Tableau 3.11 Calcul des débits des ruissellements avec les canaux de déviation N° 3 & 4 (1/2)

Runoff Calculation by Rational Method (Present Land Use)

Alt. - Diversion 3 and 4 (Lower reaches)

Calc. Point	Sub-basin Combination	Total Area (sq.km)	Runoff Coeff. f	Design tc (min)	Calc. Q(1.05) (cu.m/s)	Calc. Q(2) (cu.m/s)	Calc. Q(5) (cu.m/s)	Calc. Q(10) (cu.m/s)	Calc. Q(25) (cu.m/s)	Calc. Q(50) (cu.m/s)	Calc. Q(100) (cu.m/s)
20	11	0.62	0.41	42	1.3	1.6	2.1	2.6	3.5	4.3	5.3
21	14	1.09	0.20	12	3.2	3.8	5.1	6.3	8.4	10.4	13.0
22	Ain Snoubar Dam	1.09	0.20	12	3.2	3.8	5.1	6.3	8.4	10.4	13.0
23	14-15	1.71	0.23	25	3.1	3.8	5.0	6.2	8.3	10.2	12.7
24	14-16	1.83	0.24	33	2.7	3.3	4.5	5.5	7.3	9.1	11.3
25	12	0.39	0.24	9	1.7	2.1	2.8	3.5	4.6	5.7	7.1
26	12-13	0.46	0.24	14	1.4	1.7	2.3	2.8	3.8	4.7	5.8
27	12-16	2.29	0.24	33	3.4	4.2	5.6	6.9	9.2	11.4	14.1
28	12-17	3.09	0.31	52	4.1	5.0	6.7	8.3	11.0	13.6	16.9
29	Dam - L	3.09	0.31	52	4.1	5.0	6.7	8.3	11.0	13.6	16.9
30	11-17	3.71	0.33	52	5.2	6.4	8.5	10.5	14.0	17.4	21.5
31	18	0.17	0.27	27	0.3	0.4	0.5	0.7	0.9	1.1	1.4
32	19	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
33	Dam - A	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
34	19-20	1.14	0.25	26	2.2	2.6	3.5	4.4	5.8	7.2	8.9
35	21	0.20	0.20	7	0.9	1.1	1.5	1.8	2.4	3.0	3.7
36	Dam - E	0.20	0.20	7	0.9	1.1	1.5	1.8	2.4	3.0	3.7
37	21-22	0.32	0.34	14	1.4	1.7	2.2	2.8	3.7	4.6	5.7
38	19-22	1.46	0.27	26	3.0	3.7	4.9	6.0	8.0	9.9	12.3
39	19-23	1.93	0.31	48	2.7	3.3	4.4	5.5	7.3	9.1	11.3
40	Dam - M	1.93	0.31	48	2.7	3.3	4.4	5.5	7.3	9.1	11.3
41	18-23	2.10	0.31	48	3.0	3.6	4.8	6.0	8.0	9.9	12.2
42	18-24	2.22	0.31	57	2.7	3.3	4.4	5.5	7.3	9.0	11.2
43	25	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
44	Dam - D	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
45	25-26	1.92	0.23	43	2.2	2.7	3.6	4.5	5.9	7.3	9.1
46	Dam - N1	1.92	0.23	43	2.2	2.7	3.6	4.5	5.9	7.3	9.1
47	18-26	4.14	0.27	57	4.4	5.4	7.2	8.9	11.9	14.7	18.2
48	18-27	4.18	0.27	58	4.4	5.4	7.2	8.9	11.8	14.6	18.1
49	32	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
50	Dam - B	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
51	32-33	1.42	0.22	29	2.2	2.7	3.5	4.4	5.8	7.2	8.9
52	31-33	1.65	0.24	41	2.3	2.8	3.8	4.7	6.2	7.7	9.5
53	29	0.21	0.20	7	1.0	1.2	1.5	1.9	2.5	3.1	3.9
54	Dam - C	0.21	0.20	7	1.0	1.2	1.5	1.9	2.5	3.1	3.9
55	29-30	0.57	0.23	27	1.0	1.2	1.6	1.9	2.6	3.2	4.0
56	Dam - N2	0.57	0.23	27	1.0	1.2	1.6	1.9	2.6	3.2	4.0
57	29-33	2.42	0.24	41	3.0	3.7	4.9	6.1	8.1	10.0	12.5
58	28-33	2.47	0.24	45	2.9	3.5	4.6	5.8	7.7	9.5	11.8
59	18-33	6.65	0.26	98	6.8	8.3	11.0	13.6	18.1	22.4	27.8
60	18-34	7.49	0.26	74	6.2	7.6	10.1	12.5	16.6	20.6	25.6
61	36	0.10	0.36	27	0.3	0.3	0.4	0.5	0.7	0.9	1.1
-	Div. 4 (11-17)	3.71	0.33	57	4.9	5.9	7.9	9.8	13.0	16.1	20.0
71	11-17,35	3.81	0.33	57	5.0	6.1	8.1	10.0	13.3	16.5	20.5
62	11-17,36-37	3.98	0.34	66	4.8	5.8	7.7	9.6	12.7	15.8	19.5
72	11-17,36-37	3.98	0.34	66	4.8	5.8	7.7	9.6	12.7	15.8	19.5
63	11-17,36-38	4.26	0.33	74	4.5	5.5	7.3	9.0	12.0	14.9	18.5
64	39	0.53	0.29	64	0.4	0.5	0.7	0.9	1.2	1.5	1.8
65	11-17,36-39	4.79	0.32	74	4.9	6.0	8.0	9.9	13.1	16.2	20.1
66	11-17,36-40	5.30	0.31	83	4.8	5.8	7.8	9.6	12.8	15.8	19.6
67	35	0.46	0.20	56	0.4	0.5	0.6	0.7	1.0	1.2	1.5
68	11-40	13.25	0.28	83	10.8	13.2	17.5	21.7	28.8	35.7	44.3

Tableau 3.11 Calcul des débits des ruissellements avec les canaux de déviation N° 3 & 4 (2/2)

Runoff Calculation by Rational Method (Future Land Use Condition)

Alt. - Diversion 3 and 4 (Lower reaches)

Calc. Point	Sub-basin Combination	Total Area (sq.km)	Runoff Coeff. f	Design tc (min)	Calc. Q(1.05) (cu.m/s)	Calc. Q(2) (cu.m/s)	Calc. Q(5) (cu.m/s)	Calc. Q(10) (cu.m/s)	Calc. Q(25) (cu.m/s)	Calc. Q(50) (cu.m/s)	Calc. Q(100) (cu.m/s)
20	11	0.62	0.74	42	2.3	2.9	3.8	4.7	6.3	7.6	9.6
21	14	1.09	0.21	12	3.3	4.0	5.4	6.7	8.9	11.0	13.6
22	Ain Snoussi Dam	1.09	0.21	12	3.3	4.0	5.4	6.7	8.9	11.0	13.6
23	14-15	1.71	0.33	25	4.4	5.4	7.2	8.9	11.9	14.7	18.2
24	14-16	1.83	0.36	33	4.1	5.0	6.7	8.3	11.0	13.6	16.9
25	12	0.39	0.63	9	4.5	5.5	7.3	9.1	12.1	15.0	18.5
26	12-13	0.46	0.66	14	3.9	4.7	6.3	7.8	10.3	12.8	15.9
27	12-16	2.29	0.42	33	6.0	7.3	9.8	12.1	16.1	19.9	24.7
28	12-17	3.09	0.51	52	6.8	8.2	11.0	13.6	18.0	22.4	27.7
29	Dam - L	3.09	0.51	52	6.8	8.2	11.0	13.6	18.0	22.4	27.7
30	11-17	3.71	0.55	52	8.7	10.7	14.2	17.6	23.4	29.0	35.9
31	18	0.17	0.66	27	0.8	1.0	1.3	1.7	2.2	2.7	3.4
32	19	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
33	Dam - A	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
34	19-20	1.14	0.31	26	2.7	3.3	4.4	5.4	7.2	8.9	11.1
35	21	0.20	0.26	7	1.2	1.4	1.9	2.4	3.1	3.9	4.8
36	Dam - E	0.20	0.26	7	1.2	1.4	1.9	2.4	3.1	3.9	4.8
37	21-22	0.32	0.46	14	1.9	2.3	3.0	3.8	5.0	6.2	7.7
38	19-22	1.46	0.34	26	3.8	4.6	6.1	7.6	10.1	12.5	15.5
39	19-23	1.93	0.44	48	3.9	4.7	6.3	7.8	10.4	12.9	16.0
40	Dam - M	1.93	0.44	48	3.9	4.7	6.3	7.8	10.4	12.9	16.0
41	18-23	2.10	0.46	48	4.4	5.4	7.2	8.9	11.8	14.6	18.2
42	18-24	2.22	0.47	57	4.1	5.1	6.7	8.3	11.1	13.7	17.0
43	25	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
44	Dam - D	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
45	25-26	1.92	0.41	43	4.0	4.8	6.4	7.9	10.6	13.1	16.2
46	Dam - N1	1.92	0.41	43	4.0	4.8	6.4	7.9	10.6	13.1	16.2
47	18-26	4.14	0.44	57	7.2	8.6	11.7	14.5	19.3	24.0	29.7
48	18-27	4.18	0.45	58	7.4	9.0	11.9	14.8	19.7	24.4	30.2
49	32	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
50	Dam - B	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
51	32-33	1.42	0.27	29	2.7	3.3	4.3	5.4	7.1	8.8	11.0
52	31-33	1.85	0.39	41	3.8	4.6	6.1	7.6	10.1	12.5	15.5
53	29	0.21	0.29	7	1.4	1.7	2.2	2.8	3.7	4.6	5.7
54	Dam - C	0.21	0.29	7	1.4	1.7	2.2	2.8	3.7	4.6	5.7
55	29-30	0.57	0.60	27	2.5	3.1	4.1	5.1	6.7	8.4	10.4
56	Dam - N2	0.57	0.60	27	2.5	3.1	4.1	5.1	6.7	8.4	10.4
57	29-39	2.42	0.44	41	5.6	6.8	9.0	11.2	14.9	18.4	22.8
58	28-39	2.47	0.45	45	5.4	6.6	8.7	10.8	14.4	17.8	22.1
59	18-39	6.65	0.45	58	11.7	14.3	19.0	23.6	31.3	38.8	48.1
60	18-34	7.49	0.48	74	11.5	14.0	18.7	23.1	30.7	38.1	47.2
61	36	0.10	0.60	27	0.6	0.7	1.0	1.2	1.6	2.0	2.4
-	Div. 4 (11-17)	3.71	0.55	57	8.1	9.9	13.1	16.3	21.7	26.8	33.3
71	11-17,36	3.61	0.55	57	8.3	10.2	13.5	16.7	22.2	27.6	34.2
62	11-17,36-37	3.98	0.56	66	7.8	9.6	12.7	15.8	20.9	25.9	32.2
72	11-17,36-37	3.98	0.56	66	7.8	9.6	12.7	15.8	20.9	25.9	32.2
63	11-17,36-38	4.26	0.58	74	7.9	9.6	12.8	15.9	21.1	26.2	32.4
64	39	0.53	0.26	64	0.5	0.6	0.8	1.0	1.3	1.6	2.0
65	11-17,36-39	4.79	0.54	74	8.3	10.1	13.4	16.6	22.1	27.4	34.0
66	11-17,36-40	5.30	0.55	89	8.5	10.3	13.8	17.0	22.6	28.1	34.8
67	35	0.46	0.20	56	0.4	0.5	0.6	0.7	1.0	1.2	1.5
68	11-40	13.25	0.50	80	19.3	23.5	31.3	38.7	51.5	63.8	79.1

Tableau 3.12 Calcul des débits des ruissellements avec les canaux de déviation N° 3 & 5 (1/2)

Runoff Calculation by Rational Method (Present Land Use)

Alt. - Diversion 3 and 5 (Lower reaches)

Calc. Point	Sub-basin Combination	Total Area (sq.km)	Runoff Coeff. f	Design tc (min)	Calc. Q(1.05) (cu.m/s)	Calc. Q(2) (cu.m/s)	Calc. Q(5) (cu.m/s)	Calc. Q(10) (cu.m/s)	Calc. Q(25) (cu.m/s)	Calc. Q(50) (cu.m/s)	Calc. Q(100) (cu.m/s)
20	11	0.62	0.41	42	1.3	1.6	2.1	2.6	3.5	4.3	5.3
21	14	1.09	0.20	12	3.2	3.8	5.1	6.3	8.4	10.4	13.0
22	Ain Snoussi Dam	1.09	0.20	12	3.2	3.8	5.1	6.3	8.4	10.4	13.0
23	14-15	1.71	0.23	25	3.1	3.8	5.0	6.2	8.3	10.2	12.7
24	14-16	1.83	0.24	33	2.7	3.3	4.5	5.5	7.3	9.1	11.3
25	12	0.39	0.24	9	1.7	2.1	2.8	3.5	4.6	5.7	7.1
26	12-13	0.46	0.24	14	1.4	1.7	2.3	2.8	3.8	4.7	5.8
27	12-16	2.29	0.24	33	3.4	4.2	5.6	6.9	9.2	11.4	14.1
28	12-17	3.09	0.31	52	4.1	5.0	6.7	8.3	11.0	13.6	16.9
29	Dam - L	3.09	0.31	52	4.1	5.0	6.7	8.3	11.0	13.6	16.9
30	11-17	3.71	0.33	52	5.2	6.4	8.5	10.5	14.0	17.4	21.5
31	11-18	3.88	0.33	59	4.9	6.0	8.0	9.9	13.2	16.4	20.3
32	19	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
33	Dam - A	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
34	19-20	1.14	0.25	26	2.2	2.6	3.5	4.4	5.8	7.2	8.9
35	21	0.20	0.20	7	0.9	1.1	1.5	1.8	2.4	3.0	3.7
36	Dam - E	0.20	0.20	7	0.9	1.1	1.5	1.8	2.4	3.0	3.7
37	21-22	0.32	0.34	14	1.4	1.7	2.2	2.8	3.7	4.6	5.7
38	19-22	1.46	0.27	26	3.0	3.7	4.9	6.0	8.0	9.9	12.3
39	19-23	1.93	0.31	48	2.7	3.3	4.4	5.5	7.3	9.1	11.3
40	Dam - M	1.93	0.31	48	2.7	3.3	4.4	5.5	7.3	9.1	11.3
41	11-23	5.81	0.32	59	7.2	8.8	11.6	14.4	19.2	23.8	29.5
42	24	0.12	0.27	25	0.3	0.3	0.4	0.5	0.7	0.8	1.0
43	25	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
44	Dam - D	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
45	25-26	1.92	0.23	49	2.2	2.7	3.6	4.5	5.9	7.3	9.1
46	Dam - N1	1.92	0.23	43	2.2	2.7	3.6	4.5	5.9	7.3	9.1
47	24-26	2.04	0.23	43	2.4	2.9	3.8	4.7	6.3	7.8	9.7
48	24-27	2.09	0.23	44	2.4	2.9	3.8	4.7	6.3	7.8	9.7
49	32	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
50	Dam - B	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
51	32-33	1.42	0.22	29	2.2	2.7	3.5	4.4	5.8	7.2	8.9
52	31-33	1.85	0.24	41	2.3	2.8	3.8	4.7	6.2	7.7	9.5
53	29	0.21	0.20	7	1.0	1.2	1.5	1.9	2.5	3.1	3.9
54	Dam - C	0.21	0.20	7	1.0	1.2	1.5	1.9	2.5	3.1	3.9
55	29-30	0.57	0.23	27	1.0	1.2	1.6	1.9	2.6	3.2	4.0
56	Dam - N2	0.57	0.23	27	1.0	1.2	1.6	1.9	2.6	3.2	4.0
57	29-33	2.42	0.24	41	3.0	3.7	4.9	6.1	8.1	10.0	12.5
58	28-33	2.47	0.24	45	2.9	3.5	4.6	5.8	7.7	9.5	11.8
59	24-30	4.55	0.24	45	5.3	6.4	8.6	10.6	14.1	17.5	21.7
60	24-34	5.39	0.25	60	5.1	6.3	8.3	10.3	13.7	17.0	21.1
61	36	0.10	0.36	27	0.3	0.3	0.4	0.5	0.7	0.9	1.1
71	36	0.10	0.36	27	0.3	0.3	0.4	0.5	0.7	0.9	1.1
62	36-37	0.27	0.41	38	0.6	0.8	1.0	1.2	1.6	2.0	2.5
-	Div. 5 (11-23)	5.81	0.32	67	6.5	7.9	10.5	13.0	17.3	21.4	26.5
72	11-23,36-37	6.08	0.33	67	7.0	8.5	11.3	14.0	18.6	23.1	28.6
63	11-23,36-38	6.36	0.33	76	6.6	8.0	10.7	13.2	17.5	21.7	27.0
64	39	0.53	0.23	64	0.4	0.5	0.7	0.9	1.2	1.5	1.8
65	11-23,36-39	6.89	0.32	76	6.9	8.4	11.2	13.9	18.4	22.8	28.3
66	11-23,36-40	7.40	0.31	84	6.6	8.1	10.7	13.3	17.6	21.9	27.1
67	35	0.46	0.20	56	0.4	0.5	0.6	0.7	1.0	1.2	1.5
68	11-40	13.25	0.28	84	10.7	13.0	17.3	21.5	28.5	35.4	43.9

Tableau 3.12 Calcul des débits des ruissellements avèc les canaux de déviation N° 3 & 5 (2/2)

Runoff Calculation by Rational Method (Future Land Use Condition)

Alt. - Diversion 3 and 5 (Lower reaches)

Calc. Point	Sub-basin Combination	Total Area (sq.km)	Runoff Coeff. f	Design tc (min)	Calc. Q(1.05) (cu.m/s)	Calc. Q(2) (cu.m/s)	Calc. Q(5) (cu.m/s)	Calc. Q(10) (cu.m/s)	Calc. Q(25) (cu.m/s)	Calc. Q(50) (cu.m/s)	Calc. Q(100) (cu.m/s)
20	11	0.62	0.74	42	2.3	2.9	3.6	4.7	6.3	7.6	9.6
21	14	1.09	0.21	12	3.3	4.0	5.4	6.7	8.9	11.0	13.6
22	Ain Snoussi Dam	1.09	0.21	12	3.3	4.0	5.4	6.7	8.9	11.0	13.6
23	14-15	1.71	0.33	25	4.4	5.4	7.2	8.9	11.9	14.7	18.2
24	14-16	1.89	0.36	33	4.1	5.0	6.7	8.3	11.0	13.6	16.9
25	12	0.39	0.63	9	4.5	5.5	7.3	9.1	12.1	15.0	18.5
26	12-13	0.46	0.66	14	3.9	4.7	6.3	7.8	10.3	12.8	15.9
27	12-16	2.29	0.42	39	6.0	7.3	9.8	12.1	16.1	19.9	24.7
28	12-17	3.09	0.51	52	6.8	8.2	11.0	13.6	18.0	22.4	27.7
29	Dam - L	3.09	0.51	52	6.8	8.2	11.0	13.6	18.0	22.4	27.7
30	11-17	3.71	0.55	52	8.7	10.7	14.2	17.6	23.4	29.0	35.9
31	11-18	3.88	0.55	59	8.2	10.0	13.4	16.6	22.0	27.3	33.8
32	19	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
33	Dam - A	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
34	19-20	1.14	0.31	26	2.7	3.3	4.4	5.4	7.2	8.9	11.1
35	21	0.20	0.26	7	1.2	1.4	1.9	2.4	3.1	3.9	4.8
36	Dam - E	0.20	0.26	7	1.2	1.4	1.9	2.4	3.1	3.9	4.8
37	21-22	0.32	0.46	14	1.9	2.3	3.0	3.8	5.0	6.2	7.7
38	19-22	1.46	0.34	26	3.8	4.6	6.1	7.6	10.1	12.5	15.5
39	19-23	1.93	0.44	48	3.9	4.7	6.3	7.8	10.4	12.9	16.0
40	Dam - M	1.93	0.44	48	3.9	4.7	6.3	7.8	10.4	12.9	16.0
41	11-23	5.81	0.51	59	11.4	14.0	18.6	23.0	30.6	37.9	47.0
42	24	0.12	0.70	25	0.7	0.8	1.1	1.3	1.8	2.2	2.7
43	25	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
44	Dam - D	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
45	25-26	1.92	0.41	43	4.0	4.8	6.4	7.9	10.6	13.1	16.2
46	Dam - N1	1.92	0.41	43	4.0	4.8	6.4	7.9	10.6	13.1	16.2
47	24-26	2.04	0.43	43	4.4	5.4	7.1	8.9	11.8	14.6	18.1
48	24-27	2.09	0.44	44	4.5	5.5	7.3	9.1	12.0	14.9	18.5
49	32	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
50	Dam - B	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
51	32-33	1.42	0.27	29	2.7	3.3	4.3	5.4	7.1	8.8	11.0
52	31-33	1.85	0.39	41	3.8	4.6	6.1	7.6	10.1	12.5	15.5
53	29	0.21	0.29	7	1.4	1.7	2.2	2.8	3.7	4.6	5.7
54	Dam - C	0.21	0.29	7	1.4	1.7	2.2	2.8	3.7	4.6	5.7
55	29-30	0.57	0.60	27	2.5	3.1	4.1	5.1	6.7	8.4	10.4
56	Dam - N2	0.57	0.60	27	2.5	3.1	4.1	5.1	6.7	8.4	10.4
57	29-33	2.42	0.44	41	5.6	6.8	9.0	11.2	14.9	18.4	22.8
58	28-33	2.47	0.45	45	5.4	6.6	8.7	10.8	14.4	17.8	22.1
59	24-33	4.55	0.44	45	9.7	11.8	15.7	19.5	25.8	32.0	39.7
60	24-34	5.39	0.49	60	10.1	12.3	16.3	20.2	26.9	33.3	41.3
61	36	0.10	0.60	27	0.6	0.7	1.0	1.2	1.6	2.0	2.4
71	36	0.10	0.60	27	0.6	0.7	1.0	1.2	1.6	2.0	2.4
62	36-37	0.27	0.60	36	1.2	1.5	1.9	2.4	3.2	4.0	4.9
-	Div. 5 (11-23)	5.81	0.51	67	10.3	12.6	16.7	20.7	27.5	34.1	42.3
72	11-23,36-37	6.06	0.53	67	11.2	13.7	18.2	22.5	29.9	37.1	46.0
63	11-23,36-38	6.36	0.54	76	10.7	13.1	17.4	21.6	28.7	35.6	44.1
64	39	0.53	0.26	64	0.5	0.6	0.8	1.0	1.3	1.6	2.0
65	11-23,36-39	6.89	0.52	76	11.2	13.7	18.2	22.5	29.9	37.1	46.0
66	11-23,36-40	7.40	0.53	84	11.3	13.8	18.3	22.7	30.2	37.4	46.4
67	35	0.46	0.20	56	0.4	0.5	0.6	0.7	1.0	1.2	1.5
68	11-40	13.25	0.50	84	19.1	23.3	30.9	38.3	51.0	63.1	78.3

Tableau 3.13 Calcul des débits des ruissellements avec les canaux de déviation N° 3, 4 & 5 (1/2)

Runoff Calculation by Rational Method (Present Land Use)

Alt. - Diversion 3, 4 and 5 (Lower reaches)

Calc. Point	Sub-basin Combination	Total Area (sq.km)	Runoff Coeff. f	Design tc (min)	Calc. Q(1.05) (cu.m/s)	Calc. Q(2) (cu.m/s)	Calc. Q(5) (cu.m/s)	Calc. Q(10) (cu.m/s)	Calc. Q(25) (cu.m/s)	Calc. Q(50) (cu.m/s)	Calc. Q(100) (cu.m/s)
20	11	0.62	0.41	42	1.3	1.6	2.1	2.6	3.5	4.3	5.3
21	14	1.09	0.20	12	3.2	3.8	5.1	6.3	8.4	10.4	13.0
22	Ain Snoussi Dam	1.09	0.20	12	3.2	3.8	5.1	6.3	8.4	10.4	13.0
23	14-15	1.71	0.23	25	3.1	3.8	5.0	6.2	8.3	10.2	12.7
24	14-16	1.83	0.24	39	2.7	3.3	4.5	5.5	7.3	9.1	11.3
25	12	0.39	0.24	9	1.7	2.1	2.8	3.5	4.6	5.7	7.1
26	12-13	0.46	0.24	14	1.4	1.7	2.3	2.8	3.8	4.7	5.8
27	12-16	2.29	0.24	39	3.4	4.2	5.6	6.9	9.2	11.4	14.1
28	12-17	3.09	0.31	52	4.1	5.0	6.7	8.3	11.0	13.6	16.9
29	Dam - L	3.09	0.31	52	4.1	5.0	6.7	8.3	11.0	13.6	16.9
30	11-17	3.71	0.33	52	5.2	6.4	8.5	10.5	14.0	17.4	21.5
31	18	0.17	0.27	27	0.3	0.4	0.5	0.7	0.9	1.1	1.4
32	19	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
33	Dam - A	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
34	19-20	1.14	0.25	26	2.2	2.6	3.5	4.4	5.8	7.2	8.9
35	21	0.20	0.20	7	0.9	1.1	1.5	1.8	2.4	3.0	3.7
36	Dam - E	0.20	0.20	7	0.9	1.1	1.5	1.8	2.4	3.0	3.7
37	21-22	0.32	0.34	14	1.4	1.7	2.2	2.8	3.7	4.6	5.7
38	19-22	1.46	0.27	26	3.0	3.7	4.9	6.0	8.0	9.9	12.3
39	19-23	1.93	0.31	46	2.7	3.3	4.4	5.5	7.3	9.1	11.3
40	Dam - M	1.93	0.31	46	2.7	3.3	4.4	5.5	7.3	9.1	11.3
41	18-23	2.10	0.31	46	3.0	3.6	4.8	6.0	8.0	9.9	12.2
42	24	0.12	0.27	25	0.3	0.3	0.4	0.5	0.7	0.8	1.0
43	25	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
44	Dam - D	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
45	25-26	1.92	0.23	43	2.2	2.7	3.6	4.5	5.9	7.3	9.1
46	Dam - N1	1.92	0.23	43	2.2	2.7	3.6	4.5	5.9	7.3	9.1
47	24-26	2.04	0.23	43	2.4	2.9	3.8	4.7	6.3	7.8	9.7
48	24-27	2.08	0.23	44	2.4	2.9	3.8	4.7	6.3	7.8	9.7
49	32	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
50	Dam - B	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
51	32-33	1.42	0.22	29	2.2	2.7	3.5	4.4	5.8	7.2	8.9
52	31-33	1.85	0.24	41	2.3	2.8	3.8	4.7	6.2	7.7	9.5
53	29	0.21	0.20	7	1.0	1.2	1.5	1.9	2.5	3.1	3.9
54	Dam - C	0.21	0.20	7	1.0	1.2	1.5	1.9	2.5	3.1	3.9
55	29-30	0.57	0.23	27	1.0	1.2	1.6	1.9	2.6	3.2	4.0
56	Dam - N2	0.57	0.23	27	1.0	1.2	1.6	1.9	2.6	3.2	4.0
57	29-33	2.42	0.24	41	3.0	3.7	4.9	6.1	8.1	10.0	12.5
58	28-33	2.47	0.24	45	2.9	3.5	4.6	5.8	7.7	9.5	11.8
59	24-33	4.55	0.24	45	5.3	6.4	8.6	10.6	14.1	17.5	21.7
60	24-34	5.39	0.25	60	5.1	6.3	8.3	10.3	13.7	17.0	21.1
61	36	0.10	0.36	27	0.3	0.3	0.4	0.5	0.7	0.9	1.1
-	Div. 4 (11-17)	3.71	0.33	57	4.9	5.9	7.9	9.8	13.0	16.1	20.0
71	11-17,36	3.81	0.33	57	5.0	6.1	8.1	10.0	13.3	16.5	20.5
62	11-17,36-37	3.90	0.34	66	4.6	5.6	7.7	9.6	12.7	15.8	19.5
-	Div. 5 (18-23)	2.10	0.31	56	2.6	3.2	4.3	5.3	7.0	8.7	10.8
72	11-23,36-37	6.00	0.33	66	7.1	8.6	11.4	14.2	18.8	23.4	29.0
63	11-23,36-38	6.36	0.33	74	6.7	8.2	10.9	13.5	17.9	22.2	27.6
64	39	0.53	0.23	64	0.4	0.5	0.7	0.9	1.2	1.5	1.8
65	11-23,36-39	6.89	0.32	74	7.1	8.6	11.4	14.2	18.8	23.3	29.0
66	11-23,36-40	7.40	0.31	83	6.7	8.1	10.8	13.4	17.8	22.1	27.4
67	35	0.46	0.20	56	0.4	0.5	0.6	0.7	1.0	1.2	1.5
68	11-40	13.25	0.28	83	10.8	13.2	17.5	21.7	28.8	35.7	44.3

Tableau 3.13 Calcul des débits des ruissellements avec les canaux de déviation N° 3, 4 & 5 (2/2)

Runoff Calculation by Rational Method (Future Land Use Condition)

Alt. - Diversion 3, 4 and 5 (Lower reaches)

Calc. Point	Sub-basin Combination	Total Area (sq.km)	Runoff Coeff. f	Design tc (min)	Calc. Q(1.05) (cu.m/s)	Calc. Q(2) (cu.m/s)	Calc. Q(5) (cu.m/s)	Calc. Q(10) (cu.m/s)	Calc. Q(25) (cu.m/s)	Calc. Q(50) (cu.m/s)	Calc Q(100) (cu.m/s)
20	11	0.62	0.74	42	2.3	2.9	3.8	4.7	6.3	7.6	9.6
21	14	1.09	0.21	12	3.3	4.0	5.4	6.7	8.9	11.0	13.6
22	Ain Snoussi Dam	1.09	0.21	12	3.3	4.0	5.4	6.7	8.9	11.0	13.6
23	14-15	1.71	0.33	25	4.4	5.4	7.2	8.9	11.9	14.7	18.2
24	14-16	1.83	0.36	33	4.1	5.0	6.7	8.3	11.0	13.6	16.9
25	12	0.39	0.63	9	4.5	5.5	7.3	9.1	12.1	15.0	18.5
26	12-13	0.46	0.66	14	3.9	4.7	6.3	7.8	10.3	12.8	15.9
27	12-16	2.29	0.42	33	6.0	7.3	9.8	12.1	16.1	19.9	24.7
28	12-17	3.09	0.51	52	6.8	8.2	11.0	13.6	18.0	22.4	27.7
29	Dam - L	3.09	0.51	52	6.8	8.2	11.0	13.6	18.0	22.4	27.7
30	11-17	3.71	0.55	52	8.7	10.7	14.2	17.6	23.4	29.0	35.9
31	18	0.17	0.66	27	0.8	1.0	1.3	1.7	2.2	2.7	3.4
32	19	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
33	Dam - A	0.92	0.20	12	2.7	3.2	4.3	5.4	7.1	8.8	10.9
34	19-20	1.14	0.31	26	2.7	3.3	4.4	5.4	7.2	8.9	11.1
35	21	0.20	0.26	7	1.2	1.4	1.9	2.4	3.1	3.9	4.8
36	Dam - E	0.20	0.26	7	1.2	1.4	1.9	2.4	3.1	3.9	4.8
37	21-22	0.32	0.46	14	1.9	2.3	3.0	3.8	5.0	6.2	7.7
38	19-22	1.46	0.94	26	3.8	4.6	6.1	7.6	10.1	12.5	15.5
39	19-23	1.93	0.44	46	3.9	4.7	6.3	7.8	10.4	12.9	16.0
40	Dam - M	1.93	0.44	46	3.9	4.7	6.3	7.8	10.4	12.9	16.0
41	18-23	2.10	0.46	46	4.4	5.4	7.2	8.9	11.6	14.6	18.2
42	24	0.12	0.70	25	0.7	0.8	1.1	1.3	1.8	2.2	2.7
43	25	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
44	Dam - D	1.02	0.20	15	2.5	3.0	4.0	4.9	6.6	8.1	10.1
45	25-26	1.92	0.41	43	4.0	4.8	6.4	7.9	10.6	13.1	16.2
46	Dam - N1	1.92	0.41	43	4.0	4.8	6.4	7.9	10.6	13.1	16.2
47	24-26	2.04	0.43	43	4.4	5.4	7.1	8.9	11.8	14.6	18.1
48	24-27	2.06	0.44	44	4.5	5.5	7.3	9.1	12.0	14.9	18.5
49	32	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
50	Dam - B	1.11	0.20	17	2.4	2.9	3.9	4.8	6.4	8.0	9.9
51	32-33	1.42	0.27	29	2.7	3.3	4.3	5.4	7.1	8.8	11.0
52	31-33	1.85	0.39	41	3.8	4.6	6.1	7.6	10.1	12.5	15.5
53	29	0.21	0.29	7	1.4	1.7	2.2	2.8	3.7	4.6	5.7
54	Dam - C	0.21	0.29	7	1.4	1.7	2.2	2.8	3.7	4.6	5.7
55	29-30	0.57	0.60	27	2.5	3.1	4.1	5.1	6.7	8.4	10.4
56	Dam - N2	0.57	0.60	27	2.5	3.1	4.1	5.1	6.7	8.4	10.4
57	29-33	2.42	0.44	41	5.6	6.8	9.0	11.2	14.9	18.4	22.8
58	28-33	2.47	0.45	45	5.4	6.6	8.7	10.8	14.4	17.8	22.1
59	24-33	4.55	0.44	45	9.7	11.8	15.7	19.5	25.8	32.0	39.7
60	24-34	5.39	0.49	60	10.1	12.3	16.3	20.2	26.9	33.3	41.3
61	36	0.10	0.60	27	0.6	0.7	1.0	1.2	1.6	2.0	2.4
-	Div. 4 (11-17)	3.71	0.55	57	8.1	9.9	13.1	16.3	21.7	26.8	33.3
71	11-17,36	3.81	0.55	57	8.3	10.2	13.5	16.7	22.2	27.6	34.2
62	11-17,36-37	3.96	0.56	66	7.8	9.6	12.7	15.8	20.9	25.9	32.2
-	Div. 5 (18-23)	2.10	0.46	56	3.9	4.7	6.3	7.8	10.4	12.9	16.0
72	11-23,36-37	6.06	0.53	66	11.3	13.8	18.4	22.8	30.3	37.5	46.5
63	11-23,36-38	6.36	0.54	74	11.0	13.4	17.8	22.1	29.3	36.4	45.1
64	39	0.53	0.26	64	0.5	0.6	0.8	1.0	1.3	1.6	2.0
65	11-23,36-39	6.89	0.52	74	11.5	14.0	18.6	23.0	30.6	37.9	47.0
66	11-23,36-40	7.40	0.53	83	11.4	13.9	18.5	22.9	30.5	37.8	46.8
67	35	0.46	0.20	56	0.4	0.5	0.6	0.7	1.0	1.2	1.5
68	11-40	13.25	0.50	83	19.3	23.5	31.3	38.7	51.5	63.8	79.1

Tableau 4.1 Proportions de l'occupation actuelle du sol dans la zone d'étude à la commune de l'Ariana

	Goveronorate of Ariana						Goveronorate of Tunis	
	Raoued	Ariana Superior	Bori Louzir	Ariana Medina	Soukra	Sabkhet Ariana	La Marsa	Total
Residential	4.5km2	0.5km2	2.3km2	2.2km2	1.7km2	–	6.4km2	17.6km2
Commercial	–	–	–	0.1km2	–	–	0.2km2	0.3km2
Administrative / Institutional	0.1km2	0.1km2	–	0.5km2	0.1km2	–	0.4km2	1.2km2
Recreational	–	–	–	0.1km2	0.3km2	–	0.5km2	0.9km2
Industrial	–	–	–	–	0.1km2	–	0.05km2	0.15km2
Agricultural	10.1km2	–	2.7km2	–	9.0km2	–	8.1km2	29.9km2
Green Area	6.3km2	4.3km2	–	–	–	–	4.5km2	15.1km2
Open Space	9.0km2	0.4km2	1.1km2	0.2km2	–	–	3.0km2	13.7km2
ONAS	0.2km2	–	–	–	–	–	1.0km2	1.2km2
Historic sites	–	–	–	–	–	–	1.0km2	1.0km2
Sebkhet Ariana	–	–	–	–	–	36.5km2	–	36.5km2
Total	30.2km2	5.3km2	6.1km2	3.1km2	11.2km2	36.5km2	25.1km2	117.5km2

Source: calculated by the study team

Tableau 4.2 Proportions de l'occupation Future du sol dans la zone d'étude à la commune de l'Ariana

	Goverenorate of Ariana						Governorate of Tunis	Total
	Raoued	Ariana Superior	Bori Louzir	Ariana Media	Soukra	Sebkhet Ariana	La Marsa	
Residential	7.2km2	1.8km2	5.3km2	2.4km2	2.1km2	-	8.9km2	27.7km2
high density	0.4km2	-	0.6km2	0.2km2	0.2km2	-	-	1.4km2
medium density	6.6km2	1.6km2	4.7km2	1.2km2	0.9km2	-	2.0km2	17.0km2
low density	-	-	-	-	0.8km2	-	6.7km2	7.5km2
Mixed use	-	-	-	0.2km2	0.2km2	-	0.2km2	0.6km2
Ariana center	-	0.2km2	-	0.7km2	-	-	-	0.9km2
Media type	0.2km2	-	-	0.1km2	-	-	-	0.3km2
Commercial	0.05km2	-	0.05km2	0.1km2	-	-	0.2km2	0.4km2
Administrational / Institutional	0.35km2	0.3km2	0.2km2	0.5km2	0.1km2	-	0.5km2	1.9km2
Recreational	1.3km2	2.5km2	0.15km2	0.1km2	0.5km2	-	1.3km2	5.9km2
sports/activities	0.5km2	-	0.15km2	0.1km2	0.05km2	-	0.3km2	1.1km2
parks	0.8km2	2.5km2	-	-	0.45km2	-	0.2km2	4.0km2
touristic	-	-	-	-	-	-	0.8km2	0.8km2
Industrial	-	-	-	-	-	-	0.5km2	0.5km2
Agricultural	5.2km2	-	-	-	8.2km2	-	6.3km2	19.7km2
Green area	6.2km2	0.7km2	-	-	-	-	3.1km2	10.0km2
Inundated zone	10.7km2	-	0.4km2	-	0.3km2	-	1.6km2	13.3km2
Reserved/ cemetry	-	-	-	-	-	-	0.2km2	0.2km2
Historic sites	-	-	-	-	-	-	1.0km2	1.0km2
ONAS	-	-	-	-	-	-	1.0km2	1.0km2
Petrolium storage	0.8km2	-	-	-	-	-	-	0.8km2
Sebkhet Ariana	-	-	-	-	-	35.4km2	-	35.4km2
Total	31.8km2	5.3km2	6.1km2	3.1km2	11.2km2	35.4km2	24.6km2	117.5m2

Source : Calculated by the study team

Tableau 6.1 Caractéristiques des zones humides dans la zone du Grand Tunis

Aspect	Sebkhet Ariana	Sebkhet Sijoumi	Tunis Lake
Area	8x4 km; 2500 ha	9x4 km; 300 ha	10x5 km; 4100 ha
Altitude	0-50 m	0-50 m	0-50 m
Site Description	Geology (recent alluvial/lacustral deposits) Water Chemistry (saline) Hydrology (water level varies with rainfall) Depth-fluctuations/permanence (dries out completely most summers leaving thick salt crust; shallow)	Geology (a closed basin, recent alluvial and lacustral deposits); water chemistry (saline but variable); hydrology (inflow of polluted water prevents it from drying in summer); Depth/fluctuation/permanence (permanent in winter, dry in summer with salt crust, wastewater areas remain wet and marshy throughout, very shallow, < 1.4 m)	Geology (on alluvial plain with sediment transported by Oued Mejerdah and Miliane). receives most of capital's waste water and is very eutrophic (south lake); Salinity higher than in Gulf of Tunis because of wastewaters. salinity 35-44 g/l; Hydrology (localised exchange of water between north and south lake via causeway , and canals to the sea.
Floral value		Atriplex amplexicaulis, A. glauca	Phytoplankton 100-400 mg/m Chl.a
Faunal value	Brine shrimp, copepods, rotifers and nematodes. Important for migrating and wintering waterfowl; 1987: 11,557 Anatids, 2458 flamingoes, 3800 little stint, 20 grebes and many thousands of waders; Totalling upto 17,000 birds. Flamingoes have nested on the lake and the crane (Grus grus) used the lake as a roosting place; now due to disturbances there have been no crane for last five years; Interchange of birds with Tunis lake and Sebkhet Sijoumi; number of breeding birds is very small because of human activities around the Sebkhet.	Very important for birds. The marshy areas are major wader stopover sites during migration. Interchange of birds with Sebkhet Ariana and Tunis Lake. Flamingoes and waders in large nos. (up to 25,000). Sewage outlet from the Bardo and Melassine area attract dabbling ducks and waders. The Sebkhet is particularly important for birds with the reclamation of Tunis north lake. Flamingo nos. are dictated by availability of water. Breeding birds are very rare as people cross the water easily and this disturbs the bird population.	Crustaceans in salines; fish: eel, mulet, loup, daurade, shrimp Important for wintering birds; flamingoes (5000), ducks (20000), waders (10,000) Fulica atra (20,000); Breeding colonies of Little Egret
Conservation Measures	Legal status (unprotected but hunting is prohibited); management plan (none); Should be declared a Ramsar protected site because of bird nos. and species, and its relationship with Tunis lake and Sebket Sijoumi	Legal status (unprotected but hunting is prohibited; management plan (none); Should be declared a Ramsar protected site because of bird nos. and species, and its relationship with Tunis lake and Sebket Ariana.	Legal status (unprotected but hunting is prohibited); management plan (none); Should be declared a Ramsar protected site because of bird nos. and species, and its relationship with Sebkhet Sijoumi and Sebket Ariana.
Hydrological values	Used to be almost rainfed, but presence of a purification plant has resulted in sporadic discharge of water. The plant's settling ponds are a great source of bird diversity.	Inflow of wastewater from Tunis attracts very rich bird populations.	Lake is never dry; Polluted waters of South lake attract very large no. of birds.
Socio-economic values	The Sebkhet could form part of a wetland educational center for Tunis school children; great potential due to proximity to Tunis; Scientific work: surveys of wintering waterfowl have been carried out since 60s.	Enormous potential for the development of educational facilities and a visitor center for Tunis.	Enormous potential for the development of educational facilities and a visitor center for Tunis.
Land Tenure	State ownership	State ownership	State ownership
Land Use	On site salt pans (1 x 1.5 km), water purification plant, rubbish tipping; In catchment (urbanization, quarrying, industry, agriculture, roads, forests)	On site (rubbish tipping, constructed station for composting on east shore and car wrecking on the south shore. Also used for disposal of urban wastewater from Tunis. In catchment (urbanization on north shore, tree plantations on eastern shore and olive groves to the west.	Significant industrial and domestic wastewater discharge into South lake; North lake cleaned up and land reclaimed for urbanization; cleaner North lake is attracting fewer birds.
Disturbances and Threats	Encroachment for urban development and increased pressures from tourism develop.	Pollution and rubbish tipping, urban effluent; breeding flamingoes disturbed by humans.	
References	Scott (1980), Ben Abdelkader (1985), Gaultier (1987)	Scott(1980), Ben Abdelkader (1985), Gaultier (1987), Monval & Pirot (1989)	Scott(1980), Ben Abdelkader (1985), Gaultier(1987), Monval & Pirot (1989)

Source: Friends of the Birds, Tunis (1993)

Tableau 6.2 Nombres maximums et moyens des oiseaux dans les cinq dernières années (1989-1993) dans les zones humides du Grand Tunis

Site	Species		Frequency.	Maximum	Average Nos.
	Scientific Name	Common Name	of Counts	Number	in recent 5 years
Sebkhet	Aythya Fuligula		5	8	2
Ariana	Tadorna Tadorna	Shelduk		506	251
	Anas Species			100	20
Tunis Lake	Anas Acuta	Duck	5	1,250	520
	Aythya ferina	Pochard		5,150	1,386
	Anas Clypeata	Shoveler		6,540	2,008
	Anas Platyrhynchos	Mallard		60	31
	Aythya Fuligula			350	71
	Anas Crecca	Winter teal		350	153
	Tadorna Tadorna	Shelduk		260	113
	Anas Strepera			7	2
	Fulica Atra			21,800	5,750
	Anas Penelope			650	265
	Aythya Ferina	Pochard	5	150	52
Sebkhet	Tadorna Tadorna	Shelduk	5	4,000	2,067
Sijoumi	Anas Clypeata	Shovler		3,600	2,080
	Anas Crecca	Teal		500	140
	Anas Acuta	Duck		1,000	276
	Fulica Atra			2,500	715

Source: Friends of the Birds, Tunis, 1993

Tableau 6.3 Matrice de l'évaluation de l'impact environnemental de Oued Ennkhilet et Sebkhet Ariana

	Environmental parameters																					
	Natural physical resources					Natural ecology				Economic values					Socio-economic/quality of life							
Project Component	Watershed erosion	Surface water hydrology	Surface water quality	Ground water	Soil erosion	Green area	Freshwater fisheries	Marine fisheries	Land use changes	Roads	Drainage/flooding	Canal/weir maintenance	Employment opportunities (short term)		Public health	Water supplies	Cultural building/sights	Recreation	Environmental aesthetics	Transportation disruption	Air pollution	Noise pollution
Proposed works (Post Construction effects)																						
(1) River improvement works by excavation, backfilling and concreting along GP8 and Road 533	N	1	1	N	1	2	N	N	N	1	2	1	N		2	N	N	2	2	N	N	N
(2) Construction of flood diversion channel of 4 km length from Road 533 to Sebkhet Ariana	N	1	1	N	1	2	N	N	N	1	2	1	N		2	N	N	2	2	N	N	N
(3) Widening of river channel along road 533	N	1	1	N	1	1	N	N	N	1	2	1	N		2	N	N	2	2	N	N	N
(4) Improvement of outlet facilities of Sebkhet Ariana crossing the public roads.	N	1	1	N	1	N	N	N	N	1	2	1	N		2	N	N	2	2	N	N	N
(5) Excavated soil at the proposed retarding basins (pond type G,H,I,J,K,L,M,N) will be utilized as fill material for dam type retarding basin (A,B,C,D,E, & F)	N	N	N	N	1	N	N	N	N	N	2	1	N		2	N	N	2	2	N	N	N
Type of Works (During Construction Effects)																						
(1) Excavation & fill by tight to middle classes of earthmoving equipment	(1)	N	N	N	(1)	(1)	N	N	N	N	N	(1)	2		(1)	N	N	(1)	(1)	(1)	(1)	(1)
(2) Piling work using pile driver or vibration hammer	(1)	N	N	N	(1)	(1)	N	N	N	N	N	(1)	2		(1)	N	N	(1)	(1)	(1)	(1)	(1)
(3) Soil transportation	(1)	N	N	N	N	N	N	N	N	N	N	(1)	2		(1)	N	N	N	(1)	(1)	(1)	(1)
(4) Concreting	N	N	N	N	N	N	N	N	N	N	N	(1)	2		N	N	N	N	(1)	(1)	(1)	(1)

Notes: Levels of effects

N = No significant effect. 1 = Slight effect 2 = Significant effect 3 = Major effect

Parentheses indicate negative or adverse effect

Tableau 6.4 Mesures de mitigation environnementale pour les impacts négatifs possibles durant les travaux de construction des ouvrages de protection

Possible negative impacts during construction works	Mitigation measures
Disruption of transportation and possible occurence of accidents	Appropriate diversion, supervision and security arrangements for traffic control at construction site with adequate signs and manpower.
Air pollution due to construction works and transportation of construction materials.	Appropriate mitigation measures like regular sprinkling of water at construction site.
Noise pollution	Avoid working at night in or near densely populated areas. Determine work shifts to cause minimum noise pollution.
Conservation of river bank soil	Use appropriate construction methods to minimize soil erosion and create suitable landscaping.
Public health hazard	Construct clean and adequate temporary quarters for labor force employed for construction works with adequate sanitation facilities.

Tableau 7.1 Zones inondables et durées à Oued Ennkhilet

Zone-A (Refer to Fig.10.1)

Return Period (year)	Present Land Use Condition					Future Land Use Condition (2020)				
	Flood Area (ha)				Duration (hours)	Flood Area (ha)				Duration (hours)
	Urban	Agricul.	Open	Total		Urban	Agricul.	Open	Total	
1.05	5	7	1	13	2	24	0	0	24	3
2	9	13	1	23	3	36	0	0	36	5
5	14	20	2	36	4	47	0	0	47	8
10	18	26	2	46	5	58	0	1	59	10
25	28	39	4	71	8	81	0	1	82	15
50	37	52	5	94	10	105	0	1	106	20
100	46	65	6	117	12	116	0	1	117	24

Zone-B (Refer to Fig.10.1)

Return Period (year)	Present Land Use Condition					Future Land Use Condition (2020)				
	Flood Area (ha)				Duration (hours)	Flood Area (ha)				Duration (hours)
	Urban	Agricul.	Open	Total		Urban	Agricul.	Open	Total	
1.05	9	13	27	49	4	33	8	20	61	7
2	14	20	40	74	6	45	11	28	84	11
5	18	26	53	97	9	58	14	36	108	14
10	23	33	66	122	11	71	18	45	134	18
25	29	43	86	158	15	91	22	57	170	25
50	36	53	105	194	20	110	27	69	206	30
100	45	66	131	242	24	129	32	81	242	35

Zone-C&D (Refer to Fig.10.1)

Return Period (year)	Present Land Use Condition					Future Land Use Condition (2020)				
	Flood Area (ha)				Duration (hours)	Flood Area (ha)				Duration (hours)
	Urban	Agricul.	Open	Total		Urban	Agricul.	Open	Total	
1.05	17	3	20	40	4	34	0	16	50	7
2	25	5	30	60	6	47	0	22	69	11
5	33	6	40	79	9	61	0	28	89	14
10	41	8	49	98	11	74	0	34	108	18
25	54	10	64	128	15	94	0	44	138	25
50	66	13	79	158	20	114	0	53	167	30
100	82	16	98	196	24	134	0	62	196	35

Zone-E&F (Refer to Fig.10.1)

Return Period (year)	Present Land Use Condition					Future Land Use Condition (2020)				
	Flood Area (ha)				Duration (hours)	Flood Area (ha)				Duration (hours)
	Urban	Agricul.	Open	Total		Urban	Agricul.	Open	Total	
1.05	5	22	12	39	4	13	4	31	48	7
2	8	32	18	58	6	19	5	44	68	11
5	10	43	24	77	9	24	6	57	87	14
10	13	54	30	97	11	29	8	69	106	18
25	16	70	39	125	15	37	10	88	135	25
50	20	86	48	154	20	45	12	107	164	30
100	25	107	60	192	24	53	14	125	192	35

Tableau 8.1 Distribution des débits de la crue décennale pour le criblage des bassins d'écrêtement

(Unit : m3/s)

Stretch	w/o R.B	Ain Snoussi		R.B-A		R.B-B		R.B-C		R.B-D		R.B-E		R.B-F		R.B-G		R.B-H		R.B-I		R.B-J		R.B-K		R.B-L		R.B-M		R.B-N1		R.B-N2	
No.	Peak Q	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.	Peak Q	Differ.
E-1	40.5	39.5	1.0	39.9	0.6	39.4	1.1	40.5	0.0	39.6	0.9	40.5	0.0	40.5	0.0	37.4	3.1	40.5	0.0	35.4	5.1	38.0	2.5	38.0	2.5	33.2	7.3	36.7	3.8	36.7	3.8	39.2	1.3
E-2	37.4	36.0	1.4	36.4	1.0	36.6	0.8	36.9	0.5	36.2	1.2	36.9	0.5	37.4	0.0	33.8	3.6	36.5	0.9	31.6	5.8	34.7	2.7	34.7	2.7	29.3	8.1	33.0	4.4	33.0	4.4	35.9	1.5
E-3	32.0	30.8	1.2	30.8	1.2	32.0	0.0	32.0	0.0	31.0	1.0	31.5	0.5	32.0	0.0	28.2	3.8	31.0	1.0	25.8	6.2	28.6	3.4	28.6	3.4	23.6	8.4	27.3	4.7	29.4	2.6	32.0	0.0
E-4	29.4	28.2	1.2	28.7	0.7	29.4	0.0	29.4	0.0	29.4	0.0	29.4	0.0	29.2	0.2	25.5	3.9	28.9	0.5	22.8	6.6	26.3	3.1	26.3	3.1	20.4	9.0	25.8	3.6	29.4	0.0	29.4	0.0
E-5	29.4	28.2	1.2	28.7	0.7	29.4	0.0	29.4	0.0	29.4	0.0	29.4	0.0	29.2	0.2	25.5	3.9	28.9	0.5	22.8	6.6	26.3	3.1	26.3	3.1	20.4	9.0	25.8	3.6	29.4	0.0	29.4	0.0
E-6	25.8	24.2	1.6	25.8	0.0	25.8	0.0	25.8	0.0	25.8	0.0	25.8	0.0	25.4	0.4	21.5	4.3	25.1	0.7	18.8	7.0	22.3	3.5	22.3	3.5	18.4	7.4	25.8	0.0	25.8	0.0	25.8	0.0
E-7	25.8	24.2	1.6	25.8	0.0	25.8	0.0	25.8	0.0	25.8	0.0	25.8	0.0	25.4	0.4	21.5	4.3	25.1	0.7	18.8	7.0	22.3	3.5	22.3	3.5	18.4	7.4	25.8	0.0	25.8	0.0	25.8	0.0
E-8	18.4	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	17.8	0.6	11.4	7.0	16.9	1.5	8.5	9.9	12.1	6.3	15.2	3.2	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0
E-9.D/S	18.4	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	17.8	0.6	10.9	7.5	16.9	1.5	7.0	11.4	12.1	6.3	15.1	3.3	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0
E-9.U/S	18.4	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0	17.8	0.6	10.9	7.5	16.9	1.5	7.0	11.4	12.1	6.3	15.1	3.3	18.4	0.0	18.4	0.0	18.4	0.0	18.4	0.0
E-10	12.1	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	6.2	5.9	10.6	1.5	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0	12.1	0.0
E-11	6.2	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	2.8	3.4	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0	6.2	0.0
C1-1	5.8	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0	5.8	0.0
C1-2	4.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0	4.0	0.0
C1-3	2.4	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0	2.4	0.0
C1-4	1.2	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2	0.0
G2-1.D/S	7.8	7.8	0.0	6.0	1.8	7.8	0.0	7.8	0.0	7.8	0.0	7.3	0.5	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0
G2-1.M/S	7.8	7.8	0.0	6.0	1.8	7.8	0.0	7.8	0.0	7.8	0.0	7.3	0.5	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0
G2-1.U/S	7.8	7.8	0.0	6.0	1.8	7.8	0.0	7.8	0.0	7.8	0.0	7.3	0.5	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0	7.8	0.0
G2-2	5.4	5.4	0.0	2.5	2.9	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0	5.4	0.0
G1-1.D/S	13.6	11.5	2.1	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0
G1-1.U/S	13.6	11.5	2.1	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0
G1-2	8.9	5.3	3.6	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0	8.9	0.0
G1'	9.1	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0	9.1	0.0
C3-1	7.6	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	6.8	0.8	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	3.1	4.5	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0
C3-2	4.5	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	3.7	0.8	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0	4.5	0.0
C-4	9.3	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	1.5	7.8	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0	9.3	0.0
R2-1	11.2	11.2	0.0	11.2	0.0	8.8	2.4	10.4	0.8	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	11.2	0.0	7.6	3.6
R2-2.D/S	7.6	7.6	0.0	7.6	0.0	5.2	2.4	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0
R2-2.U/S	7.6	7.6	0.0	7.6	0.0	5.2	2.4	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0	7.6	0.0

Note : "R.B" = Retarding Basin, "Peak Q" = Peak Discharge, "Differ." = Difference of Discharge between in case with and without Retarding Basin

Tableau 8.2 Criblage des bassins d'écrêtement possible pour l'étude des variantes

Number of Retarding Basin	Type	Catchment Area (km2)	Construction Cost of Retarding Basin (DT 1,000) (A)	Decreased River Improvement Cost by Retarding Basin (DT 1,000) (B)	Retarding Basin Cost less Decreased River Impro. Cost (DT 1,000) (C)=(A)-(B)	Costs Ratio (D)=(A)/(B)	Selected Retarding Basin	Remarks
Ain Snoussi	Dam	1.09	58.0	174.1	-116.1	0.33	Existing	Existing retarding basin constructed by the Ministry of Agriculture.
A	Dam	0.92	42.9	118.1	-75.2	0.36	O	It shows a high economic advantage.
B	Dam	1.11	741.8	82.6	659.2	8.98		It shows a low economic advantage.
C	Dam	0.21	123.2	8.7	114.5	14.16		It shows a low economic advantage.
D	Dam	1.02	251.5	33.3	218.2	7.55		It shows a low economic advantage.
E	Dam	0.2	114.0	18.0	96.0	6.33		It shows a low economic advantage.
F	Dam	0.25	84.2	22.3	61.9	3.78		It shows a low economic advantage.
G	Pond	1.62	467.9	1,486.9	-1,019.0	0.31	O	It shows a high economic advantage. Further study in combination with Retarding Basin I is required.
H	Pond	0.36	1,119.6	152.2	967.4	7.36		It shows a low economic advantage.
I	Pond	2.46	1,752.0	1,476.4	275.6	1.19	O	It shows a relatively high economic advantage. Further study in combination with Retarding Basins G, J1 and diversion plan is required.
J1	Pond	1.05	580.3	930.5	-350.2	0.62	O	It shows a high economic advantage. Further study in combination with Retarding Basin I and diversion plan is required.
J2	Pond	0.34	-	-	-	-		It is a prospective retarding basin site, however this site is discarded for alternative study because housing development at the site was commenced during the Study.
K	Pond	0.71	2,014.5	632.3	1,382.2	3.19		It shows a low economic advantage.
L	Pond	3.09	1,053.8	533.6	520.2	1.97	O	It shows a relatively high economic advantage. Further study in combination with Retarding Basin M, Ain Snoussi Dam and diversion plan is required.
M	Pond	1.93	460.4	197.4	263.0	2.33	O	It shows a relatively high economic advantage. Further study in combination with Retarding Basins A, L and diversion plan is required.
N1	Pond	1.92	1,170.8	119.4	1,051.4	9.81		It shows a low economic advantage.
N2	Pond	0.57	712.3	48.2	664.1	14.78		It shows a low economic advantage.

Tableau 8.3 Distribution des débits des crues dans les variantes avec canaux de déviation

Stretch No.	Distributed Flood Discharge (m3/s)							
	Alt. Div.0	Alt. Div.3	Alt. Div.4	Alt. Div.5	Alt. Div.2&3	Alt. Div.3&4	Alt. Div.3&5	Alt. Div.3,4&5
E-1	40	40	40	40	40	40	40	40
E-2	40	35	24	22	35	24	22	22
E-3	35	26	16	10	26	16	10	10
E-4	30	22	9	1.4	22	9	1.4	1.4
E-5	30	22	9	28	22	9	22	9
E-6	24	16	1.8	24	16	1.8	16	1.8
E-7	24	16	24	24	16	16	16	16
E-8	20	3.5	20	20	3.5	3.5	3.5	3.5
E-9,D/S	20	20	20	20	16	20	20	20
E-9,U/S	20	20	20	20	16	20	20	20
E-10	14	14	14	14	14	14	14	14
E-11	7	7	7	7	7	7	7	7
C1-1	6	6	26	30	6	18	24	24
C1-2	4	4	26	30	4	18	24	24
C1-3	2.4	2.4	26	2.4	2.4	18	2.4	18
C1-4	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
G2-1,D/S	8	8	8	8	8	8	8	8
G2-1,M/S	8	8	8	8	8	8	8	8
G2-1,U/S	8	8	8	8	8	8	8	8
G2-2	6	6	6	6	6	6	6	6
G1-1,D/S	12	12	12	12	12	12	12	12
G1-1,U/S	12	12	12	12	12	12	12	12
G1-2	6	6	6	6	6	6	6	6
G1'	10	10	10	10	10	10	10	10
C3-1	9	9	9	9	9	9	9	9
C3-2	5	5	5	5	6	5	5	5
C-4	10	10	10	10	10	10	10	10
R2-1	12	12	12	12	12	12	12	12
R2-2,D/S	8	8	8	8	8	8	8	8
R2-2,U/S	8	8	8	8	8	8	8	8
Div. 2,D/S	0	0	0	0	6	0	0	0
Div. 2,M/S	0	0	0	0	6	0	0	0
Div. 2,U/S	0	0	0	0	6	0	0	0
Div. 3,D/S	22	28	22	22	28	28	28	28
Div. 3,U/S	4	20	4	4	16	20	20	20
Div. 4	0	0	26	0	0	18	0	18
Div. 5,D/S	0	0	0	30	0	0	24	9
Div. 5,U/S	0	0	0	30	0	0	24	9

Tableau 8.4 Distribution des débits des crues dans les variantes avec bassins d'écrêtement

Stretch/ Facility	Distributed Flood Discharge (m3/s)								
	Alt. U-1	Alt. U-2	Alt. U-3	Alt. D-1	Alt. D-2	Alt. D-3	Alt. D-4	Alt. D-5	Alt. D-6
E-1	-	-	-	28	30	30	35	40	40
E-2	-	-	-	22	24	22	18	24	22
E-3	-	-	-	14	16	10	9	14	10
E-4	-	-	-	8	12	1.4	1.8	8	1.4
E-5	-	-	-	8	12	12	1.8	8	8
E-6	-	-	-	6	6	6	1.8	1.8	1.8
E-7	-	-	-	6	6	6	16	16	16
E-8	-	-	-	3.5	3.5	3.5	3.5	3.5	3.5
E-9,D/S	3	3	14	-	-	-	-	-	-
E-9,U/S	3	3	14	-	-	-	-	-	-
E-10	1.2	1.4	7	-	-	-	-	-	-
E-11	7	7	7	-	-	-	-	-	-
C1-1	-	-	-	6	6	14	16	16	22
C1-2	-	-	-	4	4	14	16	16	20
C1-3	-	-	-	2.4	2.4	2.4	16	16	16
C1-4	-	-	-	1.2	1.2	1.2	1.2	1.2	1.2
G2-1,D/S	-	-	-	7	7	7	7	7	7
G2-1,M/S	-	-	-	7	7	7	7	7	7
G2-1,U/S	-	-	-	7	7	7	7	7	7
G2-2	-	-	-	2.8	2.8	2.8	2.8	2.8	2.8
G1-1,D/S	-	-	-	12	12	12	12	12	12
G1-1,U/S	-	-	-	12	12	12	12	12	12
G1-2	-	-	-	6	6	6	6	6	6
G1'	-	-	-	10	10	10	10	10	10
C3-1	0.5	0.4	0.5	-	-	-	-	-	-
C3-2	8	6	8	-	-	-	-	-	-
C-4	2.6	2.6	2.6	-	-	-	-	-	-
R2-1	-	-	-	12	12	12	12	12	12
R2-2,D/S	-	-	-	8	8	8	8	8	8
R2-2,U/S	-	-	-	8	8	8	8	8	8
Div. 2,D/S	-	6	-	-	-	-	-	-	-
Div. 2,M/S	-	6	-	-	-	-	-	-	-
Div. 2,U/S	-	6	-	-	-	-	-	-	-
Div. 3,D/S	22	24	26	-	-	-	-	-	-
Div. 3,U/S	5	7	14	-	-	-	-	-	-
Div. 4	-	-	-	-	-	-	16	16	16
Div. 5,D/S	-	-	-	-	-	12	-	-	8
Div. 5,U/S	-	-	-	-	-	12	-	-	8
Ain Snoussi	-	-	-	Exist	Exist	Exist	Exist	Exist	Exist
R.B-A	-	-	-	Required	Required	Required	Required	Required	Required
R.B-B	-	-	-	-	-	-	-	-	-
R.B-C	-	-	-	-	-	-	-	-	-
R.B-D	-	-	-	-	-	-	-	-	-
R.B-E	-	-	-	-	-	-	-	-	-
R.B-F	-	-	-	-	-	-	-	-	-
R.B-G	Required	Required	Required	-	-	-	-	-	-
R.B-H	-	-	-	-	-	-	-	-	-
R.B-I	Required	Required	-	-	-	-	-	-	-
R.B-J	Required	Required	-	-	-	-	-	-	-
R.B-K	-	-	-	-	-	-	-	-	-
R.B-L	-	-	-	Required	Required	Required	-	-	-
R.B-M	-	-	-	Required	-	-	Required	-	-
R.B-N1	-	-	-	-	-	-	-	-	-
R.B-N2	-	-	-	-	-	-	-	-	-

Tableau 8.5 Coûts de construction de la variante avec canaux de déviation

Stretch No.	Construction Cost (DT 1,000)							
	Alt. Div.0	Alt. Div.3	Alt. Div.4	Alt. Div.5	Alt. Div.2&3	Alt. Div.3&4	Alt. Div.3&5	Alt. Div.3,4&5
E-1	786	786	786	786	786	786	786	786
E-2	619	563	439	415	563	439	415	415
E-3	178	127	92	67	127	92	67	67
E-4	1,054	867	480	0	867	480	0	0
E-5	70	58	32	65	58	32	58	32
E-6	710	537	0	710	537	0	537	0
E-7	40	30	40	40	30	30	30	30
E-8	1,555	0	1,555	1,555	0	0	0	0
E-9,D/S	613	613	613	613	559	613	613	613
E-9,U/S	709	709	709	709	634	709	709	709
E-10	129	129	129	129	129	129	129	129
E-11	403	403	403	403	403	403	403	403
C1-1	176	176	250	266	176	219	243	243
C1-2	159	159	222	235	159	196	215	215
C1-3	192	192	339	192	192	294	192	294
C1-4	0	0	0	0	0	0	0	0
G2-1,D/S	188	188	188	188	188	188	188	188
G2-1,M/S	220	220	220	220	220	220	220	220
G2-1,U/S	3	3	3	3	3	3	3	3
G2-2	104	104	104	104	104	104	104	104
G1-1,D/S	389	389	389	389	389	389	389	389
G1-1,U/S	107	107	107	107	107	107	107	107
G1-2	182	182	182	182	182	182	182	182
G1'	130	130	130	130	130	130	130	130
C3-1	0	0	0	0	0	0	0	0
C3-2	0	0	0	0	0	0	0	0
C-4	437	437	437	437	437	437	437	437
R2-1	113	113	113	113	113	113	113	113
R2-2,D/S	264	264	264	264	264	264	264	264
R2-2,U/S	132	132	132	132	132	132	132	132
Div. 2,D/S	0	0	0	0	140	0	0	0
Div. 2,M/S	0	0	0	0	154	0	0	0
Div. 2,U/S	0	0	0	0	31	0	0	0
Div. 3,D/S	0	187	0	0	187	187	187	187
Div. 3,U/S	0	483	0	0	373	483	483	483
Div. 4	0	0	586	0	0	498	0	498
Div. 5,D/S	0	0	0	203	0	0	187	146
Div. 5,U/S	0	0	0	394	0	0	353	244
Improve.Cost	9,659	7,615	8,356	8,450	7,486	6,689	6,663	6,203
Diversion Cost	0	671	586	597	885	1,168	1,210	1,558
Total Cost	9,659	8,286	8,942	9,047	8,371	7,857	7,873	7,761

Note: "Improve. Cost"=River Improvement Cost, "Diversion Cost"=Construction Cost of Diversion Channel

Tableau 8.6 Coûts de construction de la variante avec bassins d'écrêtement

Stretch/ Facility	Construction Cost (DT 1,000)								
	Alt. U-1	Alt. U-2	Alt. U-3	Alt. D-1	Alt. D-2	Alt. D-3	Alt. D-4	Alt. D-5	Alt. D-6
E-1	-	-	-	633	659	659	722	786	786
E-2	-	-	-	415	439	415	359	439	415
E-3	-	-	-	79	92	67	64	79	67
E-4	-	-	-	0	558	0	0	0	0
E-5	-	-	-	0	37	37	0	0	0
E-6	-	-	-	0	0	0	0	0	0
E-7	-	-	-	0	0	0	30	30	30
E-8	-	-	-	0	0	0	0	0	0
E-9,D/S	0	0	448	-	-	-	-	-	-
E-9,U/S	0	0	608	-	-	-	-	-	-
E-10	0	0	122	-	-	-	-	-	-
E-11	403	403	403	-	-	-	-	-	-
C1-1	-	-	-	176	176	203	211	211	235
C1-2	-	-	-	159	159	182	189	189	202
C1-3	-	-	-	192	192	192	282	282	282
C1-4	-	-	-	0	0	0	0	0	0
G2-1,D/S	-	-	-	180	180	180	180	180	180
G2-1,M/S	-	-	-	211	211	211	211	211	211
G2-1,U/S	-	-	-	3	3	3	3	3	3
G2-2	-	-	-	87	87	87	87	87	87
G1-1,D/S	-	-	-	389	389	389	389	389	389
G1-1,U/S	-	-	-	107	107	107	107	107	107
G1-2	-	-	-	182	182	182	182	182	182
G1'	-	-	-	130	130	130	130	130	130
C3-1	0	0	0	-	-	-	-	-	-
C3-2	0	0	0	-	-	-	-	-	-
C-4	0	0	0	-	-	-	-	-	-
R2-1	-	-	-	113	113	113	113	113	113
R2-2,D/S	-	-	-	264	264	264	264	264	264
R2-2,U/S	-	-	-	132	132	132	132	132	132
Div. 2,D/S	-	140	-	-	-	-	-	-	-
Div. 2,M/S	-	154	-	-	-	-	-	-	-
Div. 2,U/S	-	31	-	-	-	-	-	-	-
Div. 3,D/S	0	64	125	-	-	-	-	-	-
Div. 3,U/S	44	120	321	-	-	-	-	-	-
Div. 4	-	-	-	-	-	-	471	471	471
Div. 5,D/S	-	-	-	-	-	155	-	-	143
Div. 5,U/S	-	-	-	-	-	266	-	-	237
Ain Snoussi	-	-	-	Exist	Exist	Exist	Exist	Exist	Exist
R.B-A	-	-	-	66	66	66	66	66	66
R.B-B	-	-	-	-	-	-	-	-	-
R.B-C	-	-	-	-	-	-	-	-	-
R.B-D	-	-	-	-	-	-	-	-	-
R.B-E	-	-	-	-	-	-	-	-	-
R.B-F	-	-	-	-	-	-	-	-	-
R.B-G	355	355	355	-	-	-	-	-	-
R.B-H	-	-	-	-	-	-	-	-	-
R.B-I	971	855	-	-	-	-	-	-	-
R.B-J	522	212	-	-	-	-	-	-	-
R.B-K	-	-	-	-	-	-	-	-	-
R.B-L	-	-	-	851	851	851	-	-	-
R.B-M	-	-	-	253	-	-	437	-	-
R.B-N1	-	-	-	-	-	-	-	-	-
R.B-N2	-	-	-	-	-	-	-	-	-
Improve. Cost	403	403	1,581	3,451	4,108	3,552	3,655	3,813	3,814
Diversion Cost	44	509	446	0	0	421	471	471	851
R.B Cost	1,848	1,421	355	1,169	917	917	503	66	66
Total Cost	2,294	2,333	2,382	4,621	5,025	4,890	4,628	4,350	4,730

Note : "Improve. Cost" = River Improvement Cost, "Diversion Cost" = Construction Cost of Diversion Channel, "R.B Cost" = Construction Cost of Retarding Basin

Tableau 8.7 Résumé de l'étude comparative des variantes

Alternative Plan	Direct Construction Cost + Land Acquisition Cost (1,000 DT)				Remarks	Ranking	
	River Improvement	Diversion	Retarding Basin	Total		Group	Total
River Improvement Plan							
1. Alt. Div. 0	9,659	0	0	9,659	Only River Impr.	(1)	9
Diversion + River Improvement Plan							
2. Alt. Div. 3	7,615	671	0	8,286	Div.3 + River Impr.	(4)	5
3. Alt. Div. 4	8,356	586	0	8,942	Div. 4 + River Impr.	(6)	7
4. Alt. Div. 5	8,450	597	0	9,047	Div. 5 + River Impr.	(7)	8
5. Alt. Div. 2 & 3	7,486	885	0	8,371	Div. 2 & 3 + River Impr.	(5)	6
6. Alt. Div. 3 & 4	6,689	1,168	0	7,857	Div. 3 & 4 + River Impr.	(2)	3
7. Alt. Div. 3 & 5	6,663	1,210	0	7,873	Div. 3 & 5 + River Impr.	(3)	4
8. Alt. Div. 3, 4 & 5	6,203	1,558	0	7,761	Div. 3, 4 & 5 + River Impr.	(1)	2
Retarding Basin + Diversion + River Improvement Plan							
9. Alt. U-1 + D-5	4,216	515	1,914	6,644	R.B-A,G,I&J1 + Div.3&4 + River Impr.		1
- Upstream Basin							
9.1 Alt. U-1	403	44	1,848	2,294	R.B-G,I&J1 + Div.3 + River Impr.	(1)	
9.2 Alt. U-2	403	509	1,421	2,333	R.B-G,I&J1 + Div.2&3 + River Impr.	(2)	
9.3 Alt. U-3	1,581	446	355	2,382	R.B-G + Div.3 + River Impr.	(3)	
- Downstream Basin							
9.4 Alt. D-1	3,451	0	1,169	4,621	R.B-A,L&M + River Impr.	(2)	
9.5 Alt. D-2	4,108	0	917	5,025	R.B-A&L + River Impr.	(6)	
9.6 Alt. D-3	3,552	421	917	4,890	R.B-A&L + Div.5 + River Impr.	(5)	
9.7 Alt. D-4	3,655	471	503	4,629	R.B-A&M + Div.4 + River Impr.	(3)	
9.8 Alt. D-5	3,813	471	66	4,350	R.B-A + Div.4 + River Impr.	(1)	
9.9 Alt. D-6	3,814	851	66	4,730	R.B-A + Div.4&5 + River Impr.	(4)	

Note : "River Impr." = River Improvement , "Div." = Diversion , "R.B" = Reatarding Basin

Tableau 10.1 Zone industrielle de la Charguia/Ariana: emploi par secteur, 1990

Subsector	Units	Employees	Employees per Unit
Agriculture/Food	148	2,687	18.16
Building Materials /Construction	32	690	21.56
Mechanical/Electrical	75	2,820	37.60
Chemicals/Plastics	22	343	15.59
Textiles/Leather	209	10,558	50.52
Others	84	1,811	21.56
TOTAL:	570	18,909	33.17

Tableau 10.2 Commune de l'Ariana: Production et productivité agricole estimée

Crop	Area Cultivated (ha)	Production (ton)	Productivity (ton/ha)
Winter Crops	3,000	27,050	9.02
Summer Crops (Vegetables)	6,500	123,300	18.97
Irrigated Cereals (Haboub)	2,800	8,900	3.18
Animal Feedstuff	2,500	11,250	4.50
Cotton	80	160	2.0
Root Crops	100	3,500	35.0

Source : Note Relating to the flood Prone Areas ofSoukra-Chotrana, Ministry of Interior, District of Tunis

Tableau 10.3 Différence des coûts opérationnels des véhicules dans les cas avec ou sans inondations

(DT per 1,000 vehicle/km)

Vehicle Type	Non-flooded Case	Flooded Case	Difference
Private Car/Taxi	114.51	143.3	28.79
Bus	459.57	511.17	51.60
Light/Medium Goods	247.59	333.70	86.11
Heavy.goods	663.81	900.54	236.73

Tableau 10.4 Zone Z: Superficie estimé et dégâts pour les bâtiments

Category	Present Land Use H/holds (No)	Areas (m2)	Damages DT(1,000)	Future Land Use H/holds (No)	Areas (m2)	Damages DT(1,000)
Popular	810	48,600	729.0	2,400	144,000	2,160.0
Medium	184	18,400	460.0	544	544,000	13,600.0
High	86	12,900	451.5	256	38,400	1,344.0
TOTAL:			1,641.0			17,104.0

Tableau 10.5 Oued Ennkhilet - Estimation du nombre journalier des passagers sur la GP-8

Category	Vehicles	Occup. Rate	Total Passengers
Passenger and taxis	43,100	3.8	163,780
Buses	1,700	45	76,500
Light vehicles	20,300	2.0	40,600
Heavy vehicles	18,600	2.0	37,200
2 wheels	800	1.5	1,200
TOTAL:	84,500		319,280

Tableau 11.1 Résumé du coût du projet, Ennkhilet 1ère étape

(US$1.0 = DT1.0)

	Cost Items	F.C (1,000 US$)	L.C (1,000 DT)	Total (1,000 DT)
1.	Direct construction cost <1	3,646	2,856	6,502
2.	Land acquisition and compensation costs	0	3,738	3,738
3.	Government's administration expenses <2	0	325	325
4.	Engineering services expenses <3	780	195	975
	Sub-total	4,426	7,114	11,540
5.	Price contingency <4	356	1,356	1,712
6.	Physical contingency <5	600	1,241	1,841
	Total	5,382	9,711	15,093

Notes
- <1 : including TVA
- <2 : 5 % of direct construction cost
- <3 : 15 % of direct construction cost for detailed design and const. supervision including price and physical contingencies, 80 % of F.C
- <4 : 2.3 % F.C and 6.2 % L.C p.a.
- <5 : 15 % of total 1+2+3+5

Table 11.2 Résumé du coût du projet, Ennkhilet 2ème étape

(US$1.0 = DT1.0)

	Cost Items	F.C (1,000 US$)	L.C (1,000 DT)	Total (1,000 DT)
1.	Direct construction cost <1	4,140	3,327	7,467
2.	Land acquisition and compensation costs	0	0	0
3.	Government's administration expenses <2	0	373	373
4.	Engineering services expenses <3	896	224	1,120
	Total	5,036	3,924	8,960

Notes <1 : including TVA
<2 : 5 % of direct construction cost
<3 : 15 % of direct construction cost for detailed design and const. supervision excluding price and physical contingencies, due to unknown factor, 80 % of F.C

Table 11.3 Planning annuel de financement, Ennkhilet 1ère étape

unit (F.C: 1,000 US$, L.C & Total: 1,000 DT)

	Cost Items	F.C	L.C	Total	1994		1995		1996		1997		1998	
					F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
1.	Direct construction cost <1	3,646	2,856	6,502	0	0	0	0	729	571	1,823	1,428	1,094	857
2.	Land acquisition and compensation costs	0	3,738	3,738	0	0	0	3,738	0	0	0	0	0	0
3.	Government's administration expenses <2	0	325	325	0	16	0	65	0	98	0	65	0	81
4.	Engineering services expenses <3	780	195	975	0	0	234	59	156	39	195	49	195	49
	Sub-total *	4,426	7,114	11,540	0	16	0	3,803	729	669	1,823	1,493	1,094	938
5.	Price contingency <4	356	1,356	1,712	0	1	0	487	52	132	173	406	131	329
6.	Physical contingency <5	600	1,241	1,842										
	Total	5,383	9,711	15,094										

Notes
- <1 : including TVA
- <2 : 5 % of direct construction cost
- <3 : 15 % of direct construction cost for detailed design and construction supervision including price and physical contingencies, 80 % F.C
- <4 : 2.3 % F.C & 6.2 % L.C p.a., period for 1994-1998
- <5 : 15 % of total 1+2+3+5, period for 1994-1998
- * : Sub-total in each year (1994-1998) excludes E/S cost (item 4).

Tableau 13.1 Coût Bénéfice pour le projet de protection contre les inondations de Oued Ennkhilet

EIRR = 24.6% (Unit : 1,000 DT)

No.	Year	Cost			Benefit	Net Benefit
		Construction	O&M	Total		
1	1994	19	0	19	0	-19
2	1995	4,666	0	4,666	0	-4,666
3	1996	1,673	23	1,696	663	-1,033
4	1997	3,732	82	3,814	1,327	-2,487
5	1998	2,385	117	2,502	1,990	-512
6	1999		117	117	2,653	2,536
7	2000		117	117	2,894	2,777
8	2001		117	117	3,136	3,019
9	2002		117	117	3,377	3,260
10	2003		117	117	3,618	3,501
11	2004		117	117	3,860	3,743
12	2005		117	117	4,101	3,984
13	2006		117	117	4,342	4,225
14	2007		117	117	4,584	4,467
15	2008		117	117	4,825	4,708
16	2009		117	117	5,066	4,949
17	2010		117	117	5,307	5,190
18	2011		117	117	5,549	5,432
19	2012		117	117	5,790	5,673
20	2013		117	117	6,031	5,914
21	2014		117	117	6,273	6,156
22	2015		117	117	6,514	6,397
23	2016		117	117	6,755	6,638
24	2017		117	117	6,997	6,880
25	2018		117	117	7,238	7,121
26	2019		117	117	7,479	7,362
27	2020		117	117	7,720	7,603
28	2021		117	117	7,720	7,603
29	2022		117	117	7,720	7,603
30	2023		117	117	7,720	7,603
31	2024		117	117	7,720	7,603
32	2025		117	117	7,720	7,603
33	2026		117	117	7,720	7,603
34	2027		117	117	7,720	7,603
35	2028		117	117	7,720	7,603
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50	2043		117	117	7,720	7,603

FIGURES

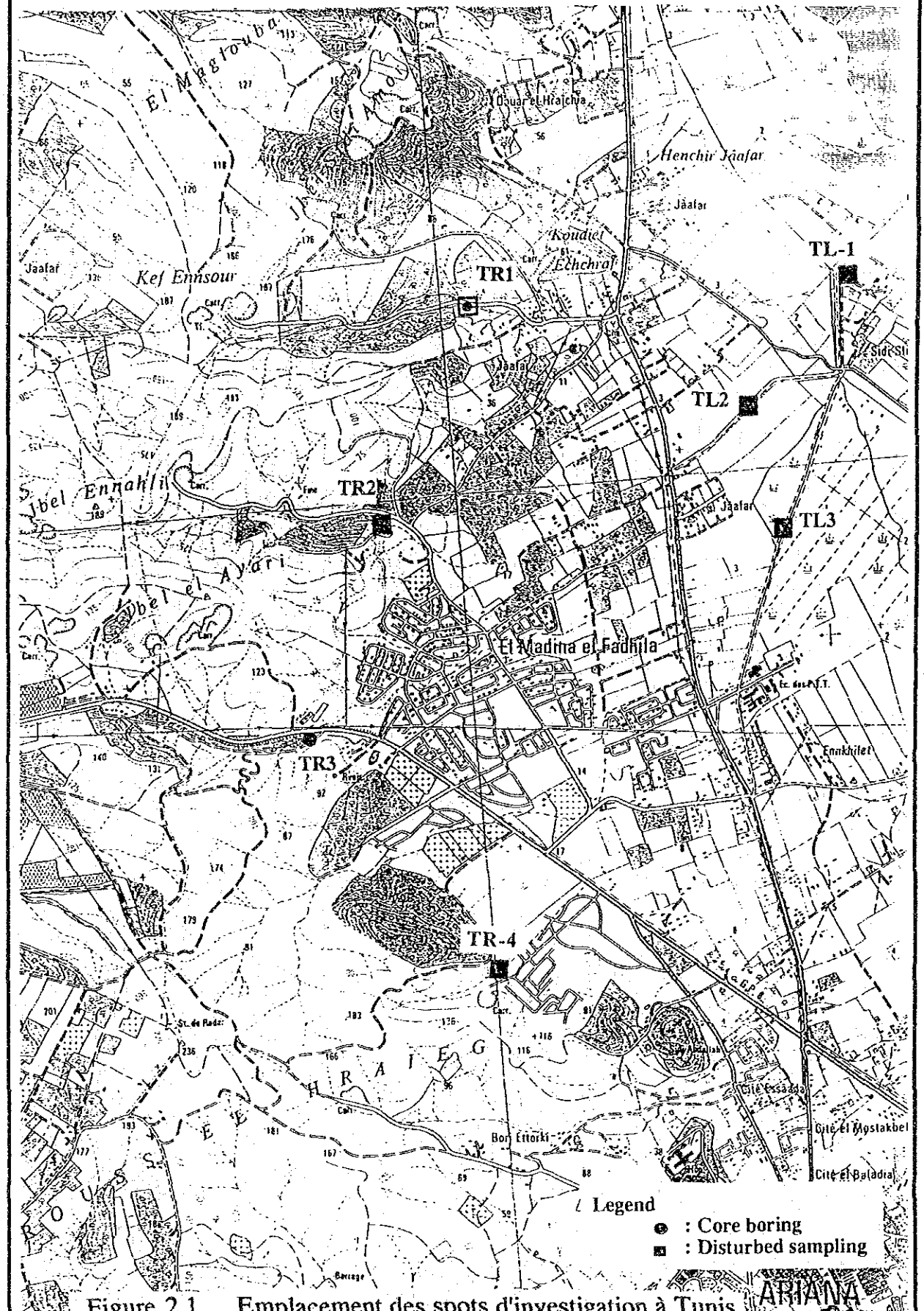


Figure 2.1 Emplacement des spots d'investigation à Tunis

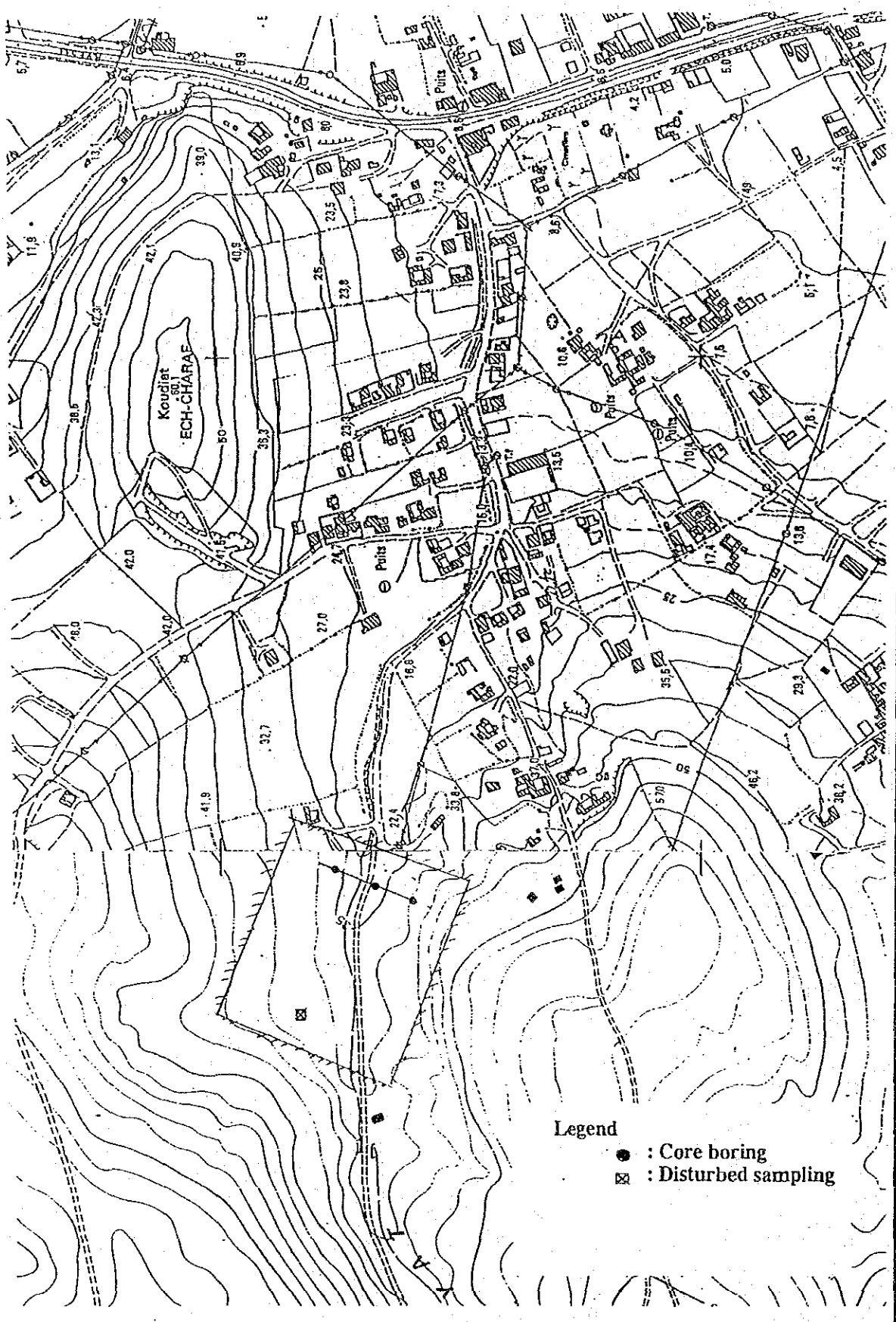


Figure 2.2 Emplacement détaillé de TR1

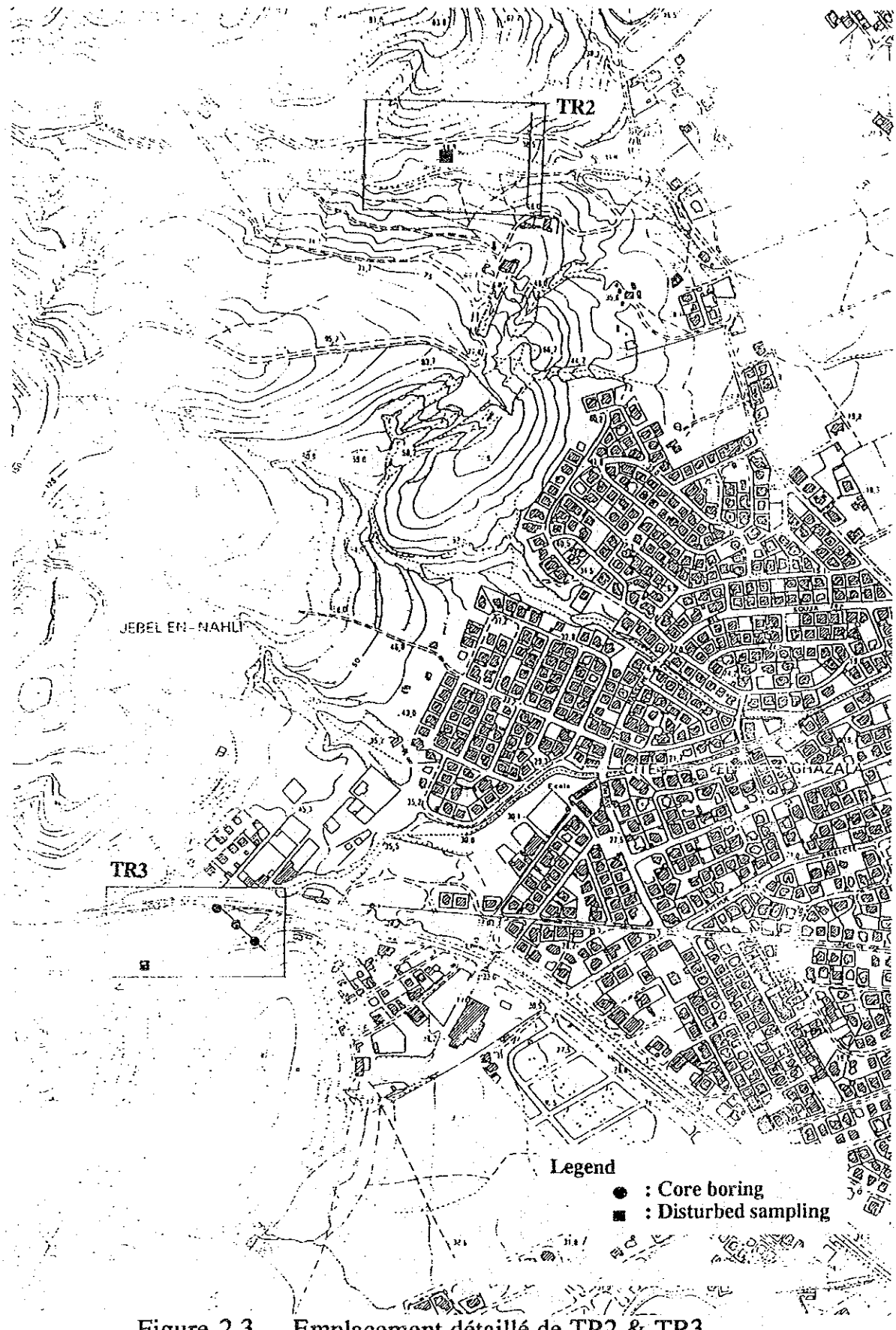


Figure 2.3 Emplacement détaillé de TR2 & TR3

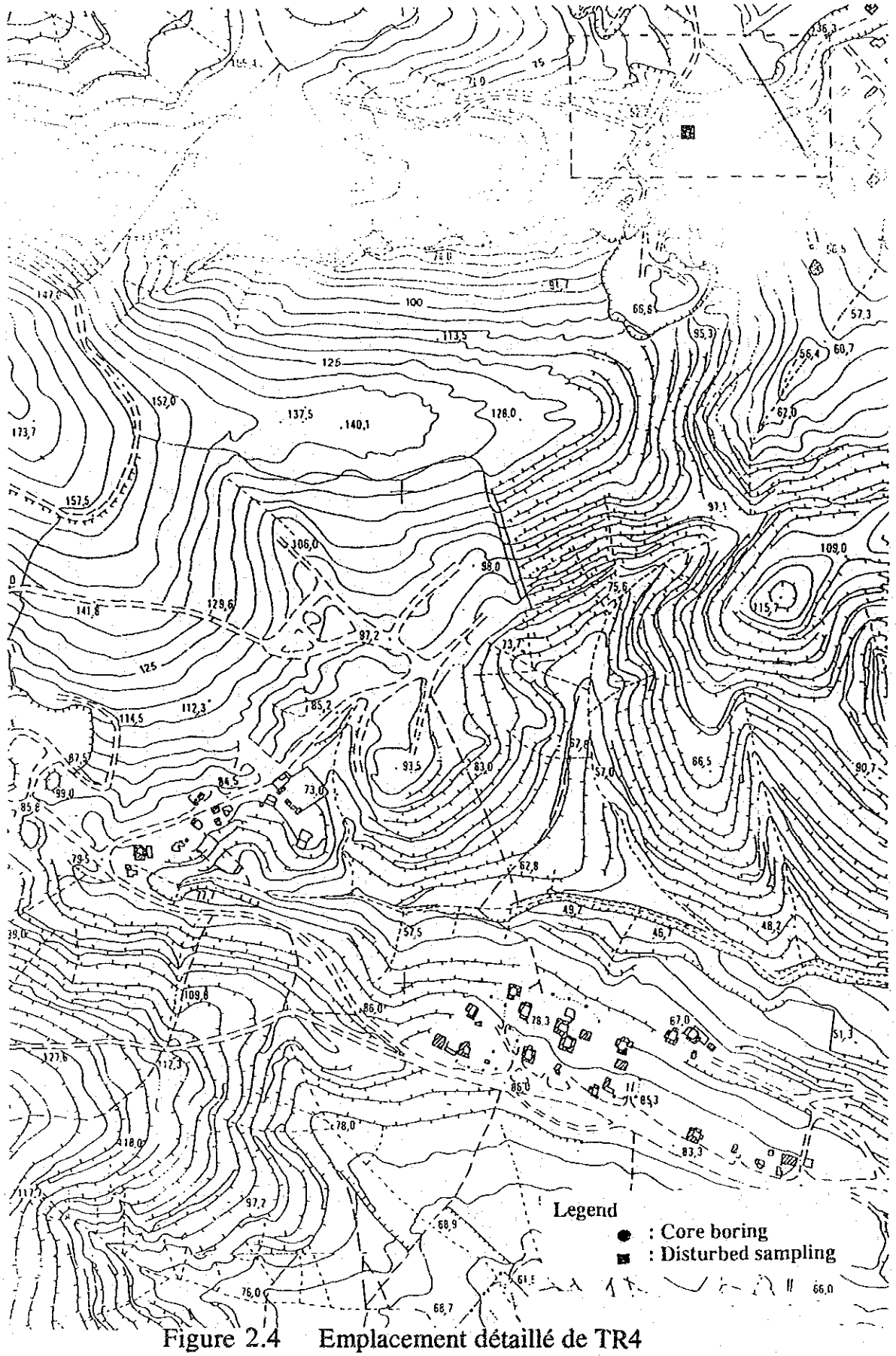


Figure 2.4 Emplacement détaillé de TR4

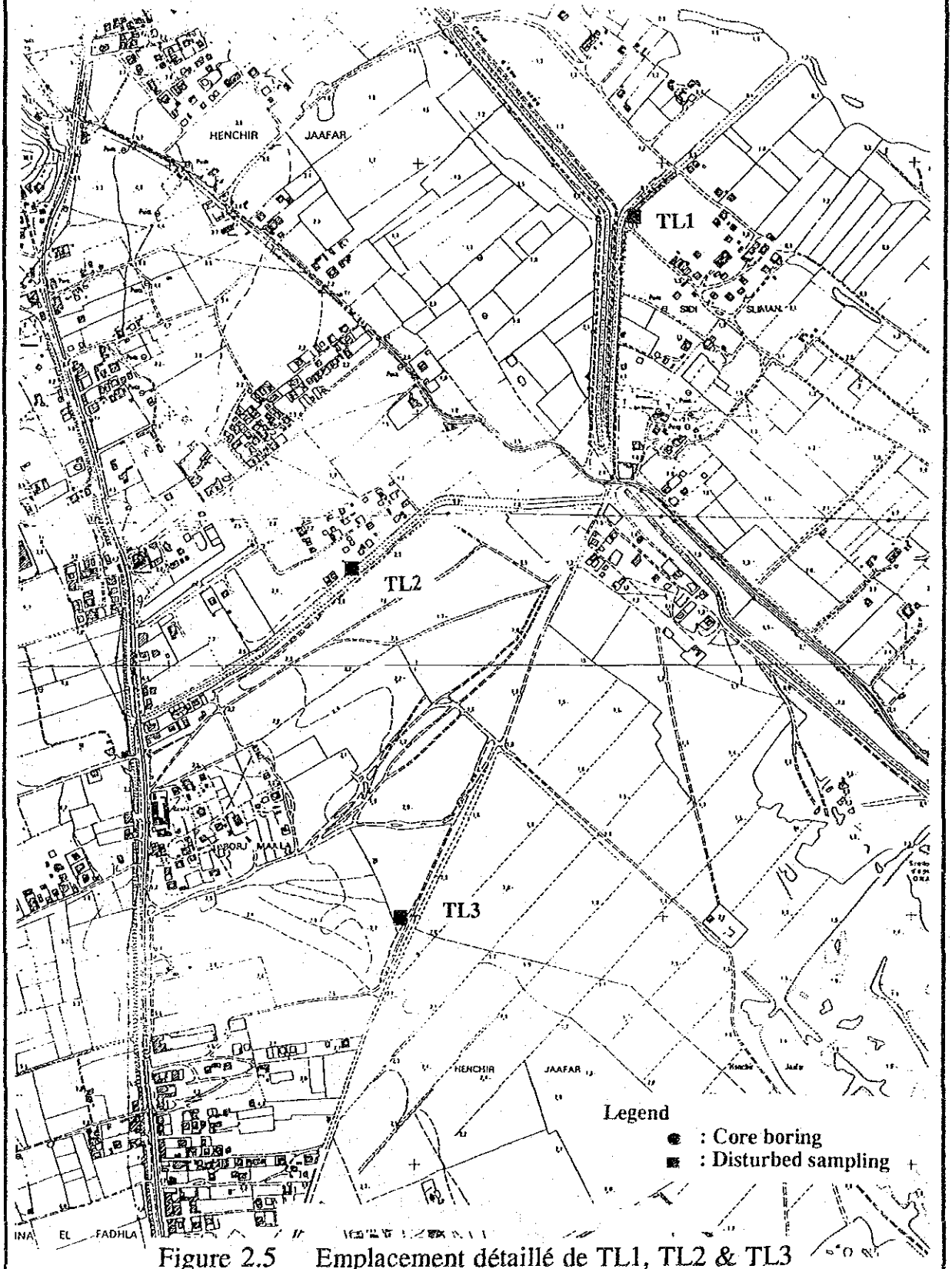


Figure 2.5 Emplacement détaillé de TL1, TL2 & TL3

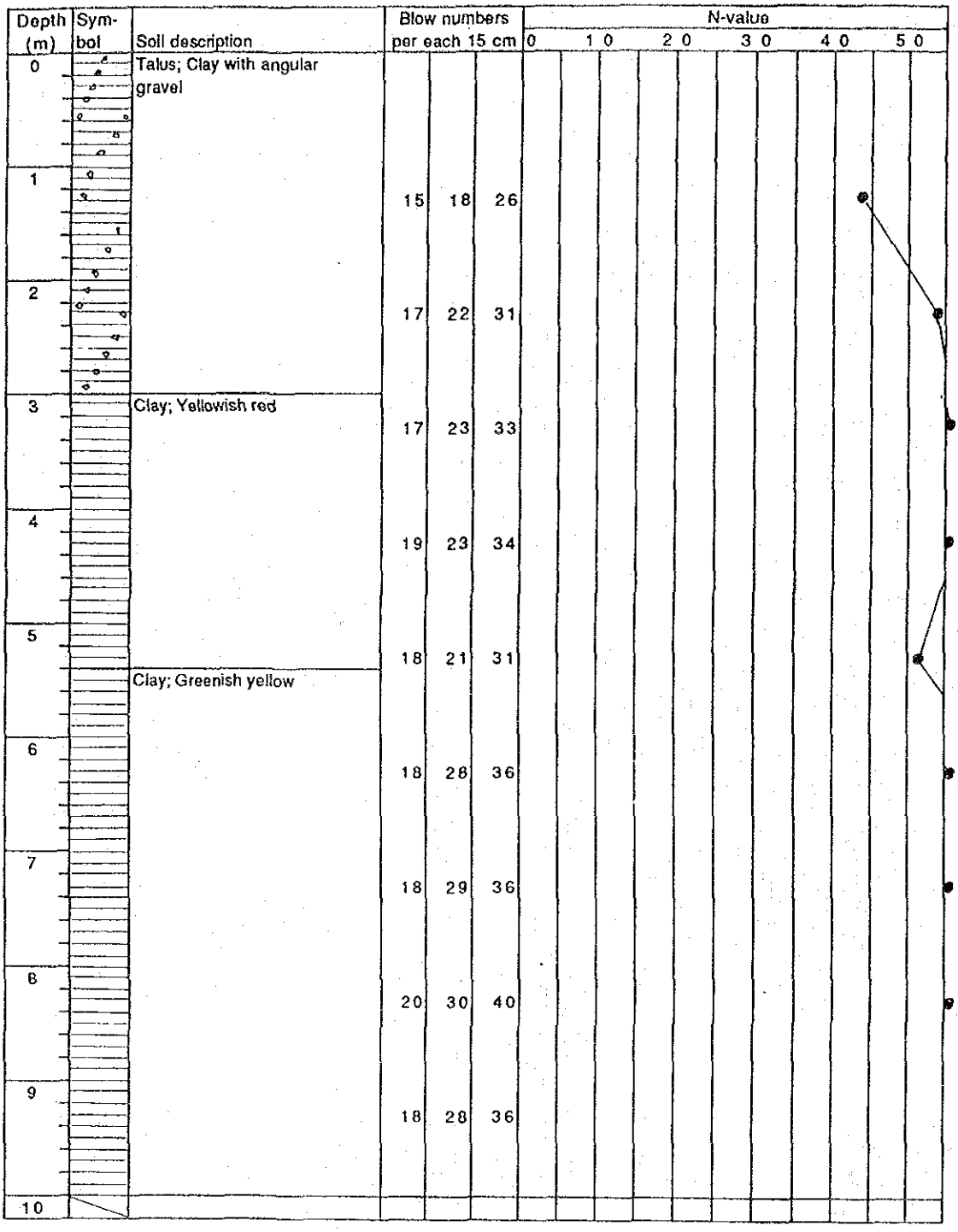


Figure 2.6 Carnet de forage de SC1

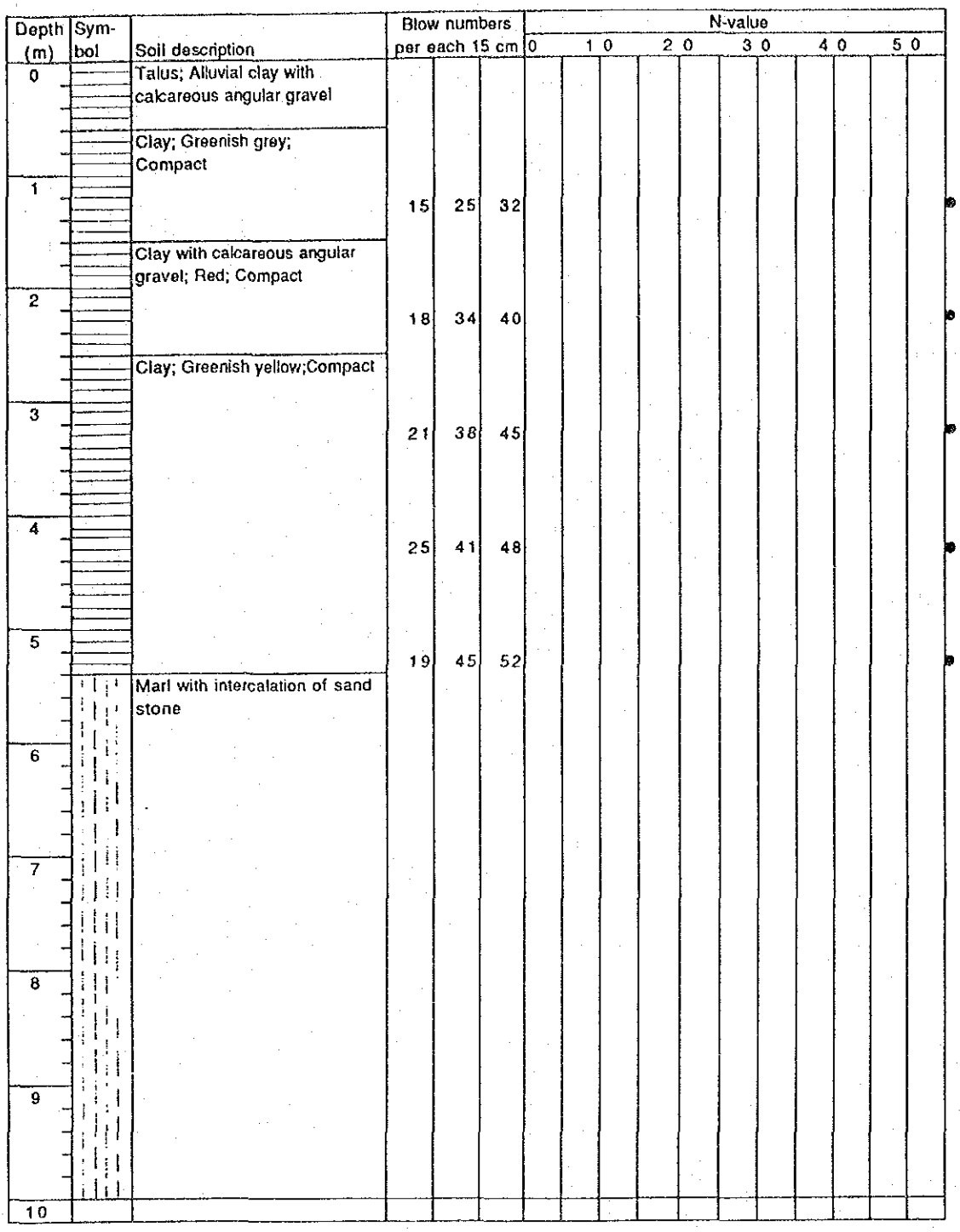


Figure 2.7 Carnet de forage de SC2

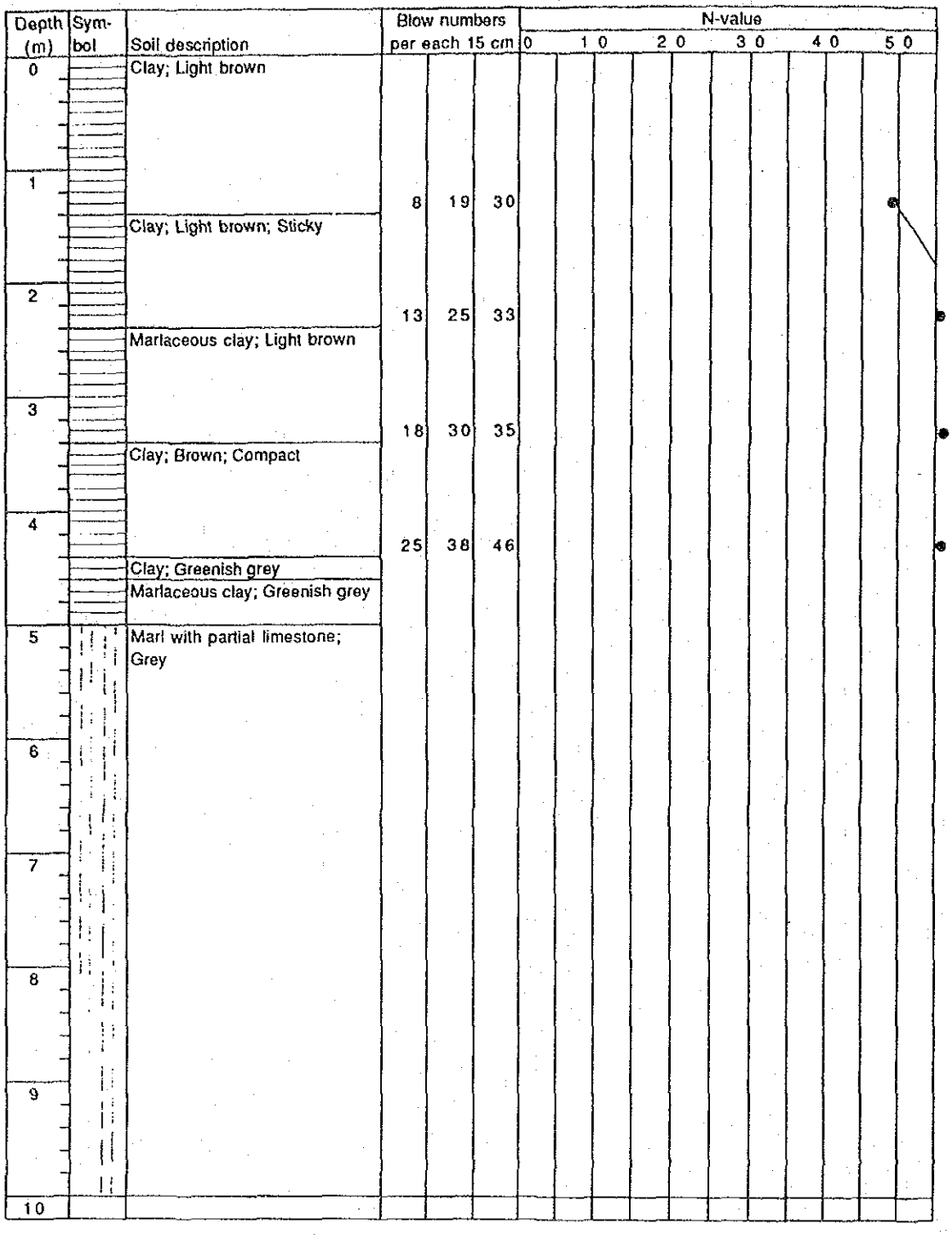


Figure 2.8 Carnet de forage de SC3

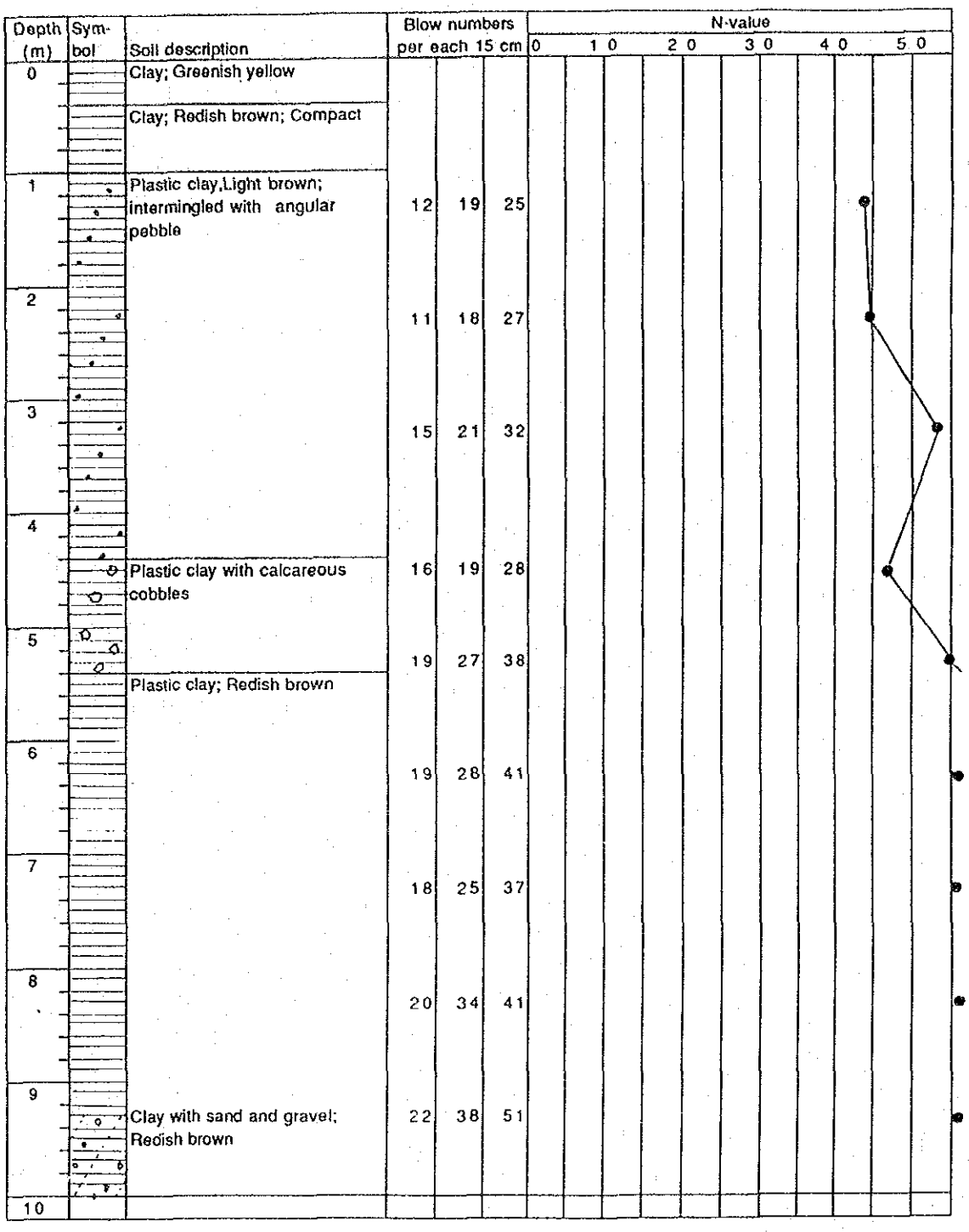


Figure 2.9 Carnet de forage de SC4

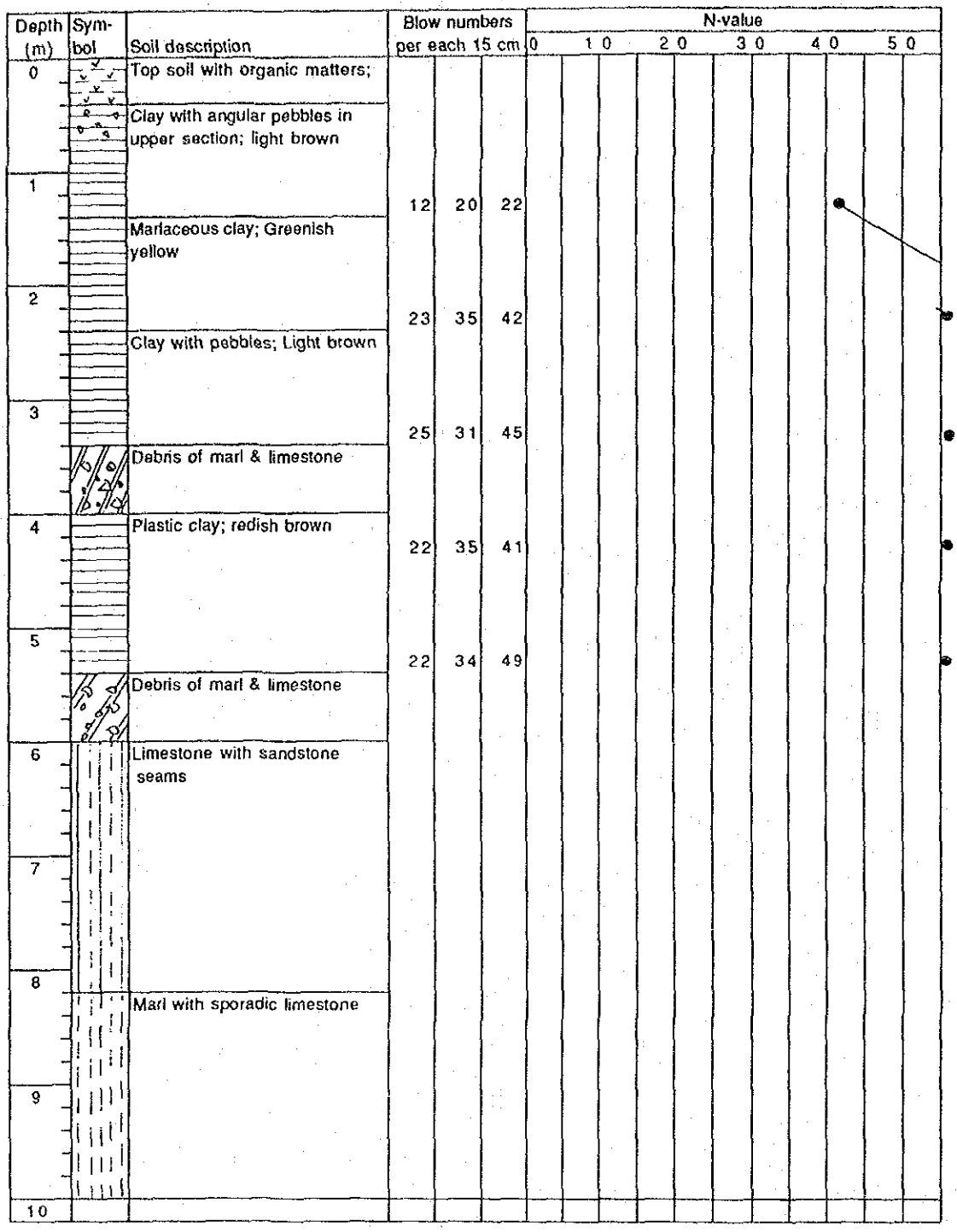


Figure 2.10 Carnet de forage de SC5

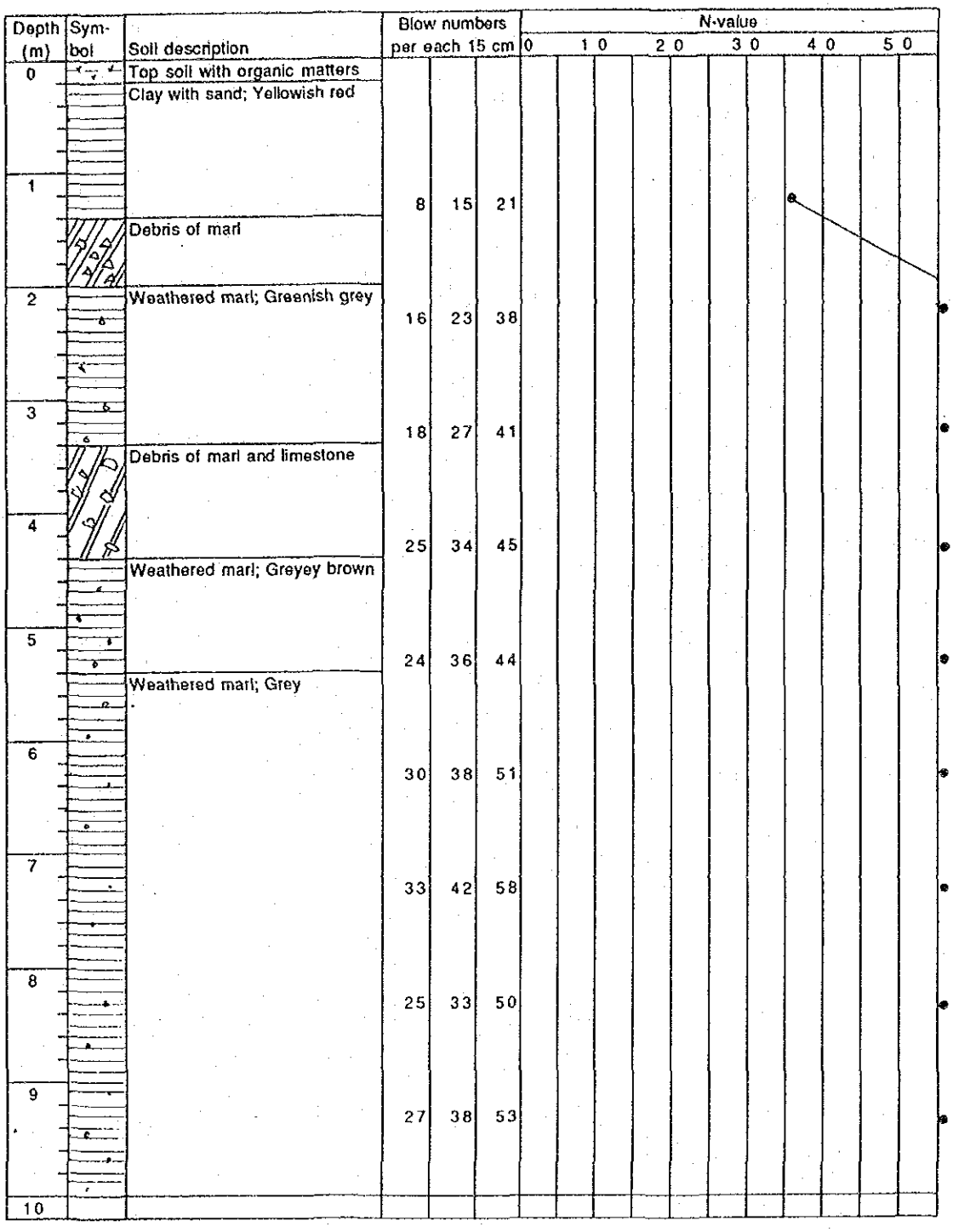


Figure 2.11 Carnet de forage de SC6

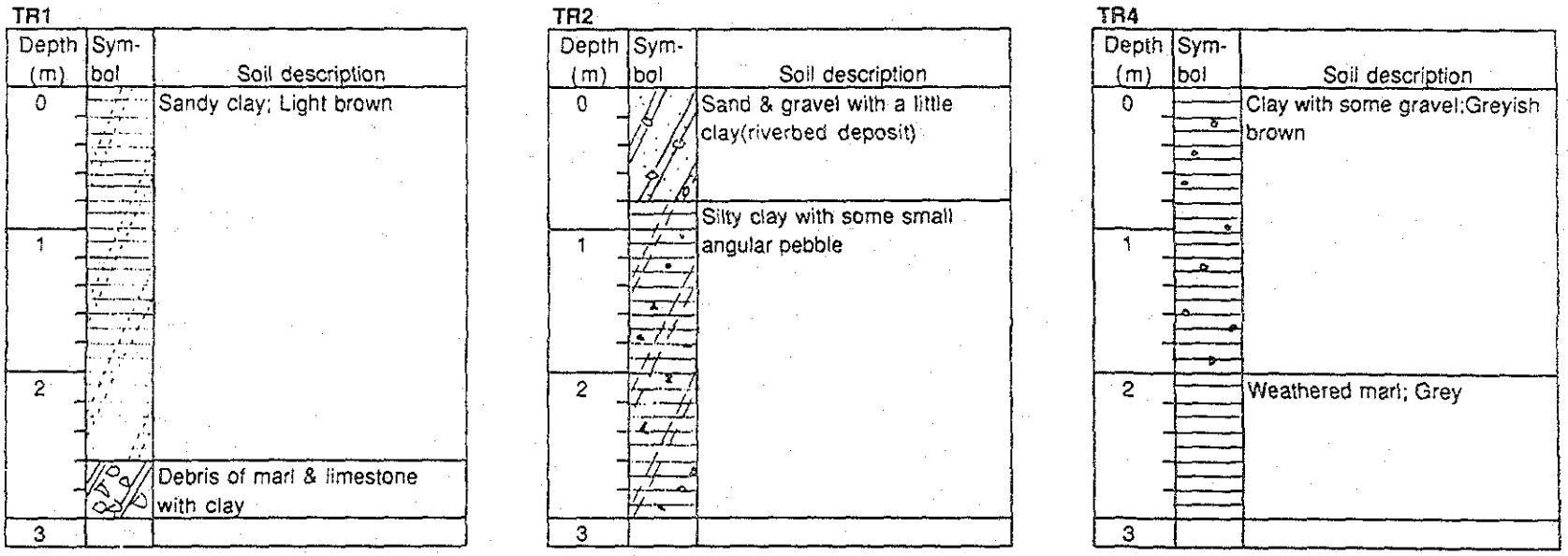


Figure 2.12 Carnet de forage des échantillons de matériaux pour corps de barrage

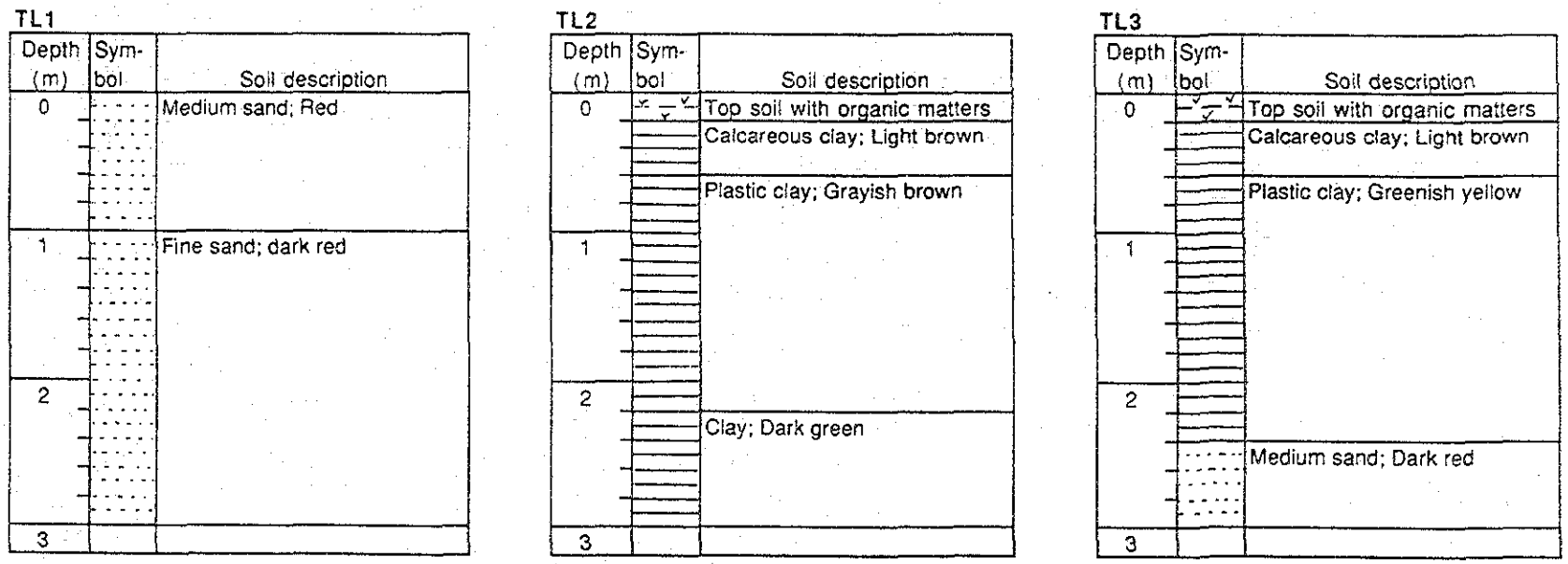


Figure 2.13 Carnet de forage des échantillons de matériaux pour corps de digues

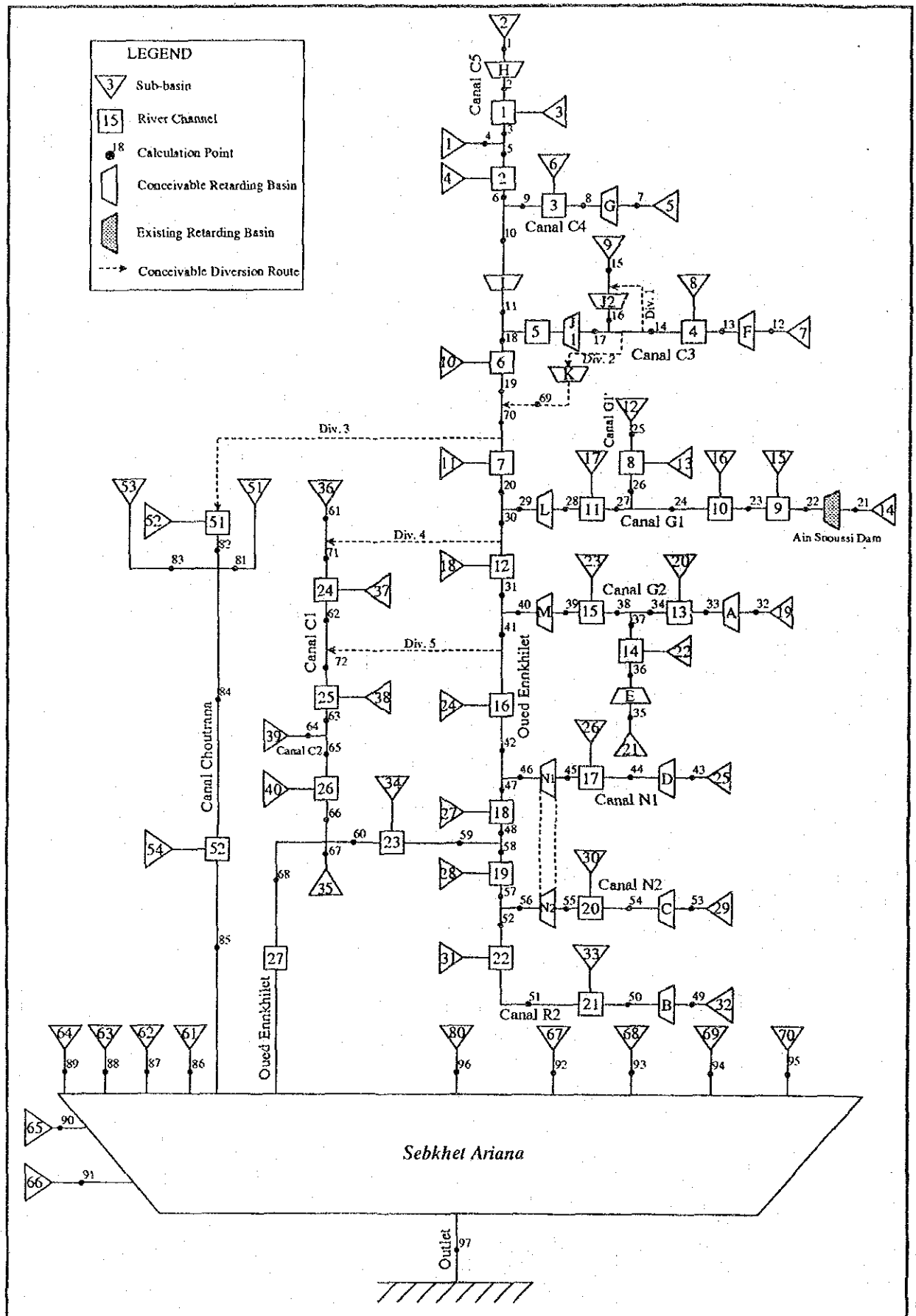


Figure 3.1 Modélisation des oueds dans le bassin de Sebkhet Ariana

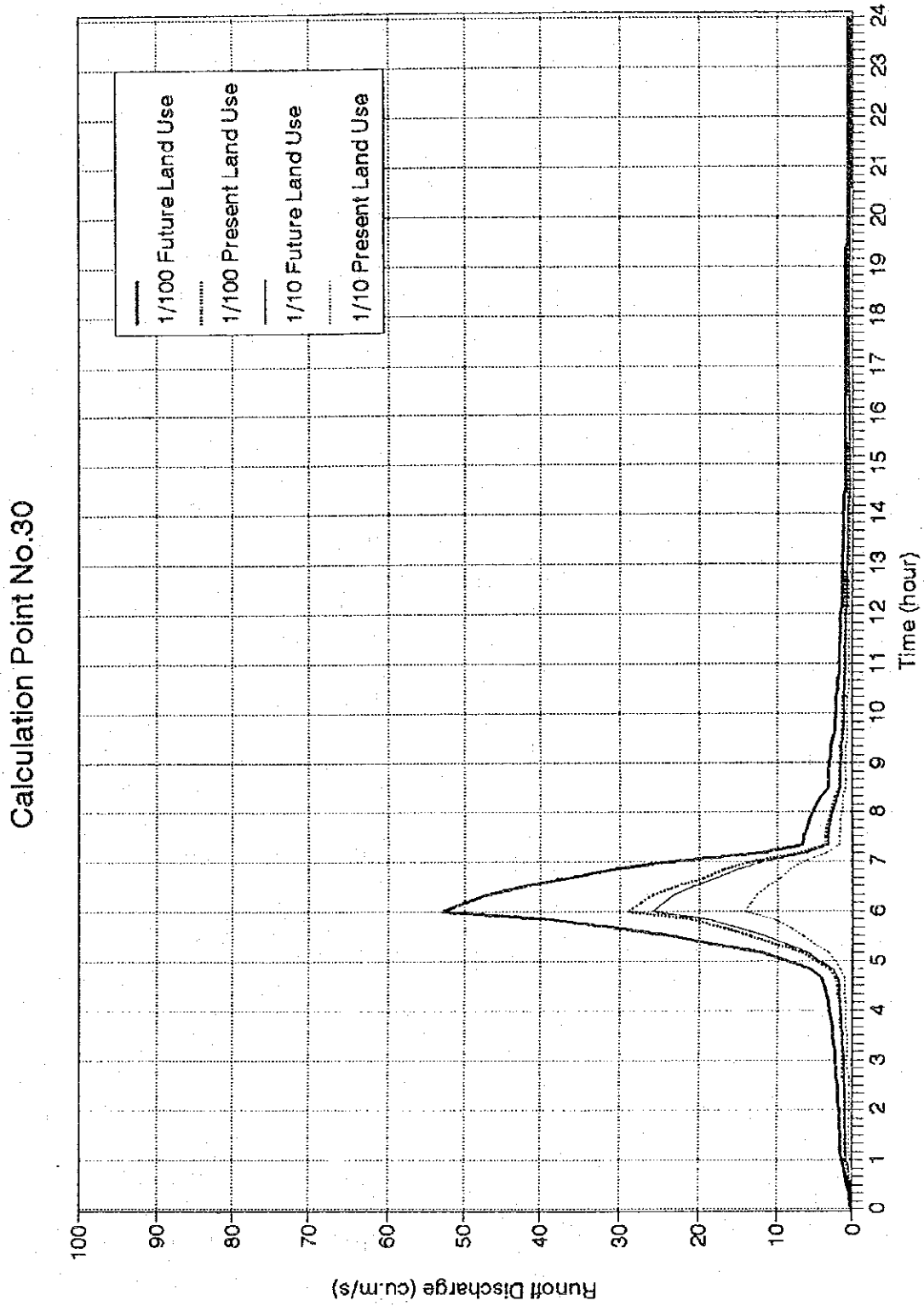


Figure 3.2 Hydrogramme des ruissellements dans le bassin de Oued Ennkhilet (1/4)

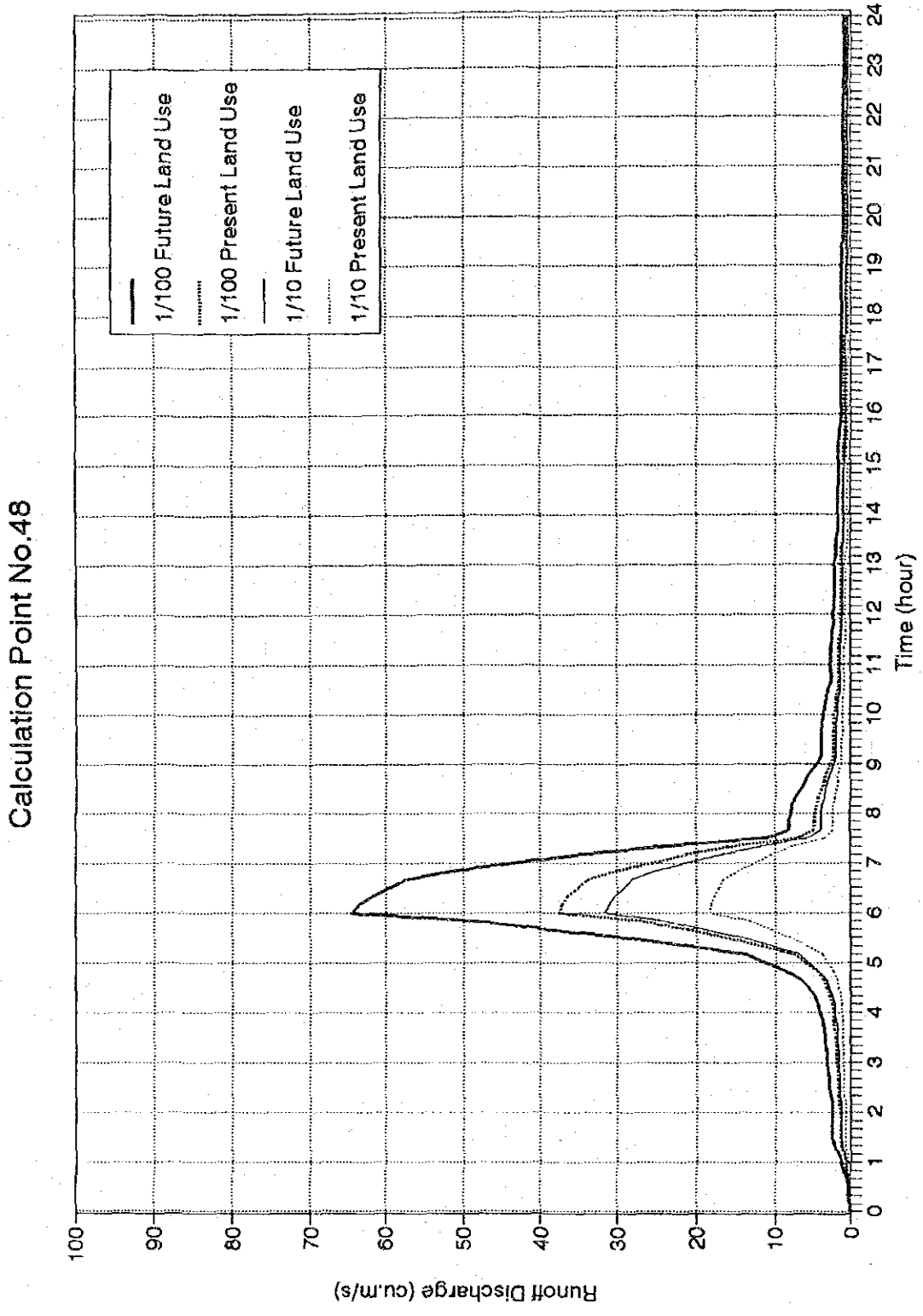


Figure 3.2 Hydrogramme des ruissellements dans le bassin de Oued Ennkhilet (2/4)

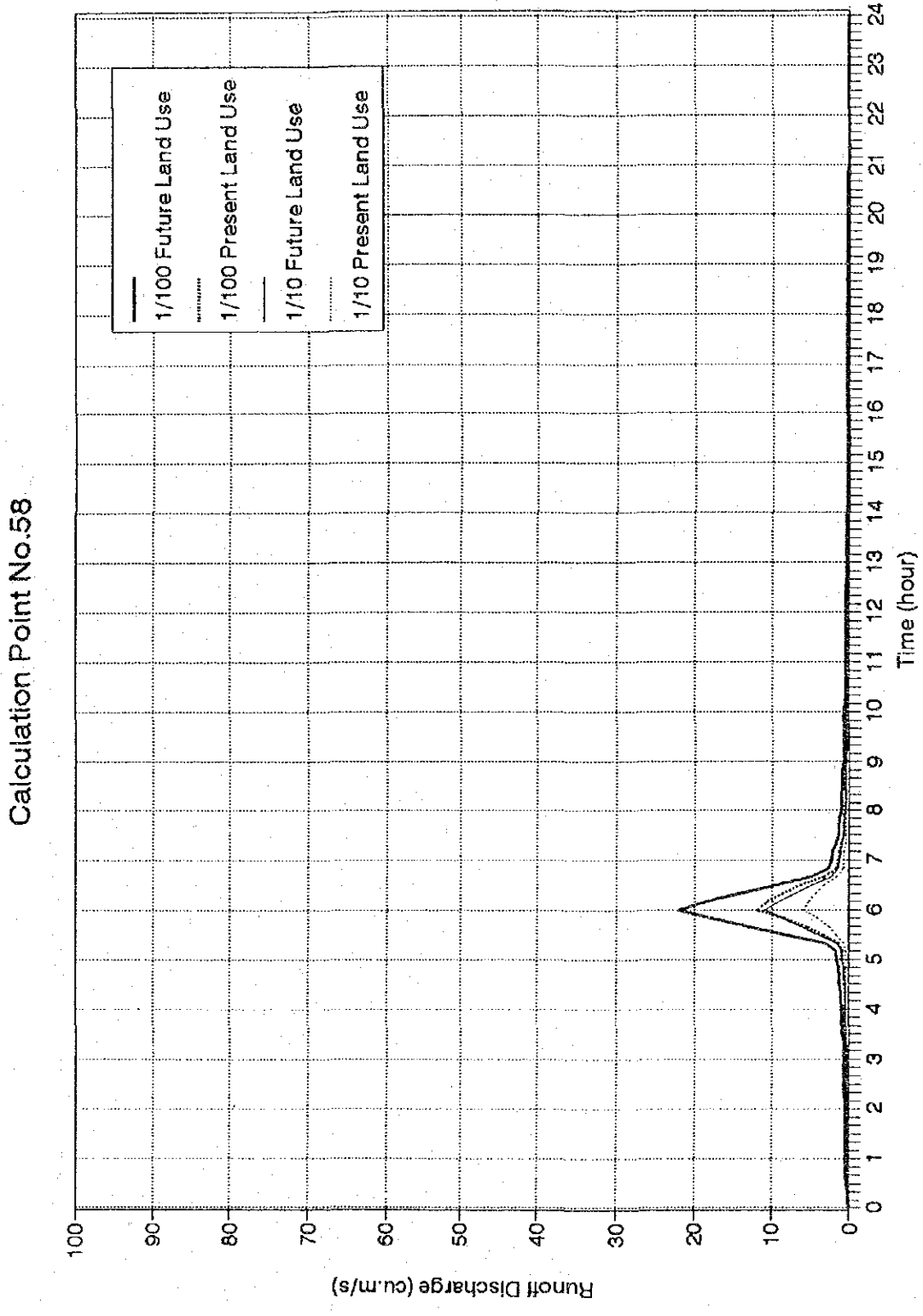


Figure 3.2 Hydrogramme des ruissellements dans le bassin de Oued Ennkhilet (3/4)

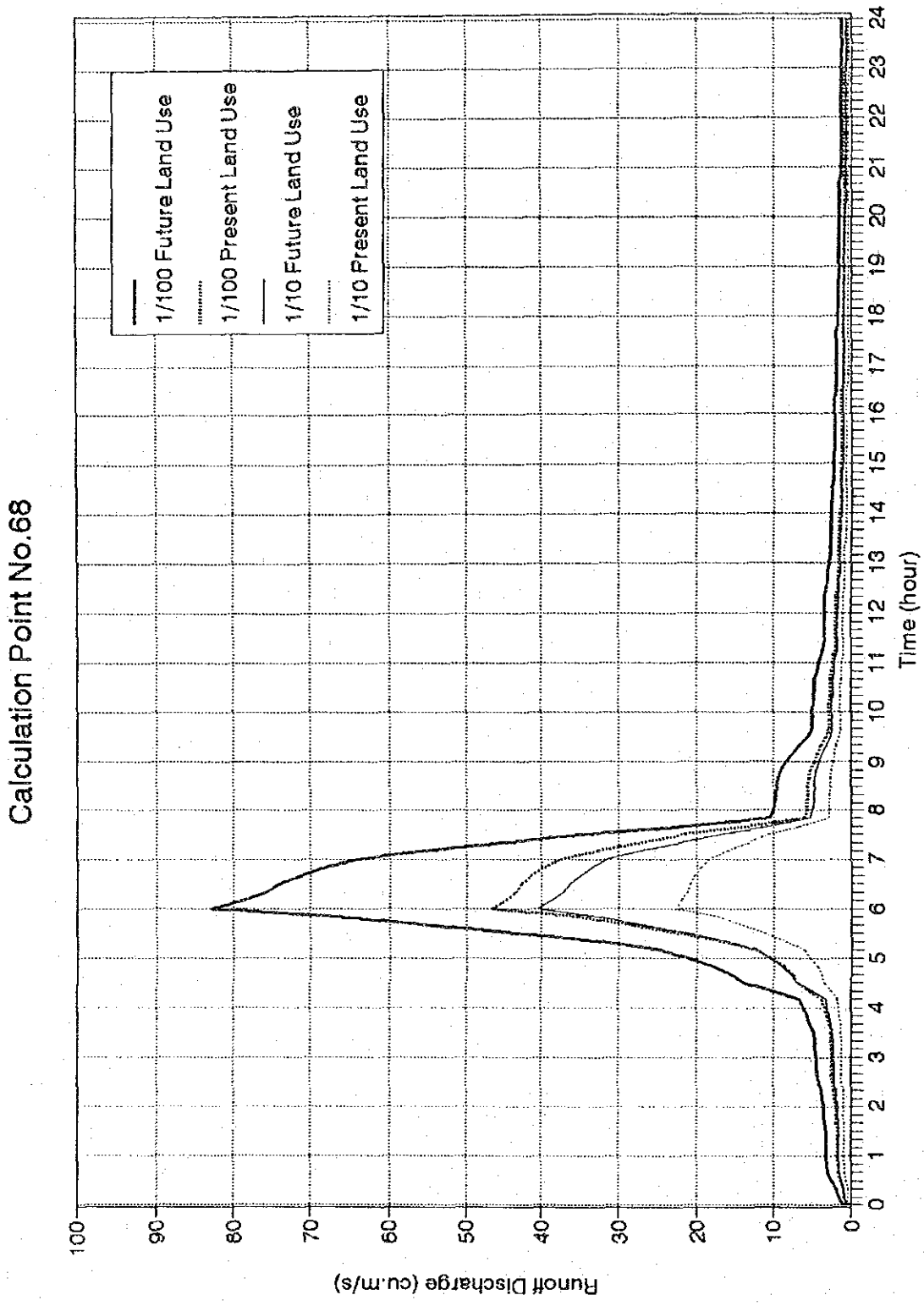


Figure 3.2 Hydrogramme des ruissellements dans le bassin de Oued Ennkhilet (4/4)

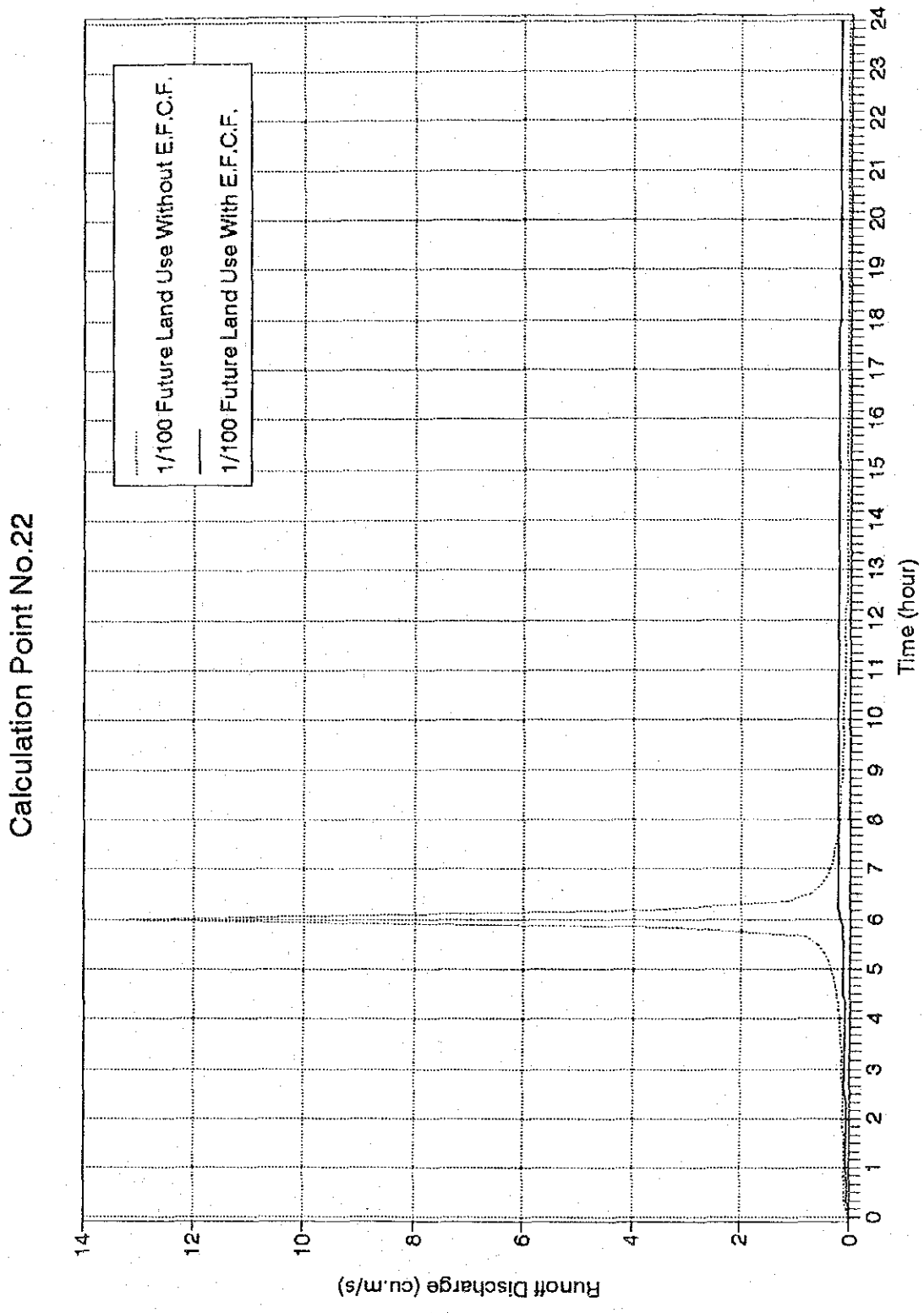


Figure 3.3 Hydrogramme des ruissellements avec les ouvrages de protection existants (1/4)

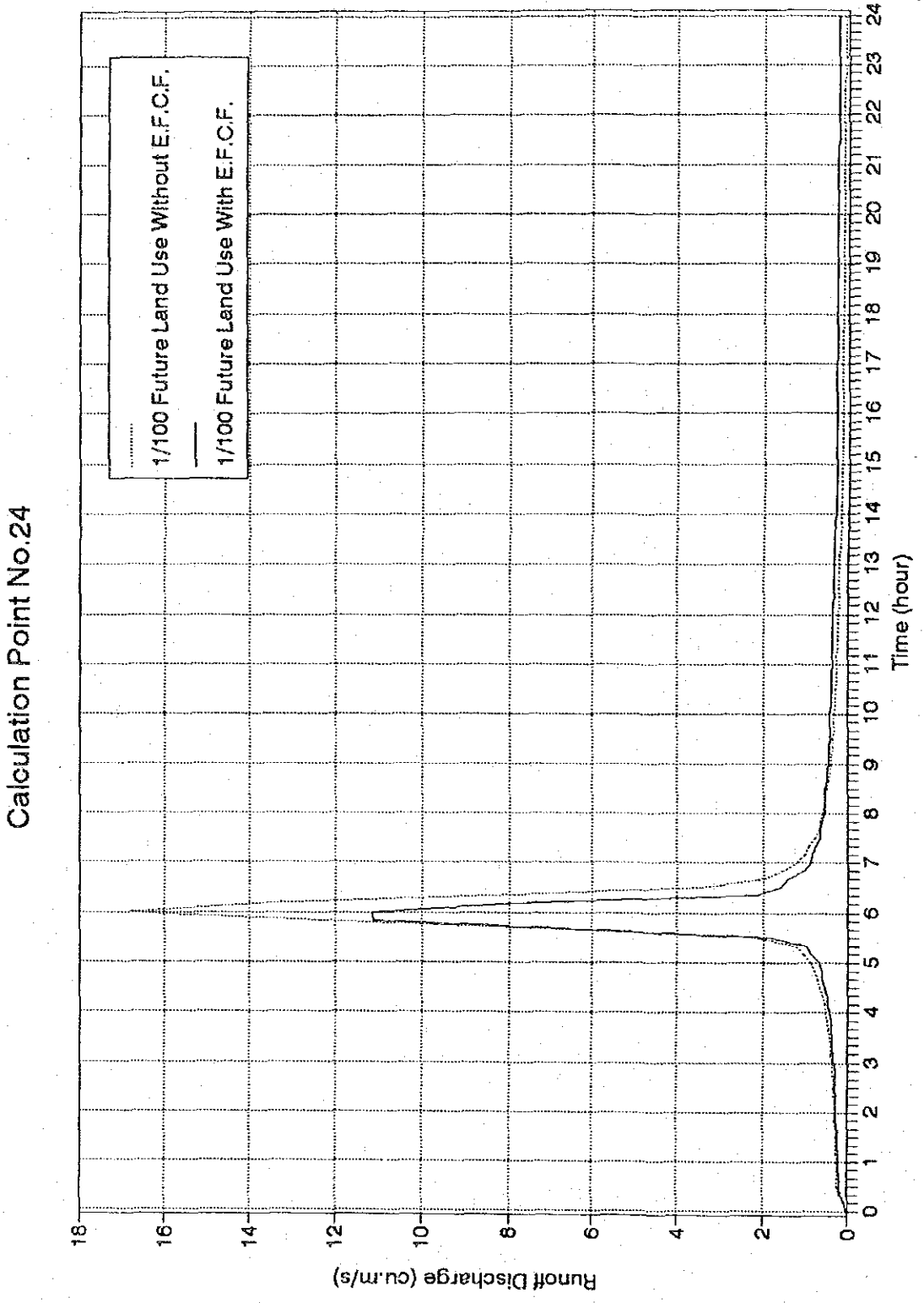


Figure 3.3 Hydrogramme des ruissellements avec les ouvrages de protection existants (2/4)

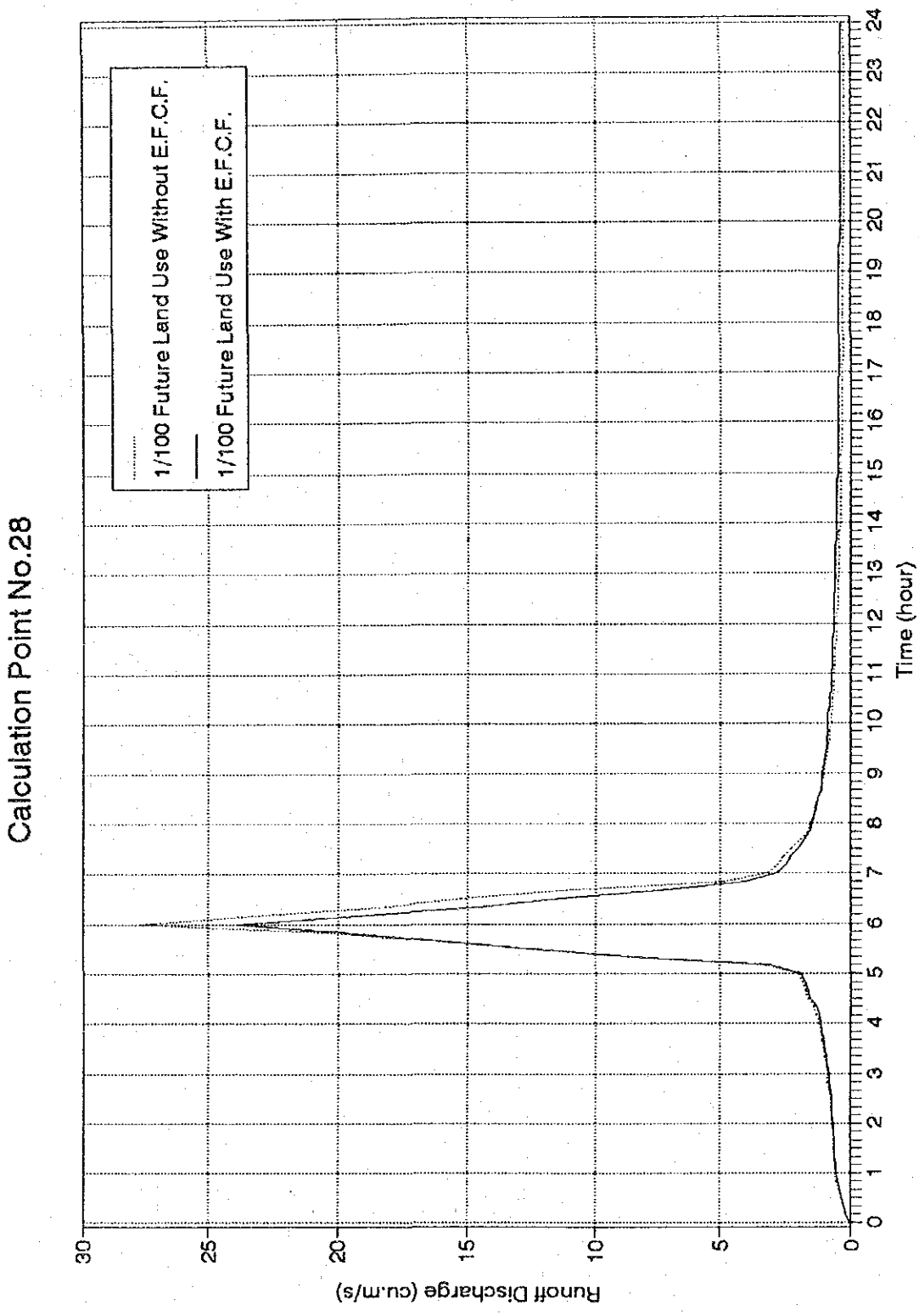


Figure 3.3 Hydrogramme des ruissellements avec les ouvrages de protection existants (3/4)

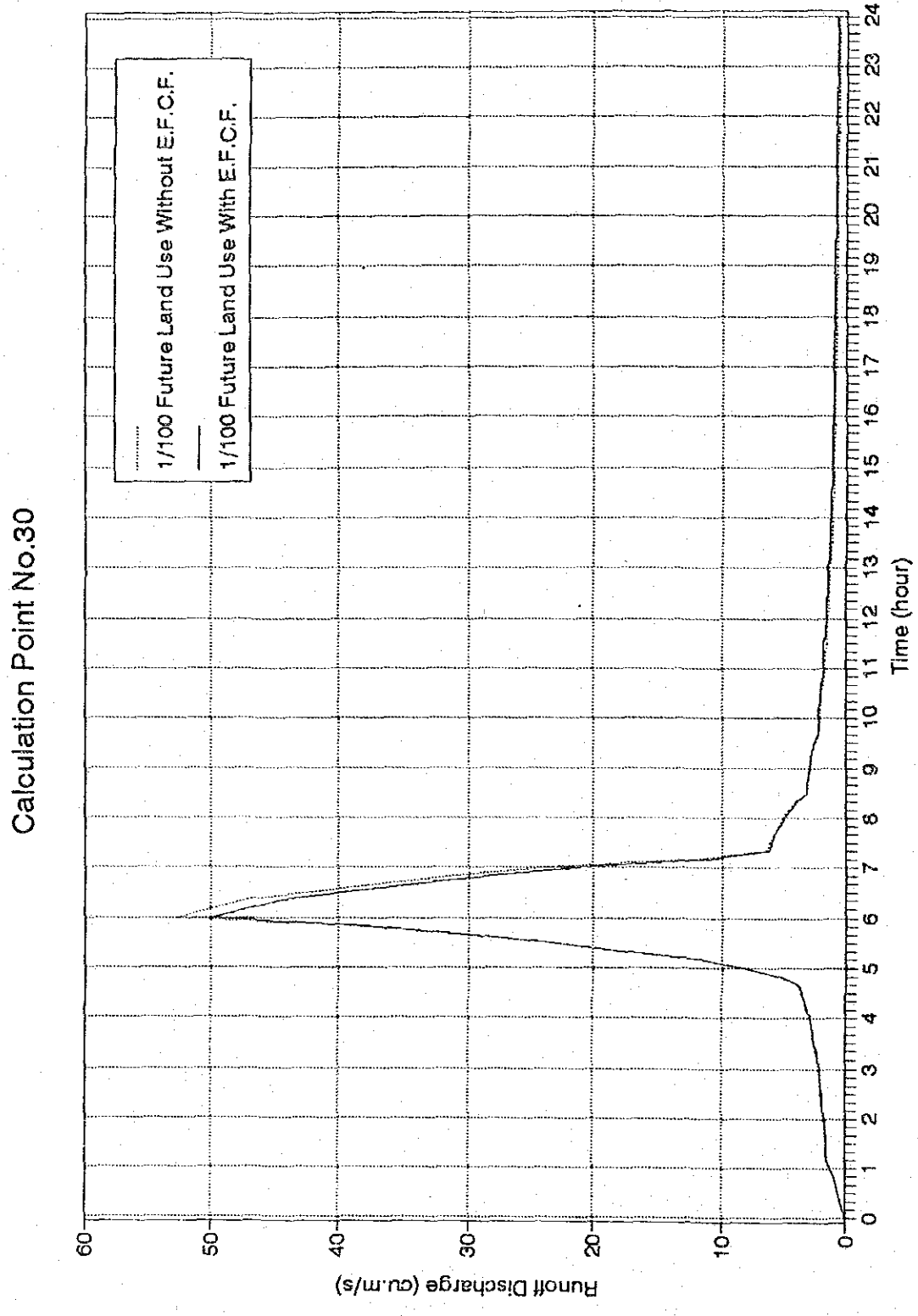


Figure 3.3 Hydrogramme des ruissellements avec les ouvrages de protection existants (4/4)

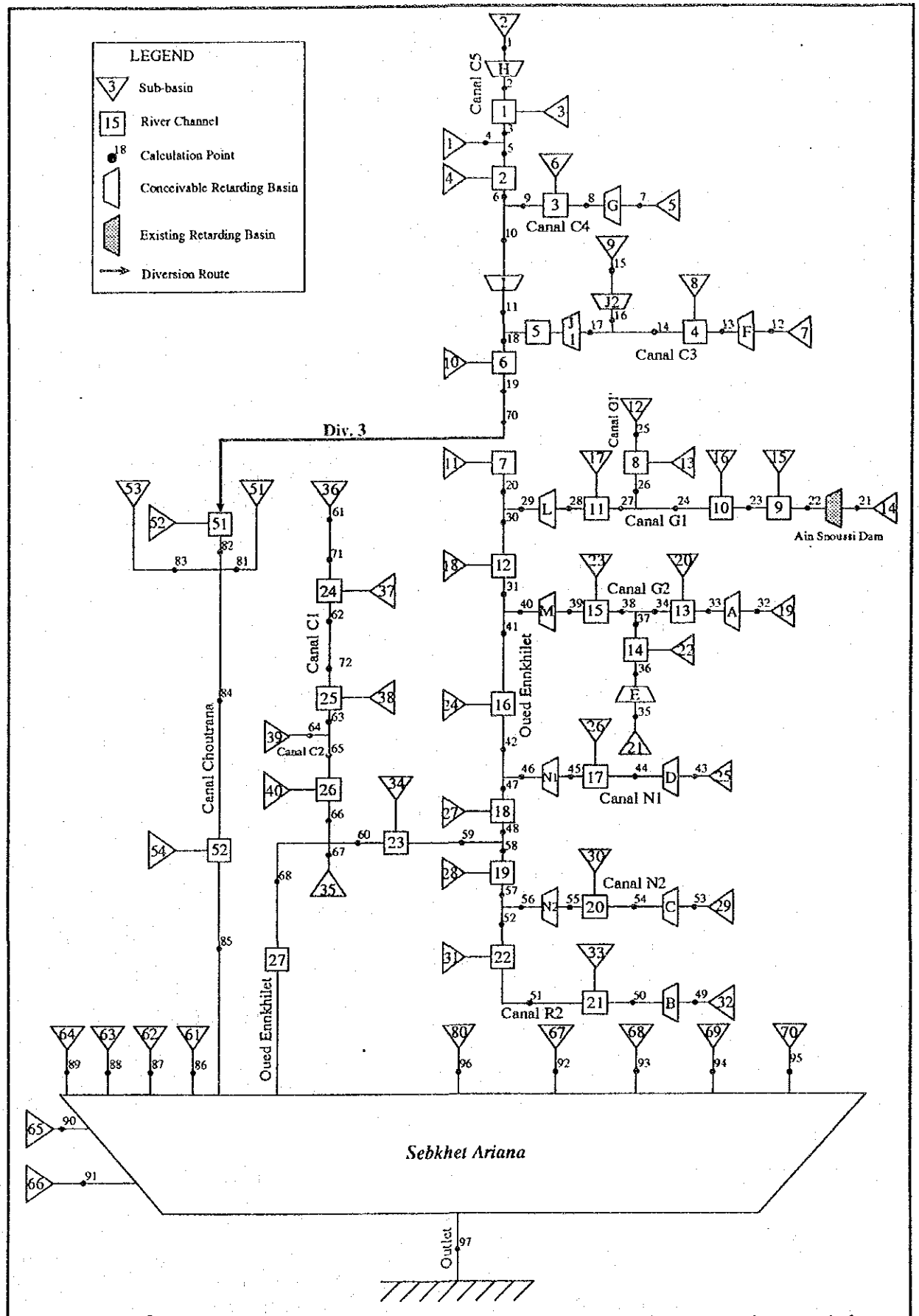


Figure 3.4 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°3

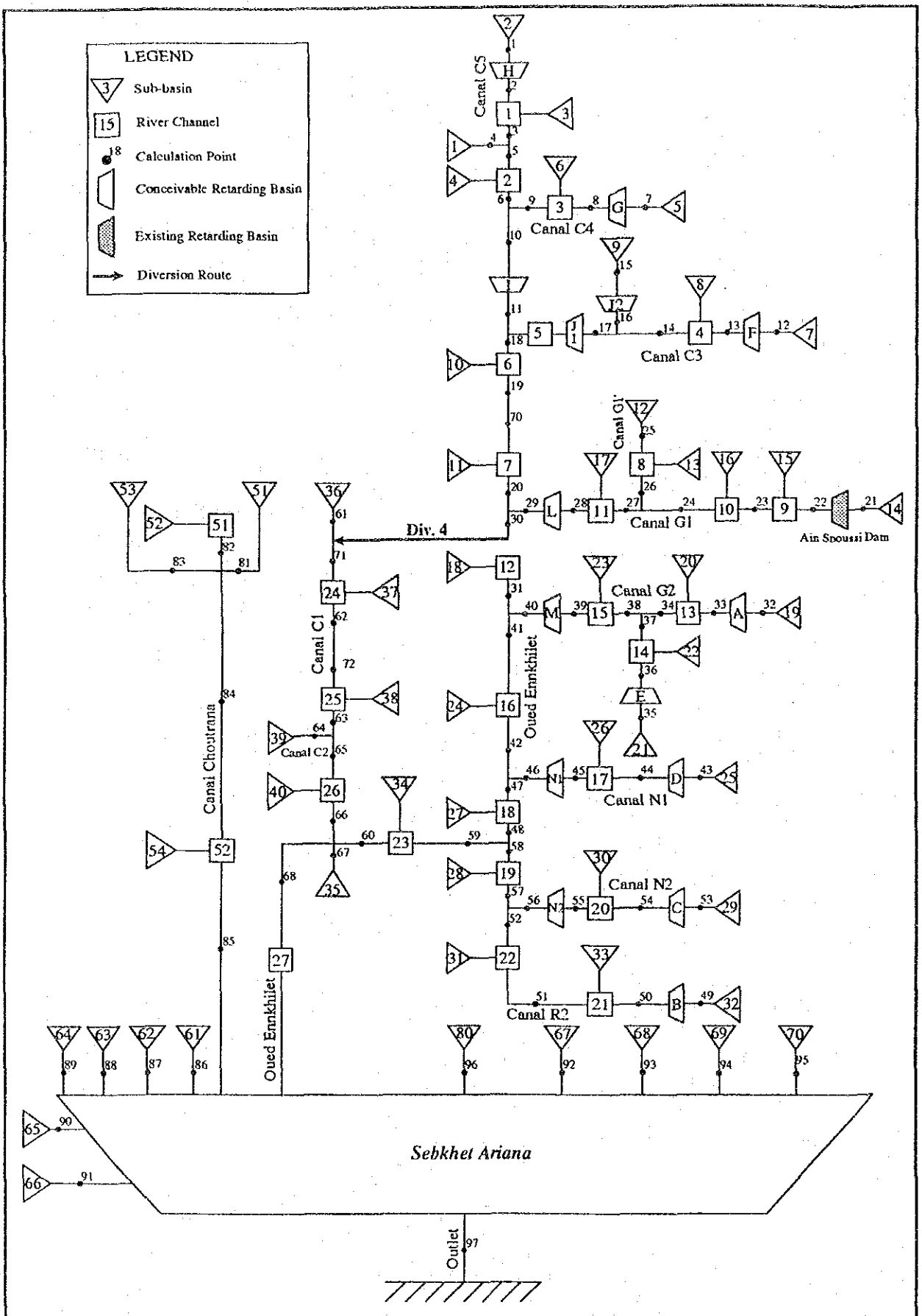


Figure 3.5 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°4

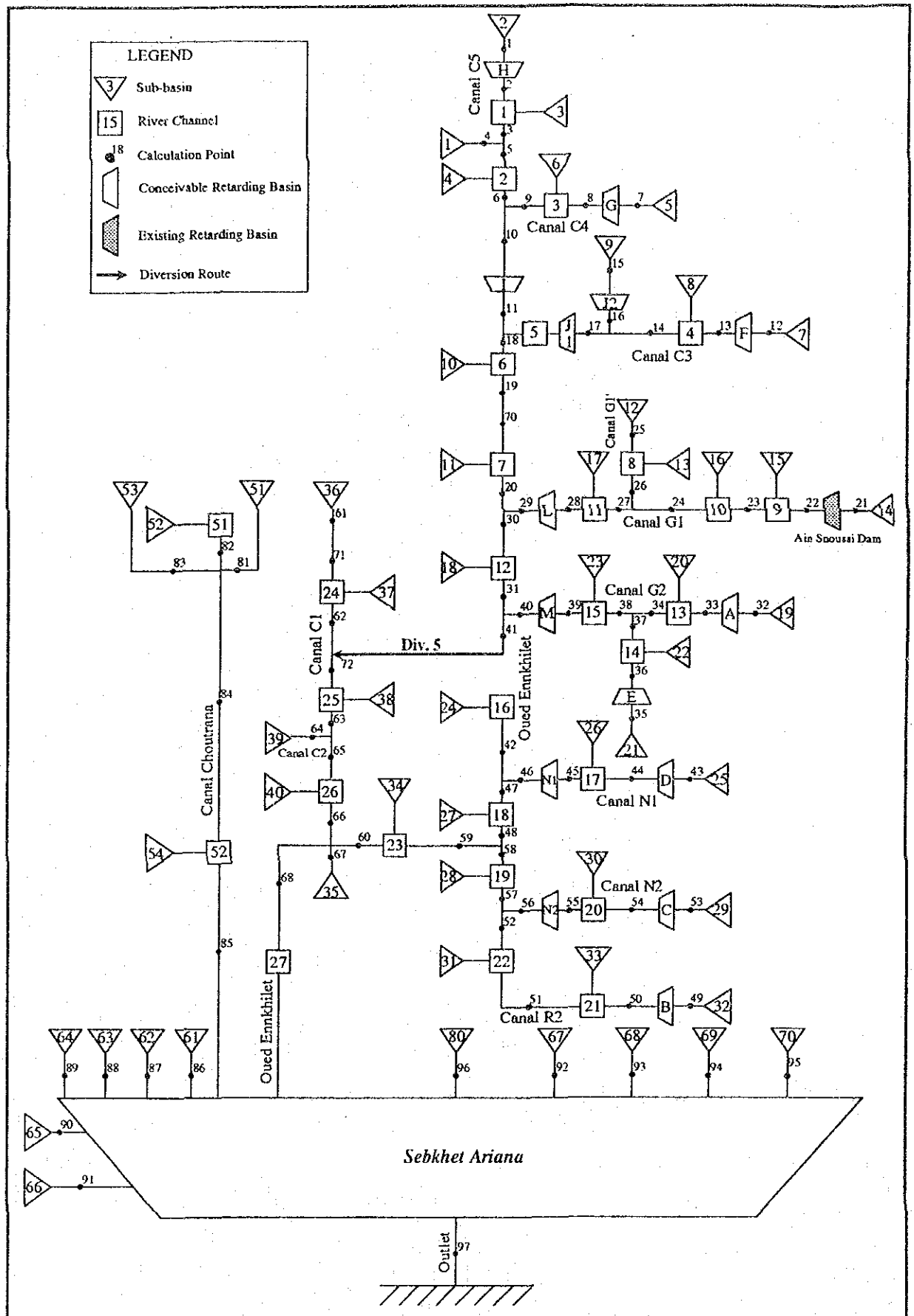


Figure 3.6 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°5

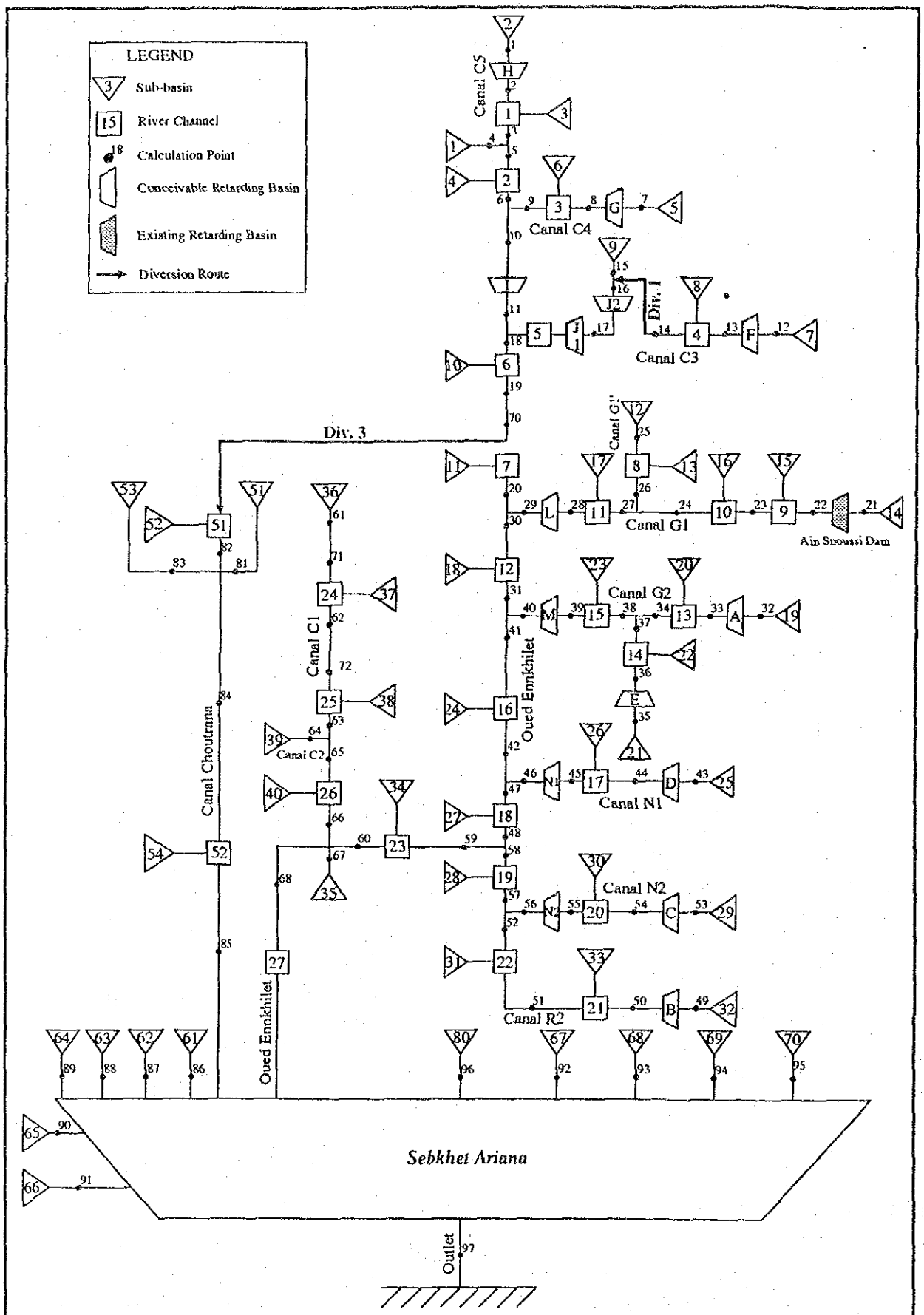


Figure 3.7 Modélisation du système de Oued Ennkhilet, avec canaux de déviation N°1 & 3

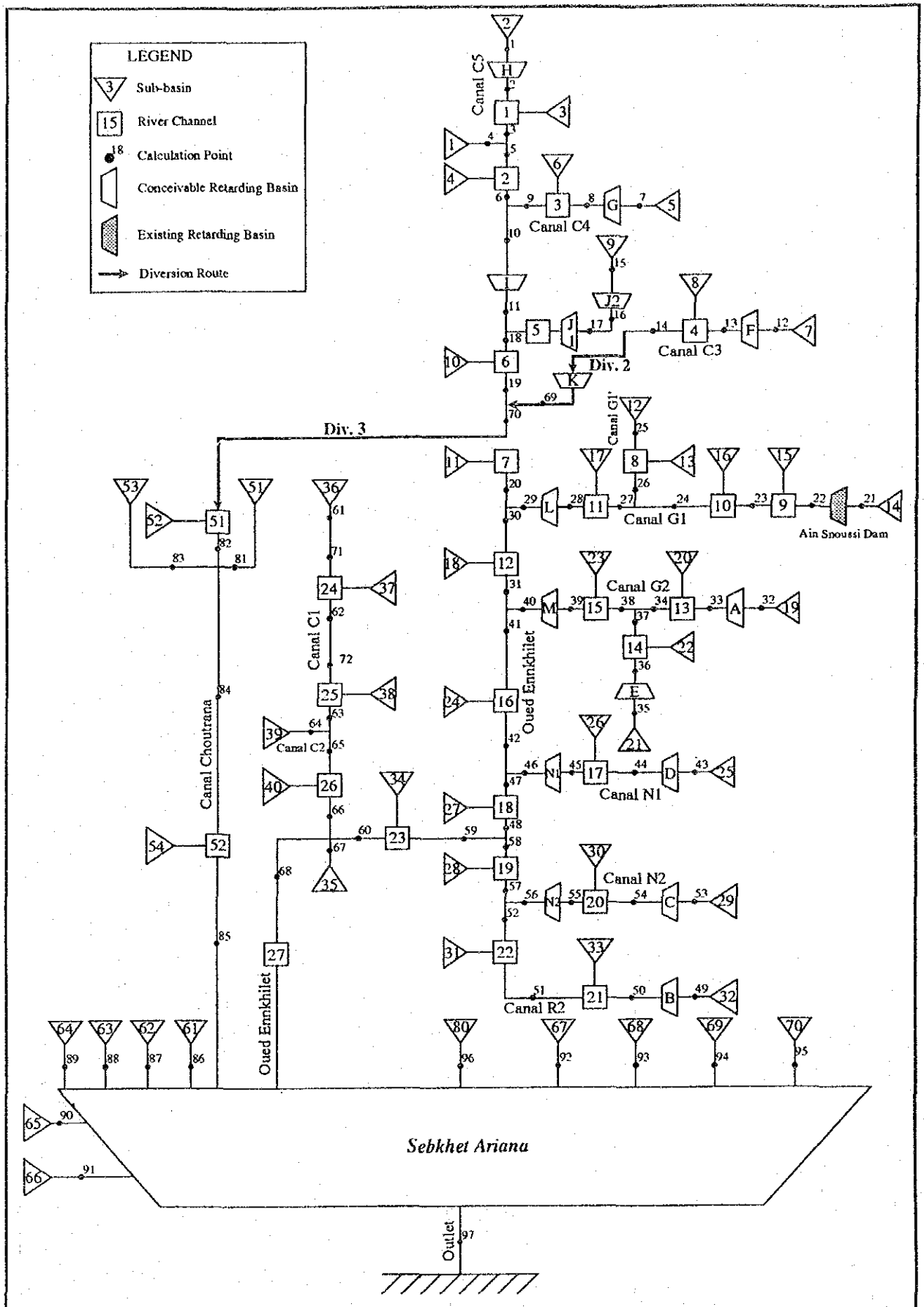


Figure 3.8 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°2 & 3

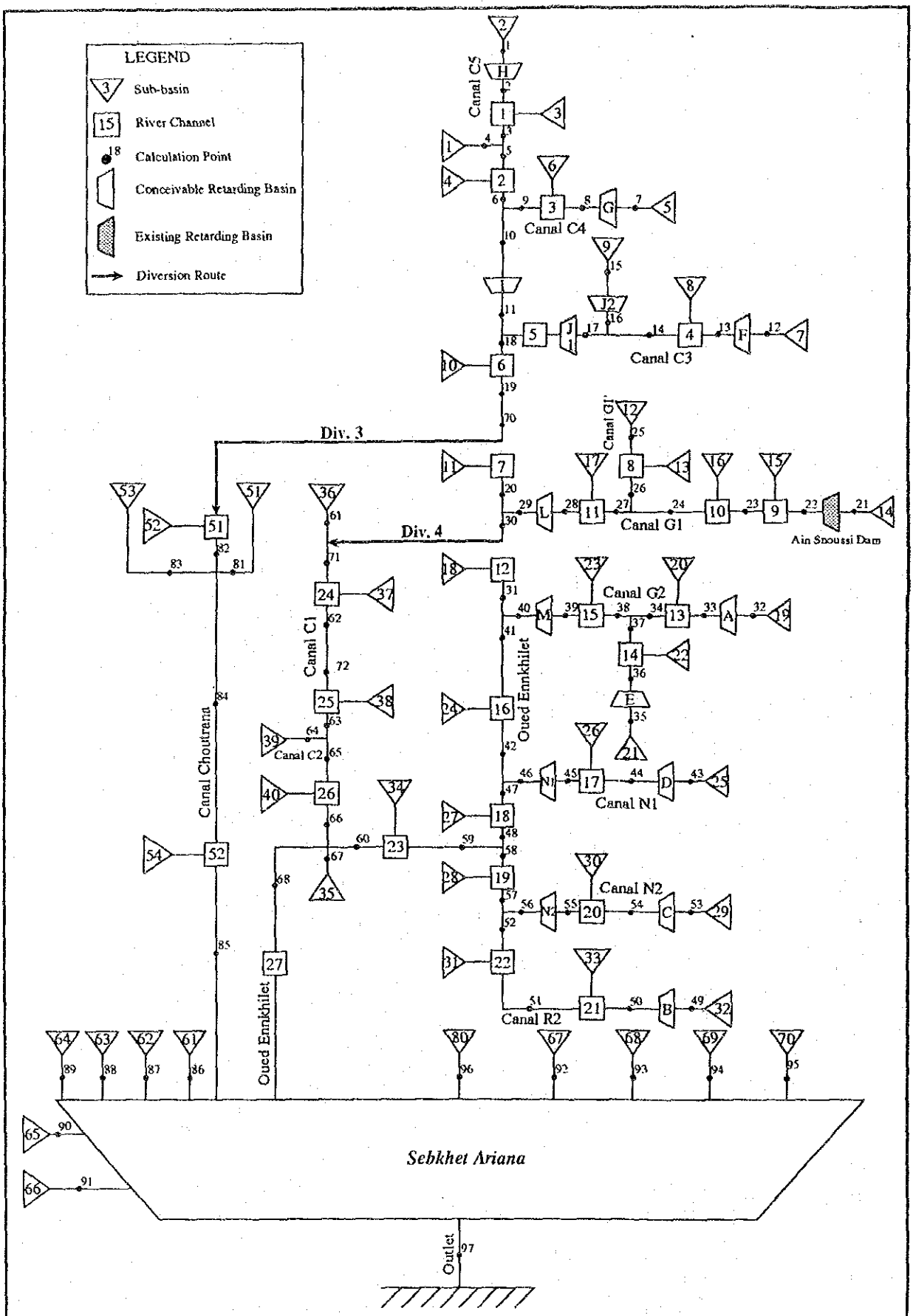


Figure 3.9 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°3 & 4

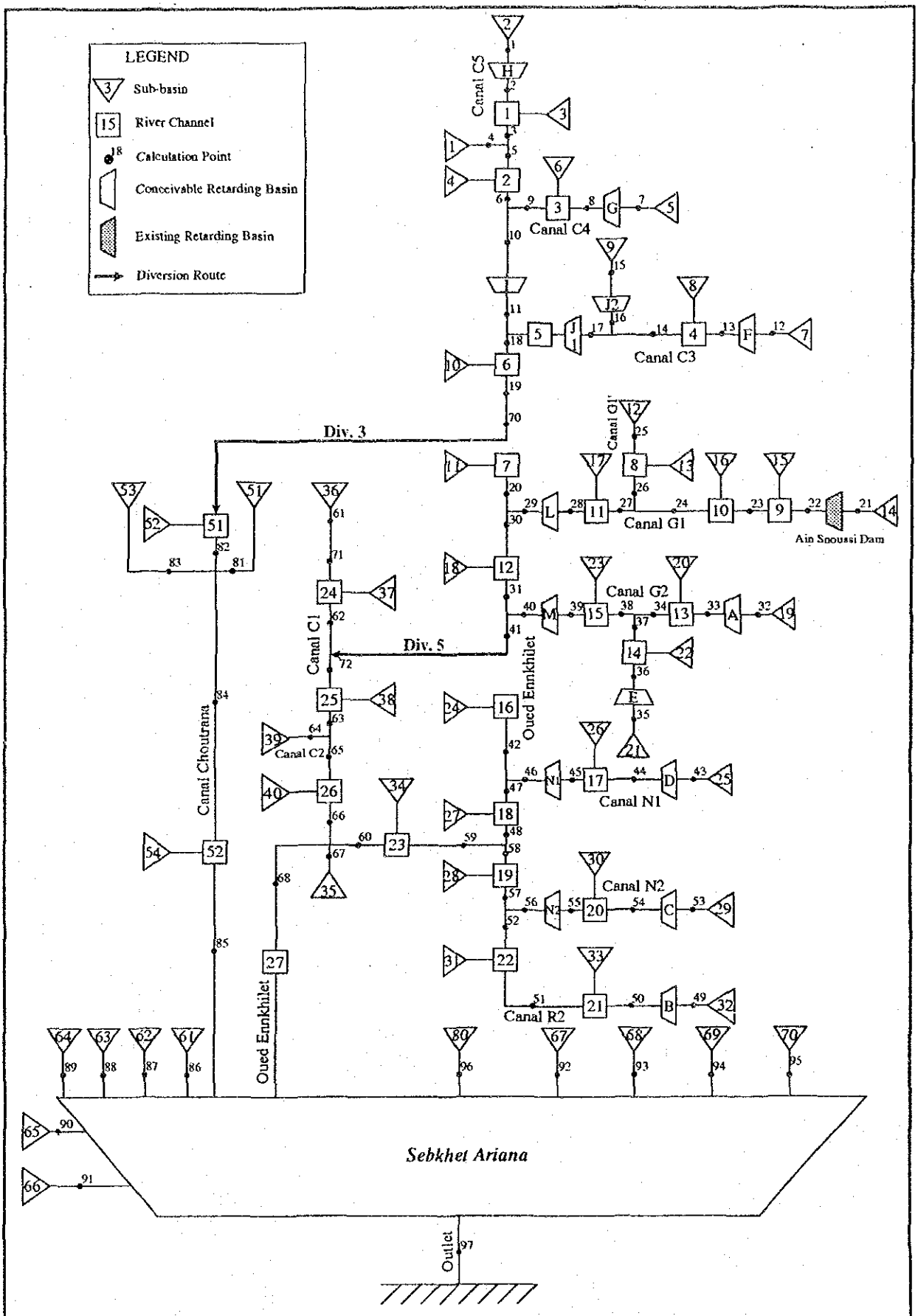


Figure 3.10 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°3 & 5

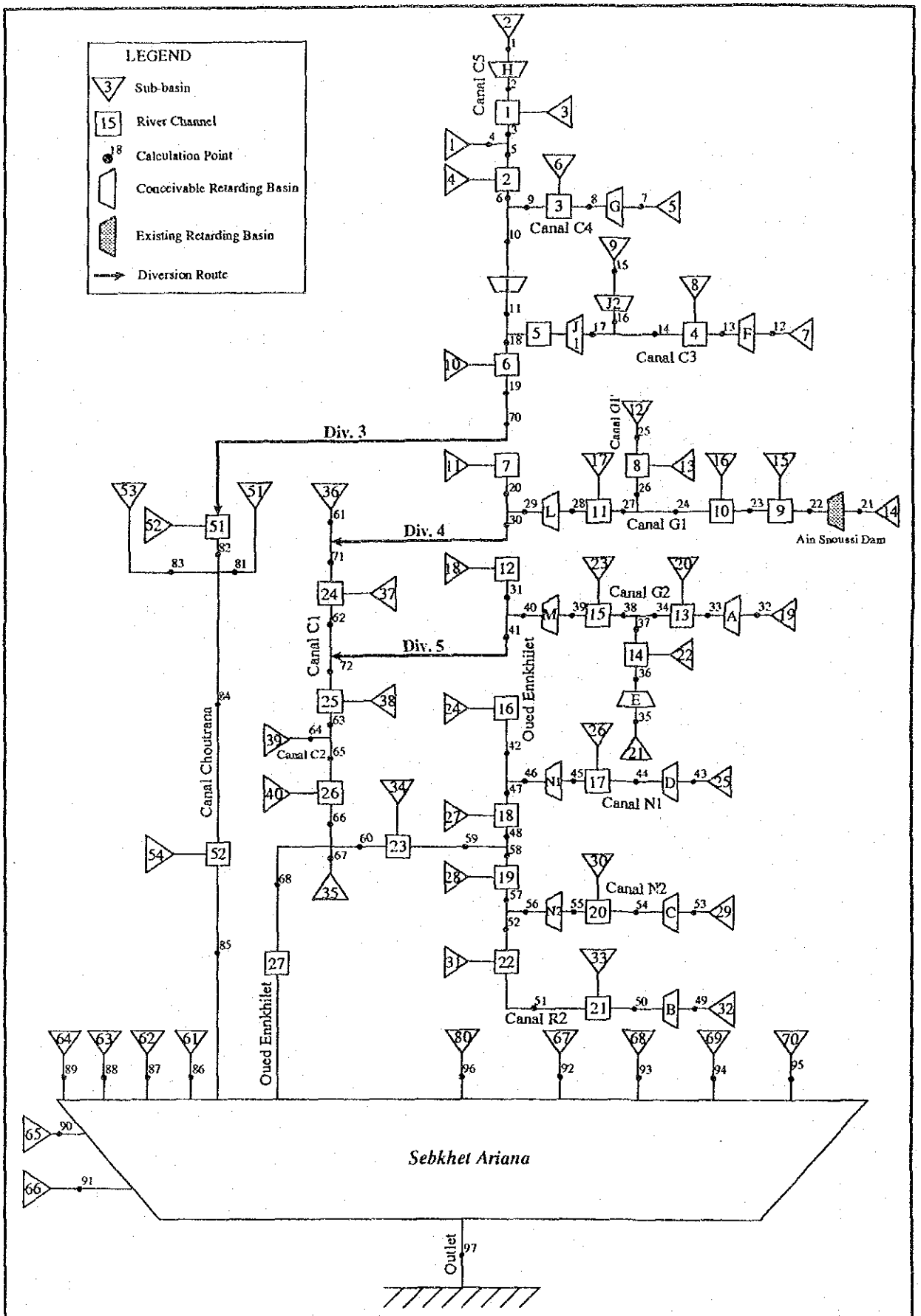


Figure 3.11 Modélisation du système de Oued Ennkhilet, avec le canal de déviation N°3,4& 5

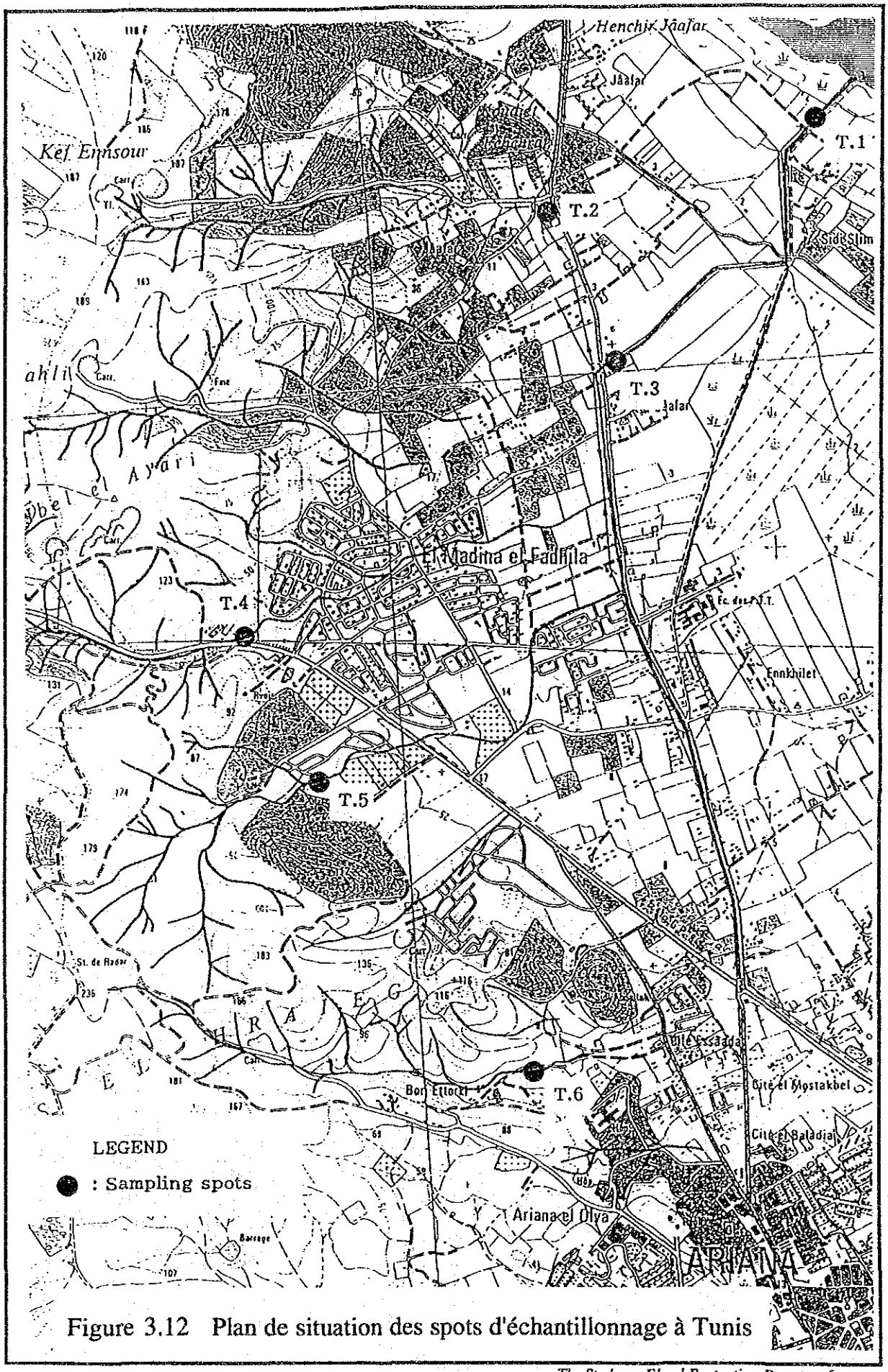
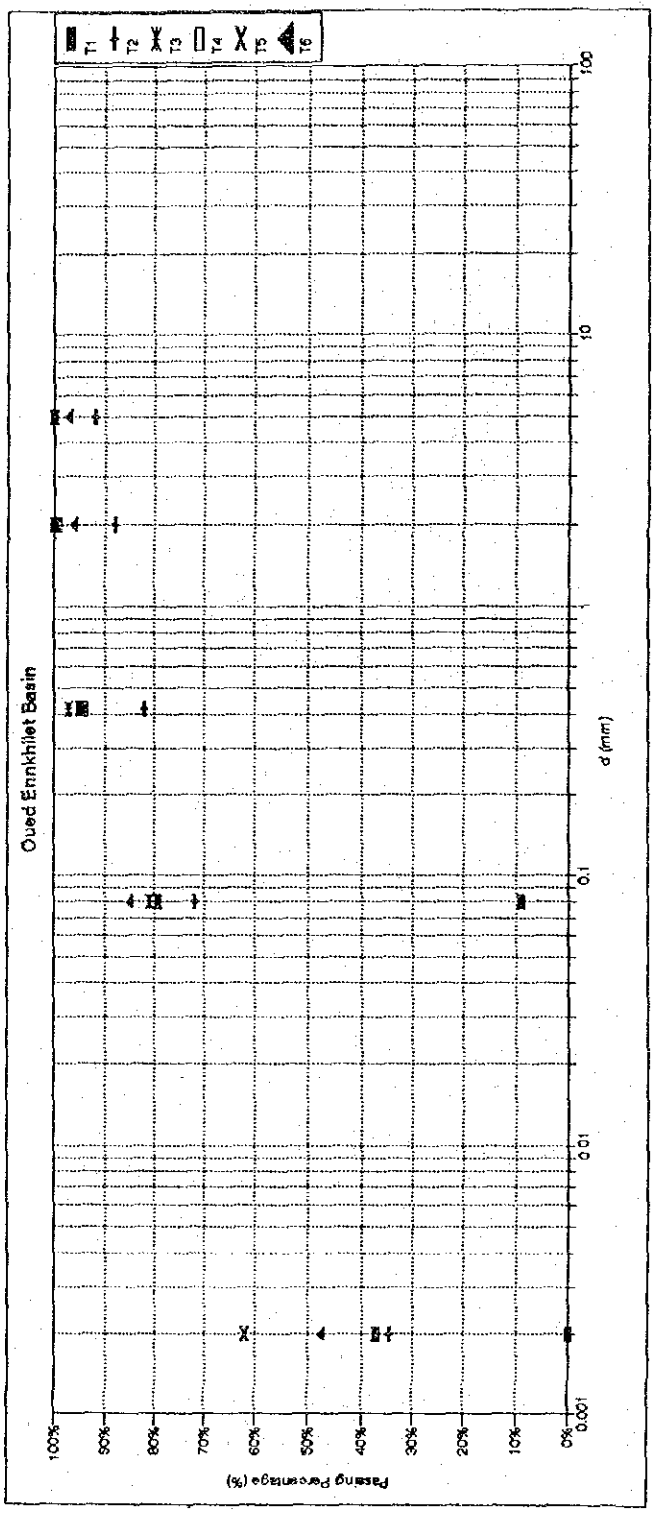


Figure 3.12 Plan de situation des spots d'échantillonnage à Tunis



Sampling Point	Specific Gravity	Gradation Test (Passing Percentage)					d50 (mm)
		< 0.002mm	< 0.08mm	< 0.42mm	< 2mm	< 5mm	
T1 (+ 0.3 km)	2.66	0.0%	9.0%	95.0%	100.0%	100.0%	0.0220
T2 (+ 2.9 km)	2.68	34.5%	72.0%	82.0%	88.0%	92.0%	0.0080
T3 (+ 2.1 km)	2.68	37.5%	81.0%	97.0%	100.0%	100.0%	0.0060
T4 (+ 4.9 km)	2.68	37.0%	79.5%	94.0%	99.0%	100.0%	0.0070
T5 (+ 5.3 km)	2.68	62.0%	79.5%	95.0%	99.5%	100.0%	0.0016
T6 (+ 6.2 km)	2.67	47.5%	85.0%	94.0%	96.0%	97.0%	0.0026

Figure 3.13 Résultat du tests de granulométrie dans le bassin de Oued Ennkhilet

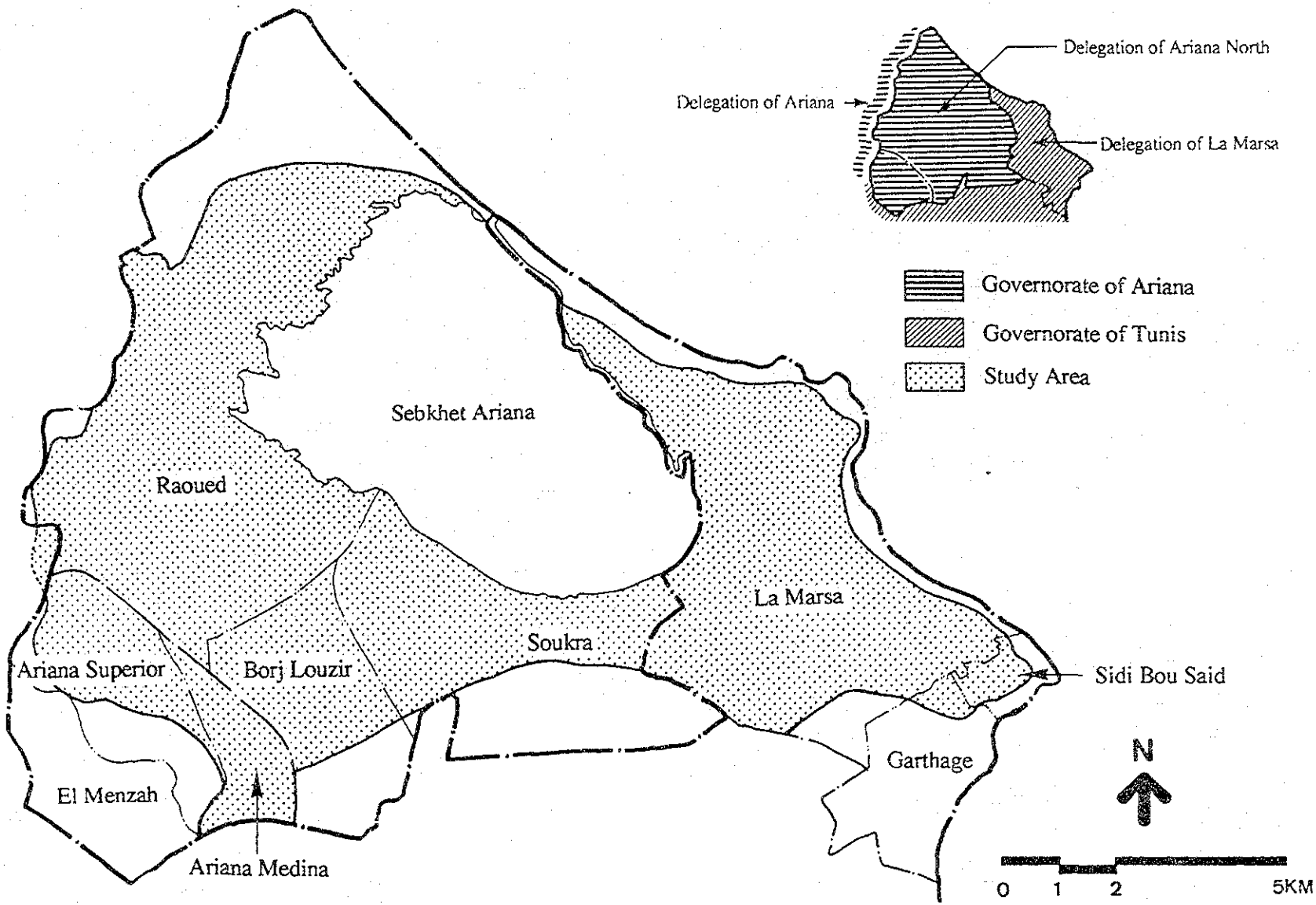


Figure 4.1 Emplacement de la zone d'étude

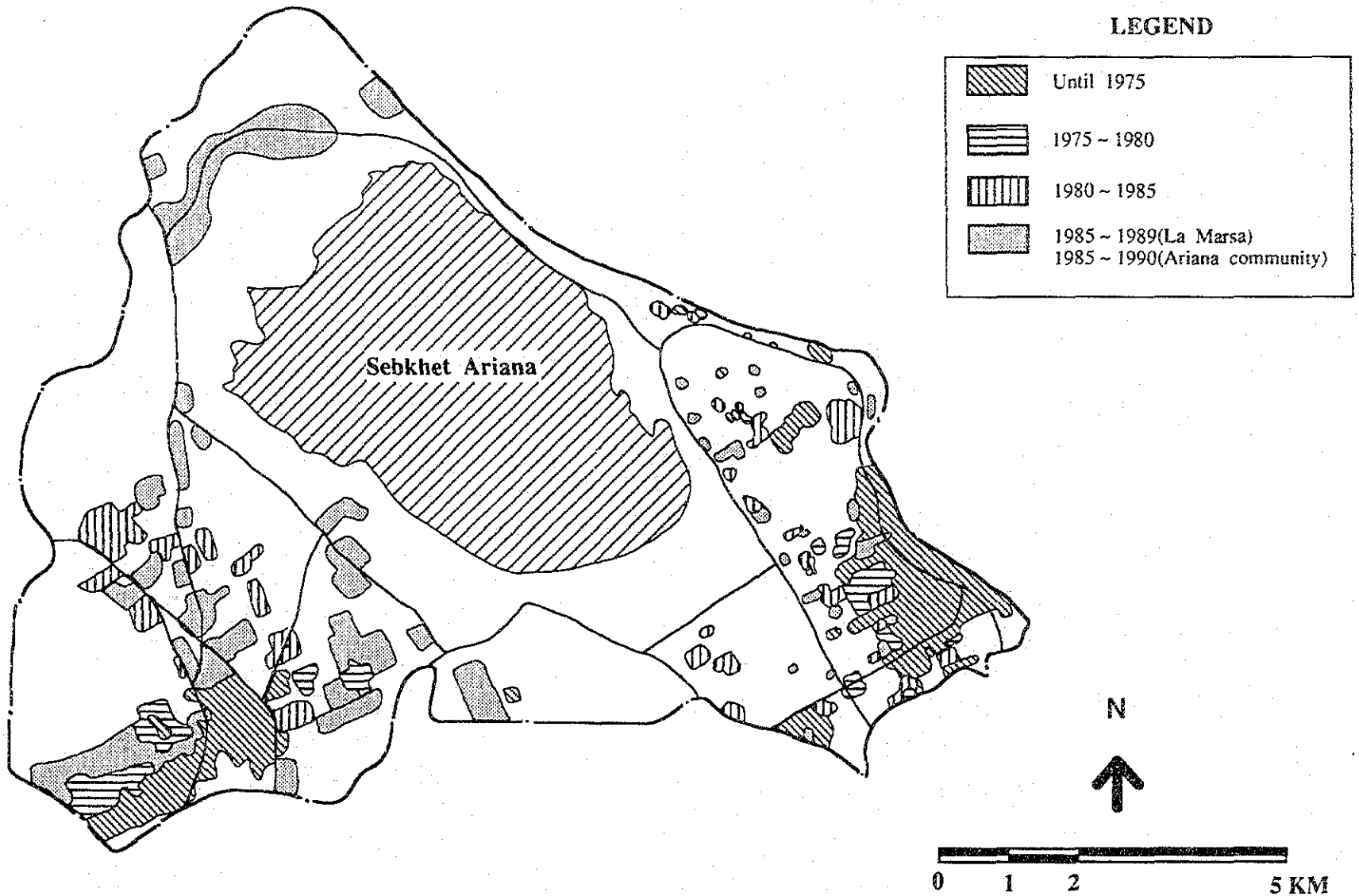


Figure 4.2 Développement de l'urbanisation dans la commune de l'Ariana