

Table 3.25 Calculated Basic Flood Runoff in Sousse (1/4)

Oued Blibene Basin		(Runoff Calculation by Rational Formula)									
Calc. Point	Sub-basin Combination	Total Area (sq.km)	Present Land Use Condition				Future Land Use Condition				
			Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)	Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)	
1	1	3.98	0.24	51	19.9	9.1	0.32	51	26.5	12.1	
2	1-2	4.48	0.24	60	19.9	9.1	0.31	60	25.7	11.7	
3	3	2.18	0.24	33	15.0	6.9	0.38	33	23.8	10.9	
4	1-3	6.66	0.24	60	29.5	13.5	0.34	60	41.8	19.1	
5	1-4	7.03	0.24	68	28.4	13.0	0.33	68	39.1	17.9	
6	5	0.85	0.24	24	7.4	3.4	0.50	24	15.5	7.1	
7	1-5	7.88	0.24	68	31.8	14.6	0.35	68	46.4	21.2	
8	1-6	9.14	0.24	88	30.5	14.0	0.36	88	45.8	20.9	
9	11	0.37	0.40	16	7.3	3.3	0.80	16	14.5	6.6	
10	10-11	0.94	0.47	25	15.6	7.1	0.80	25	26.5	12.1	
11	8,10-11	1.29	0.49	35	17.4	8.0	0.80	35	28.4	13.0	
12	9	0.16	0.38	11	3.7	1.7	0.80	11	8.3	3.8	
13	8-11	1.45	0.47	35	18.8	8.6	0.80	35	31.9	14.6	
14	7-11	1.50	0.47	37	18.6	8.5	0.80	37	31.7	14.5	
15	12	0.34	0.60	24	7.4	3.4	0.80	24	9.9	4.5	
16	1-12	10.98	0.28	68	42.8	19.6	0.44	68	67.2	30.7	
17	1-13	11.51	0.29	101	41.9	19.2	0.45	101	65.1	29.7	
18	18	2.36	0.24	36	15.3	7.0	0.32	36	20.4	9.3	
19	17-18	2.91	0.27	57	15.1	6.9	0.41	57	22.9	10.5	
20	1-13,17-18	14.42	0.29	101	52.5	24.0	0.44	101	79.7	36.4	
21	1-14,17-18	14.50	0.29	106	51.0	23.3	0.44	106	77.3	35.4	
22	16	0.45	0.56	17	11.8	5.4	0.80	17	16.9	7.7	
23	1-14,16-18	14.95	0.30	106	54.4	24.9	0.46	106	83.4	38.1	
24	1-18	15.13	0.30	116	51.5	23.5	0.46	116	78.9	36.1	

Table 3.25 Calculated Basic Flood Runoff in Sousse (2/4)

Oued Hallow Basin (Runoff Calculation by Rational Formula)											
Calc. Point	Sub-basin Combination	Total Area (sq.km)	Present Land Use Condition				Future Land Use Condition				
			Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)	Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)	
1	1	1.48	0.52	33	22.1	10.1	0.80	33	34.0	15.6	
2	2	1.34	0.28	23	14.1	6.4	0.80	23	40.3	18.4	
3	1-2	2.82	0.41	33	33.2	15.2	0.80	33	64.9	29.6	
4	1-3	3.37	0.40	47	29.8	13.6	0.80	45	61.6	28.2	
5	1-4	3.70	0.38	57	27.0	12.3	0.80	54	59.1	27.0	
6	6	1.51	0.24	32	10.7	4.9	0.50	32	22.2	10.2	
7	6-7	3.09	0.26	53	16.3	7.4	0.53	53	33.2	15.2	
8	1-4, 6-7	6.79	0.33	57	43.0	19.7	0.68	54	92.2	42.1	
9	1-7	7.01	0.33	67	39.4	18.0	0.68	63	84.9	38.8	
10	18	0.70	0.56	17	18.4	8.4	0.80	17	26.3	12.0	
11	17-18	1.09	0.55	27	20.0	9.1	0.80	27	29.1	13.3	
12	16-18	1.55	0.51	37	20.9	9.5	0.80	37	32.8	15.0	
13	15-18	1.73	0.50	49	18.6	8.5	0.80	49	29.7	13.6	
14	14	0.46	0.56	28	8.4	3.8	0.80	28	11.9	5.5	
15	13-14	0.60	0.54	42	7.8	3.6	0.80	42	11.5	5.3	
16	1-7, 13-18	9.34	0.37	67	58.8	26.9	0.71	63	118.1	54.0	
17	1-8, 13-18	10.01	0.36	80	53.8	24.6	0.70	77	107.6	49.2	
18	12	0.56	0.52	27	9.7	4.4	0.80	27	14.9	6.8	
19	1-8, 12-18	10.57	0.37	80	58.4	26.7	0.70	77	113.6	51.9	
20	1-9, 12-18	10.65	0.37	85	56.2	25.7	0.70	82	109.3	50.0	
21	10	1.63	0.48	63	13.9	6.4	0.68	63	19.7	9.0	
22	1-10, 12-18	12.28	0.39	85	68.4	31.2	0.70	82	126.0	57.6	
23	1-18	12.34	0.39	90	65.9	30.1	0.70	87	121.2	55.4	

Table 3.25 Calculated Basic Flood Runoff in Sousse (3/4)

Oued Hammam Basin (Runoff Calculation by Rational Formula)										
Calc. Point	Sub-basin Combination	Total Area (sq.km)	Present Land Use Condition				Future Land Use Condition			
			Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)	Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)
1	1	46.00	0.20	260	57.4	26.2	0.20	260	57.4	26.2
2	2	13.00	0.20	100	32.9	15.0	0.20	100	32.9	15.0
3	1-2	59.00	0.20	260	73.6	33.7	0.20	260	73.6	33.7
4	1-3	99.00	0.20	344	100.4	45.9	0.20	344	100.4	45.9
5	4	14.60	0.20	84	42.0	19.2	0.20	84	42.0	19.2
6	1-4	113.60	0.20	344	115.3	52.7	0.20	344	115.3	52.7
7	Dam 3 (Lain)	113.60	0.20	344	115.3	52.7	0.20	344	115.3	52.7
8	1-5	135.40	0.20	436	115.3	52.7	0.21	436	121.0	55.3
9	6	12.60	0.20	136	25.4	11.6	0.23	136	29.2	13.4
10	1-6	148.00	0.20	436	126.0	57.6	0.21	436	132.3	60.5
11	Dam 4 (R.B.-A)	148.00	0.20	436	126.0	57.6	0.21	436	132.3	60.5
12	1-7	163.00	0.20	506	124.3	56.8	0.22	506	136.7	62.5
13	Dam 5 (R.B.-B)	163.00	0.20	506	124.3	56.8	0.22	506	136.7	62.5
14	1-8	163.40	0.20	516	122.8	56.1	0.22	516	135.1	61.8
15	12	8.50	0.20	78	25.9	11.8	0.20	78	25.9	11.8
16	Dam 2 (M'darrej)	8.50	0.20	78	25.9	11.8	0.20	78	25.9	11.8
17	12-13	9.70	0.22	102	26.6	12.2	0.27	102	32.7	14.9
18	10	12.60	0.20	76	39.1	17.9	0.23	76	44.9	20.5
19	Dam 1 (Guemgame)	12.60	0.20	76	39.1	17.9	0.23	76	44.9	20.5
20	10-11	13.10	0.20	84	37.7	17.2	0.25	84	47.2	21.6
21	10-13	22.80	0.21	102	59.7	27.3	0.26	102	73.9	33.8
22	10-14	23.90	0.22	128	55.4	25.3	0.29	128	73.1	33.4
23	15	4.10	0.28	52	23.6	10.8	0.44	52	37.0	16.9
24	10-15	28.00	0.22	128	64.9	29.7	0.31	128	91.5	41.8
25	10-16	28.30	0.22	138	62.1	28.4	0.31	138	87.5	40.0
26	17	10.80	0.20	90	28.6	13.5	0.23	90	34.0	15.5
27	10-17	39.10	0.22	138	85.8	39.2	0.29	138	113.1	51.7
28	10-18	44.90	0.22	168	85.2	38.9	0.32	168	123.9	56.6
29	1-8,10-18	208.30	0.21	516	164.4	75.1	0.24	516	187.9	85.9
30	1-18	222.30	0.21	576	161.7	73.9	0.26	576	200.2	91.5

Table 3.25 Calculated Basic Flood Runoff in Sousse (4/4)

Oued Hamdoun Basin (Runoff Calculation by Rational Formula)										
Calc. Point	Sub-basin Combination	Total Area (sq.km)	Present Land Use Condition				Future Land Use Condition			
			Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)	Runoff Coeff. f	Design tc (min)	Calc. Q(100) (cu.m/s)	Calc. Q(10) (cu.m/s)
1	1	120.30	0.22	402	119.6	54.7	0.23	402	125.1	57.2
2	1-2	144.40	0.22	458	130.4	59.6	0.22	458	130.4	59.6
3	3	13.00	0.22	136	28.8	13.2	0.23	136	30.1	13.8
4	1-3	157.40	0.22	458	142.1	65.0	0.23	458	148.6	67.9
5	1-4	170.60	0.22	500	144.4	66.0	0.25	500	164.1	75.0
6	5	7.60	0.20	114	17.9	8.2	0.26	114	23.3	10.6
7	1-5	178.40	0.22	500	151.0	69.0	0.25	500	171.6	78.4
8	1-6	179.00	0.22	508	149.7	68.4	0.25	508	170.1	77.8
9	7	11.30	0.20	118	25.3	11.6	0.20	118	25.3	11.6
10	1-7	190.30	0.22	508	159.2	72.8	0.25	508	180.9	82.7
11	1-8	193.10	0.22	548	152.7	69.8	0.25	548	173.5	79.3
12	18	21.70	0.22	142	46.6	21.3	0.23	142	48.7	22.3
13	Dam 1 (R.B.-A)	21.70	0.22	142	46.6	21.3	0.23	142	48.7	22.3
14	18-19	23.10	0.22	160	45.4	20.8	0.23	160	47.5	21.7
15	20	4.50	0.20	68	15.2	6.9	0.20	68	15.2	6.9
16	18-20	27.60	0.22	160	54.3	24.8	0.23	160	56.7	25.9
17	18-21	33.50	0.21	226	48.7	22.3	0.26	226	60.3	27.6
18	1-8,18-21	226.60	0.22	548	179.2	81.9	0.25	548	203.6	93.1
19	1-9,18-21	226.70	0.22	552	178.3	81.5	0.25	552	202.6	92.6
20	10	6.90	0.20	120	15.3	7.0	0.20	120	15.3	7.0
21	1-10,18-21	233.60	0.22	552	183.7	84.0	0.25	552	208.8	95.4
22	1-11,18-21	234.60	0.22	566	181.1	82.8	0.25	566	205.8	94.1
23	22	20.40	0.20	166	35.5	16.2	0.26	166	46.1	21.1
24	1-11,18-22	255.00	0.22	566	196.9	90.0	0.25	566	223.7	102.3
25	1-12,18-22	256.50	0.22	576	195.5	89.4	0.25	576	222.1	101.5
26	Dam 2 (R.B.-B)	256.50	0.22	576	195.5	89.4	0.25	576	222.1	101.5
27	1-13,18-22	265.40	0.22	604	195.3	89.3	0.25	604	221.9	101.4
28	14	7.50	0.20	86	21.2	9.7	0.20	86	21.2	9.7
29	1-14,18-22	272.90	0.22	604	200.8	91.8	0.25	604	228.2	104.3
30	1-15,18-22	284.90	0.22	672	193.7	88.6	0.25	672	220.1	100.6
31	16	26.20	0.22	174	48.4	22.1	0.23	174	50.6	23.1
32	1-16,18-22	311.10	0.22	672	211.5	96.7	0.25	672	240.4	109.9
33	1-22	312.80	0.22	692	206.1	95.1	0.25	692	236.5	108.1

Table 3.26 Calculated Flood Runoff in Sousse (1/2)

Calc. Point	Sub-basin Combination	Future Land Use Condition													
		Basic Q(100) (cu.m/s)	Basic Q(10) (cu.m/s)	HM-2 Q(100) (cu.m/s)	HM-2 Q(10) (cu.m/s)	HM-3 Q(100) (cu.m/s)	HM-3 Q(10) (cu.m/s)	HM-4 Q(100) (cu.m/s)	HM-4 Q(10) (cu.m/s)	HM-5 Q(100) (cu.m/s)	HM-5 Q(10) (cu.m/s)	HM-6 Q(100) (cu.m/s)	HM-6 Q(10) (cu.m/s)	HM-7 Q(100) (cu.m/s)	HM-7 Q(10) (cu.m/s)
1	1	57.4	26.2	57.4	26.2	57.4	26.2	57.4	26.2	57.4	26.2	57.4	26.2	57.4	26.2
2	2	32.9	15.0	32.9	15.0	32.9	15.0	32.9	15.0	32.9	15.0	32.9	15.0	32.9	15.0
3	1-2	73.6	33.7	73.6	33.7	73.6	33.7	73.6	33.7	73.6	33.7	73.6	33.7	73.6	33.7
4	1-3	100.4	45.9	100.4	45.9	100.4	45.9	100.4	45.9	100.4	45.9	100.4	45.9	100.4	45.9
5	4	42.0	19.2	42.0	19.2	42.0	19.2	42.0	19.2	42.0	19.2	42.0	19.2	42.0	19.2
6	1-4	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7
7	Dam 3 (Late)	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7	115.3	52.7
8	1-5	121.0	55.3	121.0	55.3	121.0	55.3	121.0	55.3	121.0	55.3	121.0	55.3	121.0	55.3
9	6	29.2	13.4	29.2	13.4	29.2	13.4	29.2	13.4	29.2	13.4	29.2	13.4	29.2	13.4
10	1-6	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5
11	Dam 4 (R.B.-A)	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5	132.3	60.5
12	1-7	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5
13	Dam 5 (R.B.-B)	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5	136.7	62.5
14	1-8	135.1	61.8	135.1	61.8	135.1	61.8	135.1	61.8	135.1	61.8	135.1	61.8	135.1	61.8
15	12	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8
16	Dam 2 (M'darre)	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8	25.9	11.8
17	12-13	32.7	14.9	32.7	14.9	32.7	14.9	32.7	14.9	32.7	14.9	32.7	14.9	32.7	14.9
18	10	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5
19	Dam 1 (Guemgame)	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5	44.9	20.5
20	10-11	47.2	21.6	47.2	21.6	47.2	21.6	47.2	21.6	47.2	21.6	47.2	21.6	47.2	21.6
21	10-13	73.9	33.8	73.9	33.8	73.9	33.8	73.9	33.8	73.9	33.8	73.9	33.8	73.9	33.8
22	10-14	73.1	33.4	73.1	33.4	73.1	33.4	73.1	33.4	73.1	33.4	73.1	33.4	73.1	33.4
23	15	37.0	16.9	37.0	16.9	37.0	16.9	37.0	16.9	37.0	16.9	37.0	16.9	37.0	16.9
24	10-15	91.5	41.8	91.5	41.8	91.5	41.8	91.5	41.8	91.5	41.8	91.5	41.8	91.5	41.8
25	10-16	87.5	40.0	87.5	40.0	87.5	40.0	87.5	40.0	87.5	40.0	87.5	40.0	87.5	40.0
26	17	34.0	15.5	34.0	15.5	34.0	15.5	34.0	15.5	34.0	15.5	34.0	15.5	34.0	15.5
27	10-17	113.1	51.7	113.1	51.7	113.1	51.7	113.1	51.7	113.1	51.7	113.1	51.7	113.1	51.7
28	10-18	123.9	56.6	123.9	56.6	123.9	56.6	123.9	56.6	123.9	56.6	123.9	56.6	123.9	56.6
29	1-8,10-18	187.9	85.9	187.9	85.9	187.9	85.9	187.9	85.9	187.9	85.9	187.9	85.9	187.9	85.9
30	1-18	200.2	91.5	200.2	91.5	200.2	91.5	200.2	91.5	200.2	91.5	200.2	91.5	200.2	91.5

Table 3.26 Calculated Flood Runoff in Sousse (2/2)

Calc. Point	Sub-basin Combination	Future Land Use Condition											
		Basic		HD-2		HD-3		HD-4		HD-3		HD-4	
		Q(100) (cu.m/s)	Q(10) (cu.m/s)	Q(100) (cu.m/s)	Q(10) (cu.m/s)	Q(100) (cu.m/s)	Q(10) (cu.m/s)	Q(100) (cu.m/s)	Q(10) (cu.m/s)	Q(100) (cu.m/s)	Q(10) (cu.m/s)	Q(100) (cu.m/s)	Q(10) (cu.m/s)
1	1	125.1	57.2	125.1	57.2	125.1	57.2	125.1	57.2	125.1	57.2	125.1	57.2
2	1-2	130.4	59.6	130.4	59.6	130.4	59.6	130.4	59.6	130.4	59.6	130.4	59.6
3	3	30.1	13.8	30.1	13.8	30.1	13.8	30.1	13.8	30.1	13.8	30.1	13.8
4	1-3	148.6	67.9	148.6	67.9	148.6	67.9	148.6	67.9	148.6	67.9	148.6	67.9
5	1-4	164.1	75.0	164.1	75.0	164.1	75.0	164.1	75.0	164.1	75.0	164.1	75.0
6	5	23.3	10.6	23.3	10.6	23.3	10.6	23.3	10.6	23.3	10.6	23.3	10.6
7	1-5	171.6	78.4	171.6	78.4	171.6	78.4	171.6	78.4	171.6	78.4	171.6	78.4
8	1-6	170.1	77.8	170.1	77.8	170.1	77.8	170.1	77.8	170.1	77.8	170.1	77.8
9	7	25.3	11.6	25.3	11.6	25.3	11.6	25.3	11.6	25.3	11.6	25.3	11.6
10	1-7	180.9	82.7	180.9	82.7	180.9	82.7	180.9	82.7	180.9	82.7	180.9	82.7
11	1-8	173.5	79.3	173.5	79.3	173.5	79.3	173.5	79.3	173.5	79.3	173.5	79.3
12	18	48.7	22.3	48.7	22.3	48.7	22.3	48.7	22.3	48.7	22.3	48.7	22.3
13	Dem 1 (R.B.-A)	48.7	22.3	48.7	22.3	48.7	22.3	48.7	22.3	48.7	22.3	48.7	22.3
14	18-19	47.5	21.7	47.5	21.7	47.5	21.7	47.5	21.7	47.5	21.7	47.5	21.7
15	20	15.2	6.9	15.2	6.9	15.2	6.9	15.2	6.9	15.2	6.9	15.2	6.9
16	18-20	56.7	25.9	56.7	25.9	56.7	25.9	56.7	25.9	56.7	25.9	56.7	25.9
17	18-21	60.3	27.6	60.3	27.6	60.3	27.6	60.3	27.6	60.3	27.6	60.3	27.6
18	1-8,18-21	203.6	93.1	203.6	93.1	203.6	93.1	203.6	93.1	203.6	93.1	203.6	93.1
19	1-9,18-21	202.6	92.6	202.6	92.6	202.6	92.6	202.6	92.6	202.6	92.6	202.6	92.6
20	10	15.3	7.0	15.3	7.0	15.3	7.0	15.3	7.0	15.3	7.0	15.3	7.0
21	1-10,18-21	208.8	95.4	208.8	95.4	208.8	95.4	208.8	95.4	208.8	95.4	208.8	95.4
22	1-11,18-21	205.8	94.1	205.8	94.1	205.8	94.1	205.8	94.1	205.8	94.1	205.8	94.1
23	22	46.1	21.1	46.1	21.1	46.1	21.1	46.1	21.1	46.1	21.1	46.1	21.1
24	1-11,18-22	223.7	102.3	223.7	102.3	223.7	102.3	223.7	102.3	223.7	102.3	223.7	102.3
25	1-12,18-22	222.1	101.5	222.1	101.5	222.1	101.5	222.1	101.5	222.1	101.5	222.1	101.5
26	Dem 2 (R.B.-B)	222.1	101.5	222.1	101.5	222.1	101.5	222.1	101.5	222.1	101.5	222.1	101.5
27	1-13,18-22	221.9	101.4	221.9	101.4	221.9	101.4	221.9	101.4	221.9	101.4	221.9	101.4
28	14	21.2	9.7	21.2	9.7	21.2	9.7	21.2	9.7	21.2	9.7	21.2	9.7
29	1-14,18-22	228.2	104.3	228.2	104.3	228.2	104.3	228.2	104.3	228.2	104.3	228.2	104.3
30	1-15,18-22	220.1	100.6	220.1	100.6	220.1	100.6	220.1	100.6	220.1	100.6	220.1	100.6
31	16	50.6	23.1	50.6	23.1	50.6	23.1	50.6	23.1	50.6	23.1	50.6	23.1
32	1-16,18-22	240.4	109.9	240.4	109.9	240.4	109.9	240.4	109.9	240.4	109.9	240.4	109.9
33	1-22	236.5	108.1	236.5	108.1	236.5	108.1	236.5	108.1	236.5	108.1	236.5	108.1

Table 4.1 PRESENT LAND USE COMPOSITION IN GREATER TUNIS

LAND USE CATEGORY	GOVERNORATE				TOTAL
	TUNIS	ARIANA	BEN AROUS	TOTAL	
	AREA (km2)	AREA (km2)	AREA (km2)	AREA (km2)	
URBAN AREAS	105	122	109	331	
AGRICULTURAL AREAS	100	1053	358	1497	
SEBKHET	26 (Sijoumi)	50 (Ariana)	-	76	
LAKE	42 (Tunis lake)	-	-	42	
GREEN AREAS	15	333	220	582	
TOTAL	288	1,558	687	2,528	

Source : Identification Brochure of each Governorate

Table 4.2 PRESENT BUILT-UP URBAN AREAS IN GREATER TUNIS

CATEGORY	GOVERNORATE							
	TUNIS		ARIANA		BEN AROUS		TOTAL	
	AREA (km ²)	(%)	AREA (km ²)	(%)	AREA (km ²)	(%)	AREA (km ²)	(%)
FORMAL HOUSING	38.91	53	15.22	21	18.92	26	73.05	100
SPONTANEOUS HABITAT	10.57	31	19.16	54	5.17	15	34.90	100
SOCIAL INFRASTRUCTURES	8.89	49	5.98	33	3.33	18	18.20	100
INDUSTRIAL ZONES	5.76	34	3.66	22	7.32	44	16.74	100
TOTAL	64.13		44.02		34.74		142.89	

Source : Brochure of the Governorate of Tunis

Table 4.3 PRESENT FLOOD PRONE LOCALITIES IN GREATER TUNIS (1/4)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
<p><u>Governorate of Ariana</u></p> <p>1. Cité Al-Intilaka Municipality of M'inhla East of MC 31 road to Raoued</p> <p>2. Cité Al-tadhamen Municipality of Wadi-Eifil West of MC 31 road to Raoued North of Sebkhel Ariana</p> <p>3. Sidi Amor-Municipality of Ariana. Along the RVE 533 road to Raoued. North of Sebkhel Ariana</p> <p>4. Borj El-Khsous at Raoued in the Municipality of Ariana.</p> <p>5. Borj-Louzir. Municipality of Ariana. In the the plain of Choutrana between GPI0 and GP8 roads</p> <p>6. Cité Mostakbal-Municipality of Ariana between the GP8 and the RVE 533 road to Raoued</p> <p>7. El-Bousenc-Municipality of Ariana-in the plain of Choutrana North of GPI0 road</p>	<p>Temporary flooding area resulting from housing constructions that obstruct the stormwater flows.</p> <p>Serious flooding problem resulting from construction of spontaneous settlements in the river bed of Oued Gariana and obstruction of stormwater flows.</p> <p>Important flooding problem due to the presence of wastewater canal of ONAS that obstructs the runoff of stormwater flows.</p> <p>Temporary flooding area due to the presence of canal ONAS that blocks the discharge of stormwater flows</p> <p>Serious flooding problems resulting from construction of spontaneous settlements that obstruct the existing stormwater earth drains.</p> <p>Significant flooding problem resulting from the construction of spontaneous housing that obstruct the natural flow of stormwater.</p> <p>Serious permanent flooding problems resulting from construction of spontaneous settlements that obstruct the existin stormwater earth drains.</p>	<p>Presence of dike that was constructed by ONAS to divert flows to storm basin at Nougra. However problems still persist.</p> <p>Absence of drains, road gullies and stormwater system.</p> <p>Flat lands that do not dispose of any drainage infrastructure. Presence of spontaneous habitat. Drainage design works are needed.</p> <p>Flat area deprived of drainage infrastructure and requires design work.</p> <p>Flat lands deprived of drainage infrastructure and presence of water table at shallow depth.</p> <p>Flat land deprived of drainage infrastructure.</p> <p>Flat land deprived of drainage infrastructure and presence of water table at shallow depth.</p>

Source : District of Tunis

Table 4.3 PRESENT FLOOD PRONE LOCALITIES IN GREATER TUNIS (2/4)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
8. El-Mansoura-Municipality of Ariana-plain of Choutram East of GP8 road	Critical permanent flooding of spontaneous settlements due to the absence of drains and poor soil conditions.	Flat area deprived of drainage and sewerage infrastructure and high water table.
9. La Soukra-Municipality of Ariana. South of Sebkhel Ariana along the GP10 road	Serious permanent stagnation of water as a result of absence of drains and poor soil conditions.	Flat area deprived of drainage infrastructure and high water table.
10. Dar Fadhal- Municipality of Ariana- South of Sebkhel Ariana along the GP10	serious permanent flooding of water due to absence of drains and unsuitable soil conditions.	Problem area is deprived of drainage infrastructure and high water table.
11. Raoued-Municipality of Ariana-North and East of sebkhel Ariana	Area suffering from significant flooding problems during rain season due to the presence of canal ONAS to the north, the road to Gammarrh on the East and poor soil conditions that hinder run off and discharge operations.	Relatively flat lands deprived of drainage facilities and having a high water table level.
<u>Governorate of Tunis</u>		
12. Al-kram and Khayreddinen-Municipality of La Goulette at the north-east corner of Tunis Lake	Serious flooding during the rain season due to housing constructions that obstruct run off flows.	The canal ONAS that is supposed to serve the area is obstructed and is not allowed to discharge in the North lake.
13. Faubourg of the Medina, La Fayette and Petite Sicile-Municipality of Tunis in the city center west of Tunis Lake	Area of temporary flooding during rainy season due to low lying flat lands in heavily constructed areas.	The existing drainage system is under sized and laid flat. ONAS is in the process to rehabilitate the existing system.
14. As-Saïda. Al Maïlassine- Municipality of Bardo-North bank of Sebkhel Sejoumi	Area suffering from important flooding problem during raining events due to low lying lands that receive the run off flows of higher lands situated on the north side.	Flat basin area surrounded by higher lands and the Sebkhel Sejoumi-Absence of drainage protection facilities.

Source : District of Tunis

Table 4.3 PRESENT FLOOD PRONE LOCALITIES IN GREATER TUNIS (3/4)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
<p><u>Governorate of Ben-Arous</u></p>		
15.	<p>Port de Rades-Municipality of Rades-East of Tunis Lake</p>	<p>Flat low lying area deprived of drainage system and suffering from high water table problems.</p>
16.	<p>Mouth of Oued Milyane- Municipality of Rades</p>	<p>Area situated in basin of Oued Milyane with flat topography and presence of high water table.</p>
17.	<p>Sidi Fathallah -Municipality of Boumhel- Area located between GPI and MC 39 roads</p>	<p>Flat lands suffering from insufficient drainage protection facilities.</p>
18.	<p>Municipality of Boumhel - Area located between GPI0 and MC 39 road.</p>	<p>Flat lands suffering from insufficient drainage protection facilities.</p>
19.	<p>Bir-Alkasa'a. Municipality of Ben Arous between the Autoroute and GPI road.</p>	<p>Flat land surrounded by higher grounds and deprived of proper drainage protection system.</p>
20.	<p>Wadi Traboulstya- Municipality of Hammam-Lif South of GPI Road</p>	<p>Flat low lying area surrounded by higher lands and deprived of an adequate drainage protection system.</p>
21.	<p>Zaouiet Mornag and Mornag- Municipality of Mornag along MC 35 road</p>	<p>Area with flat topography deprived of an adequate drainage protection system .</p>
22.	<p>Sidi-Saad-Municipality of Mornag- along Oued Hama.</p>	<p>Flat area surrounded by higher grounds deprived of an adequate drainage protection with existing system that needs maintenance.</p>

Source : District of Tunis

Table 4.3 PRESENT FLOOD PRONE LOCALITIES IN GREATER TUNIS (4/4)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
23. Al-khalidiya-Municipality of Mornag- along MC 36 road	Important flooding problem during rainy season due to spontaneous housing that obstruct the natural drainage flow.	Area requiring an adequate drainage an adequate drainage protection system.
24. Fouchara center-Municipality of Fouchara on GP 3 road.	Serious flooding problem during rainy season due to spontaneous settlements that obstruct the natural drainage flow.	Low lying area requiring an adequate drainage system.
25. Hammam-Chatt Municipality of Hammam Chatt Nord of GP 1 road	Area suffering from serious flooding problems due to poor topographic and soil conditions.	Flat low area surrounded by Mount Bougornine to the south and the sea to the north and deprived of adequate drainage protection system and suffering from high water table.

Source : District of Tunis

Table 4.4 LAND ALLOCATION FOR URBAN DEVELOPMENT IN GREATER TUNIS

TASK N°	PROJECT DESCRIPTION	AREA/ EXPECTED YEAR OF COMPLETION
	<u>YEARS 1993-1996</u>	
1	- Densification of present Urban areas	
2	- Restructuring of urban expansion areas in the North and West	
3	- Execution of the following urban projects :	
3.a	North of the Ariana	171 ha/ 1996
3.b	Zone west of GP8 road	140 ha/ 1996
3.c	Residence Annasr II & II a	250 ha/ after 1996
3.d	The North Tunis lake	482 ha/ 1993
3.e	Residence El-Mourouj IV	120 ha/ 1993
3.f	Residence El-Mourouj V	120 ha/ 1996
3.g	Borj Cedria	230 ha/ 1996
	<u>YEARS 2001, 2006 & 2011</u>	
4	- Densification and restructuring operation of urban expansion areas	
5	- Development of the South Tunis lake.	495 ha/ 2001- 2011
6	- Development of urban expansion areas (UAE) in the South	
6.a	Fouchana and Mhamdia UAE	1900 ha/ to be developed on the basis of supply and demand
6.b	Zahra and Hammam Lif UAE	540 ha/ 1996-2001
7	- Development of urban expansion areas (UEA) in the Ouest	
7.a	El-Manzah and Minhla UAE	880 ha/ 1996-2001
7.b	West bank of Sebket Sejoumi UAE	1120 ha/ to be developed on the basis of supply and demand
8	- Development of urban expansion areas (UAE) in the North	
8.a	Community of Ariana North	904 ha/ 2001-2011
8.b	Zone of Raoued	700 ha/ 2001- 2011

Source : Municipal Urban Development Plans of Ariana, Tunis, El-Mourouj, Hammam-Chott, Fouchana, M'hamdia and Sejoumi.

Table 4.5 CONCEIVABLE DEVELOPMENT PROJECTS FOR SEBKHET ARIANA

TASK N°	PROJECT DESCRIPTION	OBSERVATIONS
1	<p>DREDGING</p> <ul style="list-style-type: none"> - Dredging operation of the bottom of the Sebkhet to increase its depth and therefore its capacity. Dredged materials can be used for land reclamation along the banks and for the existing landfill site on the East bank of the Sebkhet. 	<p>The Average depth of water in the Sebkhet is around 70 cm which entails a moderate cost for dredging operation .</p>
2	<p>FISH BREEDING</p> <ul style="list-style-type: none"> - Fish farming, shellfish and seaweed growing can be considered potential operations as a result of dredging works. However, these operations need to be justified through a feasibility study. 	<p>A study is to be carried out to determine the type of waters to be used (i.e sweet or salty waters), the quality and the quantities of water needed, the existing and the planned infrastructures and the market demands.</p>
3	<p>LEISURE ACTIVITIES</p> <ul style="list-style-type: none"> - Creation of recreational areas along the banks of the Sebkhet particularly during the summer season when the water surface is reduced . 	<p>The selection of the type of recreational activities will require site preparation and installation of basic infrastructure facilities.</p>
4	<p>SALT WORKS</p> <ul style="list-style-type: none"> - Creation of salt works at Bahr El-Azrag just west of the existing treatment plant coastal North. 	<p>This operation will require a feasibility study before its implementation.</p>
5	<p>LAND RECLAMATION</p> <ul style="list-style-type: none"> - Reclamation of the entire Sebkhet for urban development . 	<p>This is a large scale and a long term operation that is to be justified by a feasibility study based on the orientations and the needs for future development.</p>

Source : JICA Study Team (1993)

Table 4.6 PRESENT LAND USE COMPOSITION IN GREATER SOUSSE

LAND USE CATEGORY	DELEGATIONS										TOTAL Area (Ha)
	SOUSSE* Area (Ha)	HANNAM SOUSSE Area (Ha)	KALAA KBIRA Area (Ha)	MSAKEN Area (Ha)	KALAA SCHIRA Area (Ha)	AKOUDA Area (Ha)	AZ- ZOUHOOR Area (Ha)	ZAQUIAT SOUSSE Area (Ha)	KSIBA Area (Ha)	TOTAL Area (Ha)	
URBAN AREAS	1,014	853	340	616	210	150	46	70	116	3,415	
AGRICULTURAL AREAS	380	1,310	1,680	4,920	810	970	1,525	590	528	12,713	
INDUSTRIAL AREAS	414	245	17	162	40	12	-	-	4	894	
GREEN AREAS	148	150	110	200	32	50	5	5	49	749	
SEBKHET/LAKE	80	-	-	-	-	-	-	-	-	80	
TOTAL	2,036	2,558	2,147	5,898	1,092	1,182	1,576	665	697	17,851	

Source : Urban Development Master Plan of Sousse and Monastir - March 1993

* Sousse + Sousse Riadh

Table 4.7. PRESENT FLOOD PRONE LOCALITIES IN GREATER SOUSSE (1/3)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
<u>Sousse</u>		
1. Oued Naouar south of the port of Sousse on Avenue Taieb Ghachem	Serious flooding area due to the depression of the site and the obstruction of existing outlet structure.	Rehabilitation works are required. The existing oued is to be replaced by a concrete canal.
2. La place Lubliana West of the Port of Sousse near the cemetery	Important flooding area during rainy season as a result of obstruction of sorm flows.	Low-lying area deprived of drainage infrastructure.
3. West of the Medina at the intersection of Bejjouti road and Ave. Karoui	Temporary flooding area due to the presence of construction.	Low-lying area deprived of adequate drainage system.
4. Canal Sidi Bou Kacem between the GP12 and RVE 822 roads near Al-Aouina	Serious flooding problem resulting from overflows of canal.	Low-lying depressed area requiring flood protection works.
5. Oued Kharroub South of the GP1 road	Flooding of the upstream sections of the oued due to existing constructions obstructing the runoff flows and shallow river bed.	Rehabilitation of the bed of the Oued is needed to improve the carrying capacity.
<u>Hamman Sousse</u>		
6. North of khezma El-Gharbia along the GP1 road.	Serious flooding problem in rainy events due to the depressed site and presence of constructions	Low-lying area deprived of adequate drainage facilities
7. Area located between the GP1 and the touristic road	Frequent flooding problem resulting from runoff flows from the area west of GP1.	Low lying area receiving the storm flows from surrounding higher grounds and deprived of a drainage system.

Source : DHU documentation Service.

Table 4.7 PRESENT FLOOD PRONE LOCALITIES IN GREATER SOUSSE (2/3)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
<p><u>Hamman Soussse</u></p> <p>8. Area situated north of Oued Hamman between the GPI and the touristic road</p> <p>9. Oued Hamman west of the GPI</p> <p><u>Zaouiet Soussse</u></p> <p>10. Area located north of Zaouiet Soussse along the RVE 822 road</p>	<p>Frequent flooding problem resulting from runoff flows from the area west of the GPI.</p> <p>Serious flooding problem caused by existing construction and degraded river bed.</p> <p>Important flooding problem during rainy season.</p>	<p>Low lying area deprived of a proper drainage facilities.</p> <p>Rehabilitation works of the river bed are required .</p> <p>Low lying area deprived of proper drainage infrastructures.</p>
<p><u>Akoufa</u></p> <p>11. Urban zone at intersection of Oued Kébir and MC 48 road</p> <p>12. Areas located along the MC 48 road</p>	<p>Important flooding problem during rainy events resulting from heavy deposits and flat river bed.</p> <p>Temporary flooding problem caused by heavy runoff flows from higher grounds.</p>	<p>Relatively flat area requiring rehabilitation of drainage works.</p> <p>Area with mild slopes surrounded by heavily urbanized zones and deprived of proper drainage facilities.</p>
<p><u>Kala'a Khira</u></p> <p>13. At confluence of Oued Mdarrej and oued Guenguem on MC48 road</p> <p>14. At intersection Oued Sghir and the road of June 1st</p> <p>15. Adjacent zones of Oued Kébir between railway bridge and entrance of Akoufa</p>	<p>Serious flooding during rainy season due to presence of constructions and very shallow river bed.</p> <p>Serious flooding due to the presence of constructions in the river bed .</p> <p>Important flooding due to the presence of a depressed zone in an agricultural area.</p>	<p>Area with relatively flat slope requiring rehabilitation works of the existing river bed and drainage structure.</p> <p>Very flat area where river bed is flush with adjacent roads existing drainage is inadequate.</p> <p>Relatively flat area that needs improvement works for the evacuation of storm flows.</p>

Source : DHU documentation Service

Table 4.7 PRESENT FLOOD PRONE LOCALITIES IN GREATER SOUSSE (3/3)

LOCATION	ENCOUNTERED PROBLEM	OBSERVATIONS
<p><u>Kala'a Sghira</u> Zone located between the rail road and Ave H. Bourguiba</p>	<p>Serious flooding due to runoff flows from adjacent higher grounds with water level attaining 60 cm.</p>	<p>Area depressed with flat roads and deprived of any proper drainage facilities.</p>
<p><u>Msaken</u> South side of the town along the road in Ceinture</p>	<p>Temporarily flooded area due to the elevated road in Ceinture that obstructs runoff flows.</p>	<p>Area deprived of basic drainage infrastructure.</p>
<p>Area adjacent to the bridge on Oued Metah and the GPI road</p>	<p>Important flooding problem due to existing constructions and narrow waterway under the existing bridge.</p>	<p>Area requiring improvement works of river bed to enhance drainage operation.</p>
<p>area between Oued Djebli and the GPI road on the North-West side of town</p>	<p>Serious flooding problem due to the construction of roads in the existing river bed.</p>	<p>Low area respect to adjacent grounds that required drainage facilities.</p>

Source : DHU documentation Service.

Table 4.8 DISTRIBUTION OF SPONTANEOUS SETTLEMENTS IN GREATER SOUSSE

DELEGATION	HOUSING UNITS	LOCATION
- SOUSSE	400	Oued Kharroub/ Blibene, North-West of town between GPI and Avenue 20 Mars.
- Hammam Sousse	22	Oued Hammam East of the intersection with the GPI road.
- Akouda	40	Oued Laya (U/S of Oued Hammam) South of the Avenue de la Republique.
- Kala'a kebira	25	Oued Sghir South side of town
- Kala' Sghira	18	Oued Laya west of RVE 819 road on the North side of town
- Msaken	20	Oued Melah (u/s of Oued Hamdoun) on the South-East side of town.

Source : Rehabilitation program of the 4 Oued in Greater Sousse. Nov. 1991

Table 4.9 FUTURE LAND USE COMPOSITION IN GREATER SOUSSE

LAND USE CATEGORY	DELEGATIONS										TOTAL Area (Ha)
	SOUSSE* Area (Ha)	HAMMIAM SOUSSE Area (Ha)	KALAA KBIRA Area (Ha)	MSAKEN Area (Ha)	KALAA SGHIRA Area (Ha)	AKOUDA Area (Ha)	AZ- ZOUHOUR Area (Ha)	ZAOUIAT SOUSSE Area (Ha)	KSIBA Area (Ha)		
URBAN AREAS	2595	1253	715	970	410	220	194	80	155		6592
AGRICULTURAL AREAS	380	1310	1950	5900	810	970	1525	590	528		13963
INDUSTRIAL AREAS	516	278	34	215	50	35	11	37	10		1186
GREEN AREAS	305	250	113	300	34	66	35	50	65		1218
TOTAL	3796	3091	2812	7385	1304	1291	1765	757	758		22959

Sources : 1) Urban Development Plans of the Communities of Greater Sousse
2) Urban Development Master Plans of Sousse and Monastir - March 1993

* Sousse + Sousse Riadh

Table 6.1 Summary of Existing Environmental Conditions in Greater Tunis (1/3)

No.	River or Sebkhel	Important Reaches and/or Sub-basins	River or Sebkhel Characteristics	Economic Development in River Basin	Problem of Flooding and Causes	Environmental problems	River/Sebkhel Water Quality
1.	Oued Enkhilet	Drainage area of areas west of Sebkhel Ariana	Length: 21 km Catchment Area: 17.12 km ²	General Development: Urban area Upstream areas significant housing development is being made; downstream area has scattered spontaneous housing; tendency is towards increased urban development in the basin - both planned and unplanned; Housing area in the upstream areas is planned with several flood control measures such as dam, retention pond, and channel improvement	1. Eutrophication of river bed with dense vegetation growth 2. Crossings and culverts constructed by private means and culverts blocking river flow, causing blockage or preventing flow. 3. Garbage dumped into river blocks flow. 4. Lack of drainage system in Choutrana area. 5. No embankment or pavement on road side; road same elevation as adjoining land. 6. The OMAS canal of treated waste water as well as topography of downstream area makes drainage of river into Sebkhel Ariana difficult.	1. Spread of spontaneous settlements in middle and lower reaches. 2. Illegal and poorly constructed crossings and culverts blocking river flow. 3. Garbage disposal in middle and downstream reaches into river. 4. Erosion of roads due to problem of water stagnation and flooding. 5. Discharge of domestic waste water by spontaneous settlements into river.	Mediocre due to some domestic wastewater discharge and garbage in river.
2.	Sebkhel Ariana & surrounding area	Protected agricultural zone west of Sebkhel Ariana	area: 33.73 km ²	General Development: Agricultural plain of Soukra (protected agricultural zone) west of Sebkhel Ariana; Some urban extension plans in areas north of the Sebkhel; significant tourism development is also taking place including many hotels and a golf course in areas near the sea and north east part of Sebkhel	Problem of flooding in north part of the Sebkhel due to topographical conditions	1. Rapid urbanization and loss of agricultural land. 2. Spread of spontaneous settlements especially in the Soukra area south and south east of Sebkhel Ariana. 3. Landfill site in south east corner of the Sebkhel is a source of pollution. 4. Some wintering birds - flamingoes seen;	Sebkhel is relatively unpolluted; it dries up completely in summer
3.	Oued Greb	drains water of urban areas north west of Tunis lake	Length: 11 km Catchment Area: 18.87 km ²	Highly urbanised; planned settlements; planned urban settlements occurring in upstream areas with several flood control measures constructed.	Flooding problem controlled with adequate flood control measures;	1. Some garbage dumped into the river. 2. Eutrophication of river bed.	relatively clean and unpolluted

Table 6.1 Summary of Existing Environmental Conditions in Greater Tunis (2/3)

4.	Oued Gariana and its tributaries	drains water of urban areas north of Sebkhel Sijoumi	Length: 21 km catchment area: 86.52 km ²	General development: highly urbanised	1. Garbage and waste water disposed into the river by spontaneous settlements. Many culverts and crossings are blocked. 2. Discharge of domestic wastewater directly into the river. Oued Gariana is a virtual sewer. 3. Garbage thrown into river. 4. Very poor riverine landscape.	1. Spread of spontaneous settlements. 2. Discharge of domestic wastewater directly into the river. Oued Gariana is a virtual sewer. 3. Garbage thrown into river. 4. Very poor riverine landscape.	River water quality extremely poor due to domestic waste water discharges and garbage disposal Sebkhel water quality mediocre due to domestic and industrial waste water discharge
5.	Sebkhel Sijoumi	Acts like a retaining basin of draining waters of surrounding areas and Oued Gariana	Area: 25.84 km ² Avg. Depth:	General Development: urbanized in north and north east part; agricultural areas in western and southern areas of the Sebkhel; Sebkhel not used for any purpose; large part of it dries up in summer.	Flooding problem in spontaneous settlement areas in west part due to lack of drainage system	1. Existence of about 50 discharge points of waste water along the banks of the Sebkhel. The largest part of these is domestic waste water from the cities Essaidia and industrial El Manouba, Melhassine, Bir Aniba, Ezrouth Sidi Hassine Sijoumi, Fouchana, Meghira, El Ouardia and part of El Mourouj. Oued Gariana and the tanneries of Manouba are major sources of pollution; over 500 m ³ /d of waste water flows into the Sebkhel. 2. Pollution problems caused by landfill at Henchir El Yahoudia located in south east part of lake. 3. Eutrophication of Sebkhel Sijoumi.	Sebkhel water quality mediocre due to domestic and industrial waste water discharge
6.	Tunis North lake		area: 26 km ² Avg. Depth: 60 cm	General development: surrounding areas urbanised; the rehabilitation of the lake due to works carried out by ONAS has resulted in improvement in its quality; north-east part of the lake east of the airport is being developed for urban settlements; there already exists a shopping complex and road infrastructure land use planning with adequate green areas being done	some flooding problems in the Soukra area in spontaneous settlements in the north east part of the lake due to lack of drainage facilities.	1. The lake is protected by construction of a canal along the west bank of the lake against waste water discharges. 2. Existence of some spontaneous housing in the north east part of lake which lack adequate drainage and sanitation facilities.	Lake water quality good;

Table 6.1 Summary of Existing Environmental Conditions in Greater Tunis (3/3)

7. Tunis South Lake	area: 16 km ² avg. depth: 60 cm	Major Development: urbanised; existed of major navigation port and related dock facilities as well as the urban and industrial region of Ben Arous south of the lake.	1. Some flooding problems (temporary) in the Medina, Fayette and Petite Sicily municipality of Tunis city west of the lake due to low lying flat lands in densely populated areas. 2. Temporary flooding problem in the Port of Rades municip. managed by the AFT. The waste water of Rades in eastern part of the lake due to the presence of depression and poor soil conditions.	Water Pollution and lake eutrophication. The south lake of Tunis is heavily polluted receiving 40,000 m ³ /d of waste water mostly industrial through drainage canals coming from the Ben Arous area. The polluting industries spread all over the Governorate of Ben Arous about 450 in number of which about 270 are in zones managed by the AFT. The waste water discharges have resulted in eutrophication of the South lake and a total disequilibrium of this water body.	Extremely poor and a health hazard
8. Oued Malyian and its tributaries	length: 52 km catchment area: 1996 km ²	Major Development: Longest river of the study area; catchment basin mainly agricultural with some industrial development in downstream reaches in the governorate of Ben Arous. Water of Oued Malyian upstream of Bir Mithiga dam (primary purpose: flood protection) is used to a limited extent for irrigation; problem of excessive salinity of Malyian limits its water use for irrigation.	1. Major flooding problem near mouth of river due to low lands in surrounding area. 2. Isolated problems in Zaouiet Mornag, Mornag municipality, and some parts of Ben Arous governorate.	1. Increasing urbanisation and loss of agricultural lands. 2. Spread of spontaneous settlements in downstream areas in the governorate of Ben Arous. 3. Improper siting of industries; spread throughout the governorate of Ben Arous making pollution control costly and difficult of water as 4. Water erosion: floods resulting from high moderate, localised run-off over short periods have produced high levels of erosion (bank and bed erosion). 5. Water pollution by domestic and industrial waste discharges in downstream reaches. 6. salinity of Oued Malyian preventing its use even for irrigation. 7. Garbage dumped into river when flowing in urban settlements area. 8. Eutrophication and growth of dense vegetation in river bed blocking flow.	salinity problems and discharge of domestic and industrial waste in downstream areas river classification
9. Oued Magzette, Boukhamsa, Ain Zerga	length: 2 to 3 km catchment area: 4.2 to 6.98 km ²	Major development: upstream areas agricultural or forested; downstream areas urbanised; major coastal towns Ezzahara and hammam Lif.	1. Spontaneous settlements 2. Lack of drainage facilities. 3. Low lying coastal areas. 4. Lack of flood protection structures. 5. Eutrophication and dense vegetation growth blocking flow.	1. Presence of spontaneous settlements. 2. Lack of proper drainage and sanitation systems. 3. Eutrophication of rivers.	Poor due to domestic waste water discharges

Table 6.2 Summary of Existing Environmental Conditions in Sousse Area (1/2)

No.	River or Sebket	Important Reaches and/or Sub-basins	River or Sebket Characteristics	Economic Development in River Basin	Problem of Flooding and Causes	Environmental problems	River/Sebket Water Quality
1.	Oued Hammam		Length: 15 km Catchment Area: 222 km ²	Olive and arboriculture with several urbanized areas. Major towns are Akouda, Kalaa Kebira, Hammam Sousse Kalaa Seghira. Main industry is olive processing and leather goods production, and K. Kebira have predominantly textile and leather manufacturing units. Akouda and K. Seghira also have upholstery/furniture making units Coastal area well developed for tourism. Limited coastal fishery.	1. Occupancy of river bed & drainage areas by the people due to rarity and weak manifestation of floods. 2. Lack of adequate or very poorly maintained drainage infrastructures in urban areas. 3. Significant Eutrophication of river bed with dense vegetation growth.	1. Rapid Urban Growth and the concurrence of city-countryside. 2. Spontaneous human settlements in potential hazard zones (river bed and drainage watershed). 3. Ill effects of rapid tourism development. 4. Erosion problems: layer and claw erosion, Erosion by wear and tear, bank erosion. 5. River Pollution by discharge of domestic waste water into rivers from major urban areas and spontaneous settlements. 6. Very significant eutrophication of river bed in many places blocking water flow and creating water stagnation. 7. Coastal area pollution in prime beach resort area by discharge of polluted rivers into the sea. 8. Poor landscaping (riverine) especially in coastal tourist zone. 9. Garbage disposal heaps in river basin and in river bed itself.	River water quality very poor in downstream areas of all major towns.
2.	Oued Bibane & tributaries	Collects drainage water of north part of Sousse city	Length: 3.5 km catchment area: 15.13 km ²	Highly urbanised; main industry is tourism in coastal zone.	1. Significant eutrophication of river beds with dense vegetation growth obstructing flow. 2. Poor maintenance of existing infrastructure. 3. garbage disposal in river bed blocking flow.	1. High population density - 500-1000 p/km. 2. Spontaneous settlements near river bed. 3. Garbage disposal into river. 4. Domestic waste water discharge by spontaneous settlements into river. 5. Significant eutrophication of river bed. 6. Poor riverine landscape.	River quality poor in upstream reaches, but improves with natural purification in touristic coastal zone.

Table 6.2 Summary of Existing Environmental Conditions in Sousse Area (2/2)

No.	River or Sebket	Impottant Reaches and/or Sub-basins	River or Sebket Characteristics	Economic Development in River Basin	Problem of Flooding and Causes	Environmental problems	River/Sebket Water Quality
3.	Oued Hamilouf and its tributaries	Southern part of Sousse city	Length: 2.5 km Catchment Area: 12.34 km ²	Highly urbanised. A sweet manufacturing unit is present.	1. Significant eutrophication. 2. Garbage disposal into river bed. 3. Poor maintenance of existing infrastructure.	1. High Population density, 500-1000 p/km ² 2. Spontaneous settlements. 3. garbage disposal in river. 4. Discharge of treated waste water of South Sousse treatment plant into river. 5. Some domestic waste water discharge as well as waste from confectionary unit into river. 6. Significant eutrophication. 7. Poor riverine landscape.	Poor to mediocre due to waste water discharge and garbage disposed into river.
4.	Oued Hamdoun and its tributaries	drains water of areas from M'saken to South Sousse	Length: 14 km catchment area: 312 km ²	Olive and other arboriculture with significant number of industries in all urban areas. Major towns include M'saken city and southern industrial areas of Sousse city. Major olive processing area with around 70 units in M'saken. Tanneries, textiles and some chemical industries also present.	1. Significant eutrophication of river bed with dense vegetation growth. 2. Poor river maintenance.	1. Water Pollution: This river is the most polluted in the region. It receives the untreated waste water of M'saken city as well as urban areas situated along the river for a distance of 15 km until it reaches the sea. Further, the discharge of margines of over 70 olive processing units of M'saken as well as waste water from tannery units and dyeing units are major sources of pollution. 2. Rapid urban growth and concurrence of city country side. 3. Some spontaneous settlements in river drainage area. 4. Significant eutrophication of river bed with dense vegetation growth causing water stagnation in many places. 5. very poor riverine landscape. 6. garbage disposal heaps very near or in the river at many places. 7. Erosion problems: layer and claw erosion, erosion by wear and tear, bank erosion.	River water quality extremely poor due to domestic and industrial waste discharges over a stretch of over 15 km upto the sea.

Table 6.3 Result of Water Quality Analysis for Greater Tunis Area

Sampling Point	Sampling Date	Weather	Ambient Temp.	D.O mg/l	Water Temp C	Turbidity NTU	pH	Conductivity ms/cm	s. solid mg/l	salinity g/l	BOD mg/l	COD mg/l
1(Ennkhilet)	24/4/93 8.00 am	sunny	22	3.64	18.2	8	7.51	3.8	6.8	1.9	20	30
2 (Garana)	24/4/93 9.30 am	sunny	24	6.08	21.6	54	8.13	3.1	32	1.5	17	71
3(Greb)	24/4/93 10.00 am	sunny	24	6.55	23.4	62	8.38	2.38	43.3	1.1	21	72
4(Maliyan)	24/4/93 10.35 am	sunny	25	2.55	23.5	67	7.54	4.34	84	2.2	28	104
5(Magzette)	no flow											
6(Bouhamsa)	no flow											
7(Ain Zerga)	no flow											
8(Maliyan) near Nasan	24/4/93 12.10 pm	sunny	27	4.6	22.4	58	7.48	4.51	12	2.3	12	32
9(Maliyan) near Mornag	24/4/93 11.50 am	sunny	27	6.68	26.6	60	8.4	4.39	110	2.2	65	187
10(Maliyan) near Al Khidya	24/4/93 12.35 pm	sunny	27	7.35	22.5	203	8.26	4.64	80	2.3	19	55

Table 6.4 Result of Water Quality Analysis for Sousse Area

Sampling Point	Sampling Date	Weather	Ambient Temp.	D.O mg/l	Water Temp C	Turbidity NTU	pH	Conductivity ms/cm	s. solid mg/l	salinity g/l	BOD mg/l	COD mg/l	Total coliform MPN/100 ml
1	21/4/93 10.00 am	sunny	22	6.76	19.7	10	7.49	7.97	8.8	4.4	29	67	11000
2	21/4/93 10.25 am	sunny	23	4.92	20.9	17	7.75	2.21	35.6	1	83	193	
3	21/4/93 10.45 am	sunny	23	3.91	22	> 999	8.42	2.54	725	1.2	155	1185	
4	21/4/93 11.10 am	sunny	24	6.52	23.6	26	7.35	1.6	990	0.7	350	1932	
5	21/4/93 9.30 am	sunny	20	8.45	19.6	10	8.03	7.55	40	4.2	25	61	1500
6	21/4/93 8.45 am	sunny	19	4.4	16.4	10	7.45	3.32	8.6	1.6	25	54	14000
7	21/4/93 8.00 am	sunny	19	7.13	14.4	14	7.76	6.54	12	3.4	62	138	2100
8	no flow												
9	21/4/93 12.05 pm	sunny	27	4.2	26.7	10	7.82	11.9	11.6	0.67	25	119	

Table 6.5 Environmental Baseline Evaluation for Greater Tunis

Environmental Parameters	Oued Ghrib and Aviana Lake		Oued Ghrib and Tunis Lake		Oued Mergine & Seb. Sijoumi		Oued Malyan		Oued Magdelle & Iou Khannou		Oued Ain Zerga	
	Baseline Evaluation Importance	Without Project Condition	Baseline Evaluation Importance	Without Project Condition	Baseline Evaluation Importance	Without Project Condition	Baseline Evaluation Importance	Without Project Condition	Baseline Evaluation Importance	Without Project Condition	Baseline Evaluation Importance	Without Project Condition
NATURAL ENVIRONMENT												
Ground Phenomena												
Earthquake												
Landslides												
Rockfall												
Coastal Erosion												
Siltation												
Soil Erosion												
Soil Contamination												
Hydrographic Phenomena												
Flood												
Flow Regime (Water Balance)												
Water Quality												
Eutrophication												
Turbid/coloured water												
Dissolved Oxygen												
Saltwater Intrusion												
Sediment Deposit												
Deposit Composition												
Biosphere												
Terrestrial Flora												
Terrestrial Fauna												
Aquatic Flora and Fauna												
Vegetation												
Wildlife												
Local Climate												
Offshore Udder												
Rich Balance												
Noise and Vibration												
Offshore Noise & Vibration												
SOCIAL ENVIRONMENT												
Human Settlements												
Spontaneous Settlements												
Planned Settlements												
Living Condition												
Power and Water Supply												
Recreation												
Education												
Employment												
Industry												
Agriculture												
Fishery												
Industry												
Tourism												
Communication Systems												
Transportation Systems												
Land Reclamation												
River & Sea Transportation												
Dredging of Water												
Water and Fishing Right												
Sanitary Condition												
Spread of water borne diseases												
Other sanitary conditions												
Landscape												
Valuable Landscape or Scenery												

Importance Rating
 Rating 1 (not important)
 2 (important)
 3 (very important)
 x (not clear)

Criteria
 not affected by flooding
 affected partly by flooding
 affected significantly by flooding

Present Condition
 Rating 1 worse quality than 20 years ago
 2 almost same as 20 years ago
 3 better quality than 20 years ago
 x lack of data, further study necessary

Without Project impacts (positive or negative)
 Rating
 Criteria
 "+/-3 high significance
 "+/-2 medium significance
 "+/-1 low significance
 x impact not clear, further study necessary

Table 6.6 Environmental Baseline Evaluation for Sousse Area

Environmental Parameters	Used Territory Baseline Evaluation		Used Territory Baseline Importance		Without Project		With Project	
	Importance	Present Condition	Importance	Present Condition	Importance	Present Condition	Importance	Present Condition
NATURAL ENVIRONMENT								
Geographical	1	1	1	1				
Geological	1	1	1	1				
Hydrological	3	3	3	3	-2	-2	-2	-2
Soil	2	2	2	2				
Atmospheric Phenomena	1	1	1	1				
Water Quality	3	3	3	3	-2	-2	-2	-2
Bio-physical	3	3	3	3	-2	-2	-2	-2
Dissolved Oxygen	3	3	3	3	-2	-2	-2	-2
Saltwater Intrusion	3	3	3	3	-2	-2	-2	-2
Sediment Deposit	1	1	1	1				
Deposits	1	1	1	1				
Biosphere	1	1	1	1				
Terrrestrial Flora	1	1	1	1				
Terrrestrial Fauna	1	1	1	1				
Aquatic Flora and Fauna	1	1	1	1				
Ecosystem	1	1	1	1				
Atmosphere	1	1	1	1				
Local Climate	1	1	1	1				
Offensive Odor	1	1	1	1				
Heat Balance	1	1	1	1				
Noise and Vibration	1	1	1	1				
Offensive Noise & Vibration	1	1	1	1				
SOCIAL ENVIRONMENT								
Human Settlements	1	1	1	1				
Seasonal Settlements	3	3	3	3	-2	-2	-2	-2
Marine Settlements	3	3	3	3	-2	-2	-2	-2
Living Condition	1	1	1	1				
Power and Water Supply	1	1	1	1				
Recycling	1	1	1	1				
Education	1	1	1	1				
Employment	1	1	1	1				
Industry	2	2	2	2	-2	-2	-2	-2
Agriculture	1	1	1	1				
Industry	1	1	1	1				
Tourism	1	1	1	1				
Communication Systems	1	1	1	1				
Transportation	1	1	1	1				
River & Sea Transportation	1	1	1	1				
Utilization of Water	1	1	1	1				
Water and Fishing Right	3	3	3	3	-2	-2	-2	-2
Spread of water borne diseases	3	3	3	3	-2	-2	-2	-2
Landscape	1	1	1	1				
Valuable Landscape or Scenery	3	3	3	3	-2	-2	-2	-2

Importance Rating Criteria
 1 not affected by flooding
 2 (important) affected partly by flooding
 3 (very important) affected significantly by flooding
 x (not clear)

Present Condition Rating Criteria
 1 worse quality than 20 years ago
 2 almost same as 20 years ago
 3 better quality than 20 years ago
 x lack of data, further study necessary

Without Project impacts (positive or negative)
 Rating Criteria
 "+/-3 high significance
 "+/-2 medium significance
 "+/-1 low significance
 x impact not clear, further study necessary

Table 6.7 Initial Environmental Examination for Greater Tunis (1/2)

Environmental Parameters	Oued Enkhilet and Ariana Lake		Oued Grab and Tunis Lake		Oued Gariana and Sijumi Lake	
	Present	Without Project	Present	Without Project	Present	Without Project
NATURAL ENVIRONMENT						
Ground Phenomena						
Stream Bed Erosion	1	-1	1	-1	1	1
Geology						
Soil Erosion	1	-2	2	-2	2	1
Hydropheric Phenomena						
Groundwater	1	-1	1	1		
Flow Regime (water Balance)	1	-1	1	1	1	1
Flood	1	-2	2	-2	2	2
Water Quality						
Eutrophication	1	-2	2	-2	2	2
Turbid/Polluted water	1	-2	1	-2	1	1
Dissolved Oxygen	1	-2	1	-2	1	1
Saltwater Intrusion						
Biosphere						
Terrestrial Flora	x	0	x	0	x	0
Terrestrial Fauna	x	0	x	0	x	0
Aquatic Flora and Fauna	x	0	x	0	x	0
Ecosystem	x	0	x	0	x	0
SOCIAL ENVIRONMENT						
Settlements						
Spontaneous settlements	1	-2	1	-1	1	-2
Planned settlements	1	-1	2	-1	2	1
Industry						
Agriculture	1	-2	1	-1		
Sanitary Condition						
Spread of water borne diseases	3	-2	3	-1	3	-2
Landscape						
Valuable Landscape of Scenal	2	-1	1	-1	1	-2

Present condition rating
 Rating Criteria
 1 worse quality than 20 years ago
 2 almost same as 20 years ago
 3 better quality than 20 years ago
 x lack of data, further study necessary
 0 no significant impact

Impact rating (positive or negative)
 Rating Criteria
 *+/-3 high significance
 *+/-2 medium significance
 *+/-1 low significance
 x impact not clear, further study necessary
 0 no significant impact

Table 6.7 Initial Environmental Examination for Greater Tunis (2/2)

Environmental Parameters	Oued Malyan		With Project		ML1	ML2	ML3	ML4	ML5	Oued Ain Zerga		With Project		AZ3	AZ4
	Baseline Evaluation Present	Without Project	ML1	ML2						Baseline Evaluation Present	Without Project	AZ1	AZ2		
NATURAL ENVIRONMENT															
Ground Phenomena	1	-2	1	1	2	3	3	1	2	2	1	2	2	2	2
Stream Bed Erosion															
Geology															
Soil Erosion	1	-2	1	2	2	2	2	1	2	2	1	2	2	2	2
Hydrospenic Phenomena															
Groundwater															
Flow Regime (Water Balance)	2	-1	1	2	2	2	2	2	2	2					
Flood	1	-2	1	2	2	3	3	1	2	2	1	2	2	2	3
Water Quality															
Eutrophication	1	-2	1	2	2	2	2	1	2	2	1	2	1	1	1
Turbid/Polluted water	1	-2	1	2	2	2	2	1	2	2	1	2	1	1	1
Dissolved Oxygen	1	-2	1	2	2	2	2	1	2	2	1	2	1	1	1
Saltwater Intrusion	1	-2	x	x	x	x	x	x	x	x					
SOCIAL ENVIRONMENT															
Human settlements															
Spontaneous settlements	1	-2	0	0	0	0	0	1	0	0	1	-2	0	0	0
Planned settlements	1	-2	1	1	2	2	2	1	2	2	1	-2	1	2	2
Industry															
Agriculture	2	-2	1	2	2	2	2								
Sanitary Condition															
Spread of water borne diseases	3	-2	1	2	2	2	2	3	2	2	3	-2	1	2	2
Landscape															
Valuable Landscape or Scenery	2	-1	1	1	1	1	1	2	1	1	2	-1	1	1	1

Present condition rating

Rating	Criteria
1	worse quality than 20 years ago
2	almost same as 20 years ago
3	better quality than 20 years ago
x	lack of data, further study necessary

Impact rating (positive or negative)

Rating	Criteria
"+/+3	High significance
"+/+2	medium significance
"+/+1	low significance
x	impact not clear, further study necessary
0	no significant impact

Table 6.8 Initial Environmental Examination for Souss Area

Environmental Parameters	Oued Hammam			With Project			Oued Hamdoun			With Project							
	Baseline Evaluation Present	Without Project	Condition	HM1	HM2	HM3	HM4	HM5	HM6	HM7	Baseline Evaluation Present	Without Project	Condition	HD1	HD2	HD3	HD4
NATURAL ENVIRONMENT																	
Ground Phenomena	1	-2		1	2	2	2	2	2	3	1	-2	1	1	2	2	2
Stream Bed Erosion																	
Geology	1	-2		1	2	2	2	2	2	2	1	-2	1	2	2	2	2
Soil Erosion																	
Hydro-spheric Phenomena	1	-2		1	2	2	2	2	2	3	1	-2	1	2	2	2	2
Flood																	
Water Quality	1	-2		1	2	2	2	2	2	2	1	-2	1	-1	-1	-1	-1
Eutrophication	1	-2		1	1	1	1	1	1	1	1	-2	1	-2	-2	-2	-2
Turbid/Polluted water	1	-2		1	1	1	1	1	1	1	1	-2	1	-2	-2	-2	-2
Dissolved Oxygen	1	-2		1	1	1	1	1	1	1	1	-2	1	-2	-2	-2	-2
SOCIAL ENVIRONMENT																	
Human Settlements																	
Spontaneous Settlements	1	-2		1	-2	-2	-2	-2	-2	-2	1	-2	1	-1	-1	-1	-1
Planned Settlements	1	-2		1	2	2	2	2	2	2	1	-2	1	2	2	2	2
Industry																	
Agriculture	1	-2		1	1	1	2	1	1	2	1	-2	1	2	2	2	2
Sanitary Condition																	
Spread of Water Borne Diseases	3	-2		1	1	1	1	1	1	1	3	-2	1	-1	-1	-1	-1
Landscape																	
Valuable Landscape or Scena	2	-2		1	1	1	1	1	1	1	1	-2	1	1	1	1	1

Present Condition Rating

- Rating Criteria
- 1 worse quality than 20 years ago
 - 2 almost same as 20 years ago
 - 3 better quality than 20 years ago
 - x lack of data, further study necessary

Impact rating (positive or negative)

- Rating Criteria
- +/-3 high significance
 - +/-2 medium significance
 - +/-1 low significance
 - x impact not clear, further study necessary
 - 0 no significant impact

Table 7.1 Flood Inundation Area and Duration (1/3)

Oued Enkhilet

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	26	1.5	32	2.5
2	64	4.0	78	7.0
5	108	6.5	132	11.5
10	157	10.0	191	17.0
25	210	13.5	256	22.5
50	267	16.5	324	28.5
100	326	20.5	396	35.0

Oued Greb

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	6	4.0	21	6.0
2	12	5.0	30	8.0
5	22	6.5	59	10.5
10	34	8.0	82	12.5
25	69	10.5	114	17.0
50	90	13.0	139	21.0
100	112	16.5	159	22.0

Oued Gariana

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	58	4.0	106	7.0
2	94	7.0	171	11.5
5	125	9.0	228	15.5
10	153	11.0	278	19.0
25	179	13.0	326	22.0
50	204	15.0	370	25.0
100	227	16.5	412	28.0

Oued Maliyan

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	30	1.5	30	1.5
2	130	2.0	130	2.0
5	800	5.0	800	5.0
10	2,630	14.0	2,630	14.0
25	4,210	20.0	4,210	20.0
50	6,070	28.0	6,070	28.0
100	7,300	35.0	7,300	35.0

Table 7.1 Flood Inundation Area and Duration (2/3)

Oued Mayzette

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	3	0.5	6	1.0
2	11	1.5	20	3.5
5	23	3.5	42	6.5
10	39	6.0	70	11.5
25	59	9.0	104	17.0
50	82	12.5	145	23.5
100	108	16.5	191	31.0

Oued Bou Khamsa

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	27	3.5	55	7.5
2	41	5.5	83	11.5
5	53	7.0	106	14.5
10	63	8.5	126	17.0
25	72	10.0	144	19.5
50	80	11.0	160	22.0
100	88	12.0	176	24.0

Oued Ain Zerga

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	2	0.5	3	1.0
2	5	1.0	7	2.0
5	9	2.0	12	4.0
10	14	3.0	18	5.5
25	18	4.0	25	7.5
50	24	5.0	32	9.5
100	29	6.0	39	12.0

Oued Hammam

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	20	3.5	23	4.5
2	50	8.5	59	11.0
5	86	15.0	102	18.5
10	127	22.0	150	27.5
25	171	30.0	203	37.5
50	219	38.0	260	48.0
100	270	47.0	320	59.0

Table 7.1 Flood Inundation Area and Duration (3/3)

Oued Blibene

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	7	4.0	9	6.0
2	8	5.0	12	7.5
5	11	7.0	14	10.5
10	13	8.5	17	13.5
25	16	12.0	21	17.0
50	19	15.0	26	23.0
100	23	19.0	31	27.0

Oued Hallouf

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	23	3.0	32	5.0
2	26	3.5	38	6.0
5	31	5.0	47	10.0
10	38	6.5	54	12.0
25	46	9.0	66	16.5
50	54	11.0	72	19.5
100	61	14.0	77	23.0

Oued Hamdoun

Return Period (yr)	Present Land Use Condition		Future Land Use Condition (2020)	
	Flood Area (ha)	Duration (hr)	Flood Area (ha)	Duration (hr)
1.05	138	10.0	144	11.0
2	151	12.5	159	15.0
5	172	17.0	181	19.0
10	192	21.5	206	25.0
25	222	29.5	237	35.0
50	244	37.0	261	41.5
100	277	48.0	293	52.0

Table 8.1 Unit Cost for Major Construction Work Items

Work Items	Unit	Unit Cost (DT)
<u>1. River improvement</u>		
1) Excavation, common	m3	5.0
2) Excavation, levee	m3	6.0
3) Backfill	m3	4.0
4) Concrete, Type A (240kg/cm2)	m3	80.0
5) Concrete, Type B (150kg/cm2)	m3	65.0
6) Reinforcement bar	ton	1000.0
7) Asphalt pavement	m2	2.5
8) Steel sheet pile	m2	230.0
9) Bridge RC-T	m2	850.0
10) Demolishing of structures	L.S.	
<u>2. Construction of dam and retarding basin</u>		
1) Excavation, common	m3	5.0
2) Embankment	m3	7.0
3) Riprap	m3	20.0
4) Concrete, Type A (240kg/cm2)	m3	80.0
5) Concrete, Type B (150kg/cm2)	m3	65.0
6) Reinforcement bar	ton	1000.0
7) Sodding	m3	1.0
8) Curtain grout	ton	150.0
<u>3. Tunnel construction</u>		
1) Tunnel excavation	m3	80.0
2) lining concrete	m3	100.0
<u>4. Dredging/reclamation</u>		
1) Dredging and land reclamation	m3	5.0

Table 8.2 Construction Cost of Oued Enkhilet

First Stage (for 10 yr Flood)						Second Stage (for 100 yr Flood)						Total of First and Second Stages					
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)		Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)		Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	
I Preparatory Works (8% of II & III)						I Preparatory Works (8% of II & III)						I Preparatory Works (8% of II & III)					
II River Improvement					656,000	II River Improvement				598,000		II River Improvement				1,254,000	
1. Excavation, common	m3	5	201,400	1,007,000		1. Excavation, common	m3	5	143,200	716,000		1. Excavation, common	m3	5	344,600	1,723,000	
2. Embankment, dike	m3	6	68,100	408,600		2. Embankment, dike	m3	6	60,300	361,800		2. Embankment, dike	m3	6	128,400	770,400	
3. Backfill	m3	4	48,900	195,600		3. Backfill	m3	4	67,800	271,200		3. Backfill	m3	4	116,700	466,800	
4. Structural concrete	m3	80	22,650	1,812,000		4. Structural concrete	m3	80	27,950	2,236,000		4. Structural concrete	m3	80	50,600	4,048,000	
5. Mass concrete	m3	65	0	0		5. Mass concrete	m3	65	0	0		5. Mass concrete	m3	65	0	0	
6. Reinforcement steel bar	ton	1000	2,545	2,545,000		6. Reinforcement steel bar	ton	1000	2,916	2,916,000		6. Reinforcement steel bar	ton	1000	5,461	5,461,000	
7. Asphalt pavement	m2	2.5	2,145	5,363		7. Asphalt pavement	m2	2.5	0	0		7. Asphalt pavement	m2	2.5	2,145	5,363	
8. Road bridge, RC-T	m2	850	918	780,300		8. Road bridge, RC-T	m2	850	0	0		8. Road bridge, RC-T	m2	850	918	780,300	
9. Railway bridge	m	5000	0	0		9. Railway bridge	m	5000	0	0		9. Railway bridge	m	5000	0	0	
10. Other crossing facilities	L.S.	-	0	78,030		10. Other crossing facilities	L.S.	-	0	0		10. Other crossing facilities	L.S.	-	0	78,030	
11. Demolish of existing structure	m3	30	4,740	142,200		11. Demolish of existing structure	m3	30	0	0		11. Demolish of existing structure	m3	30	4,740	142,200	
12. Miscellaneous works (15%)	L.S.	-	-	1,046,114		12. Miscellaneous works (15%)	L.S.	-	0	975,150		12. Miscellaneous works (15%)	L.S.	-	-	2,031,264	
Sub-Total of II				8,020,000		Sub-Total of II				7,475,000		Sub-Total of II				15,495,000	
III Dam & Retarding Basin						III Dam & Retarding Basin						III Dam & Retarding Basin					
1. Excavation, common	m3	5	5,150	25,750		1. Excavation, common	m3	5	0	0		1. Excavation, common	m3	5	5,150	25,750	
2. Embankment, dike	m3	7	9,800	68,600		2. Embankment, dike	m3	7	0	0		2. Embankment, dike	m3	7	9,800	68,600	
3. Riprap	m3	20	510	10,200		3. Riprap	m3	20	0	0		3. Riprap	m3	20	510	10,200	
4. Structural concrete	m3	80	340	27,200		4. Structural concrete	m3	80	0	0		4. Structural concrete	m3	80	340	27,200	
5. Mass concrete	m3	65	0	0		5. Mass concrete	m3	65	0	0		5. Mass concrete	m3	65	0	0	
6. Reinforcement steel bar	ton	1000	23	23,000		6. Reinforcement steel bar	ton	1000	0	0		6. Reinforcement steel bar	ton	1000	23	23,000	
7. Sodding	m2	1	1,020	1,020		7. Sodding	m2	1	0	0		7. Sodding	m2	1	1,020	1,020	
8. Curtain Groat	t	150	0	0		8. Curtain Groat	t	150	0	0		8. Curtain Groat	t	150	0	0	
9. Miscellaneous works (15%)	L.S.	-	0	23,366		9. Miscellaneous works (15%)	L.S.	-	0	0		9. Miscellaneous works (15%)	L.S.	-	0	23,366	
Sub-Total of III				179,000		Sub-Total of III				0		Sub-Total of III				179,000	
Total of I to III				8,855,000		Total of I to III				8,074,000		Total of I to III				16,929,000	
IV Land Acquisition and Compensation						IV Land Acquisition and Compensation						IV Land Acquisition and Compensation					
1. Land acquisition	m2	15	95,600	1,434,000		1. Land acquisition and Compensation	m2	15	23,900	358,500		1. Land acquisition and Compensation	m2	15	119,500	1,792,500	
2. Compensation	m2	200	2,400	480,000		2. Compensation	m2	200	0	0		2. Compensation	m2	200	2,400	480,000	
Sub-Total of IV				1,914,000		Sub-Total of IV				359,000		Sub-Total of IV				2,273,000	
V Engineering Services (10% of I to III)						V Engineering Services (10% of I to III)						V Engineering Services (10% of I to III)					
				886,000						807,000						1,693,000	
VI Gov. Administration (5% of I to IV)						VI Gov. Administration (5% of I to IV)						VI Gov. Administration (5% of I to IV)					
				538,000						422,000						960,000	
VII Contingency (15% of I to VI)						VII Contingency (15% of I to VI)						VII Contingency (15% of I to VI)					
				1,829,000						1,449,000						3,278,000	
TOTAL				14,022,000		TOTAL				11,111,000		TOTAL				25,133,000	

Table 8.3 Construction Cost of Qued Greb

First Stage (for 10-yr Flood)		Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)					
II River Improvement					
1. Excavation, common	m3	5		40,500	202,500
2. Embankment, dike	m3	6		10,000	60,000
3. Backfill	m3	4		20,200	80,800
4. Structural concrete	m3	80		6,480	518,400
5. Mass concrete	m3	65		0	0
6. Reinforcement steel bar	ton	1000		550	550,000
7. Asphalt pavement	m2	2.5		200	500
8. Road bridge, RC-T	m2	850		0	0
9. Railway bridge	m	5000		0	0
10. Other crossing facilities	L.S.	-		0	0
11. Demolish of existing structure	m3	30		2,540	76,200
12. Miscellaneous works (15%)	L.S.	-		0	220,260
Sub-Total of II					
1,689,000					
III Dam & Retarding Basin					
1. Excavation, common	m3	5		60,800	304,000
2. Embankment, dike	m3	7		5,700	39,900
3. Riprap	m3	20		510	10,200
4. Structural concrete	m3	80		275	22,000
5. Mass concrete	m3	65		0	0
6. Reinforcement steel bar	ton	1000		18	18,000
7. Soldering	m2	1		1,020	1,020
8. Curtain Grout	t	150		0	0
9. Miscellaneous works (15%)	L.S.	-		0	59,268
Sub-Total of III					
454,000					
Total of I to III					
2,314,000					
IV Land Acquisition and Compensation					
1. Land acquisition	m2	70		21,000	1,470,000
2. Compensation	m2	200		1,000	200,000
Sub-Total of IV					
1,670,000					
V Engineering Services (10% of I to III)					
231,000					
VI Gov. Administration (5% of I to IV)					
199,000					
VII Contingency (15% of I to VI)					
662,000					
TOTAL					
5,076,000					

Second Stage (for 100-yr Flood)		Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)					
II River Improvement					
1. Excavation, common	m3	5		117,400	587,000
2. Embankment, dike	m3	6		0	0
3. Backfill	m3	4		33,500	134,000
4. Structural concrete	m3	80		22,230	1,778,400
5. Mass concrete	m3	65		0	0
6. Reinforcement steel bar	ton	1000		1,682	1,682,000
7. Asphalt pavement	m2	2.5		400	1,000
8. Road bridge, RC-T	m2	850		60	51,000
9. Railway bridge	m	5000		0	0
10. Other crossing facilities	L.S.	-		0	0
11. Demolish of existing structure	m3	30		2,740	82,200
12. Miscellaneous works (15%)	L.S.	-		0	648,105
Sub-Total of II					
4,969,000					
III Dam & Retarding Basin					
1. Excavation, common	m3	5		0	0
2. Embankment, dike	m3	7		0	0
3. Riprap	m3	20		0	0
4. Structural concrete	m3	80		0	0
5. Mass concrete	m3	65		0	0
6. Reinforcement steel bar	ton	1000		0	0
7. Soldering	m2	1		0	0
8. Curtain Grout	t	150		0	0
9. Miscellaneous works (15%)	L.S.	-		0	0
Sub-Total of III					
0					
Total of I to III					
5,967,000					
IV Land Acquisition and Compensation					
1. Land acquisition	m2	70		18,000	1,260,000
2. Compensation	m2	200		1,000	200,000
Sub-Total of IV					
1,460,000					
V Engineering Services (10% of I to III)					
597,000					
VI Gov. Administration (5% of I to IV)					
341,000					
VII Contingency (15% of I to VI)					
1,156,000					
TOTAL					
8,861,000					

Total of First and Second Stages		Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)					
II River Improvement					
1. Excavation, common	m3	5		157,900	789,500
2. Embankment, dike	m3	6		10,000	60,000
3. Backfill	m3	4		53,700	214,800
4. Structural concrete	m3	80		28,710	2,296,800
5. Mass concrete	m3	65		0	0
6. Reinforcement steel bar	ton	1000		2,212	2,212,000
7. Asphalt pavement	m2	2.5		600	1,500
8. Road bridge, RC-T	m2	850		60	51,000
9. Railway bridge	m	5000		0	0
10. Other crossing facilities	L.S.	-		0	0
11. Demolish of existing structure	m3	30		5,280	158,400
12. Miscellaneous works (15%)	L.S.	-		0	688,265
Sub-Total of II					
6,657,000					
III Dam & Retarding Basin					
1. Excavation, common	m3	5		60,800	304,000
2. Embankment, dike	m3	7		5,700	39,900
3. Riprap	m3	20		510	10,200
4. Structural concrete	m3	80		275	22,000
5. Mass concrete	m3	65		0	0
6. Reinforcement steel bar	ton	1000		18	18,000
7. Soldering	m2	1		1,020	1,020
8. Curtain Grout	t	150		0	0
9. Miscellaneous works (15%)	L.S.	-		0	59,268
Sub-Total of III					
454,000					
Total of I to III					
7,680,000					
IV Land Acquisition and Compensation					
1. Land acquisition	m2	70		39,000	2,730,000
2. Compensation	m2	200		2,000	400,000
Sub-Total of IV					
3,130,000					
V Engineering Services (10% of I to III)					
768,000					
VI Gov. Administration (5% of I to IV)					
541,000					
VII Contingency (15% of I to VI)					
1,818,000					
TOTAL					
13,937,000					

Table 8.4 Construction Cost of Oued Gariana

First Stage (for 10 yr Flood)						Second Stage (for 100 yr Flood)								
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
Total of First and Second Stages														
I Preparatory Works (8% of II & III)														
II River Improvement														
1. Excavation, common	m3	5	423,800	2,115,000	1. Excavation, common	m3	5	401,000	2,005,000	1. Excavation, common	m3	5	401,000	2,005,000
2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0
3. Backfill	m3	4	285,000	3. Backfill	m3	4	3,500	14,000	3. Backfill	m3	4	3,500	14,000	
4. Structural concrete	m3	80	92,200	7,376,000	4. Structural concrete	m3	80	70,800	5,664,000	4. Structural concrete	m3	80	70,800	5,664,000
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1000	6,460	6,460,000	6. Reinforcement steel bar	ton	1000	4,960	4,960,000	6. Reinforcement steel bar	ton	1000	4,960	4,960,000
7. Asphalt pavement	m2	2.5	19,100	47,750	7. Asphalt pavement	m2	2.5	0	0	7. Asphalt pavement	m2	2.5	0	0
8. Road bridge, RC-T	m2	850	9,540	8,109,000	8. Road bridge, RC-T	m2	850	0	0	8. Road bridge, RC-T	m2	850	0	0
9. Railway bridge	m	5000	15	75,000	9. Railway bridge	m	5000	0	0	9. Railway bridge	m	5000	0	0
10. Other crossing facilities	L.S.	-	-	810,900	10. Other crossing facilities	L.S.	-	-	0	10. Other crossing facilities	L.S.	-	-	0
11. Demolish of existing structure	m3	30	29,650	889,500	11. Demolish of existing structure	m3	30	750	22,500	11. Demolish of existing structure	m3	30	750	22,500
12. Miscellaneous works (15%)	L.S.	-	-	4,053,473	12. Miscellaneous works (15%)	L.S.	-	-	1,899,825	12. Miscellaneous works (15%)	L.S.	-	-	1,899,825
Sub-Total of II					Sub-Total of II					Sub-Total of II				
31,077,000					14,565,000					45,642,000				
III Dam & Retarding Basin														
1. Excavation, common	m3	5	607,500	3,037,500	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	159,800	1,119,500	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	9,800	196,000	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	2,510	200,800	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1000	176	176,000	6. Reinforcement steel bar	ton	1000	0	0	6. Reinforcement steel bar	ton	1000	0	0
7. Sodding	m2	1	19,700	19,700	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	712,395	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III					Sub-Total of III					Sub-Total of III				
5,462,000					15,730,000					5,462,000				
Total of I to III														
39,462,000														
IV Land Acquisition and Compensation														
1. Land acquisition	m2	26.27	372,000	9,772,440	1. Land acquisition	m2	50	148,000	7,400,000	1. Land acquisition and Compensation	m2	33.023	520,000	17,171,960
2. Compensation	m2	200	15,200	3,040,000	2. Compensation	m2	200	14,800	2,960,000	2. Compensation	m2	200	30,000	6,000,000
Sub-Total of IV					Sub-Total of IV					Sub-Total of IV				
12,812,000					10,360,000					23,172,000				
V Engineering Services (10% of I to III)														
3,946,000														
VI Gov. Administration (5% of I to IV)														
2,614,000														
VII Contingency (15% of I to VI)														
8,825,000														
TOTAL														
67,659,000														

Table 8.5 Construction Cost of Oued Maliyan

First Stage (for 10 yr Flood)		Second Stage (for 100 yr Flood)		Total of First and Second Stages			
Work Items	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)			1,065,000	I Preparatory Works (8% of II & III)			1,395,000
II River Improvement				II River Improvement			
1. Excavation, common	m3	5 927,000	4,635,000	1. Excavation, common	m3	5 1,317,600	6,588,000
2. Embankment, dike	m3	6 284,600	1,707,600	2. Embankment, dike	m3	6 557,000	3,342,000
3. Backfill	m3	4 0	0	3. Backfill	m3	4 0	0
4. Structural concrete	m3	80 0	0	4. Structural concrete	m3	80 0	0
5. Mass concrete	m3	65 0	0	5. Mass concrete	m3	65 0	0
6. Reinforcement steel bar	ton	1,000 0	0	6. Reinforcement steel bar	ton	1,000 0	0
7. Asphalt pavement	m2	2.5 3,000	7,500	7. Asphalt pavement	m2	2.5 3,000	7,500
8. Road bridge, RC-T	m2	850 2,000	1,700,000	8. Road bridge, RC-T	m2	850 2,000	1,700,000
9. Railway bridge	m	5,000 0	0	9. Railway bridge	m	5,000 0	0
10. Other crossing facilities	L.S.	-	170,000	10. Other crossing facilities	L.S.	-	170,000
11. Demolish of existing structure	m3	30 2,500	75,000	11. Demolish of existing structure	m3	30 2,500	75,000
12. Miscellaneous works (15%)	L.S.	-	1,244,000	12. Miscellaneous works (15%)	L.S.	-	1,782,000
Sub-Total of II			9,540,000	Sub-Total of II			13,665,000
III Hamma Dam (Allocated Cost) *			3,769,000	III Hamma Dam (Allocated Cost)			3,769,000
Total of I to III			14,374,000	Total of I to III			18,829,000
IV Land Acquisition and Compensation				IV Land Acquisition and Compensation			
1. Land acquisition	m2	1 920,000	920,000	1. Land acquisition	m2	1 1,082,000	1,082,000
2. Compensation	m2	200 1,780	356,000	2. Compensation	m2	200 1,780	356,000
Sub-Total of IV			1,276,000	Sub-Total of IV			1,438,000
V Engineering Services (10% of I to III)			1,437,000	V Engineering Services (10% of I to III)			1,883,000
VI Gov. Administration (5% of I to IV)			783,000	VI Gov. Administration (5% of I to IV)			1,014,000
VII Contingency (15% of I to VI)			2,681,000	VII Contingency (15% of I to VI)			3,475,000
TOTAL			20,551,000	TOTAL			26,639,000

Note * : Construction cost and land acquisition cost of Hamma Dam was estimated in the report of "BARRAGE SUR L'OUED EL HAMMA : ETUDE D'AVANT - PROJET, MOA, April 1990".

The cost is up-dated taking trend of consumer prices of recent 5 years into consideration and is allocated to flood control purpose.

Table 8.6 Construction Cost of Qued Mayzette

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages						
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)														
II River Improvement				211,000					198,000					409,000
1. Excavation, common	m3	5	80,000	400,000	1. Excavation, common	m3	5	70,500	352,500	1. Excavation, common	m3	5	150,500	752,500
2. Embankment, dike	m3	6	22,100	132,600	2. Embankment, dike	m3	6	5,500	33,000	2. Embankment, dike	m3	6	27,600	165,600
3. Backfill	m3	4	16,900	67,600	3. Backfill	m3	4	16,900	67,600	3. Backfill	m3	4	33,800	135,200
4. Structural concrete	m3	80	7,400	592,000	4. Structural concrete	m3	80	7,400	592,000	4. Structural concrete	m3	80	14,800	1,184,000
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	580	580,000	6. Reinforcement steel bar	ton	1,000	580	580,000	6. Reinforcement steel bar	ton	1,000	1,160	1,160,000
7. Asphalt pavement	m2	2.5	390	975	7. Asphalt pavement	m2	2.5	390	975	7. Asphalt pavement	m2	2.5	780	1,950
8. Road bridge, RC-T	m2	850	560	476,000	8. Road bridge, RC-T	m2	850	560	476,000	8. Road bridge, RC-T	m2	850	1,120	952,000
9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0
10. Other crossing facilities	L.S.	-	-	48,000	10. Other crossing facilities	L.S.	-	-	48,000	10. Other crossing facilities	L.S.	-	-	96,000
11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	0	0
12. Miscellaneous works (15%)	L.S.	-	-	345,000	12. Miscellaneous works (15%)	L.S.	-	-	323,000	12. Miscellaneous works (15%)	L.S.	-	-	668,000
Sub-Total of II				2,642,000	Sub-Total of II				2,473,000	Sub-Total of II				5,115,000
III Dam & Retarding Basin														
1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III				0	Sub-Total of III				0	Sub-Total of III				0
Total of I to III				2,853,000	Total of I to III				2,671,000	Total of I to III				5,524,000
IV Land Acquisition and Compensation														
1. Land acquisition	m2	15	15,500	232,500	1. Land acquisition	m2	15	15,500	232,500	1. Land acquisition	m2	15	31,000	465,000
2. Compensation	m2	200	500	100,000	2. Compensation	m2	200	500	100,000	2. Compensation	m2	200	1,000	200,000
Sub-Total of IV				333,000	Sub-Total of IV				333,000	Sub-Total of IV				665,000
V Engineering Services (10% of I to III)														
VI Gov. Administration (5% of I to IV)				150,000	V Engineering Services (10% of I to III)				267,000	VI Gov. Administration (5% of I to IV)				552,000
VII Contingency (15% of I to VI)				543,000	VI Gov. Administration (5% of I to IV)				150,000	VII Contingency (15% of I to VI)				309,000
TOTAL				4,173,000	VII Contingency (15% of I to VI)				512,000	TOTAL				8,108,000

Table 8.7 Construction Cost of Oued Bou Khamsa

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages						
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)				198,000	I Preparatory Works (8% of II & III)				177,000	I Preparatory Works (8% of II & III)				375,000
II River Improvement				256,500	II River Improvement				255,500	II River Improvement				512,000
1. Excavation, common	m3	5	51,300	0	1. Excavation, common	m3	5	51,100	0	1. Excavation, common	m3	5	102,400	512,000
2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0
3. Backfill	m3	4	20,700	82,800	3. Backfill	m3	4	20,400	81,600	3. Backfill	m3	4	41,100	164,400
4. Structural concrete	m3	80	8,400	672,000	4. Structural concrete	m3	80	8,400	672,000	4. Structural concrete	m3	80	16,800	1,344,000
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	900	900,000	6. Reinforcement steel bar	ton	1,000	900	900,000	6. Reinforcement steel bar	ton	1,000	1,800	1,800,000
7. Asphalt pavement	m2	2.5	7,700	19,250	7. Asphalt pavement	m2	2.5	7,700	19,250	7. Asphalt pavement	m2	2.5	15,400	38,500
8. Road bridge, RC-T	m2	850	140	119,000	8. Road bridge, RC-T	m2	850	0	0	8. Road bridge, RC-T	m2	850	140	119,000
9. Railway bridge	m	5,000	17	82,500	9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	17	82,500
10. Other crossing facilities	L.S.	-	-	12,000	10. Other crossing facilities	L.S.	-	-	0	10. Other crossing facilities	L.S.	-	-	12,000
11. Demolish of existing structure	m3	30	280	8,400	11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	280	8,400
12. Miscellaneous works (15%)	L.S.	-	-	323,000	12. Miscellaneous works (15%)	L.S.	-	-	290,000	12. Miscellaneous works (15%)	L.S.	-	-	612,000
Sub-Total of II				2,475,000	Sub-Total of II				2,218,000	Sub-Total of II				4,693,000
III Dam & Retarding Basin				0	III Dam & Retarding Basin				0	III Dam & Retarding Basin				0
1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain GROUT	t	150	0	0	8. Curtain GROUT	t	150	0	0	8. Curtain GROUT	t	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III				0	Sub-Total of III				0	Sub-Total of III				0
Total of I to III				2,673,000	Total of I to III				2,395,000	Total of I to III				5,068,000
IV Land Acquisition and Compensation				96,000	IV Land Acquisition and Compensation				95,000	IV Land Acquisition and Compensation				192,000
1. Land acquisition	m2	15	6,400	96,000	1. Land acquisition	m2	15	6,400	95,000	1. Land acquisition	m2	15	12,800	192,000
2. Compensation	m2	200	1,000	200,000	2. Compensation	m2	200	1,000	200,000	2. Compensation	m2	200	2,000	400,000
Sub-Total of IV				295,000	Sub-Total of IV				295,000	Sub-Total of IV				592,000
V Engineering Services (10% of I to III)				267,000	V Engineering Services (10% of I to III)				240,000	V Engineering Services (10% of I to III)				507,000
VI Gov. Administration (5% of I to IV)				148,000	VI Gov. Administration (5% of I to IV)				135,000	VI Gov. Administration (5% of I to IV)				283,000
VII Contingency (15% of I to VI)				508,000	VII Contingency (15% of I to VI)				460,000	VII Contingency (15% of I to VI)				968,000
TOTAL				3,892,000	TOTAL				3,526,000	TOTAL				7,418,000

Table 8.8 Construction Cost of Qued Ain Zerga

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages			
Work Items	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)			131,000	I Preparatory Works (8% of II & III)			121,000	I Preparatory Works (8% of II & III)			252,000
II River Improvement			148,500	II River Improvement			162,000	II River Improvement			310,500
1. Excavation, common	m3	5	29,700	1. Excavation, common	m3	5	32,400	1. Excavation, common	m3	5	62,100
2. Embankment, dike	m3	6	0	2. Embankment, dike	m3	6	0	2. Embankment, dike	m3	6	0
3. Backfill	m3	4	9,200	3. Backfill	m3	4	14,600	3. Backfill	m3	4	23,800
4. Structural concrete	m3	80	1,500	4. Structural concrete	m3	80	7,200	4. Structural concrete	m3	80	8,700
5. Mass concrete	m3	65	0	5. Mass concrete	m3	65	0	5. Mass concrete	m3	65	0
6. Reinforcement steel bar	ton	1,000	120	6. Reinforcement steel bar	ton	1,000	520	6. Reinforcement steel bar	ton	1,000	640
7. Asphalt pavement	m2	2.5	2,750	7. Asphalt pavement	m2	2.5	0	7. Asphalt pavement	m2	2.5	2,750
8. Road bridge, RC-T	m2	850	540	8. Road bridge, RC-T	m2	850	0	8. Road bridge, RC-T	m2	850	540
9. Railway bridge	m	5,000	14	9. Railway bridge	m	5,000	0	9. Railway bridge	m	5,000	14
10. Other crossing facilities	L.S.	-	46,000	10. Other crossing facilities	L.S.	-	0	10. Other crossing facilities	L.S.	-	46,000
11. Demolish of existing structure	m3	30	1,500	11. Demolish of existing structure	m3	30	0	11. Demolish of existing structure	m3	30	1,500
12. Miscellaneous works (15%)	L.S.	-	150,700	12. Miscellaneous works (15%)	L.S.	-	197,500	12. Miscellaneous works (15%)	L.S.	-	348,200
Sub-Total of II			1,156,000	Sub-Total of II			1,514,000	Sub-Total of II			2,670,000
III Dam & Retarding Basin			35,500	III Dam & Retarding Basin			0	III Dam & Retarding Basin			35,500
1. Excavation, common	m3	5	7,100	1. Excavation, common	m3	5	0	1. Excavation, common	m3	5	7,100
2. Embankment, dike	m3	7	31,300	2. Embankment, dike	m3	7	0	2. Embankment, dike	m3	7	31,300
3. Riprap	m3	20	1,100	3. Riprap	m3	20	0	3. Riprap	m3	20	1,100
4. Structural concrete	m3	80	500	4. Structural concrete	m3	80	0	4. Structural concrete	m3	80	500
5. Mass concrete	m3	65	0	5. Mass concrete	m3	65	0	5. Mass concrete	m3	65	0
6. Reinforcement steel bar	ton	1,000	40	6. Reinforcement steel bar	ton	1,000	0	6. Reinforcement steel bar	ton	1,000	40
7. Sodding	m2	1	2,100	7. Sodding	m2	1	0	7. Sodding	m2	1	2,100
8. Curtain Groat	t	150	55,500	8. Curtain Groat	t	150	0	8. Curtain Groat	t	150	55,500
9. Miscellaneous works (15%)	L.S.	-	62,200	9. Miscellaneous works (15%)	L.S.	-	0	9. Miscellaneous works (15%)	L.S.	-	62,200
Sub-Total of III			477,000	Sub-Total of III			0	Sub-Total of III			477,000
Total of I to III			1,764,000	Total of I to III			1,635,000	Total of I to III			3,399,000
IV Land Acquisition and Compensation			198,000	IV Land Acquisition and Compensation			12,000	IV Land Acquisition and Compensation			210,000
1. Land acquisition	m2	30	6,600	1. Land acquisition	m2	30	400	1. Land acquisition	m2	30	7,000
2. Compensation	m2	200	0	2. Compensation	m2	200	0	2. Compensation	m2	200	0
Sub-Total of IV			198,000	Sub-Total of IV			12,000	Sub-Total of IV			210,000
V Engineering Services (10% of I to III)			177,000	V Engineering Services (10% of I to III)			163,000	V Engineering Services (10% of I to III)			340,000
VI Gov. Administration (5% of I to IV)			99,000	VI Gov. Administration (5% of I to IV)			82,000	VI Gov. Administration (5% of I to IV)			181,000
VII Contingency (15% of I to VI)			336,000	VII Contingency (15% of I to VI)			284,000	VII Contingency (15% of I to VI)			620,000
TOTAL			2,574,000	TOTAL			2,176,000	TOTAL			4,750,000

Table 8.9 Construction Cost of Oued Hammam

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages						
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)														
II River Improvement				333,000					30,000					363,000
1. Excavation, common	m3	5	218,500	1,092,500	1. Excavation, common	m3	5	218,500	1,092,500	1. Excavation, common	m3	5	218,500	1,092,500
2. Embankment, dike	m3	6	26,200	157,200	2. Embankment, dike	m3	6	54,000	324,000	2. Embankment, dike	m3	6	80,200	481,200
3. Backfill	m3	4	0	0	3. Backfill	m3	4	0	0	3. Backfill	m3	4	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Asphalt pavement	m2	2.5	5,000	12,500	7. Asphalt pavement	m2	2.5	0	0	7. Asphalt pavement	m2	2.5	5,000	12,500
8. Road bridge, RC-T	m2	850	2,500	2,125,000	8. Road bridge, RC-T	m2	850	0	0	8. Road bridge, RC-T	m2	850	2,500	2,125,000
9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0
10. Other crossing facilities	L.S.	-	-	213,000	10. Other crossing facilities	L.S.	-	-	0	10. Other crossing facilities	L.S.	-	-	213,000
11. Demolish of existing structure	m3	30	500	15,000	11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	500	15,000
12. Miscellaneous works (15%)	L.S.	-	-	542,300	12. Miscellaneous works (15%)	L.S.	-	-	48,600	12. Miscellaneous works (15%)	L.S.	-	-	590,900
Sub-Total of II				4,158,000	Sub-Total of II				373,000	Sub-Total of II				4,531,000
III Dam & Retarding Basin														
1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain GROUT	t	150	0	0	8. Curtain GROUT	t	150	0	0	8. Curtain GROUT	t	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III				0	Sub-Total of III				0	Sub-Total of III				0
Total of I to III				4,491,000	Total of I to III				403,000	Total of I to III				4,894,000
IV Land Acquisition and Compensation														
1. Land acquisition	m2	15	19,700	295,500	1. Land acquisition	m2	15	11,900	178,500	1. Land acquisition	m2	15	31,600	474,000
2. Compensation	m2	200	0	0	2. Compensation	m2	200	0	0	2. Compensation	m2	200	0	0
Sub-Total of IV				295,500	Sub-Total of IV				178,500	Sub-Total of IV				474,000
V Engineering Services (10% of I to III)														
				450,000					40,000					490,000
VI Gov. Administration (5% of I to IV)														
				240,000					29,000					269,000
VII Contingency (15% of I to VI)														
				822,000					98,000					920,000
TOTAL				6,299,000	TOTAL				748,000	TOTAL				7,047,000

Table 8.10 Construction Cost of Qued Bilibere

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages						
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of II & III)				243,000	I Preparatory Works (8% of II & III)				3,000	I Preparatory Works (8% of II & III)				246,000
II River Improvement					II River Improvement					II River Improvement				
1. Excavation, common	m3	5	28,600	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	28,600	143,000
2. Embankment, dike	m3	6	300	1,800	2. Embankment, dike	m3	6	400	2,400	2. Embankment, dike	m3	6	700	4,200
3. Backfill	m3	4	0	0	3. Backfill	m3	4	0	0	3. Backfill	m3	4	0	0
4. Structural concrete	m3	80	2,800	224,000	4. Structural concrete	m3	80	200	16,000	4. Structural concrete	m3	80	3,000	240,000
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	200	200,000	6. Reinforcement steel bar	ton	1,000	20	20,000	6. Reinforcement steel bar	ton	1,000	220	220,000
7. Asphalt pavement	m2	2.5	4,400	11,000	7. Asphalt pavement	m2	2.5	0	0	7. Asphalt pavement	m2	2.5	4,400	11,000
8. Road bridge, RC-T	m2	850	2,190	1,861,500	8. Road bridge, RC-T	m2	850	0	0	8. Road bridge, RC-T	m2	850	2,190	1,861,500
9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0
10. Other crossing facilities	L.S.	-	-	187,000	10. Other crossing facilities	L.S.	-	-	0	10. Other crossing facilities	L.S.	-	-	187,000
11. Demolish of existing structure	m3	30	200	6,000	11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	200	6,000
12. Miscellaneous works (15%)	L.S.	-	-	395,200	12. Miscellaneous works (15%)	L.S.	-	-	5,800	12. Miscellaneous works (15%)	L.S.	-	-	401,000
Sub-Total of II				3,030,000	Sub-Total of II				44,000	Sub-Total of II				3,074,000
III Dam & Retarding Basin					III Dam & Retarding Basin					III Dam & Retarding Basin				
1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain Grout	l	150	0	0	8. Curtain Grout	l	150	0	0	8. Curtain Grout	l	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III				0	Sub-Total of III				0	Sub-Total of III				0
Total of I to III				3,273,000	Total of I to III				47,000	Total of I to III				3,320,000
IV Land Acquisition and Compensation					IV Land Acquisition and Compensation					IV Land Acquisition and Compensation				
1. Land acquisition	m2	40	1,800	72,000	1. Land acquisition	m2	40	200	8,000	1. Land acquisition	m2	40	2,000	80,000
2. Compensation	m2	200	200	40,000	2. Compensation	m2	200	0	0	2. Compensation	m2	200	200	40,000
Sub-Total of IV				112,000	Sub-Total of IV				8,000	Sub-Total of IV				120,000
V Engineering Services (10% of I to III)				328,000	V Engineering Services (10% of I to III)				4,000	V Engineering Services (10% of I to III)				332,000
VI Gov. Administration (5% of I to IV)				170,000	VI Gov. Administration (5% of I to IV)				2,000	VI Gov. Administration (5% of I to IV)				172,000
VII Contingency (15% of I to VI)				583,000	VII Contingency (15% of I to VI)				9,000	VII Contingency (15% of I to VI)				592,000
TOTAL				4,466,000	TOTAL				70,000	TOTAL				4,536,000

Table 8.11 Construction Cost of Oued Hallouf

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages						
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of I & II)														
II River Improvement														
1. Excavation, common	m3	5	99,900	499,500	1. Excavation, common	m3	5	94,600	473,000	1. Excavation, common	m3	5	194,500	972,500
2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0
3. Backfill	m3	4	57,900	231,600	3. Backfill	m3	4	20,600	82,400	3. Backfill	m3	4	78,500	314,000
4. Structural concrete	m3	80	6,300	504,000	4. Structural concrete	m3	80	6,700	536,000	4. Structural concrete	m3	80	13,000	1,040,000
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	610	610,000	6. Reinforcement steel bar	ton	1,000	660	660,000	6. Reinforcement steel bar	ton	1,000	1,270	1,270,000
7. Asphalt pavement	m2	2.5	13,000	32,500	7. Asphalt pavement	m2	2.5	4,000	10,000	7. Asphalt pavement	m2	2.5	17,000	42,500
8. Road bridge, RC-T	m2	850	2,700	2,295,000	8. Road bridge, RC-T	m2	850	0	0	8. Road bridge, RC-T	m2	850	2,700	2,295,000
9. Railway bridge	m	5,000	90	450,000	9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	90	450,000
10. Other crossing facilities	L.S.	-	-	230,000	10. Other crossing facilities	L.S.	-	-	0	10. Other crossing facilities	L.S.	-	-	230,000
11. Demolish of existing structure	m3	30	440	13,200	11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	440	13,200
12. Miscellaneous works (15%)	L.S.	-	-	730,000	12. Miscellaneous works (15%)	L.S.	-	-	264,000	12. Miscellaneous works (15%)	L.S.	-	-	994,000
Sub-Total of II				5,596,000	Sub-Total of II				2,025,000	Sub-Total of II				7,621,000
III Dam & Retarding Basin														
1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III				0	Sub-Total of III				0	Sub-Total of III				0
Total of I to III				6,044,000	Total of I to III				2,187,000	Total of I to III				8,231,000
IV Land Acquisition and Compensation														
1. Land acquisition	m2	40	30,900	1,236,000	1. Land acquisition	m2	40	14,300	572,000	1. Land acquisition and Compensation	m2	40	45,200	1,808,000
2. Compensation	m2	200	1,000	200,000	2. Compensation	m2	200	1,000	200,000	2. Compensation	m2	200	2,000	400,000
Sub-Total of IV				1,436,000	Sub-Total of IV				772,000	Sub-Total of IV				2,208,000
V Engineering Services (10% of I to III)														
VI Gov. Administration (5% of I to IV)				374,000	V Engineering Services (10% of I to III)				219,000	V Engineering Services (10% of I to III)				823,000
VII Contingency (15% of I to VI)				1,269,000	VI Gov. Administration (5% of I to IV)				148,000	VI Gov. Administration (5% of I to IV)				522,000
TOTAL				9,727,000	VII Contingency (15% of I to VI)				499,000	VII Contingency (15% of I to VI)				1,768,000
					TOTAL				3,825,000	TOTAL				13,552,000

Table 8.12 Construction Cost of Oued Hamdoun

First Stage (for 10 yr Flood)				Second Stage (for 100 yr Flood)				Total of First and Second Stages						
Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)	Work Items	Unit	Unit Price (DT)	Volume	Amount (DT)
I Preparatory Works (8% of I to III)				340,000	I Preparatory Works (8% of II & III)				211,000	I Preparatory Works (8% of II & III)				541,000
II River Improvement					II River Improvement					II River Improvement				
1. Excavation, common	m3	5	361,200	1,806,000	1. Excavation, common	m3	5	459,100	2,295,500	1. Excavation, common	m3	5	820,300	4,101,500
2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0	2. Embankment, dike	m3	6	0	0
3. Backfill	m3	4	0	0	3. Backfill	m3	4	0	0	3. Backfill	m3	4	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Asphalt pavement	m2	2.5	3,800	9,500	7. Asphalt pavement	m2	2.5	0	0	7. Asphalt pavement	m2	2.5	3,800	9,500
8. Road bridge, RC-T	m2	850	1,880	1,598,000	8. Road bridge, RC-T	m2	850	0	0	8. Road bridge, RC-T	m2	850	1,880	1,598,000
9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0	9. Railway bridge	m	5,000	0	0
10. Other crossing facilities	L.S.	-	-	160,000	10. Other crossing facilities	L.S.	-	-	0	10. Other crossing facilities	L.S.	-	-	160,000
11. Demolish of existing structure	m3	30	120	3,600	11. Demolish of existing structure	m3	30	0	0	11. Demolish of existing structure	m3	30	120	3,600
12. Miscellaneous works (15%)	L.S.	-	-	536,600	12. Miscellaneous works (15%)	L.S.	-	-	344,300	12. Miscellaneous works (15%)	L.S.	-	-	880,900
Sub-Total of II				4,114,000	Sub-Total of II				2,640,000	Sub-Total of II				6,754,000
III Dam & Retarding Basin					III Dam & Retarding Basin					III Dam & Retarding Basin				
1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0	1. Excavation, common	m3	5	0	0
2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0	2. Embankment, dike	m3	7	0	0
3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0	3. Riprap	m3	20	0	0
4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0	4. Structural concrete	m3	80	0	0
5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0	5. Mass concrete	m3	65	0	0
6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0	6. Reinforcement steel bar	ton	1,000	0	0
7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0	7. Sodding	m2	1	0	0
8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0	8. Curtain Grout	t	150	0	0
9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0	9. Miscellaneous works (15%)	L.S.	-	-	0
Sub-Total of III				0	Sub-Total of III				0	Sub-Total of III				0
Total of I to III				4,444,000	Total of I to III				2,851,000	Total of I to III				7,295,000
IV Land Acquisition and Compensation					IV Land Acquisition and Compensation					IV Land Acquisition and Compensation				
1. Land acquisition	m2	30	0	0	1. Land acquisition	m2	30	0	0	1. Land acquisition	m2	30	0	0
2. Compensation	m2	200	0	0	2. Compensation	m2	200	0	0	2. Compensation	m2	200	0	0
Sub-Total of IV				0	Sub-Total of IV				0	Sub-Total of IV				0
V Engineering Services (10% of I to III)				445,000	V Engineering Services (10% of I to III)				285,000	V Engineering Services (10% of I to III)				730,000
VI Gov. Administration (5% of I to IV)				223,000	VI Gov. Administration (5% of I to IV)				142,000	VI Gov. Administration (5% of I to IV)				365,000
VII Contingency (15% of I to VI)				767,000	VII Contingency (15% of I to VI)				492,000	VII Contingency (15% of I to VI)				1,259,000
TOTAL				5,879,000	TOTAL				3,770,000	TOTAL				9,649,000

Table 9.1 Cost Benefit Streams for Oued Ennkhlilet

EIRR = 12%		(Unit : 1,000 DT)						
No.	Year	Cost				Benefit		Net Benefit
		River	Drain	River+Drain	O&M	Total	Total	
1	1995	2,167	209	2,376	0	2,376	0	-2,376
2	1996	2,167	209	2,376	12	2,388	390	-1,997
3	1997	2,167	209	2,376	24	2,399	781	-1,619
4	1998	2,167	209	2,376	36	2,411	1,171	-1,240
5	1999	2,167	209	2,376	48	2,423	1,562	-862
6	2000	2,167	209	2,376	59	2,435	1,952	-483
7	2001	2,167	209	2,376	71	2,447	2,031	-416
8	2002	2,167	209	2,376	83	2,459	2,110	-349
9	2003	2,167	209	2,376	95	2,471	2,189	-282
10	2004	2,167	209	2,376	107	2,483	2,268	-215
11	2005	1,513	209	1,722	119	1,841	2,347	506
12	2006		209	209	127	336	2,426	2,090
13	2007		209	209	128	337	2,505	2,168
14	2008		209	209	129	338	2,584	2,246
15	2009		209	209	131	339	2,663	2,324
16	2010		209	209	132	340	2,742	2,402
17	2011		209	209	133	341	2,821	2,480
18	2012		209	209	134	342	2,900	2,558
19	2013		209	209	135	343	2,979	2,635
20	2014		209	209	136	344	3,058	2,713
21	2015		209	209	137	345	3,137	2,791
22	2016		209	209	138	346	3,216	2,869
23	2017		209	209	139	347	3,295	2,947
24	2018		209	209	140	348	3,374	3,025
25	2019		209	209	141	349	3,453	3,103
26	2020		209	209	142	351	3,532	3,181
27	2021				143	143	3,611	3,468
28	2022				143	143	3,611	3,468
29	2023				143	143	3,611	3,468
30	2024				143	143	3,611	3,468
31	2025				143	143	3,611	3,468
32	2026				143	143	3,611	3,468
33	2027				143	143	3,611	3,468
34	2028				143	143	3,611	3,468
35	2029				143	143	3,611	3,468
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50	2044				143	143	3,611	3,468

Table 9.2 Cost Benefit Streams for Oued Greb

EIRR = 8%		(Unit : 1,000 DT)						
No.	Year	Cost				Benefit		Net Benefit
		River	Drain	River+Drain	O&M	Total	Total	
1	1995	802	351	1,152	0	1,152	0	-1,152
2	1996	802	351	1,152	6	1,158	149	-1,009
3	1997	802	351	1,152	12	1,164	298	-866
4	1998	802	351	1,152	17	1,170	447	-723
5	1999	802	351	1,152	23	1,175	596	-579
6	2000	802	351	1,152	29	1,181	745	-436
7	2001	802	351	1,152	35	1,187	806	-381
8	2002	802	351	1,152	40	1,193	866	-326
9	2003	802	351	1,152	46	1,198	927	-271
10	2004	802	351	1,152	52	1,204	988	-216
11	2005	802	351	1,152	58	1,210	1,049	-161
12	2006	802	351	1,152	63	1,216	1,109	-106
13	2007	802	351	1,152	69	1,222	1,170	-51
14	2008	802	351	1,152	75	1,227	1,231	4
15	2009	802	351	1,152	81	1,233	1,292	58
16	2010	802	351	1,152	86	1,239	1,352	113
17	2011	226	351	577	92	669	1,413	744
18	2012		351	351	95	446	1,474	1,028
19	2013		351	351	97	448	1,534	1,087
20	2014		351	351	99	449	1,595	1,146
21	2015		351	351	100	451	1,656	1,205
22	2016		351	351	102	453	1,717	1,264
23	2017		351	351	104	455	1,777	1,323
24	2018		351	351	106	456	1,838	1,382
25	2019		351	351	107	458	1,899	1,441
26	2020		351	351	109	460	1,960	1,500
27	2021				111	111	2,020	1,909
28	2022				111	111	2,020	1,909
29	2023				111	111	2,020	1,909
30	2024				111	111	2,020	1,909
31	2025				111	111	2,020	1,909
32	2026				111	111	2,020	1,909
33	2027				111	111	2,020	1,909
34	2028				111	111	2,020	1,909
35	2029				111	111	2,020	1,909
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50	2044				111	111	2,020	1,909

Table 9.3 Cost Benefit Streams for Oued Gariana

ERR = 4% (Unit : 1,000 DT)

No.	Year	Cost				Total	Benefit		Net Benefit
		River	Drain	River+Drain	O&M		Benefit	Benefit	
1	1995	10,520	1,433	11,953	0	11,953	0	-11,953	
2	1996	10,520	1,433	11,953	60	12,013	956	-11,057	
3	1997	10,520	1,433	11,953	120	12,073	1,912	-10,161	
4	1998	10,520	1,433	11,953	179	12,132	2,867	-9,265	
5	1999	10,520	1,433	11,953	239	12,192	3,823	-8,369	
6	2000	10,520	1,433	11,953	299	12,252	4,779	-7,473	
7	2001	10,520	1,433	11,953	359	12,312	4,863	-7,449	
8	2002	10,520	1,433	11,953	418	12,372	4,947	-7,425	
9	2003	10,465	1,433	11,898	478	12,376	5,031	-7,345	
10	2004		1,433	1,433	538	1,971	5,115	3,144	
11	2005		1,433	1,433	545	1,978	5,199	3,221	
12	2006		1,433	1,433	552	1,985	5,283	3,298	
13	2007		1,433	1,433	559	1,992	5,367	3,375	
14	2008		1,433	1,433	566	1,999	5,451	3,451	
15	2009		1,433	1,433	573	2,006	5,535	3,528	
16	2010		1,433	1,433	581	2,014	5,619	3,605	
17	2011		1,433	1,433	588	2,021	5,703	3,682	
18	2012		1,433	1,433	595	2,028	5,787	3,759	
19	2013		1,433	1,433	602	2,035	5,871	3,835	
20	2014		1,433	1,433	609	2,042	5,954	3,912	
21	2015		1,433	1,433	616	2,049	6,038	3,989	
22	2016		1,433	1,433	624	2,057	6,122	4,066	
23	2017		1,433	1,433	631	2,064	6,206	4,143	
24	2018		1,433	1,433	638	2,071	6,290	4,219	
25	2019		1,433	1,433	645	2,078	6,374	4,296	
26	2020		1,433	1,433	652	2,085	6,458	4,373	
27	2021				659	659	6,542	5,883	
28	2022				659	659	6,542	5,883	
29	2023				659	659	6,542	5,883	
30	2024				659	659	6,542	5,883	
31	2025				659	659	6,542	5,883	
32	2026				659	659	6,542	5,883	
33	2027				659	659	6,542	5,883	
34	2028				659	659	6,542	5,883	
35	2029				659	659	6,542	5,883	
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•	•				•	•	•	•	
50	2044				659	659	6,542	5,883	

Table 9.4 Cost Benefit Streams for Oued Maliyan

ERR = 12% (Unit : 1,000 DT)

No.	Year	Cost				Total	Benefit		Net Benefit
		River	Drain	River+Drain	O&M		Benefit	Benefit	
1	1995	3,150	588	3,738	0	3,738	0	-3,738	
2	1996	3,150	588	3,738	19	3,757	389	-3,368	
3	1997	3,150	588	3,738	37	3,776	778	-2,998	
4	1998	3,150	588	3,738	56	3,794	1,167	-2,627	
5	1999	3,150	588	3,738	75	3,813	1,556	-2,257	
6	2000	3,150	588	3,738	93	3,832	1,945	-1,887	
7	2001	3,150	588	3,738	112	3,850	2,225	-1,626	
8	2002	2,426	588	3,015	131	3,146	2,504	-642	
9	2003		588	588	146	734	2,784	2,049	
10	2004		588	588	149	737	3,063	2,326	
11	2005		588	588	152	740	3,343	2,602	
12	2006		588	588	155	743	3,622	2,879	
13	2007		588	588	158	746	3,902	3,156	
14	2008		588	588	161	749	4,181	3,432	
15	2009		588	588	164	752	4,461	3,709	
16	2010		588	588	167	755	4,740	3,985	
17	2011		588	588	169	758	5,020	4,262	
18	2012		588	588	172	761	5,299	4,539	
19	2013		588	588	175	764	5,579	4,815	
20	2014		588	588	178	767	5,859	5,092	
21	2015		588	588	181	770	6,138	5,368	
22	2016		588	588	184	773	6,418	5,645	
23	2017		588	588	187	776	6,697	5,922	
24	2018		588	588	190	779	6,977	6,198	
25	2019		588	588	193	781	7,256	6,475	
26	2020		588	588	196	784	7,536	6,751	
27	2021				199	199	7,815	7,616	
28	2022				199	199	7,815	7,616	
29	2023				199	199	7,815	7,616	
30	2024				199	199	7,815	7,616	
31	2025				199	199	7,815	7,616	
32	2026				199	199	7,815	7,616	
33	2027				199	199	7,815	7,616	
34	2028				199	199	7,815	7,616	
35	2029				199	199	7,815	7,616	
•	•				•	•	•	•	
•	•				•	•	•	•	
•	•				•	•	•	•	
50	2044				199	199	7,815	7,616	

Table 9.5 Cost Benefit Streams for Oued Mayzette

No.	Year	Cost				Total	Benefit		Net
		River	Drain	River+Drain	O&M		Benefit	Benefit	
1	1995	641	83	724	0	724	0	-724	
2	1996	641	83	724	4	728	93	-635	
3	1997	641	83	724	7	732	185	-546	
4	1998	641	83	724	11	735	278	-457	
5	1999	641	83	724	14	739	370	-368	
6	2000	641	83	724	18	742	463	-279	
7	2001	641	83	724	22	746	500	-246	
8	2002	641	83	724	25	750	538	-212	
9	2003	641	83	724	29	753	575	-178	
10	2004	641	83	724	33	757	613	-144	
11	2005	641	83	724	36	760	650	-110	
12	2006	421	83	504	40	544	687	143	
13	2007		83	83	42	125	725	599	
14	2008		83	83	43	126	762	636	
15	2009		83	83	43	126	800	673	
16	2010		83	83	44	127	837	710	
17	2011		83	83	44	127	874	747	
18	2012		83	83	44	128	912	784	
19	2013		83	83	45	128	949	821	
20	2014		83	83	45	128	987	858	
21	2015		83	83	46	129	1,024	895	
22	2016		83	83	46	129	1,061	932	
23	2017		83	83	47	130	1,099	969	
24	2018		83	83	47	130	1,136	1,006	
25	2019		83	83	47	130	1,174	1,043	
26	2020		83	83	48	131	1,211	1,080	
27	2021				48	48	1,248	1,200	
28	2022				48	48	1,248	1,200	
29	2023				48	48	1,248	1,200	
30	2024				48	48	1,248	1,200	
31	2025				48	48	1,248	1,200	
32	2026				48	48	1,248	1,200	
33	2027				48	48	1,248	1,200	
34	2028				48	48	1,248	1,200	
35	2029				48	48	1,248	1,200	
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.	
50	2044				48	48	1,248	1,200	

Table 9.6 Cost Benefit Streams for Oued Bou Khamsa

No.	Year	Cost				Total	Benefit		Net
		River	Drain	River+Drain	O&M		Benefit	Benefit	
1	1995	598	95	693	0	693	0	-693	
2	1996	598	95	693	3	696	96	-600	
3	1997	598	95	693	7	700	192	-507	
4	1998	598	95	693	10	703	289	-415	
5	1999	598	95	693	14	707	385	-322	
6	2000	598	95	693	17	710	481	-229	
7	2001	598	95	693	21	714	491	-223	
8	2002	598	95	693	24	717	501	-216	
9	2003	598	95	693	28	721	511	-210	
10	2004	598	95	693	31	724	521	-203	
11	2005	598	95	693	35	728	531	-196	
12	2006	263		358	38	396	541	145	
13	2007		95	95	40	135	551	416	
14	2008		95	95	40	136	561	425	
15	2009		95	95	41	136	571	435	
16	2010		95	95	41	137	581	445	
17	2011		95	95	42	137	591	454	
18	2012		95	95	42	138	601	464	
19	2013		95	95	43	138	611	473	
20	2014		95	95	43	139	621	483	
21	2015		95	95	44	139	631	492	
22	2016		95	95	44	140	641	502	
23	2017		95	95	45	140	652	511	
24	2018		95	95	45	141	662	521	
25	2019		95	95	46	141	672	531	
26	2020		95	95	46	141	682	540	
27	2021				47	47	692	645	
28	2022				47	47	692	645	
29	2023				47	47	692	645	
30	2024				47	47	692	645	
31	2025				47	47	692	645	
32	2026				47	47	692	645	
33	2027				47	47	692	645	
34	2028				47	47	692	645	
35	2029				47	47	692	645	
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50	2044				47	47	692	645	

Table 9.7 Cost Benefit Streams for Oued Ain Zerga

No.	Year	Cost					Total	Net	
		River	Drain	River+Drain		O&M		Benefit	Benefit
				River	Drain				
1	1995	395	24	419	0	419	0	-419	
2	1996	395	24	419	2	421	62	-359	
3	1997	395	24	419	4	423	123	-300	
4	1998	395	24	419	6	425	185	-240	
5	1999	395	24	419	8	427	246	-181	
6	2000	395	24	419	10	429	308	-121	
7	2001	395	24	419	13	432	321	-110	
8	2002	395	24	419	15	434	334	-99	
9	2003	395	24	419	17	436	348	-88	
10	2004	395	24	419	19	438	361	-77	
11	2005	412	24	419	21	440	374	-66	
12	2006		24	41	23	64	387	323	
13	2007		24	24	23	48	401	353	
14	2008		24	24	23	48	414	366	
15	2009		24	24	23	48	427	379	
16	2010		24	24	24	48	440	393	
17	2011		24	24	24	48	454	406	
18	2012		24	24	24	48	467	419	
19	2013		24	24	24	48	480	432	
20	2014		24	24	24	48	493	445	
21	2015		24	24	24	48	507	458	
22	2016		24	24	24	49	520	471	
23	2017		24	24	24	49	533	484	
24	2018		24	24	25	49	546	497	
25	2019		24	24	25	49	560	511	
26	2020		24	24	25	49	573	524	
27	2021				25	25	586	561	
28	2022				25	25	586	561	
29	2023				25	25	586	561	
30	2024				25	25	586	561	
31	2025				25	25	586	561	
32	2026				25	25	586	561	
33	2027				25	25	586	561	
34	2028				25	25	586	561	
35	2029				25	25	586	561	
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50	2044				25	25	586	561	

Table 9.8 Cost Benefit Streams for Oued Hammam

No.	Year	Cost					Total	Net	
		River	Drain	River+Drain		O&M		Benefit	Benefit
				River	Drain				
1	1995	963	524	1,487	0	1,487	0	-1,487	
2	1996	963	524	1,487	7	1,494	327	-1,167	
3	1997	963	524	1,487	15	1,502	655	-847	
4	1998	963	524	1,487	22	1,509	982	-527	
5	1999	963	524	1,487	30	1,517	1,310	-207	
6	2000	963	524	1,487	37	1,524	1,637	113	
7	2001	702	524	1,226	45	1,270	1,704	434	
8	2002		524	262	51	313	1,772	1,459	
9	2003		524	524	52	576	1,839	1,263	
10	2004		524	524	55	578	1,906	1,328	
11	2005		524	524	57	581	1,974	1,393	
12	2006		524	524	60	583	2,041	1,458	
13	2007		524	524	63	586	2,108	1,522	
14	2008		524	524	65	589	2,176	1,587	
15	2009		524	524	68	591	2,243	1,652	
16	2010		524	524	70	594	2,311	1,717	
17	2011		524	524	73	597	2,378	1,781	
18	2012		524	524	76	599	2,445	1,846	
19	2013		524	524	78	602	2,513	1,911	
20	2014		524	524	81	604	2,580	1,976	
21	2015		524	524	83	607	2,647	2,040	
22	2016		524	524	86	610	2,715	2,105	
23	2017		524	524	89	612	2,782	2,170	
24	2018		524	524	91	615	2,849	2,234	
25	2019		524	524	94	617	2,917	2,299	
26	2020		524	524	97	620	2,984	2,364	
27	2021				99	99	3,051	2,952	
28	2022				99	99	3,051	2,952	
29	2023				99	99	3,051	2,952	
30	2024				99	99	3,051	2,952	
31	2025				99	99	3,051	2,952	
32	2026				99	99	3,051	2,952	
33	2027				99	99	3,051	2,952	
34	2028				99	99	3,051	2,952	
35	2029				99	99	3,051	2,952	
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50	2044				99	99	3,051	2,952	

Table 9.9 Cost Benefit Streams for Oued Bilibene

(Unit : 1,000 DT)

No.	Year	Cost				Benefit	Net
		River	Drain	River+Drain	O&M		
1	1995	681	153	834	0	834	0
2	1996	681	153	834	66	838	-772
3	1997	681	153	834	133	843	-710
4	1998	681	153	834	199	847	-648
5	1999	681	153	834	266	851	-585
6	2000	750	153	903	332	924	-592
7	2001		153	153	340	179	161
8	2002		153	153	348	179	168
9	2003		153	153	355	180	175
10	2004		153	153	363	181	182
11	2005		153	153	371	182	189
12	2006		153	153	379	182	196
13	2007		153	153	387	183	203
14	2008		153	153	395	184	211
15	2009		153	153	402	185	218
16	2010		153	153	410	186	225
17	2011		153	153	418	186	232
18	2012		153	153	426	187	239
19	2013		153	153	434	188	246
20	2014		153	153	441	189	253
21	2015		153	153	449	189	260
22	2016		153	153	457	190	267
23	2017		153	153	465	191	274
24	2018		153	153	473	192	281
25	2019		153	153	481	192	288
26	2020		153	153	488	193	295
27	2021				496	41	456
28	2022				496	41	456
29	2023				496	41	456
30	2024				496	41	456
31	2025				496	41	456
32	2026				496	41	456
33	2027				496	41	456
34	2028				496	41	456
35	2029				496	41	456
50	2044				496	41	456

Table 9.10 Cost Benefit Streams for Oued Hallouf

(Unit : 1,000 DT)

No.	Year	Cost				Benefit	Net
		River	Drain	River+Drain	O&M		
1	1995	1,505	242	1,748	0	1,748	0
2	1996	1,505	242	1,748	298	1,756	-1,459
3	1997	1,505	242	1,748	596	1,765	-1,170
4	1998	1,505	242	1,748	893	1,774	-880
5	1999	1,505	242	1,748	1,191	1,783	-591
6	2000	1,505	242	1,748	1,489	1,791	-302
7	2001	1,505	242	1,748	1,536	1,800	-264
8	2002	1,505	242	1,748	1,584	1,809	-225
9	2003	564	242	806	1,631	876	755
10	2004		242	242	1,679	316	1,363
11	2005		242	242	1,726	318	1,409
12	2006		242	242	1,774	319	1,455
13	2007		242	242	1,821	320	1,501
14	2008		242	242	1,869	321	1,548
15	2009		242	242	1,916	322	1,594
16	2010		242	242	1,964	324	1,640
17	2011		242	242	2,011	325	1,686
18	2012		242	242	2,059	326	1,733
19	2013		242	242	2,106	327	1,779
20	2014		242	242	2,154	329	1,825
21	2015		242	242	2,201	330	1,871
22	2016		242	242	2,249	331	1,918
23	2017		242	242	2,296	332	1,964
24	2018		242	242	2,344	333	2,010
25	2019		242	242	2,391	335	2,057
26	2020		242	242	2,439	336	2,103
27	2021				2,486	95	2,392
28	2022				2,486	95	2,392
29	2023				2,486	95	2,392
30	2024				2,486	95	2,392
31	2025				2,486	95	2,392
32	2026				2,486	95	2,392
33	2027				2,486	95	2,392
34	2028				2,486	95	2,392
35	2029				2,486	95	2,392
50	2044				2,486	95	2,392

Table 9.11 Cost Benefit Streams for Oued Hamdoun

No.	Year	Cost			Total	Benefit	Net
		River	Drain	River+Drain			
1	1995	894	608	1,502	0	1,502	-1,502
2	1996	894	608	1,502	8	1,510	188
3	1997	894	608	1,502	15	1,517	376
4	1998	894	608	1,502	23	1,525	564
5	1999	894	608	1,502	30	1,532	752
6	2000	894	608	1,502	38	1,540	940
7	2001	894	608	1,502	45	1,547	957
8	2002	894	608	1,502	53	1,555	975
9	2003	894	608	1,502	60	1,562	992
10	2004	761	608	1,369	68	1,436	1,010
11	2005	608	608	608	74	682	1,027
12	2006	608	608	608	77	686	1,045
13	2007	608	608	608	81	689	1,062
14	2008	608	608	608	84	692	1,079
15	2009	608	608	608	87	695	1,097
16	2010	608	608	608	90	698	1,114
17	2011	608	608	608	93	701	1,132
18	2012	608	608	608	96	704	1,149
19	2013	608	608	608	99	707	1,167
20	2014	608	608	608	102	710	1,184
21	2015	608	608	608	105	713	1,201
22	2016	608	608	608	108	716	1,219
23	2017	608	608	608	111	719	1,236
24	2018	608	608	608	114	722	1,254
25	2019	608	608	608	117	725	1,271
26	2020	608	608	608	120	728	1,289
27	2021				123	731	1,306
28	2022				123	733	1,306
29	2023				123	735	1,306
30	2024				123	737	1,306
31	2025				123	739	1,306
32	2026				123	741	1,306
33	2027				123	743	1,306
34	2028				123	745	1,306
35	2029				123	747	1,306
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50	2044				123	123	1,306
							1,183

FIGURES

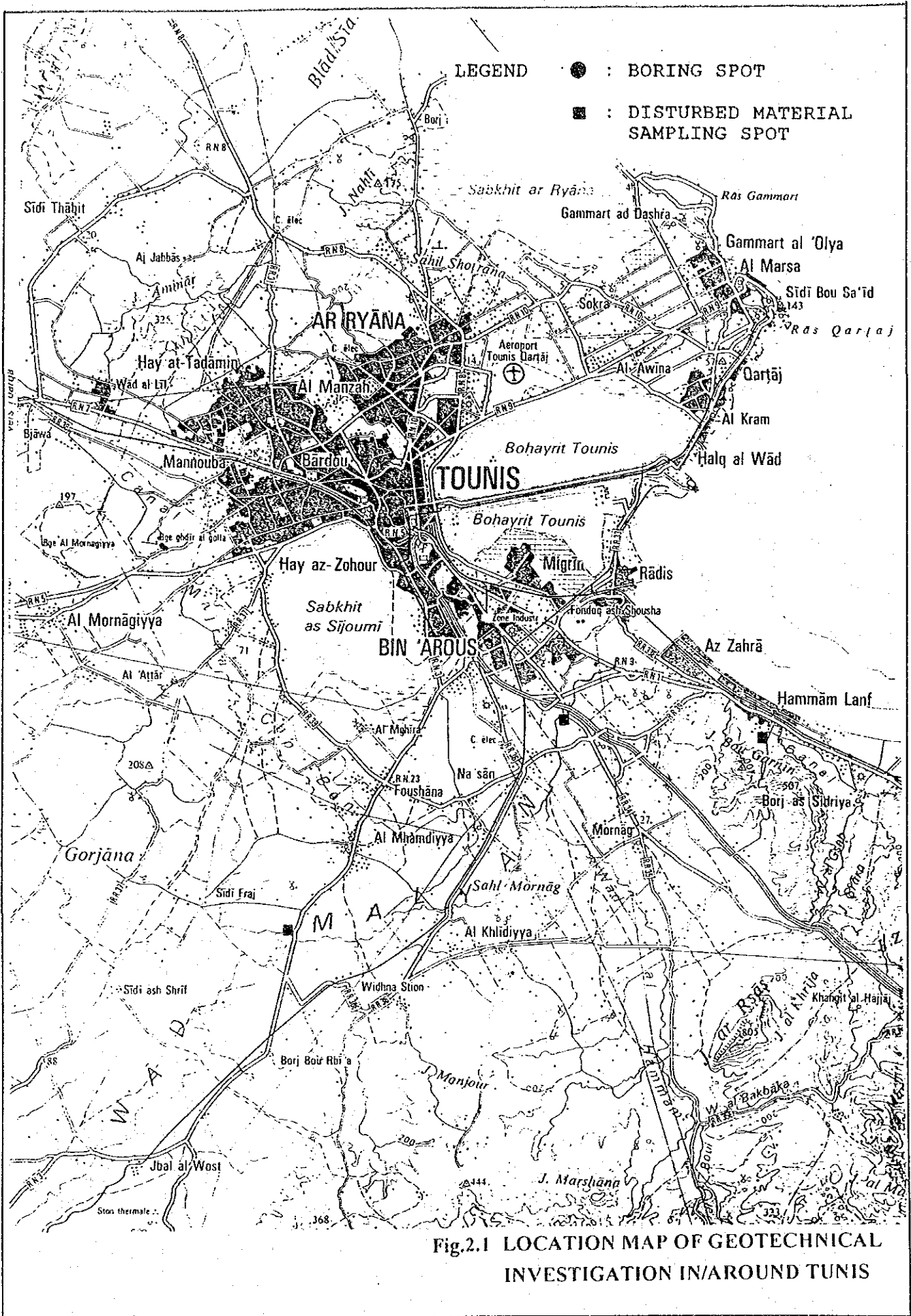


Fig.2.1 LOCATION MAP OF GEOTECHNICAL INVESTIGATION IN/AROUND TUNIS

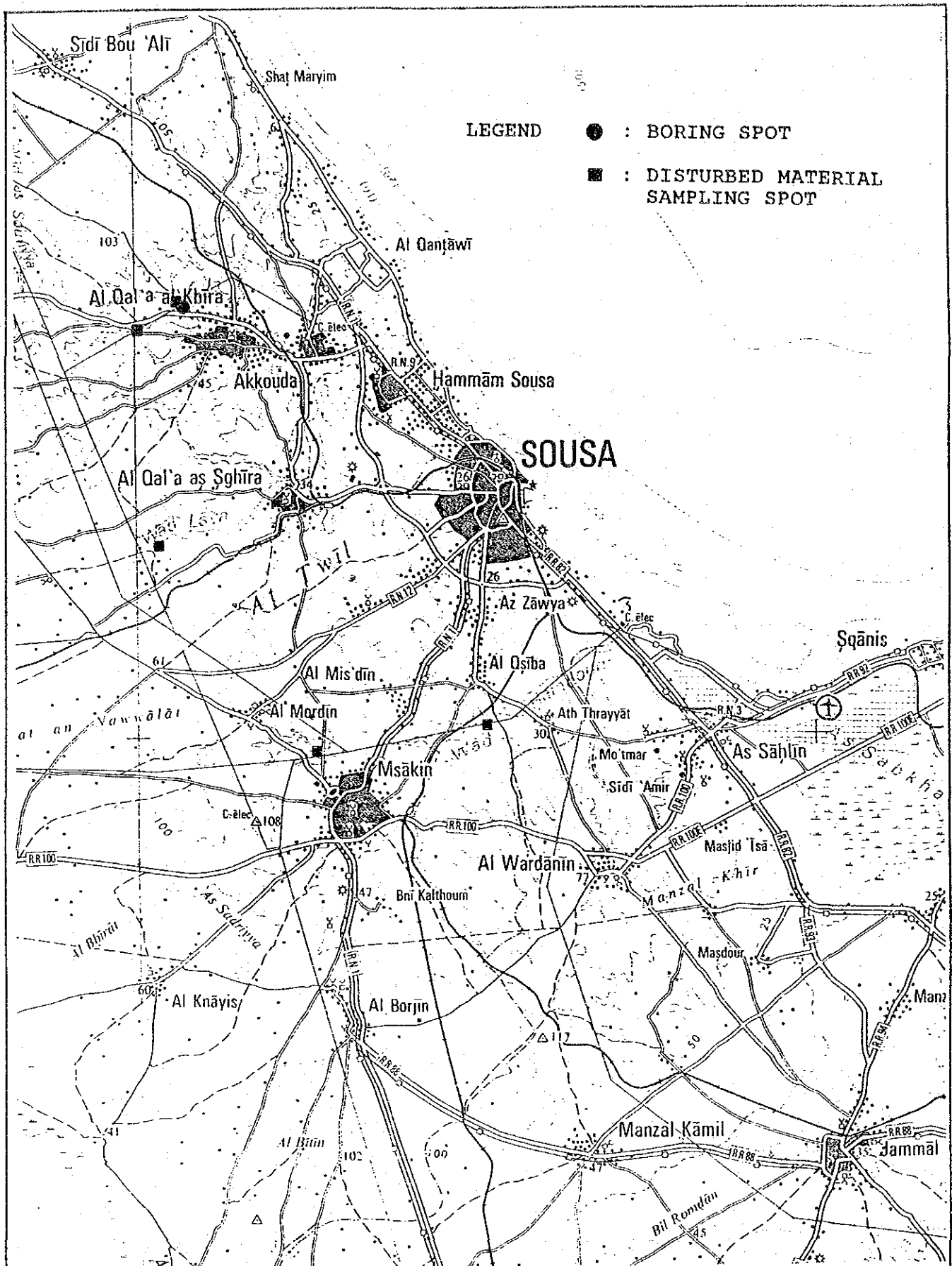


Fig.2.2 LOCATION MAP OF GEOTECHNICAL INVESTIGATION IN/AROUND SOUSSE

Fig.2.3 Log of Core boring (1)

BORING No. : SC 1

Drilled from April 26 to 28

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION	STANDARD PENETRATION						PERME- BILITY	
				N	0	10	20	30	40		50
0		0.55	Marlaceous silty sand, light grey								
1		1.55	Clay, yellowish brown; locally marlaceous	56							
2		2.55	Sandy clay, yellowish brown	55<							
3		3.55	Fine sand, yellowish brown	36							
4		4.55	Fine sand with intercalation of thin clay layer light brown	40							
5		5.55	Clay, brown	72							1.7 E-4
6		6.55	Clay, red	55<							
7		7.55	Clay with a little sand, reddish brown	55<							
8		8.55	Marlaceous silty sand, red	55<							
9		9.55		57							
10		10.55	Silty sand, reddish brown	55<							1.22 E-5
11		11.55	Silty sand with a little clay, yellowish brown	47							
12		12.55	Silty sand, red	55<							
13		13.55	Cleyey/silty sand	53							
14		14.55	Silty fine sand, yellowish brown	55<							
15		15.55	Silty fine sand with hard lumps, yellowish brown	55<							6.2 E-5
16		16.55	Silty fine sand with reddish clay lumps, yellowish brown	55<							
17		17.55		55<							
18		18.55	Silty sand, reddish brown	55<							
19				73							
20			Silty sand with reddish clay	55<							1.3 E-4

Fig.2.3 Log of Core boring (2)

BORING No. : SC 2

Drilled from April 16 to 18

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION	STANDARD PENETRATION						PERME- BILITY	
				N	0	10	20	30	40		50
0											
1		1.00	Silty fine sand, yellowish brown								
		1.40	Sandy clay, brown								
2											
3			Silty fine sand, yellowish brown								
4		4.00									
5			Fine sand, whitish yellow								1.8 E-4
		5.30									
6			Marlaceous silty sand,								
7		7.00									
8			Clay with sand, reddish								
				90<							
9		9.00									
				90<							
10			Sand, yellowish brown								1.22 E-5
11		11.30									
				29							
12											
				43							
13			Silty fine sand with intercalation of clay layers								
				56							
14											
				63							
15		15.00									1.4 E-5
				48							
16											
17											
18											
19											
20											

Fig.2.3 Log of Core boring (3)

BORING No. : SC 3

Drilled from April 19 to 20

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION	STANDARD PENETRATION						PERMEABILITY	
				N	0	10	20	30	40		50
0											
1											
2											
3											
4											
5			Silty fine sand with intercalation of clay layers yellowish brown								5.8 E-5
6		6.20									
7			Sandy clay, brown								
8		8.35									
9			Sand with a little silt								1.0 E-5
10											
11		11.00									
12			Clayey sand, reddish								
13		13.00									
		13.35	Hard clay								
14		14.00	Silty fine sand, reddish								
		14.80	Clay								
15		15.00	Marlaceous fine sand, light grey								2.4 E-5
16											
17											
18											
19											
20											

Fig. 2.4 Logs of Sampling pits

T-1

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0			Gravelly clay, dark brown
1			
2			
3			
		3.00	

S-2

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0			Fine sand, yellowish brown
1			
2			
3			
		3.00	

T-2

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0			Plastic clay, yellowish brown
1			
2			
3			
		3.00	

S-3

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0		1.30	Clayey fine sand, yellowish brown
1			Fine sand with a little clay and small gravel yellowish brown
2		3.00	
3			

T-3

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0			Silty clay, brown
1			
2			
3			

S-4

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0			gravelly fine sand, reddish
1			
2			
3			
		3.00	

S-1

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0		1.70	Fine sand, yellowish brown
1			
2		3.00	Fine sand with some clay, Grey
3			

S-5

SCL (m)	SYMB	DEPTH (m)	STRATUM DESCRIPTION
0		0.80	Fine sand with a little clay and gravel with organic matters
1			
2		3.00	Sandy clay with a little gravel, yellowish brown
3			

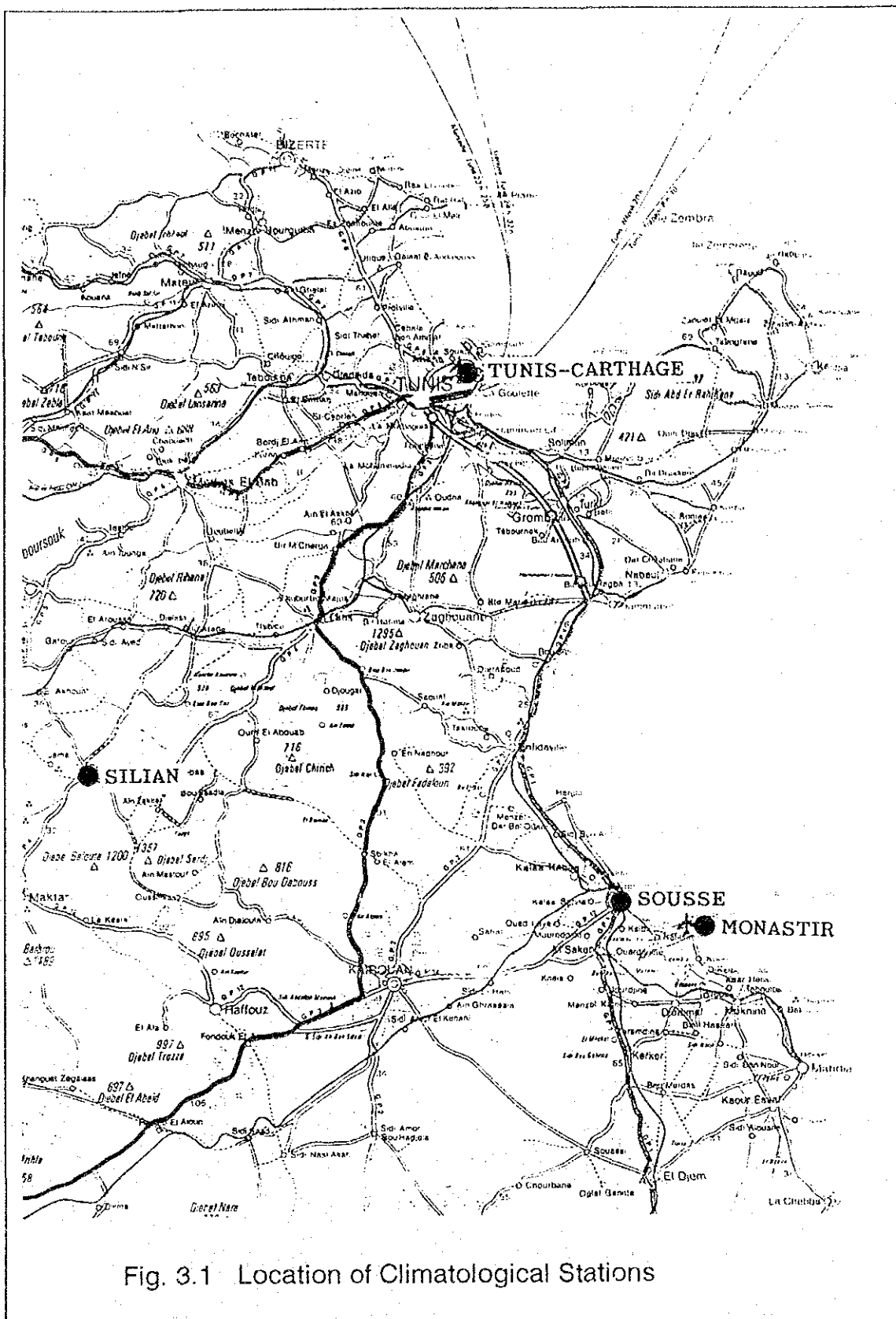
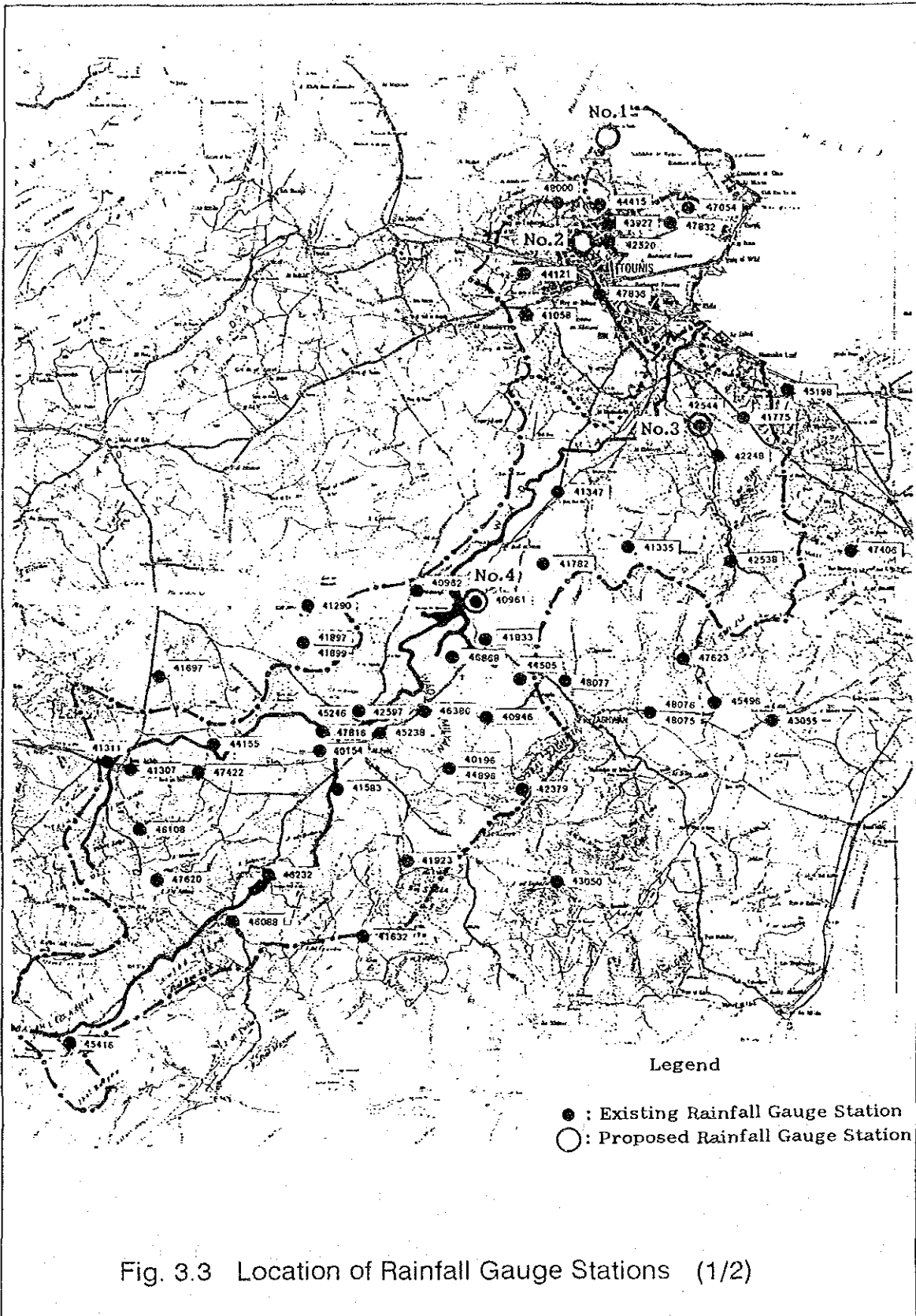


Fig. 3.1 Location of Climatological Stations



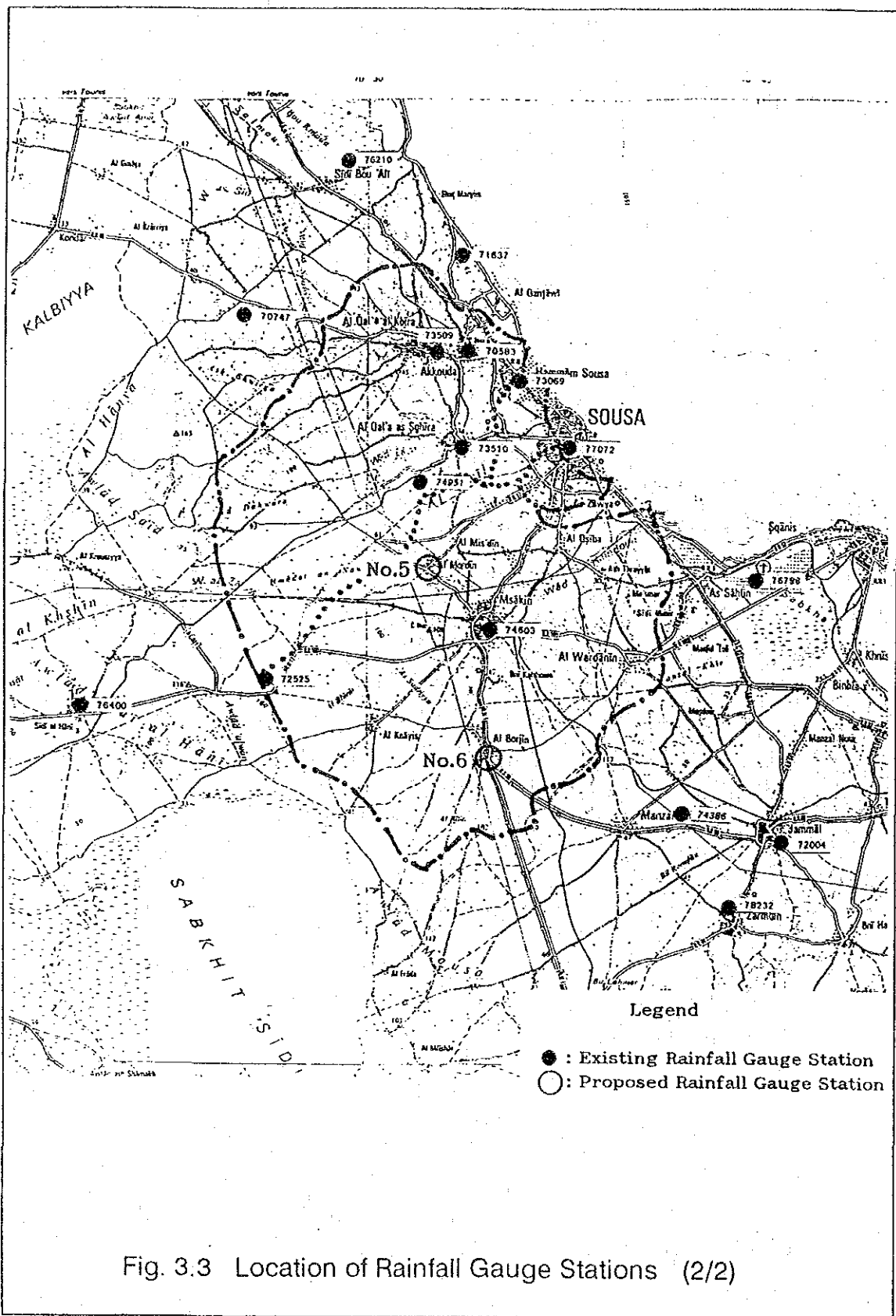


Fig. 3.3 Location of Rainfall Gauge Stations (2/2)

