47	1.50	1.39	1.68	1.57	1.01	1.49	1.83	2.32	1.57	1.67	1.37	1.78	1.53	1.54	1.90	1.23	0.44	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	1.08	1.20	2.32	1	0.87	12		
16.	1993	1.10	1.02	1.18	1.47	1.50	1.51	1.47	1.57	1.01	1.87	1.66	2.32	1.58	1.67	1.66	1.90	1.94	1.91	1.89	1.23	0.59	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.78	2.32	1	0.91	3		
17.	1994	1.10	0.85	1.18	1.47	1.50	1.51	1.68	1.57	0.89	1.87	1.83	2.32	1.46	1.04	1.00	1.89	1.94	1.27	1.70	1.12	0.59	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.43	0.92	2.32	1	0.86	13		
18.	1995	1.10	1.14	1.18	1.27	1.50	1.51	0.97	1.57	1.01	1.87	1.83	2.32	1.39	0.64	1.78	1.89	1.94	1.92	1.26	1.23	0.59	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.89	0.50	2.32	15	0.88	8		
19.	1996	0.87	0.52	0.76	0.87	1.50	1.51	1.68	1.38	1.01	1.87	1.64	2.07	1.57	0.44	1.68	1.45	1.35	1.92	1.90	1.23	0.55	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.77	0.35	2.07	19	0.80	22		
20.	1997	1.02	1.14	0.92	1.47	1.50	1.51	1.68	1.57	1.01	1.87	1.34	2.09	1.57	1.67	0.74	1.90	1.84	1.27	1.90	1.14	0.59	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.00	1.33	2.09	18	0.89	7		
21.	1998	1.10	0.90	0.80	1.47	1.50	1.51	1.68	1.57	0.84	1.87	1.82	2.32	1.08	0.49	0.70	1.58	1.94	1.90	1.03	1.23	0.60	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.40	1.13	2.32	13	0.81	20		
22.	1999	0.83	0.52	1.18	1.16	0.66	1.51	1.68	1.57	1.01	1.34	1.82	1.47	1.37	1.65	1.54	1.89	1.94	1.92	1.90	1.23	0.59	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.22	1.94	21	0.83	18		
23.	2000	0.79	0.36	0.52	1.47	1.50	1.51	1.68	1.57	1.01	1.63	1.75	2.32	0.81	0.00	0.15	1.77	1.52	1.92	1.22	1.23	0.42	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.38	1.40	2.32	1	0.75	24			
24.	2001	0.96	1.14	1.18	1.47	1.27	1.51	1.68	1.42	0.36	1.87	1.83	2.00	1.39	0.70	1.67	1.60	1.94	1.92	1.48	1.23	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.64	1.27	2.00	20	0.88	9			
<b>Max.</b>		1.10	1.14	1.18	1.47	1.50	1.51	1.68	1.57	1.01	1.87	1.83	2.32	1.58	1.67	1.78	1.90	1.94	1.92	1.90	1.23	0.60	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	1.08	1.40	2.32						
<b>Ave.</b>		0.89	0.86	1.03	1.35	1.44	1.39	1.61	1.46	0.95	1.80	1.77	2.15	1.32	1.24	1.34	1.51	1.66	1.68	1.71	1.18	0.54	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.73	1.06			0.86					

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**Table D.8 (1/3) Gross Unit Irrigation Water Requirement by Year, 2010, Cropping Pattern A**

**Future Cropping Pattern (2010)**

**For 24 Years from 1978 to 2001**

**A-II Kone Upper & Middle Reaches, Van Phong Proper, Van Phong Extension (La Tinh), Ha Thanh**

**(using ETo data at Quy Nhon and Rainfall data at Cay Muong (Binh Tuong))**

(Unit: l/s/ha)

No.	Year	Cropping Period																								Max. (l/s/ha)	Rank	Ave. (l/s/ha)	Rank													
		Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.							Sept.			Oct.			Nov.			Dec.			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					1	2	3	1	2	3	1	2	3				
1.	1978	0.01	0.92	0.96	0.85	1.12	0.82	1.03	1.10	1.31	1.03	0.59	0.36	0.59	0.47	1.37	1.41	0.51	0.86	0.65	1.20	0.96	1.08	1.09	0.89	0.35	0.23	0.65	0.18	0.21	0.00	0.00	0.50	0.79	0.76	0.61	0.49	1.41	15	0.72	17	
2.	1979	0.73	0.81	0.96	1.15	0.99	0.82	1.22	1.06	1.35	0.94	0.75	1.25	0.63	0.26	1.12	0.78	0.87	0.85	1.30	1.34	0.58	0.65	1.10	1.13	0.85	0.52	0.00	0.45	0.00	0.00	0.08	0.00	0.64	0.56	0.75	0.80	1.35	18	0.76	10	
3.	1980	0.88	0.92	0.89	1.14	1.12	0.80	1.06	1.14	1.32	1.05	0.85	1.01	0.80	0.62	0.14	0.55	0.79	1.02	1.08	1.34	0.61	1.07	0.91	0.68	0.13	0.16	0.10	0.00	0.00	0.00	0.00	0.00	0.80	0.66	0.39	0.78	1.34	21	0.69	20	
4.	1981	0.87	0.92	0.82	1.04	1.12	0.82	1.22	1.14	1.35	1.05	0.36	1.21	0.83	0.85	0.71	1.36	0.12	1.04	1.21	0.33	1.09	1.08	0.78	1.13	0.60	0.33	0.19	0.14	0.00	0.00	0.00	0.03	0.38	0.12	0.44	0.81	1.36	16	0.71	18	
5.	1982	0.80	0.91	0.81	1.14	1.11	0.82	1.22	1.14	0.89	0.39	0.87	0.67	0.56	1.37	1.46	0.55	0.93	1.21	1.33	1.34	1.12	1.07	1.08	0.30	0.74	0.63	0.18	0.30	0.00	0.03	0.00	0.33	0.55	0.63	0.77	0.81	1.46	7	0.78	5	
6.	1983	0.69	0.89	0.96	1.15	1.12	0.82	1.20	1.14	1.35	1.05	1.12	0.71	1.28	0.25	1.47	0.27	1.26	0.59	1.32	1.34	1.10	0.00	0.95	1.13	0.40	0.58	0.12	0.00	0.00	0.00	0.00	0.05	0.81	0.99	0.00	0.69	1.47	6	0.75	11	
7.	1984	0.84	0.93	0.92	1.15	1.12	0.82	1.22	1.14	1.35	1.05	0.93	0.47	0.45	1.47	0.41	0.06	1.10	1.31	1.28	1.03	0.64	0.84	1.08	1.13	0.39	0.93	0.00	0.20	0.00	0.10	0.00	0.57	0.10	0.59	0.76	0.48	1.47	4	0.75	13	
8.	1985	0.87	0.91	0.94	1.13	1.12	0.75	1.22	1.14	1.35	1.03	1.00	0.50	0.69	0.69	1.16	1.33	0.88	1.31	1.04	0.91	1.12	1.08	1.01	1.13	0.28	0.73	0.00	0.18	0.00	0.04	0.00	0.13	0.09	0.72	0.52	0.61	1.35	18	0.77	7	
9.	1986	0.89	0.93	0.95	1.13	1.10	0.79	1.22	0.98	1.35	1.05	1.12	1.25	1.35	0.61	1.24	1.44	0.68	1.34	0.88	0.92	0.68	0.80	0.20	1.10	0.42	0.75	0.39	0.00	0.25	0.00	0.07	0.40	0.42	0.00	0.76	0.07	1.44	10	0.76	8	
10.	1987	0.89	0.84	0.96	1.15	1.12	0.47	1.22	1.14	1.35	1.00	1.10	1.25	1.41	1.45	0.74	0.29	1.29	1.26	1.06	0.84	1.01	1.08	0.81	0.58	0.46	0.11	0.63	0.19	0.24	0.00	0.00	0.01	0.21	0.99	0.63	0.81	1.45	8	0.80	1	
11.	1988	0.73	0.83	0.93	1.15	1.10	0.19	1.22	1.14	1.35	1.05	1.00	0.98	1.41	1.47	1.20	0.83	0.91	1.36	0.80	0.48	0.69	1.06	1.10	0.64	0.83	0.36	0.04	0.00	0.00	0.01	0.00	0.52	0.73	0.93	0.57	0.79	1.47	4	0.79	4	
12.	1989	0.74	0.84	0.86	1.15	1.12	0.78	1.11	0.58	0.81	0.81	1.09	1.25	0.30	1.09	0.66	0.93	1.25	0.76	0.32	0.92	0.87	0.75	0.53	0.67	0.28	0.08	0.68	0.13	0.02	0.10	0.00	0.33	0.46	1.00	0.40	0.52	1.25	24	0.67	22	
13.	1990	0.68	0.92	0.94	1.15	1.11	0.82	1.22	1.10	1.34	1.05	0.49	0.60	0.94	0.94	0.21	1.13	0.43	0.72	0.82	0.85	0.95	0.52	0.38	1.13	0.36	0.27	0.80	0.02	0.00	0.00	0.00	0.03	0.79	0.68	0.73	0.24	1.34	22	0.68	21	
14.	1991	0.86	0.93	0.96	1.15	1.12	0.26	1.22	0.60	1.35	0.98	0.79	0.84	1.24	1.47	1.48	0.43	1.29	1.17	0.44	1.33	1.12	0.71	1.10	1.13	0.57	0.27	0.00	0.00	0.16	0.00	0.00	0.48	0.36	0.53	0.05	0.70	1.48	1	0.76	9	
15.	1992	0.54	0.49	0.64	1.15	1.12	0.82	1.22	1.14	1.35	0.85	0.90	1.25	0.93	1.45	1.19	0.49	0.65	1.13	1.32	1.07	0.43	1.08	1.03	0.60	0.95	0.41	0.00	0.01	0.01	0.00	0.00	0.42	0.29	0.93	0.69	0.24	1.45	8	0.74	14	
16.	1993	0.77	0.66	0.96	1.15	1.09	0.82	1.02	0.87	1.05	0.94	1.12	1.13	0.94	0.36	1.48	1.26	1.16	1.32	1.22	1.33	0.90	0.49	1.03	0.80	0.95	0.71	0.41	0.16	0.03	0.00	0.00	0.36	0.74	0.87	0.00	0.43	1.48	1	0.79	2	
17.	1994	0.89	0.43	0.96	1.02	1.12	0.82	1.22	1.10	0.91	1.03	1.12	1.25	1.41	0.21	0.92	1.42	1.29	0.68	1.26	1.22	1.12	1.08	1.10	0.25	0.36	0.01	0.54	0.05	0.00	0.00	0.01	0.56	0.54	0.05	0.35	0.59	1.42	13	0.75	12	
18.	1995	0.65	0.93	0.94	0.97	1.12	0.82	1.21	1.14	1.27	1.04	1.12	1.06	1.20	0.36	0.55	1.28	1.13	1.01	1.09	1.12	0.68	0.39	0.83	0.09	0.57	0.11	0.10	0.00	0.21	0.00	0.00	0.43	0.38	1.00	0.19	0.62	1.28	23	0.71	19	
19.	1996	0.80	0.68	0.94	1.03	0.97	0.82	1.22	1.14	1.35	1.05	0.84	1.25	1.19	0.07	1.14	1.05	0.77	1.19	1.33	1.22	1.12	0.81	1.09	0.99	0.24	0.52	0.07	0.42	0.00	0.00	0.00	0.00	0.00	0.07	0.12	0.26	0.75	1.35	18	0.74	15
20.	1997	0.87	0.93	0.95	1.00	1.06	0.82	1.22	1.14	1.33	1.02	0.01	1.25	0.69	0.38	0.60	1.44	0.55	1.36	1.30	1.09	1.02	1.08	0.74	1.11	0.94	0.58	0.00	0.18	0.18	0.00	0.00	0.46	0.81	0.35	0.68	0.81	1.44	10	0.78	6	
21.	1998	0.89	0.33	0.91	1.15	1.12	0.82	1.20	1.14	1.16	1.03	0.99	1.18	0.85	1.10	1.24	1.44	1.07	1.22	1.07	0.86	1.04	0.61	0.94	0.76	0.61	0.28	0.02	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.77	1.44	10	0.73	16
22.	1999	0.79	0.13	0.82	0.95	0.92	0.43	0.78	1.14	1.35	0.69	1.04	0.36	0.35	1.42	0.14	1.07	0.80	1.14	1.16	0.79	1.11	1.08	0.29	0.78	0.54	0.51	0.00	0.03	0.00	0.00	0.00	0.30	0.13	0.00	0.00	0.79	1.42	14	0.61	24	
23.	2000	0.87	0.85	0.44	1.15	1.12	0.82	1.22	1.12	1.35	0.55	0.21	1.20	1.36	0.08	0.48	1.22	0.89	0.52	0.49	1.34	0.49	0.77	0.65	0.50	0.94	0.46	0.45	0.00	0.00	0.01	0.07	0.00	0.37	0.17	0.27	0.37	1.36	17	0.63	23	
24.	2001	0.77	0.66	0.96	1.15	1.09	0.82	1.02	0.87	1.05	0.94	1.12	1.13	0.94	0.36	1.48	1.26	1.16	1.32	1.22	1.33	0.90	0.49	1.03	0.80	0.95	0.71	0.41	0.16	0.03	0.00	0.00	0.36	0.74	0.87	0.00	0.43	1.48	1	0.79	2	
<b>Max.</b>		0.89	0.93	0.96	1.15	1.12	0.82	1.22	1.14	1.35	1.05	1.12	1.25	1.41	1.47	1.48	1.44	1.29	1.36	1.33	1.34	1.12	1.08	1.10	1.13	0.95	0.93	0.80	0.45	0.25	0.10	0.08	0.57	0.81	1.00	0.77	0.81	1.48				
<b>Ave.</b>		0.76	0.78	0.89	1.10	1.09	0.74	1.16	1.05	1.25	0.94	0.86	0.97	0.93	0.78	0.94	0.97	0.91	1.07	1.04	1.06	0.89	0.82	0.87	0.81	0.57	0.43	0.24	0.12	0.06	0.01	0.01	0.26	0.47	0.57	0.41	0.60			0.73		

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**Table D.9 (1/3) Gross Unit Irrigation Water Requirement by Year, 2020, Cropping Pattern A**

**Future Cropping Pattern (2020)**

**For 24 Years from 1978 to 2001**

**A-II Kone Upper & Middle Reaches, Van Phong Proper, Van Phong Extension (La Tinh), Ha Thanh**

**(using ETo data at Quy Nhon and Rainfall data at Cay Muong (Binh Tuong))**

(Unit: l/s/ha)

No.	Year	Cropping Period																								Max.	Rank	Ave.	Rank													
		Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.							Sept.			Oct.			Nov.			Dec.			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					1	2	3	1	2	3	1	2	3	(l/s/ha)	(l/s/ha)		
1.	1978	0.01	0.85	0.89	0.79	1.04	0.77	0.96	1.02	1.22	0.95	0.55	0.34	0.55	0.44	1.27	1.30	0.47	0.80	0.60	1.12	0.89	1.00	1.01	0.83	0.32	0.21	0.61	0.17	0.19	0.00	0.00	0.47	0.73	0.70	0.56	0.45	1.30	15	0.67	16	
2.	1979	0.68	0.75	0.89	1.07	0.91	0.77	1.13	0.99	1.24	0.86	0.69	1.15	0.58	0.24	1.03	0.71	0.80	0.78	1.20	1.24	0.54	0.60	1.02	1.05	0.79	0.48	0.00	0.42	0.00	0.00	0.07	0.00	0.59	0.52	0.69	0.74	1.24	18	0.70	9	
3.	1980	0.82	0.85	0.83	1.06	1.04	0.74	0.98	1.06	1.21	0.97	0.78	0.92	0.74	0.57	0.13	0.51	0.73	0.94	1.00	1.24	0.57	1.00	0.85	0.63	0.12	0.15	0.09	0.00	0.00	0.00	0.00	0.00	0.74	0.62	0.36	0.73	1.24	21	0.64	20	
4.	1981	0.80	0.86	0.76	0.97	1.04	0.76	1.13	1.06	1.24	0.97	0.33	1.11	0.76	0.78	0.65	1.25	0.11	0.96	1.12	0.30	1.01	1.00	0.73	1.05	0.56	0.31	0.18	0.13	0.00	0.00	0.00	0.03	0.35	0.11	0.40	0.75	1.25	16	0.66	18	
5.	1982	0.74	0.85	0.76	1.06	1.03	0.77	1.13	1.06	0.82	0.36	0.80	0.61	0.51	1.26	1.34	0.51	0.86	1.11	1.23	1.24	1.04	1.00	1.00	0.28	0.69	0.59	0.16	0.27	0.00	0.03	0.00	0.31	0.51	0.59	0.71	0.75	1.34	7	0.72	5	
6.	1983	0.64	0.83	0.89	1.07	1.04	0.77	1.12	1.06	1.24	0.97	1.03	0.65	1.18	0.23	1.35	0.25	1.15	0.54	1.21	1.24	1.02	0.00	0.88	1.05	0.38	0.53	0.11	0.00	0.00	0.00	0.00	0.05	0.75	0.92	0.00	0.64	1.35	6	0.69	11	
7.	1984	0.78	0.87	0.86	1.07	1.04	0.77	1.13	1.06	1.24	0.97	0.85	0.43	0.42	1.36	0.38	0.06	1.01	1.20	1.18	0.95	0.59	0.78	1.01	1.05	0.36	0.86	0.00	0.19	0.00	0.10	0.00	0.53	0.09	0.55	0.71	0.45	1.36	4	0.69	13	
8.	1985	0.81	0.85	0.87	1.05	1.04	0.70	1.13	1.06	1.24	0.95	0.92	0.46	0.63	0.64	1.07	1.23	0.81	1.21	0.96	0.84	1.04	1.00	0.94	1.05	0.26	0.68	0.00	0.17	0.00	0.04	0.00	0.12	0.09	0.67	0.49	0.57	1.24	18	0.71	7	
9.	1986	0.83	0.87	0.88	1.05	1.02	0.73	1.13	0.91	1.24	0.97	1.03	1.15	1.24	0.56	1.14	1.32	0.63	1.24	0.81	0.85	0.63	0.74	0.19	1.02	0.39	0.70	0.37	0.00	0.23	0.00	0.07	0.37	0.39	0.00	0.70	0.06	1.32	10	0.71	8	
10.	1987	0.83	0.78	0.89	1.07	1.04	0.44	1.13	1.06	1.24	0.92	1.01	1.15	1.30	1.33	0.68	0.26	1.18	1.16	0.98	0.78	0.94	1.00	0.75	0.54	0.43	0.11	0.58	0.18	0.22	0.00	0.00	0.01	0.20	0.92	0.58	0.75	1.33	8	0.74	1	
11.	1988	0.68	0.77	0.86	1.07	1.02	0.18	1.13	1.06	1.24	0.97	0.92	0.90	1.30	1.36	1.10	0.76	0.84	1.25	0.74	0.45	0.64	0.98	1.02	0.60	0.77	0.33	0.04	0.00	0.00	0.01	0.00	0.48	0.67	0.86	0.53	0.73	1.36	4	0.73	4	
12.	1989	0.69	0.78	0.80	1.07	1.04	0.73	1.03	0.54	0.75	0.74	1.00	1.15	0.28	1.00	0.61	0.86	1.15	0.70	0.30	0.85	0.81	0.70	0.49	0.62	0.26	0.07	0.63	0.12	0.02	0.09	0.00	0.31	0.43	0.93	0.37	0.48	1.15	24	0.62	22	
13.	1990	0.64	0.86	0.88	1.07	1.03	0.77	1.13	1.02	1.23	0.97	0.45	0.55	0.87	0.87	0.20	1.04	0.39	0.66	0.75	0.79	0.88	0.48	0.35	1.05	0.33	0.25	0.74	0.02	0.00	0.00	0.00	0.02	0.73	0.63	0.68	0.22	1.23	22	0.63	21	
14.	1991	0.80	0.87	0.89	1.07	1.04	0.24	1.13	0.56	1.24	0.90	0.73	0.77	1.14	1.36	1.36	0.40	1.18	1.07	0.40	1.23	1.04	0.66	1.02	1.05	0.53	0.25	0.00	0.00	0.15	0.00	0.00	0.45	0.33	0.49	0.05	0.65	1.36	1	0.70	10	
15.	1992	0.50	0.46	0.59	1.07	1.04	0.76	1.13	1.06	1.24	0.78	0.83	1.15	0.86	1.33	1.10	0.45	0.60	1.04	1.21	0.99	0.40	1.01	0.96	0.56	0.88	0.38	0.00	0.01	0.01	0.00	0.00	0.39	0.27	0.86	0.64	0.22	1.33	8	0.69	14	
16.	1993	0.71	0.61	0.89	1.07	1.01	0.77	0.95	0.81	0.97	0.86	1.03	1.04	0.86	0.33	1.36	1.16	1.07	1.22	1.13	1.23	0.83	0.45	0.96	0.74	0.88	0.66	0.38	0.15	0.03	0.00	0.00	0.33	0.69	0.80	0.00	0.40	1.36	1	0.73	2	
17.	1994	0.83	0.40	0.89	0.95	1.04	0.77	1.13	1.02	0.84	0.95	1.03	1.15	1.30	0.19	0.84	1.31	1.18	0.63	1.17	1.13	1.04	1.01	1.02	0.23	0.33	0.01	0.50	0.04	0.00	0.00	0.01	0.52	0.50	0.05	0.32	0.55	1.31	13	0.69	12	
18.	1995	0.60	0.87	0.88	0.90	1.04	0.77	1.12	1.06	1.17	0.96	1.03	0.97	1.10	0.34	0.51	1.17	1.04	0.93	1.00	1.04	0.63	0.36	0.77	0.09	0.53	0.10	0.09	0.00	0.19	0.00	0.00	0.40	0.35	0.92	0.17	0.57	1.17	23	0.65	19	
19.	1996	0.74	0.63	0.88	0.95	0.90	0.77	1.13	1.06	1.24	0.97	0.78	1.15	1.10	0.06	1.05	0.97	0.70	1.10	1.23	1.13	1.04	0.75	1.01	0.92	0.23	0.49	0.07	0.39	0.00	0.00	0.00	0.00	0.06	0.11	0.24	0.70	1.24	18	0.68	15	
20.	1997	0.80	0.87	0.89	0.93	0.99	0.77	1.13	1.06	1.22	0.94	0.01	1.15	0.63	0.35	0.56	1.32	0.50	1.25	1.20	1.01	0.94	1.00	0.69	1.03	0.87	0.54	0.00	0.16	0.16	0.00	0.00	0.42	0.75	0.33	0.64	0.75	1.32	10	0.72	6	
21.	1998	0.83	0.30	0.85	1.07	1.04	0.77	1.12	1.06	1.07	0.95	0.91	1.09	0.78	1.01	1.15	1.32	0.99	1.13	0.99	0.80	0.97	0.56	0.88	0.70	0.57	0.26	0.01	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.71	1.32	10	0.67	17
22.	1999	0.73	0.12	0.76	0.88	0.85	0.40	0.72	1.06	1.24	0.63	0.96	0.33	0.32	1.31	0.13	0.99	0.73	1.05	1.07	0.73	1.03	1.01	0.27	0.72	0.50	0.47	0.00	0.03	0.00	0.00	0.00	0.27	0.12	0.00	0.00	0.73	1.31	14	0.56	24	
23.	2000	0.80	0.79	0.41	1.07	1.04	0.76	1.13	1.04	1.24	0.51	0.19	1.10	1.25	0.07	0.44	1.13	0.81	0.48	0.45	1.24	0.46	0.72	0.60	0.47	0.87	0.42	0.42	0.00	0.00	0.01	0.07	0.00	0.34	0.15	0.25	0.35	1.25	17	0.58	23	
24.	2001	0.71	0.61	0.89	1.07	1.01	0.77	0.95	0.81	0.97	0.86	1.03	1.04	0.86	0.33	1.36	1.16	1.07	1.22	1.13	1.23	0.83	0.45	0.96	0.74	0.88	0.66	0.38	0.15	0.03	0.00	0.00	0.33	0.69	0.80	0.00	0.40	1.36	1	0.73	2	
<b>Max.</b>		0.83	0.87	0.89	1.07	1.04	0.77	1.13	1.06	1.24	0.97	1.03	1.15	1.30	1.36	1.36	1.32	1.18	1.25	1.23	1.24	1.04	1.01	1.02	1.05	0.88	0.86	0.74	0.42	0.23	0.10	0.07	0.53	0.75	0.93	0.71	0.75	1.36				
<b>Ave.</b>		0.71	0.72	0.83	1.02	1.01	0.68	1.08	0.98	1.15	0.87	0.79	0.89	0.86	0.72	0.87	0.89	0.83	0.99	0.96	0.99	0.82	0.76	0.81	0.75	0.53	0.40	0.22	0.11	0.06	0.01	0.01	0.24	0.43	0.53	0.38	0.56			0.68		



**Table D.9 (3/3) Gross Unit Irrigation Water Requirement by Year, 2020, Cropping Pattern C**

**Future Cropping Pattern (2020)  
For 24 Years from 1978 to 2001**

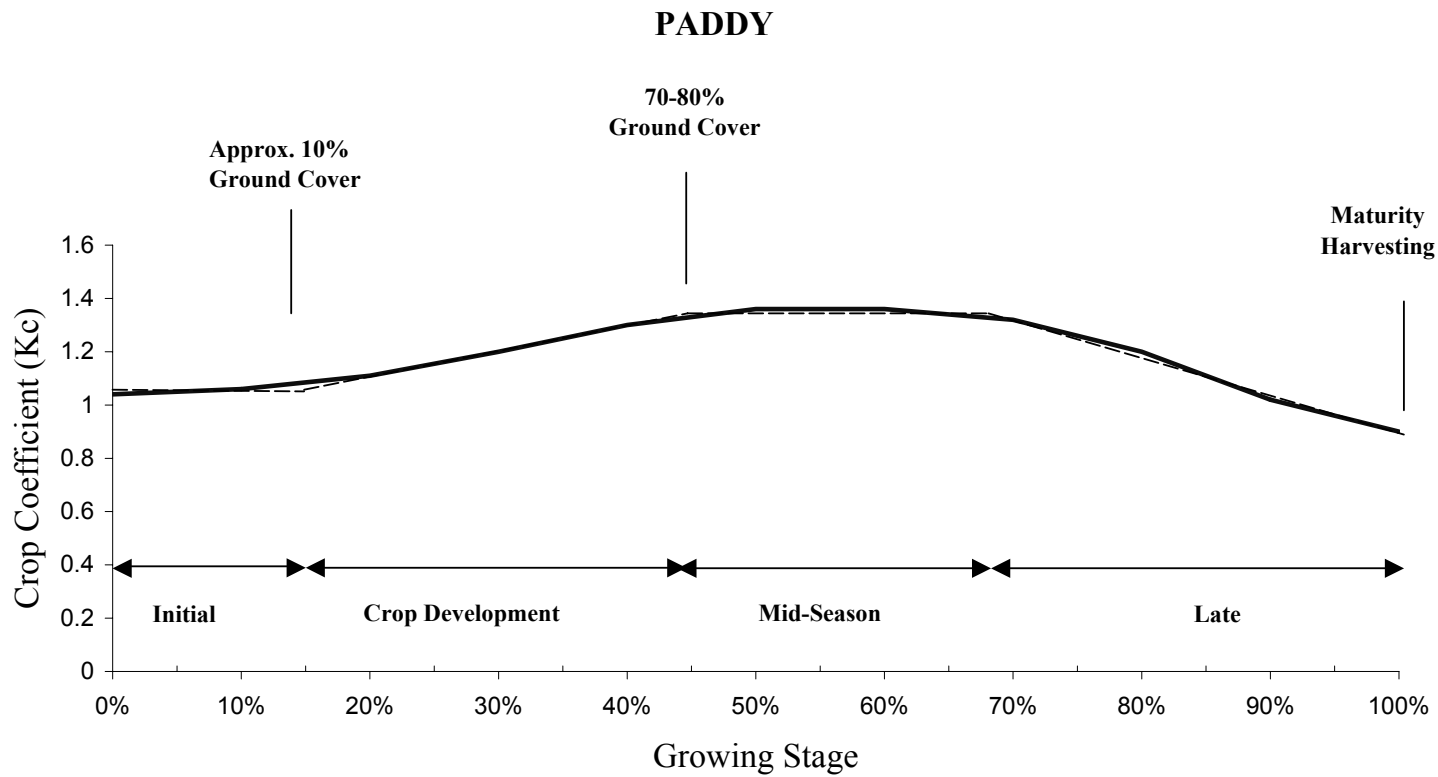
**C-1 Tan An - Dap Da Lower Reaches  
(using ETo data at Quy Nhon and Rainfall data at Quy Nhon)**

(Unit: l/s/ha)

No.	Year	Cropping Period																								Max. (l/s/ha)	Rank	Ave. (l/s/ha)	Rank													
		Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.							Sept.			Oct.			Nov.			Dec.			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					1	2	3	1	2	3	1	2	3				
1.	1978	0.38	0.44	1.01	0.58	1.29	1.30	1.45	1.31	0.91	1.25	0.88	1.44	0.10	0.24	1.31	1.38	1.49	0.52	0.74	0.78	0.40	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.74	0.68	1.49	1	0.59	23		
2.	1979	0.28	0.97	1.01	1.26	1.17	1.30	1.45	1.38	0.91	1.25	1.10	1.42	0.94	0.91	1.10	0.89	0.90	0.89	1.36	1.00	0.55	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.62	0.96	1.45	24	0.66	11
3.	1980	0.94	0.97	1.01	1.02	1.29	1.30	1.45	1.38	0.83	1.25	1.10	1.44	0.75	0.93	0.54	0.72	0.44	0.89	1.44	1.00	0.49	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.65	0.87	1.45	22	0.64	14
4.	1981	0.94	0.97	0.41	1.17	1.29	1.30	1.30	1.38	0.91	1.25	1.09	1.42	1.09	0.75	0.85	1.41	0.00	0.91	1.46	0.37	0.48	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.96	1.46	19	0.61	21	
5.	1982	0.94	0.38	0.91	1.26	1.07	1.30	1.45	1.38	0.90	1.24	1.08	1.44	1.08	1.18	1.20	0.59	1.48	1.21	1.44	0.88	0.54	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.65	0.96	1.48	10	0.69	4	
6.	1983	0.76	0.69	1.01	1.26	1.29	1.30	1.45	1.38	0.91	1.25	1.10	1.44	1.09	1.19	1.30	1.17	1.49	0.77	1.46	0.86	0.53	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.23	0.54	1.49	1	0.69	5	
7.	1984	0.58	0.97	0.91	1.17	1.29	1.30	1.45	1.38	0.91	1.25	1.10	1.40	0.61	1.05	1.17	0.28	1.48	1.42	0.93	1.00	0.47	0.08	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.65	0.55	1.48	10	0.66	10	
8.	1985	0.86	0.66	0.79	1.26	1.29	1.30	1.45	1.19	0.91	1.09	1.10	0.88	0.23	0.49	0.75	1.43	1.06	1.42	1.46	0.76	0.27	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.75	1.46	19	0.61	20		
9.	1986	0.87	0.97	1.01	1.07	1.29	0.33	1.34	1.38	0.91	1.21	1.10	1.44	1.03	0.87	1.04	1.45	1.49	1.47	1.46	0.98	0.50	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.59	1.49	1	0.68	6		
10.	1987	0.94	0.97	0.74	1.26	1.29	0.66	1.45	1.38	0.91	1.24	1.10	1.43	1.09	1.19	1.24	0.90	1.38	1.47	1.46	0.98	0.53	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.58	0.96	1.47	13	0.71	1	
11.	1988	0.64	0.54	1.01	1.26	1.22	1.11	1.44	1.38	0.91	1.25	1.04	1.44	1.09	1.09	1.33	0.98	1.24	1.47	1.46	0.58	0.55	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.64	0.85	1.47	13	0.69	3	
12.	1989	0.86	0.97	0.86	1.26	1.29	1.19	0.97	0.30	0.65	1.25	1.10	1.44	1.09	1.06	0.51	0.75	1.49	1.34	1.14	0.99	0.29	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.31	0.73	1.49	1	0.62	18		
13.	1990	0.87	0.77	0.85	1.26	1.21	1.30	1.37	1.27	0.91	1.25	1.10	0.77	1.09	1.21	0.81	1.25	0.45	1.47	1.43	0.95	0.34	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.42	0.21	1.47	13	0.63	17		
14.	1991	0.51	0.97	0.91	1.26	1.29	0.74	1.45	0.71	0.84	1.01	1.10	0.95	1.00	1.21	1.03	0.47	1.49	1.47	1.44	0.93	0.50	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.35	0.96	1.49	9	0.64	15		
15.	1992	0.41	0.00	0.53	1.26	1.29	1.19	1.45	1.38	0.91	1.00	1.10	1.44	1.09	1.19	0.95	1.34	1.11	1.13	1.44	1.00	0.34	0.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.74	0.83	1.45	22	0.65	13		
16.	1993	0.94	0.87	1.01	1.26	1.29	1.30	1.27	1.37	0.91	1.25	0.98	1.44	1.09	1.18	1.18	1.45	1.48	1.45	1.41	1.00	0.54	0.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.54	1.48	10	0.70	2		
17.	1994	0.94	0.73	1.01	1.26	1.29	1.30	1.45	1.38	0.80	1.25	1.10	1.44	0.97	0.63	0.65	1.42	1.47	0.84	1.27	0.88	0.52	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.29	0.63	1.47	17	0.65	12		
18.	1995	0.94	0.97	1.01	1.09	1.29	1.30	0.83	1.38	0.90	1.25	1.10	1.42	0.90	0.37	1.33	1.43	1.49	1.47	0.87	0.98	0.52	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.61	0.34	1.49	1	0.67	8		
19.	1996	0.74	0.44	0.65	0.74	1.29	1.30	1.45	1.21	0.91	1.25	0.95	1.24	1.07	0.25	1.22	1.02	0.96	1.47	1.46	0.99	0.47	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.24	1.47	13	0.60	22		
20.	1997	0.87	0.97	0.79	1.26	1.29	1.30	1.45	1.38	0.91	1.25	0.77	1.23	1.09	1.21	0.43	1.45	1.40	0.85	1.46	0.89	0.53	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.69	0.91	1.46	19	0.68	7		
21.	1998	0.94	0.77	0.68	1.26	1.29	1.30	1.45	1.38	0.73	1.25	1.08	1.43	0.64	0.28	0.45	1.15	1.49	1.42	0.66	1.00	0.55	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.27	0.78	1.49	1	0.61	19		
22.	1999	0.71	0.44	1.01	0.99	0.56	1.30	1.45	1.38	0.90	0.85	1.09	0.85	0.88	1.14	1.11	1.42	1.49	1.47	1.44	1.00	0.52	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	1.49	1	0.63	16		
23.	2000	0.68	0.31	0.44	1.26	1.29	1.30	1.45	1.38	0.90	1.06	1.03	1.44	0.47	0.00	0.10	1.27	1.11	1.46	0.83	0.98	0.33	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.26	0.96	1.46	18	0.56	24			
24.	2001	0.82	0.97	1.01	1.26	1.09	1.30	1.45	1.22	0.33	1.25	1.10	1.17	0.91	0.41	1.21	1.18	1.49	1.46	1.07	0.99	0.55	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.87	1.49	1	0.66	9			
<b>Max.</b>		0.94	0.97	1.01	1.26	1.29	1.30	1.45	1.38	0.91	1.25	1.10	1.44	1.09	1.21	1.33	1.45	1.49	1.47	1.46	1.00	0.55	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.74	0.96	1.49						
<b>Ave.</b>		0.76	0.74	0.86	1.16	1.23	1.19	1.38	1.28	0.85	1.19	1.06	1.31	0.89	0.83	0.95	1.12	1.22	1.24	1.27	0.91	0.47	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.48	0.73			0.65				

DT-17

DF-1



\* Data Source: Report on Irrigation Water Requirement and Water Balance, Binh Dinh Irrigation Project, Directorate of Irrigation and Rural Engineering, Ministry of Agriculture, Republic of Vietnam, 1974

**Figure D.1 (1/4) Crop Coefficient Curve (Paddy)**

DF-2

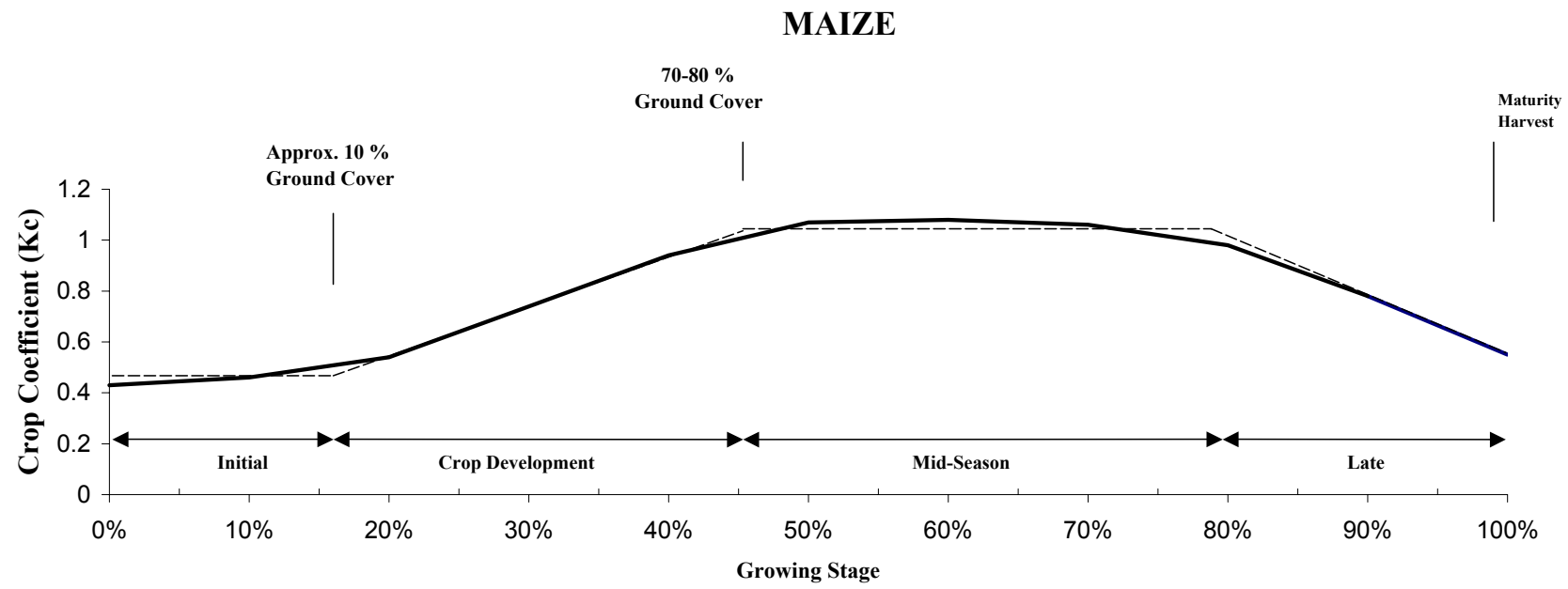


Figure D.1 (2/4) Crop Coefficient Curve (Maize)



# SOYBEANS

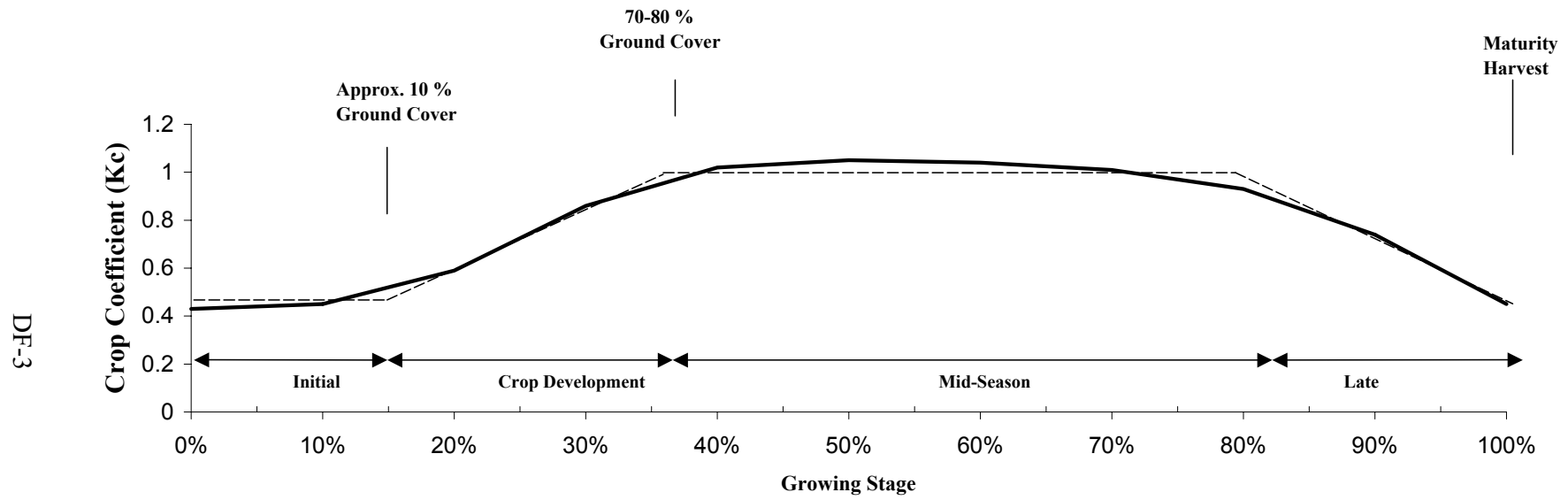
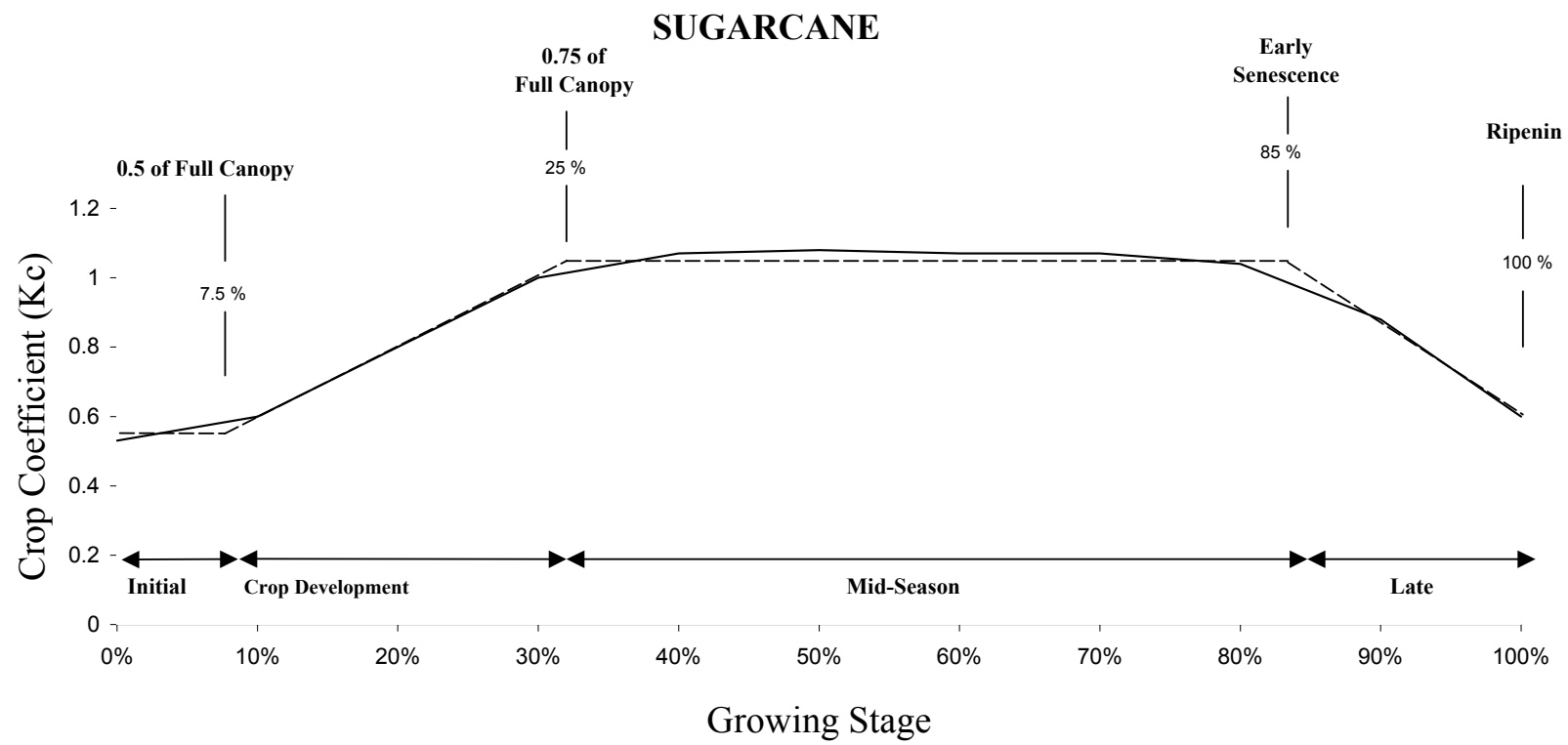


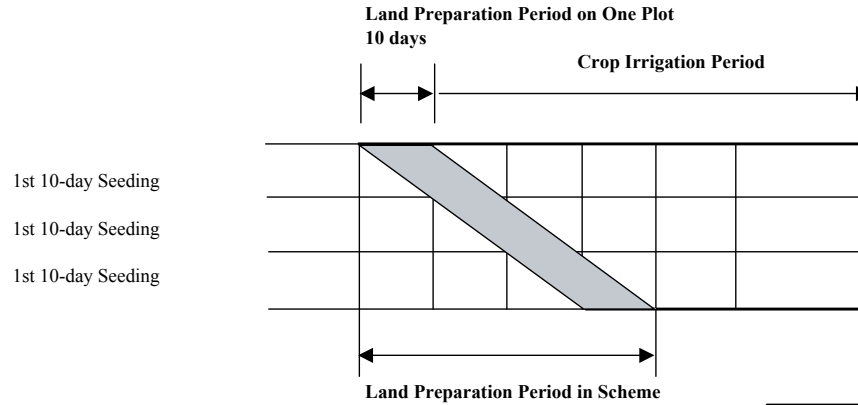
Figure D.1 (3/4) Crop Coefficient Curve (Soybeans)

DF-4



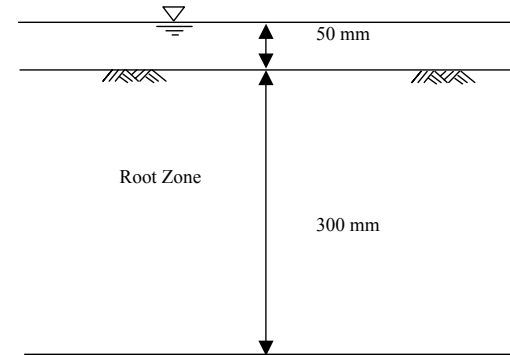
**Figure D.1 (4/4) Crop Coefficient Curve (Sugarcane)**

**Kone, Ha Thanh, La Tinh River Basins**



**Land Preparation Water Requirement**

(1)	Land Soaking and Standing Water				
		Winter-Spring Paddy	Summer-Autumn Paddy	3rd Crop Paddy	
	Land Soaking	10 mm	100 mm	55 mm	
	Standing Water	50 mm	50 mm	50 mm	
	<b>Total</b>	<b>60 mm</b>	<b>150 mm</b>	<b>105 mm</b>	
					for 10 days
(2)	Percolation		2 mm/day		
(3)	Evaporation from Water Surface		$E_p = E_{To} \times 1.1$		



Porosity :

$\frac{10}{300}$	= 3 %	for Winter-Spring Paddy
$\frac{100}{300}$	= 33 %	for Summer-Autumn Paddy
$\frac{55}{300}$	= 18 %	for 3rd Crop Paddy

**Figure D.2 Land Preparation Water Requirement**

## **Appendix E**

### **Water Balance Analysis**

# Appendix E

## Water Balance Analysis

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**Annex**  
**Water Balance Study Incorporating Released Water**  
**from An Khe Hydropower**

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## **Appendix E Water Balance Analysis**

### **1 WATER BALANCE ANALYSIS**

#### **1.1 Objectives of the Study**

The water balance analysis is made to evaluate water balance of the present situation as well as future conditions of the target year 2020 and year 2010 as an intermediate year. Proposed Dinh Binh Reservoir is studied of its necessary development scale to meet future water requirement in terms of necessary storage capacity as well as flood control capacity.

#### **1.2 Water Balance System**

The analysis is made in the Kone River basin including Ha Thanh River, while only some irrigation water demand in the La Tinh River basin is incorporated in the analysis of the Kone River basin.

The analysis incorporates the following components:

- (a) Water resources : - river runoff in natural flow condition  
- existing and proposed reservoir storage
- (b) Water demands : - agriculture and fishery uses  
- domestic use  
- industrial use  
- hydropower generation by water release for the other requirement is verified to satisfy a predetermined dependability( subordinate requirement)
- (c) River maintenance flow.

Water balance is examined at each water intake location as water demanding point on the respective river course. Water balance of the whole basin taking actual river system into account is also evaluated in order to determine necessary water release of the multi-purpose dam (Dinh Binh Dam reservoir). Availability of the river maintenance flow is examined at the river mouth as a whole basin basis.

A schematic model for the analysis of the Kone River and Ha Thanh River basins are presented in Figure E.1

## 2 BASIC CONDITION OF WATER BALANCE ANALYSIS

### 2.1 Basic Condition

Water balance analysis is made in 10-day basis. Balance calculation was carried out every ten days by giving water resources and water demand data as 10-day basis for duration of 24 years. Natural flow of a series of 1978 to 2001 was applied for the analysis as water resources.

Return flow rate is assumed to be 10 % for irrigation water and not considered ( 0 %)of demand for domestic and industrial waters.

### 2.2 Water Resources

#### (1) Catchment area

Principal catchment area of the basin applied in the analysis are as follows:

Kone River basin	:	3,010 km <sup>2</sup>
Vinh Son Dam	:	214 km <sup>2</sup>
Dinh Binh Dam	:	1,040 km <sup>2</sup> (cumulative)
Van Phong Weir	:	1,677 km <sup>2</sup> (cumulative)
Binh Thanh	:	2,250 km <sup>2</sup> (cumulative)
Nui Mot dam	:	110 km <sup>2</sup>
Thuam Ninh Dam	:	78.5 km <sup>2</sup>
Ha Thanh River basin	:	630 km <sup>2</sup>

#### (2) Natural Flow

River runoff series in terms of natural flow estimated as described in Chapter 4 is used for the analysis for 24 years (1978 to 2001). The 10-days runoff series at the respective sub-catchment area tabulated in Table E.1 and it's characteristics of applied runoff series are presented in Figure E.2.

#### (3) Reservoirs

The following existing and proposed reservoirs are studied in the analysis:

Status	Reservoir	Main River System	Effective Storage Volume (MCM)		Main Purpose
			Existing	Proposed	
Existing	Vinh Son	Kone R.	102.0	132	Power
	Thuam Ninh	Kone R.	32.3		W/supply
	Nui Mot	Tan An R.	108.5		W/supply
	Hoi Son	La Tinh R.	43.7		W/supply
Proposed	Dinh Binh	Kone R.		279.5 <sup>(1)</sup>	Multi-purpose
	Suoi Chiep	Ha Thanh R.		8.0	W/supply

Note: 1) Effective storage volume to be proposed in the Master Plan. Effective storage for water supply purpose was examined at 188.8, 209.9, 279.5 and 360.2 MCM.

Other than the above-listed reservoirs, several small scale reservoirs (1.0 million m<sup>3</sup><storage capacity<15.0 million m<sup>3</sup>), both existing and proposed ones, are incorporated in the analysis as an exclusive reservoir of the respective irrigation scheme. The said small scale reservoirs are incorporated in the Study as shown in Table E.2.

## 2.3 Water Demand

### (1) Irrigation Water Demand

Irrigation water demand is the most major water requirement in the basin. The major irrigation schemes are individually incorporated in the analysis as shown in Table E.3 and Figure E.1, however small scale irrigation schemes are combined by area together with related small-scale reservoirs. Irrigation area considered in the study are shown as follows by river:

River	Irrigation Area (ha)			Note
	Present	2010	2020	
Kone River				
Upper Kone	1,510	5,417	20,020	until Binh Thanh
Dap Da	7,179	8,151	9,656	
Go Cham	3,866	6,006	6,160	
Tan An	7,818	8,040	10,097	
Ha Thanh	-	-	2,039	Water to be supplied from Kone River
La Tinh	-	-	6,297	Only related area to be supplied from Van Phong
Ha Thanh	1,180	2,394	3,928 – 2,246	Area in 2020 is adjusted according to water availability. Area in 2010 shows the decreased one following the 2020 adjustment.

Water supply to the irrigation system in the La Tinh River from the Kone River through Van Phong Weir is incorporated in the manner that only insufficient water supply capacity of the Hoi Son Reservoir is covered by the transferred water from the Kone River.

### (2) Other Agricultural Water requirement

In addition to the irrigation water requirement, other agricultural water requirement including the coastal shrimp culture and livestock are assumed in the water demand as follows:

<u>Water Demand</u>	<u>Present (m<sup>3</sup>/day)</u>	<u>2010 (m<sup>3</sup>/day)</u>	<u>2020 (m<sup>3</sup>/day)</u>
Coastal shrimp culture			
Kone River basin	-	34,300	34,300
Ha Thanh River basin	-	51,400	51,400
Livestock			
Kone River basin	2,300	3,500	4,600
Ha Thanh River basin	3,400	5,200	6,900

(3) Domestic and Industrial Water Supply Requirement

Water requirement for the domestic and industrial demands estimated are incorporated in the analysis as well, which is summarized as follows:

River	(unit : m <sup>3</sup> /day)					
	Present(2001)		2010		2020	
	Domestic	Industry	Domestic	Industry	Domestic	Industry
Kone River						
Upper Kone	2,382	49,300	7,419	82,525	12,385	195,367
Dap Da	7,585	0	24,114	0	41,715	0
Tan An	6,249	0	22,383	85,000	57,468	170,000
Ha Thanh	165	0	770	19,250	1,329	38,500

Remarks : Demand for river surface water only

(4) River Maintenance Flow

River maintenance flow is examined of its availability at the following predetermined points:

Kone River,	River mouth	: 0.70 million m <sup>3</sup> /day (equiv.to 8.1 m <sup>3</sup> /sec) (as total amount for a river basin)
	Binh Thanh	: 0.57 million m <sup>3</sup> /day (equiv.to 6.6 m <sup>3</sup> /sec) (diverging to Dap Da and Tan An Rivers)
Ha Thanh River,	River mouth	: 0.11 million m <sup>3</sup> /day (equiv.to 1.3 m <sup>3</sup> /sec)

### 3. EVALUATION OF WATER BALANCE ANALYSIS

Evaluation is made on the results of those in 2001, 2010 and 2020. Water supply condition against water demand is evaluated of its tightness in accordance with the applicable criteria for 2020 set out as follows:

<u>Water demand</u>	<u>Allowable probability or years that insufficient water supply (water shortage) condition will occur</u>
(a) Agriculture, Fishery	: Less than 1/4 probability of the examined 24 years or Less than 6 years ( <u>5 years</u> in 24 years at the most)
(b) Domestic use, Industry	: Less than 1/10 probability of the examined 24 years or <u>2 years</u> in 24 years at the most)
(c) River maintenance flow	: Less than 1/4 probability of the examined 24 years or Less than 6 years ( <u>5 years</u> in 24 years at the most)

## **4 PRESENT WATER BALANCE SITUATION AGAINST 2001 DEMAND**

### **4.1 Kone River**

In the Kone River basin at present, there are 3 existing reservoirs that have an effective storage capacity bigger than 30 million m<sup>3</sup> i.e. Nui Mot Dam and Thuan Nhin Dam as well as Vinh Son Dam which is of hydropower purpose.

Examination on the present water balance situation is made for the following water demands:

- (i) Water demand that would be supplied by the aforesaid dams located upstream(deficit would be manageable by the upstream dams on the main stream).
  - (ii) Another demand is rather small-scale irrigation scheme with the exclusive small scale reservoir(s) on the tributaries(deficit is not manageable by the upstream dams on the main stream).
- (1) Water Demand on the Main Stream (deficit manageable)

Result of the water balance analysis on the present condition are summarized in the following manner:

- (i) Water balance against agriculture and fishery water demands, as well as domestic and industry demands,
- (ii) Demand in the upstream reaches between Dinh Binh Dam site and Binh Thanh, as well as downstream reaches between Binh Thanh and river mouth,
- (iii) Water balance condition is examined by not considering river maintenance flow.
- (iv) It is assumed in the analysis that the Nui Mot reservoir supplies its storage water exclusively to the irrigation scheme at downstream of the dam, but not cover water demand along the Tan An River.
- (v) Water shortage condition is expressed in terms of rate of water deficit in respective year against a corresponding total water demands in the year.
- (vi) Number of year to suffer water shortage(drought year) is defined as that rate is higher than 5%, tentatively.

**(a) Water Deficit Rate Against Annual Total Demands**

**(No Regulation by Release from Vinh Son Dam)**

(unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Irrigation	-	-	-	-	-	-	-	-	-	-	-			
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Irrigation	3.4	12.1	12.0	4.1	1.1	41.5	6.9	5.6	7.8	9.2	13.5			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Up-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Up-IR		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-IR		6.1	18.6	5.3	9.7	17.4	2.0	11.9	1.2	-	10.9	-	-	1.5	15 years

**(b) Water Deficit Rate Against Annual Total Demands**

**(With Regulation by Release from Vinh Son Dam)**

(unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Irrigation	-	-	-	-	-	-	-	-	-	-	-			
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Irrigation	-	-	-	-	-	29.5	-	-	-	-	0.3			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Up-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Up-IR		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-IR		-	4.8	-	-	7.9	-	-	-	-	-	-	-	-	2 years

According to the analysis result, no water shortage is found in the domestic and industrial water demands in the whole basin as well as in the irrigation demands in the upstream reaches.

While irrigation water demands in the downstream reaches encounters water deficit frequently, but which condition would be much improved by release from the Vinh Son Dam.

In both cases above, a part of water deficits to be caused by taking water from the Tan An River could be eased or eliminated by water release under adequate operation of the Nui Mot Dam.

**(2) Water Supply on the Tributaries (deficit not manageable)**

Water balance condition in each irrigation scheme on the tributaries including the Nui Mot Dam is examined in the similar manner. Some of the existing small-scale irrigation schemes on the tributaries of the Kone River are found deficit every year.



**Water Deficit Rate Against Annual Demand** (unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Kone Riv.	Hon Lap Irrig.	-	-	-	-	-	10.6	-	-	-	-	-			
	Hon Ga Irrig.	17.2	-	-	-	-	56.4	-	3.0	3.5	1.4	11.2			
	Thuan Ninh Irrig.	-	-	-	-	-	-	-	-	-	-	-			
Dap Da Riv.	Suoi Chai Irrig.	28.0	47.0	39.6	46.2	30.1	67.6	13.2	42.4	41.9	46.7	43.6			
Tan An	Tui Thien Irrig.	-	-	-	-	-	22.9	-	-	-	-	9.0			
	Nui Mot	-	-	-	-	-	-	-	-	-	-	-			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Hon Lap		-	-	-	-	-	-	-	-	-	-	-	-	-	1 year
Hon Ga		-	-	7.0	8.4	18.5	-	7.4	-	-	13.1	-	-	1.9	8 years
Thuan Ninh		-	-	-	-	-	-	-	-	-	-	-	-	-	
Suoi Chai		13.5	50.0	38.3	45.9	53.1	41.0	42.9	34.5	34.2	51.7	15.7	5.0	43.9	24 years
Tui Thien		-	-	0.3	1.4	12.3	-	0.3	-	-	4.1	-	-	-	3 years
Nui Mot		-	-	-	-	-	-	-	-	-	-	-	-	-	No Deficit

#### 4.2 Ha Thanh River

In the present condition that there is no available reservoir for annual water regulating capacity to meet a certain water demand in the basin, water resources in the Ha Thanh River basin seems to be abundant against still low water requirement from the river surface water.

It is substantially observed that there is no water deficit in the basin except severe drought year that may occur only once or twice during examined 24 years series, as long as water balance evaluation is concerned.

Water balance condition in each existing irrigation scheme in the Ha Thanh River basin is examined in a similar manner as follows:

**Water Deficit Rate Against Annual Demand** (unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Main Riv.	Ha Thanh Irrig.	0.5	1.3	-	3.3	-	12.8	0.8	-	-	0.7	-			
	Ha Thanh D/I	-	-	-	-	-	-	-	-	-	-	-			
Tributaries	Long My Irrig.	-	-	-	-	-	-	-	-	-	-	-			
	Cay Da Irrigation	36.3	79.6	52.9	62.1	39.2	87.5	60.8	45.8	47.1	55.0	56.7			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Ha Thanh Ir.		-	-	-	-	5.1	-	1.8	-	-	-	-	-	-	2 years
Ha Thanh D/I		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Long My		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Cay Da		35.8	60.0	45.0	56.7	76.3	35.4	70.4	55.8	30.2	80.4	21.3	22.9	46.3	24 years

Water balance analysis on the present water demand by the existing demand schemes in the Ha Thanh River basin shows scarce water shortage conditions except Cay Da irrigation schemes.

## 5 FUTURE WATER BALANCE SITUATION AGAINST 2010 DEMAND

### 5.1 Kone River

In the Kone River basin of 2010 condition, there will be three existing reservoirs only. However, the storage capacity of the Vinh Son Dam is expected to increase to 132 million m<sup>3</sup>.

Examination on the 2010 water balance situation is made for the water demands that some increase of water demands is expected in every water demand fields:

- (1) Water supply on the main stream (deficit manageable)

Result of the water balance analysis on the present condition are summarized in different condition from the preceding sections that water balance condition is examined by considering river maintenance flow.

Water balance condition is examined by considering river maintenance flow.

#### (a) Water Deficit Rate Against Annual Total Demands

(No River Maintenance Flow is Considered)

(No Regulation by Release from Vinh Son Dam)

(unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988		
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-		
Upstream	Irrigation	-	-	-	-	-	-	-	-	-	-	-		
Downstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-		
Downstream	Irrigation	5.0	11.9	12.3	3.7	3.4	47.0	7.2	11.8	14.6	15.8	21.1		
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Up-DI	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Up-IR	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-DI	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-IR	8.4	19.9	13.0	14.4	24.8	6.8	11.7	1.2	0.7	11.7	-	-	6.7	18 years

#### (b) Water Deficit Rate Against Annual Total Demands

(River Maintenance Flow is Considered)

(No Regulation by Release from Vinh Son Dam)

(unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988		
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-		
Upstream	Irrigation	-	-	-	-	-	-	-	-	-	-	-		
Downstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-		
Downstream	Irrigation	14.0	34.7	29.9	10.6	13.7	74.7	22.7	28.2	33.7	32.0	45.4		
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Up-DI	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Up-IR	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-DI	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-IR	21.7	39.3	29.6	34.2	50.9	21.6	34.0	7.9	3.4	26.6	1.3	-	18.6	21 years

**(c) Water Deficit Rate Against Annual Total Demands**

**(No River Maintenance Flow is Considered)**

**(With Regulation by Release from Vinh Son Dam)**

(unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Upstream	Irrigation	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Irrigation	-	-	-	-	-	30.7	0.1	-	-	-	3.0			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Up-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Up-IR		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-IR		-	2.0	-	-	13.4	-	0.6	-	-	-	-	-	4.0	2 years

**(d) Water Deficit Rate Against Annual Total Demands**

**(River Maintenance Flow is Considered)**

**(With Regulation by Release from Vinh Son Dam)**

(unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Upstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Upstream	Irrigation	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Domestic/Industry	-	-	-	-	-	-	-	-	-	-	-			
Downstream	Irrigation	6.7	-	4.7	-	1.7	48.0	8.3	10.4	10.4	8.6	18.7			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Drought
Up-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Up-IR		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-DI		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Down-IR		11.3	7.9	10.5	7.0	23.9	9.8	4.9	2.1	3.4	-	1.3	-	16.4	14 years

Water balance of all demands in the upstream area as well as whole domestic and industrial demands are still sufficient even in case of no water release from the Vinh Son Dam.

Due to remarkable increase of the irrigation area by 30 % towards year 2010, although it is expected that storage capacity of the Vinh Son Dam will be increased by 2010, it is obviously observed that drought condition of irrigation schemes in the downstream reaches would become more severe than the present condition in case of no availability of reservoir storage of the Vinh Son Dam. Furthermore, the water balance situation with a requirement of the river maintenance flow will not be satisfactory even if incorporation of the water release from the Vinh Son Dam was considered.

(2) Water supply on the tributaries (deficit not manageable)

Water balance condition in each irrigation scheme on the tributaries including the Nui Mot Dam is examined in the similar manner. Conceivable water balance situation in 2010 will be very diverse according to each irrigation scheme. Particularly, the Nui Mot reservoir seems to have enough space to supply its storage water to the irrigation schemes in the Tan

An River basin.

**Water Deficit Rate Against Annual Demand** (unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Kone Riv.	Hon Lap Irrig.	-	-	-	-	-	11.8	-	-	-	-	-			
	Hon Ga Irrig.	-	7.2	-	-	-	52.6	-	0.9	-	-	-			
	Thuan Ninh Irrig.	-	41.3	3.0	-	0.3	74.7	1.9	10.2	9.5	6.9	16.3			
Dap Da Riv.	Suoi Chai Irrig.	10.9	35.0	25.6	33.9	16.7	56.6	-	30.3	27.7	34.7	30.4			
Tan An Riv.	Tui Thien Irrig.	-	-	-	-	-	20.4	-	-	-	-	6.3			
	Nui Mot	-	-	-	-	-	-	-	-	-	-	-			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Def. yrs.
	Hon Lap	-	-	-	-	1.2	-	-	-	-	-	-	-	-	1 year
	Hon Ga	-	-	4.0	6.0	16.1	-	3.2	-	-	10.3	-	-	-	5 years
	Thuan Ninh	-	19.1	13.3	13.6	23.1	4.9	19.0	4.4	-	17.9	-	-	10.4	13 years
	Suoi Chai	-	30.0	23.9	34.3	39.4	29.5	29.7	21.4	23.0	40.7	-	0.8	31.8	20 years
	Tui Thien	-	-	-	-	10.1	-	-	-	-	1.4	-	-	-	3 years
	Nui Mot	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit

## 5.2 Ha Thanh River

Irrigation area is proposed to increase by 1,200 ha, which increased area would be double of the present one, while new reservoirs will be available by 2010, which total storage capacity will be 13 million m<sup>3</sup> only. Furthermore, the industrial water demands is projected being raised in 2010.

Due to such sharp increase of water demands, the water balance situation in the analysis is quite different from the present situation.

Thanh River basin is examined as follows:

		Water Deficit Rate Against Annual Demand (unit %)													
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Main Riv.	Ha Thanh Irrig.	1.6	10.4	-	6.9	0.8	28.7	6.6	-	1.0	5.9	3.4			
	Ha Thanh D/I	-	-	-	-	-	-	-	-	-	-	-			
	Coastal Shrimp	-	8.7	-	2.7	-	21.6	4.7	-	0.4	0.8	1.1			
River mouth with River Maintenance Flow		2.4	12.9	1.3	11.4	6.2	22.8	9.5	1.6	5.1	11.5	7.8			
Tributaries	Suoi Chinh Irrig.	-	-	-	-	-	19.5	-	-	-	-	-			
	Long My Irrig.	-	-	-	-	-	-	-	-	-	-	-			
	Cay Da Irrig.	29.6	75.3	47.1	56.5	32.7	86.5	56.5	40.1	39.5	50.2	50.2			
	Phu Tai Irrig.	-	-	-	-	-	2.2	-	-	-	-	-			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Def. yrs.
Ha Thanh Ir.	-	-	1.4	5.3	15.5	-	8.5	0.7	0.6	4.3	-	-	2.6	8 yrs.	
Ha Thanh D/I	-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit	
Coastal Shrimp	-	-	-	1.2	17.2	-	11.0	-	-	4.1	-	-	1.7	4 yrs.	
River Mouth	1.6	0.6	4.3	9.9	14.1	0.4	10.6	3.6	4.0	10.9	2.8	-	9.2	13 years	
Suoi Chinh Ir	-	-	-	-	10.2	-	-	-	-	1.6	-	-	-	2 yrs.	
Long My	-	-	-	-	-	-	-	-	-	-	-	-	-		
Cay Da	25.6	52.0	38.1	51.1	70.9	30.9	65.5	51.1	27.4	75.8	14.8	15.2	41.3	24 yrs.	
Phu Tai	-	-	-	-	-	-	-	-	-	-	-	-	-		

As seen in the above, the drought condition in whole the basin with the river maintenance flow would occur almost every year, while every other year in case no river maintenance flow is considered. Similar situation is found for the HaThanh irrigation scheme. The other water demands except Cay Da irrigation scheme scarcely encounter water shortage condition.

## 6 FUTURE WATER BALANCE SITUATION AGAINST 2020 DEMAND

### 6.1 Kone River

#### (1) Development Scale of Dinh Binh Reservoir

In the 2020 case, the proposed Dinh Binh Dam is integrated in the analysis in addition to the existing reservoirs. Further, a small-scale reservoir as a part of the proposed irrigation system are also incorporated in the analysis as shown in Figure E.3.

Firstly the water balance study is undertaken so as to find out the most appropriate reservoir development scale of the Dinh Binh Dam so as to meet the projected water demands in 2020.

In the analysis, dam discharge amount is worked out with 10 day interval in order to eliminate water deficits in the downstream reaches of the dam as much as possible under the condition that flood control space in the reservoir is to be secured during flood season as a flood control measure.

#### (2) Effective Storage Alternatives

Effective storage volume of approx. 210 million m<sup>3</sup> available for water supply proposed by the previous feasibility study undertaken by MARD/HEC1 is assumed in the current study as minimum requirement to cope with 2020 water demand. While minimum effective storage to secure the flood control space for late flood, i.e. 200 million m<sup>3</sup>, is estimated at 189 million m<sup>3</sup>.

To cope with 2020 water demand, bigger effective storage capacity than 189 million m<sup>3</sup> are examined in the current analysis, i.e. 210, 279 and 360 million m<sup>3</sup> in terms of the effective storage volume for water supply.

#### (3) Flood Control Volume Alternatives

According to the flood control plan discussed in the succeeding Chapter 10, a certain amount of flood control space is expected to be secured in the reservoir storage during a flood season, as follows:

##### (a) Major flood season ( September to November)

A flood control space of approx. 100 million m<sup>3</sup> to 375 million m<sup>3</sup> as well as the effective storage capacity in the flood season retaining 0.0 to 100 million m<sup>3</sup> according to the reservoir development scale.

##### (b) Late flood season (December).

In any development scale alternatives, 200, 120 and 55 million m<sup>3</sup> respectively in the first, second and third 10days.

(4) Examined development Scale

In the study, the water transfer to the La Tinh River basin is included.

Examined alternatives with a combination of effective storage capacity and flood control space are summarized below:

**Reservoir Development Scale Alternatives**

(unit : million m<sup>3</sup>)

	Gross Storage Volume	Effective Storage Capacity for Water Supply			Expected Flood Control Space	
		Non-flood season	Major flood season	Late flood season	Major flood season	Late flood season
		Jan.-Aug.	Sep.-Nov.	Dec.	Sep.-Nov.	Dec.
I-1	237.5	209.9	0.0	1) 21.2	221.2	1) 200.0
I-2			100.0	2) 101.2 3) 166.2		
II-1	309.1	279.5	0.0	1) 92.8	292.8	
II-2			100.0	2) 172.8 3) 237.8		
III-1	391.8	360.2	0.0	1) 175.5	375.5	
III-2			100.0	2) 255.5 3) 320.5		

Remarks: In Late Flood season (December), the effective storage volume and the flood control space will be gradually increased and decreased every 10 days, respectively, 1) 1<sup>st</sup>-10<sup>th</sup>, 2) 11<sup>th</sup> to 20<sup>th</sup>, 3) 21<sup>th</sup> to 31<sup>th</sup>.

(5) Reservoir Operation Rule Applied for the Analysis

In the present water balance analysis, preliminary reservoir operation procedure is predetermined to control reservoir storage volume in flood control aspect according to the three seasons a year as shown in the preceding Paragraph (4), i.e.: no-flood season (January to August), major flood season (September to November) and late flood season (December).

In addition to the above, a procedure on reservoir outflow control in the water supply aspect is predetermined as well. A concept of this rule is to discharge reservoir storage to meet water demand in the downstream reaches as long as storage water is available.

(a) Operation for Reservoir Storage Control

In annual operation for reservoir storage control, the highest priority is given to the following matter, respectively according to the flood seasons:

- (i) Non-flood season : Securing effective storage capacity for water supply is prioritized provided that water supply demand is satisfied
- (ii) Major flood season : Predetermined flood control space is to be secured
- (iii) Late flood season : Predetermined flood control space is to be secured, while the effective storage capacity for water supply shall be restored towards the non-flood

season.

(b) Operation for Reservoir Outflow Control

Reservoir outflow control is to be made in the following manner that current reservoir storage will not exceed the respective effective storage capacities according to the flood seasons:

(i) Current Reservoir Storage = Effective Storage Capacity

- $Q_{out} = Q_{in}$             when  $Q_{in} > Q_{demand}$
- $Q_{out} = Q_{demand}$     when  $Q_{in} < Q_{demand}$

(ii) Current Reservoir Storage < Effective Storage Capacity

- $Q_{out} = Q_{demand}$     until Current Reservoir Storage reaches to the Effective Storage Capacity, when  $Q_{in} > Q_{demand}$
- $Q_{out} = Q_{demand}$     until Current Reservoir Storage become the lowest, when  $Q_{in} < Q_{demand}$

(iii) Current Reservoir Storage = the lowest

- $Q_{out} = Q_{in}$             when  $Q_{in} < Q_{demand}$
- $Q_{out} = Q_{demand}$     when  $Q_{in} > Q_{demand}$

In the above,

- $Q_{out}$             : Necessary outflow volume from the reservoir
- $Q_{in}$             : Inflow volume to the reservoir
- $Q_{demand}$       : Water demand in downstream reaches

(6) Water Balance Analysis by Development Scale

Water balance analysis is made for the several alternatives as shown above with the assumption that the reservoir storage of the Dinh Vinh Dam and Vinh Son Dam is incorporated but storage capacity of the Nui Mot Dam will be considered later in the analysis.

Water balance condition in 2020 is shown below in terms of annual water deficit estimated by accumulating deficits per 10 day calculation interval:



**Annual Water Deficit in Whole Basin by Development Alternatives**

(unit : million m<sup>3</sup>)

Alternatives	Eff. Storage	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
I-1	209.9	-	75	-	-	-	641	-	-	20	61	196	
I-2		-	75	-	-	-	641	-	-	20	61	196	
II-1	279.5	-	50	-	-	-	638	-	-	-	-	119	
II-2		-	-	-	-	-	566	-	-	-	-	119	
III-1	360.2	-	50	-	-	-	638	-	-	-	-	40	
III-2		-	-	-	-	-	542	-	-	-	-	40	
Alternatives	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
I-1	-	110	13	115	290	-	160	-	-	88	-	-	-
I-2	-	110	13	115	290	-	160	-	-	88	-	-	-
II-1	-	76	-	40	209	-	88	-	-	20	-	-	-
II-2	-	40	-	40	209	-	88	-	-	20	-	-	-
III-1	-	76	-	40	209	-	88	-	-	20	-	-	-
III-2	-	-	-	-	131	-	72	-	-	-	-	-	-

(7) Detailed Examination

In the most of cases, minor difference is observed between comparative cases (such as I-1 and I-2) of flood control volume during major flood season, therefore only one case for each reservoir development scale, i.e. Alternative I-1, II-1 and III-1 are examined in detail as follows:

### Annual Water Deficit by Area

(unit : million m<sup>3</sup>)

		Alternative	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987				
Whole Basin	at River Mouth	I-1	-	75	-	-	-	640	-	-	20	61				
	(except demand in tributaries)	II-1	-	50	-	-	-	640	-	-	-	-				
		III-1	-	50	-	-	-	640	-	-	-	-				
Upstream Reaches	Irrigations (Water taken from main river only)	I-1	-	23	-	-	-	188	-	-	-	12				
		II-1	-	10	-	-	-	188	-	-	-	-				
		III-1	-	10	-	-	-	188	-	-	-	-				
	Domestic&Industry	I-1	-	2.1	-	-	-	8.5	-	-	-	-				
		II-1	-	1.4	-	-	-	8.5	-	-	-	-				
		III-1	-	1.4	-	-	-	8.5	-	-	-	-				
	Other Irrigations			-	22.1	-	-	-	53.6	-	3.6	1.8	0.9			
Downstream Reaches	Main Rivers Area	I-1	-	50	-	-	-	444	-	-	20	39				
		II-1	-	39	-	-	-	444	-	-	-	-				
		III-1	-	39	-	-	-	444	-	-	-	-				
	Nui Mot			-	-	-	-	-	-	-	-	-				
	Other Tributaries			1.3	7.6	4.2	6.0	2.3	15	-	5.8	5.1	6.5			
		Alt.	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Whole Basin	I-1	196	-	110	13	115	290	-	160	-	-	88	-	-	-	
	II-1	119	-	76	-	40	209	-	88	-	-	20	-	-	-	
	III-1	40	-	76	-	-	209	-	88	-	-	20	-	-	-	
Up-irrigation (Main)	I-1	62	-	20	3.2	23.9	103	-	14	-	-	4.3	-	-	-	
	II-1	51	-	11	-	6.8	80	-	6.9	-	-	-	-	-	-	
	III-1	13	-	11	-	-	80	-	6.8	-	-	-	-	-	-	
Up- D & I	I-1	5.0	-	1.9	0.8	2.8	5.9	-	1.5	-	-	0.3	-	-	-	
	II-1	3.3	-	0.6	-	1.3	5.9	-	1.1	-	-	-	-	-	-	
	III-1	1.5	-	0.6	-	-	5.9	-	1.1	-	-	-	-	-	-	
Up-Other Irr			8.9	-	3.8	5.9	6.8	15	-	8.2	-	-	10	-	-	-
Down-Main	I-1	129	-	88	9.0	88	181	-	145	-	-	83	-	-	-	
	II-1	65	-	64	-	32	123	-	80	-	-	20	-	-	-	
	III-1	26	-	64	-	-	123	-	80	-	-	20	-	-	-	
Nui Mot			-	-	-	-	-	-	-	-	-	-	-	-	-	
Down-Others			6.3	-	3.9	4.6	6.9	8.8	5.3	5.8	3.3	3.7	8.7	-	-	5.9

According to the result shown above, every alternatives do not satisfy the evaluation criteria mentioned in succeeding Section 6.3. Therefore, water shortage, which is not too severe, is examined if such condition could be improved by operation of the Dinh Binh Dam and the Nui Mot Dam.

In case of very severe drought such as those in 1983 case, which drought conditions are expressed in the shadowed column of the above table, such deficit can not be covered by the water storage of the Nui Mot Dam that storage capacity is 108 million m<sup>3</sup>. In Alternative I-1 case, it is estimated to be 6 times(years) that severe drought condition will occur. Such severe condition could not be improved by such a way to in order to satisfy the predetermined criteria that water shortage for the irrigation demand should be 5 years or less out of the examined 24 years.

Possibility of Alternative II-1 if the situation would be improved to the satisfactory level is examined as follows:

- a) Water shortage of the domestic and industrial demands is to be improved (figures of thick character), except in 1983 and 1993, by shifting deficits to the irrigation and fishery demands,
- b) Water shortage of the irrigation demands in upstream reaches for 1990, 1992 and 1998 (figures in double line column) is to be improved by appropriate operation of the Din Binh Dam.
- c) Water shortage of the irrigation demands in downstream reaches for 1990, 1992 and 1998 (figures in double line column) is to be absorbed by the appropriate integrated operation of the Dinh Binh and Nui Mot Dams. According to the analysis, this improvement causes water deficits by 2 times in 1990 in the irrigation scheme that directly receive water supply from the Nui Mot Dam.

(8) Result of Water Balance Analysis in Kone River Basin

Consequently, the water balance situation of the **Alternative II-1** would meet the predetermined condition except some irrigation schemes on the tributaries as follows:

Water Demand	Water Shortage in 24 years	Drought Year
Domestic and Industry in whole basin	2 years	1983, 1993
Irrigation and Fishery related to the Main Rivers	5 years	1979, 1983, 1988, 1993 and 1995
Nui Mot	1 year	1990
Hon Lap, Hon Ga	1 to 2 years	1983, 1993 (Hon Ga only)
Thuan Ninh, Dong Sim	9 years	1979, 1983, (1985), 1988, (1990), 1991-93, 1995 and 198
Tui Thien	12 years	1979, 1983, 1985-88, 1991-93, 1995, 1998, 2001
Suoi Chai	20 years	Except 1984, 1988, 1999 and 2000

In water supply capacity aspect, Alternative II-1&3 as well as Alternative III-1&3 will meet the requirement and conditions, while Alternatives I-1&3 will not have a sufficient storage capacity.

## 6.2 Ha Thanh River

(1) Water Balance on Original Development Plan

In the Ha Thanh River basin, the water demand projected in 2020 will be much increased comparing to the present one mainly due to the development of irrigation system as well as new development of industry zone which will take water from the Ha Thanh River.

Development of the irrigation system towards 2020 is presumed as follows in terms of its area:

Category	Water Source (Ha Thanh River)	Irrigation Area (ha)			
		Original Plan		Alternative Plan	
		Present	2020	Present	2020
Existing & Expansion	Main river without a reservoir	990	1,480	990	718
	Tributary with a reservoir	190	426	190	206
New Development	Tributary with a reservoir	0	2,022	0	1,322

The Suoi Chiep reservoir, which was previously planned to be an exclusive reservoir with an irrigation scheme, is currently proposed as a reservoir for water supply with regulating capacity.

Due to remarkable increase of water demands including irrigation, industry and fishery as well as river maintenance flow incorporated in the analysis, water deficit is estimated to occur almost every other year according to the analysis, as follows:

Water Deficit Rate Against Annual Demand												(unit %)			
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Main Riv.	Ha Thanh Irrig.	-	12.4	-	9.8	-	38.8	6.7	-	-	6.7	4.5			
	Ha Thanh D/I	-	-	-	-	-	-	-	-	-	-	-			
	Coastal Shrimp	-	8.9	-	1.5	-	24.6	5.2	-	-	2.1	2.0			
Tributaries	Suoi Chinh Irrig.	-	-	-	-	-	14.5	-	-	-	-	-			
	Da Mai Irrig.	-	-	-	-	-	-	-	-	-	-	-			
	Long My Irrig.	-	-	-	-	-	-	-	-	-	-	-			
	Cay Da Irrig.	25.3	73.0	43.2	53.0	27.8	85.6	52.9	35.5	34.2	45.8	45.7			
	Phu Tai Irrig.	-	-	-	-	-	-	-	-	-	-	-			
River mouth with River Maintenance Flow		-	8.9	-	8.6	2.3	20.9	4.5	-	-	6.7	3.8			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Def. yrs.
Ha Thanh Ir.		-	-	-	5.9	22.3	-	7.1	-	-	7.7	-	-	2.8	9 years
Ha Thanh D/I		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Coastal Shrimp		-	-	-	1.8	17.5	-	11.7	-	-	4.6	-	-	2.2	5 years
Suoi Chinh Ir		-	-	-	-	9.4	-	-	-	-	4.3	-	-	-	2 years
Da Mai Ir.		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Long My		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Cay Da		19.9	48.6	33.0	47.0	67.8	25.9	63.2	46.7	22.3	73.4	10.2	10.3	36.3	Every yr.
Phu Tai		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
River mouth w/RMF		-	-	-	6.5	11.4	-	8.4	-	-	7.5	-	-	-	11 years

## (2) Water Balance on Alternative Plan

Improvement measure of severe drought condition foreseen in 2020 in order to meet the prescribed condition, an alternative plan as mentioned in (2) above was studied that the

irrigation development area in 2020 is decreased as follows:

	Original Plan (ha)	Alternative Plan (ha)
Ha Thanh Irrigation	1,480	718
Da Mai Irrigation	700	0
Long My Irrigation	330	110

Examined water balance condition under the alternative plan decreasing development area is remarkably improved as follows even though the condition of tributaries has no change:

**Water Deficit Rate Against Annual Demand** (unit %)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988			
Main Riv.	Ha Thanh Irrig.	-	1.0	-	-	-	19.9	-	-	-	-	-			
	Ha Thanh D/I	-	-	-	-	-	-	-	-	-	-	-			
	Coastal Shrimp	-	2.6	-	-	-	18.5	-	-	-	-	-			
River mouth with River Maintenance Flow		-	4.0	-	2.0	-	17.7	-	-	-	-	-			
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Def. yrs.
Ha Thanh Ir.		-	-	-	-	8.8	-	-	-	-	-	-	-	-	2 years
Ha Thanh D/I		-	-	-	-	-	-	-	-	-	-	-	-	-	No deficit
Coastal Shrimp		-	-	-	-	10.1	-	1.0	-	-	-	-	-	-	2 years
River mouth w/RMF		-	-	-	-	7.1	-	2.6	-	-	-	-	-	-	45 years

The alternative development plan satisfy the required condition of the development plan in 2020 of the Ha Thanh River basin.

**Table E.1 (1) 10-Days Natural Runoff Series at Cay Muong in Runoff Volume (Catchment area : 1,677 km2)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	70.20	31.71	34.01	64.46	88.37	13.11	43.01	75.02	72.06	103.68	56.47	34.65	23.06	56.45	60.49	43.30	82.04	32.64	67.21	138.46	40.25	173.38	128.30	85.03
Jan2	59.88	25.09	27.86	52.62	73.00	10.97	35.13	60.01	58.44	81.06	46.07	28.16	19.04	46.17	51.94	35.42	66.10	26.54	53.90	111.64	33.70	143.11	104.74	66.12
Jan3	47.90	22.36	25.10	47.34	64.90	10.19	31.52	53.21	52.04	71.92	41.14	25.39	17.45	41.63	47.56	31.94	58.41	23.86	47.63	98.72	31.12	131.85	111.02	56.70
Feb1	37.04	16.78	18.73	35.26	48.63	7.92	23.57	39.31	38.59	52.72	30.64	19.16	13.12	31.30	33.39	24.03	43.40	19.63	35.54	72.73	22.71	86.20	83.07	41.98
Feb2	29.79	14.14	15.73	29.51	40.38	6.89	19.76	32.54	32.07	43.47	25.59	16.23	11.15	26.73	27.69	20.26	35.35	15.09	29.20	59.88	19.24	70.12	66.26	35.05
Feb3	20.43	9.74	12.11	20.29	27.74	4.93	15.18	22.11	21.87	29.69	19.65	11.27	7.75	21.53	21.03	14.01	23.90	10.39	22.22	40.52	13.41	51.63	49.91	23.86
Mar1	22.16	10.59	11.66	21.97	30.03	5.49	14.51	23.69	23.51	32.46	18.65	12.32	8.51	20.95	19.91	15.28	25.57	11.32	21.06	43.23	14.60	61.35	46.75	26.02
Mar2	18.99	9.16	10.02	18.90	25.82	4.91	12.49	20.12	20.05	26.87	16.03	11.05	7.42	19.60	16.93	13.24	21.49	9.75	17.97	36.55	12.70	48.07	39.41	22.64
Mar3	17.82	8.74	9.56	17.93	24.60	4.82	11.89	19.08	18.86	25.01	15.18	11.41	7.15	19.34	15.91	12.65	22.06	9.31	16.95	34.07	12.48	43.91	36.68	22.16
Apr1	14.04	6.97	7.60	14.22	19.50	3.96	9.43	14.77	14.82	19.44	12.01	8.35	5.75	17.63	13.37	10.09	17.15	7.39	13.38	26.48	9.94	33.51	28.48	16.61
Apr2	13.03	6.26	6.77	12.67	17.39	3.61	8.40	12.90	13.01	17.17	10.64	7.46	5.17	13.83	11.67	8.99	14.75	6.64	11.74	23.31	8.77	29.60	26.21	14.52
Apr3	12.67	5.62	6.11	11.34	15.36	3.34	7.51	11.69	11.54	14.85	9.47	6.70	4.67	12.34	10.42	8.11	12.78	5.92	10.42	20.33	8.18	28.80	22.22	13.06
May1	15.00	11.01	9.80	8.80	22.33	3.58	18.90	26.49	10.40	8.07	10.38	19.32	4.93	15.27	8.70	8.99	10.03	9.82	17.00	18.40	14.07	41.00	19.23	14.45
May2	18.18	10.31	20.99	18.16	16.30	7.85	17.63	14.58	35.31	7.14	9.51	12.80	13.11	11.22	8.91	8.37	17.87	12.82	61.29	20.87	11.55	32.99	34.90	36.02
May3	14.83	15.02	43.98	32.43	13.43	5.44	28.77	14.19	28.00	11.36	8.27	24.10	56.09	12.61	10.28	14.33	25.10	17.71	28.96	43.95	14.86	61.96	33.32	17.08
Jun1	9.01	26.56	23.84	18.57	18.53	3.89	35.04	10.92	11.43	17.35	9.36	25.25	21.00	19.08	12.06	8.54	14.78	21.94	22.24	24.95	7.78	37.39	49.79	22.45
Jun2	13.57	28.01	29.28	37.16	39.26	7.91	64.55	15.67	11.85	13.04	11.77	17.68	84.08	10.17	25.59	8.35	12.01	14.20	39.83	24.57	8.13	63.82	30.01	15.54
Jun3	10.25	60.35	43.36	31.38	18.06	11.84	13.14	10.05	11.96	7.31	7.02	18.19	51.62	8.31	13.63	11.35	27.04	17.44	23.76	13.79	15.82	41.00	35.79	13.06
Jul1	19.13	14.18	15.90	35.45	10.47	6.87	13.59	5.94	7.13	7.91	5.35	11.15	15.01	6.68	5.43	5.56	10.40	11.62	20.23	16.25	19.66	19.58	29.02	7.64
Jul2	17.14	11.67	13.04	47.75	10.08	5.94	10.96	5.67	6.55	7.53	5.09	10.56	12.82	6.28	5.06	4.66	8.65	11.18	16.28	16.44	16.91	19.06	25.15	7.06
Jul3	16.53	11.13	13.50	48.50	9.30	5.20	12.07	5.61	7.08	7.72	5.07	13.78	11.58	5.97	8.42	5.11	8.36	8.67	14.07	15.81	14.60	18.72	25.24	7.02
Aug1	11.32	8.61	9.74	36.80	7.72	10.33	8.41	4.74	6.96	6.18	4.15	11.55	9.44	5.08	7.40	4.05	6.73	7.02	10.95	11.89	15.47	14.54	20.34	8.36
Aug2	9.77	6.93	8.11	28.17	7.12	11.31	7.21	4.42	6.79	5.87	3.89	20.42	11.09	4.71	6.90	3.70	6.07	5.96	9.38	10.77	11.72	13.66	18.36	11.68
Aug3	9.80	6.39	8.16	24.50	8.44	8.44	6.89	4.57	6.44	6.34	4.01	21.71	7.94	4.88	8.88	3.84	6.26	12.36	8.99	10.90	12.54	14.45	30.72	11.84
Sep1	8.69	5.50	10.77	19.22	10.38	8.81	6.71	4.45	5.87	9.42	3.43	27.17	12.23	4.23	6.04	3.91	27.68	15.65	7.84	9.01	10.32	15.54	22.26	7.50
Sep2	16.49	4.98	14.63	17.31	8.21	11.06	5.19	11.78	4.63	52.62	3.73	86.14	29.71	4.22	10.73	4.61	38.60	43.09	11.67	8.93	17.92	21.31	21.35	7.86
Sep3	20.15	10.26	44.50	29.00	12.67	13.18	8.48	49.75	6.32	41.67	20.87	57.79	21.74	10.22	18.29	7.39	27.78	23.91	20.23	102.50	43.28	23.90	20.68	12.37
Oct1	19.13	14.44	188.94	30.59	12.63	50.31	12.93	95.84	179.71	25.20	101.46	50.50	138.42	28.37	47.48	164.86	27.99	207.50	19.72	67.43	68.37	56.94	31.99	11.48
Oct2	16.79	162.08	116.12	261.03	20.32	146.82	219.27	205.82	60.36	20.04	365.46	49.27	647.79	22.47	86.81	77.88	60.70	124.14	76.27	46.07	58.91	176.42	129.46	29.84
Oct3	61.51	138.90	367.60	578.30	33.54	330.58	123.42	92.39	310.81	19.12	137.46	40.48	274.36	356.55	681.06	209.50	191.69	311.31	443.85	60.13	296.22	360.14	113.10	314.72
Nov1	186.74	53.46	486.02	483.96	65.03	223.62	308.31	214.82	165.40	243.04	185.90	33.13	158.02	112.36	201.15	64.49	58.16	325.72	391.18	343.07	140.51	671.65	52.32	140.75
Nov2	90.24	188.71	462.46	420.87	37.47	344.59	114.11	262.31	143.12	424.90	149.61	80.57	487.65	98.22	163.40	46.95	63.70	218.71	583.55	81.79	595.37	180.71	503.85	155.26
Nov3	48.97	98.07	173.25	189.60	26.08	116.52	277.27	368.25	106.84	300.20	83.26	61.29	194.41	324.03	97.80	224.26	97.74	127.28	445.06	64.85	628.14	215.36	210.57	64.90
Dec1	55.38	81.75	121.60	283.76	23.13	81.38	294.10	271.81	656.62	113.87	63.08	50.21	113.63	118.13	76.13	308.98	82.02	106.37	526.10	100.00	431.90	754.53	179.82	51.94
Dec2	45.27	55.10	107.54	190.23	19.81	68.58	111.90	112.28	148.91	88.77	56.94	38.61	89.78	176.23	59.69	304.84	64.96	99.83	297.81	68.88	427.30	355.73	135.93	101.26
Dec3	56.69	46.51	94.61	124.19	17.22	60.22	118.08	120.76	164.97	78.26	47.85	32.55	78.81	84.63	65.66	118.49	56.21	161.65	270.93	54.88	200.15	182.55	189.05	89.97

**Table E.1 (2) 10-Days Natural Runoff Series at Dinh Binh Dam Site in Runoff Volume (Catchment area : 1,040 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	56.74	26.67	23.41	46.65	60.86	10.38	30.72	53.65	52.90	78.13	39.24	24.29	16.87	41.92	44.03	29.79	60.51	22.02	48.89	99.95	30.27	127.24	90.20	62.80
Jan2	45.45	20.53	19.24	38.03	50.72	8.64	25.09	42.70	42.89	60.70	32.02	19.44	13.88	34.17	37.96	24.49	48.75	17.89	39.16	80.54	25.24	104.90	74.02	48.99
Jan3	34.10	18.25	17.36	34.24	44.88	8.00	22.49	37.82	38.15	54.00	28.61	17.44	12.73	30.77	35.17	22.04	43.05	16.11	34.40	71.25	23.51	96.42	84.70	41.89
Feb1	26.05	13.65	12.92	25.44	33.67	6.19	16.82	27.89	28.25	39.49	21.33	13.15	9.49	23.09	24.72	16.58	32.10	13.07	26.20	52.50	17.07	60.73	61.02	31.07
Feb2	21.00	11.49	10.84	21.25	27.83	5.37	14.09	23.05	23.46	32.53	17.87	11.13	8.02	19.75	20.47	14.01	26.05	10.22	21.19	43.24	14.40	49.59	48.04	26.05
Feb3	14.39	7.89	8.36	14.58	19.10	3.84	10.82	15.63	15.98	22.26	13.69	7.72	5.56	16.14	15.51	9.69	17.60	7.07	16.14	29.29	10.03	36.43	36.18	17.54
Mar1	15.47	8.55	8.07	15.79	20.65	4.26	10.33	16.72	17.15	24.56	13.07	8.43	6.09	15.70	14.67	10.58	18.84	7.72	15.30	31.25	10.91	44.70	33.79	19.11
Mar2	13.15	7.39	6.96	13.56	17.76	3.80	8.91	14.18	14.63	20.27	11.25	7.56	5.29	14.63	12.46	9.18	15.81	6.66	13.06	26.42	9.48	34.67	28.45	16.63
Mar3	12.30	7.03	6.63	12.86	16.82	3.72	8.47	13.46	13.72	18.85	10.67	7.56	5.07	14.78	11.68	8.80	16.69	6.38	12.31	24.64	9.35	31.54	26.46	16.38
Apr1	9.67	5.59	5.30	10.30	13.36	3.04	6.70	10.38	10.77	14.64	8.46	5.67	4.07	14.71	9.93	7.04	13.18	5.10	9.76	19.17	7.43	24.03	20.49	12.29
Apr2	9.40	5.03	4.73	9.04	12.14	2.77	5.97	9.05	9.45	13.06	7.47	5.07	3.63	11.50	8.87	6.26	11.69	4.67	8.54	16.80	6.52	21.54	18.76	10.70
Apr3	9.12	4.51	4.30	8.16	10.51	2.57	5.35	8.30	8.37	11.18	6.70	4.55	3.27	10.48	8.15	5.66	10.08	4.13	7.57	14.74	6.13	21.57	16.08	9.62
May1	10.43	9.39	6.84	6.54	15.42	2.65	13.35	19.43	7.53	6.06	7.34	11.44	3.45	12.87	6.62	6.29	7.81	6.92	12.47	13.28	10.21	32.22	13.89	10.71
May2	13.26	9.66	14.13	18.38	11.17	5.49	12.52	10.43	25.65	5.36	6.74	7.95	8.88	9.45	6.78	5.89	13.84	8.96	42.20	14.73	8.77	26.45	24.30	26.41
May3	11.65	16.19	29.96	35.67	9.18	3.85	18.97	10.11	18.37	8.53	5.87	14.88	36.24	10.77	7.84	9.77	21.26	13.75	20.41	32.76	12.79	47.06	23.36	12.67
Jun1	6.79	25.54	16.92	19.66	12.63	2.90	22.06	7.79	7.81	13.49	6.78	15.11	14.79	15.97	9.06	5.91	13.53	17.13	16.76	18.60	6.61	26.04	34.30	18.35
Jun2	10.07	30.50	19.18	27.23	29.16	6.27	34.30	11.05	8.06	10.85	8.12	10.47	44.10	8.39	19.25	5.78	10.88	13.07	28.85	18.16	6.82	42.03	22.54	12.66
Jun3	7.65	65.66	26.19	20.96	13.80	10.00	7.01	7.04	8.22	6.04	5.16	10.21	24.56	6.75	10.50	7.83	23.04	15.76	17.92	10.20	13.20	28.47	29.55	10.58
Jul1	13.20	14.25	9.64	24.95	7.98	5.38	8.01	4.16	4.93	6.36	3.92	5.94	7.42	5.21	4.20	4.07	8.55	10.85	16.12	11.96	18.26	13.42	23.44	6.01
Jul2	12.95	11.64	7.92	28.43	8.13	4.81	6.69	3.90	4.52	5.98	3.59	5.58	6.24	4.96	3.91	3.35	7.08	11.96	13.63	12.76	14.51	13.14	19.64	5.51
Jul3	13.69	10.73	8.90	25.94	7.06	4.24	7.08	3.91	4.77	6.10	3.65	7.30	5.68	4.70	5.75	3.91	6.78	9.30	11.00	11.87	12.98	12.86	18.90	5.41
Aug1	9.23	8.28	6.52	18.79	5.78	6.34	5.07	3.30	4.92	4.84	3.01	6.36	4.52	3.95	4.97	3.14	5.43	7.33	8.49	8.95	11.28	10.05	15.41	6.98
Aug2	7.91	6.70	5.38	16.56	5.27	7.12	4.42	3.09	4.35	4.59	2.81	10.70	4.92	3.65	5.69	2.84	4.85	5.89	7.27	8.08	8.75	9.18	13.91	11.04
Aug3	8.27	6.18	5.33	14.72	5.83	5.11	4.29	3.17	4.35	4.95	2.90	11.41	3.66	3.82	8.03	2.95	5.04	9.35	6.92	8.24	9.28	9.93	21.38	13.16
Sep1	7.26	5.16	7.46	11.52	8.09	5.94	4.17	3.33	3.84	9.18	2.46	15.35	7.74	3.37	5.69	3.44	30.10	12.28	5.98	6.77	7.52	11.16	15.91	8.29
Sep2	14.58	4.69	10.39	10.29	7.00	7.65	3.21	10.56	3.10	54.68	2.86	50.02	31.22	3.20	10.04	4.53	33.79	36.06	9.62	6.90	13.14	15.03	15.23	8.38
Sep3	18.35	7.53	34.27	15.73	11.34	11.02	4.81	47.48	4.23	35.45	16.66	38.77	18.17	6.67	15.65	6.91	21.51	17.62	17.83	88.40	33.77	18.36	14.48	11.61
Oct1	17.19	10.12	133.18	17.37	12.45	31.33	7.83	60.48	147.97	20.89	81.22	30.59	112.35	20.68	43.61	131.20	19.61	154.00	15.82	53.88	48.31	46.17	22.47	10.57
Oct2	14.20	112.72	82.63	187.13	21.49	93.23	152.36	138.31	49.60	16.87	242.97	30.28	463.39	15.46	66.29	59.65	36.84	97.26	69.18	35.88	42.12	122.91	69.56	29.01
Oct3	59.10	86.08	249.02	399.45	34.35	234.56	88.02	62.69	250.49	15.72	84.24	25.38	206.44	246.88	471.80	154.32	112.29	218.83	356.73	49.10	188.28	252.62	76.82	226.32
Nov1	149.03	34.83	339.77	325.41	58.26	160.26	199.64	172.07	120.17	196.51	122.28	22.52	113.70	70.70	144.36	48.00	41.20	243.54	280.77	256.69	96.32	473.49	34.14	99.82
Nov2	78.64	131.47	342.48	284.15	30.03	257.19	78.48	199.16	121.80	294.55	94.71	66.70	350.33	66.36	116.55	34.33	51.76	160.42	416.88	57.97	412.59	125.61	385.88	108.46
Nov3	38.77	66.15	123.39	128.02	20.36	83.41	207.55	229.84	86.82	201.48	58.89	50.92	149.83	246.80	68.49	167.75	79.89	95.85	329.60	46.18	421.25	151.80	150.67	45.90
Dec1	47.79	59.92	86.95	194.35	18.06	58.61	224.11	209.40	504.80	78.76	44.64	39.22	87.46	88.27	53.47	233.43	54.35	81.17	374.16	85.16	320.01	542.02	127.09	36.73
Dec2	39.06	39.88	79.24	139.21	15.73	49.20	78.24	83.78	110.38	61.53	40.69	27.94	66.04	138.09	41.89	231.09	43.10	84.68	225.37	53.71	295.32	246.76	101.24	84.27
Dec3	49.72	31.92	68.76	85.93	13.66	43.18	87.19	92.91	130.19	54.77	33.26	24.04	58.77	62.36	47.42	87.67	36.98	129.59	196.42	41.33	141.60	128.17	147.48	70.06

ET-2

**Table E.1 (3) 10-Days Natural Runoff Series at Binh Thanh in Runoff Volume (Catchment area : 2,250 km2)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	87.02	36.58	43.58	78.68	113.81	15.93	57.43	94.68	91.87	123.68	72.57	44.62	27.87	69.14	73.52	55.21	101.03	41.46	80.14	166.21	48.31	203.93	158.94	101.87
Jan2	73.87	29.46	35.65	64.29	93.42	13.28	46.86	76.01	74.55	96.92	59.15	36.26	22.99	56.32	61.71	45.18	81.87	33.56	64.38	134.06	40.75	174.20	129.47	80.02
Jan3	60.38	26.32	32.06	57.86	83.32	12.36	42.02	67.48	66.39	85.82	52.74	32.76	21.01	50.79	57.27	40.72	71.95	30.17	57.36	118.56	37.68	154.03	132.26	68.41
Feb1	46.88	19.80	23.94	43.16	62.31	9.61	31.39	49.94	49.25	63.05	39.23	24.73	15.83	38.18	40.21	30.58	53.27	24.25	43.49	87.30	27.57	104.69	99.35	50.66
Feb2	37.83	16.74	20.09	36.19	51.85	8.35	26.27	41.41	40.92	51.98	32.70	20.95	13.44	32.50	33.43	25.75	43.57	18.97	35.01	71.95	23.35	84.94	79.80	42.24
Feb3	25.96	11.56	15.44	24.90	35.59	5.94	20.14	28.18	27.92	35.49	25.73	14.57	9.34	26.86	25.43	17.78	29.47	13.07	26.64	48.70	16.22	62.61	60.15	28.87
Mar1	28.23	12.59	14.85	26.98	38.49	6.65	19.25	30.24	30.04	38.74	23.78	15.94	10.26	25.76	24.09	19.38	31.48	14.19	25.23	51.96	17.69	72.96	56.46	31.54
Mar2	24.23	10.93	12.74	23.26	33.08	5.94	16.58	25.75	25.63	32.02	20.37	14.86	8.95	24.89	20.56	16.76	26.51	12.27	21.55	43.94	15.40	57.48	47.73	27.41
Mar3	22.79	10.45	12.15	22.08	31.54	5.86	15.74	24.37	24.12	29.81	19.26	16.93	8.61	24.05	19.37	16.01	26.51	11.67	20.30	40.96	15.03	52.63	44.38	27.01
Apr1	18.01	8.36	9.66	17.53	25.10	4.80	12.48	18.97	18.96	23.18	15.22	11.60	6.92	20.74	15.91	12.75	20.20	9.25	16.02	31.87	12.00	40.37	34.55	20.12
Apr2	16.36	7.46	8.57	15.63	22.17	4.38	11.08	16.61	16.65	20.36	13.43	10.26	6.22	16.50	13.77	11.40	17.39	8.25	14.08	28.48	10.59	35.19	32.49	17.59
Apr3	15.60	6.74	7.72	14.02	19.64	4.04	9.91	14.90	14.77	17.72	11.98	9.18	5.63	14.73	12.09	10.21	15.14	7.36	12.49	24.50	9.72	33.81	26.99	15.84
May1	18.28	12.93	12.37	10.77	28.64	4.00	25.61	34.30	13.31	9.63	13.11	28.22	5.94	18.11	10.43	11.29	11.96	12.23	20.19	22.41	16.71	47.25	23.43	17.60
May2	21.42	11.70	26.57	18.03	20.81	9.80	23.20	18.99	43.41	8.54	11.99	18.16	15.32	13.14	10.73	10.49	22.25	16.42	70.07	26.49	13.67	38.28	45.88	44.37
May3	16.97	16.07	61.45	30.79	17.11	6.84	41.00	18.68	32.64	13.56	10.39	34.36	62.71	14.38	12.24	17.59	28.15	22.24	30.61	52.70	15.96	74.56	42.76	20.71
Jun1	10.71	28.45	32.61	13.23	23.74	4.98	56.41	14.03	13.52	20.40	11.24	31.95	21.18	23.54	14.73	10.86	15.73	26.27	23.92	28.77	8.77	48.87	63.59	24.89
Jun2	16.05	26.47	40.48	29.13	44.68	8.92	103.33	20.10	14.34	15.12	14.46	21.77	114.20	12.06	29.18	10.50	13.10	14.89	43.67	29.19	9.29	81.97	36.23	17.94
Jun3	12.13	60.08	59.83	31.14	20.51	13.66	20.26	12.87	14.36	8.53	8.27	20.36	79.46	9.87	15.18	14.18	30.86	18.07	24.23	16.05	15.41	49.51	41.29	15.18
Jul1	24.24	13.31	22.27	37.10	11.95	8.57	19.30	7.65	8.74	9.31	6.55	15.56	22.60	8.08	6.26	6.45	12.08	9.75	19.60	18.99	16.30	23.85	35.17	8.97
Jul2	20.50	11.09	18.17	50.34	11.28	7.24	15.49	7.27	8.04	9.05	6.96	13.44	19.34	7.54	5.82	5.69	10.07	8.31	16.08	18.31	13.36	22.65	29.82	8.35
Jul3	19.29	10.83	17.79	50.58	10.91	6.44	16.23	7.25	8.80	9.07	6.39	16.30	17.52	7.17	9.11	5.85	9.77	7.13	14.61	17.62	11.47	22.13	31.69	8.35
Aug1	13.39	8.51	13.15	36.48	9.17	12.94	11.35	6.13	8.22	7.29	5.17	12.99	13.93	6.20	7.83	4.65	7.91	5.61	11.58	13.37	13.81	17.22	24.45	9.18
Aug2	11.61	6.84	10.87	29.58	8.53	14.57	9.72	5.76	8.24	6.85	4.86	24.14	15.98	5.69	6.73	4.32	7.15	5.24	9.94	12.17	9.94	16.67	21.74	11.04
Aug3	11.60	6.38	10.86	25.77	9.99	11.09	9.24	5.92	7.63	7.49	5.03	25.04	11.27	5.88	7.98	4.49	7.48	13.94	9.61	12.29	10.78	17.25	37.88	10.96
Sep1	10.21	5.40	13.66	20.36	10.96	10.85	8.86	5.51	6.93	8.86	4.28	27.87	16.22	5.09	5.43	4.12	25.06	16.02	8.45	10.18	9.12	17.85	26.82	7.03
Sep2	19.02	4.87	18.37	18.54	8.74	13.10	6.83	11.41	5.62	41.01	4.64	84.56	33.50	5.26	8.77	4.51	42.89	45.94	13.50	9.72	17.86	24.54	26.40	7.18
Sep3	23.54	11.18	49.97	35.06	13.35	16.58	13.46	45.95	7.60	37.70	24.64	59.35	26.05	18.55	18.36	7.42	32.62	29.51	25.48	102.26	44.04	28.35	25.16	11.12
Oct1	21.13	17.06	238.52	36.54	12.38	81.94	20.70	129.37	188.02	26.29	122.04	59.90	158.22	62.90	41.45	196.24	38.26	249.39	24.96	70.80	77.38	67.41	41.76	11.23
Oct2	19.74	208.84	144.56	326.68	23.76	198.64	297.13	275.76	66.55	20.35	490.78	63.42	795.87	43.04	98.97	94.19	80.34	143.00	121.65	50.38	66.54	207.44	194.87	28.56
Oct3	79.19	179.36	458.52	748.26	37.29	430.16	159.55	117.91	336.83	19.54	190.79	51.17	332.79	466.15	861.17	261.86	252.25	389.02	529.50	71.82	400.08	473.71	154.32	380.44
Nov1	235.63	68.20	618.15	635.50	71.47	291.38	454.94	258.42	194.48	310.23	259.28	40.73	195.97	160.69	246.87	78.76	75.36	371.11	468.52	426.04	184.97	842.82	72.06	171.65
Nov2	103.89	235.80	558.07	552.04	43.07	435.01	154.19	317.89	154.20	546.31	185.88	94.47	596.18	133.34	199.97	57.53	71.68	257.74	712.40	102.68	731.92	239.15	583.65	197.23
Nov3	60.33	124.34	215.08	251.04	35.11	149.33	341.49	495.93	125.60	397.80	106.74	74.34	218.52	352.51	130.63	283.71	110.27	153.76	535.03	81.15	797.09	286.76	262.97	80.30
Dec1	64.85	108.46	150.73	382.78	28.20	104.81	347.96	344.11	790.19	147.17	80.52	60.27	136.62	139.60	97.76	377.39	106.42	125.89	658.63	110.70	494.67	887.20	231.69	64.26
Dec2	52.48	69.61	130.64	239.44	24.08	90.12	142.51	143.12	178.22	114.89	70.91	47.22	108.19	204.28	75.77	367.04	82.19	111.25	330.47	81.88	546.58	453.22	165.94	117.99
Dec3	62.80	59.69	114.18	159.64	20.86	80.71	147.07	150.97	193.70	100.24	61.08	39.70	99.14	101.42	79.78	145.80	72.55	179.44	321.87	65.76	244.77	226.25	217.04	105.87



**Table E.1 (4) 10-Days Natural Runoff Series in Nui Mot in Runoff Volume (Catchment area : 180 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	7.09	3.29	3.71	4.38	9.20	1.76	5.50	7.46	7.78	8.04	6.05	4.98	3.29	6.32	4.72	3.57	8.37	3.41	5.91	11.64	3.24	11.59	10.48	6.87
Jan2	5.37	2.67	3.02	3.51	7.49	1.56	3.93	6.04	6.31	6.37	4.92	3.79	2.70	4.84	3.82	2.91	6.87	2.76	4.67	9.39	2.70	9.88	8.42	5.37
Jan3	4.48	2.41	2.70	3.15	6.67	1.40	3.51	5.45	5.60	5.66	4.38	3.49	2.45	4.33	3.42	2.64	5.94	2.50	4.46	8.31	2.49	8.48	8.25	4.68
Feb1	3.73	1.81	2.02	2.42	4.97	1.03	2.60	4.01	4.14	4.15	3.23	2.59	1.81	3.23	2.51	1.97	4.36	1.87	3.95	6.12	1.86	6.35	6.01	3.49
Feb2	3.01	1.54	1.68	2.00	4.13	0.89	2.17	3.27	3.44	3.42	2.70	2.19	1.52	2.70	2.11	1.66	3.60	1.57	2.97	5.06	1.56	5.17	4.84	2.91
Feb3	2.04	1.06	1.30	1.38	2.82	0.62	1.66	2.22	2.50	2.36	2.10	1.53	1.05	2.13	1.63	1.14	2.45	1.07	2.24	3.43	1.09	3.75	3.67	2.00
Mar1	2.19	1.16	1.24	1.51	3.04	0.69	1.57	2.39	2.55	2.73	1.94	1.71	1.14	2.09	1.56	1.24	2.59	1.18	2.11	3.66	1.18	3.86	3.45	2.16
Mar2	1.86	1.04	1.07	1.30	2.60	0.60	1.35	2.03	2.16	2.18	1.66	2.14	0.98	2.09	1.35	1.07	2.19	1.00	1.85	3.10	1.04	3.20	3.03	1.93
Mar3	1.75	0.97	1.00	1.24	2.45	0.59	1.27	1.92	2.03	2.03	1.56	3.05	0.93	1.93	1.28	1.01	2.06	0.96	1.67	2.89	0.99	2.97	2.75	2.32
Apr1	1.37	0.77	0.80	0.99	1.94	0.48	0.99	1.50	1.60	1.57	1.24	2.07	0.74	1.66	1.04	0.81	1.58	0.76	1.32	2.26	0.80	2.34	2.15	2.00
Apr2	1.20	0.69	0.71	0.89	1.71	0.43	0.89	1.33	1.39	1.37	1.08	1.77	0.69	1.35	0.91	0.73	1.37	0.67	1.34	2.08	0.71	1.99	2.12	1.60
Apr3	1.08	0.62	0.64	0.79	1.51	0.40	0.79	1.19	1.24	1.19	0.97	1.51	0.65	1.27	0.81	0.65	1.21	0.60	1.08	1.73	0.64	1.81	1.71	1.43
May1	1.18	1.18	1.01	0.60	2.17	0.34	2.06	4.97	1.10	0.65	1.05	3.13	0.63	1.53	0.71	0.73	0.96	0.98	1.65	1.59	1.10	2.19	1.48	1.55
May2	1.29	0.77	2.53	0.79	1.61	0.63	1.81	2.81	3.39	0.58	0.96	2.10	1.88	1.02	0.75	0.65	2.12	1.40	4.83	1.76	0.90	1.95	2.64	3.58
May3	0.94	0.71	7.72	0.85	1.35	0.53	2.77	3.25	2.15	0.92	0.82	3.27	3.84	1.15	0.82	1.45	1.74	1.41	1.52	2.28	1.13	3.68	2.35	1.58
Jun1	0.62	1.22	2.60	0.26	1.79	0.25	4.91	2.05	0.93	1.34	0.85	2.92	0.95	2.81	1.10	0.90	1.12	1.50	1.29	1.09	0.61	2.26	3.12	1.63
Jun2	0.86	1.29	3.94	0.35	2.50	0.31	9.21	2.79	1.04	0.95	1.11	2.06	8.03	1.42	2.00	0.89	0.98	0.80	1.93	1.19	0.65	3.27	1.87	1.35
Jun3	0.64	2.26	8.39	0.38	1.36	0.48	1.72	1.71	1.05	0.56	0.62	1.46	6.31	1.09	0.99	0.97	2.63	0.83	1.07	0.70	0.82	2.04	1.89	1.13
Jul1	2.04	0.52	2.80	0.56	0.79	0.36	1.51	1.00	0.64	0.60	0.53	1.11	1.76	0.83	0.43	0.45	1.28	0.35	0.86	0.87	0.65	0.99	1.59	0.68
Jul2	1.46	0.46	2.29	0.92	0.74	0.35	1.26	0.89	0.60	0.57	0.79	0.90	1.50	0.79	0.43	0.41	1.07	0.32	0.78	0.81	0.43	0.87	1.22	0.65
Jul3	1.34	0.48	2.08	0.70	0.76	0.30	1.17	0.84	0.69	0.57	0.77	0.86	1.83	0.73	0.64	0.38	0.98	0.29	0.73	0.85	0.42	0.87	1.51	0.62
Aug1	1.03	0.35	1.55	0.55	0.64	0.39	0.90	0.68	0.64	0.49	0.56	0.69	1.48	0.63	0.48	0.35	0.79	0.26	0.60	0.69	0.41	0.73	1.06	0.54
Aug2	0.89	0.35	1.27	0.51	0.60	0.48	0.75	0.60	0.62	0.43	0.52	1.06	1.52	0.52	0.49	0.29	0.69	0.26	0.52	0.67	0.35	0.70	0.93	0.52
Aug3	0.86	0.35	1.19	0.48	0.64	0.36	0.72	0.61	0.54	0.48	0.51	0.90	1.24	0.57	0.50	0.29	0.72	0.40	0.56	0.67	0.35	0.78	1.64	0.52
Sep1	0.72	0.26	1.05	0.41	0.63	0.29	0.60	0.53	0.43	0.41	0.43	0.67	1.10	0.47	0.35	0.26	0.79	0.40	0.47	0.60	0.30	0.63	1.12	0.43
Sep2	1.32	0.26	1.23	0.39	0.53	0.26	0.52	0.59	0.45	0.80	0.75	0.88	1.24	0.78	0.35	0.30	1.93	1.98	0.98	0.68	0.39	0.60	1.03	0.45
Sep3	2.40	0.41	1.83	1.79	0.60	1.31	0.95	2.12	0.84	0.60	1.75	1.11	0.96	3.63	0.37	0.85	3.28	4.86	3.58	5.80	0.96	0.68	0.90	0.42
Oct1	2.88	0.89	10.86	2.03	0.55	9.51	1.11	7.55	9.84	0.97	14.34	2.94	5.44	10.62	0.42	25.28	6.23	19.27	5.16	3.02	1.71	1.64	2.82	0.53
Oct2	2.63	17.42	6.43	24.54	3.35	13.31	18.24	17.81	4.10	0.96	56.86	9.31	54.35	6.99	2.19	8.62	5.86	9.62	27.85	2.59	2.89	5.67	24.19	1.13
Oct3	12.24	15.19	18.90	57.40	6.92	23.66	11.34	6.29	13.42	1.11	17.40	8.35	23.51	32.03	47.93	18.78	17.23	28.30	34.22	5.97	35.52	39.65	15.44	19.36
Nov1	28.40	5.51	31.22	47.67	8.63	22.75	44.35	16.57	11.87	37.57	37.00	8.06	13.22	17.92	12.48	7.01	7.66	17.00	28.68	30.35	19.19	51.28	7.16	10.92
Nov2	9.60	18.00	31.73	48.05	4.10	28.94	12.59	23.19	6.70	40.96	15.81	16.35	37.72	12.91	14.04	4.81	4.70	14.33	51.39	7.62	48.37	17.57	37.16	17.12
Nov3	6.16	9.60	12.26	21.48	4.29	10.13	27.79	44.48	9.63	31.22	11.92	10.74	11.16	10.78	9.94	24.55	3.90	10.63	37.93	6.00	50.41	26.30	21.26	5.76
Dec1	6.54	13.54	8.13	34.39	3.21	7.36	23.42	31.82	53.45	12.30	8.92	7.52	11.16	8.35	6.80	35.42	6.32	8.15	44.69	6.23	24.19	42.89	22.05	4.43
Dec2	5.20	6.30	6.52	17.55	2.72	7.49	10.80	13.05	11.85	9.81	7.28	6.15	8.23	9.47	5.05	27.58	5.88	6.12	17.93	5.38	43.52	34.50	11.81	8.78
Dec3	4.98	5.09	5.75	13.02	2.36	7.27	11.80	12.43	12.07	8.32	6.44	4.81	12.99	6.38	5.10	12.24	6.73	13.31	26.19	4.41	16.18	14.83	11.32	6.32

**Table E.1 (5) 10-Days Natural Runoff Series in Lavi River Basin in Runoff Volume (Catchment area : 110 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	5.01	2.33	2.12	2.67	6.00	1.38	3.74	3.90	4.38	4.00	3.93	3.18	0.41	3.77	2.26	2.34	4.28	2.17	3.01	4.54	2.33	7.20	5.79	3.02
Jan2	3.53	1.93	1.75	2.20	4.90	1.15	2.83	3.15	3.56	3.21	3.19	2.38	0.35	3.08	1.86	1.92	3.46	1.76	2.44	3.75	2.05	7.17	4.68	2.65
Jan3	3.11	1.75	1.56	1.98	4.35	1.05	2.51	2.85	3.18	2.85	2.82	2.13	0.36	2.76	1.68	1.75	3.08	1.58	2.17	3.40	1.81	5.61	4.73	2.23
Feb1	2.38	1.34	1.18	1.49	3.23	0.79	1.87	2.12	2.37	2.12	2.08	1.60	0.26	2.08	1.25	1.30	2.29	1.20	2.72	2.57	1.35	4.10	3.58	1.68
Feb2	1.93	1.13	0.99	1.26	2.70	0.67	1.57	1.76	1.96	1.75	1.73	1.37	0.26	1.75	1.06	1.10	1.88	0.98	2.08	2.18	1.13	3.43	2.89	1.41
Feb3	1.32	0.79	0.75	0.86	1.83	0.48	1.19	1.22	1.42	1.18	1.49	0.93	0.21	1.37	0.81	0.76	1.28	0.67	1.56	1.51	0.79	2.32	2.19	0.98
Mar1	1.42	0.88	0.73	0.95	1.98	0.52	1.15	1.30	1.46	1.28	1.30	1.05	0.21	1.38	0.79	0.82	1.38	0.73	1.45	1.65	0.86	2.43	2.06	1.06
Mar2	1.21	0.76	0.63	0.82	1.69	0.44	0.98	1.12	1.24	1.08	1.11	2.78	0.17	1.46	0.67	0.72	1.18	0.63	1.21	1.44	0.74	2.02	1.75	0.98
Mar3	1.15	0.74	0.60	0.79	1.61	0.43	0.92	1.06	1.18	1.02	1.04	3.56	0.19	1.44	0.65	0.68	1.12	0.59	1.12	1.38	0.71	1.87	1.62	1.34
Apr1	0.90	0.60	0.48	0.62	1.25	0.35	0.73	0.84	0.92	0.80	0.81	2.04	0.17	1.44	0.52	0.54	0.87	0.47	0.86	1.11	0.57	1.48	1.27	1.20
Apr2	0.79	0.53	0.43	0.57	1.11	0.33	0.65	0.74	0.81	0.70	0.71	1.68	0.44	1.11	0.45	0.50	0.76	0.43	0.89	1.00	0.52	1.26	1.11	0.95
Apr3	0.70	0.49	0.38	0.52	0.98	0.26	0.59	0.67	0.72	0.61	0.62	1.41	0.57	0.97	0.43	0.43	0.67	0.35	0.92	0.90	0.44	1.19	0.98	0.84
May1	1.17	0.89	0.63	0.38	1.42	0.26	1.65	1.49	0.65	0.34	0.68	2.82	0.54	1.13	0.35	0.49	0.54	0.63	1.34	0.82	0.78	1.41	0.86	0.93
May2	1.44	0.63	1.20	0.49	1.03	0.43	1.48	0.85	2.35	0.31	0.63	1.86	1.17	0.80	0.39	0.45	0.86	1.54	1.72	0.90	0.61	1.23	2.63	2.01
May3	1.20	0.56	1.17	0.51	0.85	0.37	2.63	0.94	1.55	0.50	0.51	2.62	8.23	0.86	0.83	1.16	0.72	1.44	0.56	1.18	0.86	2.48	2.64	0.94
Jun1	0.76	0.83	0.62	0.17	1.15	0.19	17.69	0.64	0.68	0.86	0.57	2.21	2.43	1.66	1.59	1.03	0.48	1.45	0.50	0.59	0.47	1.61	4.60	1.04
Jun2	0.93	0.84	0.96	0.23	1.60	0.23	24.11	1.04	0.70	0.58	0.69	1.53	50.04	0.84	2.62	0.91	0.46	0.77	0.69	0.69	0.46	2.32	2.22	0.78
Jun3	0.71	1.07	1.54	0.20	0.88	0.44	2.65	0.70	0.72	0.35	0.41	1.10	10.71	0.71	1.24	1.06	0.93	0.81	0.42	0.43	0.57	1.47	2.09	0.68
Jul1	1.29	0.29	0.65	0.36	0.52	0.37	2.27	0.42	0.43	0.35	0.35	0.59	3.14	0.69	0.52	0.48	0.35	0.28	0.36	0.52	0.33	0.71	1.74	0.38
Jul2	1.15	0.26	0.52	0.44	0.49	0.37	1.86	0.37	0.41	0.53	0.43	0.51	2.51	0.58	0.43	0.45	0.35	0.26	0.35	0.51	0.26	0.60	1.37	0.37
Jul3	1.30	0.29	0.48	0.38	0.48	0.29	1.68	0.38	0.38	0.49	0.91	0.54	2.21	0.54	0.41	0.42	0.35	0.28	0.29	0.67	0.29	0.60	1.53	0.38
Aug1	0.92	0.29	0.39	0.32	0.43	0.44	1.26	0.36	0.35	0.35	0.68	0.64	1.61	0.43	0.35	0.36	0.26	0.17	1.04	0.52	0.28	0.52	1.11	0.41
Aug2	0.79	0.26	0.37	0.26	0.40	0.77	1.05	0.26	0.34	0.35	0.58	4.58	1.32	0.39	0.28	0.29	0.26	0.17	1.09	0.44	0.31	0.43	0.97	0.60
Aug3	1.16	0.20	0.44	0.29	0.38	0.75	0.96	0.29	0.30	0.37	0.54	2.36	1.29	0.38	0.33	0.29	0.29	0.25	3.03	0.48	0.29	0.48	2.31	0.86
Sep1	0.98	0.21	0.43	0.26	0.73	0.56	0.77	0.29	0.26	0.27	0.43	1.71	1.10	0.57	0.26	0.35	0.47	0.20	2.26	0.41	0.26	0.38	1.54	0.65
Sep2	1.26	0.17	1.10	0.22	0.77	0.54	0.64	0.48	0.26	0.50	0.48	1.37	1.34	0.59	0.26	0.71	1.29	0.75	11.34	0.41	0.51	0.36	1.44	0.58
Sep3	3.46	0.28	0.84	1.00	0.69	0.73	0.62	2.32	0.35	0.37	1.27	1.12	1.04	0.96	0.35	1.44	1.59	0.64	17.57	4.41	1.31	0.35	1.18	0.54
Oct1	3.72	1.01	10.49	0.98	0.83	8.09	0.62	5.63	6.04	0.42	9.56	1.18	8.04	1.85	0.62	18.36	3.82	8.51	19.73	2.27	2.47	0.64	2.93	1.24
Oct2	2.89	12.22	9.18	12.44	1.90	12.09	13.91	14.29	2.52	0.44	28.91	1.34	39.59	2.19	3.77	5.80	2.41	4.36	51.94	1.77	2.45	3.46	13.03	2.31
Oct3	25.03	9.70	19.22	34.21	1.95	19.09	8.09	5.40	14.63	0.48	12.23	1.53	10.67	16.77	33.25	12.65	6.02	15.80	26.64	5.52	18.99	24.97	11.50	30.00
Nov1	17.84	3.77	18.63	38.07	3.84	17.11	25.28	10.32	7.09	14.82	15.47	1.09	6.60	5.22	9.00	5.37	4.33	11.24	19.22	22.15	10.14	34.62	4.68	7.54
Nov2	7.29	5.93	15.11	30.04	2.13	24.01	8.54	15.21	4.83	28.35	8.05	0.90	19.49	4.88	7.81	3.93	2.54	7.81	11.06	5.50	26.52	10.63	11.41	12.99
Nov3	5.30	5.80	7.42	21.63	3.96	7.72	10.12	23.86	4.80	17.53	5.98	0.76	7.29	3.97	6.53	12.53	2.43	6.34	19.84	4.30	33.30	15.82	8.61	5.53
Dec1	4.51	6.67	5.10	18.27	2.67	5.76	10.46	16.15	22.55	7.14	4.69	0.65	6.64	3.52	4.78	12.39	2.66	4.69	8.70	4.40	13.94	22.07	6.58	4.29
Dec2	3.54	3.34	4.25	11.21	2.20	5.38	5.64	7.34	6.24	6.45	3.98	0.54	5.87	4.28	3.62	13.54	2.66	3.42	6.99	3.80	23.47	16.27	4.35	4.48
Dec3	3.14	2.92	3.65	8.36	1.87	4.85	5.74	6.48	5.88	5.46	3.65	0.51	6.20	3.12	3.21	6.29	3.65	4.98	6.19	3.16	9.63	8.07	3.64	4.02

ET-5

**Table E.1 (6) 10-Days Natural Runoff Series in North Mountain Area in Runoff Volume (Catchment area : 130 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	5.93	2.75	2.52	3.15	7.09	1.63	4.42	4.61	5.20	4.73	4.64	3.75	0.48	4.46	2.68	2.76	5.04	2.57	3.55	5.37	2.75	8.50	6.84	3.57
Jan2	4.20	2.29	2.07	2.59	5.78	1.36	3.33	3.72	4.19	3.78	3.76	2.82	0.43	3.63	2.20	2.28	4.10	2.08	2.87	4.45	2.43	8.48	5.53	3.12
Jan3	3.69	2.07	1.85	2.33	5.14	1.24	2.98	3.38	3.77	3.37	3.34	2.54	0.40	3.27	1.98	2.06	3.63	1.87	2.56	4.01	2.13	6.63	5.60	2.64
Feb1	2.82	1.58	1.39	1.76	3.82	0.93	2.21	2.49	2.79	2.49	2.46	1.90	0.35	2.46	1.49	1.54	2.71	1.41	3.23	3.04	1.58	4.84	4.23	1.99
Feb2	2.29	1.35	1.18	1.49	3.18	0.80	1.86	2.08	2.33	2.06	2.05	1.60	0.29	2.06	1.25	1.30	2.23	1.17	2.47	2.57	1.34	4.03	3.41	1.66
Feb3	1.56	0.94	0.90	1.03	2.18	0.55	1.42	1.43	1.67	1.41	1.75	1.11	0.21	1.63	0.97	0.89	1.52	0.79	1.85	1.78	0.92	2.76	2.58	1.16
Mar1	1.68	1.04	0.86	1.11	2.34	0.60	1.37	1.55	1.73	1.51	1.56	1.23	0.26	1.65	0.92	0.98	1.63	0.86	1.72	1.95	1.00	2.87	2.42	1.26
Mar2	1.45	0.91	0.74	0.98	2.00	0.53	1.17	1.32	1.47	1.29	1.30	3.28	0.26	1.71	0.80	0.84	1.38	0.73	1.43	1.71	0.88	2.39	2.06	1.15
Mar3	1.37	0.88	0.72	0.92	1.88	0.51	1.10	1.26	1.39	1.20	1.22	4.20	0.23	1.72	0.77	0.81	1.33	0.70	1.32	1.63	0.84	2.22	1.93	1.58
Apr1	1.08	0.70	0.57	0.74	1.49	0.43	0.88	0.99	1.09	0.94	0.96	2.40	0.17	1.71	0.60	0.65	1.02	0.55	1.02	1.31	0.67	1.75	1.50	1.43
Apr2	0.94	0.63	0.52	0.68	1.30	0.35	0.77	0.88	0.96	0.83	0.83	2.00	0.52	1.31	0.54	0.59	0.90	0.49	1.06	1.18	0.60	1.49	1.30	1.11
Apr3	0.84	0.59	0.44	0.61	1.17	0.35	0.69	0.79	0.85	0.73	0.73	1.66	0.68	1.14	0.49	0.52	0.79	0.43	1.08	1.06	0.53	1.43	1.16	0.99
May1	1.38	1.05	0.75	0.45	1.68	0.31	1.95	1.76	0.76	0.40	0.80	3.34	0.64	1.34	0.41	0.57	0.64	0.75	1.58	0.97	0.92	1.66	1.01	1.10
May2	1.70	0.75	1.42	0.58	1.22	0.51	1.75	1.00	2.78	0.37	0.74	2.19	1.38	0.95	0.46	0.53	1.01	1.82	2.04	1.07	0.72	1.46	3.11	2.37
May3	1.42	0.66	1.38	0.60	1.00	0.43	3.11	1.11	1.84	0.59	0.61	3.10	9.73	1.02	0.99	1.37	0.85	1.70	0.66	1.40	1.02	2.93	3.12	1.12
Jun1	0.90	0.98	0.73	0.20	1.35	0.23	20.91	0.76	0.81	1.02	0.67	2.61	2.87	1.96	1.88	1.22	0.56	1.71	0.59	0.70	0.56	1.91	5.44	1.23
Jun2	1.10	1.00	1.14	0.27	1.90	0.27	28.49	1.23	0.82	0.68	0.81	1.80	59.14	0.99	3.09	1.08	0.54	0.91	0.81	0.82	0.55	2.74	2.62	0.93
Jun3	0.84	1.26	1.82	0.24	1.04	0.52	3.13	0.82	0.85	0.41	0.49	1.30	12.66	0.84	1.46	1.25	1.10	0.96	0.49	0.51	0.68	1.74	2.47	0.80
Jul1	1.52	0.35	0.76	0.45	0.60	0.45	2.68	0.49	0.52	0.43	0.35	0.67	3.70	0.81	0.61	0.58	0.43	0.35	0.44	0.60	0.40	0.83	2.05	0.44
Jul2	1.36	0.35	0.61	0.53	0.58	0.42	2.20	0.45	0.46	0.61	0.51	0.61	2.96	0.67	0.52	0.54	0.40	0.29	0.36	0.61	0.35	0.72	1.62	0.46
Jul3	1.53	0.35	0.58	0.47	0.57	0.38	2.00	0.47	0.48	0.58	1.08	0.63	2.61	0.63	0.48	0.49	0.38	0.29	0.38	0.80	0.30	0.71	1.81	0.41
Aug1	1.10	0.31	0.47	0.35	0.52	0.52	1.49	0.41	0.40	0.43	0.81	0.78	1.90	0.52	0.40	0.42	0.35	0.26	1.24	0.60	0.32	0.60	1.31	0.45
Aug2	0.95	0.28	0.43	0.35	0.44	0.92	1.23	0.35	0.35	0.41	0.69	5.42	1.56	0.45	0.35	0.35	0.35	0.24	1.28	0.53	0.36	0.52	1.12	0.70
Aug3	1.39	0.29	0.50	0.32	0.48	0.88	1.14	0.38	0.38	0.44	0.64	2.80	1.52	0.48	0.41	0.36	0.35	0.29	3.57	0.57	0.35	0.57	2.70	0.99
Sep1	1.18	0.26	0.52	0.26	0.86	0.66	0.91	0.36	0.35	0.35	0.51	2.00	1.30	0.67	0.28	0.37	0.54	0.27	2.65	0.44	0.29	0.43	1.81	0.77
Sep2	1.49	0.26	1.31	0.28	0.91	0.64	0.74	0.58	0.27	0.58	0.56	1.62	1.57	0.72	0.29	0.85	1.56	0.89	13.37	0.48	0.59	0.43	1.71	0.68
Sep3	4.10	0.32	0.99	1.18	0.81	0.86	0.74	2.75	0.37	0.42	1.49	1.33	1.24	1.14	0.41	1.69	1.87	0.75	20.77	5.20	1.55	0.44	1.38	0.63
Oct1	4.39	1.19	12.41	1.16	0.99	9.56	0.73	6.66	7.14	0.51	11.30	1.39	9.52	2.17	0.73	21.70	4.52	10.05	23.34	2.68	2.91	0.74	3.46	1.47
Oct2	3.42	14.44	10.85	14.72	2.24	14.27	16.43	16.89	2.99	0.52	34.17	1.59	46.79	2.57	4.46	6.87	2.83	5.14	61.38	2.10	2.89	4.08	15.39	2.71
Oct3	29.59	11.50	22.71	40.44	2.30	22.56	9.57	6.39	17.29	0.57	14.45	1.81	12.59	19.81	39.27	14.93	7.12	18.68	31.48	6.53	22.44	29.48	13.60	35.44
Nov1	21.07	4.43	22.00	45.01	4.54	20.20	29.89	12.18	8.38	17.52	18.27	1.28	7.78	6.19	10.64	6.33	5.11	13.28	22.69	26.18	11.98	40.93	5.56	8.94
Nov2	8.61	7.01	17.84	35.50	2.52	28.37	10.10	17.99	5.73	33.51	9.52	1.06	23.04	5.75	9.24	4.61	3.02	9.24	13.08	6.51	31.35	12.56	13.49	15.36
Nov3	6.25	6.85	8.79	25.57	4.67	9.11	11.93	28.21	5.69	20.70	7.06	0.91	8.61	4.67	7.72	14.80	2.85	7.50	23.47	5.08	39.35	18.72	10.17	6.55
Dec1	5.35	7.90	6.04	21.59	3.15	6.81	12.36	19.09	26.65	8.42	5.55	0.77	7.86	4.17	5.66	14.63	3.14	5.56	10.26	5.19	16.48	26.07	7.78	5.06
Dec2	4.20	3.94	5.00	13.23	2.61	6.36	6.67	8.65	7.37	7.61	4.73	0.65	6.95	5.08	4.29	16.00	3.15	4.07	8.25	4.48	27.73	19.24	5.14	5.28
Dec3	3.74	3.44	4.31	9.88	2.21	5.74	6.77	7.66	6.96	6.44	4.30	0.60	7.34	3.66	3.78	7.45	4.33	5.88	7.31	3.74	11.40	9.53	4.29	4.77

**Table E.1 (7) 10-Days Natural Runoff Series in Ha Thanh River Basin in Runoff Volume (Catchment area : 590 km2)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	20.98	12.67	13.30	14.26	30.86	6.48	18.75	25.25	27.10	27.71	20.84	17.06	14.32	23.61	17.25	11.93	30.84	12.15	20.89	43.69	11.23	39.12	36.71	24.51
Jan2	17.36	9.45	10.81	11.35	25.43	5.81	12.87	20.72	21.95	21.99	17.09	13.42	11.75	17.57	14.63	9.75	25.32	9.91	16.68	35.17	9.27	32.26	29.48	19.42
Jan3	13.90	8.49	9.69	10.26	22.40	5.19	11.64	18.71	19.50	19.61	15.02	12.58	10.65	15.83	13.44	8.80	21.77	8.90	16.73	31.10	8.61	27.79	29.47	16.94
Feb1	12.63	6.37	7.22	8.01	16.61	3.84	8.54	13.80	14.42	14.32	11.15	9.18	7.79	11.66	9.46	6.60	16.03	6.67	14.12	22.83	6.49	21.01	21.12	12.58
Feb2	10.29	5.41	6.01	6.52	13.82	3.28	7.06	11.18	11.95	11.81	9.27	7.75	6.55	9.71	7.92	5.57	13.19	5.59	10.51	18.80	5.40	17.12	16.99	10.48
Feb3	6.97	3.71	4.59	4.53	9.45	2.31	5.39	7.60	8.99	8.19	7.07	5.39	4.47	7.38	6.10	3.84	8.91	3.84	7.90	12.71	3.78	12.69	12.83	7.17
Mar1	7.44	4.02	4.40	4.92	10.20	2.54	5.09	8.13	9.04	9.97	6.70	6.09	4.86	7.39	5.83	4.22	9.51	4.29	7.41	13.53	4.15	12.81	12.04	7.74
Mar2	6.30	3.72	3.78	4.26	8.69	2.23	4.35	6.89	7.67	7.83	5.75	7.03	4.19	7.16	5.03	3.60	8.01	3.59	6.71	11.43	3.60	10.74	10.81	6.80
Mar3	5.89	3.35	3.59	4.07	8.20	2.18	4.10	6.46	7.17	7.27	5.42	9.06	3.96	6.52	4.79	3.45	7.53	3.40	5.99	10.63	3.49	9.97	9.75	8.05
Apr1	4.58	2.67	2.83	3.25	6.46	1.75	3.24	5.09	5.61	5.64	4.27	6.30	3.13	5.68	3.92	2.73	5.80	2.71	4.80	8.26	2.80	7.93	7.62	7.17
Apr2	4.00	2.38	2.49	2.89	5.69	1.59	2.84	4.46	4.91	4.87	3.76	5.40	2.80	4.60	3.43	2.44	5.04	2.40	4.89	7.67	2.50	6.72	7.44	5.92
Apr3	3.56	2.16	2.26	2.60	5.05	1.43	2.52	4.07	4.33	4.27	3.34	4.67	2.59	4.74	3.02	2.18	4.42	2.15	4.00	6.36	2.25	6.09	6.01	5.30
May1	3.75	3.95	3.55	1.99	7.27	1.31	6.28	22.75	3.88	2.30	3.65	9.64	2.64	6.02	2.66	2.41	3.54	3.55	6.24	5.77	3.77	7.28	5.22	5.73
May2	4.31	2.60	9.79	2.53	5.31	2.21	5.85	14.90	11.69	2.04	3.34	6.59	7.70	3.85	2.77	2.23	8.13	4.86	19.42	6.14	3.59	6.52	8.48	12.37
May3	3.04	2.42	32.66	2.98	4.72	1.87	7.66	16.67	7.39	3.23	2.89	10.63	9.22	4.34	3.04	4.16	6.82	4.61	6.41	7.69	4.96	11.41	7.30	5.71
Jun1	2.05	4.34	9.69	0.86	6.23	1.01	9.66	10.50	3.28	4.61	2.98	10.51	2.95	11.45	3.91	2.47	4.39	5.01	5.36	3.84	2.63	6.75	9.47	5.87
Jun2	2.72	4.78	15.50	1.27	8.55	1.15	12.90	13.75	3.62	3.34	4.02	8.02	14.17	5.97	7.52	2.59	3.81	2.91	8.31	4.20	2.56	9.43	6.34	4.81
Jun3	2.14	8.89	36.61	1.63	4.60	1.47	2.62	8.25	3.63	1.95	2.23	5.57	9.84	4.50	3.69	2.86	9.97	3.01	4.64	2.53	3.26	6.16	6.24	4.06
Jul1	7.49	2.16	11.49	2.31	2.70	1.15	2.46	4.63	2.25	2.13	1.93	3.76	2.89	3.30	1.65	1.26	5.01	1.17	3.69	3.14	3.00	3.02	5.06	2.41
Jul2	5.33	1.87	9.29	3.59	2.51	1.05	2.09	4.10	2.06	1.96	2.68	3.18	2.61	3.07	1.54	1.18	4.23	1.09	3.33	2.89	2.04	2.70	4.01	2.35
Jul3	4.86	1.80	8.45	2.90	2.57	1.02	2.03	3.74	2.45	2.00	2.28	3.14	4.50	2.82	2.37	1.18	3.89	1.12	3.03	2.97	1.94	2.75	4.70	2.28
Aug1	3.69	1.44	6.18	2.29	2.18	1.11	1.62	2.99	2.72	1.68	1.83	2.39	3.97	2.36	1.93	1.00	3.02	0.95	2.42	2.50	1.72	2.32	3.50	2.00
Aug2	3.16	1.28	5.08	1.94	2.03	1.21	1.43	2.62	2.37	1.57	1.75	2.30	4.67	2.05	2.10	0.95	2.66	0.88	2.13	2.34	1.42	2.24	3.10	1.78
Aug3	3.00	1.27	4.73	1.87	2.13	0.96	1.43	2.57	2.02	1.62	1.73	2.23	4.24	2.09	2.29	0.98	2.86	1.16	2.08	2.41	1.42	2.70	4.50	1.81
Sep1	2.45	1.05	4.00	1.50	2.22	0.86	1.23	2.16	1.62	1.38	1.41	1.87	3.91	1.68	1.57	0.85	2.71	1.69	1.94	2.04	1.29	2.17	3.09	1.56
Sep2	4.48	0.95	4.30	1.55	1.79	0.71	1.07	2.36	1.66	2.93	2.68	2.67	3.89	3.62	1.44	0.96	5.69	7.86	2.06	2.91	1.40	1.89	2.72	1.59
Sep3	7.15	1.42	7.73	6.04	2.11	5.74	2.51	8.43	3.55	2.24	5.88	4.26	3.01	14.28	1.43	3.34	12.44	28.76	6.01	25.12	3.10	2.35	2.64	1.57
Oct1	10.26	2.57	35.74	7.32	1.94	28.09	2.68	24.68	41.33	3.66	53.20	17.01	14.45	47.34	1.71	105.08	23.13	64.41	7.46	11.50	6.35	6.33	11.16	1.67
Oct2	9.24	57.86	16.25	81.92	14.79	36.75	56.38	53.09	15.22	4.47	208.97	44.25	173.08	26.85	9.68	39.15	20.41	34.85	42.83	11.58	13.44	21.15	84.40	4.22
Oct3	24.03	54.16	46.16	185.08	31.67	64.51	35.42	19.09	40.92	5.26	56.30	35.68	89.87	111.80	157.50	62.48	59.43	90.41	99.88	26.98	130.40	130.88	50.49	45.43
Nov1	94.09	19.02	86.55	147.24	33.83	69.89	143.54	49.57	42.22	152.21	129.76	39.85	45.81	76.01	40.01	25.94	28.79	54.68	97.84	102.41	71.11	154.33	24.03	34.55
Nov2	35.29	72.72	104.67	166.43	15.97	85.50	39.78	79.82	23.09	132.54	55.72	75.72	119.10	49.46	50.10	18.01	17.06	47.57	199.49	25.81	170.48	54.49	138.90	53.61
Nov3	20.41	31.92	39.80	62.70	14.10	31.10	101.27	146.53	37.97	106.70	42.47	48.52	38.57	40.23	31.80	90.94	13.21	36.89	133.82	20.40	161.69	88.30	73.11	17.52
Dec1	23.15	52.47	25.83	108.52	11.81	22.34	79.97	117.77	188.14	42.95	31.62	32.15	40.56	31.08	22.23	138.80	22.46	28.60	170.22	21.35	83.28	143.61	81.80	13.50
Dec2	18.85	24.27	20.74	60.13	10.01	23.72	35.88	46.67	40.95	33.00	25.83	28.17	28.52	33.50	16.55	98.81	22.78	21.64	68.62	18.94	146.99	130.18	45.77	29.79
Dec3	18.46	18.39	18.28	43.93	8.71	23.91	40.38	44.10	41.30	28.56	22.63	21.98	52.12	23.07	16.95	45.96	23.91	50.73	109.68	15.26	54.59	52.03	42.02	19.75

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**Table E.1 (8) 10-Days Natural Runoff Series in Delta in Runoff Volume (Catchment area : 380 km2)**

(Million m3)

	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	
Jan1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	0.00	
Jan2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	0.00
Jan3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01	0.00
Feb1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.59	0.00
May2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.59	0.00
May3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.85	0.00
Jun1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00
Aug2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00
Aug3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00
Sep1	10.01	43.81	2.44	0.00	2.81	0.00	0.00	2.10	0.00	16.92	0.00	0.00	2.08	0.00	0.00	10.50	0.00	10.67	2.50	9.73	48.75	19.96	2.00	0.00	0.00	0.00	0.00
Sep2	10.01	43.81	2.44	0.00	2.81	0.00	0.00	2.10	0.00	16.92	0.00	0.00	2.08	0.00	0.00	10.50	0.00	10.67	2.50	9.73	48.75	19.96	2.00	0.00	0.00	0.00	0.00
Sep3	10.01	43.81	2.44	0.00	2.81	0.00	0.00	2.10	0.00	16.92	0.00	0.00	2.08	0.00	0.00	10.50	0.00	10.67	2.50	9.73	48.75	19.96	2.00	0.00	0.00	0.00	0.00
Oct1	37.90	25.66	43.05	43.95	70.46	102.75	19.48	68.23	43.64	36.44	54.71	8.25	91.71	6.91	104.23	57.58	87.73	80.08	28.81	50.59	102.85	31.70	58.89	67.87	53.53	60.93	
Oct2	37.90	25.66	43.05	43.95	70.46	102.75	19.48	68.23	43.64	36.44	54.71	8.25	91.71	6.91	104.23	57.58	87.73	80.08	28.81	50.59	102.85	31.70	58.89	67.87	53.53	60.93	
Oct3	41.69	28.22	47.36	48.34	77.51	113.02	21.43	75.05	48.00	40.09	60.18	9.07	100.89	7.60	114.65	63.33	96.50	88.09	31.69	55.65	113.13	34.87	64.78	74.66	58.88	67.03	
Nov1	41.84	44.54	22.19	22.86	41.69	107.68	11.78	42.93	77.38	84.90	7.49	125.03	22.46	5.79	31.74	21.86	11.97	31.39	0.51	25.09	67.34	25.21	124.26	71.96	30.97	15.78	
Nov2	41.84	44.54	22.19	22.86	41.69	107.68	11.78	42.93	77.38	84.90	7.49	125.03	22.46	5.79	31.74	21.86	11.97	31.39	0.51	25.09	67.34	25.21	124.26	71.96	30.97	15.78	
Nov3	41.84	44.54	22.19	22.86	41.69	107.68	11.78	42.93	77.38	84.90	7.49	125.03	22.46	5.79	31.74	21.86	11.97	31.39	0.51	25.09	67.34	25.21	124.26	71.96	30.97	15.78	
Dec1	0.40	0.00	0.00	3.49	0.00	15.84	0.00	4.19	2.18	16.44	41.58	0.00	0.00	0.00	12.70	1.75	0.00	36.23	16.24	2.93	8.84	2.68	34.98	56.41	8.07	2.37	
Dec2	0.40	0.00	0.00	3.49	0.00	15.84	0.00	4.19	2.18	16.44	41.58	0.00	0.00	0.00	12.70	1.75	0.00	36.23	16.24	2.93	8.84	2.68	34.98	56.41	8.07	2.37	
Dec3	0.44	0.00	0.00	3.84	0.00	17.42	0.00	4.61	2.40	18.08	45.74	0.00	0.00	0.00	13.97	1.93	0.00	39.86	17.87	3.22	9.72	2.95	38.48	62.05	8.87	2.60	

ET-8

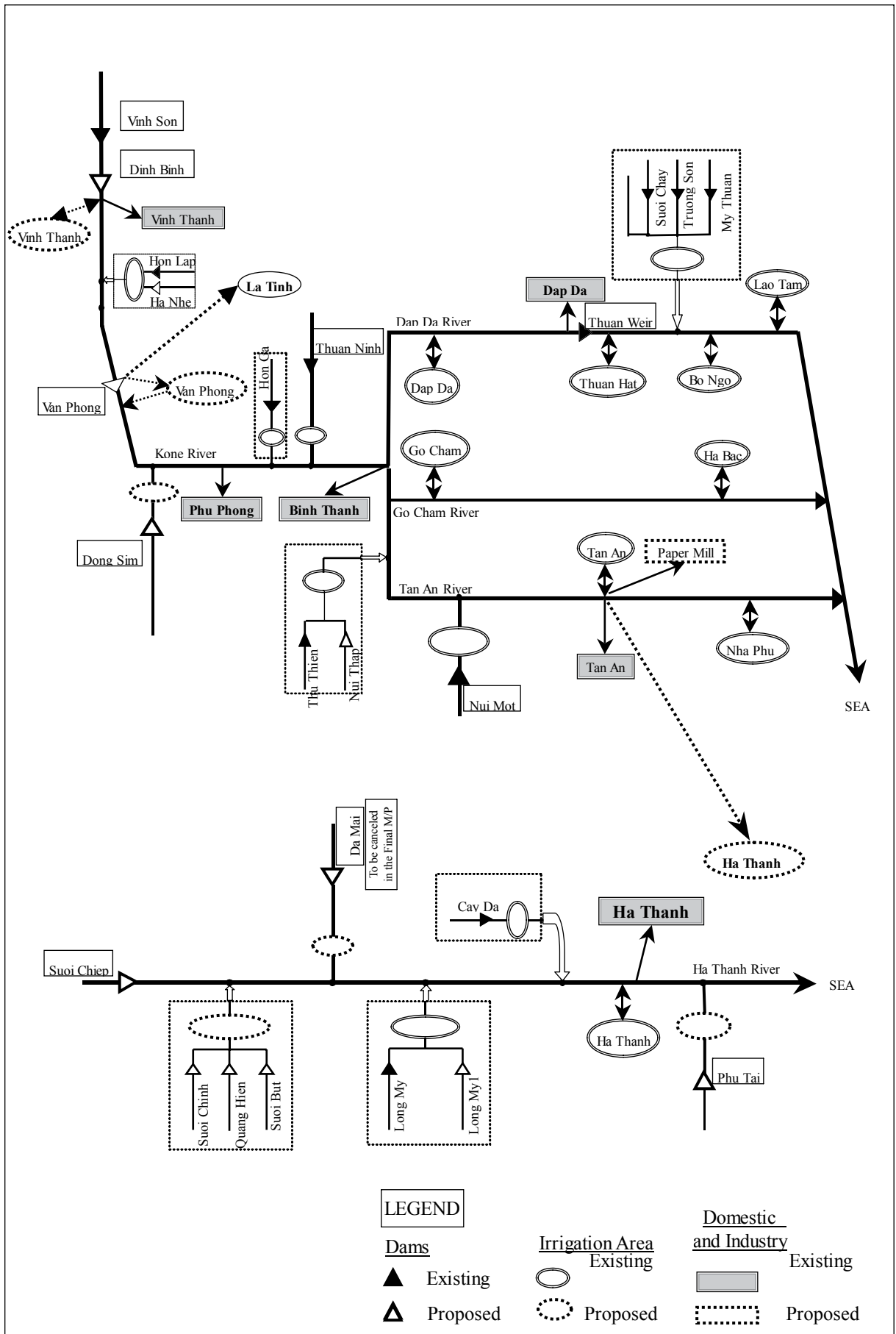
**Table E.2 Existing and Proposed Reservoirs Considered in the Water Balance Analysis**

River	Reservoir	Catchment Area(km <sup>2</sup> )	Effective Storage Volume Available(MCM)		
			Present	2010	2020
<b>Kone</b>	Vinh Son 1&2	214.0	102.0	102.0	102.0
	Vinh Son 3	72.0		30.0	30.0
	Dinh Binh	826.0			209.9
	Hon Lap	30.4	2.00	2.00	3.96
	Dong Sim	35.0			11.5
	Hon Ga	6.0	1.8	1.8	1.8
	Thuan Ninh	78.5	32.3	32.3	32.3
	Thu Thien/Nui Thap	12.0	1.25	1.25	3.4
	Suoi Chai/Truong Son/My Thuan	32.3	6.24	6.24	6.24
	Nui Mot	110.0	108.5	108.5	108.5
<b>Ha Thanh</b>	Suoi Chiep	23.0			8.0
	Suoi Chinh/Quang Hien/Suoi But	33.0		2.5	8.1
	Long My/Long My1	15.3	2.88	2.88	5.69
	Cay Da	1.1	0.95	0.95	0.95
	Phu Tai	30.2		10.7	10.7

**Table E.3 Existing and Proposed Irrigation Area Considered in the Water Balance Analysis**

River	Irrigation System	Irrigation Area (ha)		
		Present	2010	2020
<b>Kone</b>	Hon Lap	210	282	430
	Vinh Thanh		328	1,340
	Van Phong			14,340
	Hon Ga	120	150	150
	Thuan Ninh	1,060	2,700	2,700
	Dong Sim		1,060	1,060
	Dap Da	3,301	4,273	7,676
	Thuan Hat	989	989	58
	Bo Ngo	866	866	
	Lao Tham	1,087	1,087	986
	Suoi Chay/Truong Son/My Thuan	936	936	936
	Go Cham	3,566	5,706	5,860
	Ha Bac	300	300	300
	Thu Tien/Nui Thap	120	342	342
	Nui Mot	2,920	2,920	3,000
	Tan An	4,215	4,215	4,716
	Nha Phu	563	563	
	Ha Thanh			2,039
<b>Ha Thanh</b>	Suoi Chinh/Quang Hien/Suoi But		322	679
	Da Mai		0 (700)	0 (700)
	Long My/Long My1	110	110	110 (330)
	Cay Da	80	96	96
	Ha Thanh	990	1,223	718 (1,480)
	Phu Thai		643	643
<b>La Tinh</b>	Cay Gai	-	-	5,014
	Cay Ke	-	-	1,280

Remarks: Water demand at the present water intake location are shown in the table in terms of irrigation area.

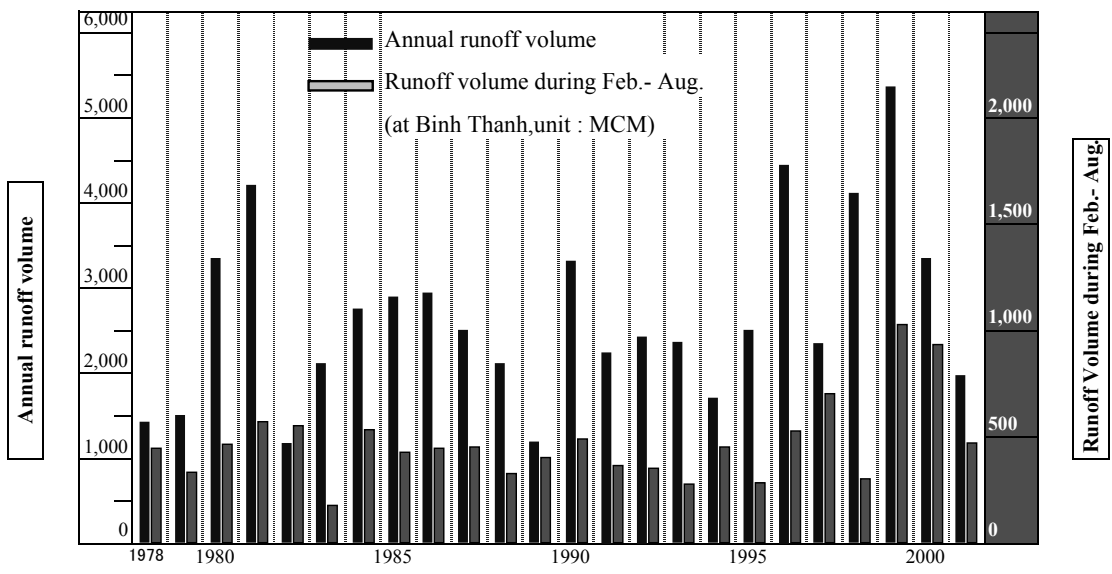
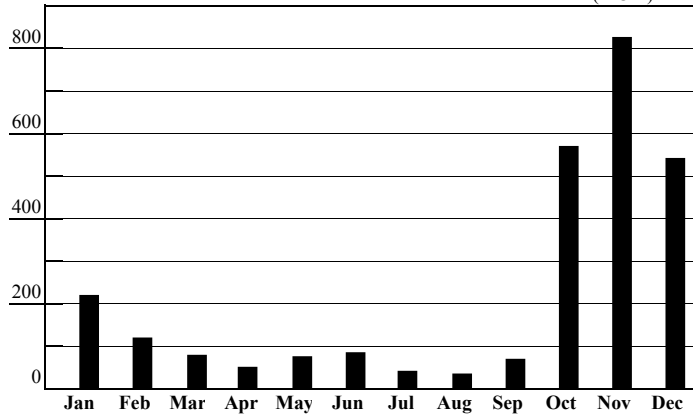


**Figure E-1**  
**Schematic Model of Water Balance Analysis**

### Monthly Runoff Volume (24 years average)

(Binh Thanh)

(MCM)



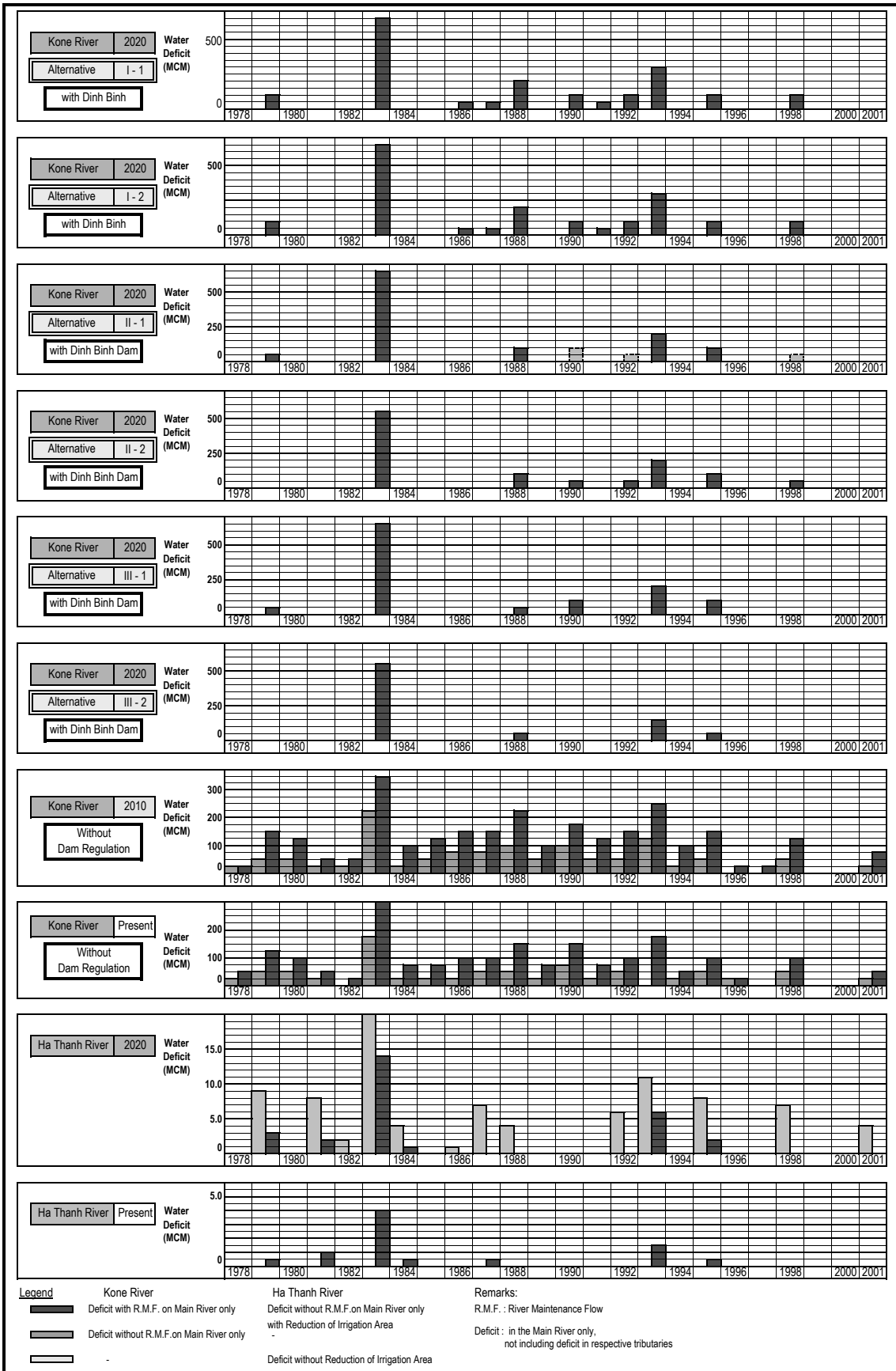
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Figure E.2

Characteristics of Natural Runoff





## ANNEX

# WATER BALANCE STUDY INCORPORATING RELEASED WATER FROM AN KHE HYDROPOWER

## 1 Water Balance Analysis

### 1.1 Objectives of the Study

The water balance analysis is made to evaluate water balance of the future conditions of the target year 2020 and year 2010 when the released water from the Ba River basin is available through the An Khe Hydropower scheme.

Proposed Dinh Binh Reservoir is studied of its necessary development scale to meet future water supply requirement in terms of necessary storage capacity with water availability from the Ba River.

### 1.2 Water Balance System

The analysis is made in the Kone River basin including some irrigation water demand in the La Tinh River basin

The analysis incorporates the following components:

- (a) Water resources :
  - river runoff in natural flow condition of the Kone River basin itself
  - existing and proposed reservoir storage
  - water to be released through An Khe Hydropower
- (b) Water demands :
  - agriculture and fishery uses
  - domestic use
  - industrial use
  - hydropower generation by water release for the other requirement is verified to satisfy a predetermined dependability( subordinate requirement)
- (c) River maintenance flow.

Water balance is examined at each water intake location as water demanding point on the respective river course. Water balance of the whole basin taking actual river system into account is also evaluated in order to determine necessary water release of the multi-purpose dam (Dinh Binh Dam reservoir). Availability of the river maintenance flow is examined at the river mouth as a whole basin basis.

A schematic model for the analysis of the Kone River basin is presented in Figure EA-1.

## **2 Basic Condition of Water Balance Analysis**

### **2.1 Basic Condition**

Water balance analysis is made in 10-day basis. Balance calculation was carried out every ten days by giving water resources and water demand data as 10-day basis for duration of 24 years. Natural flow of a series of 1978 to 2001 was applied for the analysis as water resources.

Return flow rate is assumed to be 10 % for irrigation water and not considered (0 %) of demand for domestic and industrial waters.

### **2.2 Water Resources**

#### **(1) Catchment area**

Principal catchment area of the basin applied in the analysis are as follows:

Kone River basin	:	3,010 km <sup>2</sup>
Vinh Son Dam	:	214 km <sup>2</sup>
Dinh Binh Dam	:	1,040 km <sup>2</sup> (cumulative)
Van Phong Weir	:	1,677 km <sup>2</sup> (cumulative)
Binh Thanh	:	2,250 km <sup>2</sup> (cumulative)
Nui Mot dam	:	110 km <sup>2</sup>
Thuam Ninh Dam	:	78.5 km <sup>2</sup>

A details of the related catchment area is shown in the diagram as presented in Figure EA-2.

#### **(2) Natural Flow**

River runoff series in terms of natural flow estimated as described in Chapter 4 is used for the analysis for 24 years (1978 to 2001). The 10-days runoff series at the respective sub-catchment area tabulated in Table 1 and its characteristics of applied runoff series are presented in Figure EA-3.

(3) Reservoirs

The following existing and proposed reservoirs are studied in the analysis:

Status	Reservoir	Main River System	Effective Storage Volume (MCM)		Main Purpose
			Existing	Proposed	
Existing	Vinh Son	Kone R.	102.0	132	Power
	Thuan Ninh	Kone R.	32.3		W/supply
	Nui Mot	Tan An R.	108.5		W/supply
	Hoi Son	La Tinh R.	43.7		W/supply
Proposed	Dinh Binh	Kone R.		279.5 <sup>(1)</sup>	Multi-purpose

Note: 1) Effective storage volume to be proposed in the Master Plan. Effective storage for water supply purpose was examined at 188.8, 209.9, 279.5 and 360.2 MCM.

Other than the above-listed reservoirs, several small scale reservoirs (1.0 million m<sup>3</sup><storage capacity<15.0 million m<sup>3</sup>), both existing and proposed ones, are incorporated in the analysis as an exclusive reservoir of the respective irrigation scheme. The said small scale reservoirs are incorporated in the Study as shown in Table EA-2 and Figure EA-2.

(4) Released Water from An Khe Hydropower Scheme

The following information of available water to be released to the Kone River basin is given and water release in 90 % dependability is assumed in the water balance analysis:

	Monthly Average Discharge (m <sup>3</sup> /sec)												Annual Total Volume (MCM)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<b>90% Dependability</b>	13.8	11.4	10.1	9.8	12.5	12.9	13.4	12.2	17.6	13.8	44.6	19.8	504.3
75% Dependability	14.5	12.6	11.9	12.0	14.3	20.9	17.1	27.6	31.2	25.1	31.6	20.8	629.5

## 2.3 Water Demand

(1) Irrigation Water Demand

Irrigation water demand is the most major water requirement in the basin. The major irrigation schemes are individually incorporated in the analysis as shown in Table 3 and Figure 1, however small scale irrigation schemes are combined by area together with related small-scale reservoirs.

Water supply to the irrigation system in the La Tinh River from the Kone River through Van Phong Weir is incorporated in the manner that only insufficient water supply

capacity of the Hoi Son Reservoir is covered by the transferred water from the Kone River.

Irrigation area considered in the study are summarized as follows by river.

River	Irrigation Area (ha)			Note
	Present	2010	2020	
Kone River				
Upper Kone	1,510	5,417	20,020	until Binh Thanh
Dap Da	7,179	8,151	9,656	
Go Cham	3,866	6,006	6,160	
Tan An	7,818	8,040	10,097	
Ha Thanh	-	-	2,039	Water to be supplied from Kone River

### (2) Other Agricultural Water requirement

In addition to the irrigation water requirement, other agricultural water requirement including the coastal shrimp culture and livestock are assumed in the water demand as follows:

<u>Water Demand</u>	<u>Present (m<sup>3</sup>/day)</u>	<u>2010 (m<sup>3</sup>/day)</u>	<u>2020 (m<sup>3</sup>/day)</u>
Coastal shrimp culture			
Kone River basin	-	34,300	34,300
Livestock			
Kone River basin	2,300	3,500	4,600

### (3) Domestic and Industrial Water Supply Requirement

Water requirement for the domestic and industrial demands estimated are incorporated in the analysis as well, which is summarized as follows:

River	(unit : m <sup>3</sup> /day)					
	Present(2001)		2010		2020	
	Domestic	Industry	Domestic	Industry	Domestic	Industry
Kone River						
Upper Kone	2,382	49,300	7,419	82,525	12,385	195,367
Dap Da	7,585	0	24,114	0	41,715	0
Tan An	6,249	0	22,383	85,000	57,468	170,000

Remarks : Demand for river surface water only

### (5) River Maintenance Flow

River maintenance flow is examined of its availability at the following predetermined points:

Kone River,	River mouth	: 0.70 million m <sup>3</sup> /day (equiv.to 8.1 m <sup>3</sup> /sec) (as total amount for a river basin)
	Binh Thanh	: 0.57 million m <sup>3</sup> /day (equiv.to 6.6 m <sup>3</sup> /sec) (diverging to Dap Da and Tan An Rivers)

## 2.4 Related Hydropower Scheme

### (1) Vinh Son H/P

The Vinh Son H/P is located at the most upstream reaches of the Kone River. As of early 2003, one hydropower plant with two reservoirs is in operation and one more reservoir is planned in the Ba River basin to increase the energy output. A general feature of the Vinh Son H/P is as described below:

#### Vinh Son H/P

- Location : Dak Kron Bung Riv.(Kone Riv.basin)
- Max.power discharge : 13.2 m<sup>3</sup>/sec
- Max. power output : 66 MW
- Annual energy output : 228.5GWh (present), 318.5GWh (planned)

	<u>Reservoir A</u>	<u>Reservoir B</u>	<u>Reservoir C</u>
River	: Dak Phan Riv. (Kone Riv.basin)	: Dak Som Riv. (Kone Riv.basin)	: Ba River
Max. waterlevel	: El. 780.8 m	: El. 832.1 m	: El. 990.7 m
Catchment area	: 97 km <sup>2</sup>	: 117 km <sup>2</sup>	: 72 km <sup>2</sup>
Gross storage	: 34 MCM	: 97 MCM	: 77.5 MCM
Effective Storage	: 22 MCM	: 80 MCM	: 102 MCM

### (2) An Khe- Kanak H/P

The An Khe- Kanak H/P is the hydropower development plan substantially in the Ba River basin. The Kanak dam/reservoir/HP and An Khe dam/reservoir are to be located in the Ba River basin, while the An Khe H/P will be located at the Suoi Ca River in the Kone River basin, Tai Son District. Regulated water at the Kanak reservoir will be taken at the An Khe Dam and then conveyed to the An Khe H/P through waterway from the Ba River to the Kone River basins.

General feature of both schemes are presented as follows:

	<u>Kanak H/P</u>	<u>An Khe H/P</u>
Location	: Ba River	Suoi Ca River (Kone Riv.basin)
Max.power discharge	: 36.8 m <sup>3</sup> /sec	47.9 m <sup>3</sup> /sec
Max.Head	: 59.2 m	377 m
Installed capacity	: 13 MW	150 MW
Annual energy output	: 56.8GWh	655GWh

	<u>Kanak Reservoir</u>	<u>An Khe Reservoir</u>
River	: Ba River	Ba River
Normal waterlevel	: El. 515 m	El. 427.5 m
Catchment area	: 833 km <sup>2</sup>	1,246 km <sup>2</sup>
Gross storage	: 314 MCM	13 MCM
Effective Storage	: 298 MCM	0 MCM

### 3 Evaluation of Water Balance Analysis

Evaluation is made on the results of those in 2010 and 2020. Water supply condition against water demand is evaluated of its tightness in accordance with the applicable criteria for 2020 set out as follows:

<u>Water demand</u>	<u>Allowable probability or years that insufficient water supply (water shortage) condition will occur</u>
(a) Agriculture, Fishery	: Less than 1/4 probability of the examined 24 years or Less than 6 years ( <u>5 years</u> in 24 years at the most)
(b) Domestic use, Industry	: Less than 1/10 probability of the examined 24 years or <u>2 years</u> in 24 years at the most)
(c) River maintenance flow	: Less than 1/4 probability of the examined 24 years or Less than 6 years ( <u>5 years</u> in 24 years at the most)

### 4 Future Water Balance Situation Against 2010 Demand

The different conditions in 2010 from those of present-2001 is assumed as follows:

- 1) Three existing reservoirs are available,
- 2) The effective storage capacity of the Vinh Son Dam is expected to increase to 132 million m<sup>3</sup>,
- 3) Water from the Ba River is available as described in 2.2 (4),
- 4) Some increase of water demands is expected in every water demand fields,

5) River maintenance flow is to be considered.

Water balance analysis is made under the conditions stated above against manageable water demands on the main stream that water deficit could be supplemented by the reservoir release and/or transferred water through the An Khe HP.

(1) Water Demands on the Main Stream (deficit manageable)

As seen in Table 4, which shows annual water deficit(manageable only) in the whole basin under the condition with/without the water transfer from the Ba River. Comparing to the frequent water shortage situation which may happen every 3 years on average in case of no-water from the Ba River, the expected condition would change for the situation with scarce water shortage that only 2 times of the examined 24 years is identified as the drought year.

However in 2010 case, this favorable situation would be realized by lots of contribution of the Vinh Son reservoir that the lowest reservoir storage of each year would be below 10 % of the full capacity for 6 times of the examined years even excluding two drought years. The Vinh Son Dam is of a main purpose of hydropower generation, and such low water level may be undesirable for the operation of hydropower generation.

(2) Water supply on the tributaries (deficit not manageable)

Water balance condition in each irrigation scheme on the tributaries including the Nui Mot Dam is examined but no change will be expected from the examination of Non-An Khe alternatives.

## **5 Future Water Balance Situation Against 2020 Demand**

### **5.1 Dam Development Alternative**

In the 2020 case, the proposed Dinh Binh Dam is integrated in the analysis in addition to the existing reservoirs.

The water balance analysis is made in a similar manner to the analysis without considering water transfer from the Ba River, which is described in the main text of this Appendix E. Examined alternatives are based on the other one as well as the analysis procedure.

Prior to the analysis for 2020, a minimum storage requirement was worked out in view of flood control purpose that a flood inflow volume of the 5 % probable late flood needs to be fully regulated by the Dinh Binh reservoir. Some 190 million m<sup>3</sup> is the minimum requirement to absorb the objective inflow, and a 200 million m<sup>3</sup> is set forth as a required flood control volume that the corresponding effective storage for water supply is to be 188.8 million m<sup>3</sup> as minimum capacity.



## 5.2 Effective Storage Alternatives

The previous feasibility study undertaken by MARD/HEC1 proposed the reservoir development scale of the effective storage volume of approx. 210 million m<sup>3</sup> available for water supply. While, the current JICA Study has proposed the dam development scale with 5 m higher dam height than the previous F/S that the effective storage volume for water supply in the JICA proposal is 279 million m<sup>3</sup>. The minimum effective storage to secure the flood control space for the late flood, is estimated at 189 million m<sup>3</sup> as stated in (1) above.

Hence, to cope with 2020 water demand by the Dinh Binh Dam as well as available water transferred from the Ba River, three(3) alternatives are examined in the present analysis, i.e. 189, 210 and 279 million m<sup>3</sup> in terms of the effective storage volume for water supply.

## 5.3 Flood Control Volume Alternatives

According to the flood control plan discussed in the main text of this Appendix E, Chapter 10, a certain amount of flood control space is expected to be secured in the reservoir storage during a flood season, as follows:

(a) Major flood season ( September to November)

A flood control space is approx. 100 million m<sup>3</sup> to 293 million m<sup>3</sup>. The effective storage capacity in the flood season is retained by 0.0 to 100 million m<sup>3</sup> according to the reservoir development scale.

(b) Late flood season (December).

In any development scale alternatives, 200, 120 and 55 million m<sup>3</sup> are secured respectively in the first, second and third 10days.

## 5.4 Examined Development Scale

In the study, the water transfer to the La Tinh River basin is included.

Examined alternatives with a combination of effective storage capacity and flood control space are summarized below:

### Reservoir Development Scale Alternatives

(unit : million m<sup>3</sup>)

Case No.	Gross Storage Vol. (at Surchage water level)	Effective Storage Capacity for Water Supply			Expected Flood Control Space	
		Non-flood season	Major flood season	Late flood season	Major flood season	Late flood season
IV-1	216.3	188.8	0.0	0.0	200.0	200.0
IV-2			100.0	→80.0 →145.0	100.0	→120.0 →55.0
I-1	237.5	209.9	0.0	21.2	221.2	
I-2			100.0	→101.2 →166.2	121.2	
II-1	309.1	279.5	0.0	92.8	292.8	
II-2			100.0	→172.8 →237.8	192.8	

Remarks: River maintenance flow is incorporated.

#### 5.5 Water Balance Analysis by Development Scale

Water balance analysis is made for the several alternatives as shown above with the assumption that:

- (a) The reservoir storage of the Dinh Vinh Dam and Vinh Son Dam is available for the whole downstream demands as long as it is manageable one.
- (b) Supplemental release of reservoir storage is to be done by the Dinh Binh Dam first, and then Vinh Son Dam in case that no more storage is available in the Dinh Binh.
- (c) Storage capacity of the Nui Mot Dam is used only for the irrigation area at immediate downstream of the dam in the preliminary computation.

Water balance condition in 2020 is shown below in terms of annual water deficit estimated by accumulating deficits per 10 day calculation interval:

**Annual Water Deficit in Whole Basin by Development Alternatives**

(unit : million m<sup>3</sup>)

Alternatives	Eff. Storage	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
I-1	209.9	-	-	-	-	-	342	-	-	-	-	-	
I-2		-	-	-	-	-	342	-	-	-	-	-	
II-1	279.5	-	-	-	-	-	340	-	-	-	-	-	
II-2		-	-	-	-	-	268	-	-	-	-	-	
IV-1	188.8	-	-	-	-	-	363	-	-	-	-	-	
IV-2		-	-	-	-	-	363	-	-	-	-	-	
Alternatives	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
I-1	-	-	-	-	45	-	-	-	-	-	-	-	-
I-2	-	-	-	-	46	-	-	-	-	-	-	-	-
II-1	-	-	-	-	-	-	-	-	-	-	-	-	-
II-2	-	-	-	-	-	-	-	-	-	-	-	-	-
IV-1	-	-	-	-	69	-	-	-	-	-	-	-	-
IV-2	-	-	-	-	69	-	-	-	-	-	-	-	-

**5.6 Detailed Examination**

Examination of each alternative is made in Table 5 to Table 10, respectively to clarify the effect of transferred water from Ba River by comparison of annual water deficit under with/without condition.

Except for several years when the reservoir storage of the Vinh Son is still at 132 MCM, which shows the reservoir to be full, the Dinh Binh reservoir will have been of no available storage remained.

It is found in every case that very severe water shortage situation is still remained in 1983 although deficit is much less than the “without-case” by 40 to 50 %. In 1993, water deficit is still found in the smaller dam scale alternatives, however Alternative II-1 / II-2, which is the highest dam case in comparison, has no deficit, respectively.

The following table shows number of severe drought year when no available water in the Vinh Son reservoir and number of rather severe drought condition that scarce water is remained (20 % for instance) in the Vinh Son reservoir.

	Water Deficit in the Basin (times)	Scarce Storage Remained in the Vinh Son Reservoir (times)	TOTAL Nos.
Alternative I-1	2	2	4
Alternative I-2	2	1	3
Alternative II-1	1	2	3
Alternative II-2	1	1	2
Alternative IV-1	2	2	4
Alternative IV-2	2	2	4

In the cases of Alternatives IV-1 and IV-2, in which both case show almost same result, number of times when the lowest storage of Vinh Son is below about 20 % is only 4 times, i.e. in 1983, 1988, 1990 and 1993. Hence, even if it is assumed to be drought year in such condition that the lowest reservoir storage of Vinh Son is lower than 20 % of the full capacity, the drought year will be caused for 4 times only. That satisfy the evaluation criteria set forth for the irrigation demand, in Chapter 3 of this paper.

It is concluded that the minimum dam development scale is to be identified at Alternative IV-1 with available water from the Ba River through the An Khe H.P. that meet both water supply requirement and flood control requirement to regulate the 5 % probable late flood. The outline of the development scale is shown below:

#### **Development Plan**

- Alternative Dinh Binh Dam Scale No : Dam Alt.IV-1
- Dinh Binh Dam Crest Level : EL.93.70 m
- Dinh Binh Dam Flood Control Volume : 200.0 MCM
- Dinh Binh Dam Effective Storage : 188.8 MCM
- Annual Average Discharge from the Ba River : 16.0 m<sup>3</sup>/s
- La Tinh River Basin : Water supply to La Tinh River basin is included

**Table EA-1 (1) 10-Days Natural Runoff Series at Cay Muong in Runoff Volume (Catchment area : 1,677 km<sup>2</sup>)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	70.20	31.71	34.01	64.46	88.37	13.11	43.01	75.02	72.06	103.68	56.47	34.65	23.06	56.45	60.49	43.30	82.04	32.64	67.21	138.46	40.25	173.38	128.30	85.03
Jan2	59.88	25.09	27.86	52.62	73.00	10.97	35.13	60.01	58.44	81.06	46.07	28.16	19.04	46.17	51.94	35.42	66.10	26.54	53.90	111.64	33.70	143.11	104.74	66.12
Jan3	47.90	22.36	25.10	47.34	64.90	10.19	31.52	53.21	52.04	71.92	41.14	25.39	17.45	41.63	47.56	31.94	58.41	23.86	47.63	98.72	31.12	131.85	111.02	56.70
Feb1	37.04	16.78	18.73	35.26	48.63	7.92	23.57	39.31	38.59	52.72	30.64	19.16	13.12	31.30	33.39	24.03	43.40	19.63	35.54	72.73	22.71	86.20	83.07	41.98
Feb2	29.79	14.14	15.73	29.51	40.38	6.89	19.76	32.54	32.07	43.47	25.59	16.23	11.15	26.73	27.69	20.26	35.35	15.09	29.20	59.88	19.24	70.12	66.26	35.05
Feb3	20.43	9.74	12.11	20.29	27.74	4.93	15.18	22.11	21.87	29.69	19.65	11.27	7.75	21.53	21.03	14.01	23.90	10.39	22.22	40.52	13.41	51.63	49.91	23.86
Mar1	22.16	10.59	11.66	21.97	30.03	5.49	14.51	23.69	23.51	32.46	18.65	12.32	8.51	20.95	19.91	15.28	25.57	11.32	21.06	43.23	14.60	61.35	46.75	26.02
Mar2	18.99	9.16	10.02	18.90	25.82	4.91	12.49	20.12	20.05	26.87	16.03	11.05	7.42	19.60	16.93	13.24	21.49	9.75	17.97	36.55	12.70	48.07	39.41	22.64
Mar3	17.82	8.74	9.56	17.93	24.60	4.82	11.89	19.08	18.86	25.01	15.18	11.41	7.15	19.34	15.91	12.65	22.06	9.31	16.95	34.07	12.48	43.91	36.68	22.16
Apr1	14.04	6.97	7.60	14.22	19.50	3.96	9.43	14.77	14.82	19.44	12.01	8.35	5.75	17.63	13.37	10.09	17.15	7.39	13.38	26.48	9.94	33.51	28.48	16.61
Apr2	13.03	6.26	6.77	12.67	17.39	3.61	8.40	12.90	13.01	17.17	10.64	7.46	5.17	13.83	11.67	8.99	14.75	6.64	11.74	23.31	8.77	29.60	26.21	14.52
Apr3	12.67	5.62	6.11	11.34	15.36	3.34	7.51	11.69	11.54	14.85	9.47	6.70	4.67	12.34	10.42	8.11	12.78	5.92	10.42	20.33	8.18	28.80	22.22	13.06
May1	15.00	11.01	9.80	8.80	22.33	3.58	18.90	26.49	10.40	8.07	10.38	19.32	4.93	15.27	8.70	8.99	10.03	9.82	17.00	18.40	14.07	41.00	19.23	14.45
May2	18.18	10.31	20.99	18.16	16.30	7.85	17.63	14.58	35.31	7.14	9.51	12.80	13.11	11.22	8.91	8.37	17.87	12.82	61.29	20.87	11.55	32.99	34.90	36.02
May3	14.83	15.02	43.98	32.43	13.43	5.44	28.77	14.19	28.00	11.36	8.27	24.10	56.09	12.61	10.28	14.33	25.10	17.71	28.96	43.95	14.86	61.96	33.32	17.08
Jun1	9.01	26.56	23.84	18.57	18.53	3.89	35.04	10.92	11.43	17.35	9.36	25.25	21.00	19.08	12.06	8.54	14.78	21.94	22.24	24.95	7.78	37.39	49.79	22.45
Jun2	13.57	28.01	29.28	37.16	39.26	7.91	64.55	15.67	11.85	13.04	11.77	17.68	84.08	10.17	25.59	8.35	12.01	14.20	39.83	24.57	8.13	63.82	30.01	15.54
Jun3	10.25	60.35	43.36	31.38	18.06	11.84	13.14	10.05	11.96	7.31	7.02	18.19	51.62	8.31	13.63	11.35	27.04	17.44	23.76	13.79	15.82	41.00	35.79	13.06
Jul1	19.13	14.18	15.90	35.45	10.47	6.87	13.59	5.94	7.13	7.91	5.35	11.15	15.01	6.68	5.43	5.56	10.40	11.62	20.23	16.25	19.66	19.58	29.02	7.64
Jul2	17.14	11.67	13.04	47.75	10.08	5.94	10.96	5.67	6.55	7.53	5.09	10.56	12.82	6.28	5.06	4.66	8.65	11.18	16.28	16.44	16.91	19.06	25.15	7.06
Jul3	16.53	11.13	13.50	48.50	9.30	5.20	12.07	5.61	7.08	7.72	5.07	13.78	11.58	5.97	8.42	5.11	8.36	8.67	14.07	15.81	14.60	18.72	25.24	7.02
Aug1	11.32	8.61	9.74	36.80	7.72	10.33	8.41	4.74	6.96	6.18	4.15	11.55	9.44	5.08	7.40	4.05	6.73	7.02	10.95	11.89	15.47	14.54	20.34	8.36
Aug2	9.77	6.93	8.11	28.17	7.12	11.31	7.21	4.42	6.79	5.87	3.89	20.42	11.09	4.71	6.90	3.70	6.07	5.96	9.38	10.77	11.72	13.66	18.36	11.68
Aug3	9.80	6.39	8.16	24.50	8.44	8.44	6.89	4.57	6.44	6.34	4.01	21.71	7.94	4.88	8.88	3.84	6.26	12.36	8.99	10.90	12.54	14.45	30.72	11.84
Sep1	8.69	5.50	10.77	19.22	10.38	8.81	6.71	4.45	5.87	9.42	3.43	27.17	12.23	4.23	6.04	3.91	27.68	15.65	7.84	9.01	10.32	15.54	22.26	7.50
Sep2	16.49	4.98	14.63	17.31	8.21	11.06	5.19	11.78	4.63	52.62	3.73	86.14	29.71	4.22	10.73	4.61	38.60	43.09	11.67	8.93	17.92	21.31	21.35	7.86
Sep3	20.15	10.26	44.50	29.00	12.67	13.18	8.48	49.75	6.32	41.67	20.87	57.79	21.74	10.22	18.29	7.39	27.78	23.91	20.23	102.50	43.28	23.90	20.68	12.37
Oct1	19.13	14.44	188.94	30.59	12.63	50.31	12.93	95.84	179.71	25.20	101.46	50.50	138.42	28.37	47.48	164.86	27.99	207.50	19.72	67.43	68.37	56.94	31.99	11.48
Oct2	16.79	162.08	116.12	261.03	20.32	146.82	219.27	205.82	60.36	20.04	365.46	49.27	647.79	22.47	86.81	77.88	60.70	124.14	76.27	46.07	58.91	176.42	129.46	29.84
Oct3	61.51	138.90	367.60	578.30	33.54	330.58	123.42	92.39	310.81	19.12	137.46	40.48	274.36	356.55	681.06	209.50	191.69	311.31	443.85	60.13	296.22	360.14	113.10	314.72
Nov1	186.74	53.46	486.02	483.96	65.03	223.62	308.31	214.82	165.40	243.04	185.90	33.13	158.02	112.36	201.15	64.49	58.16	325.72	391.18	343.07	140.51	671.65	52.32	140.75
Nov2	90.24	188.71	462.46	420.87	37.47	344.59	114.11	262.31	143.12	424.90	149.61	80.57	487.65	98.22	163.40	46.95	63.70	218.71	583.55	81.79	595.37	180.71	503.85	155.26
Nov3	48.97	98.07	173.25	189.60	26.08	116.52	277.27	368.25	106.84	300.20	83.26	61.29	194.41	324.03	97.80	224.26	97.74	127.28	445.06	64.85	628.14	215.36	210.57	64.90
Dec1	55.38	81.75	121.60	283.76	23.13	81.38	294.10	271.81	656.62	113.87	63.08	50.21	113.63	118.13	76.13	308.98	82.02	106.37	526.10	100.00	431.90	754.53	179.82	51.94
Dec2	45.27	55.10	107.54	190.23	19.81	68.58	111.90	112.28	148.91	88.77	56.94	38.61	89.78	176.23	59.69	304.84	64.96	99.83	297.81	68.88	427.30	355.73	135.93	101.26
Dec3	56.69	46.51	94.61	124.19	17.22	60.22	118.08	120.76	164.97	78.26	47.85	32.55	78.81	84.63	65.66	118.49	56.21	161.65	270.93	54.88	200.15	182.55	189.05	89.97

EAT-1

**Table EA-1 (2) 10-Days Natural Runoff Series at Dinh Binh Dam Site in Runoff Volume (Catchment area : 1,040 km<sup>2</sup>)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	56.74	26.67	23.41	46.65	60.86	10.38	30.72	53.65	52.90	78.13	39.24	24.29	16.87	41.92	44.03	29.79	60.51	22.02	48.89	99.95	30.27	127.24	90.20	62.80
Jan2	45.45	20.53	19.24	38.03	50.72	8.64	25.09	42.70	42.89	60.70	32.02	19.44	13.88	34.17	37.96	24.49	48.75	17.89	39.16	80.54	25.24	104.90	74.02	48.99
Jan3	34.10	18.25	17.36	34.24	44.88	8.00	22.49	37.82	38.15	54.00	28.61	17.44	12.73	30.77	35.17	22.04	43.05	16.11	34.40	71.25	23.51	96.42	84.70	41.89
Feb1	26.05	13.65	12.92	25.44	33.67	6.19	16.82	27.89	28.25	39.49	21.33	13.15	9.49	23.09	24.72	16.58	32.10	13.07	26.20	52.50	17.07	60.73	61.02	31.07
Feb2	21.00	11.49	10.84	21.25	27.83	5.37	14.09	23.05	23.46	32.53	17.87	11.13	8.02	19.75	20.47	14.01	26.05	10.22	21.19	43.24	14.40	49.59	48.04	26.05
Feb3	14.39	7.89	8.36	14.58	19.10	3.84	10.82	15.63	15.98	22.26	13.69	7.72	5.56	16.14	15.51	9.69	17.60	7.07	16.14	29.29	10.03	36.43	36.18	17.54
Mar1	15.47	8.55	8.07	15.79	20.65	4.26	10.33	16.72	17.15	24.56	13.07	8.43	6.09	15.70	14.67	10.58	18.84	7.72	15.30	31.25	10.91	44.70	33.79	19.11
Mar2	13.15	7.39	6.96	13.56	17.76	3.80	8.91	14.18	14.63	20.27	11.25	7.56	5.29	14.63	12.46	9.18	15.81	6.66	13.06	26.42	9.48	34.67	28.45	16.63
Mar3	12.30	7.03	6.63	12.86	16.82	3.72	8.47	13.46	13.72	18.85	10.67	7.56	5.07	14.78	11.68	8.80	16.69	6.38	12.31	24.64	9.35	31.54	26.46	16.38
Apr1	9.67	5.59	5.30	10.30	13.36	3.04	6.70	10.38	10.77	14.64	8.46	5.67	4.07	14.71	9.93	7.04	13.18	5.10	9.76	19.17	7.43	24.03	20.49	12.29
Apr2	9.40	5.03	4.73	9.04	12.14	2.77	5.97	9.05	9.45	13.06	7.47	5.07	3.63	11.50	8.87	6.26	11.69	4.67	8.54	16.80	6.52	21.54	18.76	10.70
Apr3	9.12	4.51	4.30	8.16	10.51	2.57	5.35	8.30	8.37	11.18	6.70	4.55	3.27	10.48	8.15	5.66	10.08	4.13	7.57	14.74	6.13	21.57	16.08	9.62
May1	10.43	9.39	6.84	6.54	15.42	2.65	13.35	19.43	7.53	6.06	7.34	11.44	3.45	12.87	6.62	6.29	7.81	6.92	12.47	13.28	10.21	32.22	13.89	10.71
May2	13.26	9.66	14.13	18.38	11.17	5.49	12.52	10.43	25.65	5.36	6.74	7.95	8.88	9.45	6.78	5.89	13.84	8.96	42.20	14.73	8.77	26.45	24.30	26.41
May3	11.65	16.19	29.96	35.67	9.18	3.85	18.97	10.11	18.37	8.53	5.87	14.88	36.24	10.77	7.84	9.77	21.26	13.75	20.41	32.76	12.79	47.06	23.36	12.67
Jun1	6.79	25.54	16.92	19.66	12.63	2.90	22.06	7.79	7.81	13.49	6.78	15.11	14.79	15.97	9.06	5.91	13.53	17.13	16.76	18.60	6.61	26.04	34.30	18.35
Jun2	10.07	30.50	19.18	27.23	29.16	6.27	34.30	11.05	8.06	10.85	8.12	10.47	44.10	8.39	19.25	5.78	10.88	13.07	28.85	18.16	6.82	42.03	22.54	12.66
Jun3	7.65	65.66	26.19	20.96	13.80	10.00	7.01	7.04	8.22	6.04	5.16	10.21	24.56	6.75	10.50	7.83	23.04	15.76	17.92	10.20	13.20	28.47	29.55	10.58
Jul1	13.20	14.25	9.64	24.95	7.98	5.38	8.01	4.16	4.93	6.36	3.92	5.94	7.42	5.21	4.20	4.07	8.55	10.85	16.12	11.96	18.26	13.42	23.44	6.01
Jul2	12.95	11.64	7.92	28.43	8.13	4.81	6.69	3.90	4.52	5.98	3.59	5.58	6.24	4.96	3.91	3.35	7.08	11.96	13.63	12.76	14.51	13.14	19.64	5.51
Jul3	13.69	10.73	8.90	25.94	7.06	4.24	7.08	3.91	4.77	6.10	3.65	7.30	5.68	4.70	5.75	3.91	6.78	9.30	11.00	11.87	12.98	12.86	18.90	5.41
Aug1	9.23	8.28	6.52	18.79	5.78	6.34	5.07	3.30	4.92	4.84	3.01	6.36	4.52	3.95	4.97	3.14	5.43	7.33	8.49	8.95	11.28	10.05	15.41	6.98
Aug2	7.91	6.70	5.38	16.56	5.27	7.12	4.42	3.09	4.35	4.59	2.81	10.70	4.92	3.65	5.69	2.84	4.85	5.89	7.27	8.08	8.75	9.18	13.91	11.04
Aug3	8.27	6.18	5.33	14.72	5.83	5.11	4.29	3.17	4.35	4.95	2.90	11.41	3.66	3.82	8.03	2.95	5.04	9.35	6.92	8.24	9.28	9.93	21.38	13.16
Sep1	7.26	5.16	7.46	11.52	8.09	5.94	4.17	3.33	3.84	9.18	2.46	15.35	7.74	3.37	5.69	3.44	30.10	12.28	5.98	6.77	7.52	11.16	15.91	8.29
Sep2	14.58	4.69	10.39	10.29	7.00	7.65	3.21	10.56	3.10	54.68	2.86	50.02	31.22	3.20	10.04	4.53	33.79	36.06	9.62	6.90	13.14	15.03	15.23	8.38
Sep3	18.35	7.53	34.27	15.73	11.34	11.02	4.81	47.48	4.23	35.45	16.66	38.77	18.17	6.67	15.65	6.91	21.51	17.62	17.83	88.40	33.77	18.36	14.48	11.61
Oct1	17.19	10.12	133.18	17.37	12.45	31.33	7.83	60.48	147.97	20.89	81.22	30.59	112.35	20.68	43.61	131.20	19.61	154.00	15.82	53.88	48.31	46.17	22.47	10.57
Oct2	14.20	112.72	82.63	187.13	21.49	93.23	152.36	138.31	49.60	16.87	242.97	30.28	463.39	15.46	66.29	59.65	36.84	97.26	69.18	35.88	42.12	122.91	69.56	29.01
Oct3	59.10	86.08	249.02	399.45	34.35	234.56	88.02	62.69	250.49	15.72	84.24	25.38	206.44	246.88	471.80	154.32	112.29	218.83	356.73	49.10	188.28	252.62	76.82	226.32
Nov1	149.03	34.83	339.77	325.41	58.26	160.26	199.64	172.07	120.17	196.51	122.28	22.52	113.70	70.70	144.36	48.00	41.20	243.54	280.77	256.69	96.32	473.49	34.14	99.82
Nov2	78.64	131.47	342.48	284.15	30.03	257.19	78.48	199.16	121.80	294.55	94.71	66.70	350.33	66.36	116.55	34.33	51.76	160.42	416.88	57.97	412.59	125.61	385.88	108.46
Nov3	38.77	66.15	123.39	128.02	20.36	83.41	207.55	229.84	86.82	201.48	58.89	50.92	149.83	246.80	68.49	167.75	79.89	95.85	329.60	46.18	421.25	151.80	150.67	45.90
Dec1	47.79	59.92	86.95	194.35	18.06	58.61	224.11	209.40	504.80	78.76	44.64	39.22	87.46	88.27	53.47	233.43	54.35	81.17	374.16	85.16	320.01	542.02	127.09	36.73
Dec2	39.06	39.88	79.24	139.21	15.73	49.20	78.24	83.78	110.38	61.53	40.69	27.94	66.04	138.09	41.89	231.09	43.10	84.68	225.37	53.71	295.32	246.76	101.24	84.27
Dec3	49.72	31.92	68.76	85.93	13.66	43.18	87.19	92.91	130.19	54.77	33.26	24.04	58.77	62.36	47.42	87.67	36.98	129.59	196.42	41.33	141.60	128.17	147.48	70.06

**Table EA-1 (3) 10-Days Natural Runoff Series at Binh Thanh in Runoff Volume (Catchment area : 2,250 km<sup>2</sup>)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	87.02	36.58	43.58	78.68	113.81	15.93	57.43	94.68	91.87	123.68	72.57	44.62	27.87	69.14	73.52	55.21	101.03	41.46	80.14	166.21	48.31	203.93	158.94	101.87
Jan2	73.87	29.46	35.65	64.29	93.42	13.28	46.86	76.01	74.55	96.92	59.15	36.26	22.99	56.32	61.71	45.18	81.87	33.56	64.38	134.06	40.75	174.20	129.47	80.02
Jan3	60.38	26.32	32.06	57.86	83.32	12.36	42.02	67.48	66.39	85.82	52.74	32.76	21.01	50.79	57.27	40.72	71.95	30.17	57.36	118.56	37.68	154.03	132.26	68.41
Feb1	46.88	19.80	23.94	43.16	62.31	9.61	31.39	49.94	49.25	63.05	39.23	24.73	15.83	38.18	40.21	30.58	53.27	24.25	43.49	87.30	27.57	104.69	99.35	50.66
Feb2	37.83	16.74	20.09	36.19	51.85	8.35	26.27	41.41	40.92	51.98	32.70	20.95	13.44	32.50	33.43	25.75	43.57	18.97	35.01	71.95	23.35	84.94	79.80	42.24
Feb3	25.96	11.56	15.44	24.90	35.59	5.94	20.14	28.18	27.92	35.49	25.73	14.57	9.34	26.86	25.43	17.78	29.47	13.07	26.64	48.70	16.22	62.61	60.15	28.87
Mar1	28.23	12.59	14.85	26.98	38.49	6.65	19.25	30.24	30.04	38.74	23.78	15.94	10.26	25.76	24.09	19.38	31.48	14.19	25.23	51.96	17.69	72.96	56.46	31.54
Mar2	24.23	10.93	12.74	23.26	33.08	5.94	16.58	25.75	25.63	32.02	20.37	14.86	8.95	24.89	20.56	16.76	26.51	12.27	21.55	43.94	15.40	57.48	47.73	27.41
Mar3	22.79	10.45	12.15	22.08	31.54	5.86	15.74	24.37	24.12	29.81	19.26	16.93	8.61	24.05	19.37	16.01	26.51	11.67	20.30	40.96	15.03	52.63	44.38	27.01
Apr1	18.01	8.36	9.66	17.53	25.10	4.80	12.48	18.97	18.96	23.18	15.22	11.60	6.92	20.74	15.91	12.75	20.20	9.25	16.02	31.87	12.00	40.37	34.55	20.12
Apr2	16.36	7.46	8.57	15.63	22.17	4.38	11.08	16.61	16.65	20.36	13.43	10.26	6.22	16.50	13.77	11.40	17.39	8.25	14.08	28.48	10.59	35.19	32.49	17.59
Apr3	15.60	6.74	7.72	14.02	19.64	4.04	9.91	14.90	14.77	17.72	11.98	9.18	5.63	14.73	12.09	10.21	15.14	7.36	12.49	24.50	9.72	33.81	26.99	15.84
May1	18.28	12.93	12.37	10.77	28.64	4.00	25.61	34.30	13.31	9.63	13.11	28.22	5.94	18.11	10.43	11.29	11.96	12.23	20.19	22.41	16.71	47.25	23.43	17.60
May2	21.42	11.70	26.57	18.03	20.81	9.80	23.20	18.99	43.41	8.54	11.99	18.16	15.32	13.14	10.73	10.49	22.25	16.42	70.07	26.49	13.67	38.28	45.88	44.37
May3	16.97	16.07	61.45	30.79	17.11	6.84	41.00	18.68	32.64	13.56	10.39	34.36	62.71	14.38	12.24	17.59	28.15	22.24	30.61	52.70	15.96	74.56	42.76	20.71
Jun1	10.71	28.45	32.61	13.23	23.74	4.98	56.41	14.03	13.52	20.40	11.24	31.95	21.18	23.54	14.73	10.86	15.73	26.27	23.92	28.77	8.77	48.87	63.59	24.89
Jun2	16.05	26.47	40.48	29.13	44.68	8.92	103.33	20.10	14.34	15.12	14.46	21.77	114.20	12.06	29.18	10.50	13.10	14.89	43.67	29.19	9.29	81.97	36.23	17.94
Jun3	12.13	60.08	59.83	31.14	20.51	13.66	20.26	12.87	14.36	8.53	8.27	20.36	79.46	9.87	15.18	14.18	30.86	18.07	24.23	16.05	15.41	49.51	41.29	15.18
Jul1	24.24	13.31	22.27	37.10	11.95	8.57	19.30	7.65	8.74	9.31	6.55	15.56	22.60	8.08	6.26	6.45	12.08	9.75	19.60	18.99	16.30	23.85	35.17	8.97
Jul2	20.50	11.09	18.17	50.34	11.28	7.24	15.49	7.27	8.04	9.05	6.96	13.44	19.34	7.54	5.82	5.69	10.07	8.31	16.08	18.31	13.36	22.65	29.82	8.35
Jul3	19.29	10.83	17.79	50.58	10.91	6.44	16.23	7.25	8.80	9.07	6.39	16.30	17.52	7.17	9.11	5.85	9.77	7.13	14.61	17.62	11.47	22.13	31.69	8.35
Aug1	13.39	8.51	13.15	36.48	9.17	12.94	11.35	6.13	8.22	7.29	5.17	12.99	13.93	6.20	7.83	4.65	7.91	5.61	11.58	13.37	13.81	17.22	24.45	9.18
Aug2	11.61	6.84	10.87	29.58	8.53	14.57	9.72	5.76	8.24	6.85	4.86	24.14	15.98	5.69	6.73	4.32	7.15	5.24	9.94	12.17	9.94	16.67	21.74	11.04
Aug3	11.60	6.38	10.86	25.77	9.99	11.09	9.24	5.92	7.63	7.49	5.03	25.04	11.27	5.88	7.98	4.49	7.48	13.94	9.61	12.29	10.78	17.25	37.88	10.96
Sep1	10.21	5.40	13.66	20.36	10.96	10.85	8.86	5.51	6.93	8.86	4.28	27.87	16.22	5.09	5.43	4.12	25.06	16.02	8.45	10.18	9.12	17.85	26.82	7.03
Sep2	19.02	4.87	18.37	18.54	8.74	13.10	6.83	11.41	5.62	41.01	4.64	84.56	33.50	5.26	8.77	4.51	42.89	45.94	13.50	9.72	17.86	24.54	26.40	7.18
Sep3	23.54	11.18	49.97	35.06	13.35	16.58	13.46	45.95	7.60	37.70	24.64	59.35	26.05	18.55	18.36	7.42	32.62	29.51	25.48	102.26	44.04	28.35	25.16	11.12
Oct1	21.13	17.06	238.52	36.54	12.38	81.94	20.70	129.37	188.02	26.29	122.04	59.90	158.22	62.90	41.45	196.24	38.26	249.39	24.96	70.80	77.38	67.41	41.76	11.23
Oct2	19.74	208.84	144.56	326.68	23.76	198.64	297.13	275.76	66.55	20.35	490.78	63.42	795.87	43.04	98.97	94.19	80.34	143.00	121.65	50.38	66.54	207.44	194.87	28.56
Oct3	79.19	179.36	458.52	748.26	37.29	430.16	159.55	117.91	336.83	19.54	190.79	51.17	332.79	466.15	861.17	261.86	252.25	389.02	529.50	71.82	400.08	473.71	154.32	380.44
Nov1	235.63	68.20	618.15	635.50	71.47	291.38	454.94	258.42	194.48	310.23	259.28	40.73	195.97	160.69	246.87	78.76	75.36	371.11	468.52	426.04	184.97	842.82	72.06	171.65
Nov2	103.89	235.80	558.07	552.04	43.07	435.01	154.19	317.89	154.20	546.31	185.88	94.47	596.18	133.34	199.97	57.53	71.68	257.74	712.40	102.68	731.92	239.15	583.65	197.23
Nov3	60.33	124.34	215.08	251.04	35.11	149.33	341.49	495.93	125.60	397.80	106.74	74.34	218.52	352.51	130.63	283.71	110.27	153.76	535.03	81.15	797.09	286.76	262.97	80.30
Dec1	64.85	108.46	150.73	382.78	28.20	104.81	347.96	344.11	790.19	147.17	80.52	60.27	136.62	139.60	97.76	377.39	106.42	125.89	658.63	110.70	494.67	887.20	231.69	64.26
Dec2	52.48	69.61	130.64	239.44	24.08	90.12	142.51	143.12	178.22	114.89	70.91	47.22	108.19	204.28	75.77	367.04	82.19	111.25	330.47	81.88	546.58	453.22	165.94	117.99
Dec3	62.80	59.69	114.18	159.64	20.86	80.71	147.07	150.97	193.70	100.24	61.08	39.70	99.14	101.42	79.78	145.80	72.55	179.44	321.87	65.76	244.77	226.25	217.04	105.87

**Table EA-1 (4) 10-Days Natural Runoff Series in Nui Mot in Runoff Volume (Catchment area : 180 km<sup>2</sup>)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	7.09	3.29	3.71	4.38	9.20	1.76	5.50	7.46	7.78	8.04	6.05	4.98	3.29	6.32	4.72	3.57	8.37	3.41	5.91	11.64	3.24	11.59	10.48	6.87
Jan2	5.37	2.67	3.02	3.51	7.49	1.56	3.93	6.04	6.31	6.37	4.92	3.79	2.70	4.84	3.82	2.91	6.87	2.76	4.67	9.39	2.70	9.88	8.42	5.37
Jan3	4.48	2.41	2.70	3.15	6.67	1.40	3.51	5.45	5.60	5.66	4.38	3.49	2.45	4.33	3.42	2.64	5.94	2.50	4.46	8.31	2.49	8.48	8.25	4.68
Feb1	3.73	1.81	2.02	2.42	4.97	1.03	2.60	4.01	4.14	4.15	3.23	2.59	1.81	3.23	2.51	1.97	4.36	1.87	3.95	6.12	1.86	6.35	6.01	3.49
Feb2	3.01	1.54	1.68	2.00	4.13	0.89	2.17	3.27	3.44	3.42	2.70	2.19	1.52	2.70	2.11	1.66	3.60	1.57	2.97	5.06	1.56	5.17	4.84	2.91
Feb3	2.04	1.06	1.30	1.38	2.82	0.62	1.66	2.22	2.50	2.36	2.10	1.53	1.05	2.13	1.63	1.14	2.45	1.07	2.24	3.43	1.09	3.75	3.67	2.00
Mar1	2.19	1.16	1.24	1.51	3.04	0.69	1.57	2.39	2.55	2.73	1.94	1.71	1.14	2.09	1.56	1.24	2.59	1.18	2.11	3.66	1.18	3.86	3.45	2.16
Mar2	1.86	1.04	1.07	1.30	2.60	0.60	1.35	2.03	2.16	2.18	1.66	2.14	0.98	2.09	1.35	1.07	2.19	1.00	1.85	3.10	1.04	3.20	3.03	1.93
Mar3	1.75	0.97	1.00	1.24	2.45	0.59	1.27	1.92	2.03	2.03	1.56	3.05	0.93	1.93	1.28	1.01	2.06	0.96	1.67	2.89	0.99	2.97	2.75	2.32
Apr1	1.37	0.77	0.80	0.99	1.94	0.48	0.99	1.50	1.60	1.57	1.24	2.07	0.74	1.66	1.04	0.81	1.58	0.76	1.32	2.26	0.80	2.34	2.15	2.00
Apr2	1.20	0.69	0.71	0.89	1.71	0.43	0.89	1.33	1.39	1.37	1.08	1.77	0.69	1.35	0.91	0.73	1.37	0.67	1.34	2.08	0.71	1.99	2.12	1.60
Apr3	1.08	0.62	0.64	0.79	1.51	0.40	0.79	1.19	1.24	1.19	0.97	1.51	0.65	1.27	0.81	0.65	1.21	0.60	1.08	1.73	0.64	1.81	1.71	1.43
May1	1.18	1.18	1.01	0.60	2.17	0.34	2.06	4.97	1.10	0.65	1.05	3.13	0.63	1.53	0.71	0.73	0.96	0.98	1.65	1.59	1.10	2.19	1.48	1.55
May2	1.29	0.77	2.53	0.79	1.61	0.63	1.81	2.81	3.39	0.58	0.96	2.10	1.88	1.02	0.75	0.65	2.12	1.40	4.83	1.76	0.90	1.95	2.64	3.58
May3	0.94	0.71	7.72	0.85	1.35	0.53	2.77	3.25	2.15	0.92	0.82	3.27	3.84	1.15	0.82	1.45	1.74	1.41	1.52	2.28	1.13	3.68	2.35	1.58
Jun1	0.62	1.22	2.60	0.26	1.79	0.25	4.91	2.05	0.93	1.34	0.85	2.92	0.95	2.81	1.10	0.90	1.12	1.50	1.29	1.09	0.61	2.26	3.12	1.63
Jun2	0.86	1.29	3.94	0.35	2.50	0.31	9.21	2.79	1.04	0.95	1.11	2.06	8.03	1.42	2.00	0.89	0.98	0.80	1.93	1.19	0.65	3.27	1.87	1.35
Jun3	0.64	2.26	8.39	0.38	1.36	0.48	1.72	1.71	1.05	0.56	0.62	1.46	6.31	1.09	0.99	0.97	2.63	0.83	1.07	0.70	0.82	2.04	1.89	1.13
Jul1	2.04	0.52	2.80	0.56	0.79	0.36	1.51	1.00	0.64	0.60	0.53	1.11	1.76	0.83	0.43	0.45	1.28	0.35	0.86	0.87	0.65	0.99	1.59	0.68
Jul2	1.46	0.46	2.29	0.92	0.74	0.35	1.26	0.89	0.60	0.57	0.79	0.90	1.50	0.79	0.43	0.41	1.07	0.32	0.78	0.81	0.43	0.87	1.22	0.65
Jul3	1.34	0.48	2.08	0.70	0.76	0.30	1.17	0.84	0.69	0.57	0.77	0.86	1.83	0.73	0.64	0.38	0.98	0.29	0.73	0.85	0.42	0.87	1.51	0.62
Aug1	1.03	0.35	1.55	0.55	0.64	0.39	0.90	0.68	0.64	0.49	0.56	0.69	1.48	0.63	0.48	0.35	0.79	0.26	0.60	0.69	0.41	0.73	1.06	0.54
Aug2	0.89	0.35	1.27	0.51	0.60	0.48	0.75	0.60	0.62	0.43	0.52	1.06	1.52	0.52	0.49	0.29	0.69	0.26	0.52	0.67	0.35	0.70	0.93	0.52
Aug3	0.86	0.35	1.19	0.48	0.64	0.36	0.72	0.61	0.54	0.48	0.51	0.90	1.24	0.57	0.50	0.29	0.72	0.40	0.56	0.67	0.35	0.78	1.64	0.52
Sep1	0.72	0.26	1.05	0.41	0.63	0.29	0.60	0.53	0.43	0.41	0.43	0.67	1.10	0.47	0.35	0.26	0.79	0.40	0.47	0.60	0.30	0.63	1.12	0.43
Sep2	1.32	0.26	1.23	0.39	0.53	0.26	0.52	0.59	0.45	0.80	0.75	0.88	1.24	0.78	0.35	0.30	1.93	1.98	0.98	0.68	0.39	0.60	1.03	0.45
Sep3	2.40	0.41	1.83	1.79	0.60	1.31	0.95	2.12	0.84	0.60	1.75	1.11	0.96	3.63	0.37	0.85	3.28	4.86	3.58	5.80	0.96	0.68	0.90	0.42
Oct1	2.88	0.89	10.86	2.03	0.55	9.51	1.11	7.55	9.84	0.97	14.34	2.94	5.44	10.62	0.42	25.28	6.23	19.27	5.16	3.02	1.71	1.64	2.82	0.53
Oct2	2.63	17.42	6.43	24.54	3.35	13.31	18.24	17.81	4.10	0.96	56.86	9.31	54.35	6.99	2.19	8.62	5.86	9.62	27.85	2.59	2.89	5.67	24.19	1.13
Oct3	12.24	15.19	18.90	57.40	6.92	23.66	11.34	6.29	13.42	1.11	17.40	8.35	23.51	32.03	47.93	18.78	17.23	28.30	34.22	5.97	35.52	39.65	15.44	19.36
Nov1	28.40	5.51	31.22	47.67	8.63	22.75	44.35	16.57	11.87	37.57	37.00	8.06	13.22	17.92	12.48	7.01	7.66	17.00	28.68	30.35	19.19	51.28	7.16	10.92
Nov2	9.60	18.00	31.73	48.05	4.10	28.94	12.59	23.19	6.70	40.96	15.81	16.35	37.72	12.91	14.04	4.81	4.70	14.33	51.39	7.62	48.37	17.57	37.16	17.12
Nov3	6.16	9.60	12.26	21.48	4.29	10.13	27.79	44.48	9.63	31.22	11.92	10.74	11.16	10.78	9.94	24.55	3.90	10.63	37.93	6.00	50.41	26.30	21.26	5.76
Dec1	6.54	13.54	8.13	34.39	3.21	7.36	23.42	31.82	53.45	12.30	8.92	7.52	11.16	8.35	6.80	35.42	6.32	8.15	44.69	6.23	24.19	42.89	22.05	4.43
Dec2	5.20	6.30	6.52	17.55	2.72	7.49	10.80	13.05	11.85	9.81	7.28	6.15	8.23	9.47	5.05	27.58	5.88	6.12	17.93	5.38	43.52	34.50	11.81	8.78
Dec3	4.98	5.09	5.75	13.02	2.36	7.27	11.80	12.43	12.07	8.32	6.44	4.81	12.99	6.38	5.10	12.24	6.73	13.31	26.19	4.41	16.18	14.83	11.32	6.32



**Table EA-1 (5) 10-Days Natural Runoff Series in Lavi River Basin in Runoff Volume (Catchment area : 110 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	5.01	2.33	2.12	2.67	6.00	1.38	3.74	3.90	4.38	4.00	3.93	3.18	0.41	3.77	2.26	2.34	4.28	2.17	3.01	4.54	2.33	7.20	5.79	3.02
Jan2	3.53	1.93	1.75	2.20	4.90	1.15	2.83	3.15	3.56	3.21	3.19	2.38	0.35	3.08	1.86	1.92	3.46	1.76	2.44	3.75	2.05	7.17	4.68	2.65
Jan3	3.11	1.75	1.56	1.98	4.35	1.05	2.51	2.85	3.18	2.85	2.82	2.13	0.36	2.76	1.68	1.75	3.08	1.58	2.17	3.40	1.81	5.61	4.73	2.23
Feb1	2.38	1.34	1.18	1.49	3.23	0.79	1.87	2.12	2.37	2.12	2.08	1.60	0.26	2.08	1.25	1.30	2.29	1.20	2.72	2.57	1.35	4.10	3.58	1.68
Feb2	1.93	1.13	0.99	1.26	2.70	0.67	1.57	1.76	1.96	1.75	1.73	1.37	0.26	1.75	1.06	1.10	1.88	0.98	2.08	2.18	1.13	3.43	2.89	1.41
Feb3	1.32	0.79	0.75	0.86	1.83	0.48	1.19	1.22	1.42	1.18	1.49	0.93	0.21	1.37	0.81	0.76	1.28	0.67	1.56	1.51	0.79	2.32	2.19	0.98
Mar1	1.42	0.88	0.73	0.95	1.98	0.52	1.15	1.30	1.46	1.28	1.30	1.05	0.21	1.38	0.79	0.82	1.38	0.73	1.45	1.65	0.86	2.43	2.06	1.06
Mar2	1.21	0.76	0.63	0.82	1.69	0.44	0.98	1.12	1.24	1.08	1.11	2.78	0.17	1.46	0.67	0.72	1.18	0.63	1.21	1.44	0.74	2.02	1.75	0.98
Mar3	1.15	0.74	0.60	0.79	1.61	0.43	0.92	1.06	1.18	1.02	1.04	3.56	0.19	1.44	0.65	0.68	1.12	0.59	1.12	1.38	0.71	1.87	1.62	1.34
Apr1	0.90	0.60	0.48	0.62	1.25	0.35	0.73	0.84	0.92	0.80	0.81	2.04	0.17	1.44	0.52	0.54	0.87	0.47	0.86	1.11	0.57	1.48	1.27	1.20
Apr2	0.79	0.53	0.43	0.57	1.11	0.33	0.65	0.74	0.81	0.70	0.71	1.68	0.44	1.11	0.45	0.50	0.76	0.43	0.89	1.00	0.52	1.26	1.11	0.95
Apr3	0.70	0.49	0.38	0.52	0.98	0.26	0.59	0.67	0.72	0.61	0.62	1.41	0.57	0.97	0.43	0.43	0.67	0.35	0.92	0.90	0.44	1.19	0.98	0.84
May1	1.17	0.89	0.63	0.38	1.42	0.26	1.65	1.49	0.65	0.34	0.68	2.82	0.54	1.13	0.35	0.49	0.54	0.63	1.34	0.82	0.78	1.41	0.86	0.93
May2	1.44	0.63	1.20	0.49	1.03	0.43	1.48	0.85	2.35	0.31	0.63	1.86	1.17	0.80	0.39	0.45	0.86	1.54	1.72	0.90	0.61	1.23	2.63	2.01
May3	1.20	0.56	1.17	0.51	0.85	0.37	2.63	0.94	1.55	0.50	0.51	2.62	8.23	0.86	0.83	1.16	0.72	1.44	0.56	1.18	0.86	2.48	2.64	0.94
Jun1	0.76	0.83	0.62	0.17	1.15	0.19	17.69	0.64	0.68	0.86	0.57	2.21	2.43	1.66	1.59	1.03	0.48	1.45	0.50	0.59	0.47	1.61	4.60	1.04
Jun2	0.93	0.84	0.96	0.23	1.60	0.23	24.11	1.04	0.70	0.58	0.69	1.53	50.04	0.84	2.62	0.91	0.46	0.77	0.69	0.69	0.46	2.32	2.22	0.78
Jun3	0.71	1.07	1.54	0.20	0.88	0.44	2.65	0.70	0.72	0.35	0.41	1.10	10.71	0.71	1.24	1.06	0.93	0.81	0.42	0.43	0.57	1.47	2.09	0.68
Jul1	1.29	0.29	0.65	0.36	0.52	0.37	2.27	0.42	0.43	0.35	0.35	0.59	3.14	0.69	0.52	0.48	0.35	0.28	0.36	0.52	0.33	0.71	1.74	0.38
Jul2	1.15	0.26	0.52	0.44	0.49	0.37	1.86	0.37	0.41	0.53	0.43	0.51	2.51	0.58	0.43	0.45	0.35	0.26	0.35	0.51	0.26	0.60	1.37	0.37
Jul3	1.30	0.29	0.48	0.38	0.48	0.29	1.68	0.38	0.38	0.49	0.91	0.54	2.21	0.54	0.41	0.42	0.35	0.28	0.29	0.67	0.29	0.60	1.53	0.38
Aug1	0.92	0.29	0.39	0.32	0.43	0.44	1.26	0.36	0.35	0.35	0.68	0.64	1.61	0.43	0.35	0.36	0.26	0.17	1.04	0.52	0.28	0.52	1.11	0.41
Aug2	0.79	0.26	0.37	0.26	0.40	0.77	1.05	0.26	0.34	0.35	0.58	4.58	1.32	0.39	0.28	0.29	0.26	0.17	1.09	0.44	0.31	0.43	0.97	0.60
Aug3	1.16	0.20	0.44	0.29	0.38	0.75	0.96	0.29	0.30	0.37	0.54	2.36	1.29	0.38	0.33	0.29	0.29	0.25	3.03	0.48	0.29	0.48	2.31	0.86
Sep1	0.98	0.21	0.43	0.26	0.73	0.56	0.77	0.29	0.26	0.27	0.43	1.71	1.10	0.57	0.26	0.35	0.47	0.20	2.26	0.41	0.26	0.38	1.54	0.65
Sep2	1.26	0.17	1.10	0.22	0.77	0.54	0.64	0.48	0.26	0.50	0.48	1.37	1.34	0.59	0.26	0.71	1.29	0.75	11.34	0.41	0.51	0.36	1.44	0.58
Sep3	3.46	0.28	0.84	1.00	0.69	0.73	0.62	2.32	0.35	0.37	1.27	1.12	1.04	0.96	0.35	1.44	1.59	0.64	17.57	4.41	1.31	0.35	1.18	0.54
Oct1	3.72	1.01	10.49	0.98	0.83	8.09	0.62	5.63	6.04	0.42	9.56	1.18	8.04	1.85	0.62	18.36	3.82	8.51	19.73	2.27	2.47	0.64	2.93	1.24
Oct2	2.89	12.22	9.18	12.44	1.90	12.09	13.91	14.29	2.52	0.44	28.91	1.34	39.59	2.19	3.77	5.80	2.41	4.36	51.94	1.77	2.45	3.46	13.03	2.31
Oct3	25.03	9.70	19.22	34.21	1.95	19.09	8.09	5.40	14.63	0.48	12.23	1.53	10.67	16.77	33.25	12.65	6.02	15.80	26.64	5.52	18.99	24.97	11.50	30.00
Nov1	17.84	3.77	18.63	38.07	3.84	17.11	25.28	10.32	7.09	14.82	15.47	1.09	6.60	5.22	9.00	5.37	4.33	11.24	19.22	22.15	10.14	34.62	4.68	7.54
Nov2	7.29	5.93	15.11	30.04	2.13	24.01	8.54	15.21	4.83	28.35	8.05	0.90	19.49	4.88	7.81	3.93	2.54	7.81	11.06	5.50	26.52	10.63	11.41	12.99
Nov3	5.30	5.80	7.42	21.63	3.96	7.72	10.12	23.86	4.80	17.53	5.98	0.76	7.29	3.97	6.53	12.53	2.43	6.34	19.84	4.30	33.30	15.82	8.61	5.53
Dec1	4.51	6.67	5.10	18.27	2.67	5.76	10.46	16.15	22.55	7.14	4.69	0.65	6.64	3.52	4.78	12.39	2.66	4.69	8.70	4.40	13.94	22.07	6.58	4.29
Dec2	3.54	3.34	4.25	11.21	2.20	5.38	5.64	7.34	6.24	6.45	3.98	0.54	5.87	4.28	3.62	13.54	2.66	3.42	6.99	3.80	23.47	16.27	4.35	4.48
Dec3	3.14	2.92	3.65	8.36	1.87	4.85	5.74	6.48	5.88	5.46	3.65	0.51	6.20	3.12	3.21	6.29	3.65	4.98	6.19	3.16	9.63	8.07	3.64	4.02

EAT-5

**Table EA-1 (6) 10-Days Natural Runoff Series in North Mountain Area in Runoff Volume (Catchment area : 130 km<sup>2</sup>)**

(Million m3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	5.93	2.75	2.52	3.15	7.09	1.63	4.42	4.61	5.20	4.73	4.64	3.75	0.48	4.46	2.68	2.76	5.04	2.57	3.55	5.37	2.75	8.50	6.84	3.57
Jan2	4.20	2.29	2.07	2.59	5.78	1.36	3.33	3.72	4.19	3.78	3.76	2.82	0.43	3.63	2.20	2.28	4.10	2.08	2.87	4.45	2.43	8.48	5.53	3.12
Jan3	3.69	2.07	1.85	2.33	5.14	1.24	2.98	3.38	3.77	3.37	3.34	2.54	0.40	3.27	1.98	2.06	3.63	1.87	2.56	4.01	2.13	6.63	5.60	2.64
Feb1	2.82	1.58	1.39	1.76	3.82	0.93	2.21	2.49	2.79	2.49	2.46	1.90	0.35	2.46	1.49	1.54	2.71	1.41	3.23	3.04	1.58	4.84	4.23	1.99
Feb2	2.29	1.35	1.18	1.49	3.18	0.80	1.86	2.08	2.33	2.06	2.05	1.60	0.29	2.06	1.25	1.30	2.23	1.17	2.47	2.57	1.34	4.03	3.41	1.66
Feb3	1.56	0.94	0.90	1.03	2.18	0.55	1.42	1.43	1.67	1.41	1.75	1.11	0.21	1.63	0.97	0.89	1.52	0.79	1.85	1.78	0.92	2.76	2.58	1.16
Mar1	1.68	1.04	0.86	1.11	2.34	0.60	1.37	1.55	1.73	1.51	1.56	1.23	0.26	1.65	0.92	0.98	1.63	0.86	1.72	1.95	1.00	2.87	2.42	1.26
Mar2	1.45	0.91	0.74	0.98	2.00	0.53	1.17	1.32	1.47	1.29	1.30	3.28	0.26	1.71	0.80	0.84	1.38	0.73	1.43	1.71	0.88	2.39	2.06	1.15
Mar3	1.37	0.88	0.72	0.92	1.88	0.51	1.10	1.26	1.39	1.20	1.22	4.20	0.23	1.72	0.77	0.81	1.33	0.70	1.32	1.63	0.84	2.22	1.93	1.58
Apr1	1.08	0.70	0.57	0.74	1.49	0.43	0.88	0.99	1.09	0.94	0.96	2.40	0.17	1.71	0.60	0.65	1.02	0.55	1.02	1.31	0.67	1.75	1.50	1.43
Apr2	0.94	0.63	0.52	0.68	1.30	0.35	0.77	0.88	0.96	0.83	0.83	2.00	0.52	1.31	0.54	0.59	0.90	0.49	1.06	1.18	0.60	1.49	1.30	1.11
Apr3	0.84	0.59	0.44	0.61	1.17	0.35	0.69	0.79	0.85	0.73	0.73	1.66	0.68	1.14	0.49	0.52	0.79	0.43	1.08	1.06	0.53	1.43	1.16	0.99
May1	1.38	1.05	0.75	0.45	1.68	0.31	1.95	1.76	0.76	0.40	0.80	3.34	0.64	1.34	0.41	0.57	0.64	0.75	1.58	0.97	0.92	1.66	1.01	1.10
May2	1.70	0.75	1.42	0.58	1.22	0.51	1.75	1.00	2.78	0.37	0.74	2.19	1.38	0.95	0.46	0.53	1.01	1.82	2.04	1.07	0.72	1.46	3.11	2.37
May3	1.42	0.66	1.38	0.60	1.00	0.43	3.11	1.11	1.84	0.59	0.61	3.10	9.73	1.02	0.99	1.37	0.85	1.70	0.66	1.40	1.02	2.93	3.12	1.12
Jun1	0.90	0.98	0.73	0.20	1.35	0.23	20.91	0.76	0.81	1.02	0.67	2.61	2.87	1.96	1.88	1.22	0.56	1.71	0.59	0.70	0.56	1.91	5.44	1.23
Jun2	1.10	1.00	1.14	0.27	1.90	0.27	28.49	1.23	0.82	0.68	0.81	1.80	59.14	0.99	3.09	1.08	0.54	0.91	0.81	0.82	0.55	2.74	2.62	0.93
Jun3	0.84	1.26	1.82	0.24	1.04	0.52	3.13	0.82	0.85	0.41	0.49	1.30	12.66	0.84	1.46	1.25	1.10	0.96	0.49	0.51	0.68	1.74	2.47	0.80
Jul1	1.52	0.35	0.76	0.45	0.60	0.45	2.68	0.49	0.52	0.43	0.35	0.67	3.70	0.81	0.61	0.58	0.43	0.35	0.44	0.60	0.40	0.83	2.05	0.44
Jul2	1.36	0.35	0.61	0.53	0.58	0.42	2.20	0.45	0.46	0.61	0.51	0.61	2.96	0.67	0.52	0.54	0.40	0.29	0.36	0.61	0.35	0.72	1.62	0.46
Jul3	1.53	0.35	0.58	0.47	0.57	0.38	2.00	0.47	0.48	0.58	1.08	0.63	2.61	0.63	0.48	0.49	0.38	0.29	0.38	0.80	0.30	0.71	1.81	0.41
Aug1	1.10	0.31	0.47	0.35	0.52	0.52	1.49	0.41	0.40	0.43	0.81	0.78	1.90	0.52	0.40	0.42	0.35	0.26	1.24	0.60	0.32	0.60	1.31	0.45
Aug2	0.95	0.28	0.43	0.35	0.44	0.92	1.23	0.35	0.35	0.41	0.69	5.42	1.56	0.45	0.35	0.35	0.35	0.24	1.28	0.53	0.36	0.52	1.12	0.70
Aug3	1.39	0.29	0.50	0.32	0.48	0.88	1.14	0.38	0.38	0.44	0.64	2.80	1.52	0.48	0.41	0.36	0.35	0.29	3.57	0.57	0.35	0.57	2.70	0.99
Sep1	1.18	0.26	0.52	0.26	0.86	0.66	0.91	0.36	0.35	0.35	0.51	2.00	1.30	0.67	0.28	0.37	0.54	0.27	2.65	0.44	0.29	0.43	1.81	0.77
Sep2	1.49	0.26	1.31	0.28	0.91	0.64	0.74	0.58	0.27	0.58	0.56	1.62	1.57	0.72	0.29	0.85	1.56	0.89	13.37	0.48	0.59	0.43	1.71	0.68
Sep3	4.10	0.32	0.99	1.18	0.81	0.86	0.74	2.75	0.37	0.42	1.49	1.33	1.24	1.14	0.41	1.69	1.87	0.75	20.77	5.20	1.55	0.44	1.38	0.63
Oct1	4.39	1.19	12.41	1.16	0.99	9.56	0.73	6.66	7.14	0.51	11.30	1.39	9.52	2.17	0.73	21.70	4.52	10.05	23.34	2.68	2.91	0.74	3.46	1.47
Oct2	3.42	14.44	10.85	14.72	2.24	14.27	16.43	16.89	2.99	0.52	34.17	1.59	46.79	2.57	4.46	6.87	2.83	5.14	61.38	2.10	2.89	4.08	15.39	2.71
Oct3	29.59	11.50	22.71	40.44	2.30	22.56	9.57	6.39	17.29	0.57	14.45	1.81	12.59	19.81	39.27	14.93	7.12	18.68	31.48	6.53	22.44	29.48	13.60	35.44
Nov1	21.07	4.43	22.00	45.01	4.54	20.20	29.89	12.18	8.38	17.52	18.27	1.28	7.78	6.19	10.64	6.33	5.11	13.28	22.69	26.18	11.98	40.93	5.56	8.94
Nov2	8.61	7.01	17.84	35.50	2.52	28.37	10.10	17.99	5.73	33.51	9.52	1.06	23.04	5.75	9.24	4.61	3.02	9.24	13.08	6.51	31.35	12.56	13.49	15.36
Nov3	6.25	6.85	8.79	25.57	4.67	9.11	11.93	28.21	5.69	20.70	7.06	0.91	8.61	4.67	7.72	14.80	2.85	7.50	23.47	5.08	39.35	18.72	10.17	6.55
Dec1	5.35	7.90	6.04	21.59	3.15	6.81	12.36	19.09	26.65	8.42	5.55	0.77	7.86	4.17	5.66	14.63	3.14	5.56	10.26	5.19	16.48	26.07	7.78	5.06
Dec2	4.20	3.94	5.00	13.23	2.61	6.36	6.67	8.65	7.37	7.61	4.73	0.65	6.95	5.08	4.29	16.00	3.15	4.07	8.25	4.48	27.73	19.24	5.14	5.28
Dec3	3.74	3.44	4.31	9.88	2.21	5.74	6.77	7.66	6.96	6.44	4.30	0.60	7.34	3.66	3.78	7.45	4.33	5.88	7.31	3.74	11.40	9.53	4.29	4.77

**Table EA-1 (7) 10-Days Natural Runoff Series in Ha Thanh River Basin in Runoff Volume (Catchment area : 590 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan1	20.98	12.67	13.30	14.26	30.86	6.48	18.75	25.25	27.10	27.71	20.84	17.06	14.32	23.61	17.25	11.93	30.84	12.15	20.89	43.69	11.23	39.12	36.71	24.51
Jan2	17.36	9.45	10.81	11.35	25.43	5.81	12.87	20.72	21.95	21.99	17.09	13.42	11.75	17.57	14.63	9.75	25.32	9.91	16.68	35.17	9.27	32.26	29.48	19.42
Jan3	13.90	8.49	9.69	10.26	22.40	5.19	11.64	18.71	19.50	19.61	15.02	12.58	10.65	15.83	13.44	8.80	21.77	8.90	16.73	31.10	8.61	27.79	29.47	16.94
Feb1	12.63	6.37	7.22	8.01	16.61	3.84	8.54	13.80	14.42	14.32	11.15	9.18	7.79	11.66	9.46	6.60	16.03	6.67	14.12	22.83	6.49	21.01	21.12	12.58
Feb2	10.29	5.41	6.01	6.52	13.82	3.28	7.06	11.18	11.95	11.81	9.27	7.75	6.55	9.71	7.92	5.57	13.19	5.59	10.51	18.80	5.40	17.12	16.99	10.48
Feb3	6.97	3.71	4.59	4.53	9.45	2.31	5.39	7.60	8.99	8.19	7.07	5.39	4.47	7.38	6.10	3.84	8.91	3.84	7.90	12.71	3.78	12.69	12.83	7.17
Mar1	7.44	4.02	4.40	4.92	10.20	2.54	5.09	8.13	9.04	9.97	6.70	6.09	4.86	7.39	5.83	4.22	9.51	4.29	7.41	13.53	4.15	12.81	12.04	7.74
Mar2	6.30	3.72	3.78	4.26	8.69	2.23	4.35	6.89	7.67	7.83	5.75	7.03	4.19	7.16	5.03	3.60	8.01	3.59	6.71	11.43	3.60	10.74	10.81	6.80
Mar3	5.89	3.35	3.59	4.07	8.20	2.18	4.10	6.46	7.17	7.27	5.42	9.06	3.96	6.52	4.79	3.45	7.53	3.40	5.99	10.63	3.49	9.97	9.75	8.05
Apr1	4.58	2.67	2.83	3.25	6.46	1.75	3.24	5.09	5.61	5.64	4.27	6.30	3.13	5.68	3.92	2.73	5.80	2.71	4.80	8.26	2.80	7.93	7.62	7.17
Apr2	4.00	2.38	2.49	2.89	5.69	1.59	2.84	4.46	4.91	4.87	3.76	5.40	2.80	4.60	3.43	2.44	5.04	2.40	4.89	7.67	2.50	6.72	7.44	5.92
Apr3	3.56	2.16	2.26	2.60	5.05	1.43	2.52	4.07	4.33	4.27	3.34	4.67	2.59	4.74	3.02	2.18	4.42	2.15	4.00	6.36	2.25	6.09	6.01	5.30
May1	3.75	3.95	3.55	1.99	7.27	1.31	6.28	22.75	3.88	2.30	3.65	9.64	2.64	6.02	2.66	2.41	3.54	3.55	6.24	5.77	3.77	7.28	5.22	5.73
May2	4.31	2.60	9.79	2.53	5.31	2.21	5.85	14.90	11.69	2.04	3.34	6.59	7.70	3.85	2.77	2.23	8.13	4.86	19.42	6.14	3.59	6.52	8.48	12.37
May3	3.04	2.42	32.66	2.98	4.72	1.87	7.66	16.67	7.39	3.23	2.89	10.63	9.22	4.34	3.04	4.16	6.82	4.61	6.41	7.69	4.96	11.41	7.30	5.71
Jun1	2.05	4.34	9.69	0.86	6.23	1.01	9.66	10.50	3.28	4.61	2.98	10.51	2.95	11.45	3.91	2.47	4.39	5.01	5.36	3.84	2.63	6.75	9.47	5.87
Jun2	2.72	4.78	15.50	1.27	8.55	1.15	12.90	13.75	3.62	3.34	4.02	8.02	14.17	5.97	7.52	2.59	3.81	2.91	8.31	4.20	2.56	9.43	6.34	4.81
Jun3	2.14	8.89	36.61	1.63	4.60	1.47	2.62	8.25	3.63	1.95	2.23	5.57	9.84	4.50	3.69	2.86	9.97	3.01	4.64	2.53	3.26	6.16	6.24	4.06
Jul1	7.49	2.16	11.49	2.31	2.70	1.15	2.46	4.63	2.25	2.13	1.93	3.76	2.89	3.30	1.65	1.26	5.01	1.17	3.69	3.14	3.00	3.02	5.06	2.41
Jul2	5.33	1.87	9.29	3.59	2.51	1.05	2.09	4.10	2.06	1.96	2.68	3.18	2.61	3.07	1.54	1.18	4.23	1.09	3.33	2.89	2.04	2.70	4.01	2.35
Jul3	4.86	1.80	8.45	2.90	2.57	1.02	2.03	3.74	2.45	2.00	2.28	3.14	4.50	2.82	2.37	1.18	3.89	1.12	3.03	2.97	1.94	2.75	4.70	2.28
Aug1	3.69	1.44	6.18	2.29	2.18	1.11	1.62	2.99	2.72	1.68	1.83	2.39	3.97	2.36	1.93	1.00	3.02	0.95	2.42	2.50	1.72	2.32	3.50	2.00
Aug2	3.16	1.28	5.08	1.94	2.03	1.21	1.43	2.62	2.37	1.57	1.75	2.30	4.67	2.05	2.10	0.95	2.66	0.88	2.13	2.34	1.42	2.24	3.10	1.78
Aug3	3.00	1.27	4.73	1.87	2.13	0.96	1.43	2.57	2.02	1.62	1.73	2.23	4.24	2.09	2.29	0.98	2.86	1.16	2.08	2.41	1.42	2.70	4.50	1.81
Sep1	2.45	1.05	4.00	1.50	2.22	0.86	1.23	2.16	1.62	1.38	1.41	1.87	3.91	1.68	1.57	0.85	2.71	1.69	1.94	2.04	1.29	2.17	3.09	1.56
Sep2	4.48	0.95	4.30	1.55	1.79	0.71	1.07	2.36	1.66	2.93	2.68	2.67	3.89	3.62	1.44	0.96	5.69	7.86	2.06	2.91	1.40	1.89	2.72	1.59
Sep3	7.15	1.42	7.73	6.04	2.11	5.74	2.51	8.43	3.55	2.24	5.88	4.26	3.01	14.28	1.43	3.34	12.44	28.76	6.01	25.12	3.10	2.35	2.64	1.57
Oct1	10.26	2.57	35.74	7.32	1.94	28.09	2.68	24.68	41.33	3.66	53.20	17.01	14.45	47.34	1.71	105.08	23.13	64.41	7.46	11.50	6.35	6.33	11.16	1.67
Oct2	9.24	57.86	16.25	81.92	14.79	36.75	56.38	53.09	15.22	4.47	208.97	44.25	173.08	26.85	9.68	39.15	20.41	34.85	42.83	11.58	13.44	21.15	84.40	4.22
Oct3	24.03	54.16	46.16	185.08	31.67	64.51	35.42	19.09	40.92	5.26	56.30	35.68	89.87	111.80	157.50	62.48	59.43	90.41	99.88	26.98	130.40	130.88	50.49	45.43
Nov1	94.09	19.02	86.55	147.24	33.83	69.89	143.54	49.57	42.22	152.21	129.76	39.85	45.81	76.01	40.01	25.94	28.79	54.68	97.84	102.41	71.11	154.33	24.03	34.55
Nov2	35.29	72.72	104.67	166.43	15.97	85.50	39.78	79.82	23.09	132.54	55.72	75.72	119.10	49.46	50.10	18.01	17.06	47.57	199.49	25.81	170.48	54.49	138.90	53.61
Nov3	20.41	31.92	39.80	62.70	14.10	31.10	101.27	146.53	37.97	106.70	42.47	48.52	38.57	40.23	31.80	90.94	13.21	36.89	133.82	20.40	161.69	88.30	73.11	17.52
Dec1	23.15	52.47	25.83	108.52	11.81	22.34	79.97	117.77	188.14	42.95	31.62	32.15	40.56	31.08	22.23	138.80	22.46	28.60	170.22	21.35	83.28	143.61	81.80	13.50
Dec2	18.85	24.27	20.74	60.13	10.01	23.72	35.88	46.67	40.95	33.00	25.83	28.17	28.52	33.50	16.55	98.81	22.78	21.64	68.62	18.94	146.99	130.18	45.77	29.79
Dec3	18.46	18.39	18.28	43.93	8.71	23.91	40.38	44.10	41.30	28.56	22.63	21.98	52.12	23.07	16.95	45.96	23.91	50.73	109.68	15.26	54.59	52.03	42.02	19.75

**Table EA-1 (8) 10-Days Natural Runoff Series in Delta in Runoff Volume (Catchment area : 380 km<sup>2</sup>)**

(Million m<sup>3</sup>)

	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		
Jan1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	0.00		
Jan2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.83	0.00	
Jan3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01	0.00	
Feb1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Feb2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Feb3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mar1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mar2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mar3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Apr1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Apr2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Apr3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
May1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.59	0.00	
May2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.59	0.00	
May3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.85	0.00	
Jun1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Jun2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Jun3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Jul1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Jul2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Jul3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Aug1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	
Aug2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	
Aug3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	
Sep1	10.01	43.81	2.44	0.00	2.81	0.00	0.00	2.10	0.00	16.92	0.00	0.00	2.08	0.00	0.00	10.50	0.00	10.67	2.50	9.73	48.75	19.96	2.00	0.00	0.00	0.00	0.00	
Sep2	10.01	43.81	2.44	0.00	2.81	0.00	0.00	2.10	0.00	16.92	0.00	0.00	2.08	0.00	0.00	10.50	0.00	10.67	2.50	9.73	48.75	19.96	2.00	0.00	0.00	0.00	0.00	0.00
Sep3	10.01	43.81	2.44	0.00	2.81	0.00	0.00	2.10	0.00	16.92	0.00	0.00	2.08	0.00	0.00	10.50	0.00	10.67	2.50	9.73	48.75	19.96	2.00	0.00	0.00	0.00	0.00	0.00
Oct1	37.90	25.66	43.05	43.95	70.46	102.75	19.48	68.23	43.64	36.44	54.71	8.25	91.71	6.91	104.23	57.58	87.73	80.08	28.81	50.59	102.85	31.70	58.89	67.87	53.53	60.93	60.93	
Oct2	37.90	25.66	43.05	43.95	70.46	102.75	19.48	68.23	43.64	36.44	54.71	8.25	91.71	6.91	104.23	57.58	87.73	80.08	28.81	50.59	102.85	31.70	58.89	67.87	53.53	60.93	60.93	
Oct3	41.69	28.22	47.36	48.34	77.51	113.02	21.43	75.05	48.00	40.09	60.18	9.07	100.89	7.60	114.65	63.33	96.50	88.09	31.69	55.65	113.13	34.87	64.78	74.66	58.88	67.03	67.03	
Nov1	41.84	44.54	22.19	22.86	41.69	107.68	11.78	42.93	77.38	84.90	7.49	125.03	22.46	5.79	31.74	21.86	11.97	31.39	0.51	25.09	67.34	25.21	124.26	71.96	30.97	15.78	15.78	
Nov2	41.84	44.54	22.19	22.86	41.69	107.68	11.78	42.93	77.38	84.90	7.49	125.03	22.46	5.79	31.74	21.86	11.97	31.39	0.51	25.09	67.34	25.21	124.26	71.96	30.97	15.78	15.78	
Nov3	41.84	44.54	22.19	22.86	41.69	107.68	11.78	42.93	77.38	84.90	7.49	125.03	22.46	5.79	31.74	21.86	11.97	31.39	0.51	25.09	67.34	25.21	124.26	71.96	30.97	15.78	15.78	
Dec1	0.40	0.00	0.00	3.49	0.00	15.84	0.00	4.19	2.18	16.44	41.58	0.00	0.00	0.00	12.70	1.75	0.00	36.23	16.24	2.93	8.84	2.68	34.98	56.41	8.07	2.37	2.37	
Dec2	0.40	0.00	0.00	3.49	0.00	15.84	0.00	4.19	2.18	16.44	41.58	0.00	0.00	0.00	12.70	1.75	0.00	36.23	16.24	2.93	8.84	2.68	34.98	56.41	8.07	2.37	2.37	
Dec3	0.44	0.00	0.00	3.84	0.00	17.42	0.00	4.61	2.40	18.08	45.74	0.00	0.00	0.00	13.97	1.93	0.00	39.86	17.87	3.22	9.72	2.95	38.48	62.05	8.87	2.60	2.60	

**Table EA.2 Existing and Proposed Reservoirs Considered in the Water Balance Analysis**

River	Reservoir	Catchment Area(km <sup>2</sup> )	Effective Storage Volume Available(MCM)		
			Present	2010	2020
<b>Kone</b>	Vinh Son 1&2	214.0	102.0	102.0	102.0
	Vinh Son 3	72.0		30.0	30.0
	Dinh Binh	826.0			209.9
	Hon Lap	30.4	2.00	2.00	3.96
	Dong Sim	35.0			11.5
	Hon Ga	6.0	1.8	1.8	1.8
	Thuan Ninh	78.5	32.3	32.3	32.3
	Thu Thien/Nui Thap	12.0	1.25	1.25	3.4
	Suoi Chai/Truong Son/My Thuan	32.3	6.24	6.24	6.24
	Nui Mot	110.0	108.5	108.5	108.5

**Table EA.3 Existing and Proposed Irrigation Area Considered in the Water Balance Analysis**

River	Irrigation System	Irrigation Area (ha)		
		Present	2010	2020
<b>Kone</b>	Hon Lap	210	282	430
	Vinh Thanh		328	1,340
	Van Phong			14,340
	Hon Ga	120	150	150
	Thuan Ninh	1,060	2,700	2,700
	Dong Sim		1,060	1,060
	Dap Da	3,301	4,273	7,676
	Thuan Hat	989	989	58
	Bo Ngo	866	866	
	Lao Tham	1,087	1,087	986
	Suoi Chay/Truong Son/My Thuan	936	936	936
	Go Cham	3,566	5,706	5,860
	Ha Bac	300	300	300
	Thu Tien/Nui Thap	120	342	342
	Nui Mot	2,920	2,920	3,000
	Tan An	4,215	4,215	4,716
	Nha Phu	563	563	
Ha Thanh			2,039	
<b>La Tinh</b>	Cay Gai	-	-	5,014
	Cay Ke	-	-	1,280

Remarks: Water demand at the present water intake location are shown in the table in terms of irrigation area.

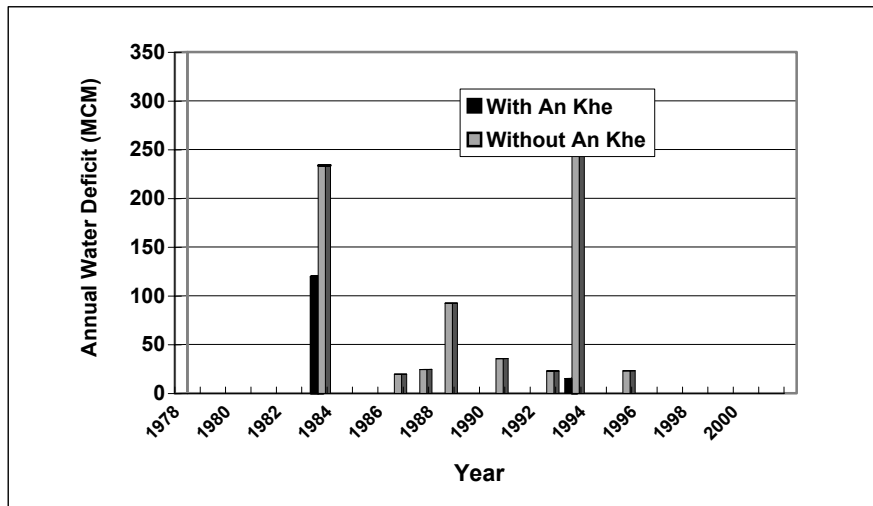
**Table EA.4 Water Deficit Comparison Between With/Without An Khe Demand 2010**  
**Dam Alternative -**

**Dinh Binh Dam:**

Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) - (Major Flood Season) -  
 (Major Flood Season) - (Late Flood Season) -  
 (Late Flood Season) -

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		117.8		
1979		88.1		
1980		40.1		
1981		94.6		
1982		55.5		
1983	119.8	0.0	233.8	
1984		60.3		
1985		42.2		
1986		9.5	19.7	
1987		4.6	24.5	
1988		4.4	92.6	
1989		108.3		
1990		2.8	35.7	
1991		26.6		
1992		6.1	23.0	
1993	15.4	0.9	310.3	
1994		73.9		
1995		0.7	23.3	
1996		117.3		
1997		117.4		
1998		34.2		
1999		132.0		
2000		132.0		
2001		117.4		

Remarks: - Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity  
 - Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above



**Table EA.5 Water Deficit Comparison Between With/Without An Khe**

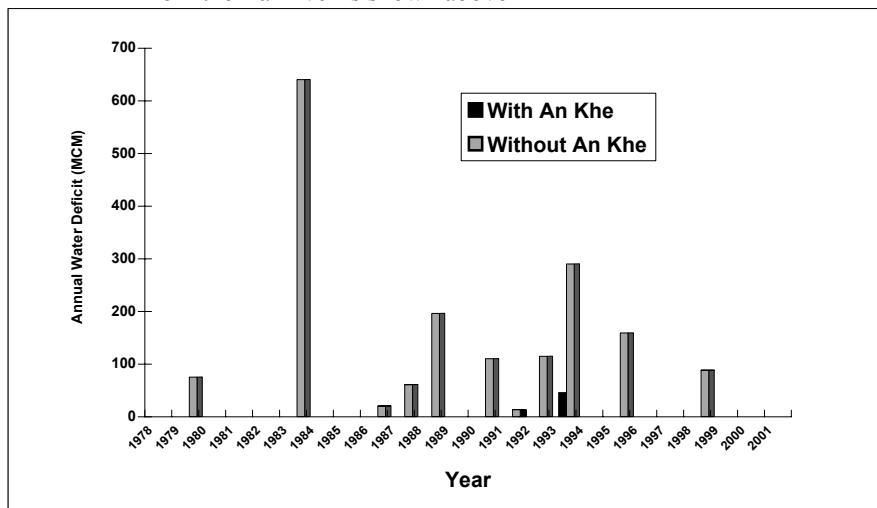
**Demand 2020**  
**Dam Alternative Alt I-1**

**Dinh Binh Dam :**

Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) 209.9 (Major Flood Season) 221.2  
 (Major Flood Season) 0.0 (Late Flood Season) 200-120-55  
 (Late Flood Season) 21.2-101.2-166.2

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		132.0		
1979		124.2	75.0	
1980		132.0		
1981		132.0		
1982		132.0		
1983	341.5	0.0	640.0	
1984		132.0		
1985		132.0		
1986		132.0	20.0	
1987		100.6	60.7	
1988		24.1	196.0	
1989		132.0		
1990		2.8	110.0	
1991		132.0	12.9	
1992		92.3	114.6	
1993	45.5	0.0	289.9	
1994		132.0		
1995		72.2	159.0	
1996		132.0		
1997		132.0		
1998		125.6	88.0	
1999		132.0		
2000		132.0		
2001		131.3		

Remarks: - Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity  
 - Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above



**Table EA.6 Water Deficit Comparison Between With/Without An Khe**

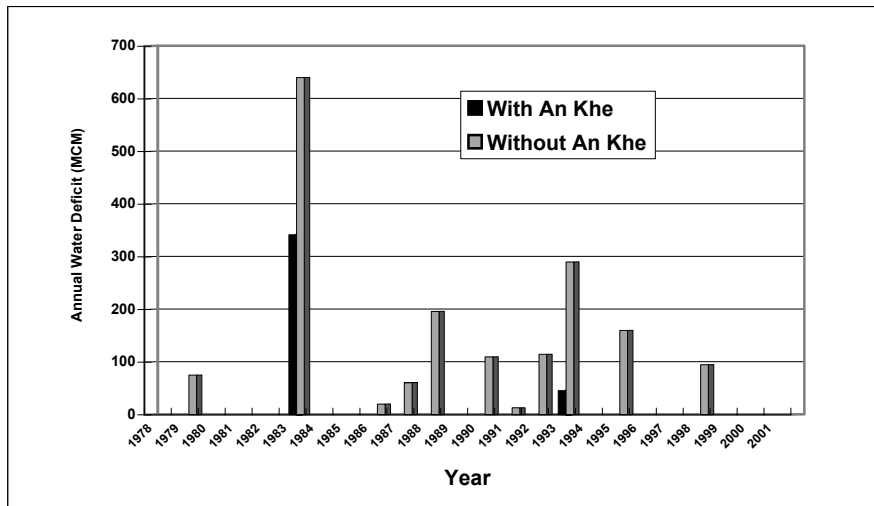
**Demand** **2020**  
**Dam Alternative** **Alt I-2**

Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) 209.9 (Major Flood Season) 121.2  
 (Major Flood Season) 100.0 (Late Flood Season) 200-120-55  
 (Late Flood Season) 21.2-101.2-166.2

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		132.0		
1979		124.2	75.0	
1980		132.0		
1981		132.0		
1982		132.0		
1983	341.5	0.0	640.0	
1984		122.9		
1985		132.0		
1986		127.0	20.0	
1987		100.6	60.7	
1988		24.1	196.0	
1989		132.0		
1990		31.4	109.8	
1991		132.0	12.9	
1992		92.3	114.6	
1993	45.5	0.0	289.9	
1994		132.0		
1995		72.2	159.8	
1996		132.0		
1997		132.0		
1998		125.6	94.8	
1999		132.0		
2000		132.0		
2001		132.0		

Remarks: - Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity

- Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above





**Table EA.7 Water Deficit Comparison Between With/Without An Khe**

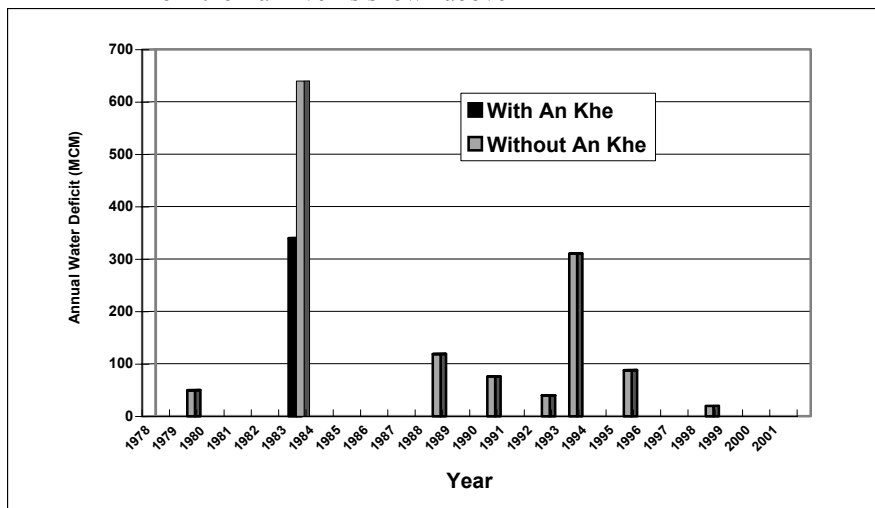
**Demand 2020**  
**Dam Alternative Alt II-1**

**Dinh Binh Dam**

Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) 279.5 (Major Flood Season) 292.8  
 (Major Flood Season) 0.0 (Late Flood Season) 200-120-55  
 (Late Flood Season) 92.8-172.8-237.8

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		132.0		
1979		119.7	50.0	
1980		132.0		
1981		132.0		
1982		132.0		
1983	340.0	0.0	640.0	
1984		122.9		
1985		132.0		
1986		126.4		
1987		132.0		
1988		89.3	119.0	
1989		132.0		
1990		2.8	76.0	
1991		132.0		
1992		125.6	40.0	
1993		23.5	310.3	
1994		132.0		
1995		132.0	88.0	
1996		132.0		
1997		132.0		
1998		132.0	20.0	
1999		132.0		
2000		132.0		
2001		129.3		

Remarks: - Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity  
 - Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above

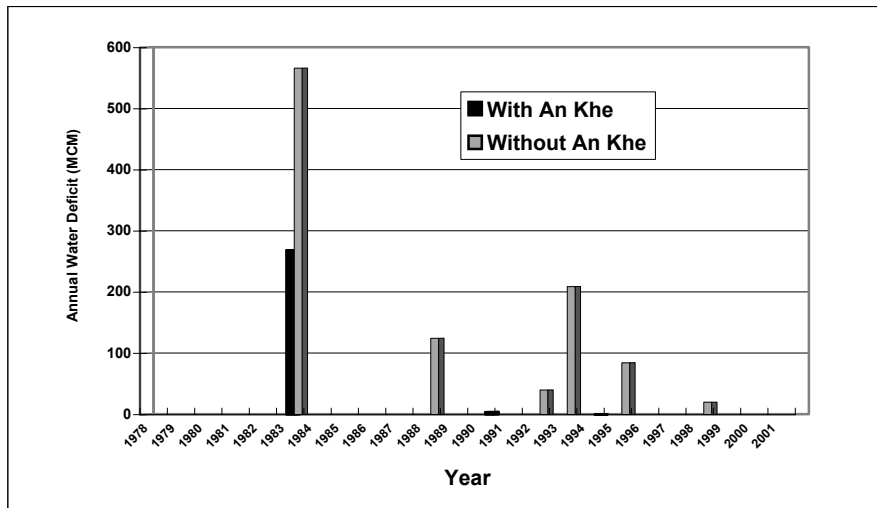


**Table EA.8 Water Deficit Comparison Between With/Without An Khe Demand 2020 Dam Alternative Alt II-2**

Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) 279.5 (Major Flood Season) 192.8  
 (Major Flood Season) 100.0 (Late Flood Season) 200-120-55  
 (Late Flood Season) 92.8-172.8-237.8

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		132.0		
1979		119.7		
1980		132.0		
1981		132.0		
1982		132.0		
1983	268.3	0.0	566.3	
1984		122.9		
1985		132.0		
1986		126.4		
1987		132.0		
1988		89.3	124.6	
1989		132.0		
1990		62.3	3.7	
1991		132.0		
1992		125.6	40.0	
1993		23.5	209.0	
1994		132.0	0.0	
1995		132.0	84.5	
1996		132.0		
1997		132.0		
1998		132.0	20.0	
1999		132.0		
2000		132.0		
2001		129.3		

Remarks: - Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity  
 - Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above



**Table EA.9 Water Deficit Comparison Between With/Without An Khe**

**Demand 2020**  
**Dam Alternative Alt IV-1**

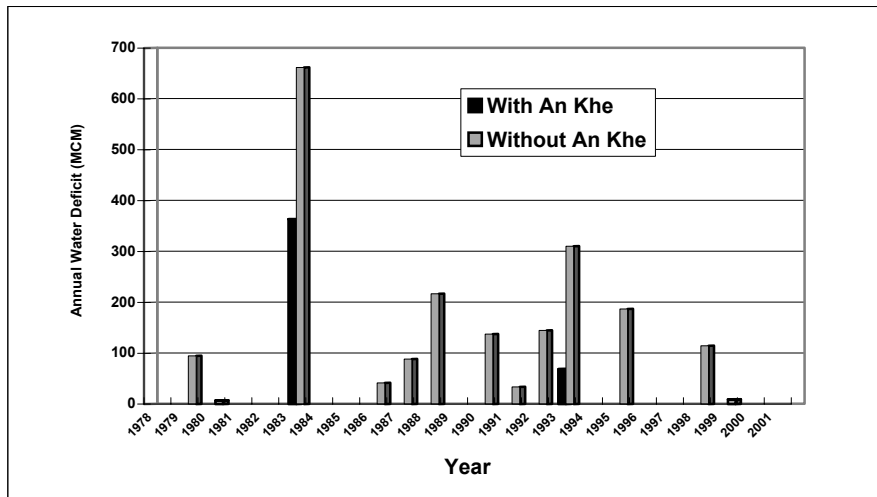
**Dinh Binh Dam**

Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) 188.8 (Major Flood Season) 200.0  
 (Major Flood Season) 0 (Late Flood Season) 200-120-55  
 (Late Flood Season) 0.0-80.0-145.0

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		132.0		
1979		122.3	94.6	
1980		132.0	6.9	
1981		132.0		
1982		132.0		
1983	363.2	0.0	661.7	
1984		127.4		
1985		132.0		
1986		125.9	41.4	
1987		80.3	88.5	
1988		3.6	216.8	
1989		132.0		
1990		2.8	137.4	
1991		129.0	33.7	
1992		74.4	144.8	
1993	68.7	0.0	310.3	
1994		132.0		
1995		50.1	186.8	
1996		132.0		
1997		126.9		
1998		49.5	114.4	
1999		132.0	9.0	
2000		132.0		
2001		104.8		

Remarks:- Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity

- Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above



**Table EA.10 Water Deficit Comparison Between With/Without An Khe**

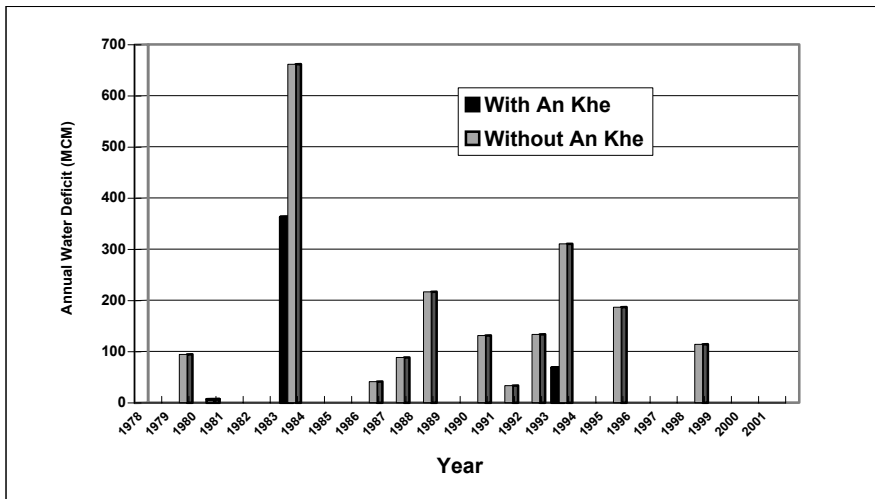
**Demand** **2020**  
**Dam Alternative** **Alt IV-2**

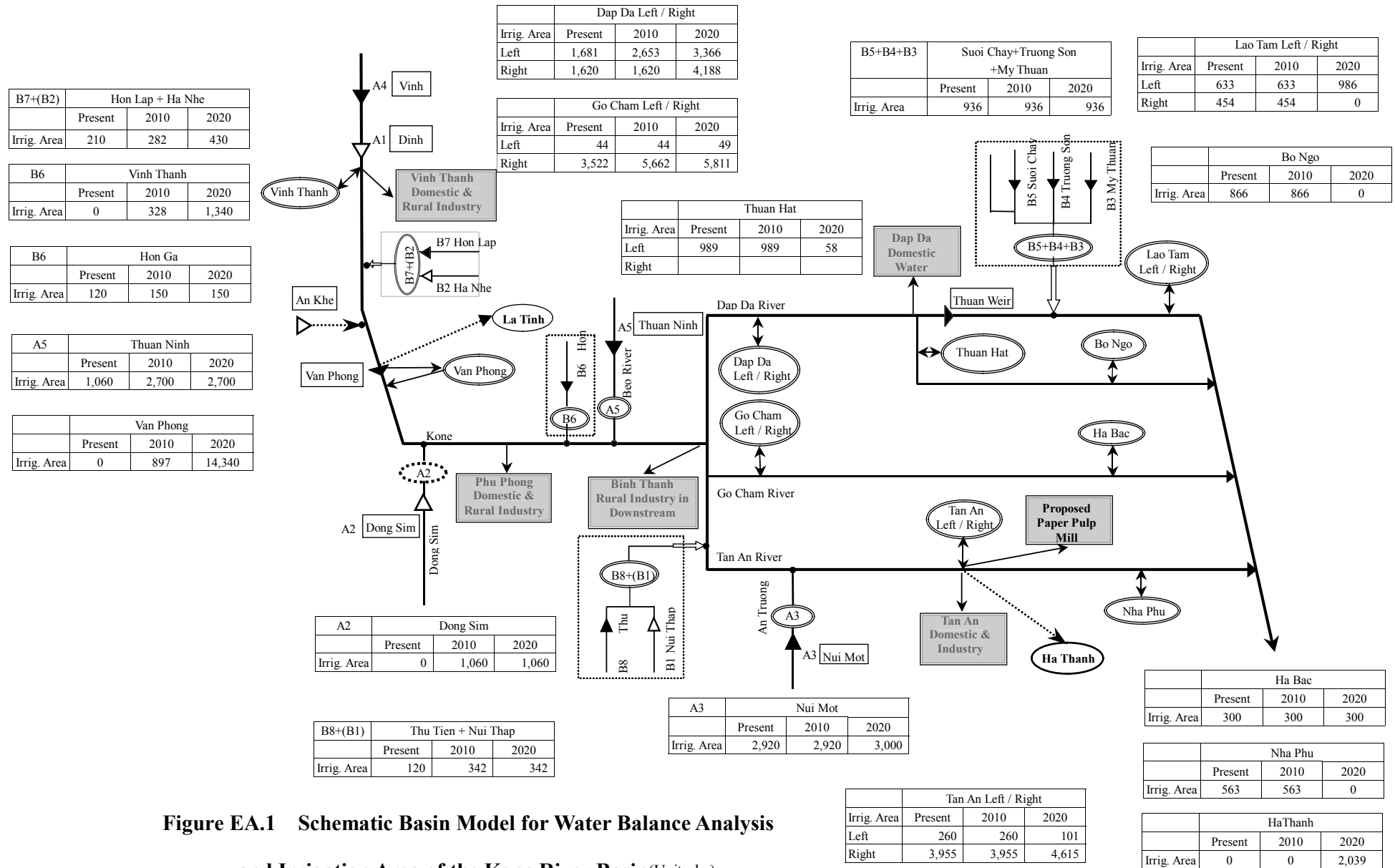
Effective Storage(MCM) : Flood Control Volume(MCM) :  
 (Non-flood season) 188.8 (Major Flood Season) 200.0  
 (Major Flood Season) 100 (Late Flood Season) 200-120-55  
 (Late Flood Season) 0.0-80.0-145.0

	With An Khe Water Transfer		Without An Khe W.T	Note
	Deficit in WholeBasin (MCM)	Lowest Storage of Vinh Son Dam (MCM)	Deficit in WholeBasin (MCM)	
1978		132.0		
1979		132.0	94.6	
1980		132.0	6.9	
1981		132.0		
1982		132.0		
1983	363.2	0.0	661.7	
1984		132.0		
1985		132.0		
1986		125.9	41.4	
1987		80.3	88.5	
1988		3.6	216.8	
1989		132.0		
1990		6.8	131.4	
1991		129.0	33.7	
1992		74.4	133.7	
1993	68.7	0.0	310.6	
1994		132.0		
1995		50.1	186.8	
1996		132.0		
1997		126.9		
1998		49.5	114.4	
1999		132.0		
2000		132.0		
2001		104.8		

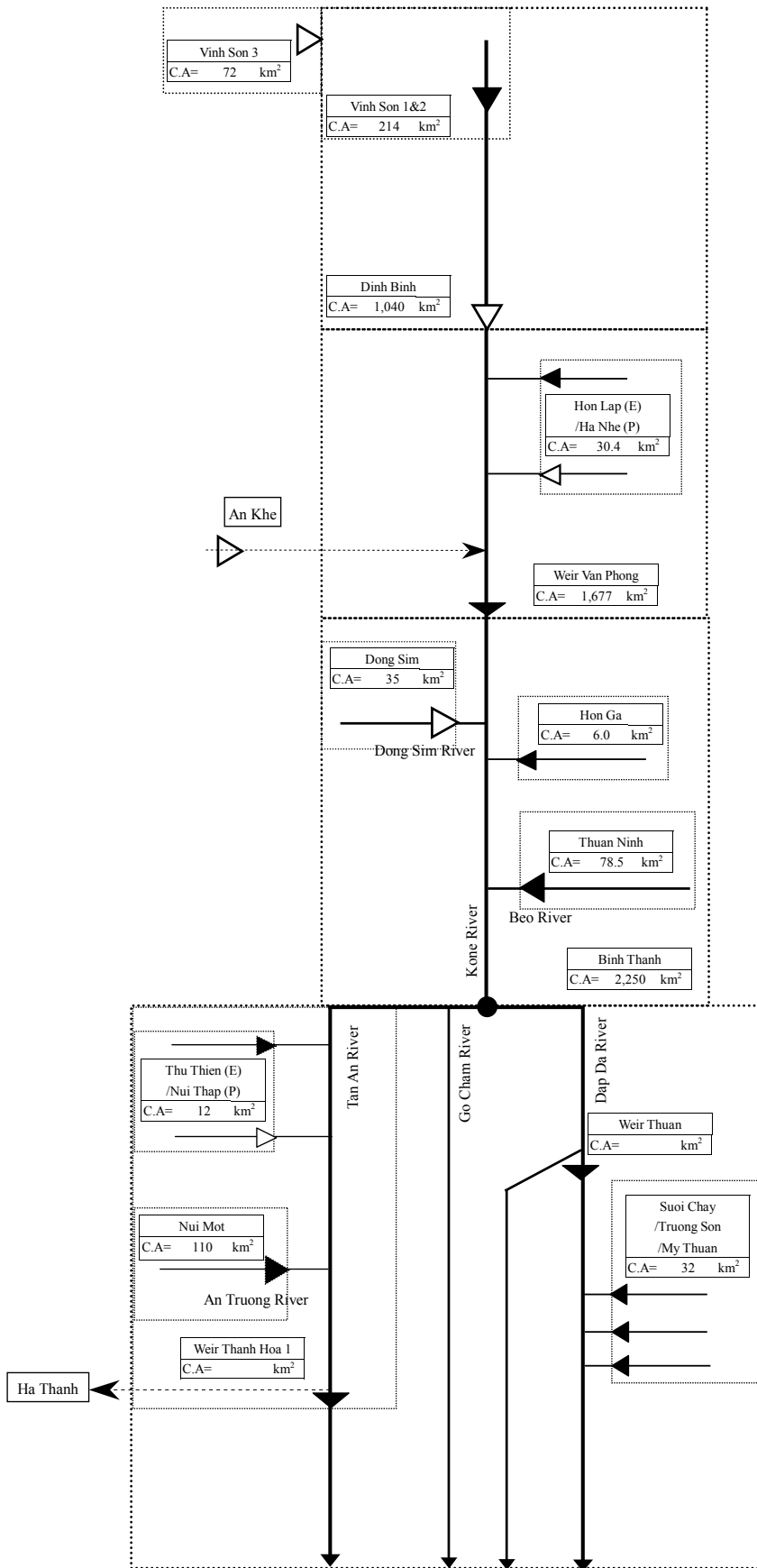
Remarks: - Shaded figure shows the lowest storage less than 50 % of the reservoir storage capacity

- Only manageable deficit by the Dinh Binh Dam and/or Transferred water from the Ba River is shown above





**Figure EA.1 Schematic Basin Model for Water Balance Analysis and Irrigation Area of the Kone River Basin (Unit : ha)**



Plan	Vinh Son 3		
	Present	2010	2020
C.A.		72.0	72.0
S-C.A.		72.0	72.0
S-Vol.		30.0	30.0

Exist.	Vinh Son 1 & 2		
	Present	2010	2020
C.A.	214	214	214
S-C.A.	214	214	214
S-Vol.	102	102	102

Plan	Dinh Binh		
	Present	2010	2020
C.A.			826
S-C.A.			1,040
S-Vol.			209.9

Exist./Plan	Hon Lap /Ha Nhe		
	Present	2010	2020
C.A.	30.4	30.4	30.4
S-Vol.	2.00	2.00	3.96

Plan	Weir Van Phong		
	Present	2010	2020
C.A.			606.6
S-C.A.			1,677
S-Vol.			-

Plan	Dong Sim		
	Present	2010	2020
C.A.	35.0	35.0	35.0
S-Vol.	0	0	11.5

Exist.	Hon Ga		
	Present	2010	2020
C.A.	6.0	6.0	6.0
S-Vol.	1.8	1.8	1.8

Exist.	Thuan Ninh		
	Present	2010	2020
C.A.	78.5	78.5	78.5
S-Vol.	32.26	32.26	32.26

	Binh Thanh		
	Present	2010	2020
C.A.	453.5	453.5	453.5
S-C.A.	2,250	2,250	2,250

Exist./Plan	Thu Thien /Nui Thap		
	Present	2010	2020
C.A.	12.0	12.0	12.0
S-Vol.	1.25	1.25	3.40

Exist.	Weir Thuan		
	Present	2010	2020
C.A.	250	250	250
S-C.A.	2,500	2,500	2,500

Exist.	Suoi Chai/ Truong Son/ My Thuan		
	Present	2010	2020
C.A.	32.3	32.3	32.3
S-Vol.	6.24	6.24	6.24

Exist.	Nui Mot		
	Present	2010	2020
C.A.	110	110	110
S-Vol.	108.53	108.53	108.53

Exist.	Weir Thanh Hoa 1		
	Present	2010	2020
C.A.	143	143	143
S-C.A.	2,515	2,515	2,515

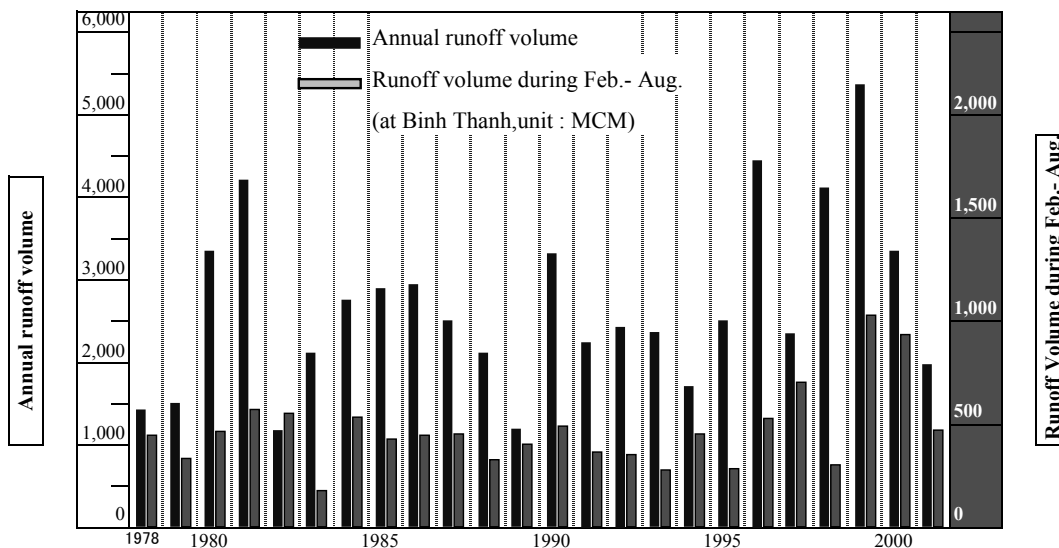
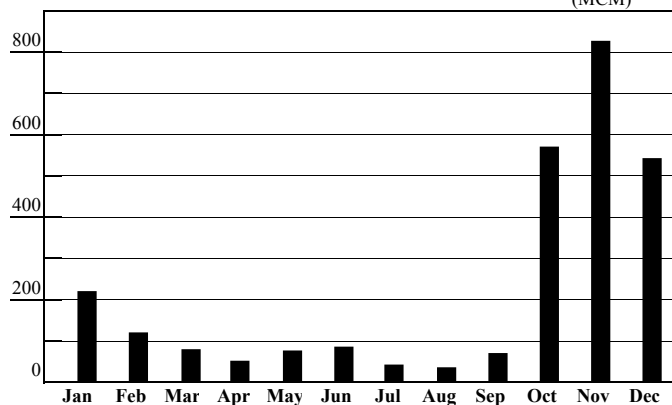
	River Mouth		
	Present	2010	2020
C.A.	606	606	606
S-C.A.	3,010	3,010	3,010

Figure EA.2 Catchment Area and Reservoir Storage Volume in the Kone River Basin

### Monthly Runoff Volume (24 years average)

(Binh Thanh)

(MCM)



The Study on Nationwide Water Resources  
Development and Management  
in the Socialist Republic of Vietnam

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure EA.3

Characteristics of Natural Runoff