

- the measures to prevent sediment deposition in front of the intake and in the flood channel will significantly reduce annual maintenance.

In view of these advantages, and the fact that Option 2 offers a substantially higher rate of return it is recommended that the diversion Option 2 be adopted.

## 9.6 Crop Water Requirements

The conventional method of estimating the project irrigation water requirement is not applicable to flood schemes where in most years, irrigation water is applied only once. The availability of irrigation water is normally less than optimum and the main factors affecting the amount of water available for plant growth are the depth of water applied during the initial irrigation and the depth and moisture holding characteristics of the soil. In order to give an indication of the deficit and hence the likely crop yields, the optimum crop water requirements have been compared with the actual soil moisture available.

The mean daily reference crop  $ET_o$ , has been calculated using the mean monthly climatic data for Sibi, which is 13 miles west and at a similar altitude to the scheme. The mean annual  $ET_o$  is 91.26 inches (2318mm), with peak daily values ranging from 0.11 inches (2.8mm) in December to 0.46 inches (11.7mm) in June. The mean monthly climatic data for Sibi, together with the mean monthly  $ET_o$  and for comparison peak daily reference crop evapotranspiration, defined as the maximum value that is likely to occur in 3 years out of 4 are given in Table 22.

For the purposes of assessing the crop water requirement, the contribution from rainfall is so low and erratic that it has been ignored. The crop water requirements, for the various crops included in the proposed cropping programme, have been derived by applying the crop factor  $K_c$  for the different growth stages, to the mean daily reference crop evapotranspiration  $ET_o$ . The crop factors are based on the values given in FAO Publication 24<sup>15</sup> for optimum plant populations, but with modifications to take account of mid-month planting. However, in practice, the planting density is likely to be less than the optimum and since the ground is kept reasonably weed free, the moisture available to individual plants will be greater than predicted. The net crop water requirements in terms of depth of application and volume per acre (acre ft) are given in Table 23.

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<sup>15</sup>Guidelines for Predicating Crop Water Requirements; FAO Irrigation and Drainage Paper 24 1984.

BMIADP - PHASE II PREPARATION STUDIES  
 CHANDIA FLOOD IRRIGATION SCHEME  
 MEAN MONTHLY CLIMATE DATA AND MONTHLY REFERENCE CROP EVAPOTRANSPIRATION (ET<sub>0</sub>) FOR SIBI  
 (File Ref: CLIMCHA)

Latitude: 29.55 deg North  
 Altitude: 436ft

	Mean Daily Temperatures		Mean Relative Humidity (%)	Mean Daily Sunshine (hrs)	Mean Wind Speed (m/s)	Mean Monthly ET <sub>0</sub> (mm)	Peak Monthly ET <sub>0</sub> (mm)
	Maximum (deg C)	Minimum (deg C)					
Note	1	1	1	1	1	2	3
January	21.5	6.1	46	7.4	.77	80	88
February	24.7	9.6	40.5	7.9	1.03	105	116
March	30.6	15.4	43.5	8.4	1.24	163	179
April	37.5	21.6	27	9.1	1.37	223	245
May	43.3	27.4	25	9.6	1.71	295	325
June	45.3	30.8	31	11.8	2.01	319	351
July	42.3	30.8	45.5	10.1	2.18	295	325
August	40.8	29.6	50	10.2	1.88	263	289
September	40.1	26.5	42	10.9	1.33	221	243
October	36.8	18.8	30.5	10.3	.94	169	186
November	30.5	12.1	35	8.9	.68	106	117
December	24.3	7.2	41.5	7.7	.6	79	87

Notes:

1. Mean monthly climatic normals (Ref: Meteorological Department - Karachi)
2. Mean monthly ET<sub>0</sub> determined using CROPWAT 5.2 program based on Penman Method (Ref: FAO 24)
3. Corrected peak daily ET<sub>0</sub> defined as the maximum ET<sub>0</sub> that is likely to occur in 3 years out of 4 (Ref: FAO 24, fig 10)

TABLE 23

CROP WATER REQUIREMENTS

BHAIAP - PHASE II PREPARATION STUDIES  
 CHANDIA FLOOD IRRIGATION SCHEME  
 OPTIMUM CROP WATER REQUIREMENT  
 (File Ref: INROJIAN)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>EVAPOTRANSPIRATION (based on data for Sibi)</b>												
Mean Daily Eto (mm)	2.59	3.75	5.26	7.43	9.5	10.62	9.51	8.47	7.37	5.44	3.52	2.54
Mean Monthly Eto (mm)	80	105	163	223	295	319	295	263	221	169	106	79
Peak Daily Eto (mm)	2.85	4.13	5.79	8.17	10.45	11.68	10.46	9.32	8.11	5.98	3.87	2.79
<b>RAINFALL (Sibi)</b>												
Monthly 50% exceedance (mm)	5	6	5	2	0	0	22	11	0	0	0	0
Monthly 80% exceedance (mm)	0	0	0	0	0	0	3	0	0	0	0	0
<b>SORGHUM INTER-CROPPED (SPRING PLANTED)</b> (50% nominal plant population)												
Crop Coeff - plant crop			.09	.26	.43	.18		.26	.43	.50	.25	.18
first ratoon												
Net Mean Daily IWR (mm)	.00	.00	.47	1.93	4.09	1.93	1.71	2.20	3.17	2.72	.88	.46
Net Mean Daily Volumetric IWR per Acre (cu ft)	0	0	68	276	584	273	245	315	453	389	126	65
<b>MUNG INTER-CROPPED (SPRING PLANTED)</b> (50% nominal plant population)												
Crop Coefficient			.18	.35	.53	.35		.00	.00	.00	.00	.00
Net Mean Daily IWR (mm)	.00	.00	.95	2.60	5.04	3.72	.00	.00	.00	.00	.00	.00
Net Mean Daily Volumetric IWR per Acre (cu ft)	0	0	135	372	720	531	0	0	0	0	0	0
<b>SORGHUM AND MUNG (SPRING PLANTED)</b>												
Crop Coefficient	0	0	.27	.61	.96	.53	.18	.26	.43	.5	.25	.18
Net Mean Daily IWR (mm)	.00	.00	1.42	4.53	9.12	5.63	1.71	2.20	3.17	2.72	.88	.46
Net Mean Daily Volumetric IWR per Acre (cu ft)	0	0	203	648	1303	804	245	315	453	389	126	65
<b>SORGHUM INTER-CROPPED (SUMMER PLANTED)</b> (50% nominal plant population)												
Crop Coeff - plant crop								.18	.35	.5	.5	.35
first ratoon												
Net Mean Daily IWR (mm)	.23	.68	1.84	3.72	.00	.00	.00	1.52	2.58	2.72	1.76	.89
Net Mean Daily Volumetric IWR per Acre (cu ft)	33	96	263	531	0	0	0	218	369	389	252	127
<b>MUNG INTER-CROPPED (SUMMER PLANTED)</b> (50% nominal plant population)												
Crop Coefficient								.18	.35	.53	.45	.35
Net Mean Daily IWR (mm)	.00	.00	.00	.00	.00	.00	.00	1.52	2.58	2.88	1.58	.89
Net Mean Daily Volumetric IWR per Acre (cu ft)	0	0	0	0	0	0	0	218	369	412	226	127
<b>SORGHUM AND MUNG (SUMMER PLANTED)</b>												
Crop Coefficient	.09	.18	.35	.5	0	0	0	.36	.7	1.03	.95	.7
Net Mean Daily IWR (mm)	.23	.68	1.84	3.72	.00	.00	.00	3.05	5.16	5.60	3.34	1.78
Net Peak Daily Volumetric IWR per Acre (cu ft)	33	96	263	531	0	0	0	436	737	801	478	254
<b>SORGHUM (SUMMER PLANTED)</b>												
Crop Coeff - plant crop								.35	.7	1	.9	.6
first ratoon												
Net Mean Daily IWR (mm)	.47	1.31	3.68	7.43	.00	.00	.00	2.96	5.16	5.44	3.17	1.52
Net Mean Daily Volumetric IWR per Acre (cu ft)	67	188	526	1062	0	0	0	424	737	777	453	218
<b>OILSEED (SUMMER PLANTED)</b>												
Crop Coefficient								.35	.65	.9	.9	.8
Net Mean Daily IWR (mm)	.00	.00	.00	.00	.00	.00	.00	2.96	4.79	4.90	3.17	2.03
Net Mean Daily Volumetric IWR per Acre (cu ft)	0	0	0	0	0	0	0	424	685	700	453	290
<b>WHEAT (SUMMER PLANTED)</b>												
Crop Coefficient	1.05	.95	.5							.18	.55	.95
Net Mean Daily IWR (mm)	2.12	3.56	2.63	.00	.00	.00	.00	.00	.00	.98	1.94	2.41
Net Mean Daily Volumetric IWR per Acre (cu ft)	389	509	376	0	0	0	0	0	0	140	277	345

Notes:

1. Eto calculations based on mean monthly climatic data for Sibi
2. Eto determined using CROMKAT 5.2 program based on Penman method (Ref: FAO 24)
3. Peak daily Eto defined as the maximum Eto that is likely to occur in 3 years out of 4 (Ref: FAO 24, Fig 10)
5. 80% reliable rainfall defined as the monthly rainfall that is exceeded in 4 years out of 5
6. The contribution from rainfall has been ignored.
7. Crop coefficients based on FAO 24, but modified to reflect scheme specific farming operations
8. Sorghum and mung are inter-cropped, so plant population for both is half the optimum, so crop coefficients are also reduced by 50%

TABLE 24

## MEAN SEASONAL CROP WATER REQUIREMENT PER ACRE

BMIADP - PHASE II PREPARATION STUDIES  
 CHANDIA FLOOD IRRIGATION SCHEME  
 MEAN SEASONAL CROP WATER REQUIREMENT PER ACRE  
 (File Ref: IWRCHAN)

Depth of water impounded per irrigation: 2 ft  
 Field irrigation efficiency: 70 %  
 Net depth of application per season: 1.4 ft

CROP	OPTIMUM IRRIGATION Volume (cu ft)	Depth (ft)	Proportion of Optimum Applied (%)
Sorghum/Mung Inter-Cropped: (Spring Planted)			
- plant crop	90260	2.07	68
- first ratoon	48776	1.12	125
Sorghum/Mung Inter-Cropped: (Summer Planted)			
- plant crop	82666	1.90	74
- first ratoon	27818	.64	219
Sorghum (Summer Planted)			
- plant crop	79688	1.83	77
- first ratoon	55485	1.27	110
Oilseed (Summer Planted)	77948	1.79	78
Wheat (Summer Planted)	61285	1.41	100

## Notes:

1. Where sorghum and mung are inter-cropped, the plant population for both is half the optimum, ie the crop coefficients are 50% of the recommended.

