D. IRRIGATION AND DRAINAGE

ANNEX D. IRRIGATION AND DRAINAGE

D-1. Irrigation(M/P)

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Table D-1-1 Irrigation Command Area In Study Area

Block Name	Irrigation Canal						Total Area	
	Nubariya C. (R)		Khandak C. (L)		Mahmoudia C. (L)			
	(ha)	(fed)	(ha)	(fed)	(ha)	(fed)	(ha)	(fed)
Qalla	-	-	-	-	5,880	14,000	5,880	14,000
Abis	-	-	-	-	3,780	9,000	3,780	9,000
Hares	26,600	63,330	-	-	-	-	26,600	63,330
Dishudi	-	-	-	-	15,330	36,500	15,330	36,500
Truga	29,430	70,070	-	-	13,650	32,500	43,080	102,570
Shereshera	36,850	87,740	8,180	19,480	11,690	27,840	56,720	135,060
Abu Hommos	-	-	8,690	20,700	11,220	26,700	19,910	47,400
Total Area	92,880	221,140	16,870	40,180	61,550	146,540	171,300	407,860
(rate)	(54%)		(10%)		(36%)		(100%)	

Note: The figures in this table are indicated with the gross areas.

Table D-1-2 Command Area of Nubariya Canal

Name of Canal (Right Side)	Area		Name of Canal (Left Side)	Area	
	(ha)	(fed)		(ha)	(fed)
1. Ferhash	27,720	66,000	1. Tahaddi (*1)	8,610	20,500
2. Side canals	1,512	3,600	2. Naser (*1)	81,900	195,000
3. Hager	42,000	100,000	3. Naser (surface)	58,800	140,000
4. Side canals	6,678	15,900	4. Ammer	7,140	17,000
5. Amlak (1-10)	8,421	20,050	5. Horeya	1,680	4,000
6. Abdel Kader	1,554	3,700	6. Thaura	14,700	35,000
7. Idris	504	1,200	7. North Tahrir	8,190	19,500
8. Emara	739	1,760	8. Mariubles	1,680	4,000
9. Waseff	1,218	2,900	9. Mariut	27,300	65,000
10. Zewel	840	2,000			
11. Bank	483	1,150			
12. Side canal	92	220			
13. Edward	1,134	2,700			
14. Kasami	294	700			
15. Haddad	1,344	3,200			
16. Sheffer	756	1,800			
17. Side canal	1,806	4,300			
18. Mustarak	10,080	24,000			
19. Side canal	4,956	11,800			
20. Hager Ext.	11,340	27,000			
21. Hares (1-4)	11,130	26,500			
Sub-total	134,600	320,480	Sub-total	210,000	500,000
Total (Right Side + Left Side)				344,600	820,480

Source: Nubariya Irrigation Directorate (Amiriya)
Note: Areas in this table are gross areas.
(*1) for sprinkler irrigation

Table D-1-3 Command Area of Mahmoudia Canal

Name of Canal (Right Side)	Area (ha)	Area (fed)	Name of Canal (Left Side)	Area (ha)	Area (fed)
1. Hadida	1,450	3,460	1. Rahmania	60	140
2. Nokla	1,450	3,460	2. Zarkun	400	950
3. Side Bably	140	340	3. Aukauf	620	1,470
4. Side Arabain	190	450	4. Khadra	1,260	3,000
5. Minacy	3,780	9,000	5. Shahaly	630	1,500
6. Side Zarkun	130	310	6. Zawyet Naim	1,260	3,000
7. Side Naser	560	1,330	7. Karawy	840	2,000
8. Abdel Aal	100	230	8. Rezka	2,180	5,200
9. Side Zawya	320	770	9. Kenawaya	2,390	5,700
10. Sharaf	130	320	10. Abu Tahuna	2,310	5,500
11. Herfa	2,810	6,700	11. EL Zeny	2,730	6,500
12. Kammahin	2,730	6,500	12. Mahalet Keel	2,730	6,500
13. Basentway	2,810	6,700	13. Kasaida	630	1,500
14. Hammamy	460	1,100	14. Koum Elbuss	2,100	5,000
15. Berka	840	2,000	15. Sidi Azab	1,260	3,000
16. S.K. EL Dawar	320	760	16. Kafla	1,430	3,400
17. Adleya	310	740	17. Maamal	840	2,000
18. Kanobeya	4530	10,780	18. Ekaab	870	2,080
19. ElKoum	140	330	19. Koum Nefra	350	840
20. Kanayes	670	1,590	20. Balakter	2,520	6,000
21. Defshow	1790	4,260	21. Desuness	1,150	2,730
22. Naseri	2010	4,770	22. Lokin	560	1,330
23. Caryon	2390	5,680	23. Side Zahara	550	1,300
24. Gharraka	170	410	24. Zahara	1,460	3,470
25. Habib	190	450	25. Koum EL Bassal	420	1,000
26. Kom ElNos	820	1,960	26. Baslakoun	2,690	6,400
27. Defshow br.	290	690	27. Awad	1,010	2,410
28. Mahroussa	770	1,850	28. Shk. Hassan	640	1,520
29. Khat ElNar	700	1,660	29. Side Saarania	660	1,570
30. Wasla	2,100	5,000	30. Saarania	700	1,670
31. Keer	1,140	2,710	31. Zaalat	520	1,230
32. Akrisha	1,340	3,200	32. Sidi Gazi	900	2,150
33. R. Kadima	940	2,230	33. Yosree	570	1,360
34. Wastany	1,180	2,820	34. Saarania Ext.	2,230	5,300
35. Lehoum	420	1,000	35. Side Nazir	210	500
36. Khorshed	780	1,870	36. Old Abis	650	1,540
37. Tawfeeky	330	780	37. New Abis	6,720	16,000
38. Montazah	1,400	3,320	38. Bad EL Haque	630	1,500
39. Qalla	440	1,040	39. Side K. Osman	470	1,120
40. R. Bahhareya	170	410	40. Beda	2,350	5,600
41. Gharby	500	1,180	41. Kodah	340	800
42. Nashed	140	330	42. Giziret Gamaa	1,550	3,700
43. Maamoura	1,260	2,990	43. Mariut	7,050	16,800
44. Roketa (drink)			44. Drinking Canal		
			45. Malaha	1,350	3,220
			46. Side Aref	250	600
			47. Qalla	440	1,040
			48. Abu Soud	90	220
Sub-total	45,140	107,480	Sub-total	63,570	151,360
Total (Right Side + Left Side)				108,710	258,840

Source; Behera Irrigation Directorate (Damanhur)
Note; Areas in this table are gross areas.

FIGURE D-1-1 IRRIGATION MAP AND EXISTING RE-USE PLAN

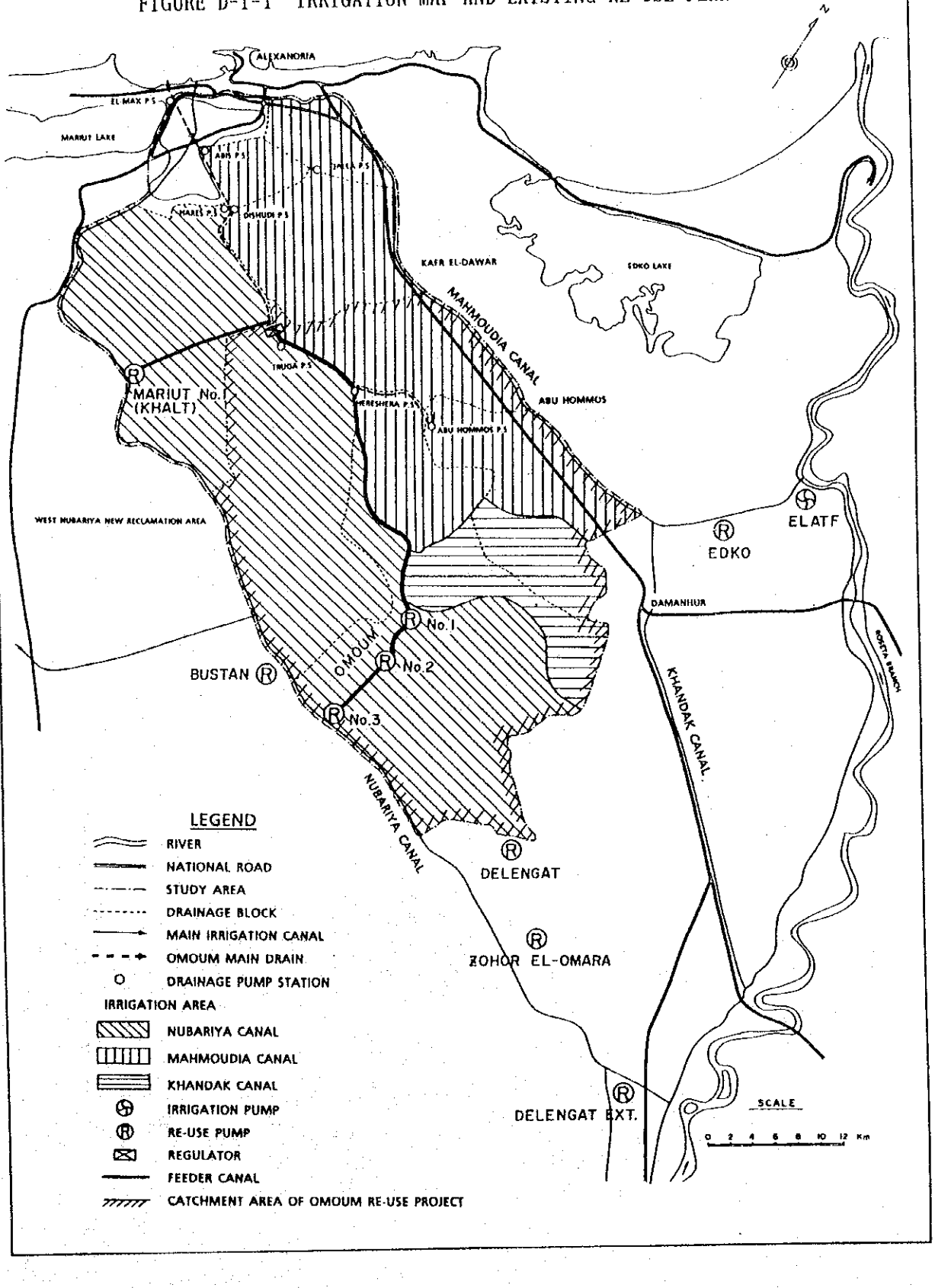


FIGURE D-1-2 WATER BALANCE OF NUBARIYA CANAL IN 1993

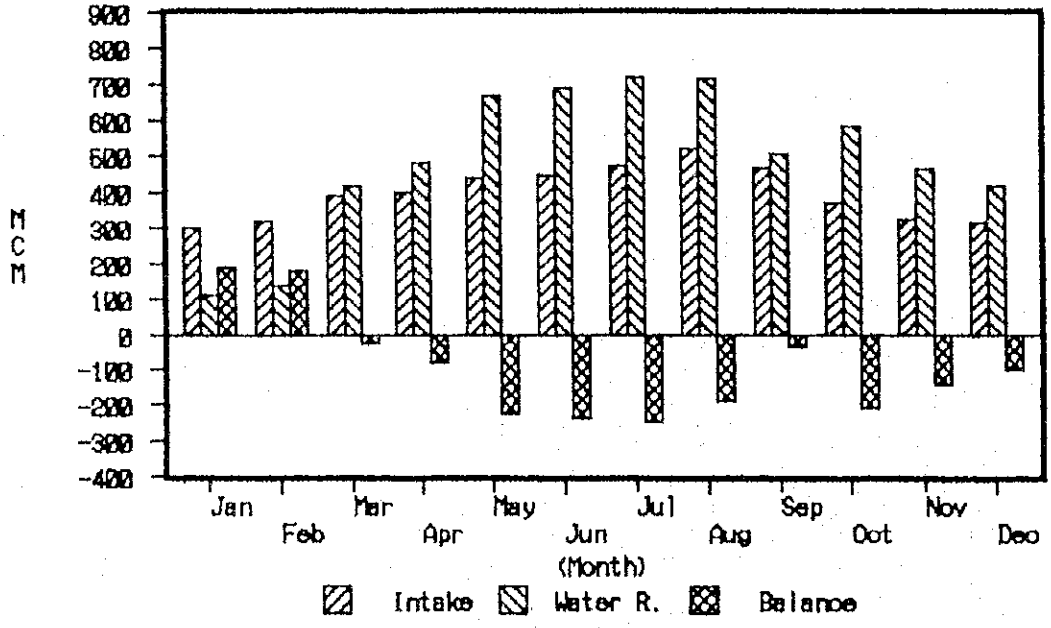


FIGURE D-1-3 WATER BALANCE OF MAHMOUDIA CANAL IN 1993

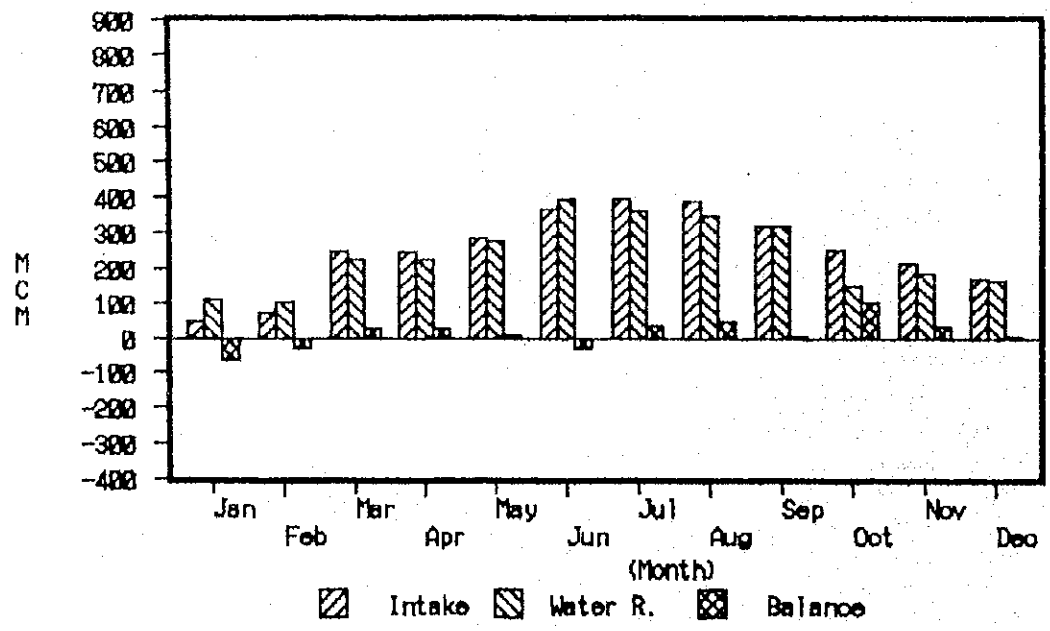


Table D-1-4 Intake Discharge of Nubariya Canal in 1993

Month	Intake Discharge (*1)		Re-use Pume (*2)				Total Intake ①
	Behery Rayah C. (MCM)	Nasery Rayah C. (MCM)	Delengat Extention (MCM)	Delengat (*3) (MCM)	Bustain (*3) (MCM)	Mariut 1 (*3) (MCM)	(MCM)
Jan	230.6	45.4	3.7	17.2	2.7	0.0	299.6
Feb	173.8	117.6	2.6	12.2	2.4	9.1	317.7
Mar	213.9	140.9	3.4	16.4	3.0	12.2	389.8
Apr	251.7	120.5	4.3	16.6	4.0	5.4	402.5
May	302.1	105.3	4.9	15.9	3.7	9.6	441.5
Jun	273.7	151.5	4.1	13.9	3.8	2.4	449.4
Jul	284.2	159.6	5.0	15.6	4.7	4.0	473.1
Aug	322.3	167.6	6.5	16.6	5.2	4.7	522.9
Sep	299.1	134.0	6.4	19.7	5.3	3.7	468.2
Oct	237.5	100.4	5.6	20.6	4.6	3.9	372.6
Nov	238.9	53.2	2.8	17.1	6.6	3.8	322.4
Dec	242.2	49.3	2.2	17.0	3.0	3.1	316.8
Total	3,070.0	1,345.3	51.5	198.8	49.0	61.9	4,776.5

Source: (*1) Nubariya Irrigation Directorate
(*2) Reuse Monitoring Report (DRI)
Note: (*3) data in 1992

Table D-1-5 Water Balance of Nubariya Canal in 1993

Month	Irrigation Water Requirement				Others (*5)	Total Water R. ②	Water Balance ①—②
	Unit Water Req. (*4)		Right S. 320,480F	Left S. 500,000F			
	Surface (m3/F/D)	Sprinkler (m3/F/D)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
Jan	6.0	8.5	19.2	35.4	52.7	107.3	192.3
Feb	12.0	8.5	38.5	52.5	47.6	138.5	179.2
Mar	15.5	11.0	154.0	210.2	52.7	416.9	-27.1
Apr	19.0	13.5	182.7	249.4	51.0	483.1	-80.6
May	26.0	18.5	258.3	352.9	52.7	663.9	-222.4
Jun	28.0	20.0	269.2	368.3	51.0	688.5	-239.1
Jul	28.0	21.0	278.2	387.2	52.7	718.1	-245.0
Aug	28.0	20.0	278.2	380.6	52.7	711.4	-188.5
Sep	20.0	14.0	192.3	261.2	51.0	504.5	-36.3
Oct	22.6	16.0	223.5	305.3	52.7	581.6	-209.0
Nov	18.5	12.0	177.9	235.5	51.0	464.3	-141.9
Dec	15.5	11.0	154.0	210.2	52.7	416.9	-100.1
Total	19.9 (*5)	14.5 (*5)	2,225.9	3,048.6	620.5	5,895.0	-1,118.5

Source: (*4) from Nubariya Irrigation Directorate
(*5) Others include Evaporation from canal, Drinking water, Navigation and Industry water (0.5 + 0.7 + 0.4 + 0.1 MCM/day).
(*6) Annual mean
Assumed actual intake coefficient = 4,776.5MCM / 5,895.0MCM = 0.81

Table D-1-6 Intake Discharge of Mahmoudia Canal in 1993

Month	Intake Discharge (*1)		Re-use (*2)				Total Intake ①
	EL ATF Pump		EL Kandak	Edko			
	No.1 (MCM)	No.2 (MCM)	(MCM)	(MCM)			(MCM)
Jan	17.7	5.6	12.8	8.4			44.5
Feb	25.0	30.2	12.3	5.0			72.5
Mar	105.3	100.8	38.0	5.2			249.3
Apr	109.3	97.7	39.2	3.2			249.4
May	133.3	102.2	43.8	6.2			285.5
Jun	136.6	135.7	78.7	15.5			366.5
Jul	132.4	154.9	84.0	23.0			394.3
Aug	132.2	151.9	82.4	25.9			392.4
Sep	115.9	119.7	52.5	30.7			318.8
Oct	96.7	93.0	40.9	23.4			254.0
Nov	82.3	85.1	37.8	11.1			216.3
Dec	53.7	73.3	28.5	13.6			169.1
Total	1,140.4	1,150.1	550.9	171.2			3,012.6

Source: (*1) Behera Irrigation Directorate
(*2) Reuse Monitoring Report (DRI)

Table D-1-7 Water Balance of Mahmoudia Canal in 1993

Month	Irrigation Water Requirement			Others (*4)		Total Water R. ②	Water Balance ①—②
	Unit W.R. (*3)	Right S. 107,480F	Left S. 151,360F	Right S.	Left S.		
	(m3/F/D)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
Jan	15.0	16.1	22.7	23.3	46.5	108.6	-64.1
Feb	15.0	16.1	22.7	21.0	42.0	101.8	-29.3
Mar	16.0	53.3	75.1	31.0	62.0	221.4	27.9
Apr	16.9	54.5	76.7	30.0	60.0	221.2	28.2
May	23.0	76.6	107.9	31.0	62.0	277.6	7.9
Jun	36.5	117.7	165.7	37.5	75.0	395.9	-29.4
Jul	30.9	103.0	145.0	38.8	77.5	364.2	30.1
Aug	28.7	95.6	134.7	38.8	77.5	346.6	45.8
Sep	26.4	85.1	119.9	37.5	75.0	317.5	1.3
Oct	7.3	24.3	34.3	31.0	62.0	151.6	102.4
Nov	12.0	38.7	54.5	30.0	60.0	183.2	33.1
Dec	12.0	40.0	56.3	23.3	46.5	166.1	3.0
Total	20.0 (*5)	721.1	1,015.5	373.2	746.0	2,855.7	156.9

Source: (*3) Behera Irrigation Directorate in 1994
Note: (*4) Alexandria water supply and domestic drinking water
(*5) Annual mean
Assumed actual intake coefficent = 3,012.6MCM / 2,855.7MCM = 1.05

Table D-1-8 Intake Discharge of Mahmoudia Canal (1989-1993)

Month	1989					1990				
	EL ATF Pump (*1)		Re-use (*2)		Total Intake (MCM)	EL ATF Pump (*1)		Re-use (*2)		Total Intake (MCM)
	No. 1+2 (MCM)	(MCM)	Kandak (MCM)	Edko (MCM)		No. 1+2 (MCM)	(MCM)	Kandak (MCM)	Edko (MCM)	
Jan	28.0		46.7	9.6	84.3	45.4		38.4	11.3	95.1
Feb	116.7		22.7	NA	139.4	80.3		16.0	1.8	98.1
Mar	115.1		71.1	10.1	196.3	101.3		40.5	14.7	156.5
Apr	172.5		44.4	12.8	229.7	165.3		62.1	15.1	242.5
May	192.2		82.2	10.4	284.8	190.1		58.3	14.1	262.5
Jun	233.6		98.5	13.9	346.0	255.1		85.7	19.1	359.9
Jul	255.7		102.5	17.9	376.1	281.9		82.0	28.2	392.1
Aug	262.1		98.0	17.6	377.7	281.1		57.5	26.7	365.3
Sep	220.5		77.4	13.7	311.6	234.2		69.0	24.0	327.2
Oct	138.4		50.2	15.8	204.4	159.3		62.6	20.2	242.1
Nov	120.0		60.6	15.6	196.2	175.6		48.1	4.0	227.7
Dec	2.3		94.5	11.3	108.1	120.6		6.4	14.6	141.6
Total	1857.1		848.8	148.7	2854.6	2090.2		626.6	193.8	2910.6

Month	1991					1992				
	EL ATF Pump (*1)		Re-use (*2)		Total Intake (MCM)	EL ATF Pump (*1)		Re-use (*2)		Total Intake (MCM)
	No. 1+2 (MCM)	(MCM)	Kandak (MCM)	Edko (MCM)		No. 1+2 (MCM)	(MCM)	Kandak (MCM)	Edko (MCM)	
Jan	108.7		42.3	13.0	164.0	5.7		11.7	9.0	26.4
Feb	101.1		21.8	NA	122.9	11.9		7.8	2.3	22.0
Mar	134.0		41.4	20.1	195.5	116.3		41.8	6.4	164.5
Apr	185.6		46.2	17.7	249.5	199.6		49.5	10.5	259.6
May	192.6		54.0	15.0	261.6	196.3		65.4	11.8	273.5
Jun	244.6		91.2	29.0	364.8	239.9		82.3	17.9	340.1
Jul	275.0		92.1	24.0	391.1	260.7		87.2	27.0	374.9
Aug	288.2		80.8	26.9	395.9	279.7		79.1	29.3	388.1
Sep	217.6		81.0	32.1	330.7	237.4		65.8	30.3	333.5
Oct	196.3		59.6	26.3	282.2	192.0		45.0	22.6	259.6
Nov	142.0		34.5	17.2	193.7	181.3		35.7	8.2	225.2
Dec	2.3		14.9	19.0	36.2	103.0		4.9	12.3	120.2
Total	2088.0		659.8	240.2	2988.0	2023.8		576.2	187.6	2787.6

Month	1993					Mean (1989-1993)				
	EL ATF Pump (*1)		Re-use (*2)		Total Intake (MCM)	EL ATF Pump (*1)		Re-use (*2)		Total Intake (MCM)
	No. 1 (MCM)	No. 2 (MCM)	Kandak (MCM)	Edko (MCM)		No. 1+2 (MCM)	(MCM)	Kandak (MCM)	Edko (MCM)	
Jan	17.7	5.6	12.8	8.4	44.5	42.2		30.4	10.3	82.9
Feb	25.0	30.2	12.3	5.0	72.5	73.0		16.1	1.8	91.0
Mar	105.3	100.8	38.0	5.2	249.3	134.6		46.6	11.3	192.4
Apr	109.3	97.7	39.2	3.2	249.4	186.0		48.3	11.9	246.1
May	133.3	102.2	43.8	6.2	285.5	201.3		60.7	11.5	273.6
Jun	136.6	135.7	78.7	15.5	366.5	249.1		87.3	19.1	355.5
Jul	132.4	154.9	84.0	23.0	394.3	272.1		89.6	24.0	385.7
Aug	132.2	151.9	82.4	25.9	392.4	279.0		79.6	25.3	383.9
Sep	115.9	119.7	52.5	30.7	318.8	229.1		69.1	26.2	324.4
Oct	96.7	93.0	40.9	23.4	254.0	175.1		51.7	21.7	248.5
Nov	82.3	85.1	37.8	11.1	216.3	157.3		43.3	11.2	211.8
Dec	53.7	73.3	28.5	13.6	169.1	71.0		29.8	14.2	115.0
Total	1140.4	1150.1	550.9	171.2	3012.6	2069.9		652.5	188.3	2910.7

Source: (*1) Behera Irrigation Directorate
(*2) Reuse Monitoring Report (DRI)

Table D-1-9 Irrigation Water Requirement in Study Area

Month	Nubaria Right S.		Mahmoudia & Khandak		Total		
	Unit W.R. (*1) (m3/F/D)	Water R. 221,140F (MCM)	Unit W.R. (*2) (m3/F/D)	Water R. 186,720F (MCM)	Water R. 407,860F (MCM)	Mean Unit Water R. (m3/F/D)	(mm/D)
Jan	6.0	13.3	15.0	28.0	41.3	10.1	2.4
Feb	12.0	26.5	15.0	28.0	54.5	13.4	3.2
Mar	15.5	106.3	16.0	92.6	198.9	15.7	3.7
Apr	19.0	126.0	16.9	94.7	220.7	18.0	4.3
May	26.0	178.2	23.0	133.1	311.4	24.6	5.9
Jun	28.0	185.8	36.5	204.5	390.2	31.9	7.6
Jul	28.0	191.9	30.9	178.9	370.8	29.3	7.0
Aug	28.0	191.9	28.7	166.1	358.1	28.3	6.7
Sep	20.0	132.7	26.4	147.9	280.6	22.9	5.5
Oct	22.5	154.2	7.3	42.3	196.5	15.5	3.7
Nov	18.5	122.7	12.0	67.2	190.0	15.5	3.7
Dec	15.5	106.3	12.0	69.5	175.7	13.9	3.3
Total/Mean	19.0	1,535.9	18.4	1,252.7	2,788.6	18.7	4.5

Source: (*1) Nubariya Irrigation Directorate in 1993
(*2) Behera Irrigation Durectorate in 1994
Note: Irrigation period in January and February is ten days.

Table D-1-10 Irrigation Water and Drainage Discharge in Study Area

Month	Irrigation Water		Discharge of Pumps		Balance	
	Intake	Unit Q.	7 Pumps	Unit Dis.		
	① (MCM)	(mm/D)	② (MCM)	(mm/D)	①-② (MCM)	(mm/D)
Jan	40.2	0.8	174.6	3.3	-134.4	-2.5
Feb	50.9	1.1	123.4	2.6	-72.5	-1.5
Mar	183.3	3.5	165.2	3.1	18.1	0.3
Apr	201.5	3.9	150.6	2.9	50.9	1.0
May	284.2	5.4	199.7	3.8	84.5	1.6
Jun	365.1	7.1	193.2	3.8	171.9	3.3
Jul	343.3	6.5	204.9	3.9	138.4	2.6
Aug	329.9	6.2	207.9	3.9	122.0	2.3
Sep	262.8	5.1	237.9	4.6	24.9	0.5
Oct	169.3	3.2	221.8	4.2	-52.5	-1.0
Nov	170.0	3.3	174.8	3.4	-4.8	-0.1
Dec	159.0	3.0	205.2	3.9	-46.2	-0.9
Total/Mean	2,559.4	4.1	2,259.2	3.6	300.2	0.5

Note: 1) Irrigation intake water is assumed basing the actual intake discharge of NUbariya and Mahmoudia Canals in 1993
2) Discharge of drainage pumps are actual records in 1993 (DRI). ETP(Easten Treatment Plant) of Qalla P.S. is not included.

FIGURE D-1-4 IRRIGATION WATER AND DRAINAGE DISCHARGE IN STUDY AREA

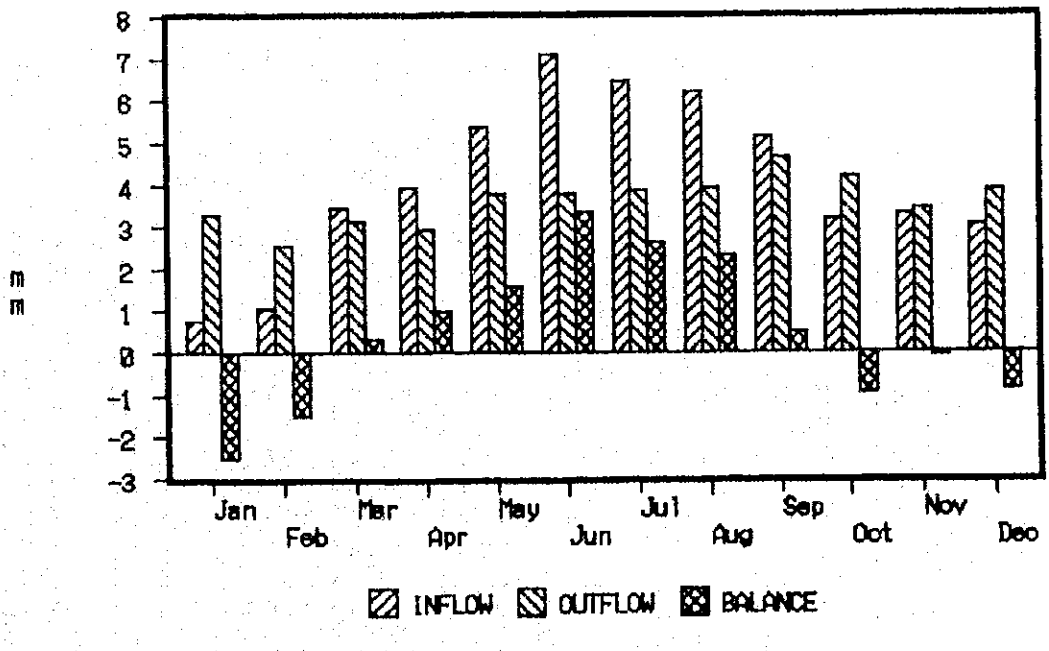


Table D-1-11 Irrigation Water and Drainage Discharge

1. Qalla Area

Month	Nubariya Canal		Mahm. & Khan.		Irri. Water		Discharge		Water Balance	
	A1= 0.0F		A2+A3= 14,000F		T.A.= 14,000F		T.A.= 14,000F			
	U.W.R.	W.R.	U.W.R.	W.R.	①+②		P.D.		③-④	
	(m3/F/D)	① (MCM)	(m3/F/D)	② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	0.0	15.0	2.2	2.2	3.8	11.1	6.1	-8.9	-4.9
Feb	12.0	0.0	15.0	2.2	2.2	3.8	9.8	6.0	-7.6	-4.6
Mar	15.5	0.0	16.0	7.3	7.3	4.0	9.5	5.2	-2.2	-1.2
Apr	19.0	0.0	16.9	7.5	7.5	4.2	13.9	7.9	-6.4	-3.7
May	26.0	0.0	23.0	10.5	10.5	5.8	17.1	9.4	-6.6	-3.6
Jun	28.0	0.0	36.5	16.1	16.1	8.8	15.0	8.5	1.1	0.6
Jul	28.0	0.0	30.9	14.1	14.1	7.7	17.2	9.4	-3.1	-1.7
Aug	28.0	0.0	28.7	13.1	13.1	7.2	18.2	10.0	-5.1	-2.8
Sep	20.0	0.0	26.4	11.6	11.6	6.6	16.3	9.2	-4.7	-2.6
Oct	22.5	0.0	7.3	3.3	3.3	1.8	15.5	8.5	-12.2	-6.7
Nov	18.5	0.0	12.0	5.3	5.3	3.0	15.3	8.7	-10.0	-5.7
Dec	15.5	0.0	12.0	5.5	5.5	3.0	14.1	7.7	-8.6	-4.7
Total	19.9	0.0	20.0	98.6	98.6	5.0	173.0	8.0	-74.4	-3.5

2. Abis Area

Month	Nubariya Canal		Mahm. & Khan.		Irri. Water		Discharge		Water Balance	
	A1= 0.0F		A2+A3= 9,000F		T.A.= 9,000F		T.A.= 9,000F			
	U.W.R.	W.R.	U.W.R.	W.R.	①+②		P.D.		③-④	
	(m3/F/D)	① (MCM)	(m3/F/D)	② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	0.0	15.0	1.4	1.4	3.8	6.4	5.5	-5.0	-4.3
Feb	12.0	0.0	15.0	1.4	1.4	3.8	5.3	5.0	-3.9	-3.7
Mar	15.5	0.0	16.0	4.7	4.7	4.0	5.9	5.0	-1.2	-1.0
Apr	19.0	0.0	16.9	4.8	4.8	4.2	4.8	4.2	0.0	0.0
May	26.0	0.0	23.0	6.7	6.7	5.8	6.1	5.2	0.6	0.5
Jun	28.0	0.0	36.5	10.3	10.3	8.8	6.9	6.1	3.4	3.0
Jul	28.0	0.0	30.9	9.1	9.1	7.7	6.1	5.2	3.0	2.5
Aug	28.0	0.0	28.7	8.4	8.4	7.2	7.3	6.2	1.1	0.9
Sep	20.0	0.0	26.4	7.5	7.5	6.6	5.7	5.0	1.8	1.6
Oct	22.5	0.0	7.3	2.1	2.1	1.8	4.4	3.8	-2.3	-1.9
Nov	18.5	0.0	12.0	3.4	3.4	3.0	4.4	3.9	-1.0	-0.9
Dec	15.5	0.0	12.0	3.5	3.5	3.0	5.1	4.4	-1.6	-1.4
Total	19.9	0.0	20.0	63.4	63.4	5.0	68.4	5.0	-5.0	-0.4

3. Hares Area

Month	Nubariya Canal		Mahm. & Khan.		Irri. Water		Discharge		Water Balance	
	A1= 69,900F		A2+A3= 0.0F		T.A.= 69,900F		T.A.= 69,900F			
	U.W.R.	W.R.	U.W.R.	W.R.	①+②		P.D.		③-④	
	(m3/F/D)	① (MCM)	(m3/F/D)	② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	3.4	15.0	0.0	3.4	1.2	50.0	5.5	-46.6	-5.1
Feb	12.0	6.8	15.0	0.0	6.8	2.3	36.3	4.4	-29.5	-3.6
Mar	15.5	27.2	16.0	0.0	27.2	3.0	41.3	4.5	-14.1	-1.5
Apr	19.0	32.3	16.9	0.0	32.3	3.7	39.4	4.5	-7.1	-0.8
May	26.0	45.6	23.0	0.0	45.6	5.0	49.1	5.4	-3.5	-0.4
Jun	28.0	47.6	36.5	0.0	47.6	5.2	50.0	5.7	-2.4	-0.3
Jul	28.0	49.1	30.9	0.0	49.1	5.4	57.8	6.4	-8.7	-1.0
Aug	28.0	49.1	28.7	0.0	49.1	5.4	55.6	6.1	-6.5	-0.7
Sep	20.0	34.0	26.4	0.0	34.0	3.9	60.3	6.8	-26.3	-3.0
Oct	22.5	39.5	7.3	0.0	39.5	4.3	61.2	6.7	-21.7	-2.4
Nov	18.5	31.4	12.0	0.0	31.4	3.6	51.0	5.8	-19.6	-2.2
Dec	15.5	27.2	12.0	0.0	27.2	3.0	55.6	6.2	-29.4	-3.2
Total	19.9	393.2	20.0	0.0	393.2	3.8	608.6	5.7	-215.4	-2.0

(continue)

4. Dishudi Area

Month	Nubariya Canal A1= 0.0F		Mahm. & Khan. A2+A3= 36,500F		Irri. Water T.A.= 36,500F ①+②		Discharge T.A.= 36,500F P.D.		Water Balance ③-④	
	U.W.R. (m3/F/D)	W.R. ① (MCM)	U.W.R. (m3/F/D)	W.R. ② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	0.0	15.0	5.7	5.7	1.2	18.5	3.9	-12.8	-2.7
Feb	12.0	0.0	15.0	5.7	5.7	1.3	16.6	3.9	-10.9	-2.5
Mar	15.5	0.0	16.0	19.0	19.0	4.0	20.2	4.3	-1.2	-0.3
Apr	19.0	0.0	16.9	19.4	19.4	4.2	17.4	3.8	2.0	0.4
May	26.0	0.0	23.0	27.3	27.3	5.8	21.1	4.4	6.2	1.3
Jun	28.0	0.0	36.5	42.0	42.0	9.1	23.8	5.2	18.2	3.9
Jul	28.0	0.0	30.9	36.7	36.7	7.7	19.9	4.2	16.8	3.5
Aug	28.0	0.0	28.7	34.1	34.1	7.2	21.8	4.6	12.3	2.6
Sep	20.0	0.0	26.4	30.4	30.4	6.6	33.0	7.2	-2.6	-0.6
Oct	22.5	0.0	7.3	8.7	8.7	1.8	24.6	5.2	-15.9	-3.4
Nov	18.5	0.0	12.0	13.8	13.8	3.0	15.3	3.3	-1.5	-0.3
Dec	15.5	0.0	12.0	14.3	14.3	3.0	19.1	4.0	-4.8	-1.0
Total	19.9	0.0	20.0	257.1	257.1	4.6	251.3	4.5	5.8	0.1

5. Truga Area

Month	Nubariya Canal A1= 63,500F		Mahm. & Khan. A2+A3= 32,500F		Irri. Water T.A.= 96,000F ①+②		Discharge T.A.= 96,000F P.D.		Water Balance ③-④	
	U.W.R. (m3/F/D)	W.R. ① (MCM)	U.W.R. (m3/F/D)	W.R. ② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	3.1	15.0	5.1	8.2	0.7	37.3	3.0	-29.1	-2.3
Feb	12.0	6.2	15.0	5.1	11.3	1.0	26.9	2.4	-15.6	-1.4
Mar	15.5	24.7	16.0	16.9	41.6	3.3	36.6	2.9	5.0	0.4
Apr	19.0	29.3	16.9	17.3	46.6	3.9	28.3	2.3	18.3	1.5
May	26.0	41.5	23.0	24.3	65.8	5.3	38.7	3.1	27.1	2.2
Jun	28.0	43.2	36.5	37.4	80.6	6.7	34.5	2.9	46.1	3.8
Jul	28.0	44.6	30.9	32.7	77.3	6.2	33.4	2.7	43.9	3.5
Aug	28.0	44.6	28.7	30.4	75.0	6.0	39.8	3.2	35.2	2.8
Sep	20.0	30.9	26.4	27.0	57.9	4.8	44.2	3.7	13.7	1.1
Oct	22.5	35.9	7.3	7.7	43.6	3.5	44.1	3.5	-0.5	0.0
Nov	18.5	28.5	12.0	12.3	40.8	3.4	34.2	2.8	6.6	0.5
Dec	15.5	24.7	12.0	12.7	37.4	3.0	41.6	3.3	-4.2	-0.3
Total	19.9	357.2	20.0	228.9	586.2	4.0	439.6	3.0	146.6	1.0

6. Shereshera Area

Month	Nubariya Canal A1= 87,740F		Mahm. & Khan. A2+A3= 47,320F		Irri. Water T.A.=135,060F ①+②		Discharge T.A.=135,060F P.D.		Water Balance ③-④	
	U.W.R. (m3/F/D)	W.R. ① (MCM)	U.W.R. (m3/F/D)	W.R. ② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	4.3	15.0	7.5	11.7	0.7	43.3	2.5	-31.6	-1.8
Feb	12.0	8.5	15.0	7.5	16.0	1.0	22.6	1.4	-6.6	-0.4
Mar	15.5	34.1	16.0	24.6	58.8	3.3	40.9	2.3	17.9	1.0
Apr	19.0	40.5	16.9	25.2	65.7	3.9	37.8	2.2	27.9	1.6
May	26.0	57.3	23.0	35.4	92.7	5.3	57.6	3.3	35.1	2.0
Jun	28.0	59.7	36.5	54.4	114.1	6.7	51.3	3.0	62.8	3.7
Jul	28.0	61.7	30.9	47.6	109.3	6.2	57.4	3.3	51.9	3.0
Aug	28.0	61.7	28.7	44.2	105.9	6.0	51.9	3.0	54.0	3.1
Sep	20.0	42.6	26.4	39.4	82.0	4.8	65.4	3.8	16.6	1.0
Oct	22.5	49.6	7.3	11.2	60.8	3.5	61.0	3.5	-0.2	0.0
Nov	18.5	39.4	12.0	17.9	57.3	3.4	44.9	2.6	12.4	0.7
Dec	15.5	34.1	12.0	18.5	52.6	3.0	58.4	3.3	-5.8	-0.3
Total	19.9	493.6	20.0	333.3	827.0	4.0	592.5	2.9	234.5	1.1

(continue)

7. Abu Hommos Area

Month	Nubariya Canal		Mahm. & Khan.		Irri. Water		Discharge		Water Balance	
	A1= 0.0F		A2+A3= 47,400F		T.A.= 47,400F		T.A.= 47,400F			
	U.W.R.	W.R.	U.W.R.	W.R.	①+②		P.D.		③-④	
	(m3/F/D)	① (MCM)	(m3/F/D)	② (MCM)	③ (MCM)	(mm/D)	④ (MCM)	(mm/D)	⑤ (MCM)	(mm/D)
Jan	6.0	0.0	15.0	7.5	7.5	1.2	8.0	1.3	-0.5	-0.1
Feb	12.0	0.0	15.0	7.5	7.5	1.3	5.9	1.1	1.6	0.3
Mar	15.5	0.0	16.0	24.7	24.7	4.0	10.8	1.7	13.9	2.3
Apr	19.0	0.0	16.9	25.2	25.2	4.2	9.0	1.5	16.2	2.7
May	26.0	0.0	23.0	35.5	35.5	5.8	10.0	1.6	25.5	4.1
Jun	28.0	0.0	36.5	54.5	54.5	9.1	11.7	2.0	42.8	7.2
Jul	28.0	0.0	30.9	47.7	47.7	7.7	13.1	2.1	34.6	5.6
Aug	28.0	0.0	28.7	44.3	44.3	7.2	13.3	2.2	31.0	5.0
Sep	20.0	0.0	26.4	39.4	39.4	6.6	13.0	2.2	26.4	4.4
Oct	22.5	0.0	7.3	11.3	11.3	1.8	11.0	1.8	0.3	0.0
Nov	18.5	0.0	12.0	17.9	17.9	3.0	9.7	1.6	8.2	1.4
Dec	15.5	0.0	12.0	18.5	18.5	3.0	10.3	1.7	8.2	1.3
Total	19.9	0.0	20.0	333.9	333.9	4.6	125.8	1.7	208.1	2.9

Note: A1,A2,A3----irrigation command area(gross) of Nubariya, Mahmoudia and Khandak canal, respectively.
T.A.---- total command area (= A1+A2+A3)
P.D.---- pump discharge data by MED
U.W.R.-- unit water requirement by Irrigation Directorates
W.R.---- intake irrigation water calculated using an irrigation command area, U.W.R. and actual intake coefficent(fi) by the Study Team.
fi------ 0.81 (Nubariya canal), 1.05 (Mahmoudia and Khandak canal)

Table D-1-12 Water Balance of Each Block in 1993

Block Name	Irri. Water (1)		Rainfall Runoff (2)		Total Inflow (3)		Pump Discharge (4)		Water Balance (5)	
	(MCM)	(mm/D)	(MCM)	(mm/D)	(1)+(2) (MCM)	(mm/D)	(MCM)	(mm/D)	(3)-(4) (MCM)	(mm/D)
Qalla	98.6	5.0	9.3	0.4	107.9	5.0	173.0	8.0	-65.1	-3.0
Abis	63.4	5.0	5.9	0.4	69.3	5.0	68.4	5.0	0.9	0.1
Hares	393.2	3.8	44.1	0.4	437.3	4.1	608.6	5.7	-171.3	-1.6
Dishudi	257.1	4.6	20.8	0.4	278.0	5.0	251.3	4.5	26.7	0.5
Truga	586.2	4.0	49.0	0.3	635.2	4.3	439.6	3.0	195.6	1.3
Shere-shera	827.0	4.0	60.9	0.3	887.8	4.3	592.5	2.9	295.3	1.4
Abu Hommos	333.9	4.6	19.9	0.3	353.8	4.9	125.8	1.7	228.0	3.1
Total	2559.4	4.1	210.0	0.3	2769.4	4.4	2259.2	3.6	510.2	0.8

Note: Drinking and sewage water is neglected in this water balance.
Inflows are calculated by the Study Team.
Pump discharges are measured by MED. But ETP of Qalla P.S. is not included.

FIGURE D-1-5 WATER BALANCE OF EACH BLOCK IN 1993

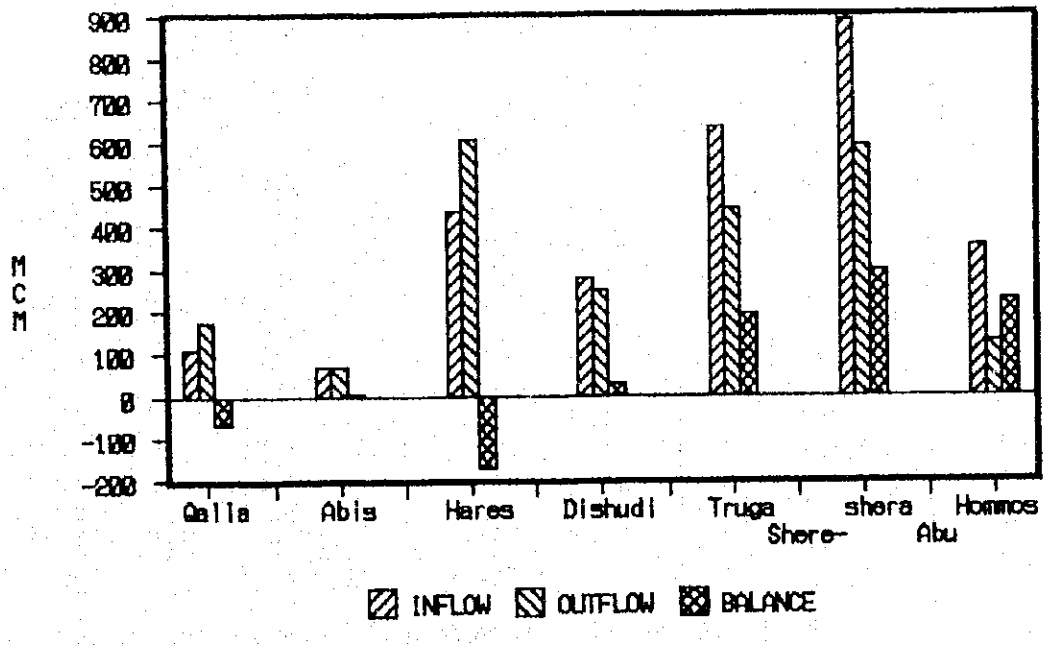


Table D-1-13 Exsisting Re-use Plan

Project Name	Kheneza	Bustan	Omoum Drain Re-use	Mariut No.1	Delengat	Edko
Drain Name (Location)	Delengat Ext (36.8km)	Tahady D. (8km)	Omoum M. (24km)	Omoum M. (23km)	Delengat D. (16km)	Edko Drain
Conveying C. (Location)	Nubaria C. (5km)	Nubaria C. (29km)	Nubaria C. (46km)	Nubaria C. (85km)	EL-Hager (25km)	Mahmoudia C
Catchment A.	50,000fed.	9,000fed.	285,000fed.	285,000fed.	70,000fed.	
Pump facility P.C.*Unit (cum/s)	3.0*3(1)	1.2*4(1)	10.0*5(1) 12.5*5(1) 12.5*5(1)	5.25*3(1)	5.0*3(1)	1.25*3(1)
Total(cum/s)	6.0	3.6	40.0-50.0	10.5cum/s	10.0cum/s	2.5cum/s
Discharge Mean Daily D. Annual (MCM)	0.160MCM	0.125MCM	4.120MCM		0.450MCM	
C.Y. 1988	NA	37	-	117	169	152
1989	NA	42	-	124	176	149
1990	NA	52	-	110	162	194
1991	NA	48	-	127	189	240
1992	NA	49	-	62	198	188
1993	52		-			
Average		46		108	179	185

Source; Nubariya Irrigation Department(Damanhour)
Note; 1. Figure in parenthesis shows a spare unit of pump.
2. There is another project that Zohor EL-Omara is under construction.
3. Omoum Drain Re-use Project has three pump stations (No.1,2 & 3). This project will start to operate in 1995. (refer to Table D-1-14)

Table D-1-14 Quantity and Quality of Mixed Water (Omoum Drain Project)

Month	Drainage W. (Omoum D.)			Pure W. (from Nubariya)			Mixed W. (Nubariya C.)		
	Dis. (MCM/M)	Salinity (ppm)	S.A.R.	Dis. (MCM/M)	Salinity (ppm)	S.A.R.	Dis. (MCM/M)	Salinity (ppm)	S.A.R.
Jan	44	2,155	20.4	166	350	1.6	210	728	7.2
Feb	33	2,545	23.8	187	350	1.6	220	677	7.0
Mar	92	2,117	25.8	263	240	1.8	355	627	9.1
Apr	91	2,303	26.1	309	290	1.5	400	647	8.3
May	79	2,228	24.2	361	300	1.7	440	646	6.7
Jun	92	2,228	25.8	378	260	1.7	470	644	7.3
Jul	85	2,281	25.3	445	265	1.7	530	590	6.3
Aug	111	2,178	22.7	359	290	1.5	470	734	7.4
Sep	125	2,084	22.1	315	330	1.9	440	798	8.6
Oct	127	1,876	20.1	233	330	1.6	360	871	7.2
Nov	56	2,084	21.5	244	340	2.9	300	668	7.3
Dec	61	2,174	27.3	239	360	1.1	300	726	6.7
Total	996	2,188	23.8	3,499	309	1.7	4,495	696	7.4
Remarks	EC=3.4 mS/cm			EC=0.48 mS/cm			EC=1.1 mS/cm		

Source; Study on the Project of Using EL-Omoum Drain Water for Irrigation Purposes (May 1984)
Note; 1) mS/cm=640ppm, 2) S.A.R.= sodium absorption ratio

Table D-1-15 Net Water Depth for Each Crop (Delta Region)

(unit; cm/month)

Crop (days)	Jan. (19)	Feb. (23)	Mar. (31)	Apr. (30)	May (31)	June (30)	July (31)	Aug. (31)	Sep. (30)	Oct. (31)	Nov. (30)	Dec. (31)	Total (348)
Winter Crop													
Wheat ①	4.3	5.5	9.6	10.5	3.4	-	-	-	-	-	4.2	4.4	41.9
Beans	4.9	6.9	9.0	4.3	-	-	-	-	-	-	4.8	4.1	34.0
Berseem S	5.3	6.3	-	-	-	-	-	-	-	-	7.9	5.0	24.5
Berseem L	5.3	6.3	9.4	14.2	11.7	-	-	-	-	-	7.9	5.0	59.8
Veg. W.②	7.7	-	-	-	-	-	-	-	6.0	8.5	10.1	9.8	42.1
Summer Crop													
Rice	-	-	-	-	-	5.0	34.2	34.7	33.9	8.8	-	-	116.6
Cotton	-	-	6.2	5.5	12.3	15.4	17.7	9.2	4.3	-	-	-	70.6
Maize	-	-	-	-	8.3	13.3	20.1	16.5	3.2	-	-	-	61.4
Sunflower	-	-	-	-	-	10.0	19.2	22.9	1.2	-	-	-	53.3
Veg. S.③	-	-	-	-	5.5	12.1	18.9	19.4	12.2	-	-	-	68.1
Perennial													
Gardens	4.7	5.8	8.2	12.9	12.9	14.6	14.6	14.0	11.7	9.3	5.8	4.7	119.2

Source; Irrigation Improvement Project Directorate(IIPD) from under TR-17 (Alexandria)
Note; 3.5cm of land preparation water (pre-irrigation) is accounted additionally in the plantary month.
①-incruding Barley, ②-mainly Potato, ③-mainly Tomato

Table D-1-16 Net Water Requirement for Each Crop (Delta Region)

(unit; m3/fed./month)

Crop (days)	Jan. (19)	Feb. (23)	Mar. (31)	Apr. (30)	May (31)	June (30)	July (31)	Aug. (31)	Sep. (30)	Oct. (31)	Nov. (30)	Dec. (31)	Total (348)
Winter Crop													
Wheat	181	231	403	441	143	-	-	-	-	-	176	185	1,760
Beans	206	290	378	181	-	-	-	-	-	-	202	172	1,428
Berseem S	223	265	-	-	-	-	-	-	-	-	332	210	1,029
Berseem L	223	265	395	596	491	-	-	-	-	-	332	210	2,512
Veg. W.	323	-	-	-	-	-	-	-	252	357	424	412	1,768
Summer Crop													
Rice	-	-	-	-	-	210	1436	1457	1424	370	-	-	4,897
Cotton	-	-	260	231	517	647	743	386	181	-	-	-	2,965
Maize	-	-	-	-	349	559	844	693	134	-	-	-	2,579
Sunflower	-	-	-	-	-	420	806	962	50	-	-	-	2,239
Veg. S.	-	-	-	-	231	508	794	815	512	-	-	-	2,860
Perennial													
Gardens	197	244	344	542	542	613	613	588	491	391	244	197	5,006

Table D-1-17 Proposed Unit Canal Water Requirement in Study Area

(unit; m3/feddan/month)

Crop	Crop Rate (%)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Net Water Requirement (*1)														
Winter Crop														
Wheat	28	51	65	113	123	40	-	-	-	-	-	49	52	493
Beans	5	10	14	19	9	-	-	-	-	-	-	10	9	71
Berseem S	25	56	66	-	-	-	-	-	-	-	-	83	53	257
Berseem L	15	33	40	59	89	74	-	-	-	-	-	50	32	377
Veg. W.	14	45	-	-	-	-	-	-	-	35	50	59	58	248
Sub-total	87	195	185	191	222	114	-	-	-	35	50	252	202	1,446
Summer Crop														
Rice	19	-	-	-	-	-	40	273	277	271	70	-	-	930
Cotton	22	-	-	57	51	114	142	164	85	40	-	-	-	652
Maize	28	-	-	-	-	98	156	236	194	38	-	-	-	722
Veg. S.	18	-	-	-	-	-	76	145	173	9	-	-	-	403
Sub-total	87	-	-	57	51	211	414	818	729	357	70	-	-	2,708
Fruit Crops	13	26	32	45	70	70	80	80	76	64	51	32	26	651
Total①	187	221	217	293	343	395	494	898	806	456	171	283	228	4,804
Unit Canal Water Requirement														
U.C.W.R. = ①/Ep (*2)		442	433	586	686	791	988	1,795	1,611	912	342	566	455	9,609

Note; (*1) Water Requirement = (Table D-1-15) /100 × 4,200m2 × Crop rate
(*2) Proposed Irrigation Efficiency (Ep) = 0.50

Table D-1-18 Proposed Canal Water Requirement in Study Area

(unit; MCM)

Block Name	Irrigated Area (fed)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Canal Water Requirement (*3)														
Abu Hommos	41,330	18	18	24	28	33	41	74	67	38	14	23	19	397
Shereshera	92,290	41	40	54	63	73	91	166	149	84	32	52	42	887
Truga	77,680	34	34	46	53	61	77	139	125	71	27	44	35	746
Dishudi	31,030	14	13	18	21	25	31	56	50	28	11	18	14	298
Hares (*4)	53,920	24	22	30	36	48	60	86	78	36	6	30	24	480
Abis	7,650	3	3	4	5	6	8	14	12	7	3	4	3	74
Qalla	11,900	5	5	7	8	9	12	21	19	11	4	7	5	114
Total	315,800	139	135	184	216	255	319	556	500	275	96	178	143	2,996

Note; (*3) = (Table D-1-17) × Proposed Irrigated Area / 1,000,000
(*4) using F/S results of Hares Area (refer to Table D-3-6)

Table D-1-19 Irrigation Excess Water in Study Area (with project)

(unit; MCM)

Block Name	Irrigated Area (fed)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Excess Water (*5)														
Abu Hommos	41,330	9	9	12	14	16	20	37	33	19	7	12	9	197
Shereshera	92,290	20	20	27	32	36	46	83	74	42	16	26	21	443
Truga	77,680	17	17	23	27	31	38	70	63	35	13	22	18	374
Dishudi	31,030	7	7	9	11	12	15	28	25	14	5	9	7	149
Hares	53,920	12	11	15	18	24	30	43	39	18	3	15	12	240
Abis	7,650	2	2	2	3	3	4	7	6	3	1	2	2	37
Qalla	11,900	3	3	3	4	5	6	11	10	5	2	3	3	58
Total	315,800	70	69	91	109	127	159	279	250	136	47	89	72	1,498

Note; (*5) = Canal Water Requirement × (1.0 - 0.50 (Proposed Irrigation Efficiency))

FIGURE D-1-6 ORGANIZATION OF IRRIGATION DIRECTORATE

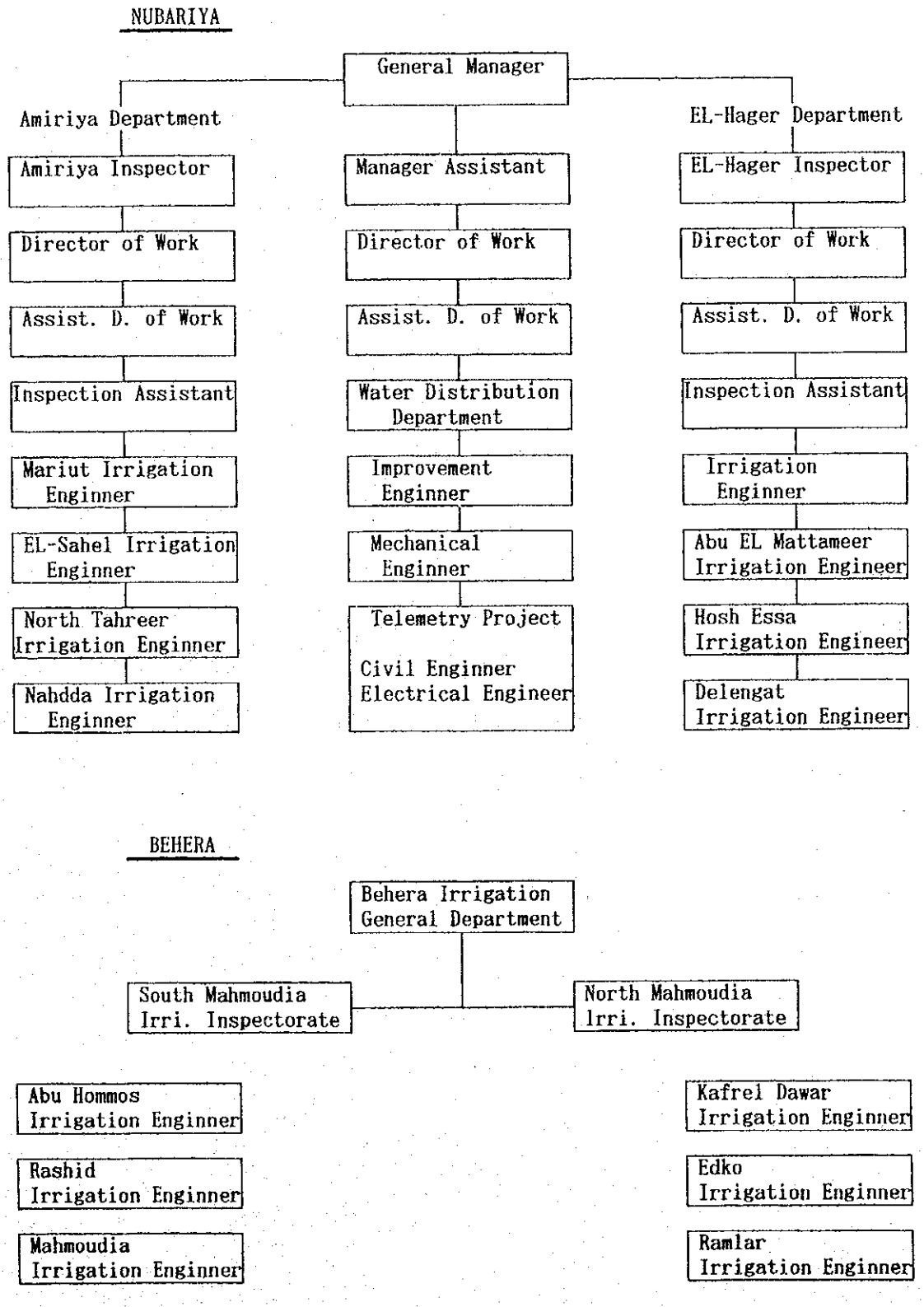


Table D-2-1 Summary of Drainage Area in Study Area

Drainage Block	Gross Area		Cultivation Area		Tile Drained Area	
	(ha)	(fed.)	(ha)	(fed.)	(ha)	(%)
			(1)		(2)	(2)/(1)
1 Qalla P.S.	5,880	14,000	5,000	11,900	0	0.0
2 Abis P.S.	3,780	9,000	3,210	7,650	0	0.0
3 Hares P.S.	26,600	63,330	22,650	53,920	210	0.9
4 Dishudi P.S.	15,330	36,500	13,030	31,030	0	0.0
5 Truga P.S.	43,080	102,570	32,620	77,680	6,180	18.9
6 Shereshera P.S.	56,720	135,060	38,760	92,290	34,250	88.4
7 Abu Hommos P.S.	19,910	47,400	17,360	41,330	17,360	100.0
Sub-total	171,300	407,860	132,630	315,800	58,000	43.7
8 Mariut Lake	9,410	22,400	(5,460)	(13,000)	0	0.0
Total (EL-Max P.S.)	180,710	430,260	132,630	315,800	58,000	43.7

Source: EPADP in Damanhur
Note: The area of Mariut Lake is calculated by the Study Team.
The value in the parenthesis means the area of water surface.

Table D-2-2 Drainage Block Area

Drainage Block	Gross Area		Cultivation Area		Tile Drained Area	
	(ha)	(fed.)	(ha)	(fed.)	(ha)	(%)
			(1)		(2)	(2)/(1)
1 Qalla P.S.	5,880	14,000	5,000	11,900	0	0.0
2 Abis P.S.	3,780	9,000	3,210	7,650	0	0.0
3 Hares P.S.						
1) Omoum left-1	1,550	3,690	1,320	3,140	0	0.0
2) Omoum left-2	1,780	4,240	1,550	3,690	0	0.0
3) Hares area-1	2,070	4,930	1,760	4,190	0	0.0
4) Hares area-2	1,880	4,480	1,600	3,810	0	0.0
5) EL Saaida-1	3,000	7,140	2,550	6,070	0	0.0
6) EL Saaida-2	1,980	4,710	1,680	4,000	0	0.0
7) Hares area-3	2,970	7,070	2,520	6,010	0	0.0
8) Hares area-4	2,500	5,950	2,130	5,060	210	9.9
9) Hares area-5	2,120	5,050	1,800	4,290	0	0.0
10) Hares area-6	2,590	6,170	2,200	5,240	0	0.0
11) Hares area-7	760	1,810	650	1,540	0	0.0
12) Abdel Hadi-1	2,300	5,470	1,950	4,650	0	0.0
13) Abdel Hadi-2	1,100	2,620	940	2,230	0	0.0
Total	26,600	63,330	22,650	53,920	210	0.9
4 Dishudi P.S.	15,330	36,500	13,030	31,030	0	0.0
5 Truga P.S.						
1) Sidi Gazy 1st	630	1,500	550	1,300	0	0.0
2) Sidi Gazy 2nd	630	1,500	540	1,280	0	0.0
3) EL Baslakon	2,730	6,500	2,410	5,730	0	0.0
4) EL Kharbotly	2,350	5,600	2,020	4,820	0	0.0
5) Awaad	2,730	6,500	2,330	5,540	0	0.0
6) Saffar	2,820	6,700	2,450	5,830	0	0.0
7) Balaqtar right side	1,760	4,200	1,530	3,630	0	0.0
8) Truga 2nd	2,230	5,300	1,940	4,610	1,870	96.4
9) Truga 1st	2,230	5,300	1,930	4,600	1,930	100.0
10) Truga 3rd	2,600	6,200	2,380	5,680	2,380	100.0

(continue)

Drainage Block	Gross Area		Cultivation Area		Tile Drained Area	
	(ha)	(fed.)	(ha)	(fed.)	(ha)	(%)
			(1)		(2)	(2)/(1)
11) Zawit Saqr	1,600	3,800	1,380	3,300	0	0.0
12) Abu EL Matameer	1,930	4,600	1,680	4,010	0	0.0
13) Kafr EL Wak	2,600	6,200	2,270	5,410	0	0.0
14) EL Ghandora	840	2,000	720	1,710	0	0.0
15) Kafr EL Saaida	4,650	11,070	3,980	9,480	0	0.0
Sub-total	32,330	76,970	28,110	66,930	6,180	22.0
16) West Truga	10,750	25,600	4,510	10,750	0	0.0
Total	43,080	102,570	32,620	77,680	6,180	18.9
6 Shereshera P.S.						
1) EL Ziny 1st	2,060	4,900	1,870	4,450	1,870	100.0
2) Mahlet Kail 1st	1,090	2,600	950	2,250	950	100.0
3) EL Ziny 2nd	1,180	2,800	1,040	2,470	1,040	100.0
4) Mahalet Kail 2nd	2,230	5,300	1,920	4,580	1,920	100.0
5) EL Shereshera 1st	1,890	4,500	1,710	4,080	1,710	100.0
6) EL Shereshera 2nd	1,970	4,700	1,770	4,210	1,770	100.0
7) EL Shereshera 3rd	1,620	3,860	1,450	3,450	1,450	100.0
8) Abu Diyab 1st	2,900	6,900	2,640	6,290	2,640	100.0
9) Harara	1,930	4,600	1,700	4,040	1,700	100.0
10) EL Shereshera 4th	1,600	3,800	1,380	3,290	1,380	100.0
11) Abu Diyab 2nd	2,180	5,200	1,890	4,500	1,890	100.0
12) El Barnogi 1st	1,890	4,500	1,630	3,880	1,630	100.0
13) Mahbob Agha	2,310	5,500	2,100	5,010	2,100	100.0
14) Gabaris EL Gharpi 1st	2,390	5,700	2,060	4,900	2,060	100.0
15) Abu EL Zrazeer 1st	2,010	4,800	1,940	4,610	1,940	100.0
16) Abu EL Zrazeer 2nd	1,930	4,600	1,660	3,960	1,660	100.0
17) EL Barnogy 2nd	2,480	5,900	2,120	5,040	2,120	100.0
18) Gabaris EL Gharpi 2nd	2,770	6,600	2,460	5,860	2,460	100.0
19) Abu EL Zrazeer 3rd	2,230	5,300	1,960	4,670	1,960	100.0
Sub-total	38,660	92,060	34,250	81,540	34,250	100.0
20) Amlak	18,060	43,000	4,510	10,750	0	0.0
Total	56,720	135,060	38,760	92,290	34,250	88.4
7 Abu Hommos P.S.						
1) Balaqtar left side	2,560	6,100	2,230	5,320	2,230	100.0
2) Abu Hommos 1st	2,400	5,700	2,090	4,970	2,090	100.0
3) Zawyet Naim	1,970	4,700	1,740	4,140	1,740	100.0
4) Abu Hommos 2nd	1,470	3,500	1,280	3,050	1,280	100.0
5) Waslet EL Ziny 2nd	1,810	4,300	1,580	3,770	1,580	100.0
6) Abu Hommos 3rd	1,010	2,400	900	2,130	900	100.0
7) Waslet EL Ziny 1st	2,350	5,600	2,050	4,870	2,050	100.0
8) Damanhur 1st	2,180	5,200	1,870	4,460	1,870	100.0
9) Waslet EL Ziny 3rd	2,270	5,400	1,970	4,700	1,970	100.0
10) Damanhur 2nd	1,890	4,500	1,650	3,920	1,650	100.0
Total	19,910	47,400	17,360	41,330	17,360	100.0
Total (from B1 to B7)	171,300	407,860	132,630	315,800	58,000	43.7
8 Mariut Lake	9,410	22,400	(5,460)	(13,000)	0	0.0
Study Area (EL-Max P.S.)	180,710	430,260	132,630	315,800	58,000	43.7

Source: EPADP in Damanhur

FIGURE D-2-1 CONTOUR MAP

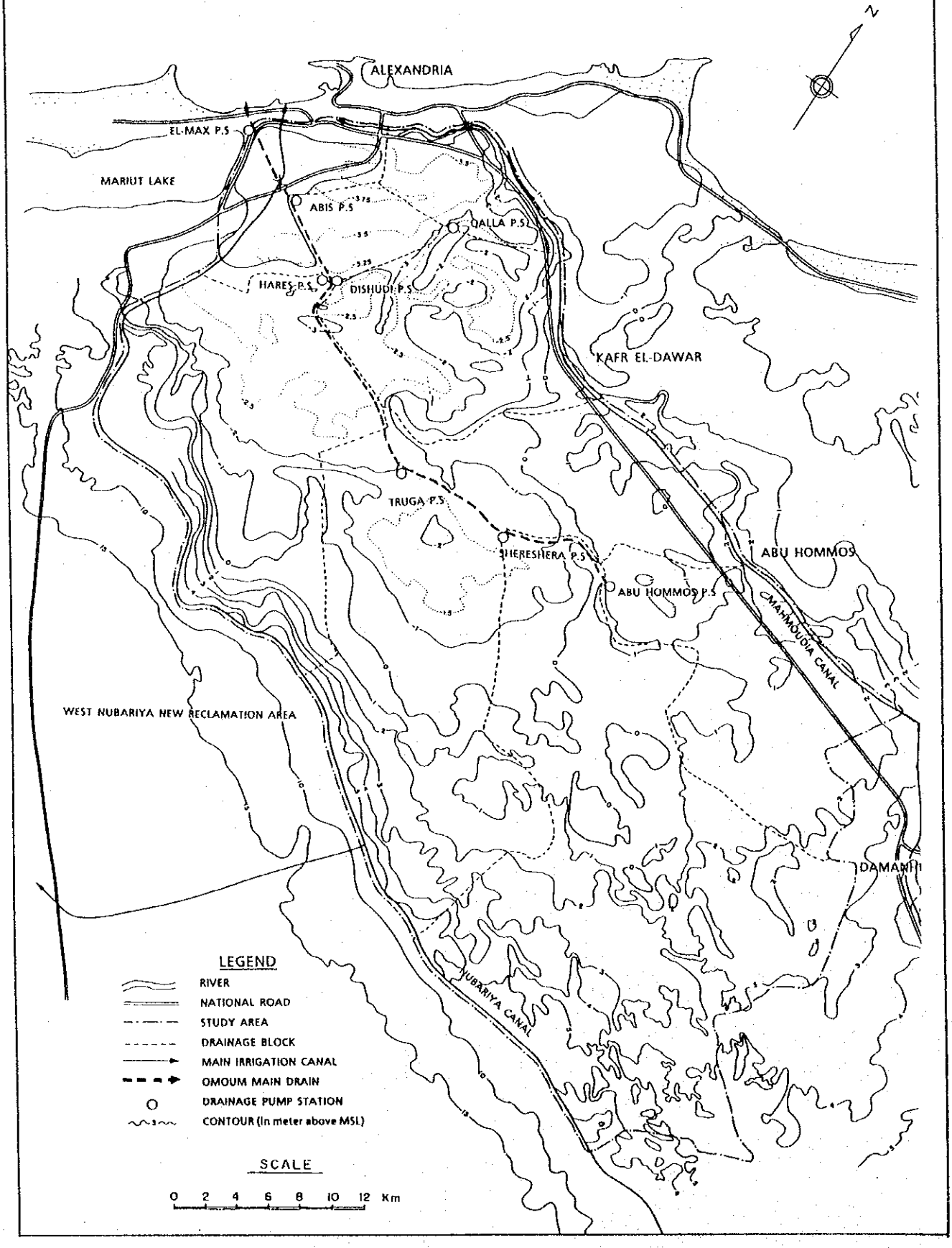
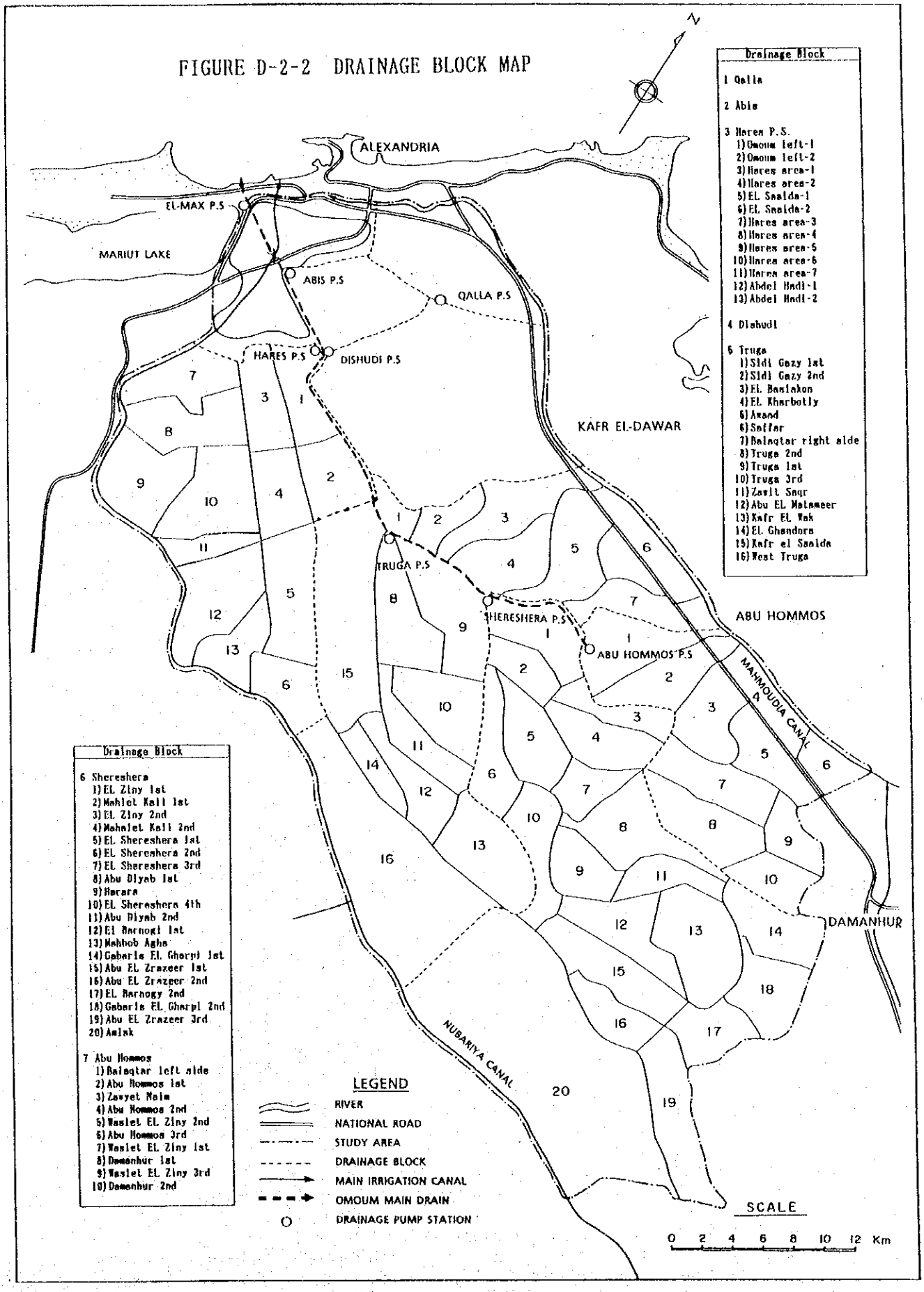


FIGURE D-2-2 DRAINAGE BLOCK MAP



Drainage Block

1 Qalla

2 Abis

3 Hares P.S.
1) Omoum left-1
2) Omoum left-2
3) Hares area-1
4) Hares area-2
5) EL Saalda-1
6) EL Saalda-2
7) Hares area-3
8) Hares area-4
9) Hares area-5
10) Hares area-6
11) Hares area-7
12) Abdel Hadi-1
13) Abdel Hadi-2

4 Dishudi

5 Truga
1) Sidi Gazy 1st
2) Sidi Gazy 2nd
3) EL Baalakon
4) EL Kharbotly
5) Awaad
6) Soffar
7) Balaqtar right side
8) Truga 2nd
9) Truga 1st
10) Truga 3rd
11) Zawit Saqr
12) Abu EL Matameer
13) Kafr EL Wak
14) EL Ghandora
15) Kafr el Saalda
16) West Truga

Drainage Block

6 Shereshera
1) EL Ziny 1st
2) Mahlet Kali 1st
3) EL Ziny 2nd
4) Mahalet Kali 2nd
5) EL Shereshera 1st
6) EL Shereshera 2nd
7) EL Shereshera 3rd
8) Abu Diyab 1st
9) Hararа
10) EL Shereshera 4th
11) Abu Diyab 2nd
12) El Barnogi 1st
13) Mahbob Agha
14) Gaberis EL Gharpi 1st
15) Abu EL Zrazeer 1st
16) Abu EL Zrazeer 2nd
17) EL Barnogy 2nd
18) Gaberis EL Gharpi 2nd
19) Abu EL Zrazeer 3rd
20) Amlak

7 Abu Hommos
1) Balaqtar left side
2) Abu Hommos 1st
3) Zawyet Naim
4) Abu Hommos 2nd
5) Waslet EL Ziny 2nd
6) Abu Hommos 3rd
7) Waslet EL Ziny 1st
8) Damanhur 1st
9) Waslet EL Ziny 3rd
10) Damanhur 2nd

Table D-2-3 Present Drainage Facilities

Block Name and/or P.Station	Drainage Area ①	Tile D. Executed ②	Open Drain Length ③	Density ④	Storage ⑤	Unit S. ⑥	Drainage Pump Capacity ⑦	Unit D. ⑧	
				③/①		⑤/①		⑦/①/D	
	(1000ha)	(%)	(km)	(m/ha)	(1000m3)	(mm)	(m3/s)	(mm)	
Abu Hommos	19.91	100.0	6.90	0.35	108.4	0.54	25.00	10.85	
Shereshera	56.72	88.4	23.80	0.42	477.7	0.84	40.00	6.09	
Truga	43.08	18.9	13.80	0.32	94.9	0.22	32.00	6.42	
Dishudi	15.33	-	7.75	0.51	76.3	0.50	12.00	6.76	
Hares	26.60	0.9	24.00	0.90	353.2	1.33	24.00	7.80	
Abis	3.78	-	5.20	1.38	42.3	1.12	5.40	12.34	
Qalla	5.88	-	5.00	0.85	34.5	0.59	10.00	14.69	
(Sub-total)	171.30	43.7	86.45	0.50	1187.2	0.69	148.40	7.48	
EL-Max	180.71						125.00	5.98	

Note: ⑤---storage capacity at the design water level

Table D-2-4 Present Drainage Situation (Water Level)

Block Name and/or P.Station	Datum Land G.L. ①	Area ②	C.W.L. (Drain) ③	Original Pump S.W.L. ④	D.W.L. ⑤	Present Designed Drain C.B.L. ⑥	W.Depth ⑦	H.W.L. ⑥+⑦ ⑧	Allow. (Drain) ④-③ ⑨
	(MSL)	(ha)	(MSL)	(MSL)	(MSL)	(MSL)	(m)	(MSL)	(m)
Abu Hommos	0.1	2.0	-2.65	-2.62	-0.80	-4.92	2.30	-2.62	0.03
Shereshera	-1.5	1.0	-4.25	-4.25	-1.60	-7.55	3.30	-4.25	0.00
Truga	-2.0	3.0	-4.75	-4.90	-2.00	-6.40	1.50	-4.90	-0.15
Dishudi	-3.0	4.0	-5.75	-5.75	-2.63	-7.75	2.00	-5.75	0.00
Hares	-3.0	1.0	-5.75	-6.00	-2.80	-8.10	2.10	-6.00	-0.25
Abis	-3.8	3.0	-6.55	-6.80	-2.70	-8.80	2.00	-6.80	-0.25
Qalla	-3.8	1.0	-6.55	-6.50	-2.50	-8.30	1.00	-7.30	0.05
(Sub-total)		15.0							
EL-Max				-3.25	0.75				

(continue)

Block Name and/or P.Station	C.W.L. (Drain) ③	Operating Pump S.W.L. ⑩	D.W.L. ⑪	Actual Pump Head Design. ⑤-④ ⑫	Operat. ⑪-⑩ ⑬	rate ⑬/⑫ ⑭	Drain O.W.D. ⑩-③ ⑮	Omoum M.Drain H.W.L. ⑯	Diff. ⑪-⑯ ⑰
	(MSL)	(MSL)	(MSL)	(m)	(m)		(m)	(MSL)	(m)
Abu Hommos	-2.65	-2.60	-1.40	1.82	1.20	0.66	0.05	-1.44	0.04
Shereshera	-4.25	-3.55	-2.10	2.65	1.45	0.55	0.70	-2.12	0.02
Truga	-4.75	-4.50	-2.10	2.90	2.40	0.83	0.25	-2.42	0.32
Dishudi	-5.75	-5.10	-2.20	3.12	2.90	0.93	0.65	-2.82	0.62
Hares	-5.75	-5.45	-2.20	3.20	3.25	1.02	0.30	-2.82	0.62
Abis	-6.55	-5.60	-2.20	4.10	3.40	0.83	0.95	-3.70	1.50
Qalla	-6.55	-6.50	-1.75	4.00	4.75	1.19	0.05		
(Sub-total)									
EL-Max		-2.70	0.65	4.00	3.35	0.84		-3.25	0.55

Note:
①---ground elevation of datum land, ②---area at G.L.
③---control water level for tile drainage = ① - 2.75m (EAPDP standard)
④---original designed suction water level, ⑤---delivery water level
⑥---drain bed elevation, ⑦---original designed water level
⑧---original designed water level. ⑨---allowance of drain water level
⑩---operating suction water level in August, 1994 ⑪---delivery W.L.
⑮---water depth over C.W.L. of the block drain, ⑯---design water level (EPADP)

FIGURE D-2-3 PRESENT SITUATION OF TILE DAINAGE IMPLEMENTATION

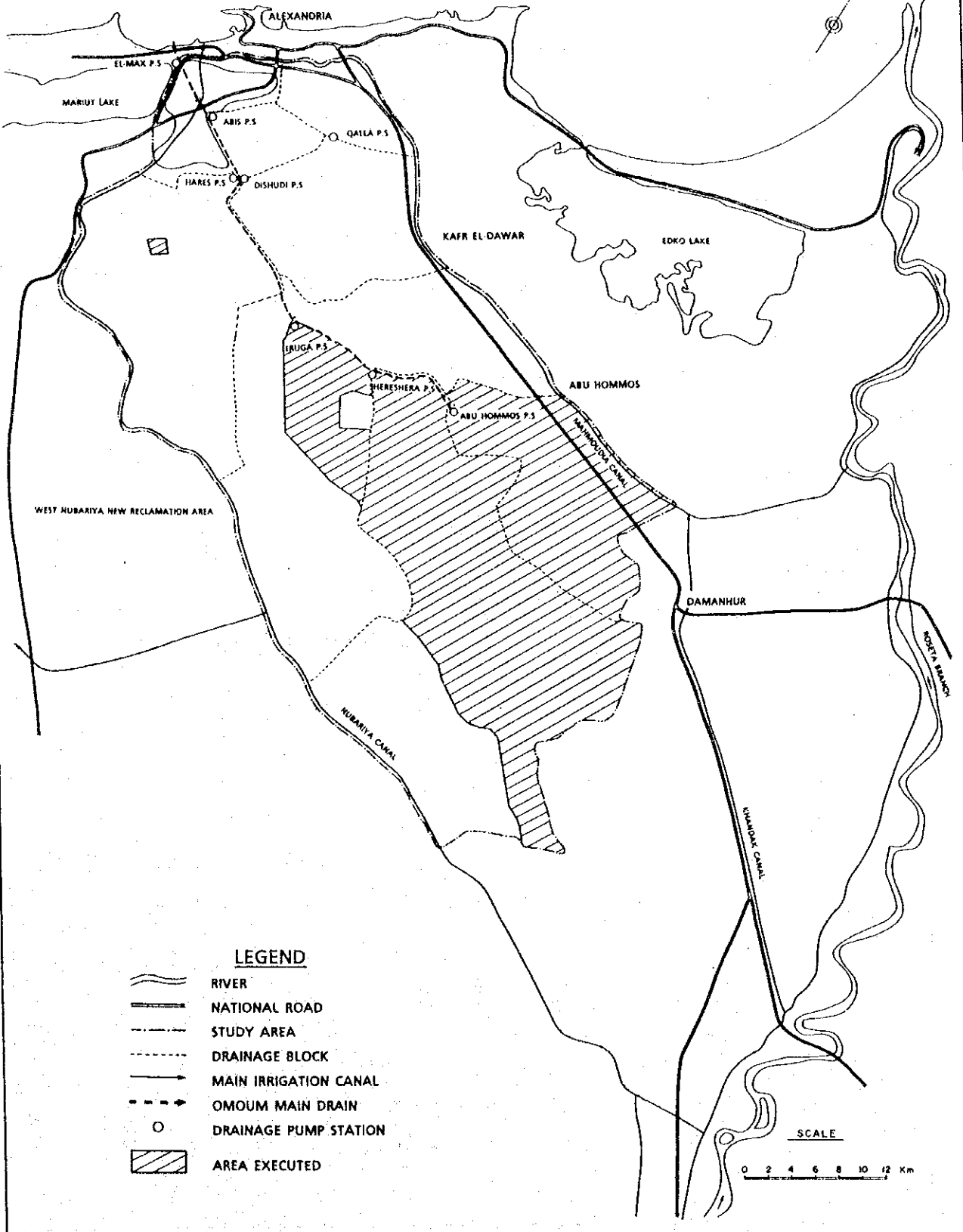
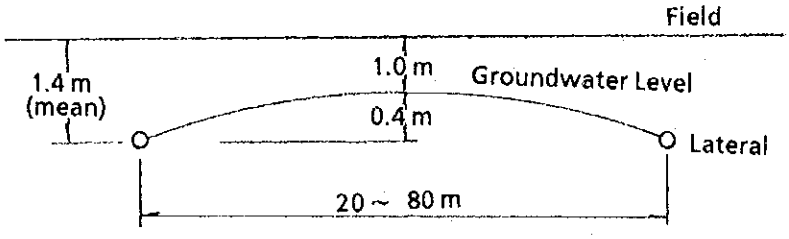
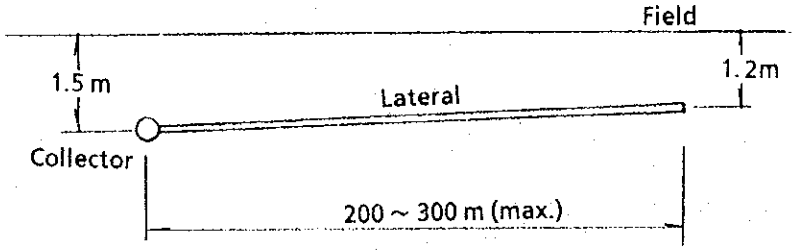


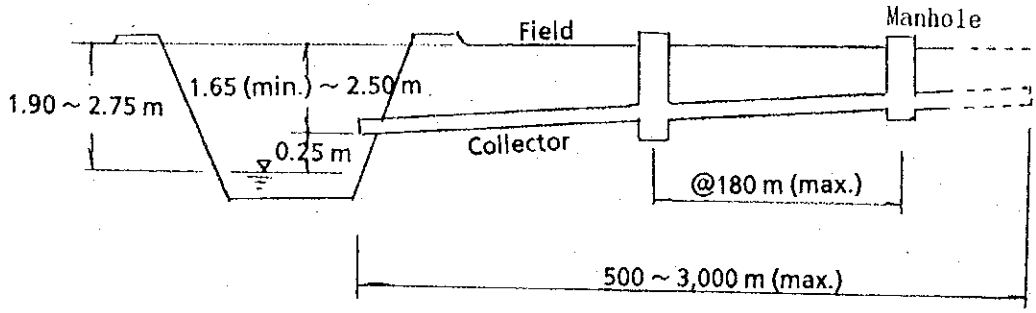
FIGURE D-2-4 TILE DRAINAGE SYSTEM (EPADP)

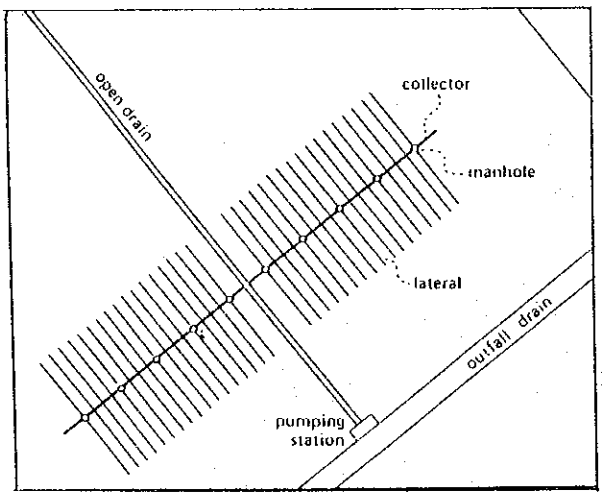


Longitudinal Section of Lateral

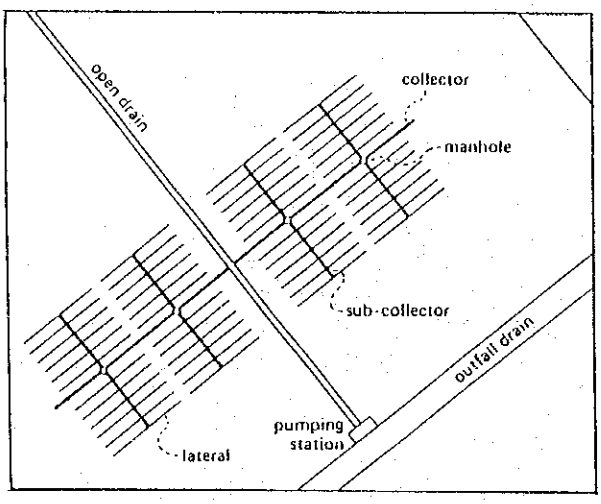


Longitudinal Section of Collector





Conventional System



Modified System

Table D-2-5 Present Drainage Situation (Tile Drainage)

Items (unit)	Abu Hommos	Shere-Shera	Truga	Dishudi	Hares	Abis	Qalla	Total/Mean
Collector drain								
Length (km)	No Data	588	786	271	472	67	No Data	2,184
Density (m/F)	"	8.9	9.0	9.4	9.0	8.7	"	9.0
Manhole								
Numbers (N)	"	5,279	7,299	2,416	4,552	666	"	20,212
Density (F/N)	"	12.6	12.0	12.0	11.6	11.5	"	12.0
Lateral drain								
Unit Dis. (mm/F/D)	"	1.5	1.5	1.5	1.5	1.5	"	1.5
Total Length (km)	"	3,465	5,330	3,540	3,020	344	"	15,699
Density (m/F)	"	52.3	60.9	122.5	57.3	45.0	"	64.6
Spacing & rate								
@80m	"	0.80	0.66	0.50	0.69	1.00	"	0.70
@70m	"	-	0.06	-	-	-	"	0.02
@60m	"	-	0.03	-	-	-	"	0.01
@50m	"	-	0.14	-	0.16	-	"	0.09
@40m	"	-	-	-	0.15	-	"	0.03
@30m	"	-	0.09	-	-	-	"	0.03
@20m	"	0.20	0.02	0.50	-	-	"	0.12
Mean spacing (m)	"	68	69	50	69	80	"	67
Rate executed up to Sep,1994 (%)	100.0	88.4	18.9	0.0	0.9	0.0	0.0	43.7
Pre-drainage investigations by FIDD								
Survey point (N)	"	14	24	17	24	4	"	83
Density (F/N)	"	4,736	3,648	1,700	2,196	1,913	"	2,929
Water depth (m)	"	0.84	0.75	0.91	0.84	0.53	"	0.81
EC of G.water (mS/cm)	"	4.6	2.4	3.7	4.3	2.9	"	3.6
Permeability (m/D)	"	0.75	1.19	0.72	1.35	1.66	"	1.06

Source: Project Planning Report of Drainage Project 5 (Dec.,1984)

Table D-2-6 Comparison of Underdrainage Standard between Egypt and Japan

Items	Egypt (EPADP)	Japan		
Drainage criteria (Groundwater level)	1.0～1.4m 1.2m (mean)	0.4～0.5m (Paddy field)	0.5～0.6m (Upland crop)	0.6～1.0m (Perennial crop)
		Sandy soil	Silty soil	Heavy cray soil
Unit discharge	1.25～1.5mm/day	10 ～50 mm/day (*3)		
k of soil (cm/sec)		1×10-3	1×10-3～10-5	> 1×10-5
Lateral drain				
Spacing	20～80m (*1)	18～33m	9～18m	> 6m
Depth	1.4m (mean)	0.6～1.0m (mean)		0.4～0.6m
	1.2～1.5m	0.6～0.8m (upstream), 0.8～1.0m (downstream)		
Slope	1/1000～1/500	1/600～1/100		
Discharge velocity	0.2～1.0m/sec	0.2m/sec～1.0m/sec		
Diameter	72mm (min.)	50mm (min.)～150mm		
Length	200～300m	30～100m (upland crop), 10～50m (paddy field)		
Collector drain				
Discharge Capacity	3.0～4.0mm/day	10 ～50 mm/day		
Depth	1.65～2.5m			
Slope	1/5000～1/1000			
Length	500～3000m	100～300m		
Manhole	@180m (max.)	Relief well		
Envelope material	Gravel (*2)	Rice hull, Faggot, Sand, Gravel, Plastic filter		

Note: (*1) 20～60m (Land Drainage in Egypt, 1989)
(*2) when the clay content is below 40%
(*3) Japan is high humidity land and its annual rainfall is 1,650mm.

FIGURE D-2-5 INUNDATION DAMAGE MAP IN DEC., 1991 FLOOD

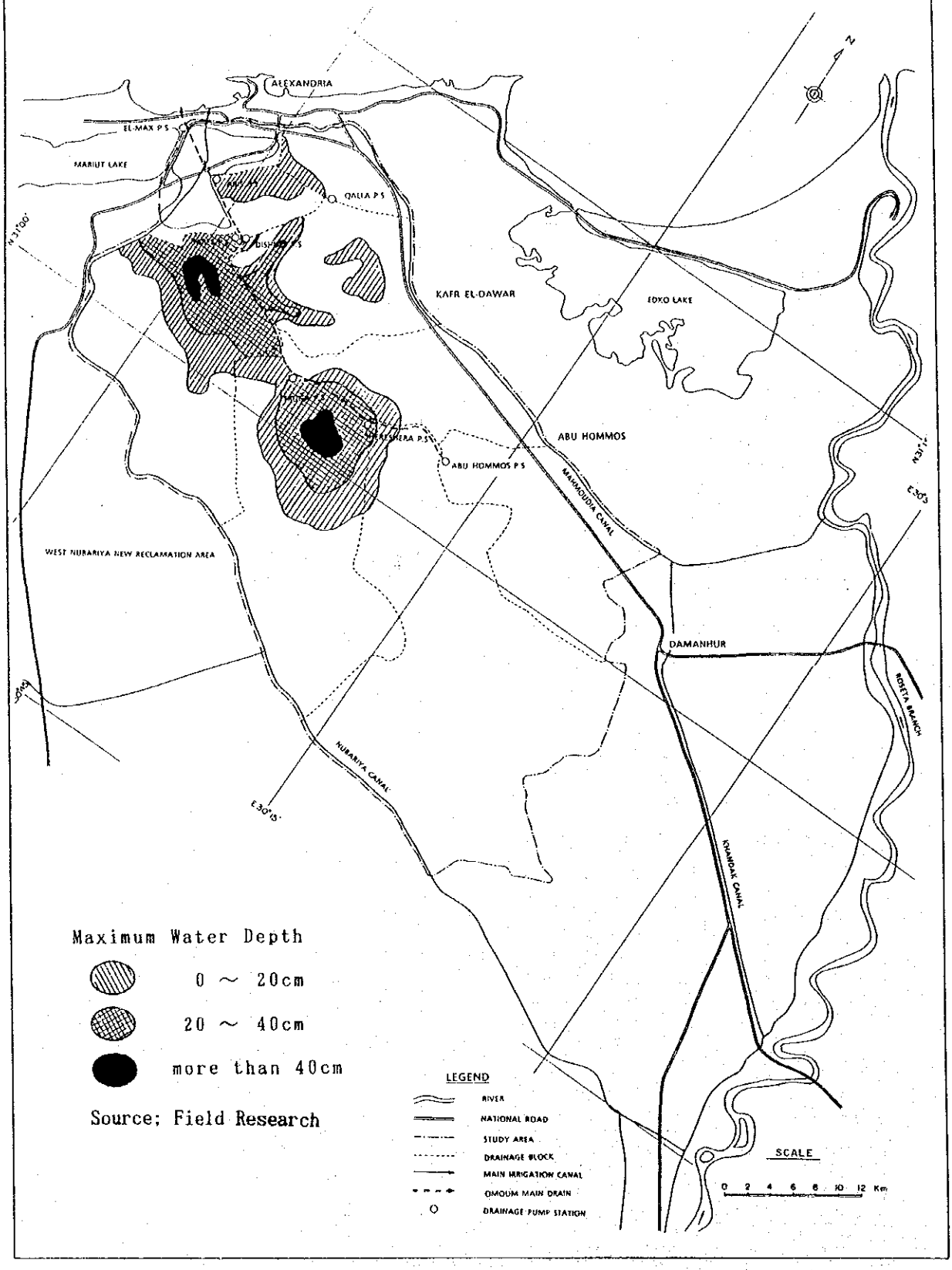


Table D-2-7 Maximum Pump Discharge Record on Monthly Base

Name	EL-Max Pump Station (*1)			Qalla Pump Station (*3)		
Area (*2)	180,710ha (430,260fed.)			5,880ha (14,000fed.)		
Order	Date	(MCM/M)	(m3/fed/D)	Date	(MCM/M)	(m3/fed/D)
1st	Jan. 1988	284.18	21	Aug. 1992	24.15	56
2nd	Dec. 1991	282.83	21	Aug. 1994	21.56	50
3rd	Jan. 1990	274.78	21	May 1989	20.62	48

Name	Abis Pump Station			Hares Pump Station		
Area (*2)	3,780ha (9,000fed.)			26,600ha (63,330fed.)		
Order	Date	(MCM/M)	(m3/fed/D)	Date	(MCM/M)	(m3/fed/D)
1st	Sep. 1992	8.29	31	Aug. 1991	65.75	33
2nd	Aug. 1992	7.97	29	Oct. 1988	64.34	33
3rd	Oct. 1990	7.47	27	Oct. 1990	64.26	33

Name	Dishudi Pump Station			Truga Pump Station		
Area (*2)	15,330ha (36,500fed.)			43,080ha (102,570fed.)		
Order	Date	(MCM/M)	(m3/fed/D)	Date	(MCM/M)	(m3/fed/D)
1st	Sep. 1993	33.01	30	Oct. 1991	79.87	25
2nd	Sep. 1991	31.49	29	Sep. 1991	76.01	25
3rd	Oct. 1988	26.71	24	Nov. 1991	72.74	24

Name	Shereshera Pump Station			Abu Hommos Pump Station		
Area (*2)	56,720ha (135,060fed.)			19,910ha (47,400fed.)		
Order	Date	(MCM/M)	(m3/fed/D)	Date	(MCM/M)	(m3/fed/D)
1st	Sep. 1994	81.82	20	Sep. 1991	17.06	12
2nd	Nov. 1994	73.62	18	Sep. 1994	16.94	12
3rd	Oct. 1990	68.63	16	Sep. 1992	15.61	11

Source: Reuse Monitoring Report (DRI) & MED from 1988 to 1994

Note: (*1) For EL-Max pump station, daily maximum discharge during 6th to 9th Dec., 1991 is used. The value is 115.19 cu.m/s or 23cu.m/fed/D.

(*2) Areas in this table mean the gross areas.

(*3) Only Qalla No.1 Pump Station without ETP

Table D-2-8 Present Unit Area Discharge

Block Name	Drainage Area	Drainage Capacity		Maximum Actual Discharge		
		Pump (1)	Drain (2)	Date	Monthly Value	
	(fed)	(m3/F/D)	(m3/F/D)		(MCM/M)	(m3/F/D)
Qalla	14,000	62	40	Aug. 1992	24.15	56
Abis	9,000	52	50	Sep. 1992	8.29	31
Hares	63,330	38	33	Aug. 1991	65.75	33
Dishudi	36,500	28	33	Sep. 1993	33.01	30
Truga	102,570	36	43	Oct. 1991	79.87	25
Shereshera	135,060	26	29	Sep. 1994	81.82	20
Abu Hommos	47,400	46	33	Sep. 1991	17.06	12
Mariut Lake	22,400					
El-Max	430,260	25	22	Jan. 1988	284.18	21

Note: (1) without stand-by pumps and ETP pump of Qalla P.S.

(2) Present unit discharge to the cultivated area (EPADP)

D-2.1 Design Discharge of Each Pump and Omoum Main Drain

1) Drainage Criteria

Following criteria were applied to estimate the design drainage discharge in the Study area.

- The drainage improvement aims at the level that the proposed inundation period will be reduced to be less than half of the present condition.

- Drainage discharge of each block will be adopted with the bigger figure in either a rainfall flood discharge in winter season or a normal discharge in dry season.

- 1/10-year probability rainfall (W=1/10) was used as design rainfall for flood drainage analysis, considering that project objectives are farmland drainage.

- Estimated flood discharge will be drained within flood concentration time.

2) Estimation of Required Pump Capacity in Each Drainage Block

The required pump capacity in each drainage block was estimated based on the following procedures;

a) Flood Concentration Time

Flood concentration time(Tp) to each pumping station was decided in accordance with a difference between the starting time of rainfall observed at Alexandria in case of the flood occurred in December 1991 and the time of occurring peak suction water level as well as shape of drainage basin in each block. (Refer to Figure D-2-6.)

b) Design Rainfall

Although two rainfall stations in the vicinity of the Study Area, that is, Alexandria and Damanhur stations, design rainfall was analyzed by Thiessen coefficient method using the former rainfall data, which has generally much rainfall in annual basis.

c) Rainfall Intensity Curve

1/10-year consecutive probable rainfall was analyzed on the basis of daily rainfall data for the period of 15 years observed at Alexandria station, and rainfall intensity curve with 1/10-year probability was prepared as shown in Figure D-2-7. An average rainfall intensity within the estimated flood concentration time can be obtained.

d) Drainage Modulus

Drainage modulus (unit area drainage discharge) can be estimated on the basis of the following equation adding 1.5mm/day as baseflow;

Drainage modulus (q) = Ri x Tc x Rc + 1.5

where; Ri: average rainfall intensity of W=1/10 (mm/day)
Tc: Thiessen coefficient
Rc: run-off coefficient, 0.65
Land use rate of the Study Area and Rc
Plain cultivable land = 85% , Rc=0.60
Resident area and others = 15% , Rc=0.90
Areal mean runoff coefficient
Rc(mean) = 0.60 x 85% + 0.90 x 15% = 0.65

e) Design Drainage Discharge at Each Pumping Station

Flood design drainage discharge at each pumping station can be estimated by multplying the above mentioned drainage modulus by independent drainage area. On the other hand, a normal drainage discharge in the dray season is calculated with irrigation excess water, groundwater and others as shown as

Table D-2-12.

In these two kind discharges, the flood discharges are indicated to be bigger figures than the normal discharge as shown in Table D-2-9. Consequently the flood discharges are adopted to the proposed drainage discharge of each block.

The total drainage discharge at seven pumping stations in the Study Area come to 151.4 cu.m/sec.

3) Design Drainage Discharge of Omoum Main Drain

The following procedures were taken to estimate the design drainage discharge for the Omoum main drain.

a) Area-Reduction Rate

According to the rainfall characteristics such as rainfall locality in the vicinity of the Study Area, some area-reduction rate should be taken into account for in extent (see Table D-2-10), so that design drainage discharge can be estimated by the following equation;

Design drainage discharge, $Q = r \times Qo = (100/A)^{(1-n)} \times Qo$

where; Q : design drainage discharge (cu.m/sec)
r : area-reduction rate
Qo : arithmetic sum of design drainage discharge(cu.m/sec)
A : drainage area (sq.km)
n : coefficient, 0.9

b) Design Drainage Discharge

The design drainage disdcharge of the Omoum main drain can be estimated as shown in Table D-2-10, applying above equation. For reference, the required discharge at the entrance of Nubariya siphon is estimated at 108 cu.m/sec as shown below, in which drainage discharge from Qalla block is subtracted.

$Q = (151 - 8 \text{ cu.m/sec}) \times (100 / 1{,}645.2 \text{ sq.km})^{0.1} = 108 \text{ cu.m/sec}$

4) Run-off Discharge from Mariut Lake and Its Catchment Area

a) Mariut Lake's Direct Catchment Area

The design run-off discharge from the Mariut Lake and its direct catchment areas can be estimated to be 23 cu.m/sec as shown below:

Q = 22 mm (W=1/10, Ri with 3-days rainfall intensity) x 9,410 ha x 0.95
= 23 cum/sec

b) Mariut Lake's Indirect Catchment Area

The Mariut Lake has its indirect catchment areas as shown below, and their discharge are calculated to be 20 cu.m/sec, which are deemed to be a base flow with constant discharge.

- Nubariya canal discharge	:	4.6 cu.m/sec(0.4MCM/day)
- Spill discharge from West Nubariya drain	:	5.0 *1/
- Airiya Drain	:	4.5 *2/
- West Treatment Plant (WTP)	:	2.0
- East Treatment Plant (ETP)	:	3.9
Total	:	20.0 cu.m/sec

Note; *1/ Q: 1.7 x 0.3^3/2 x 3.0m x 6 spans
*2/ derived from EPADP plan

5) Design Drainage Discharge at EL-Max Pumping Station

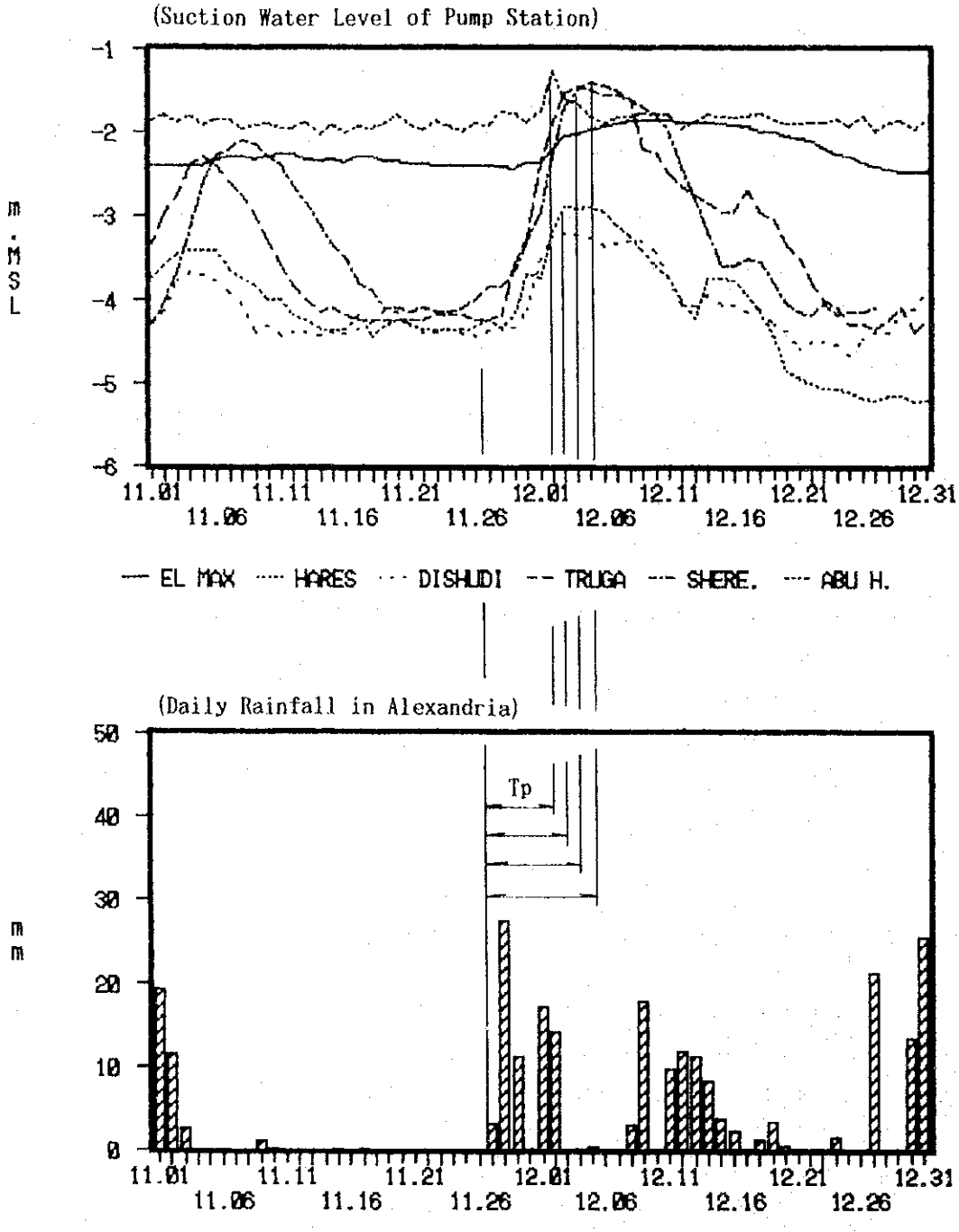
The design drainage discharge at EL- Max pumping station is estimated taking into account drainage discharge of seven drainage pumping stations, Mariut Lake's direct and indirect discharges, and the total discharge is estimated to be 150 cu.m/sec as shown below;

Q = (151 cu.m/sec + 23 cu.m/sec) x (100/1,807.1)^0.1 + 20 cu.m/sec
= 150 cu.m/sec

6) Proposed Drainage Diagram of Study Area

A proposed drainage diagram of the Study Area is shown in Figure D-2-8.

FIGURE D-2-6 HYDROGRAPH IN 1991 FLOOD



Flood Concentration Time

Abu Hommos	Tp= 6 days	Dishudi	Tp= 7 days
Shereshera	9 days	Hares	7 days
Truga	8 days		

Table D-2-9 Calculation of Proposed Pump Capacity

Drainage Block	Basin (fed.) (1)	Tp (day) (2)	Ri (mm/day) (3)	Tc (4)	Rc (5)	q (m3/F/D) (6)	Pump Capacity (m3/s) Wet S. (7)	Dry S. (8)	Proposed (9)	Exist. (10)	Increase (9)-(10)
Abu Hommos	47,400	6.0	12.1	0.70	0.65	29	16	16	16	25	-
Shereshera	135,060	9.0	9.6	0.70	0.65	25	39	37	39	40	-
Truga	102,570	8.0	10.5	0.84	0.65	30	36	31	36	32	4
Dishudi	36,500	7.0	11.5	1.00	0.65	38	16	12	16	12	4
Hares	63,330	7.0	11.5	1.00	0.65	38	28+2=30	21	30	24	6
Abis	9,000	4.0	17.6	1.00	0.65	54	5.6	3	5.6	5.4	-
Qalla	14,000	4.0	17.6	1.00	0.65	54	8.8	5	8.8	10	-
Sub-total	407,860						151.4	125	151.4	148.4	14

Note: Tp = Flood concentration time based on hydrograph of Dec. 1991 flood
Ri = Assumed rainfall intensity at probability 1/10 years
Tc = Thiessen coefficient based on Alexandria rainfall station
Rc = Runoff rate. q = (Ri×Tc×Rc+1.5mm(groundwater))×0.001×4,200m2
(7) = (6)×(1)/86,400 Hares area includes the seepage water(2.0m3/sec) from the dike.
(8) = Ordinary drainage in dry season (refer to Table D-2-12)
(9) = bigger figure in either (7) or (8)

FIGURE D-2-7 RAINFALL INTENSITY CURVE OF W=1/10 YEARS

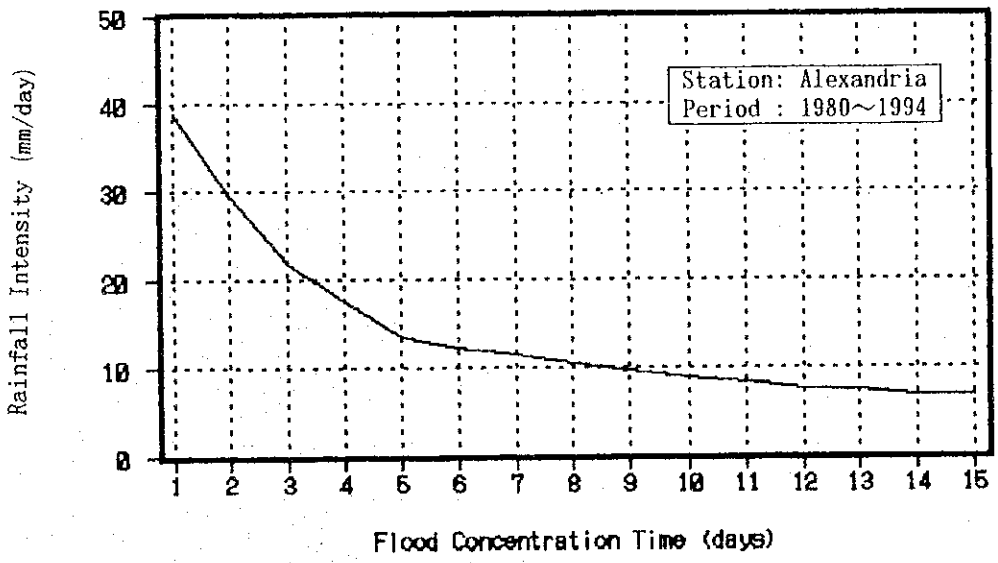
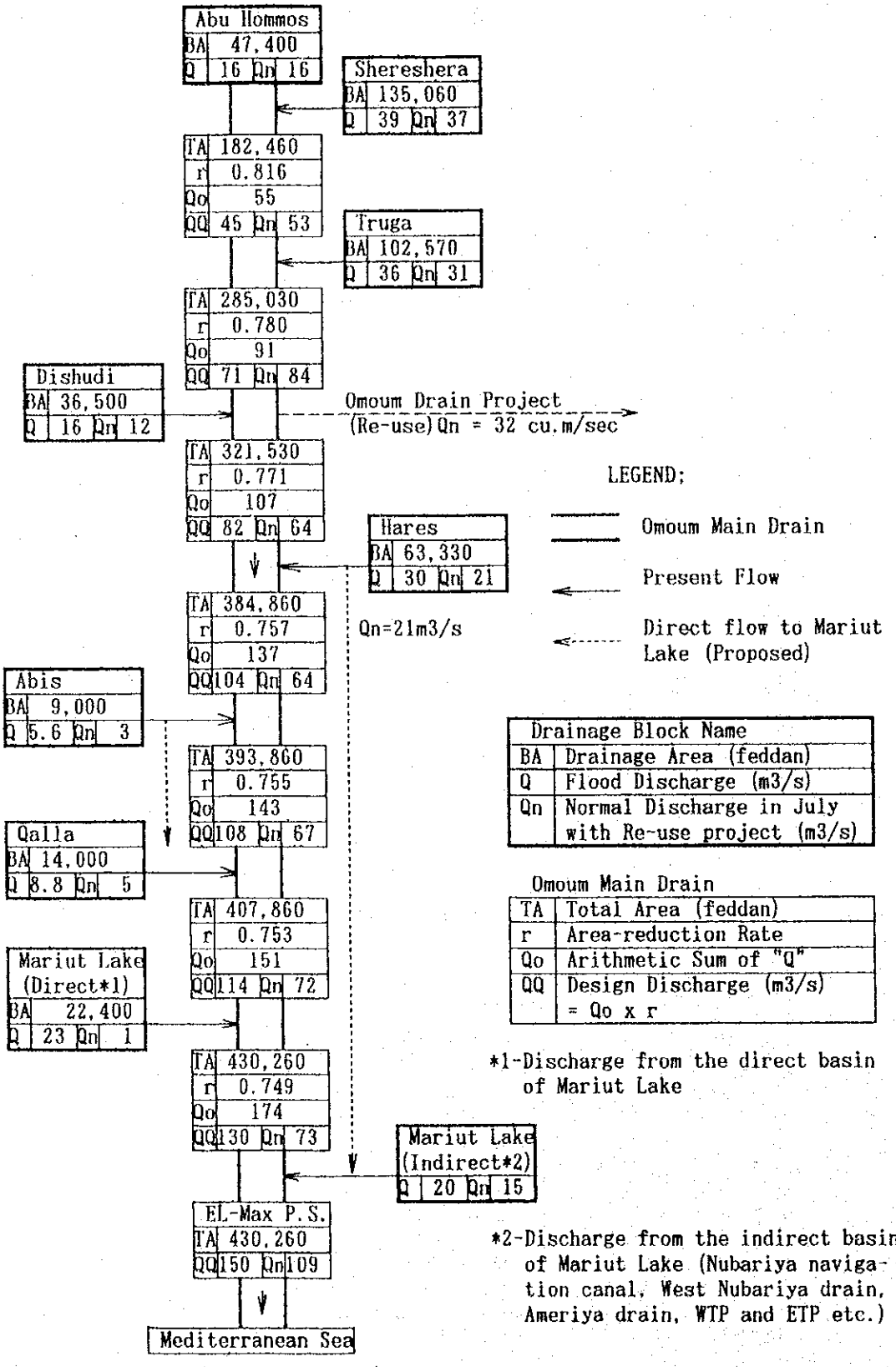


Table D-2-10 Design Discharge of Omoum Main Drain

Location	Drainage Area Block Area	Drainage Area Accumu. (1)	Direct Discharge Block	Direct Discharge Sum (2)	Reduction Rate (3)	Design Dis. (2)×(3)
Abu Hommos	199.1 km2	199.1 km2	16 m3/s	16 m3/s	0.933	15 m3/s
Shereshera	567.2	766.3	39	55	0.816	45
Truga	430.8	1,197.1	36	91	0.780	71
Dishudi	153.3	1,350.4	16	107	0.771	82
Hares	266.0	1,616.4	30	137	0.757	104
Abis	37.8	1,654.2	5.6	143	0.755	108
Qalla	58.8	1,713.0	8.8	151	0.753	114
Mariut Lake	94.1	1,807.1	23	174	0.749	130
EL-Max		1,807.1	130m3/s+20m3/s(indirect basin) =			150

Note: Mariut Lake direct runoff = 22mm/day × 94.1km2 × 0.95(runoff rate) = 23m3/sec
(3)=(100/(1))exp(1-n), n=0.9

FIGURE D-2-8 PROPOSED DRAINAGE DIAGRAM OF STUDY AREA



Drainage Block Name	
BA	Drainage Area (feddan)
Q	Flood Discharge (m3/s)
Qn	Normal Discharge in July with Re-use project (m3/s)

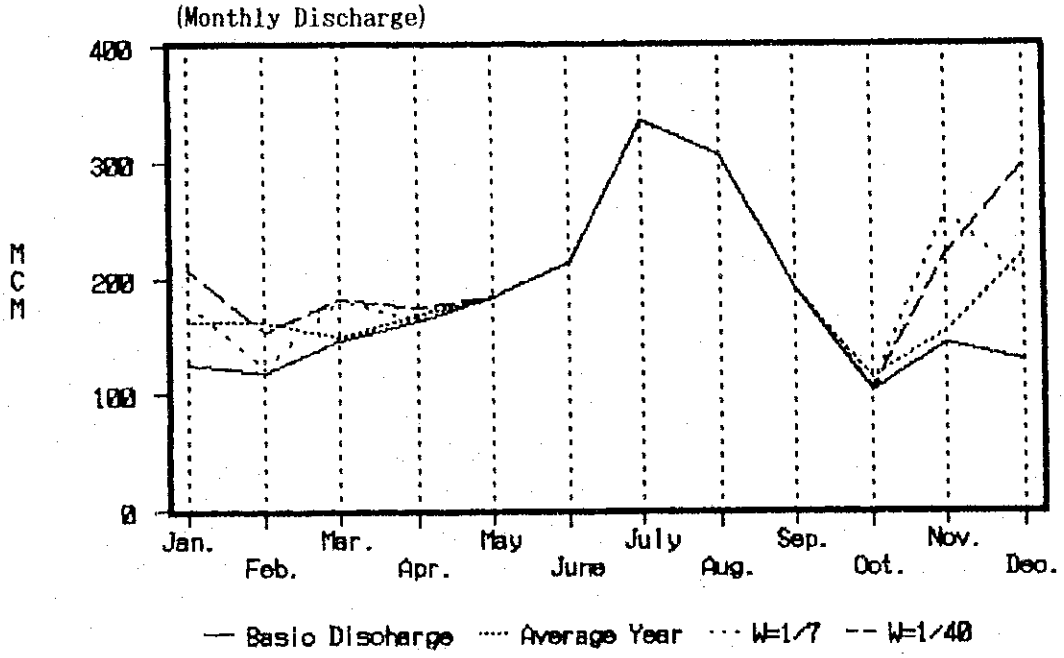
Omoum Main Drain

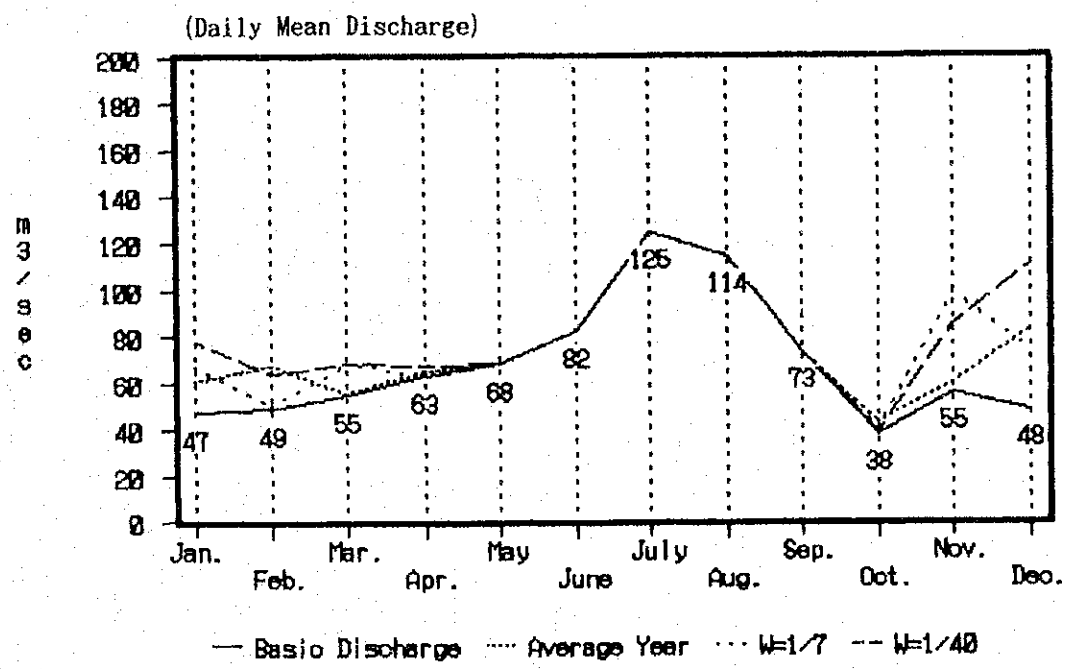
TA	Total Area (feddan)
r	Area-reduction Rate
Qo	Arithmetic Sum of "Q"
QQ	Design Discharge (m3/s) = Qo x r

*1-Discharge from the direct basin of Mariut Lake

*2-Discharge from the indirect basin of Mariut Lake (Nubariya navigation canal, West Nubariya drain, Ameriya drain, WTP and ETP etc.)

FIGURE D-2-9 PROPOSED DRAINAGE DISCHARGE OF STUDY AREA





地区用水２－４

Table D-2-11 Proposed Annual Discharge of Study Area

Probability of Annual Rainfall (W=Return Period)	Applied Year	Annual Rainfall (mm)	Basic Flow (MCM)	Rainfall Runoff (MCM)	Total Discharge (MCM)	Rate	Remarks
Average Year W=1/1	1985	202.6	2,156	200	2,356(1)	1.00	
Designed Year W=1/7	1994	273.2	2,156	273	2,429(2)	1.03	(2)/(1)
Abnormal Year W=1/40	1991	405.1	2,156	406	2,562(3)	1.09	(3)/(1)

Note; 1) Study Area = 180,710ha (430,260fed.)
2) Rainfall data in Alexandria
3) Basic flow = Excess water(irrigation losses) + Groundwater etc.

Table D-2-12 Proposed Drainage Discharge of Normal Year

(unit:MCM)

Block Name	Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	Days	31	28	31	30	31	30	31	31	30	31	30	31	
	R(mm)	35.8	44.1	2.6	5.7	0.1	-	-	-	-	12.1	10.7	91.5	202.6
1.Abu Hommos (A1=47,400F,A2=41,330F,Tc=0.70)														
Excess Water		9	9	12	14	16	20	37	33	19	7	12	9	197
Groundwater		6	5	6	5	6	5	6	6	5	6	5	6	67
Rainfall Runoff		3	4	0	1	0	-	-	-	-	1	1	8	18
Sub-total		18	18	18	20	22	25	43	39	24	14	18	23	282
(Peak Discharge = 43 MCM / 31 / 86,400 = 15.9 m3/sec)														
2.Shereshera (A1=135,060F,A2=92,290F,Tc=0.70)														
Excess Water		20	20	27	32	36	46	83	74	42	16	26	21	443
Groundwater		16	14	16	15	16	15	16	16	15	16	15	16	186
Rainfall Runoff		9	11	1	1	0	-	-	-	-	3	3	24	52
Sub-total		45	45	44	48	52	61	99	90	57	35	44	61	681
(Peak Discharge = 99 MCM / 31 / 86,400 = 36.8 m3/sec)														
3.Truga (A1=102,570F,A2=77,680F,Tc=0.84)														
Excess Water		17	17	23	27	31	38	70	63	35	13	22	18	374
Groundwater		12	11	12	12	12	12	12	12	12	12	12	12	143
Rainfall Runoff		8	10	1	1	0	-	-	-	-	3	3	22	48
Sub-total		37	38	36	40	43	50	82	75	47	28	37	52	565
(Peak Discharge = 82 MCM / 31 / 86,400 = 30.5 m3/sec)														
4.Dishudi (A1=36,500F,A2=31,030F,Tc=1.00)														
Excess Water		7	7	9	11	12	15	28	25	14	5	9	7	149
Groundwater		4	4	4	4	4	4	4	4	4	4	4	4	48
Rainfall Runoff		4	4	0	1	0	-	-	-	-	1	1	9	20
Sub-total		15	15	13	16	16	19	32	29	18	10	14	20	217
(Peak Discharge = 32 MCM / 31 / 86,400 = 12.0 m3/sec)														
5.Hares (A1=63,330F,A2=53,920F,Tc=1.00)														
Excess Water		12	11	15	18	24	30	43	39	18	3	15	12	240
Groundwater		7	7	7	7	7	7	7	7	7	7	7	7	84
Rainfall Runoff		6	8	0	1	0	-	-	-	-	2	2	16	35
Dike Seepage(*1)		5	5	5	5	5	5	5	5	5	5	5	5	60
Sub-total		30	31	27	31	36	42	55	51	30	17	29	40	419
(Peak Discharge = 55 MCM / 31 / 86,400 = 20.5 m3/sec)														
6.Abis (A1=9,000F,A2=7,650F,Tc=1.00)														
Excess Water		2	2	2	3	3	4	7	6	3	1	2	2	37
Groundwater		1	1	1	1	1	1	1	1	1	1	1	1	12
Rainfall Runoff		1	1	0	0	0	-	-	-	-	0	0	2	4
Sub-total		4	4	3	4	4	5	8	7	4	2	3	5	53
(Peak Discharge = 8 MCM / 31 / 86,400 = 3.0 m3/sec)														
7.Qalla (A1=14,000F,A2=11,900F,Tc=1.00)														
Excess Water		3	3	3	4	5	6	11	10	5	2	3	3	58
Groundwater		2	1	2	2	2	2	2	2	2	2	2	2	23
Rainfall Runoff		1	2	0	0	0	-	-	-	-	0	0	3	6
Sub-total		6	6	5	6	7	8	13	12	7	4	5	8	87
(Peak Discharge = 13 MCM / 31 / 86,400 = 4.9 m3/sec)														
Mariut Lake (A1=22,400F,A3=13,000F,Tc=1.00)														
Groundwater		3	2	3	3	3	3	3	3	3	3	3	3	35
Lake Rainfall(*2)		3	4	0	-	-	-	-	-	-	1	1	8	17
Sub-total		6	6	3	3	3	3	3	3	3	4	4	11	52
Study Area (A1=430,260F,A2=315,800F,A3=13,000F)														
Monthly Dis. (MCM)		161	163	149	168	183	213	335	306	190	114	154	220	2,356
Daily Dis.(m3/sec)		60	67	56	65	68	82	125	114	73	43	59	82	75

Note; A1=Gross area(feddan), A2=Irrigated area(feddan), A3=Water surface(feddan)
Tc=Thiessen coefficient, R=Monthly rainfall on Alexandria in 1985
Excess water=refer to Table D-1-19 , (*1)= 5MCM/month
Groundwater= 0.9mm/day × 0.001× A1 ×4,200 × nos. of days per month /1,000,000
Rainfall runoff= R × 0.001 × Tc× 0.65(runoff rate)× A1 × 4,200 /1,000,000
Lake Rainfall(*2)= R × 0.001 × Tc× 0.95(runoff rate)× A1 × 4,200 /1,000,000

Table D-2-13 Proposed Drainage Discharge of Probability W=1/7years

(unit:MCM)

Block Name	Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	Days	31	28	31	30	31	30	31	31	30	31	30	31	
	R(mm)	51.4	3.5	33.2	-	-	-	-	-	-	5.0	112.6	67.5	273.2
1. Abu Hommos (A1=47,400F, A2=41,330F, Tc=0.70)														
Excess Water		9	9	12	14	16	20	37	33	19	7	12	9	197
Groundwater		6	5	6	5	6	5	6	6	5	6	5	6	67
Rainfall Runoff		5	0	3	-	-	-	-	-	-	0	10	6	24
Sub-total		20	14	21	19	22	25	43	39	24	13	27	21	288
(Peak Discharge = 43 MCM / 31 / 86,400 = 15.9 m3/sec)														
2. Shereshera (A1=135,060F, A2=92,290F, Tc=0.70)														
Excess Water		20	20	27	32	36	46	83	74	42	16	26	21	443
Groundwater		16	14	16	15	16	15	16	16	15	16	15	16	186
Rainfall Runoff		13	1	9	-	-	-	-	-	-	1	29	17	70
Sub-total		49	35	52	47	52	61	99	90	57	33	70	54	699
(Peak Discharge = 99 MCM / 31 / 86,400 = 36.8 m3/sec)														
3. Truga (A1=102,570F, A2=77,680F, Tc=0.84)														
Excess Water		17	17	23	27	31	38	70	63	35	13	22	18	374
Groundwater		12	11	12	12	12	12	12	12	12	12	12	12	143
Rainfall Runoff		12	1	8	-	-	-	-	-	-	1	26	16	64
Sub-total		41	29	43	39	43	50	82	75	47	26	60	46	581
(Peak Discharge = 82 MCM / 31 / 86,400 = 30.5 m3/sec)														
4. Dishudi (A1=36,500F, A2=31,030F, Tc=1.00)														
Excess Water		7	7	9	11	12	15	28	25	14	5	9	7	149
Groundwater		4	4	4	4	4	4	4	4	4	4	4	4	48
Rainfall Runoff		5	0	3	-	-	-	-	-	-	0	11	7	26
Sub-total		16	11	16	15	16	19	32	29	18	9	24	18	223
(Peak Discharge = 32 MCM / 31 / 86,400 = 12.0 m3/sec)														
5. Hares (A1=63,330F, A2=53,920F, Tc=1.00)														
Excess Water		12	11	15	18	24	30	43	39	18	3	15	12	240
Groundwater		7	7	7	7	7	7	7	7	7	7	7	7	84
Rainfall Runoff		9	1	6	-	-	-	-	-	-	1	19	12	48
Dike Seepage(*1)		5	5	5	5	5	5	5	5	5	5	5	5	60
Sub-total		33	24	33	30	36	42	55	51	30	16	46	36	432
(Peak Discharge = 55 MCM / 31 / 86,400 = 20.5 m3/sec)														
6. Abis (A1=9,000F, A2=7,650F, Tc=1.00)														
Excess Water		2	2	2	3	3	4	7	6	3	1	2	2	37
Groundwater		1	1	1	1	1	1	1	1	1	1	1	1	12
Rainfall Runoff		1	0	1	-	-	-	-	-	-	0	3	2	7
Sub-total		4	3	4	4	4	5	8	7	4	2	6	5	56
(Peak Discharge = 8 MCM / 31 / 86,400 = 3.0 m3/sec)														
7. Qalla (A1=14,000F, A2=11,900F, Tc=1.00)														
Excess Water		3	3	3	4	5	6	11	10	5	2	3	3	58
Groundwater		2	1	2	2	2	2	2	2	2	2	2	2	23
Rainfall Runoff		2	0	1	-	-	-	-	-	-	0	4	3	10
Sub-total		7	4	6	6	7	8	13	12	7	4	9	8	91
(Peak Discharge = 13 MCM / 31 / 86,400 = 4.9 m3/sec)														
Mariut Lake (A1=22,400F, A3=13,000F, Tc=1.00)														
Groundwater		3	2	3	3	3	3	3	3	3	3	3	3	35
Lake Rainfall(*2)		5	0	3	-	-	-	-	-	-	0	10	6	24
Sub-total		8	2	6	3	3	3	3	3	3	3	13	9	59
Study Area (A1=430,260F, A2=315,800F, A3=13,000F)														
Monthly Dis. (MCM)		178	122	181	163	183	213	335	306	190	106	255	197	2,429
Daily Dis. (m3/sec)		66	50	68	63	68	82	125	114	73	40	99	74	77

Note; A1=Gross area(feddan), A2=Irrigated area(feddan), A3=Water surface(feddan)
Tc=Thiessen coefficient, R=Monthly rainfall on Alexandria in 1994
Excess water=refer to Table D-1-19 , (*1)= 5MCM/month
Groundwater= 0.9mm/day × 0.001× A1 ×4,200 × nos. of days per month /1,000,000
Rainfall runoff= R × 0.001 × Tc× 0.65(runoff rate)× A1 × 4,200 /1,000,000
Lake Rainfall(*2)= R × 0.001 × Tc× 0.95(runoff rate)× A1 × 4,200 /1,000,000

Table D-2-14 Proposed Drainage Discharge of Flood Year (W=1/40)

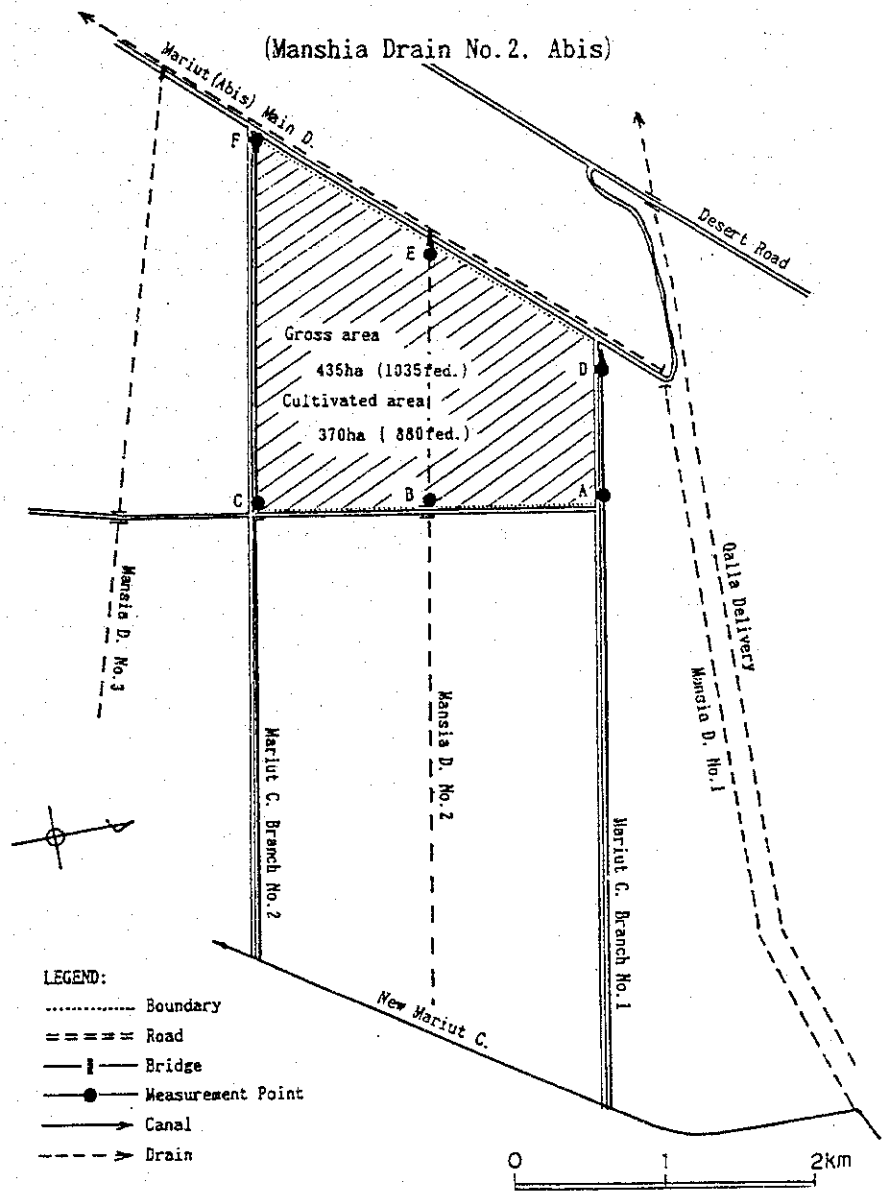
(unit:MCM)

Block Name	Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	Days	31	28	31	30	31	30	31	31	30	31	30	31	
	R(mm)	82.5	33.6	33.8	11.2	0.1	-	-	-	-	-	76.9	167.0	405.1
1.Abu Hommos (A1=47,400F, A2=41,330F, Tc=0.70)														
Excess Water		9	9	12	14	16	20	37	33	19	7	12	9	197
Groundwater		6	5	6	5	6	5	6	6	5	6	5	6	67
Rainfall Runoff		7	3	3	1	0	-	-	-	-	-	7	15	36
Sub-total		22	17	21	20	22	25	43	39	24	13	24	30	300
(Peak Discharge = 43 MCM / 31 / 86,400 = 15.9 m3/sec)														
2.Shereshera (A1=135,060F, A2=92,290F, Tc=0.70)														
Excess Water		20	20	27	32	36	46	83	74	42	16	26	21	443
Groundwater		16	14	16	15	16	15	16	16	15	16	15	16	186
Rainfall Runoff		21	9	9	3	0	-	-	-	-	-	20	43	105
Sub-total		57	43	52	50	52	61	99	90	57	32	61	80	734
(Peak Discharge = 99 MCM / 31 / 86,400 = 36.8 m3/sec)														
3.Truga (A1=102,570F, A2=77,680F, Tc=0.84)														
Excess Water		17	17	23	27	31	38	70	63	35	13	22	18	374
Groundwater		12	11	12	12	12	12	12	12	12	12	12	12	143
Rainfall Runoff		19	8	8	3	0	-	-	-	-	-	18	39	95
Sub-total		48	36	43	42	43	50	82	75	47	25	52	69	612
(Peak Discharge = 82 MCM / 31 / 86,400 = 30.5 m3/sec)														
4.Dishudi (A1=36,500F, A2=31,030F, Tc=1.00)														
Excess Water		7	7	9	11	12	15	28	25	14	5	9	7	149
Groundwater		4	4	4	4	4	4	4	4	4	4	4	4	48
Rainfall Runoff		8	3	3	1	0	-	-	-	-	-	8	17	40
Sub-total		19	14	16	16	16	19	32	29	18	9	21	28	237
(Peak Discharge = 32 MCM / 31 / 86,400 = 12.0 m3/sec)														
5.Hares (A1=63,330F, A2=53,920F, Tc=1.00)														
Excess Water		12	11	15	18	24	30	43	39	18	3	15	12	240
Groundwater		7	7	7	7	7	7	7	7	7	7	7	7	84
Rainfall Runoff		14	6	6	2	0	-	-	-	-	-	13	29	70
Dike Seepage(*1)		5	5	5	5	5	5	5	5	5	5	5	5	60
Sub-total		38	29	33	32	36	42	55	51	30	15	40	53	454
(Peak Discharge = 55 MCM / 31 / 86,400 = 20.5 m3/sec)														
6.Abis (A1=9,000F, A2=7,650F, Tc=1.00)														
Excess Water		2	2	2	3	3	4	7	6	3	1	2	2	37
Groundwater		1	1	1	1	1	1	1	1	1	1	1	1	12
Rainfall Runoff		2	1	1	0	0	-	-	-	-	-	2	4	10
Sub-total		5	4	4	4	4	5	8	7	4	2	5	7	59
(Peak Discharge = 8 MCM / 31 / 86,400 = 3.0 m3/sec)														
7.Qalla (A1=14,000F, A2=11,900F, Tc=1.00)														
Excess Water		3	3	3	4	5	6	11	10	5	2	3	3	58
Groundwater		2	1	2	2	2	2	2	2	2	2	2	2	23
Rainfall Runoff		3	1	1	0	0	-	-	-	-	-	3	6	14
Sub-total		8	5	6	6	7	8	13	12	7	4	8	11	95
(Peak Discharge = 13 MCM / 31 / 86,400 = 4.9 m3/sec)														
Mariut Lake (A1=22,400F, A3=13,000F, Tc=1.00)														
Groundwater		3	2	3	3	3	3	3	3	3	3	3	3	35
Lake Rainfall(*2)		7	3	3	1	0	-	-	-	-	-	7	15	36
Sub-total		10	5	6	4	3	3	3	3	3	3	10	18	71
Study Area (A1=430,260F, A2=315,800F, A3=13,000F)														
Monthly Dis. (MCM)		207	153	181	174	183	213	335	306	190	103	221	296	2,562
Daily Dis. (m3/sec)		77	63	68	67	68	82	125	114	73	38	85	111	81

Note; A1=Gross area(feddan), A2=Irrigated area(feddan), A3=Water surface(feddan)
Tc=Thiessen coefficient, R=Monthly rainfall on Alexandria in 1991
Excess water=refer to Table D-1-19 , (*1)= 5MCM/month
Groundwater= 0.9mm/day × 0.001× A1 ×4,200 × nos. of days per month /1,000,000
Rainfall runoff= R × 0.001 × Tc× 0.65(runoff rate)× A1 × 4,200 /1,000,000
Lake Rainfall(*2)= R × 0.001 × Tc× 0.95(runoff rate)× A1 × 4,200 /1,000,000

FIGURE D-2-10 LOCATION MAP OF DISCHARGE MEASUREMENT

(Manshia Drain No.2. Abis)



(EL Ziny 2nd. Shereshera)

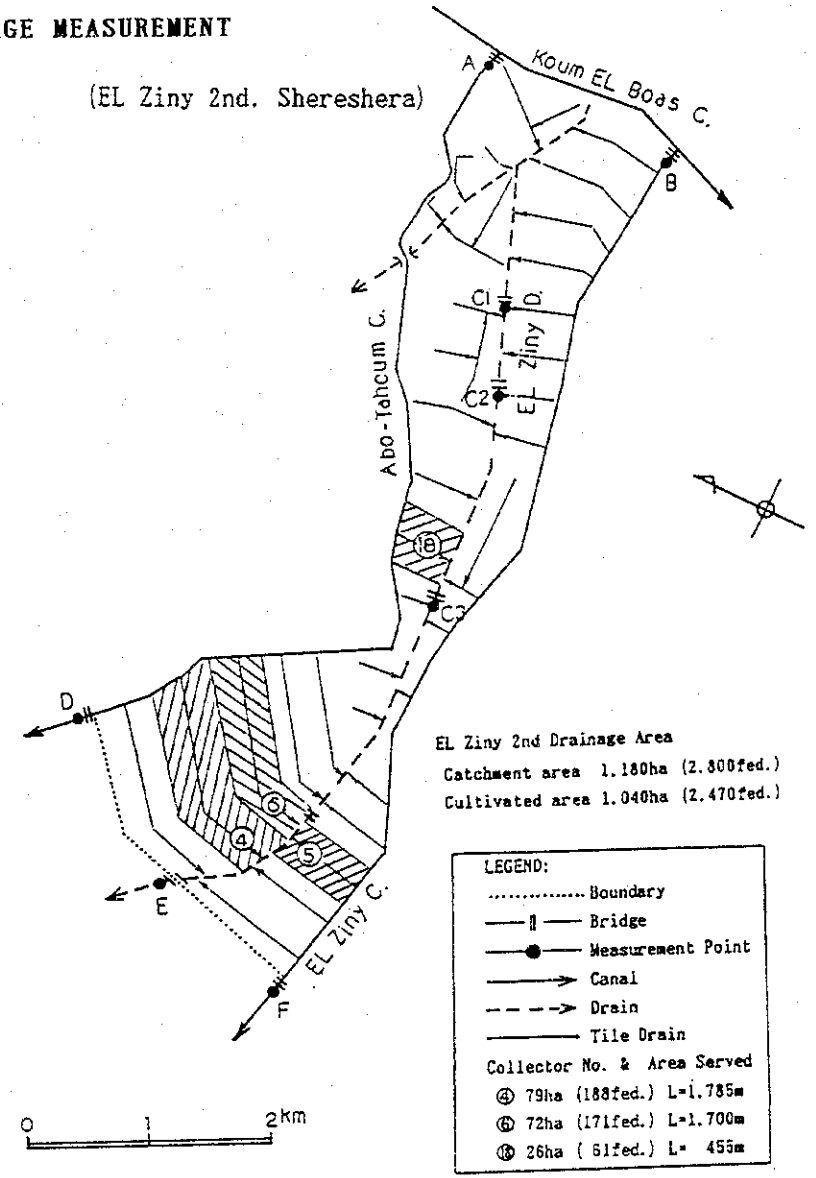


Table D-2-15 Results of Discharge Measurement

Drainage Block	Abis Drainage Block	Shereshera Drainage B.
Sample Area	Mansia Drain No.2	El Ziny 2nd
Location Map	FIGURE D-2-10(1)	FIGURE D-2-10(2)
Survey date	August 11,1994	August 8～9,1994
Drainage Area	435ha (1,035fed.)	1,180ha (2,800fed.)
Cropping	Rice Potato Others	Cotton Maize Rice
	40% 40% 20%	40% 30% 30%
Tile Drain	not yet executed	executed(100%)
Intake	Irrigated A.= 1,140fed.	Irrigated A.= 7,040fed.
Canal Name	Mariut C. Branch No.1	Abo-Tahoum C.
	Mariut C. Branch No.2	El-Ziny C.
1st servey	Aug.11 0.58m3/s	Aug.8 2.78m3/s
2nd servey		Aug.9 3.00
W.Q.(EC)	0.56mS/cm(25°)	0.54mS/cm(25°)
unit intake	44m3/F/day	34～37m3/F/day
rate	10.5mm/day	8～9mm/day
Discharge		
Open drain	Mansia Drain No.2	El Ziny Drain
1st servey	Aug.11 0.23m3/s	Aug.8 0.11m3/s
2nd servey		Aub.9 0.08
W.Q.(EC)	4.10～5.38mS/cm(25°)	3.31～4.00mS/cm(25°)
unit dis.	19m3/fed/day	2.5～3.4m3/fed/day
	4.5mm/day	0.6～0.8mm/day

Tile drain collector discharge (El Ziny 2nd)

Area & Length	A B C	Discharge (l/s)		EC (mS/cm)	
		①	②	①	②
④ 188F 1785m	2.10m 0.55m 2.65m	1.7	3.5	6.2	4.9
⑥ 171F 1700m	2.22 0.78 3.00	3.9	6.5	6.6	3.6
⑱ 61F 455m	2.19 1.10 3.29	3.6	2.7	2.4	5.5
⑤ 85F 680m		-	6.9	-	0.8
(mean)	2.2 0.8 3.0	3.1	4.9	5.1	3.7
Unit discharge	(mean)	0.7	1.0	5.1	3.7
(mm/dfay)	(maximum)	1.2	1.7	6.6	5.5

Note; ① = Aug. 1994. ② = Feb. 1995

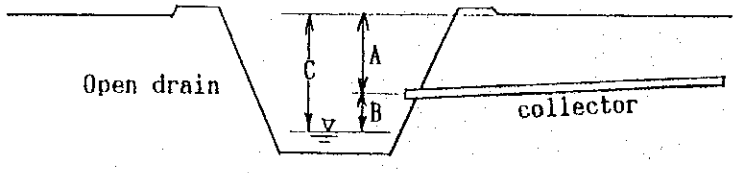


Table D-2-16 Results of Groundwater Table Survey

Drainage Block	No.	G.W.T. (m) ①	G.W.T. (m) ②	EC (mS/cm)	Remark
Abu Hommos	51	1.00	1.45	-	
	64	-	1.55	-	
	65	-	1.00	-	Rice
	66*	1.00	1.00	3.50	
	67	-	1.60	-	
	68	1.70	1.25	-	
	79	-	1.30	-	
	80	-	1.30	-	
	81	-	1.40	-	
	82	1.65	1.05	-	
(mean of Σ*, N=1)		1.00	1.00	3.50	
Shereshera	45*	1.95	0.95	3.50	
	46	1.55	1.80	-	
	47	-	1.60	-	
	52	1.37	-	1.99	(Rice)
	53*	1.60	0.95	3.70	
	54*	0.79	1.30	5.93	
	61*	0.30	1.80	5.29	
	62	0.45	0.70	1.45	(Rice)
	63	1.90	1.50	-	
	69	0.05	1.35	2.00	(Rice)
	70	1.40	1.30	5.73	(Rice)
	71*	1.75	1.05	1.75	
	71a*	0.52	1.75	7.42	
	76	0.35	1.45	1.45	(Rice)
	77*	1.10	1.05	3.22	
	78	0.25	1.10	4.00	Rice
	83	0.35	1.10	1.01	Rice
	84*	1.25	1.30	4.05	
	85*	2.00	-	1.40	
	86	0.45	0.43	2.87	(Rice)
	91*	1.20	1.05	1.51	
	92	0.40	1.70	5.80	(Rice)
	93*	1.15	1.00	5.80	
	94	1.40	1.30	1.41	Rice
	95	0.50	1.10	1.81	Rice
	97	0.10	0.85	1.52	(Rice)
(mean of Σ*, N=11)		1.24	1.22	3.96	
Not T.D.	58*	0.90	-	5.41	
	59	0.60	1.40	1.61	Rice
	60	0.40	1.40	5.13	(Rice)
	72*	0.90	1.20	1.28	
	73*	0.65	0.95	5.63	
	74*	0.85	1.00	2.78	
	75*	0.65	1.60	4.55	
	87	0.50	1.00	2.76	Rice
	88	0.50	1.55	5.16	(Rice)
	90*	0.60	1.45	1.96	
(mean of Σ*, N=6)		0.76	1.24	3.60	
out of S.A.	89	0.30	0.70	5.30	Rice
	96	-	-	-	
(mean of Σ*, N=0)		-	-	-	
Abis	7	0.20	0.80	1.18	(Rice)
Not T.D.	8	0.35	0.80	2.60	(Rice)
(mean of Σ*, N=0)		-	-	-	

Drainage Block	No.	G.W.T. (m) ①	G.W.T. (m) ②	EC (mS/cm)	Remark
Truga	29*	1.00	1.20	2.94	
	30	1.35	1.20	-	
	37*	0.70	1.40	2.17	
	38*	1.10	1.10	1.99	
	39*	0.70	1.80	3.55	
	44*	1.00	1.20	5.69	
(mean of Σ*, N=5)		0.90	1.34	3.27	
Not T.D.	25*	1.00	1.50	1.67	
	26*	1.15	1.20	5.28	
	27*	1.80	1.55	2.12	
	28*	0.90	0.85	5.16	
	40*	1.70	1.20	2.31	
	55	0.40	1.40	1.64	(Rice)
	24*	1.25	1.05	5.50	
	31*	1.05	1.20	5.50	
	32	-	1.30	-	
	35*	0.90	1.00	5.09	
	36*	1.20	1.70	5.05	
	48	-	1.30	-	
	49	-	1.25	-	
	50	-	1.35	-	
	41	1.45	1.35	-	
	43*	0.90	0.70	3.50	
	42*	1.55	1.05	-	
	56*	1.15	1.00	2.88	
	57*	0.65	0.70	2.63	
(mean of Σ*, N=13)		1.17	1.13	3.89	
Dishudi	10*	1.25	1.20	1.70	
Not T.D.	11	0.45	1.15	1.99	(Rice)
	18*	1.20	1.00	2.33	
	19*	0.85	1.35	1.27	
	20*	0.70	0.75	1.32	
	21*	0.70	0.50	3.27	
	22*	0.70	1.10	1.34	
	23*	1.30	1.30	1.75	
	33*	0.75	1.20	1.02	
(mean of Σ*, N=8)		0.93	1.05	1.75	
Hares	1*	0.90	2.00	1.57	
Not T.D.	2*	0.94	1.00	1.99	
	3*	0.95	1.20	3.55	
	4*	1.05	1.40	5.05	
	4a*	1.30	1.75	3.83	
	5*	1.35	1.50	3.11	
	5a*	0.85	1.60	1.01	
	6*	1.00	1.00	2.04	
	12*	1.00	1.00	1.85	
	13	1.75	1.00	-	
	14*	1.32	1.60	2.47	
	15*	1.40	-	4.04	
	16*	1.00	2.00	2.63	
	16a	-	-	-	
	17*	1.00	1.00	7.50	
(mean of Σ*, N=13)		1.08	1.42	3.13	
Qalla	9*	0.70	0.90	2.84	
(mean of Σ*, N=1)		0.70	0.90	2.84	

Source: Field survey by Study Team (①=Aug. 1994, ②=Feb. 1995)
Note: G.W.T.= groundwater table below the field, EC=electric conductibity in ①
Rice = survey in the paddy field, (Rice)= survey near the paddy field

Table D-2-17 Comparison of Groundwater Table

Drainage Block	Pre-investigation (FIDD in 1984)			Field Survey by JICA Study Team							
				Tile drained area				Not yet tile drained area			
	Nos. of sample	G.W.T. (m)	EC (mS/cm)	Nos. of sample	G.W.T. (m) ①	G.W.T. (m) ②	EC ① (mS/cm)	Nos. of sample	G.W.T. (m) ①	G.W.T. (m) ②	EC ① (mS/cm)
Abu Hommos	-	-	-	1	1.00	1.00	3.5	-	-	-	-
Shere-shera	14	0.84	4.6	11	1.24	1.22	4.0	6	0.76	1.24	3.6
Truga	24	0.75	2.4	5	0.90	1.34	3.3	13	1.17	1.13	3.9
Dishudi	17	0.91	3.7	-	-	-	-	8	0.93	1.05	1.8
Hares	24	0.84	4.3	-	-	-	-	13	1.08	1.42	3.1
Abis	4	0.53	2.9	-	-	-	-	-	-	-	-
Qalla	-	-	-	-	-	-	-	1	0.70	0.90	2.8
Total /Mean	83	0.81	3.6	17	1.12	1.24	3.7	41	1.02	1.22	3.2

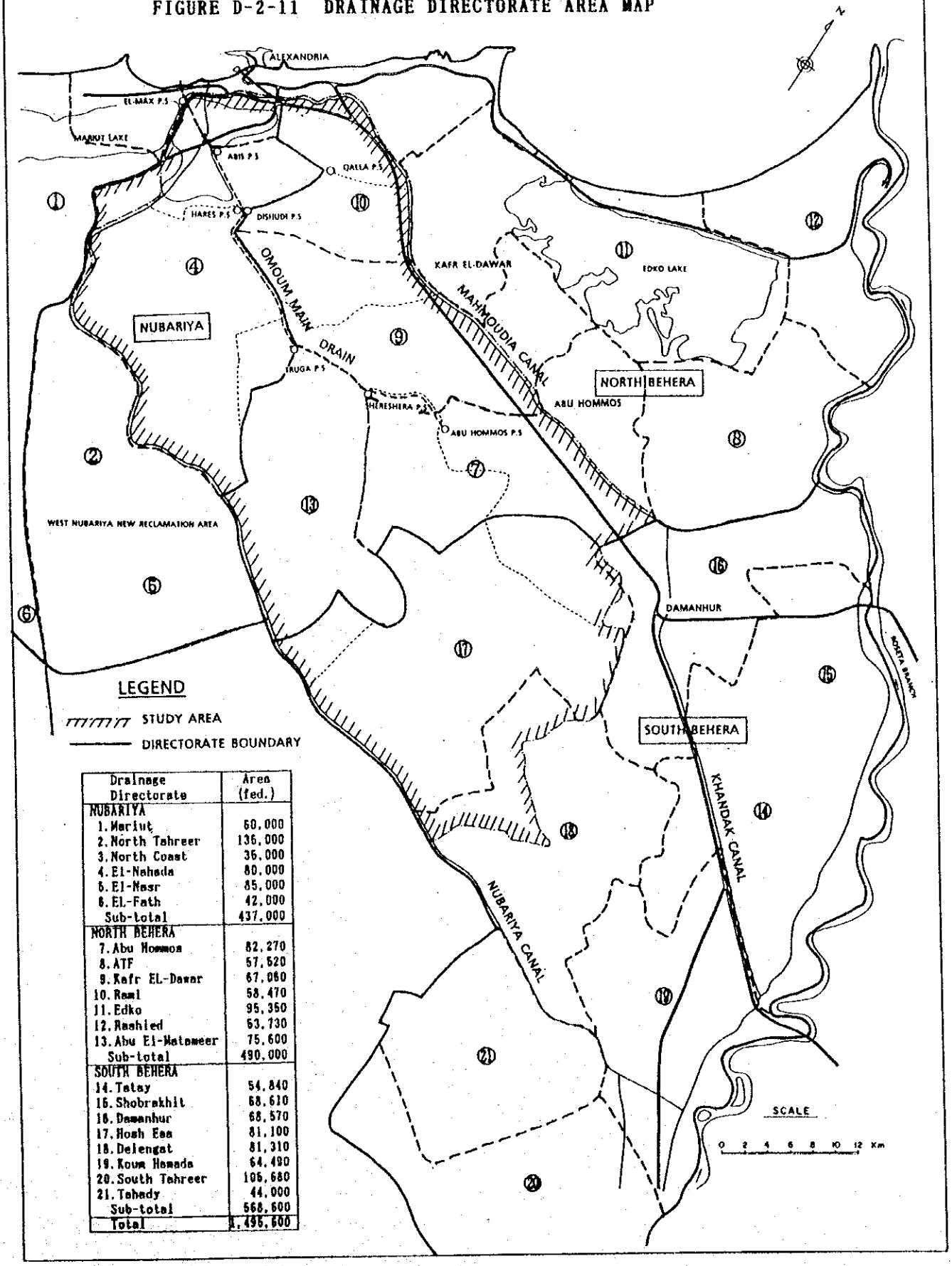
Note: Field survey .... ① = in Aug.1994, ② = in Feb.1995

Table D-2-18 Drainage Block and Directorate

Drainage Block	Drainage Directorate			
	Nubariya (fed)	North Behera (fed)	North Behera (fed)	Total (fed)
Mariut Lake	22,400	-	-	22,400
Qalla	-	14,000	-	14,000
Abis	9,000	-	-	9,000
Hares	63,330	-	-	63,330
Dishudi	-	36,500	-	36,500
Truga	6,570	89,000	7,000	102,570
Shereshera	-	28,770	106,290	135,060
Abu Hommos	-	30,500	16,900	47,400
Total (rate)	101,300 (23.5%)	198,770 (46.2%)	130,190 (30.3%)	430,260 (100%)

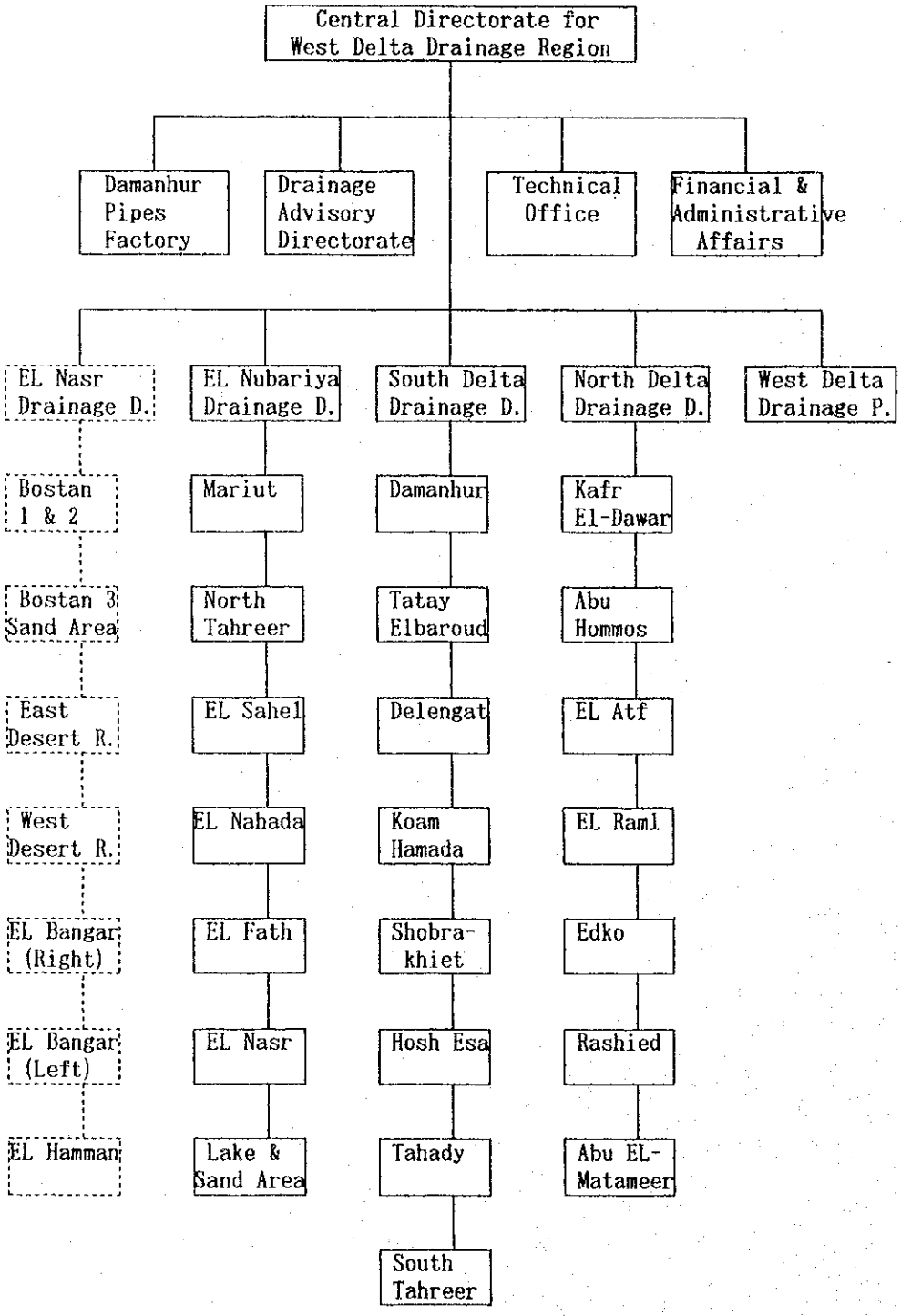
Note; refer to FIGURE D-2-11

FIGURE D-2-11 DRAINAGE DIRECTORATE AREA MAP



Drainage Directorate	Area (fed.)
NUBARIYA	
1. Mariut	60,000
2. North Tahreer	136,000
3. North Coast	36,000
4. El-Nahada	80,000
5. El-Nasr	85,000
6. EL-Fath	42,000
Sub-total	437,000
NORTH BEHERA	
7. Abu Hommos	82,270
8. ATF	57,520
9. Kafr EL-Dawar	67,060
10. Raml	58,470
11. Edko	95,350
12. Rashied	63,730
13. Abu El-Matameer	75,600
Sub-total	490,000
SOUTH BEHERA	
14. Tatay	54,840
15. Shobrakhit	68,610
16. Damanhur	68,570
17. Hosh Esa	81,100
18. Delengat	81,310
19. Koum Hamada	64,490
20. South Tahreer	105,680
21. Tahady	44,000
Sub-total	568,600
Total	1,495,600

FIGURE D-2-12 ORGANIZATION OF DRAINAGE DIRECTORATE



Note: [ ] not yet exist

Table D-3-1 Summary of Present Irrigated Area

Irrigation Area	Gross Area ①	Irrigable Area ②	Irrigated Area (Present) ③		Remarks ②/①	Remarks ③/①
	(ha)	(ha)	(ha)	(fed)	(%)	(%)
EL Hager Ext. Area	7,280	6,230	4,730	11,260	85.6	65.0
Nahda Area	10,940	9,300	8,970	21,350	85.0	82.0
EL Moshtarak Area	8,380	7,120	6,120	14,580	85.0	73.0
Total	26,600	22,650	19,820	47,190	85.2	74.5

Table D-3-2 Irrigation Blocks and Command Area

Irrigation Block	Gross Area	Irrigable Area	Irrigated Area (Present)		Irrigation Rotation Rule(2)		
	(ha)	(ha)	(ha)	(fed)	A	B	C
from Nubariya C.							
Hares Canal No1	4,430	3,800	3,630	8,640	○	○	
Hares Canal No2	1,770	1,500	1,450	3,450		○	
Hares Canal No3	2,790	2,360	2,290	5,450			○
Hares Canal No4	1,950	1,640	1,600	3,810	○		
Hares EL Omoumy	1,820	1,550	1,330	3,170		○	
EL Moshtarak C.	2,940	2,500	2,150	5,120	○	○	
EL Hager Feeding C							
Sub-total	15,700	13,350	12,450	29,640			
Direct Intake from Nubariya Canal							
Sadnauy	1,040	880	760	1,810	○		
Hammad	600	510	440	1,050	○		
Abu El-Wafa	520	440	380	900		○	
Abu EL-Kader	540	460	390	930		○	
Moh. EL Serafy	520	440	380	900			○
Karam	400	340	290	700			○
Sub-total	3,620	3,070	2,640	6,290			
from EL-Hager Extention Canal							
Left Branch No.1	1,090	1,050	710	1,690			○
Left Branch No.2	1,270	1,060	820	1,950			○
Left Branch No.3	950	790	620	1,480			○
Right Branch No.1	1,150	960	750	1,780			○
Right Branch No.2	1,400	1,170	910	2,170			○
Right Branch No.3	1,420	1,200	920	2,190			○
Sub-total	7,280	6,230	4,730	11,260			
TOTAL	26,600	22,650	19,820	47,190	29%	32%	39%

Note; (1) All figures in this table are modified with planimeter measurement by the Study Team on the basis of the data given by Nubariya Irrigation Directorate.
(2) Symboles of A, B and C indicate irrigation blocks that is irrigated during first 5 days, second 5 days and third 5 days, respectively.

Table D-3-3 Present Cropping Pattern in Hares Area

Crop, Area & Cropping Rate (Nos.of days)		Jan. (19)	Feb. (23)	Mar. (31)	Apr. (30)	May (31)	June (30)	July (31)	Aug. (31)	Sep. (30)	Oct. (31)	Nov. (30)	Dec. (31)
Wheat	(%)	100	100	100	100	40	-	-	-	-	-	20	100
16,990	(fed)	16990	16990	16990	16990	6800						3400	16990
Beans	(%)	100	100	100	70	-	-	-	-	-	-	100	100
5,190	(fed)	5190	5190	5190	3630							5190	5190
Berseem S	(%)	100	100	-	-	-	-	-	-	-	-	100	100
8,020	(fed)	8020	8020									8020	8020
Berseem L	(%)	100	100	100	100	80	-	-	-	-	-	100	100
9,910	(fed)	9910	9910	9910	9910	7930						9910	9910
Veg. W.	(%)	100	-	-	-	-	-	-	-	100	100	100	100
5,660	(fed)	5660								5660	5660	5660	5660
Cotton	(%)	-	-	50	100	100	100	100	100	85	-	-	-
8,020	(fed)			4010	8020	8020	8020	8020	8020	6820			
Maize	(%)	-	-	-	-	55	100	100	100	40	-	-	-
16,990	(fed)					9340	16990	16990	16990	6800			
Sunflower	(%)	-	-	-	-	-	100	100	100	100	-	-	-
3,780	(fed)					-	3780	3780	3780	3780			
Veg. S.	(%)	-	-	-	-	50	100	100	100	100	-	-	-
17,460	(fed)					8730	17460	17460	17460	17460			
Total													
46,250	(fed)	45770	40110	36100	38550	40820	46250	46250	46250	40520	5660	32180	45770
Intensity	(%)	99.0	86.7	78.1	83.4	88.3	100.0	100.0	100.0	87.6	12.2	69.6	99.0

Table D-3-4 Proposed Cropping Pattern in Hares Area

Crop, Area & Cropping Rate (Nos.of days)		Jan. (19)	Feb. (23)	Mar. (31)	Apr. (30)	May (31)	June (30)	July (31)	Aug. (31)	Sep. (30)	Oct. (31)	Nov. (30)	Dec. (31)
Wheat	(%)	100	100	100	100	40	-	-	-	-	-	20	100
17,270	(fed)	17270	17270	17270	17270	6910						3450	17270
Beans	(%)	100	100	100	70	-	-	-	-	-	-	100	100
6,470	(fed)	6470	6470	6470	4530							6470	6470
Berseem S	(%)	100	100	-	-	-	-	-	-	-	-	100	100
9,160	(fed)	9160	9160									9160	9160
Berseem L	(%)	100	100	100	100	80	-	-	-	-	-	100	100
11,320	(fed)	11320	11320	11320	11320	9050						11320	11320
Veg. W.	(%)	100	-	-	-	-	-	-	-	100	100	100	100
9,700	(fed)	9700								9700	9700	9700	9700
Cotton	(%)	-	-	50	100	100	100	100	100	85	-	-	-
9,160	(fed)			4580	9160	9160	9160	9160	9160	7790			
Maize	(%)	-	-	-	-	55	100	100	100	40	-	-	-
17,250	(fed)					9490	17250	17250	17250	6900			
Sunflower	(%)	-	-	-	-	-	100	100	100	100	-	-	-
4,310	(fed)					-	4310	4310	4310	4310			
Veg. S.	(%)	-	-	-	-	50	100	100	100	100	-	-	-
23,200	(fed)					11600	23200	23200	23200	23200			
Total													
53,920	(fed)	53920	44220	39640	42280	46210	53920	53920	53920	51900	9700	40100	53920
Intensity	(%)	100.0	82.0	73.5	78.4	85.7	100.0	100.0	100.0	96.3	18.0	74.4	100.0

Table D-3-5 Present Water Requirement in Hares Area

(unit; MCM)

Crop	Area (fed)	Rate (%)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Net Water Requirement(*1)															
Winter Crop															
Wheat	16,990	37.1	3	4	7	7	2	-	-	-	-	-	3	3	29
Beans	5,190	11.3	1	2	2	1	-	-	-	-	-	-	1	1	8
Berseem S	8,020	17.5	2	2	-	-	-	-	-	-	-	-	3	2	9
Berseem L	9,910	21.7	2	3	4	6	5	-	-	-	-	-	3	2	25
Veg. W.	5,660	12.4	2	-	-	-	-	-	-	-	1	2	2	2	9
Sub-total	45,770	100.0	10	11	13	14	7	-	-	-	1	2	12	10	80
Summer Crop															
Cotton	8,020	17.3	-	-	2	2	4	5	6	3	1	-	-	-	23
Maize	16,990	36.7	-	-	-	-	6	9	14	12	2	-	-	-	43
Sunflower	3,780	8.2	-	-	-	-	-	2	3	4	0	-	-	-	9
Veg. S.	17,460	37.8	-	-	-	-	4	9	14	14	9	-	-	-	50
Sub-total	46,250	100.0	-	-	2	2	14	25	37	33	12	-	-	-	125
Total	92,020	199.0	10	11	15	16	21	25	37	33	13	2	12	10	205
Water Requirement															
Net Water Req. / Ep(*2)			29	31	43	46	60	71	106	94	37	6	34	29	586

Note: (*1) Net Water Requirement = Unit water requirement(Table D-1-16) × Crop area
(*2) applied by FAO Irrigation Drainage Paper No.24,
Irrigation Efficiency(Ep) = 0.70(Ea) × 0.50(Ed) = 0.35

Table D-3-6 Proposed Water Requirement in Hares Area

(unit; MCM)

Crop	Area (fed)	Rate (%)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Net Water Requirement(*1)															
Winter Crop															
Wheat	17,270	32.0	3	4	7	8	2	-	-	-	-	-	3	3	30
Beans	6,470	12.0	1	2	2	1	-	-	-	-	-	-	1	1	8
Berseem S	9,160	17.0	2	2	-	-	-	-	-	-	-	-	3	2	9
Berseem L	11,320	21.0	3	3	4	7	6	-	-	-	-	-	4	2	29
Veg. W.	9,700	18.0	3	-	-	-	-	-	-	-	2	3	4	4	16
Sub-total	53,920	100.0	12	11	13	16	8	-	-	-	2	3	15	12	92
Summer Crop															
Cotton	9,160	17.0	-	-	2	2	5	6	7	4	2	-	-	-	28
Maize	17,250	32.0	-	-	-	-	6	10	15	12	2	-	-	-	45
Sunflower	4,310	8.0	-	-	-	-	-	2	3	4	0	-	-	-	9
Veg. S.	23,200	43.0	-	-	-	-	5	12	18	19	12	-	-	-	66
Sub-total	53,920	100.0	-	-	2	2	16	30	43	39	16	-	-	-	148
Total	107,840	200.0	12	11	15	18	24	30	43	39	18	3	15	12	240
Water Requirement															
Net Water Req. / Ep(*2)			24	22	30	36	48	60	86	78	36	6	30	24	480

Note: (*1) Net Water Requirement = Unit water requirement(Table D-1-16) × Crop area
(*2) applied by FAO Irrigation Drainage Paper No.24,
Irrigation Efficiency(Ep) = 0.70(Ea) × 0.70(Ed) ≒ 0.50

Table D-3-7 Present Designed Intake Water in Hares Area

(unit;m3/s)

Canal Name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
from Nubariya Canal													
Hares C.No1	1.90	1.90	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86	1.90	1.90	
Hares C.No2	1.00	1.00	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.00	1.00	
Hares C.No3	2.00	2.00	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.00	2.00	
Hares C.No4	1.03	1.03	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.03	1.03	
Hares Omoumy	1.10	1.10	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.10	1.10	
Direct Intake from Nubariya Canal													
Sadnauy	0.42	0.42	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.42	0.42	
Hammad	0.33	0.33	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.33	0.33	
Abu EL-Wafa	0.30	0.30	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.30	0.30	
Abu EL-Kader	0.30	0.30	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.30	0.30	
Moh. EL Serafy	0.30	0.30	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.30	0.30	
Karam	0.21	0.21	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.21	0.21	
from EL-Hager Extention Canal													
Left B. No.1	0.80	0.80	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	0.80	0.80	
Left B. No.2	0.70	0.70	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.70	0.70	
Left B. No.3	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	
Right B. No.1	0.80	0.80	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	0.80	0.80	
Right B. No.2	0.60	0.60	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	
Right B. No.3	0.50	0.50	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.50	0.50	
Total													
Daily D. (m3/s)	13.0	13.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	13.0	13.0	
No of Days	19	23	31	30	31	30	31	31	30	31	30	31	348
Monthly D. (MCM)	21	26	48	47	48	47	48	48	47	48	34	35	497

Source; Nubariya Irrigation Directorate (NID)

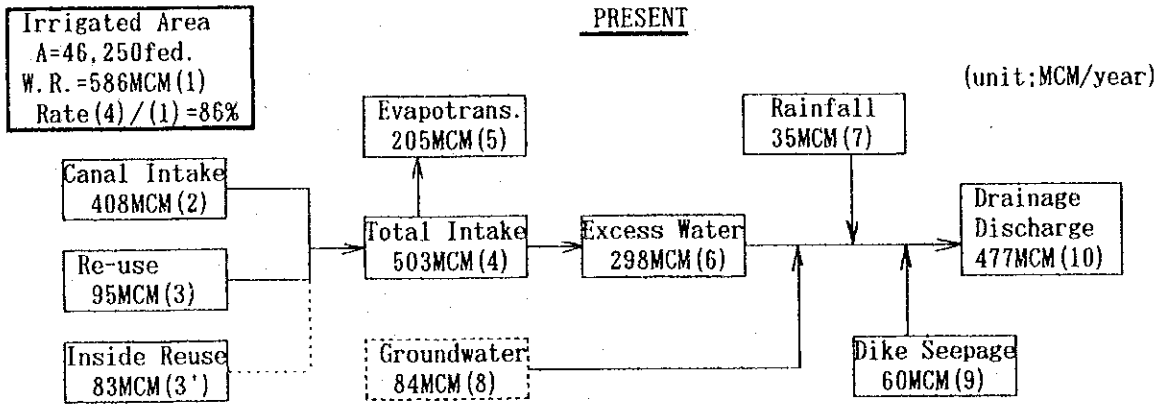
Table D-3-8 Actual Intake Water of Hares Area

(unit;MCM)

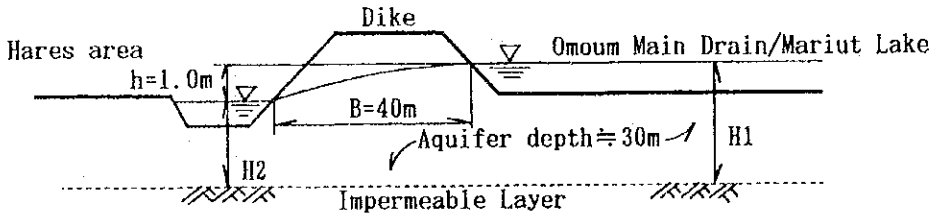
Canal Name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
West Nubariya Area													
T. Intake(1)	300	318	390	402	442	449	473	523	468	373	322	317	4,777
Water Requirement													
Right Side(2)	19	39	154	183	258	269	278	278	192	224	178	154	2,226
Left Side(3)	35	53	210	250	353	368	387	381	261	305	236	210	3,049
Other Use(4)	53	46	53	50	53	51	53	53	51	53	51	53	620
Total(5)	107	138	417	483	664	688	718	712	504	582	465	417	5,895
Intake Water of Hares Area													
Nubariya C.(6)	24	27	33	35	38	39	41	46	41	31	27	26	408
Re-use W.(7)	8	7	8	8	8	8	8	8	8	8	8	8	95
Total(8)	32	34	41	42	46	47	49	54	49	39	35	34	503

Note; (1)=Total actual intake of all West Nubariya in 1993 (NID)
(2)=Water requirement of Nubariya right side command area(320,480feddan) (NID)
(3)=Water requirement of Nubariya left side command area(500,000feddan) (NID)
(4)=Other use (drinking water, navigation and industry water etc.) (NID)
(5)=(2)+(3)+(4)
(6)=((1)-(4))× r ／(320.480×0.85)× Hares area
Intake rate(≒ requirement rate) of right side(r)= 2,226/(2,226+3,049) = 0.422
(7)=assumed re-use water from Omoum Main Drain
(8)=(6)+(7)

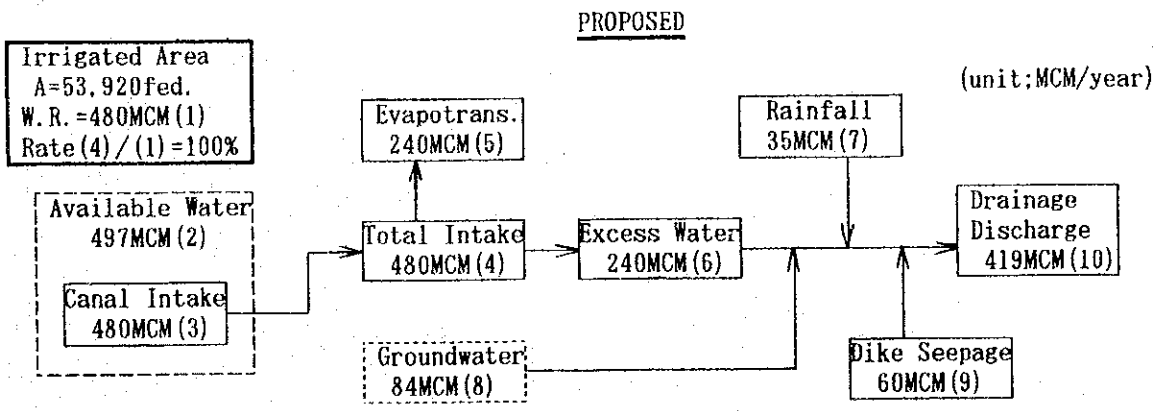
FIGURE D-3-1 WATER BALANCE IN HARES AREA



Note; (1)= present water requirement (refer to Table D-3-5)
(2)= actual intake through the Nubariya Main Canal (refer to Table D-3-8)
(3)= assumed re-use water through pipes from Omoum Main Drain
ϕ 350mm(mean diameter), flow velocity 0.8m/sec, N=40, Q=0.26MCM/day
(3')= inside reuse water calculated back using equation (1)-(2)-(3)
(4)= (2)+(3), (5)= (1)×0.35(present irrigation efficiency), (6)= (4)−(5)
(7)= 200mm/year(Alexandria) × 63,330 feddan × 0.65(runoff coefficient)
(8)= 0.9mm/day from "Hydrogeological Map of Egypt (RIGW in 1992)" = 7MCM/month
(9)= seepage water through the dike from Omoum Main Drain and Maruit Lake
$q = (H1-H2)(H1+H2) / (2 \times B) \times kc \times L$ = 2.0m3/sec, Q= q×T = 5MCM/month
B: phreatic length, kc: hydraulic conductivity of dike(kc=10-2cm/sec)
L: dike length, L=15km(Mariut Lake) + 12km(Omoum Main Drain), T:period



(10)=(6)+(7)+(8)+(9), assumed pump efficiency (actual discharge rate)
= 477MCM/600MCM(mean annual discharge of Hares Pump by DRI data) ≒ 80%



Note; (1)= proposed water requirement (refer to Table D-3-6)
(2)= design intake water from the Nubariya Canal (refer to Table D-3-7)
(3)= (4)=(1), (5)= (4)×0.50(proposed irrigation efficiency)
(6)= (4)-(5), (7), (8)= same as the present
(9)= almost same as the present, (10)=(6)+(7)+(8)+(9)

FIGURE D-3-2 WATER DEMAND AND INTAKE WATER IN HARES AREA

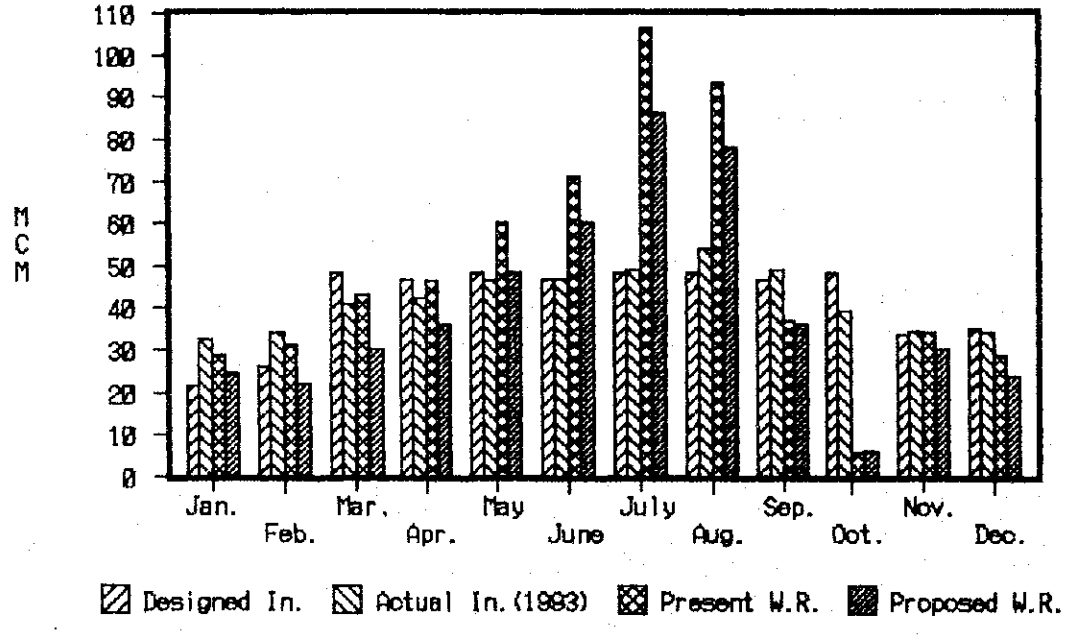


FIGURE D-3-3 PROPOSED IRRIGATION/DRAINAGE DIAGRAM OF HARES AREA

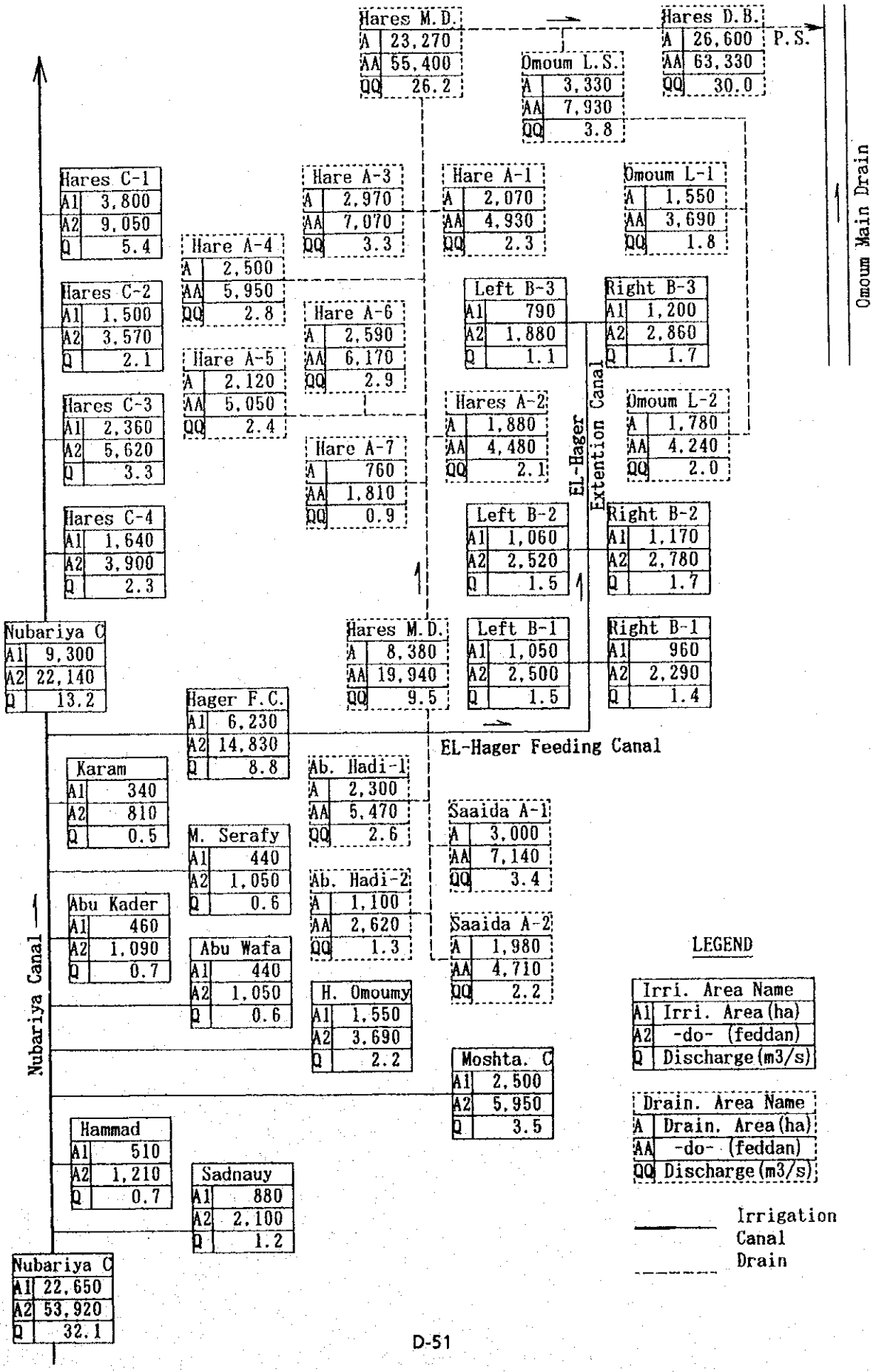
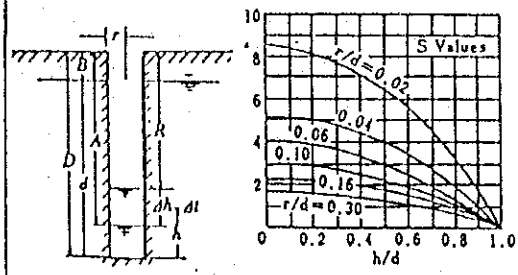


Table D-3-9 Results of Soil Survey

(1) Permeability Measurement

Site	B (cm)	A (cm)	R (cm)	EC (mS/cm)	△h (cm)	Remarks
1	86.5	122.0	110.0	14.59	12.0	
2	84.0	126.0	112.0	13.90	14.0	
3	85.5	125.5	107.5	14.80	18.0	
4	112.5	142.5	127.5	17.40	15.0	
5	73.5	119.5	87.5	4.40	32.0	
6	111.5	139.5	122.5	2.71	17.0	
7	69.5	99.5	93.5	9.25	6.0	
8	114.5	133.5	123.5	2.17	10.0	
9	109.5	127.5	117.5	6.39	10.0	
10	86.5	113.5	93.5	3.36	20.0	
11	49.5	82.5	72.5	6.49	10.0	D=180cm, r=6.35cm, h=D-(A+R)/2
Mean	89.4	121.0	106.1	8.68	14.9	d=D-B, K=0.617×r/d×1/S×△h/△t



Site	h (cm)	d (cm)	h/d	r/d	S values	△T (sec)	K (cm/sec)	Soil Profile
1	64.0	93.5	0.68	0.068	2.10	90	2.7E-03	shells
2	61.0	96.0	0.64	0.066	2.35	110	2.2E-03	shells
3	63.5	94.5	0.67	0.067	2.10	144	2.5E-03	shells
4	45.0	67.5	0.67	0.094	1.70	417	1.2E-03	heavy cray
5	76.5	106.5	0.72	0.060	2.10	413	1.4E-03	shells + cray
6	49.0	68.5	0.72	0.093	1.50	300	2.2E-03	cray + calc.
7	83.5	110.5	0.76	0.057	2.00	120	8.9E-04	cray + calc.
8	51.5	65.5	0.79	0.097	1.20	120	4.2E-03	cray + calc.
9	57.5	70.5	0.82	0.090	1.20	50	9.3E-03	cray + calc.
10	76.5	93.5	0.82	0.068	1.40	120	5.0E-03	gravels + h.p.
11	102.5	130.5	0.79	0.049	2.30	20	6.5E-03	sand + shells
Mean	66.4	90.6					3.4E-03	

(2) Intake Rate Measurement

Site	Cumulative Infilt. Formula		Intake Rate Formula		Tb (min)	Ib (mm/hr)	Remarks
	C	n	①	②	③	④	
1	0.52	0.561	17.50	-0.439	263	1.52	Cumulative Infiltration Depth
2	0.70	0.490	20.58	-0.510	306	1.11	D=CT^n, (D in mm, T in min)
3	1.18	0.352	24.92	-0.648	389	0.52	
4	0.60	0.543	19.55	-0.457	274	1.50	Intake Rate in mm/hr
5	1.22	0.400	29.28	-0.600	360	0.86	Ic=60*C*n*T^(n-1)
6	1.23	0.313	23.10	-0.687	412	0.37	=①*T^②
7	2.50	0.318	47.70	-0.682	409	0.79	Tb=600*(1-n)=③
8	1.90	0.351	40.01	-0.649	389	0.83	
9	2.70	0.310	50.22	-0.690	414	0.79	Basic Intake Rate in mm/hr
10	2.20	0.325	42.90	-0.675	405	0.75	Ib=60*C*n*Tb^(n-1)
Mean	1.48	0.396	31.58	-0.604	362	0.90	=①*③^②

Table D-4-1 Drainage Blocks of Hares Area

Drainage Block	Gross Area		Cultivation Area		Tile Drained Area	
	(ha)	(fed)	(ha) (1)	(fed)	(ha) (2)	(%) (2)/(1)
1. Omoum Left-1	1,550	3,690	1,320	3,140	0	0.0
2. Omoum Left-2	1,780	4,240	1,550	3,690	0	0.0
3. Hares Area-1	2,070	4,930	1,760	4,190	0	0.0
4. Hares Area-2	1,880	4,480	1,600	3,810	0	0.0
5. El Saaida Area-1	3,000	7,140	2,550	6,070	0	0.0
6. El Saaida Area-2	1,980	4,710	1,680	4,000	0	0.0
7. Hares Area-3	2,970	7,070	2,520	6,010	0	0.0
8. Hares Area-4	2,500	5,950	2,130	5,060	210	9.9
9. Hares Area-5	2,120	5,050	1,800	4,290	0	0.0
10. Hares Area-6	2,590	6,170	2,200	5,240	0	0.0
11. Hares Area-7	760	1,810	650	1,540	0	0.0
12. Abdel Hadi-1	2,300	5,470	1,950	4,650	0	0.0
13. Abdel Hadi-2	1,100	2,620	940	2,230	0	0.0
TOTAL	26,600	63,330	22,650	53,920	210	0.9

Source; Nubariya Drainage Directorate
Note : All block areas are measured with planimeter by the Study Team.

Daily Runoff and Discharge from Hares Area (Example; Dec. 1985)

Date	Rain (1) (mm)	Effec. Rain (2) (mm)	Rain Runoff (3) (MCM)	Seepage (4) (MCM)	Ground Water (5) (MCM)	Exess Water (6) (MCM)	Total Runoff (7) (MCM)	Pump Dis. (8) (MCM)	Storage Water (9) (MCM)
in 1985									
Dec. 1	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
2	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
3	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
4	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
5	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
6	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
7	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
8	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
9	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
10	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
11	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
12	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
13	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
14	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
15	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
16	5.0	3.25	0.86	0.17	0.24	0.39	1.66	1.66	0.00
17	18.0	11.70	3.11	0.17	0.24	0.39	3.91	2.59	1.32
18	0.2	0.13	0.03	0.17	0.24	0.39	0.83	2.15	0.00
19	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
20	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
21	29.6	19.24	5.12	0.17	0.24	0.39	5.92	2.59	3.33
22	24.1	15.67	4.17	0.17	0.24	0.39	4.97	2.59	5.70
23	0.0	0.00	0.00	0.17	0.24	0.39	0.80	2.59	3.91
24	0.6	0.39	0.10	0.17	0.24	0.39	0.90	2.59	2.22
25	9.0	5.85	1.56	0.17	0.24	0.39	2.36	2.59	1.98
26	5.0	3.25	0.86	0.17	0.24	0.39	1.66	2.59	1.05
27	0.0	0.00	0.00	0.17	0.24	0.39	0.80	1.85	0.00
28	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
29	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
30	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
31	0.0	0.00	0.00	0.17	0.24	0.39	0.80	0.80	0.00
Sub-1	0.0	0.00	0.00	1.73	2.39	3.87	7.99	7.99	
Sub-2	23.2	15.08	4.01	1.73	2.39	3.87	12.00	12.00	
Sub-3	68.3	44.40	11.81	1.90	2.63	4.26	20.60	20.60	
Total	91.5	59.48	15.82	5.36	7.42	12.00	40.60	40.60	

Note: (1)= actual daily rainfall, effective rainfall(2)= (1)×0.65
(3)= (2)×63,330fed(26,600ha), (4)=2.0m3/s×86,400
(5)= 0.9mm×63,330fed(26,600ha),
(6)= mean excess water of irrigation
15MCM/30=0.50MCM/day(in Nov.), 12MCM/31=0.39MCM/day(in Dec.)
(7)= (3)+(4)+(5)+(6),
(8)= proposed pump discharge = 30m3/s = 2.592MCM/day
(9)= storage water after the proposed pump discharge

Table D-4-2 Daily Discharge in Normal Year(1) (Hares)

(UNIT;MCM)

BLOCK=HARES CASE; 1985(MEAN)

MONTH /DAY	JAN. TQ	JAN. PQ	FEB. TQ	FEB. PQ	MAR. TQ	MAR. PQ	APR. TQ	APR. PQ	MAY TQ	MAY PQ	JUNE TQ	JULY TQ	AUG. TQ	SEP. TQ	OCT. TQ	OCT. PQ	NOV. TQ	NOV. PQ	DEC. TQ	DEC. PQ
1	0.80	0.80	2.31	2.59	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
2	0.85	0.85	2.71	2.59	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
3	0.80	0.80	0.81	1.73	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
4	0.80	0.80	1.19	1.19	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
5	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
6	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
7	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	1.29	1.29	0.80	0.80
8	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
9	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	1.41	1.41	0.80	0.80
10	0.87	0.87	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	1.88	1.88	0.80	0.80
11	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
12	1.34	1.34	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
13	0.80	0.80	0.84	0.84	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
14	0.80	0.80	2.53	2.53	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
15	0.80	0.80	1.39	1.39	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	1.66	1.66
16	1.11	1.11	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	1.10	1.10	0.91	0.91	3.91	2.59
17	0.80	0.80	0.81	0.81	1.21	1.21	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	1.46	1.46	0.91	0.91	0.83	2.15
18	1.77	1.77	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	1.06	1.06	0.91	0.91	0.80	0.80
19	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
20	0.87	0.87	0.81	0.81	0.90	0.90	1.48	1.48	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	5.92	2.59
21	2.10	2.10	0.81	0.81	0.91	0.91	1.39	1.39	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	4.97	2.59
22	0.80	0.80	0.81	0.81	0.90	0.90	1.15	1.15	1.20	1.20	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	2.59
23	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.90	2.59
24	0.80	0.80	1.06	1.06	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	2.36	2.59
25	0.80	0.80	2.03	2.03	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	1.66	2.59
26	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	1.85
27	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
28	0.80	0.80	0.81	0.81	0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
29	0.80	0.80			0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
30	0.80	0.80			0.90	0.90	1.01	1.01	1.19	1.19	1.41	1.80	1.67	1.01	0.51	0.51	0.91	0.91	0.80	0.80
31	3.69	2.59			1.02	1.02			1.19	1.19		1.80	1.67		0.51	0.51				
SUB-1	8.11	8.11	11.84	12.93	8.96	8.96	10.12	10.12	11.86	11.86	14.12	17.99	16.70	10.12	5.09	5.09	10.00	10.00	7.99	7.99
SUB-2	9.88	9.88	10.40	10.40	9.27	9.27	10.59	10.59	11.86	11.86	14.12	17.99	16.70	10.12	7.18	7.18	10.09	10.09	12.00	12.00
SUB-3	12.98	11.88	7.93	7.93	10.00	10.00	10.64	10.64	13.07	13.07	14.12	19.79	18.37	10.12	5.60	5.60	9.12	9.12	20.60	20.60
TOTAL	30.97	29.87	30.17	31.26	28.23	28.23	31.35	31.35	36.80	36.80	42.37	55.78	51.78	30.37	17.87	17.87	29.22	29.22	40.60	40.60

NOTE; RAINFALL RUNOFF COEFFICIENT= 0.65
PUMP CAPACITY= 30.0 CU.M/SEC

GRUNDWATER Q= 0.9 MM/DAY
GROSS AREA= 26600 HA

SEEPAGE= 2.0 CU.M/SEC
TQ= TOTAL RUNOFF. PQ= PUMP DISCHARGE

Table D-4-2 Daily Discharge in Normal Year(2) (Abis)

BLOCK=ABIS CASE; 1985(MEAN) (UNIT;MCM)

MONTH /DAY	JAN. TQ	JAN. PQ	FEB. TQ	FEB. PQ	MAR. TQ	MAR. PQ	APR. TQ	APR. PQ	MAY TQ	MAY PQ	JUNE TQ	JULY TQ	AUG. TQ	SEP. TQ	OCT. TQ	OCT. PQ	NOV. TQ	NOV. PQ	DEC. TQ	DEC. PQ
1	0.10	0.10	0.32	0.36	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
2	0.11	0.11	0.38	0.38	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
3	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
4	0.10	0.10	0.16	0.16	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
5	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
6	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
7	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
8	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.15	0.15	0.10	0.10
9	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
10	0.11	0.11	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.17	0.17	0.10	0.10
11	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.24	0.24	0.10	0.10
12	0.17	0.17	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
13	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
14	0.10	0.10	0.35	0.35	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
15	0.10	0.10	0.19	0.19	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
16	0.14	0.14	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.22	0.22
17	0.10	0.10	0.11	0.11	0.14	0.14	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.15	0.15	0.10	0.10	0.54	0.47
18	0.24	0.24	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.20	0.20	0.10	0.10	0.10	0.18
19	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.14	0.14	0.10	0.10	0.10	0.10
20	0.11	0.11	0.11	0.11	0.10	0.10	0.20	0.20	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
21	0.28	0.28	0.11	0.11	0.10	0.10	0.19	0.19	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.83	0.47
22	0.10	0.10	0.11	0.11	0.10	0.10	0.15	0.15	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.69	0.47
23	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.47
24	0.10	0.10	0.14	0.14	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.11	0.33
25	0.10	0.10	0.28	0.28	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.32	0.32
26	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.22	0.22
27	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
28	0.10	0.10	0.11	0.11	0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
29	0.10	0.10			0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
30	0.10	0.10			0.10	0.10	0.13	0.13	0.13	0.13	0.17	0.26	0.23	0.13	0.07	0.07	0.10	0.10	0.10	0.10
31	0.51	0.47			0.12	0.12			0.13	0.13		0.26	0.23		0.07	0.07			0.10	0.10
SUB-1	1.00	1.00	1.59	1.63	0.99	0.99	1.34	1.34	1.31	1.31	1.67	2.60	2.28	1.34	0.66	0.66	1.13	1.13	0.99	0.99
SUB-2	1.25	1.25	1.39	1.39	1.03	1.03	1.41	1.41	1.31	1.31	1.67	2.60	2.28	1.34	0.96	0.96	1.14	1.14	1.56	1.56
SUB-3	1.68	1.64	1.05	1.05	1.10	1.10	1.41	1.41	1.44	1.44	1.67	2.86	2.50	1.34	0.73	0.73	1.01	1.01	2.76	2.76
TOTAL	3.93	3.89	4.04	4.08	3.12	3.12	4.16	4.16	4.06	4.06	5.02	8.05	7.05	4.02	2.35	2.35	3.28	3.28	5.30	5.30

NOTE; RAINFALL RUNOFF COEFFICIENT= 0.65 GRUNDWATER Q= 0.9 MM/DAY SEEPAGE= 0.0 CU.M/SEC
PUMP CAPACITY= 5.4 CU.M/SEC GROSS AREA= 3780 HA TQ= TOTAL RUNOFF. PQ= PUMP DISCHARGE

Table D-4-3 Inundation Analysis in Hares Area (W=1/10 Rainfall)

Day	Rain (1)	Effec. Rain (2)	Rain Runoff (3)	Seepage (4)	Ground Water (5)	Exess Water (6)	Total (7)	Acumu. Runoff (8)	Drainage Dis. Present (9)	Drainage Dis. Proposed (10)
	(mm)	(mm)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
0								0.00	0.00	0.00
1	6.0	3.90	1.04	0.17	0.24		1.45	1.45	1.45	1.45
2	39.0	25.35	6.74	0.17	0.24		7.16	8.60	3.11	4.04
3	20.0	13.00	3.46	0.17	0.24		3.87	12.48	4.77	6.63
4				0.17	0.24	0.38	0.79	13.26	6.43	9.23
5				0.17	0.24	0.38	0.79	14.05	8.09	11.82
6				0.17	0.24	0.38	0.79	14.84	9.74	14.41
7				0.17	0.24	0.38	0.79	15.63	11.40	17.00
8				0.17	0.24	0.38	0.79	16.42	13.06	
9				0.17	0.24	0.38	0.79	17.21	14.72	
10				0.17	0.24	0.38	0.79	18.00	16.38	
11				0.17	0.24	0.38	0.79	18.79	18.04	
12				0.17	0.24	0.38	0.79	19.57	19.70	
13				0.17	0.24	0.38	0.79	20.36		
14				0.17	0.24	0.38	0.79	21.15		
15				0.17	0.24	0.38	0.79	21.94		
Total	65.0	42.25	11.24	2.59	3.59	4.52	21.94			

Note: (1)=Proposed rainfall, Effective rainfall (2)= (1) × 0.65
(3) = (2) × 63,330fed (26,600ha), (4)=2.0m3/s × 86,400
(5)=0.9mm × 63,330fed (26,600ha),
(6)= Mean excess water of irrigation in the rainy season = 0.38MCM/day
(7)= (3)+(4)+(5)+(6), (8)= accumulated of (7)
(9), (10)= Present /or Proposed accumulated drainage discharge

Table D-4-4 Inundation Analysis in Hares Area (Dec. 1991 flood)

Date Nov./ Dec. in 1991	Rain (1)	Effec. Rain (2)	Rain Runoff (3)	Seepage (4)	Ground Water (5)	Exess Water (6)	Total (7)	Accumu. Runoff (8)	Drainage Dis. Present (9)	Drainage Dis. Proposed (10)
	(mm)	(mm)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
Nov.26	-	-	-	-	-	-	-	0.00	0.00	0.00
27	3.2	2.08	0.55	0.17	0.24	-	0.97	0.97	0.97	0.97
28	27.4	17.81	4.74	0.17	0.24	-	5.15	6.12	2.62	3.56
29	11.3	7.35	1.95	0.17	0.24	-	2.37	8.48	4.28	6.15
30	0.2	0.13	0.03	0.17	0.24	-	0.45	8.93	5.94	8.74
Dec. 1	17.2	11.18	2.97	0.17	0.24	-	3.39	12.31	7.60	
2	14.2	9.23	2.46	0.17	0.24	-	2.87	15.18	9.26	
3	-	-	0.00	0.17	0.24	0.38	0.79	15.97	10.92	
4	0.2	0.13	0.03	0.17	0.24	-	0.45	16.42	12.58	
5	0.4	0.26	0.07	0.17	0.24	-	0.48	16.90	14.24	
6	-	-	0.00	0.17	0.24	0.38	0.79	17.69	15.90	
7	-	-	0.00	0.17	0.24	0.38	0.79	18.48	17.55	
8	3.0	1.95	0.52	0.17	0.24	-	0.93	19.41	19.21	
9	17.9	11.64	3.09	0.17	0.24	-	3.51	22.91		
10	-	-	0.00	0.17	0.24	0.38	0.79	23.70		
11	9.7	6.31	1.68	0.17	0.24	-	2.09	25.79		
Total	104.7	68.06	18.10	2.59	3.59	1.51	25.79			

Table D-4-5 H～A·V in Hares Area

Water Surface Level	Depth	Interval Depth	Area below Water Surface		Mean Area	Storage	Accumu. Storage	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(m.MSL)	(m)	(m)	(ha)	(fed.)	(ha)	(MCM)	(MCM)	
-3.5	-	-	-	-	-	-	-	
-3.0	0.5	0.5	100	240	50	0.3	0.3	Ground elevation of
-2.5	1.0	0.5	5,100	12,140	2,600	13.0	13.3	datum land
-2.0	1.5	0.5	7,900	18,810	6,500	32.5	45.8	=(-)3.0 m.MSL
-1.5	2.0	0.5	10,100	24,050	9,000	45.0	90.8	
-1.0	2.5	0.5	12,700	30,240	11,400	57.0	147.8	
0.0	3.5	1.0	15,900	37,860	14,300	143.0	290.8	
1.0	4.5	1.0	18,700	44,520	17,300	173.0	463.8	

Note; (4)--- measured with planimeter using the contour map
(6)--- (3)×(5)×10,000／1,000,000

FIGURE D-4-1 H ～ A・V CURVE IN HARES AREA

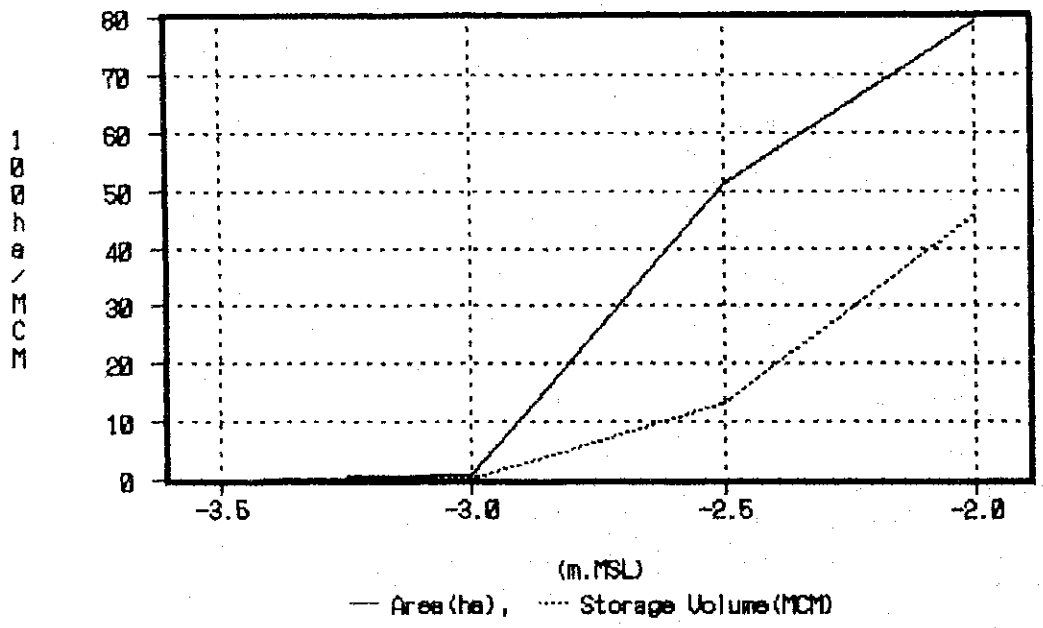


Table D-4-6 Results of Inundation Analyses in Hares Area

W=1/10 Rainfall	(Unit)	Present	Proposed	Dif.	Remarks
Inundation period	(day)	11	5	6	
Inundation storage	(MCM)	7.7	5.8	1.9	
Max. water level	(m.MSL)	-2.71	-2.78		from
Inundation depth	(m)	0.29	0.22	0.07	FIGURE D-4-1
Inundation area	(ha)	2,970	2,250	720	

Dec. 1991 Flood	(Unit)	Present	Proposed	Dif.	Remarks
Inundation period	(day)	11	3	8	
Inundation storage	(MCM)	5.9	2.3	3.6	
Max. water level	(m.MSL)	-2.78	-2.92	0.14	from
Inundation depth	(m)	0.22	0.08	0.14	FIGURE D-4-1
Inundation area	(ha)	2,280	900	1380	

FIGURE D-4-2 INUNDATION ANALYSIS IN HARES AREA (W=1/10 Rainfall)

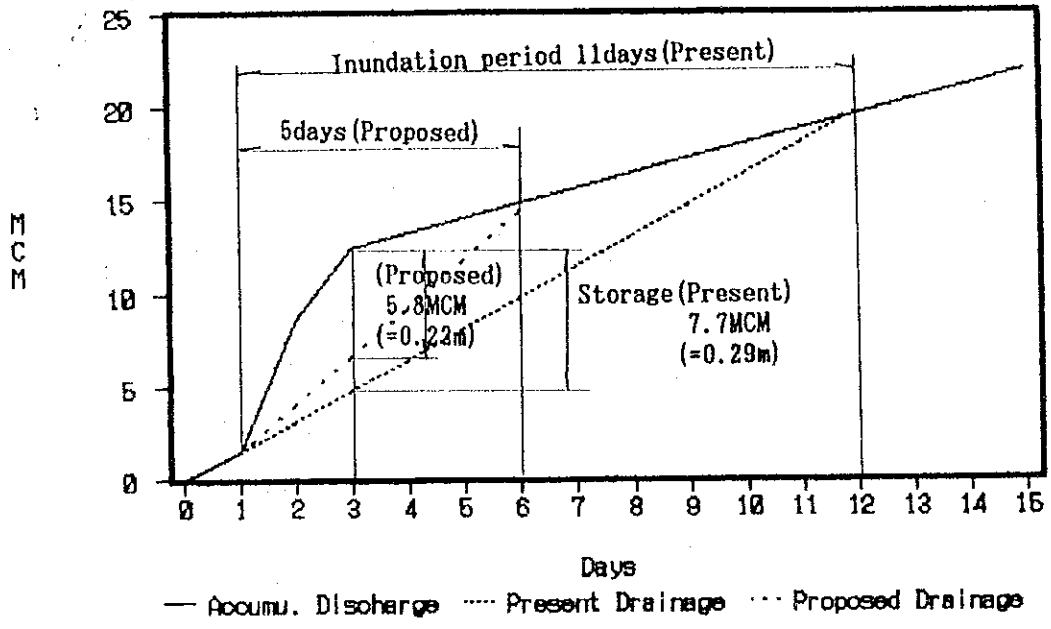
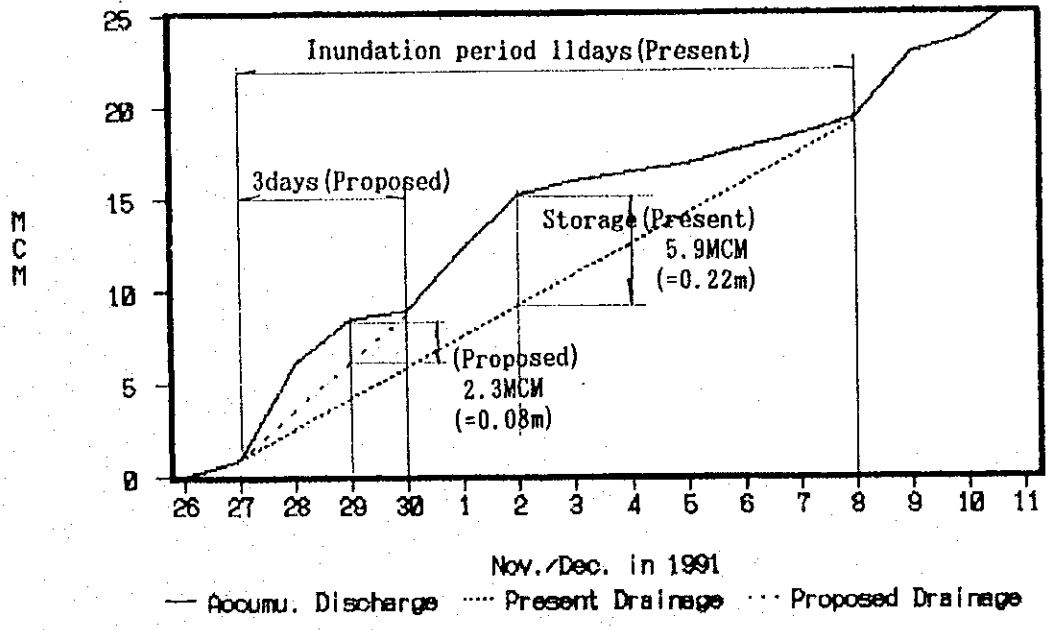


FIGURE D-4-3 INUNDATION ANALYSIS IN HARES AREA (DEC. 1991 FLOOD)



E. ALTERNATIVE STUDIES

ANNEX E. ALTERNATIVE STUDY

E-1. Master Plan

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E-2. Feasibility Study

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Table E-1-1 Cost Estimation of Alternative Plan (Case-2)

(unit : LE '000)

Description	Priority Dev.Proj.	Qalla Area	Abis Area	Hares Area	Dishudi Area	Truga Area	Sheres. Area	Abu Hommos Area	Total
1. Construction Works									
1.1 Preparation Works	493	-	-	2,080	1,377	2,538	-	-	6,488
1.2 Pump Works	126,033	-	-	32,821	5,000	5,000	-	-	168,854
1.3 Omoum Main Drain Works	43,802	-	-	-	-	-	-	-	43,802
1.4 Discharge-Channel and Resettlement Works	18,282	-	-	-	-	-	-	-	18,282
1.5 Drain Works	-	7,458	4,794	33,741	19,446	54,646	71,949	25,256	217,290
1.6 Road Works	-	4,634	2,979	20,966	12,083	33,955	44,706	15,693	135,016
1.7 Soil Improvement	-	5,712	3,667	25,872	14,884	37,262	-	-	87,397
1.8 Monitoring Set	346	-	-	-	-	-	-	-	346
1.9 Nubariya Navigation Canal	-	-	-	-	-	-	-	-	0
Sub-Total	188,956	17,804	11,440	115,480	52,790	133,401	116,655	40,949	677,475
2. On-Farm Development and Subsurface Drain Works	-	8,930	5,733	40,453	23,272	47,222	8,055	-	133,665
3. Land Acquisition and Compensation Works	-	-	-	636	-	-	-	-	636
4. Engineering and Administration Works	19,383	4,640	2,982	20,989	12,097	33,995	6,052	2,124	102,262
5. O & M Equipments	3,680	1,352	869	6,115	3,524	9,904	13,040	4,577	43,061
6. Total	212,019	32,726	21,024	183,673	91,683	224,522	143,802	47,650	957,099
7. Physical Contingency (10%)	21,202	3,273	2,103	18,367	9,168	22,452	14,380	4,765	95,710
8. Grand Total	233,221	35,999	23,127	202,040	100,851	246,974	158,182	52,415	1,052,809
9. Block-wise Allocated Costs 1/		44,004	28,273	238,255	121,722	305,626	235,405	79,524	1,052,809

Note:

1/: In caluculating block-wise costs, costs of priority Development project were allocated to each block. according to their area ratio.

Qalla Area	: 5,880 ha	Truga Area	: 43,080 ha
Qalla Area	: 5,880 ha	Truga Area	: 43,080 ha
Hares Area	: 26,600 ha	Abu Hommos Area	: 19,910 ha
Dishudi Area	: 15,330 ha		
		Total	: 171,300 ha

Table E-1-2 Cost Estimation of Alternative Plan (Case-3)

(unit : LE '000)

Description	Priority Dev.Proj.	Qalla Area	Abis Area	Hares Area	Dishudi Area	Truga Area	Sheres. Area	Abu Hommos Area	Total
1. Construction Works									
1.1 Preparation Works	477	-	-	2,080	1,377	2,538	-	-	6,472
1.2 Pump Works	52,033	-	-	32,821	5,000	5,000	-	-	94,854
1.3 Omoum Main Drain Works	43,802	-	-	-	-	-	-	-	43,802
1.4 Discharge-Channel and Resettlement Works	18,282	-	-	-	-	-	-	-	18,282
1.5 Drain Works	-	7,458	4,794	33,741	19,446	54,646	71,949	25,256	217,290
1.6 Road Works	-	4,634	2,979	20,966	12,083	33,955	44,706	15,693	135,016
1.7 Soil Improvement	-	5,712	3,667	25,872	14,884	37,262	-	-	87,397
1.8 Monitoring Set	346	-	-	-	-	-	-	-	346
1.9 Nubariya Navigation Canal	-	-	-	-	-	-	-	-	0
Sub-Total	114,940	17,804	11,440	115,480	52,790	133,401	116,655	40,949	603,459
2. On-Farm Development and Subsurface Drain Works	-	8,930	5,733	40,453	23,272	47,222	8,055	-	133,665
3. Land Acquisition and Compensation Works	-	-	-	636	-	-	-	-	636
4. Engineering and Administration Works	19,383	4,640	2,982	20,989	12,097	33,995	6,052	2,124	102,262
5. O & M Equipments	3,680	1,352	869	6,115	3,524	9,904	13,040	4,577	43,061
6. Total	138,003	32,726	21,024	183,673	91,683	224,522	143,802	47,650	883,083
7. Physical Contingency (10%)	13,800	3,273	2,103	18,367	9,168	22,452	14,380	4,765	88,308
8. Grand Total	151,803	35,999	23,127	202,040	100,851	246,974	158,182	52,415	971,391
9. Block-wise Allocated Costs 1/		41,210	26,477	225,612	114,436	285,151	208,446	70,059	971,391

Note:

1/: In caluculating block-wise costs, costs of priority Development project were allocated to each block. according to their area ratio.

Qalla Area	: 5,880 ha	Truga Area	: 43,080 ha
Abis Area	: 3,780 ha	Shereshera Area	: 56,720 ha
Hares Area	: 26,600 ha	Abu Hommos Area	: 19,910 ha
Dishudi Area	: 15,330 ha		
		Total	: 171,300 ha

Table E-1-3 Cost Estimation of Alternative Plan (Case-4)

(unit : LE '000)

Description	Priority Dev.Proj.	Qalla Area	Abis Area	Hares Area	Dishudi Area	Truga Area	Sheres. Area	Abu Hommos Area	Total
1. Construction Works									
1.1 Preparation Works	477	-	-	2,080	1,377	2,538	-	-	6,472
1.2 Pump Works	52,033	-	-	32,821	5,000	5,000	-	-	94,854
1.3 Omoum Main Drain Works	43,802	-	-	-	-	-	-	-	43,802
1.4 Discharge-Channel and Resettlement Works	18,282	-	-	-	-	-	-	-	18,282
1.5 Drain Works	-	7,458	4,794	33,741	19,446	54,646	71,949	25,256	217,290
1.6 Road Works	-	4,634	2,979	20,966	12,083	33,955	44,706	15,693	135,016
1.7 Soil Improvement	-	5,712	3,667	25,872	14,884	37,262	-	-	87,397
1.8 Monitoring Set	346	-	-	-	-	-	-	-	346
1.9 Nubariya Navigation Canal	52,300	-	-	-	-	-	-	-	52,300
Sub-Total	167,240	17,804	11,440	115,480	52,790	133,401	116,655	40,949	655,759
2. On-Farm Development and Subsurface Drain Works	-	8,930	5,733	40,453	23,272	47,222	8,055	-	133,665
3. Land Acquisition and Compensation Works	-	-	-	636	-	-	-	-	536
4. Engineering and Administration Works	19,383	4,640	2,982	20,989	12,097	33,995	6,052	2,124	102,262
5. O & M Equipments	3,680	1,352	869	6,115	3,524	9,904	13,040	4,577	43,061
6. Total	190,303	32,726	21,024	183,673	91,683	224,522	143,802	47,650	935,383
7. Physical Contingency (10%)	19,030	3,273	2,103	18,367	9,168	22,452	14,380	4,765	93,538
8. Grand Total	209,333	35,999	23,127	202,040	100,851	246,974	158,182	52,415	1,028,921
9. Block-wise Allocated Costs 1/		43,185	27,746	234,546	119,585	299,619	227,495	76,745	1,028,921

Note:

1/: In caluculating block-wise costs. costs of priority Development project were allocated to each block. according to their area ratio.

Qalla Area	: 5,880 ha	Truga Area	: 43,080 ha
Abis Area	: 3,780 ha	Shereshera Area	: 56,720 ha
Hares Area	: 26,600 ha	Abu Hommos Area	: 19,910 ha
Dishudi Area	: 15,330 ha		
		Total	: 171,300 ha

Table E-1-4 Estimation of Blockwise Economic Project Benefits

Drainage Block	Area (ha)	Financial Benefits			Economic Benefits		
		Crop Benefits 1/ ('000 LE)	Flood Damage Reduction Benefits 2/ ('000 LE)	Total ('000 LE)	Crop Benefits 1/ ('000 LE)	Flood Damage Reduction Benefits 2/ ('000 LE)	Total ('000 LE)
Qalla Area	5,000	7,130.00	218.73	7,348.73	8,250.00	218.73	8,468.73
Abis Area	3,210	4,490.00	301.15	4,791.15	5,200.00	301.15	5,501.15
Hares Area	22,650	52,980.00	1,648.40	54,628.40	62,740.00	1,648.40	64,388.40
Dishudi Area	13,030	18,440.00	256.77	18,696.77	21,350.00	256.77	21,606.77
Truga Area	32,620	46,180.00	494.52	46,674.52	53,470.00	494.52	53,964.52
Shereshera Area	38,760	54,860.00	38.04	54,898.04	63,520.00	38.04	63,558.04
Abu Hommos Area	17,360	24,480.00	212.39	24,692.39	28,350.00	212.39	28,562.39
Total	132,630	208,560.00	3,170.00	211,730.00	242,880.00	3,170.00	246,050.00

Note: 1: see Table I-2-48
2/: see Table I-2-50

Table E-1-5 Estimation of Blockwise Economic Project Costs

Drainage Block	Area		Financial Project Cost		Economic project Cost			Disbursement of Economic Project Cost 5/					
	Drainage	Irrigation	Drainage Improvement 1/	Irrigation Improvement 2/	Drainage Improvement 3/	Irrigation Improvement 4/	Total	1998	1999	2000	2001	2002	Total
	(ha)	(ha)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)	('000 LE)
Qalla Area	5,880	5,000	41,210	4,360	36,471	3,994	40,465	3,035	324	12,504	13,515	11,087	40,465
Abis Area	3,780	3,210	26,477	2,799	23,432	2,564	25,996	1,950	208	8,033	8,683	7,123	25,997
Hares Area	26,600	22,650	225,612	19,751	199,667	18,092	217,759	16,332	1,742	67,288	72,732	59,666	217,760
Dishudi Area	15,330	13,030	114,436	11,362	101,276	10,408	111,684	8,376	893	34,510	37,302	30,601	111,682
Truga Area	43,080	32,620	285,151	28,445	252,359	26,056	278,415	20,881	2,227	86,030	92,991	76,287	278,416
Shereshera Area	56,720	38,760	208,446	33,799	184,475	30,960	215,435	16,158	1,723	66,569	71,955	59,029	215,434
Abu Hommos Area	19,910	17,360	70,059	15,138	62,002	13,866	75,868	5,690	607	23,443	25,340	20,788	75,868
Total	171,300	132,630	971,391	115,654	859,682	105,940	965,622	72,422	7,724	298,377	322,518	264,581	965,622

Note: 1/: see Table E-1-2 (Case-3)
2/: Irrigation improvement costs = Irrigation area x 872 LE/ha
3/: Financial drainage costs x 0.885
0.885 : Ratio of economic cost to financial cost in Hares Area(199,580,000 LE/225,612,000 LE)
4/: Financial irrigation costs x 0.916 (see Table I-2-54, Annex I)
5/: Annual disbursement costs of the project costs are assumed as shown below, making reference to that of Hares Area.
1998 : 7.5 %
1999 : 0.8 %
2000 : 30.9 %
2001 : 33.4 %
2002 : 27.4 %

Table E-1-6 Economic Evaluation by Internal Rate of Return in Each Drainage Block

Year	Qalla Area				Abis Area				Hares Area				Dishudi Area				Truga Area				Shereshura Area				Abu Hom
	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 12.16% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 12.34% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 17.02% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 11.40% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 11.30% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 14.06% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net G 4 Yr (M L (3
1	3.04	0.42	0.00	-3.46	1.95	0.27	0.00	-2.22	16.33	1.91	0.00	-18.24	8.38	1.10	0.00	-9.48	20.88	3.08	0.00	-23.96	16.16	4.06	0.00	-20.22	5.69	1.42	
2	0.32	0.42	0.00	-0.74	0.21	0.27	0.00	-0.48	1.74	1.91	0.00	-3.65	0.89	1.10	0.00	-1.99	2.23	3.08	0.00	-5.31	1.72	4.06	0.00	-5.78	0.61	1.42	
3	12.50	0.42	0.00	-12.92	8.03	0.27	0.00	-8.30	67.29	1.91	0.00	-69.20	34.51	1.10	0.00	-35.61	86.03	3.08	0.00	-89.11	66.57	4.06	0.00	-70.63	23.44	1.42	
4	13.52	0.42	0.00	-13.94	8.69	0.27	0.00	-8.96	72.73	1.91	0.00	-74.64	37.30	1.10	0.00	-38.40	92.99	3.08	0.00	-96.07	71.96	4.06	0.00	-76.02	25.34	1.42	
5	11.09	0.42	0.00	-11.51	7.12	0.27	0.00	-7.39	59.67	1.91	0.00	-61.58	30.60	1.10	0.00	-31.70	76.29	3.08	0.00	-79.37	103.34	4.06	0.00	-107.40	20.78	1.42	
6		0.42	2.12	1.70		0.27	1.38	1.11		1.91	16.1	14.19		1.10	5.4	4.30		3.08	13.49	10.41		4.06	15.89	11.83		1.42	
7		0.42	4.24	3.82		0.27	2.75	2.48		1.91	32.2	30.29		1.10	10.81	9.71		3.08	26.98	23.90		4.06	31.78	27.72		1.42	
8		0.42	6.35	5.93		0.27	4.13	3.86		1.91	48.29	46.38		1.10	16.21	15.11		3.08	40.47	37.39		4.06	47.67	43.61		1.42	
9		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
10		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
11		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
12		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
13		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
14		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
15		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
16		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
17		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48	15.17	1.10	21.61	5.34	36.69	3.08	53.96	14.19		4.06	63.56	59.50		1.42	
18	8.92	0.42	8.47	-0.87	4.98	0.27	5.50	0.25		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50	23.66	1.42	
19		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
20		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
21		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
22		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
23		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
24		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
25		0.42	8.47	8.05		0.27	5.50	5.23	29.09	1.91	64.39	33.39	3.75	1.10	21.61	16.76	4.08	3.08	53.96	46.80		4.06	63.56	59.50		1.42	
26		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
27		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
28		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
29		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	
30		0.42	8.47	8.05		0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88	44.31	4.06	63.56	15.19		1.42	
Total	49.39				30.98				246.85				130.6				319.19				304.06				99.52		

Note : 1/: Total economic ptoject costs and replacement costs are referred to Table E-1-5 in Annex E and Table I-2-56 in Annex I.
2/: O & M costs are referred to Table E-2-55, Annex E.
3/: Economic net gains (benefits) are referred to Table E-1-4, and development period is assumed to be four years after project implementation.

ation by Internal Rate of Return in Each Drainage Block

(unit : million LE)

Abis Area				Hares Area				Dishudi Area				Truga Area				Shereshura Area				Abu Hommos				Total Area			
Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 12.34% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 17.02% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 11.40% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 11.30% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 14.06% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 18.91% (4)	Total Cost (M LE) (1)	O & M Cost (M LE) (2)	Net Gain 4 Yr Plan (M LE) (3)	IRR 14.07% (4)
1.95	0.27	0.00	-2.22	16.33	1.91	0.00	-18.24	8.38	1.10	0.00	-9.48	20.88	3.08	0.00	-23.96	16.16	4.06	0.00	-20.22	5.69	1.42	0.00	-7.11	72.43	12.26	0.00	-84.69
0.21	0.27	0.00	-0.48	1.74	1.91	0.00	-3.65	0.89	1.10	0.00	-1.99	2.23	3.08	0.00	-5.31	1.72	4.06	0.00	-5.78	0.61	1.42	0.00	-2.03	7.72	12.26	0.00	-19.98
8.03	0.27	0.00	-8.30	67.29	1.91	0.00	-69.20	34.51	1.10	0.00	-35.61	86.03	3.08	0.00	-89.11	66.57	4.06	0.00	-70.63	23.44	1.42	0.00	-24.86	298.37	12.26	0.00	-310.63
8.69	0.27	0.00	-8.96	72.73	1.91	0.00	-74.64	37.30	1.10	0.00	-38.40	92.99	3.08	0.00	-96.07	71.96	4.06	0.00	-76.02	25.34	1.42	0.00	-26.76	322.53	12.26	0.00	-334.79
7.12	0.27	0.00	-7.39	59.67	1.91	0.00	-61.58	30.60	1.10	0.00	-31.70	76.29	3.08	0.00	-79.37	103.34	4.06	0.00	-107.40	20.78	1.42	0.00	-22.20	308.89	12.26	0.00	-321.15
	0.27	1.38	1.11		1.91	16.1	14.19		1.10	5.4	4.30		3.08	13.49	10.41		4.06	15.89	11.83		1.42	7.14	5.72	0	12.26	61.52	49.26
	0.27	2.75	2.48		1.91	32.2	30.29		1.10	10.81	9.71		3.08	26.98	23.90		4.06	31.78	27.72		1.42	14.28	12.86	0	12.26	123.04	110.78
	0.27	4.13	3.86		1.91	48.29	46.38		1.10	16.21	15.11		3.08	40.47	37.39		4.06	47.67	43.61		1.42	21.42	20.00	0	12.26	184.54	172.28
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48	15.17	1.10	21.61	5.34	36.69	3.08	53.96	14.19		4.06	63.56	59.50		1.42	28.56	27.14	51.86	12.26	246.05	181.93
4.98	0.27	5.50	0.25		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50	23.66	1.42	28.56	3.48	37.56	12.26	246.05	196.23
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23	29.09	1.91	64.39	33.39	3.75	1.10	21.61	16.76	4.08	3.08	53.96	46.80		4.06	63.56	59.50		1.42	28.56	27.14	36.92	12.26	246.05	196.87
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88		4.06	63.56	59.50		1.42	28.56	27.14	0	12.26	246.05	233.79
	0.27	5.50	5.23		1.91	64.39	62.48		1.10	21.61	20.51		3.08	53.96	50.88	44.31	4.06	63.56	15.19		1.42	28.56	27.14	44.31	12.26	246.05	189.48
30.98				246.85				130.6				319.19				304.06				99.52				1,180.59			

costs and replacement costs are referred to Table E-1-5 in Annex E and Table I-2-56 in Annex I.
d to Table E-2-55, Annex E.
efits) are referred to Table E-1-4, and development period is assumed to be four years after project implementation.

FIGURE E-1-1 SCHEMATIC DIAGRAM FOR HYDRAULIC ANALYSIS
(CASE— 1)

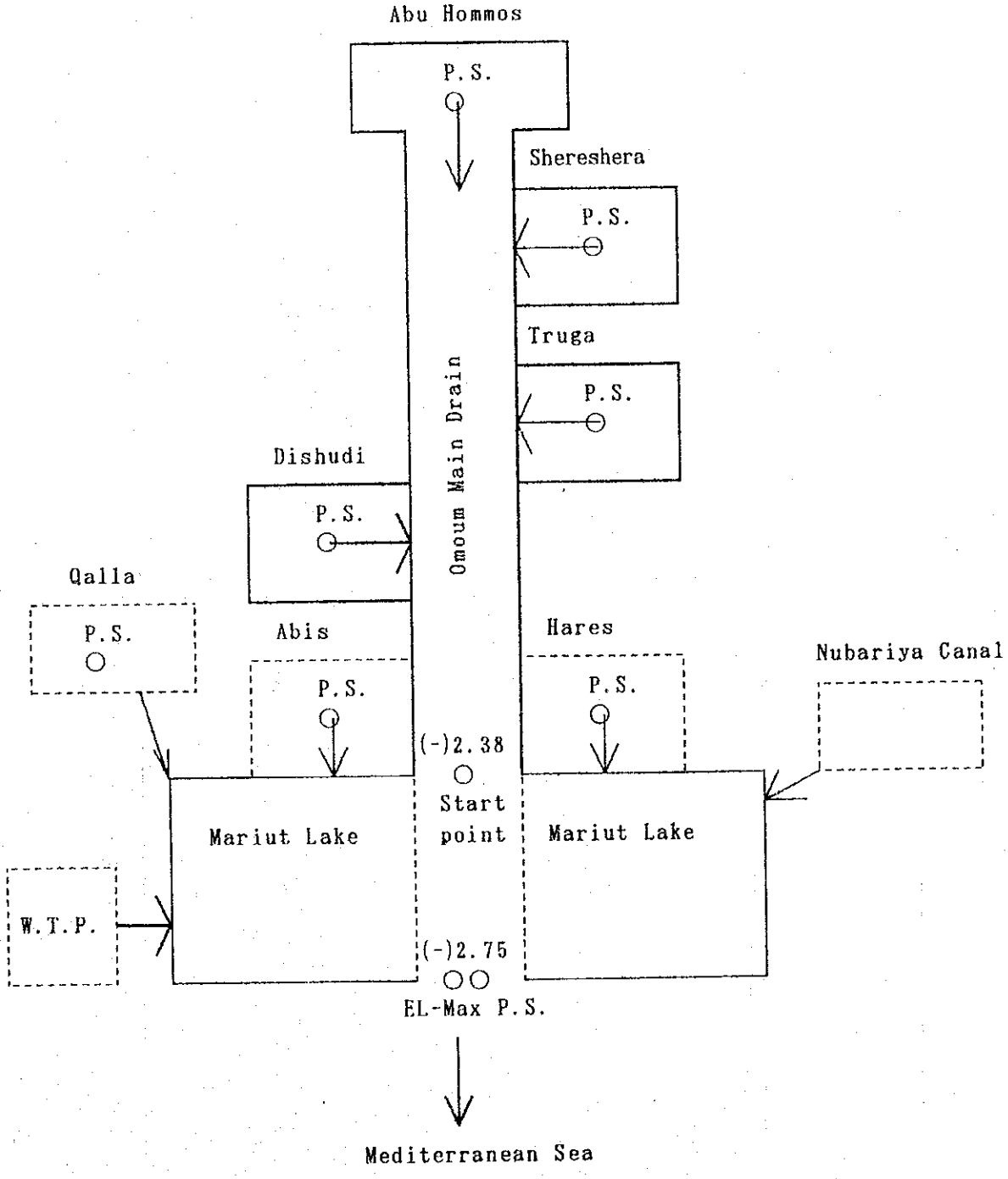

FIGURE E-1-2 RESULT OF HYDRAULIC ANALYSIS

(Alternative Plan, Case-1)

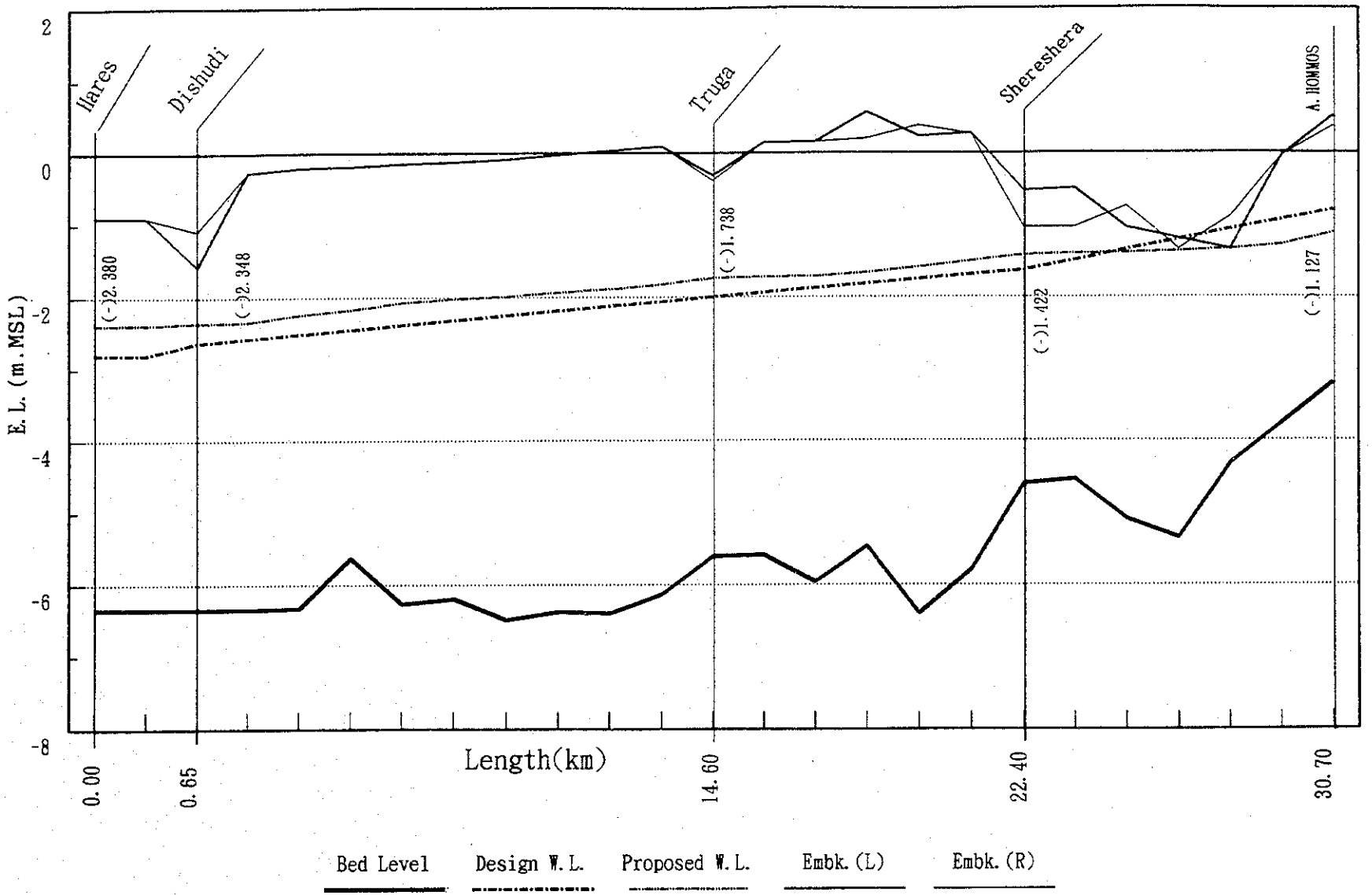

FIGURE E-1-3 SCHEMATIC DIAGRAM FOR HYDRAULIC ANALYSIS
(CASE— 2)

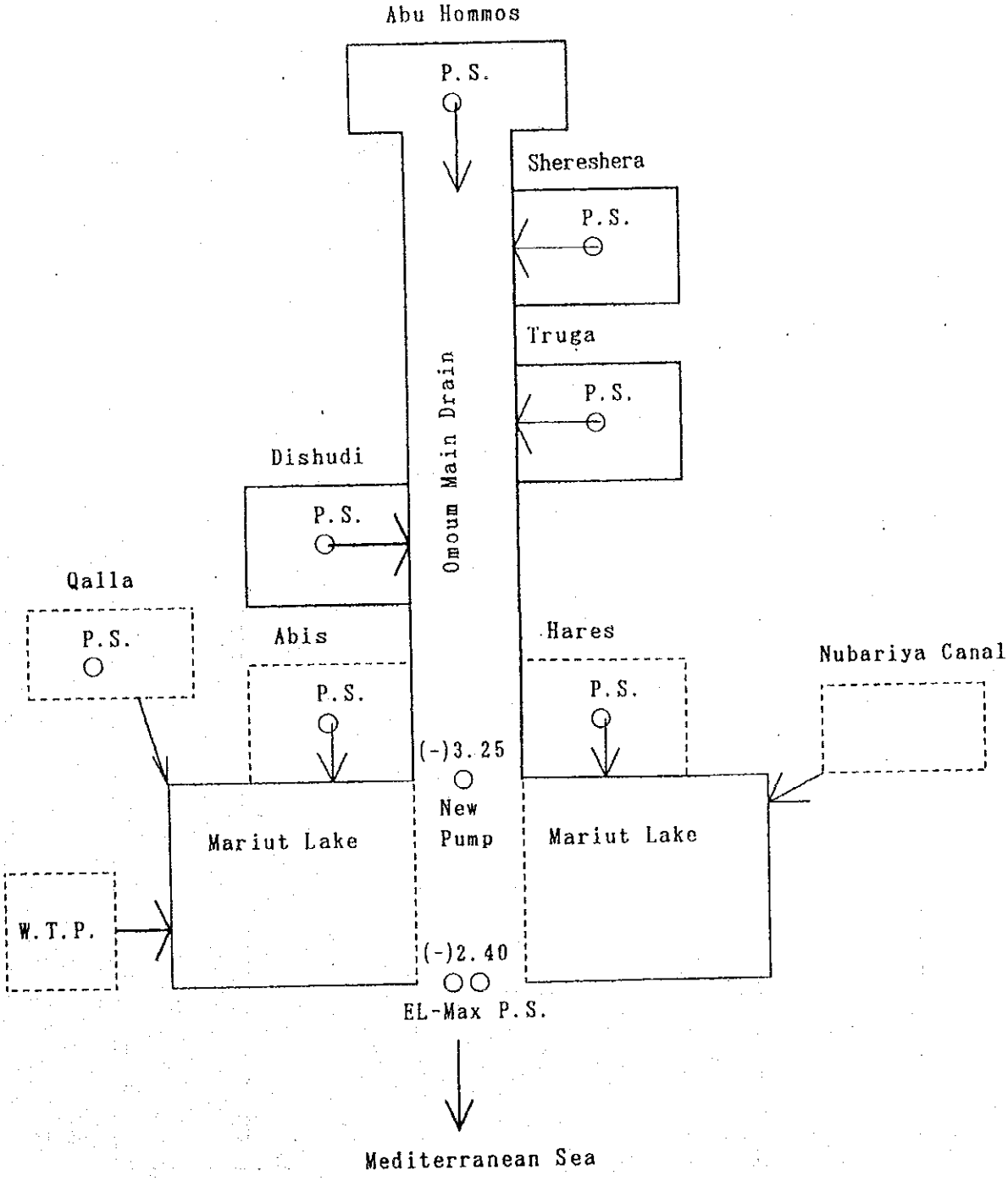

FIGURE E-1-4 RESULT OF HYDRAULIC ANALYSIS
(Alternative Plan, Case-2)

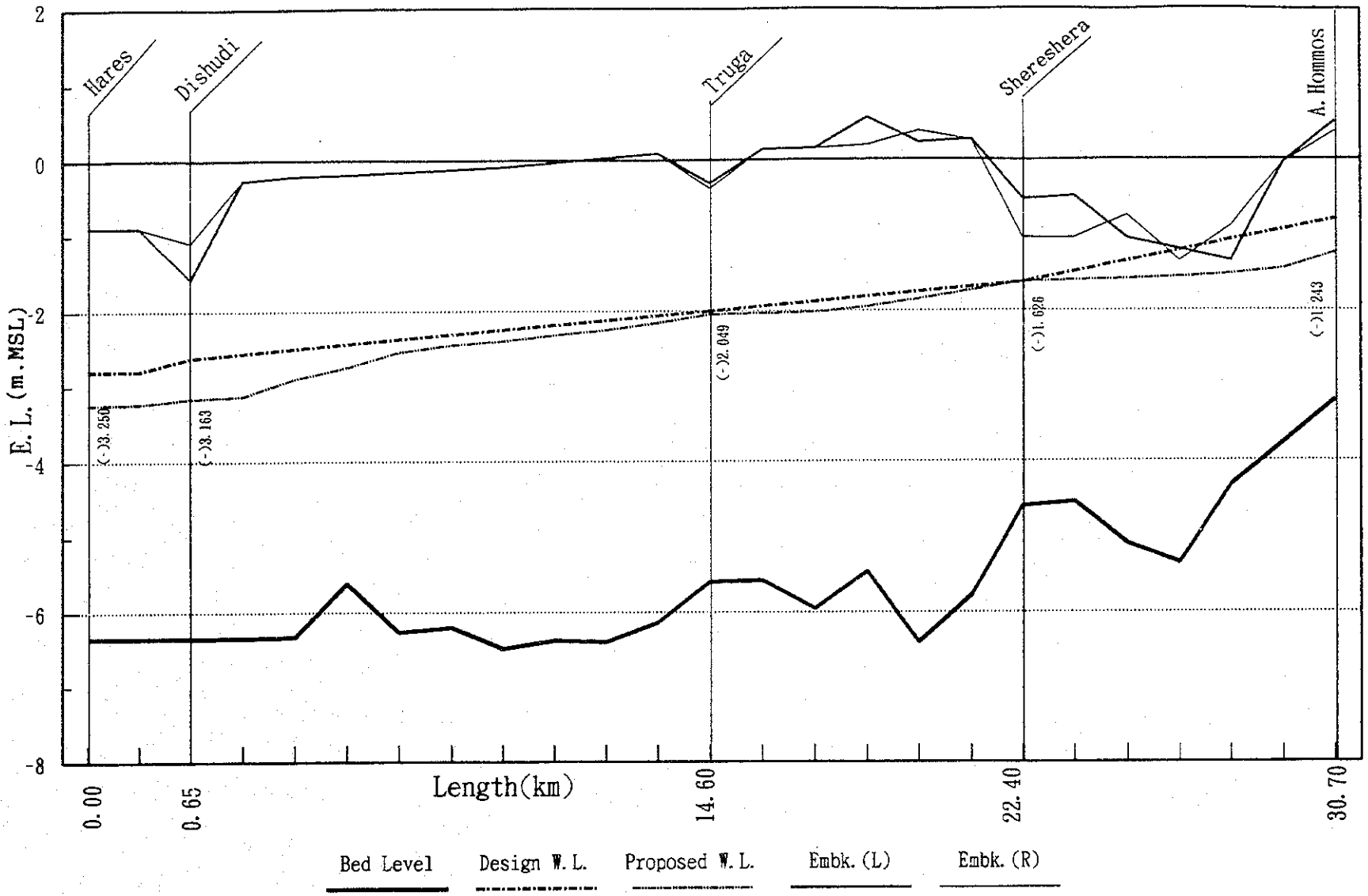

FIGURE E-1-5 SCHEMATIC DIAGRAM FOR HYDRAULIC ANALYSIS
(CASE— 3)

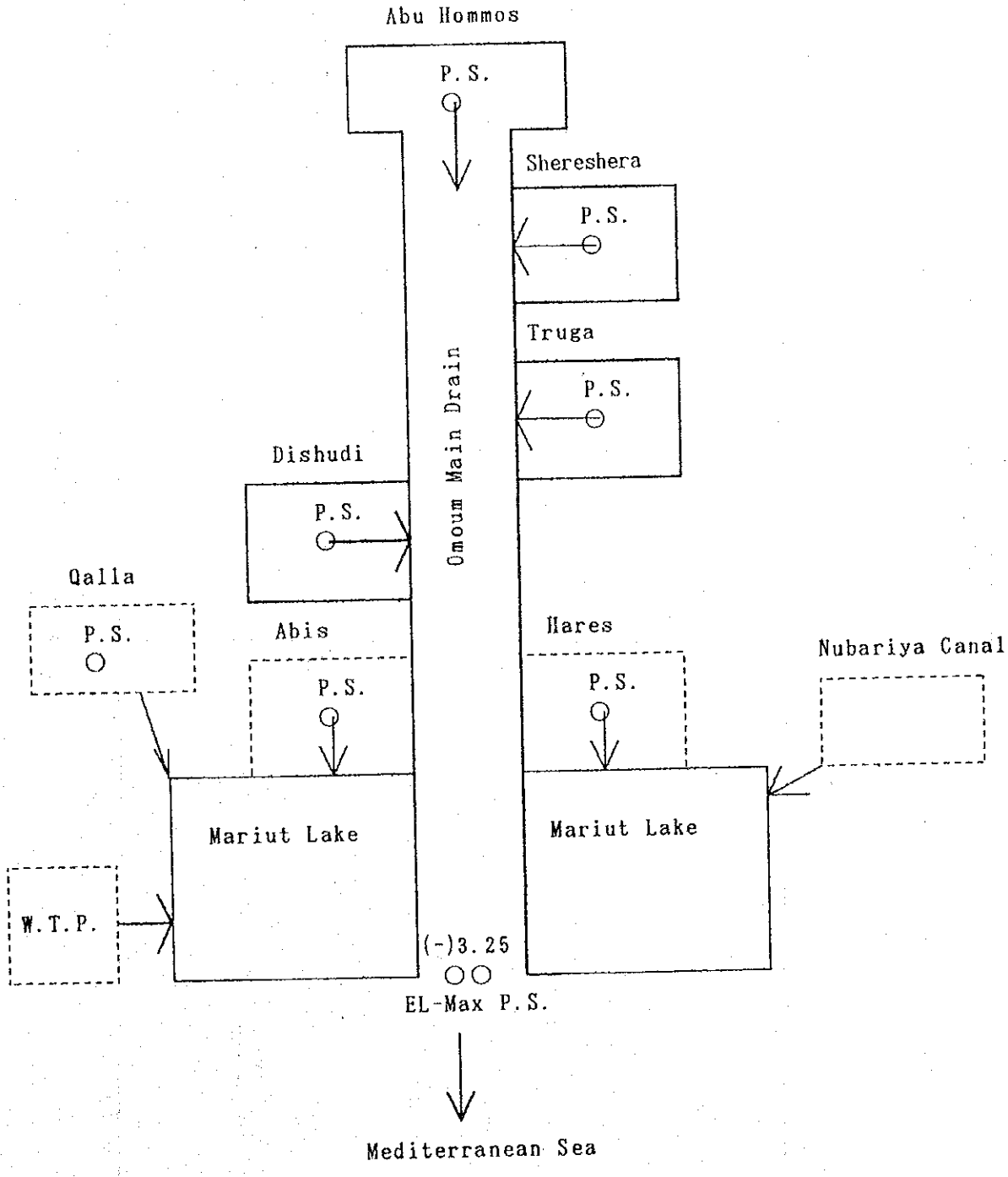

FIGURE E-1-6 RESULT OF HYDRAULIC ANALYSIS
(Alternative Plan, Case-3)