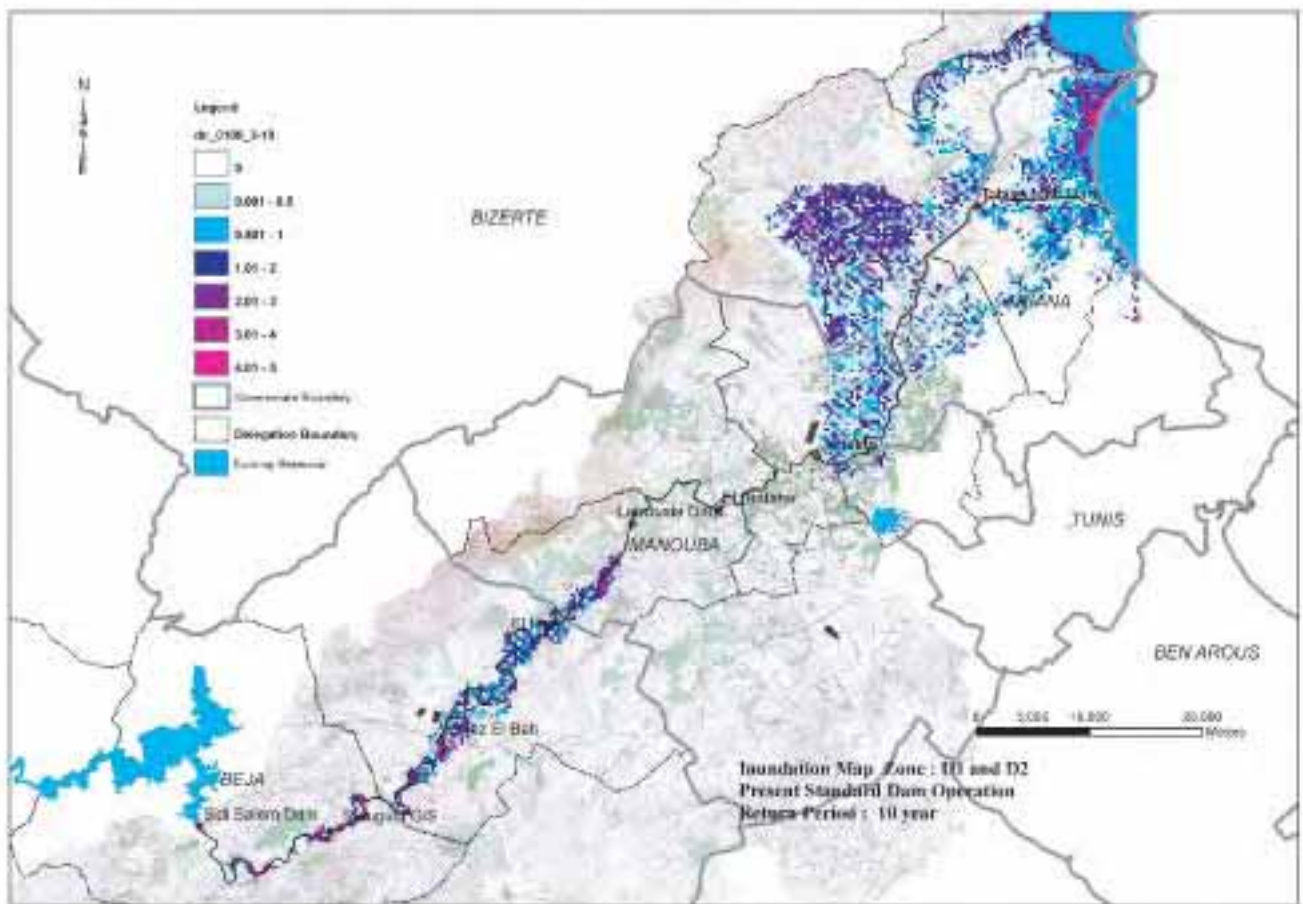
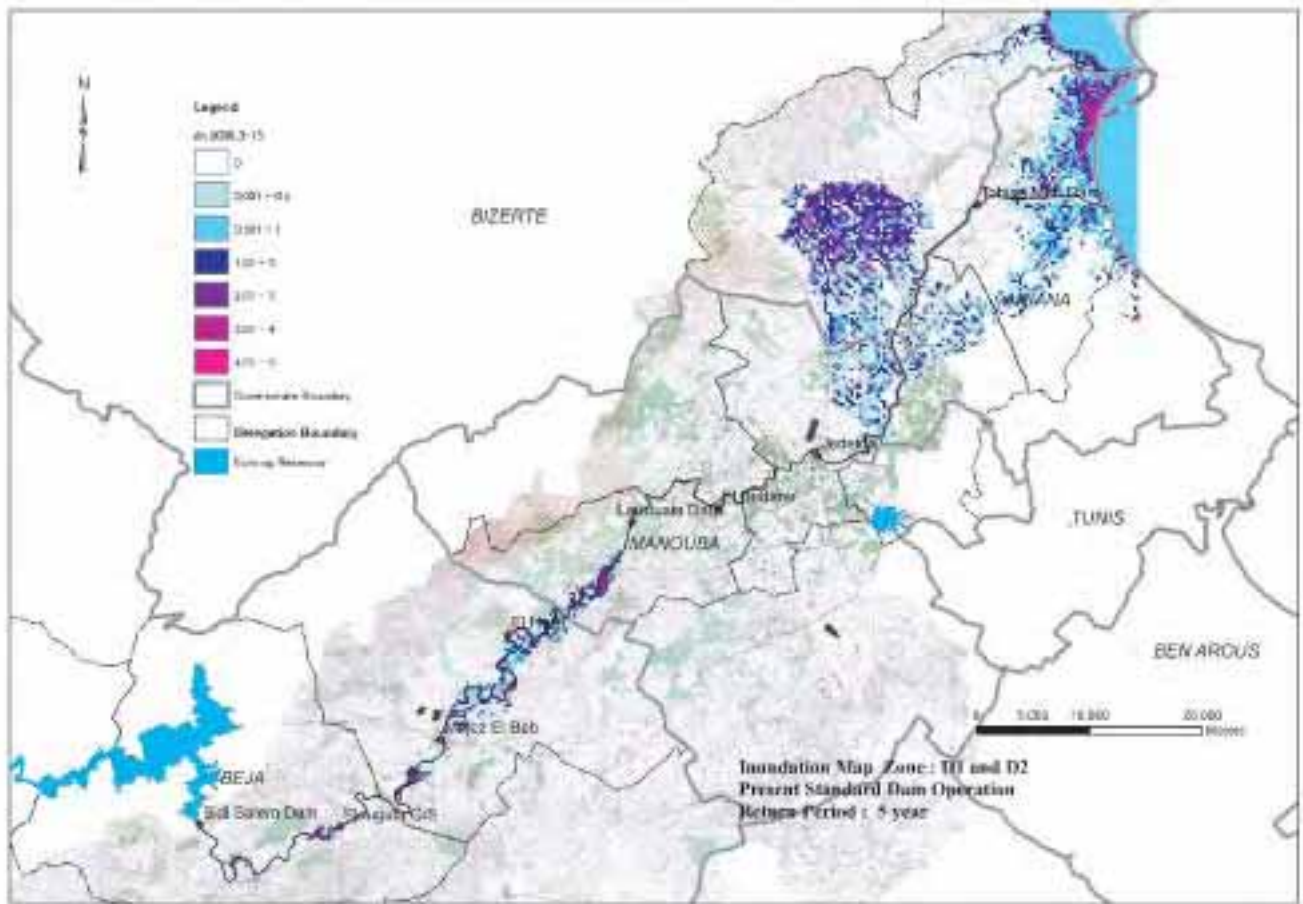
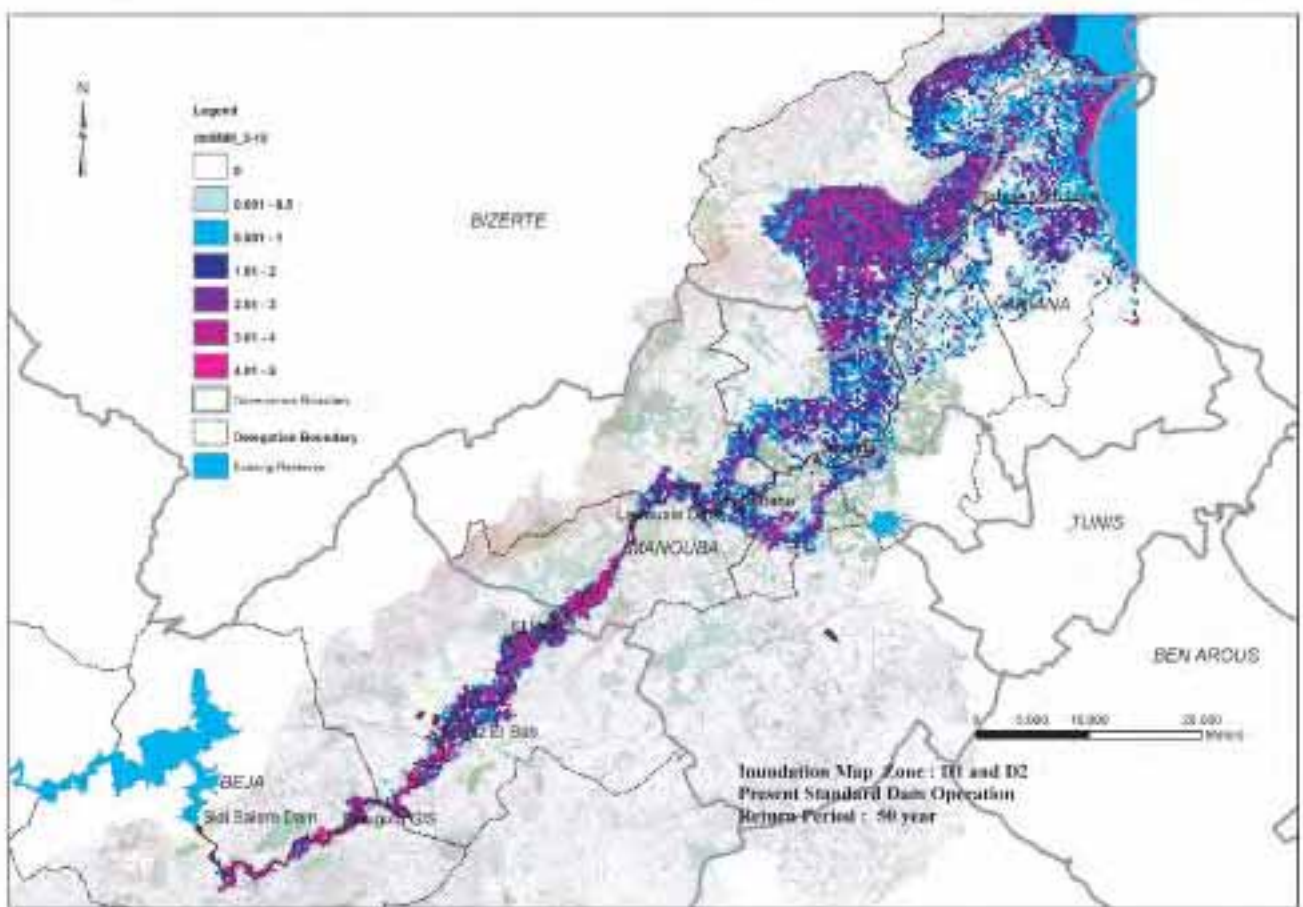
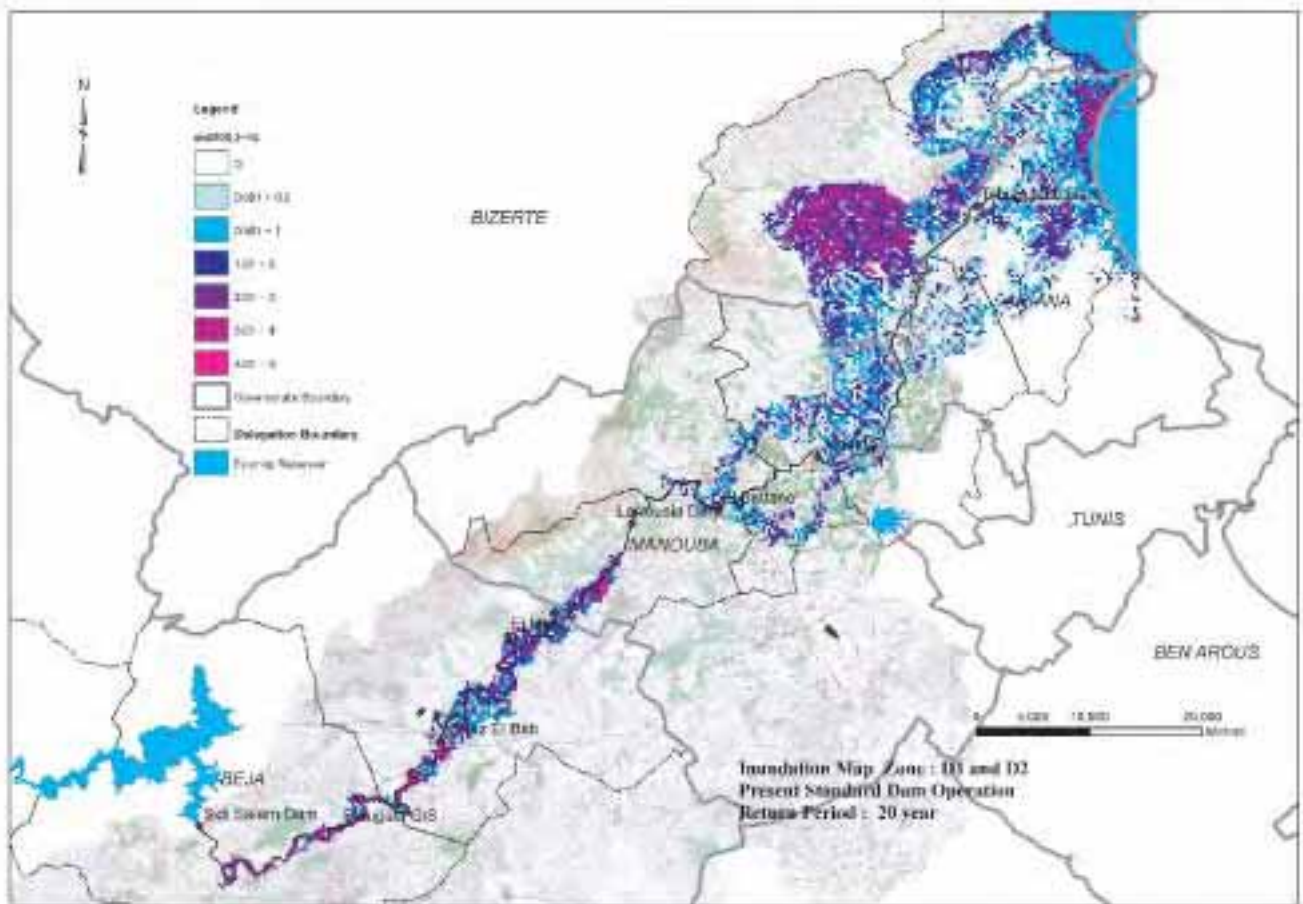


Data A7

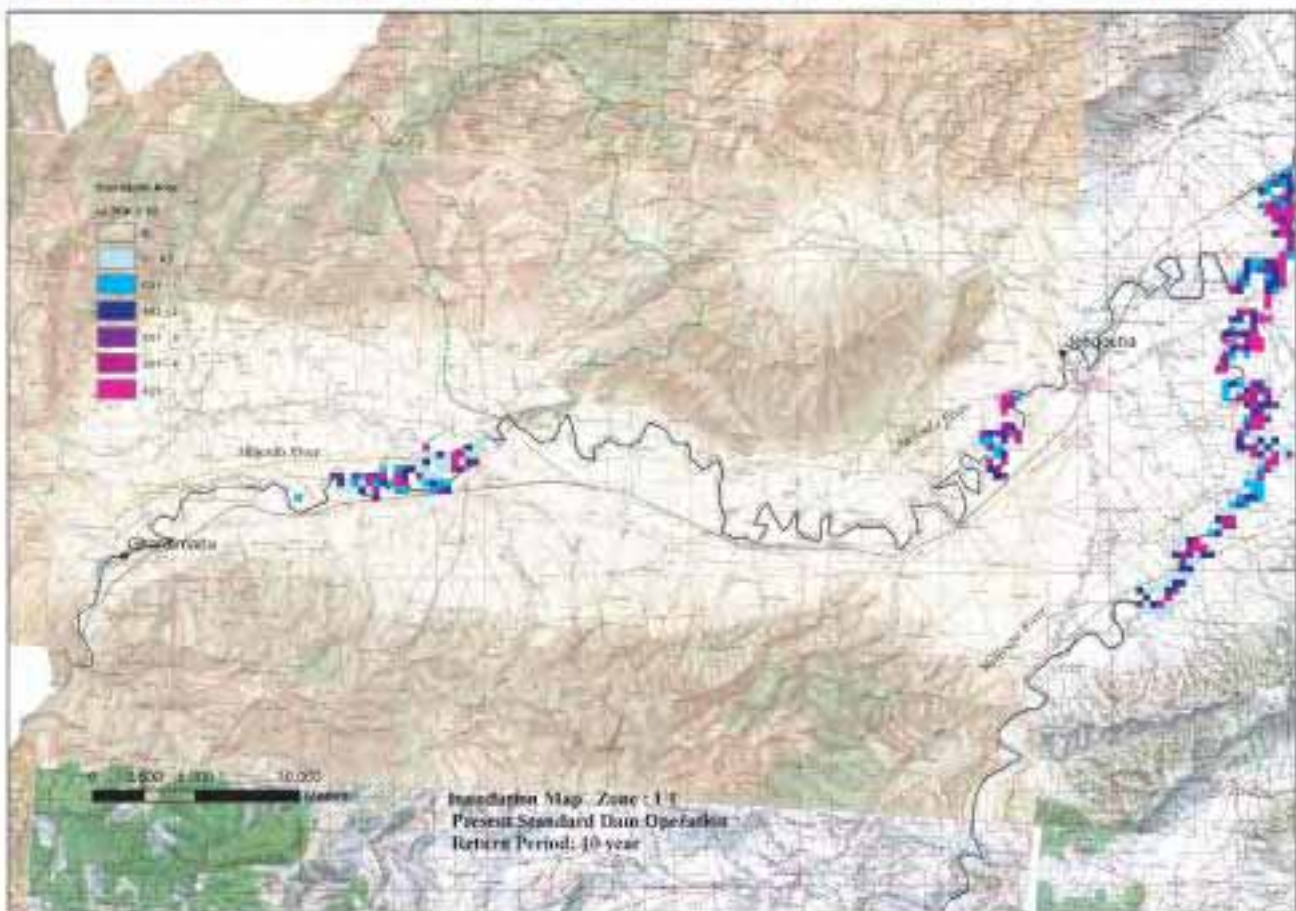
Inundation Maps (Inundation Simulation Results)



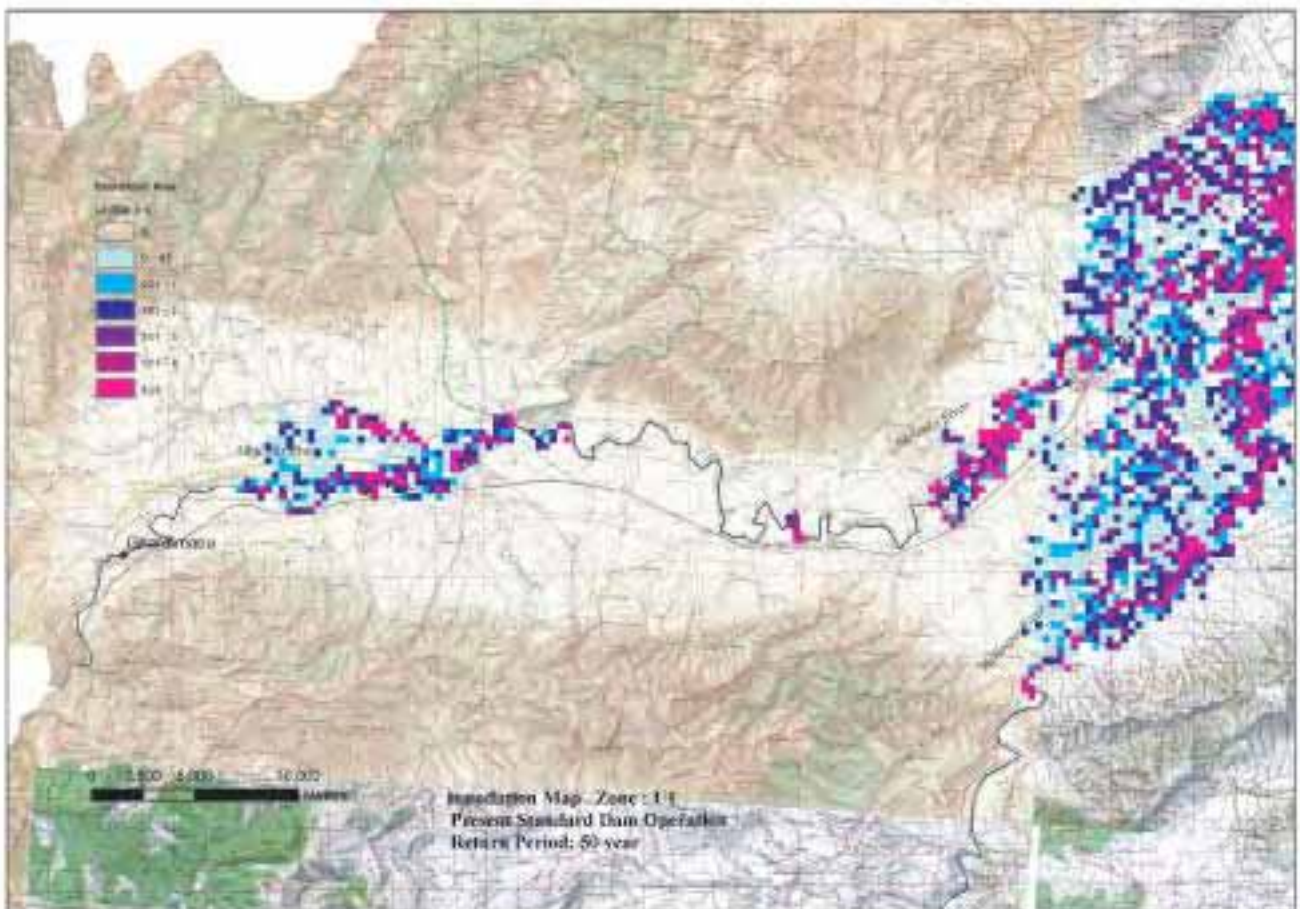
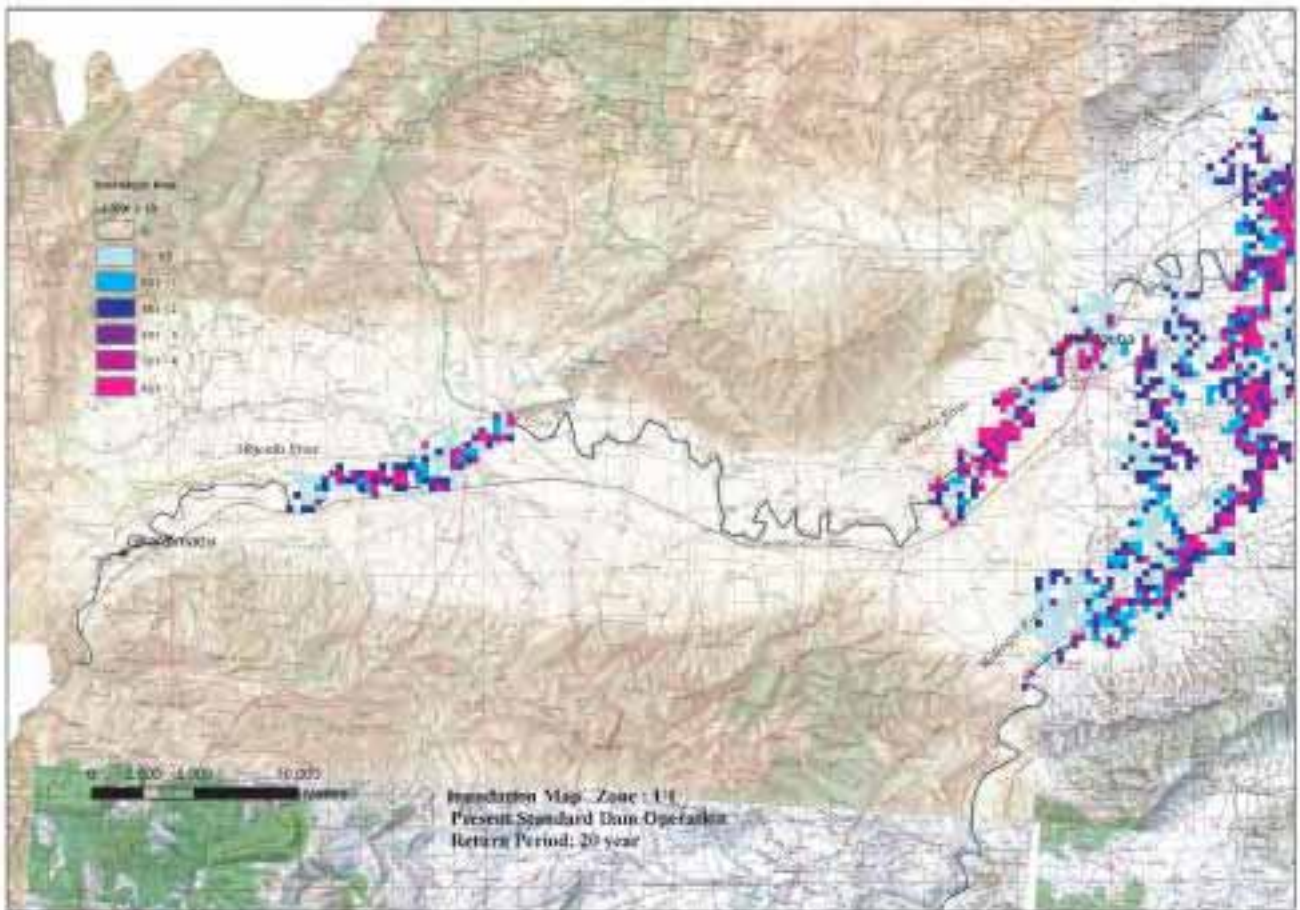
**Inundation Simulation Result
 Present Condition: Zone D1 and D2 (1/2)**



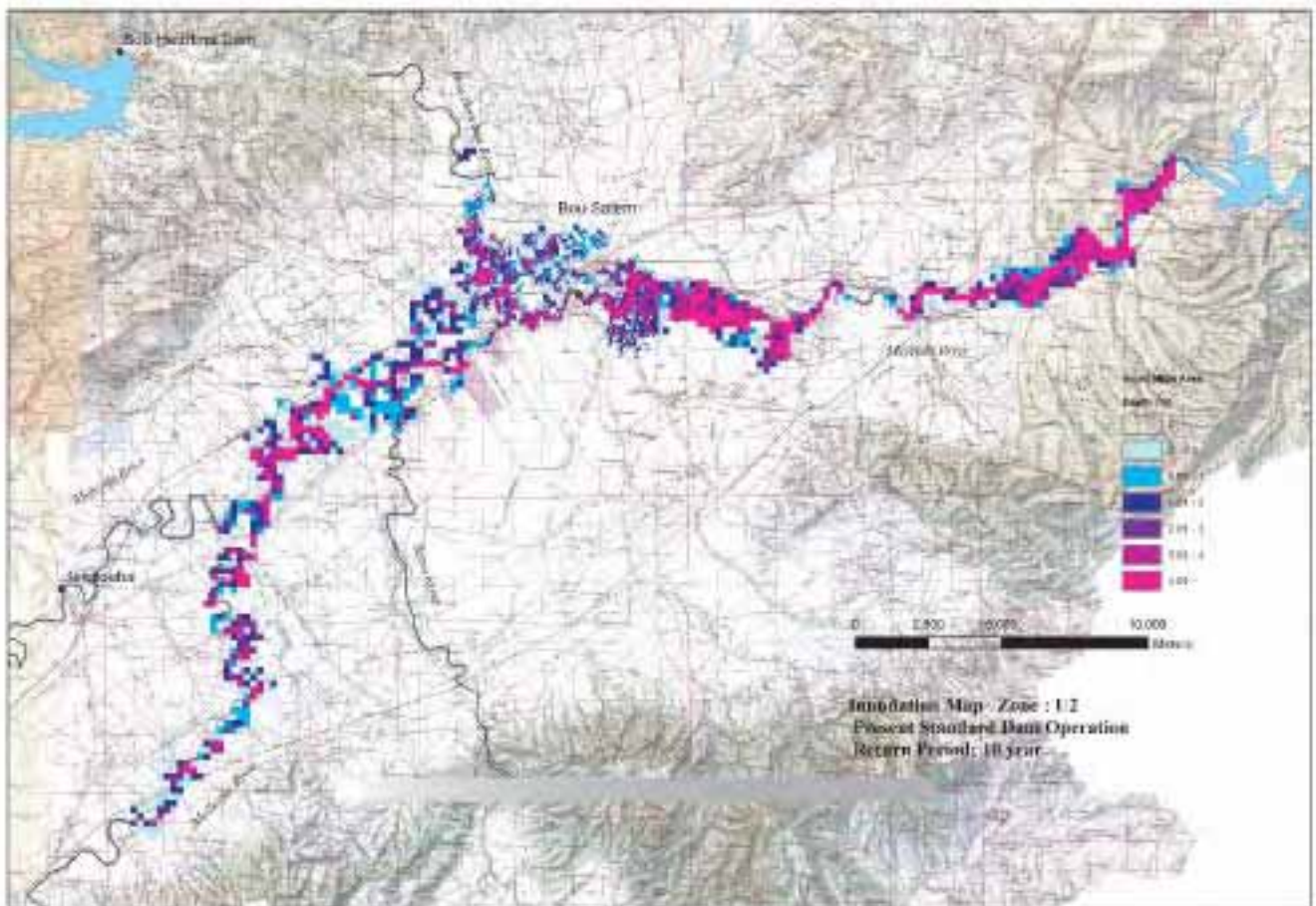
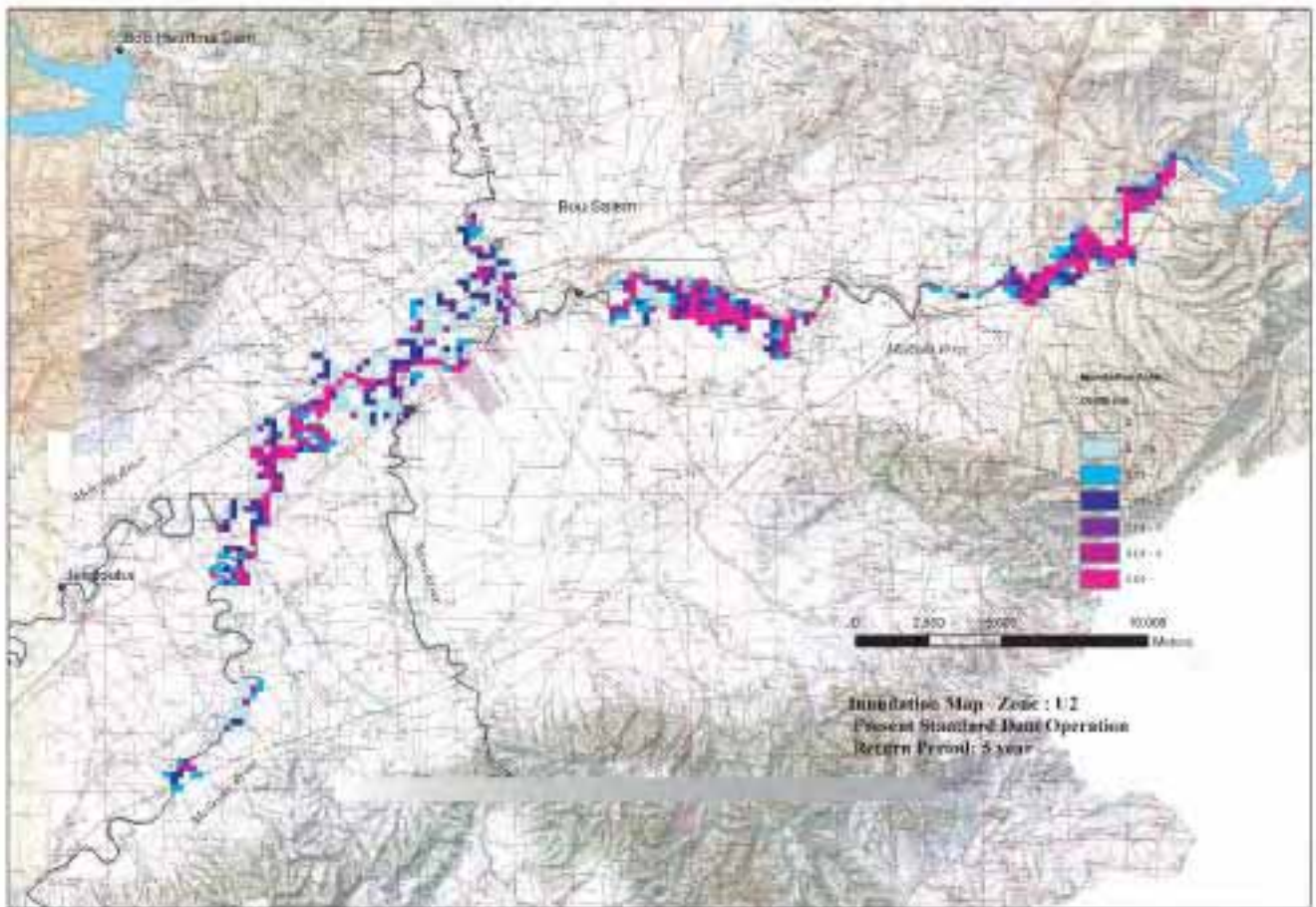
**Inundation Simulation Result
Present Condition: Zone D1 and D2 (2/2)**



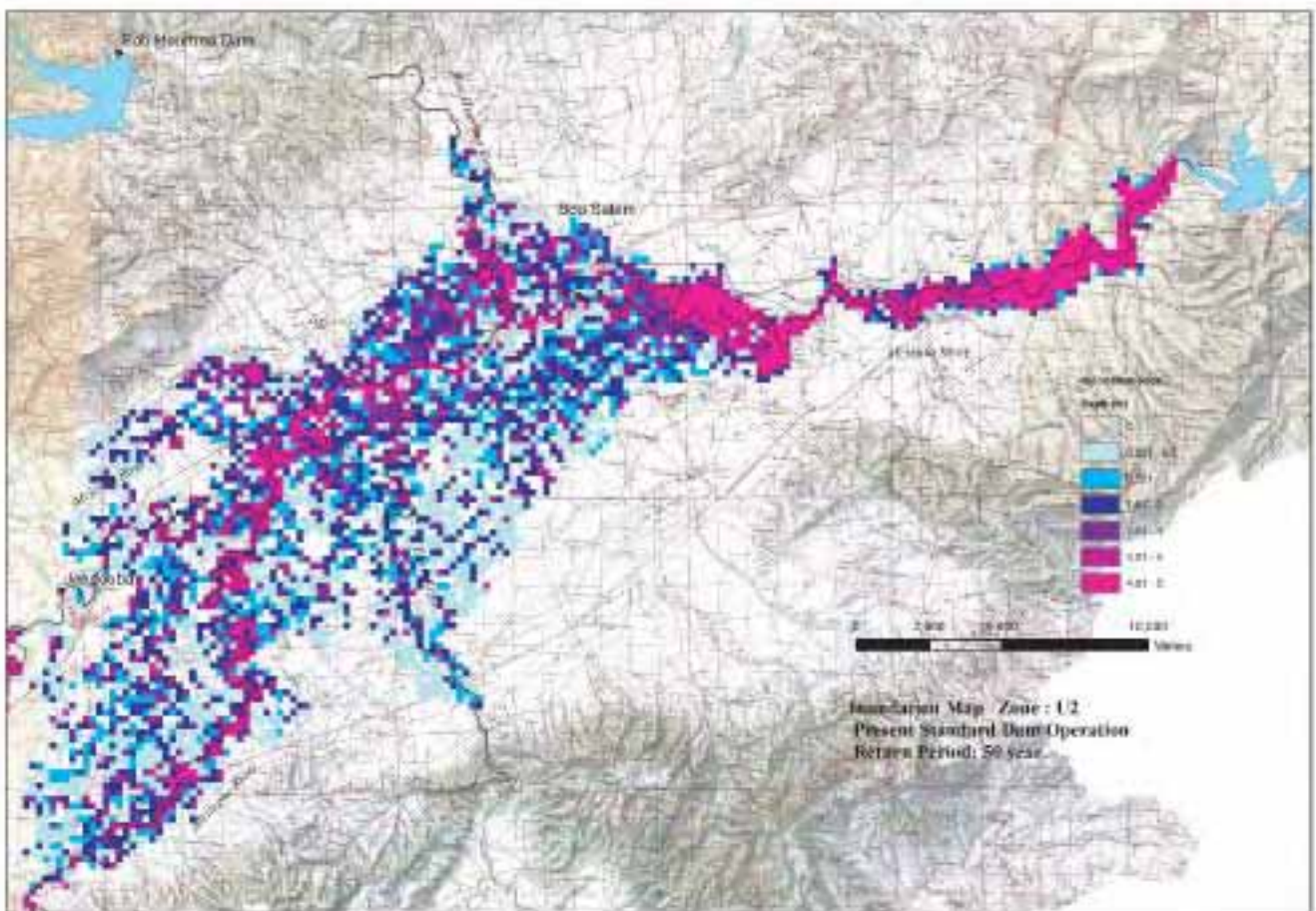
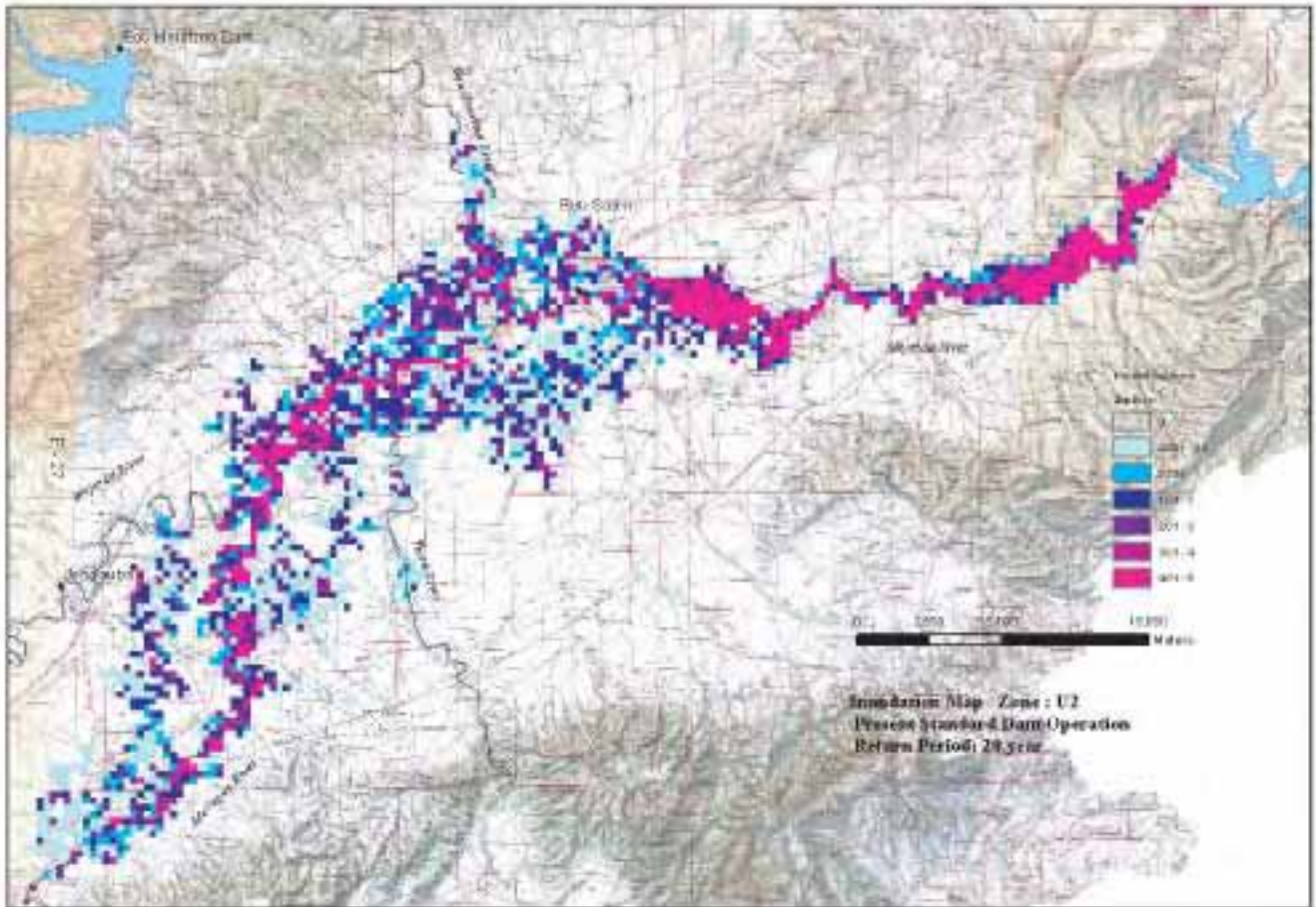
Inundation Simulation Result
Present Condition: Zone U1 (1/2)



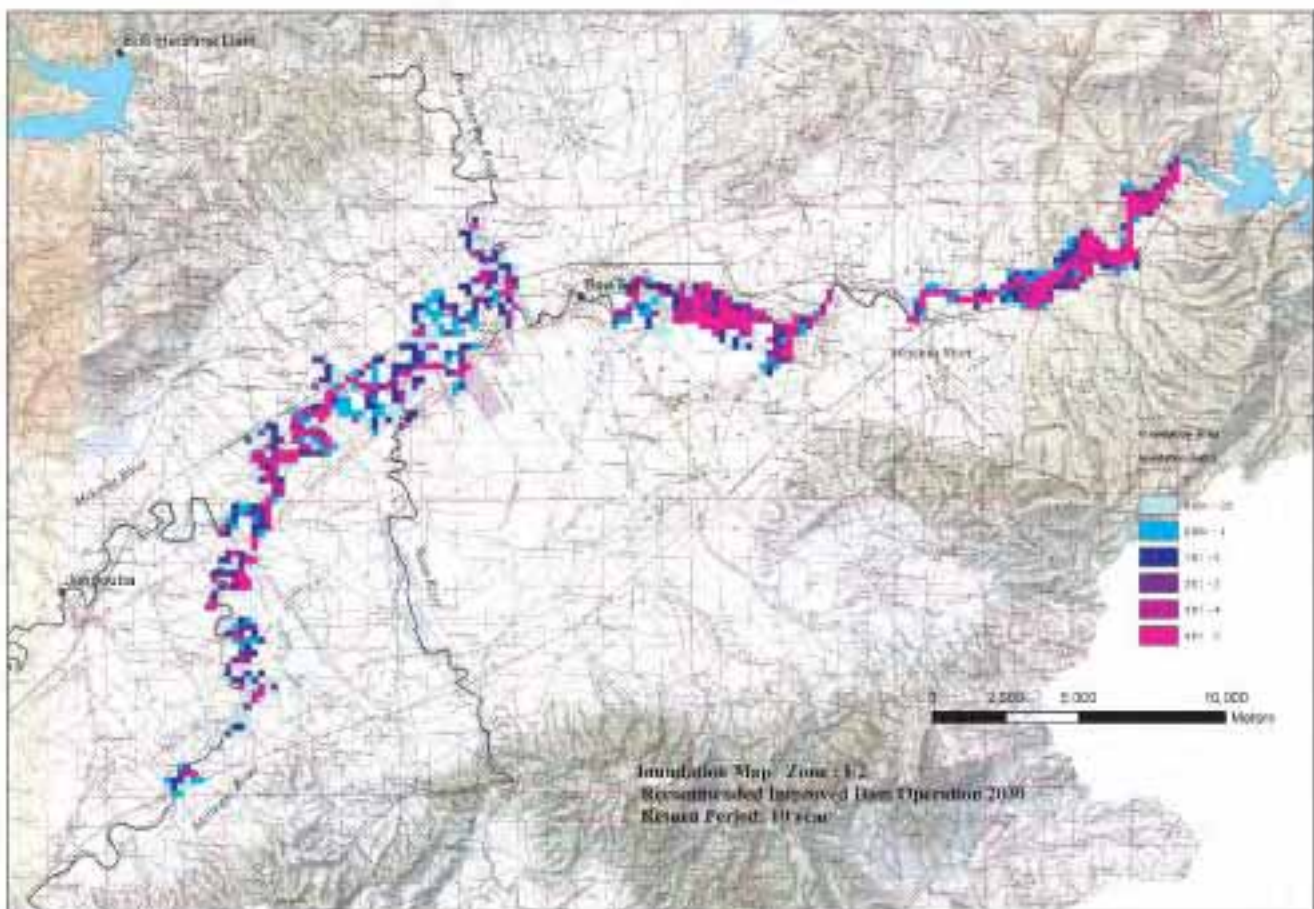
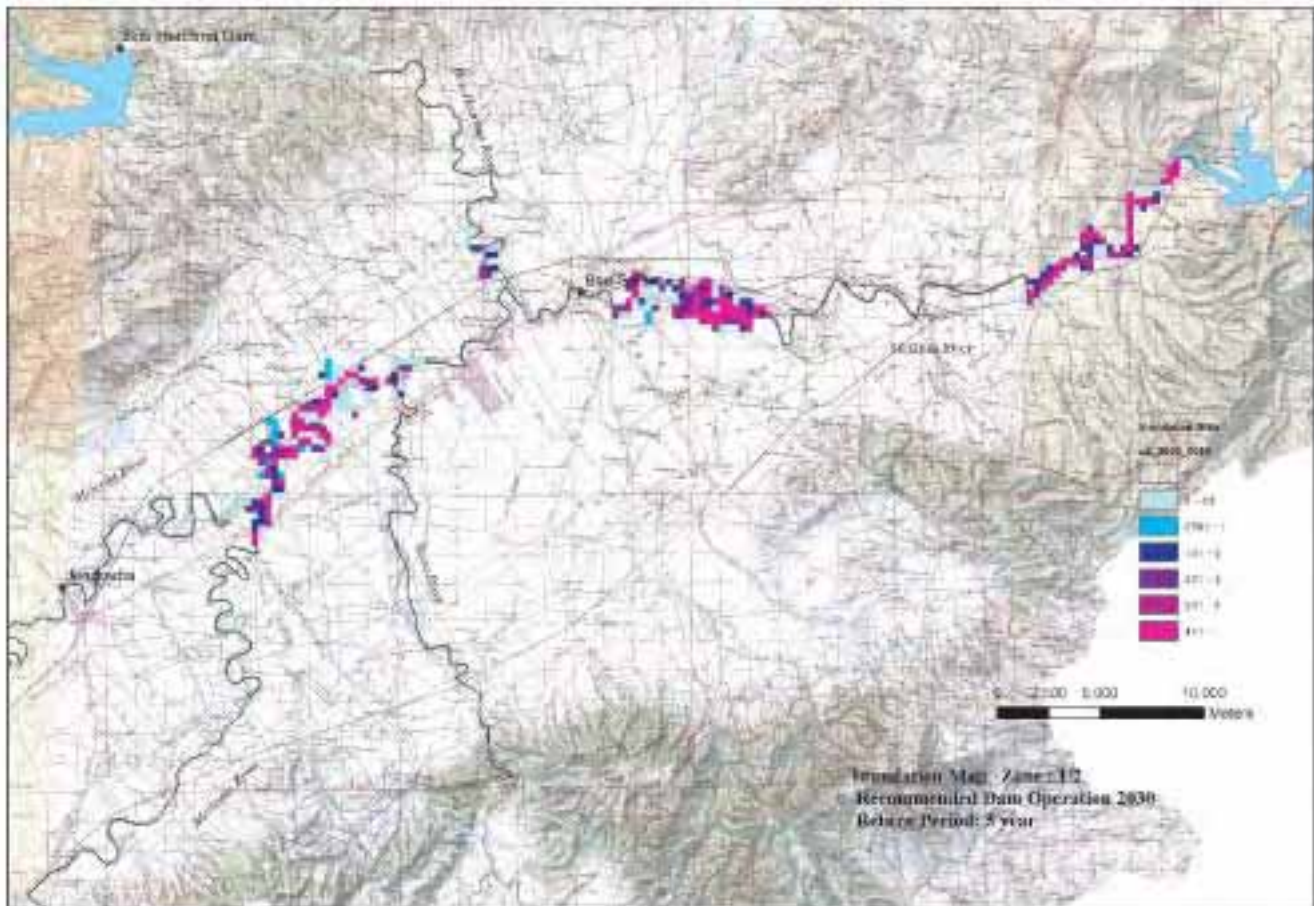
Inundation Simulation Result
Present Condition: Zone U1 (2/2)



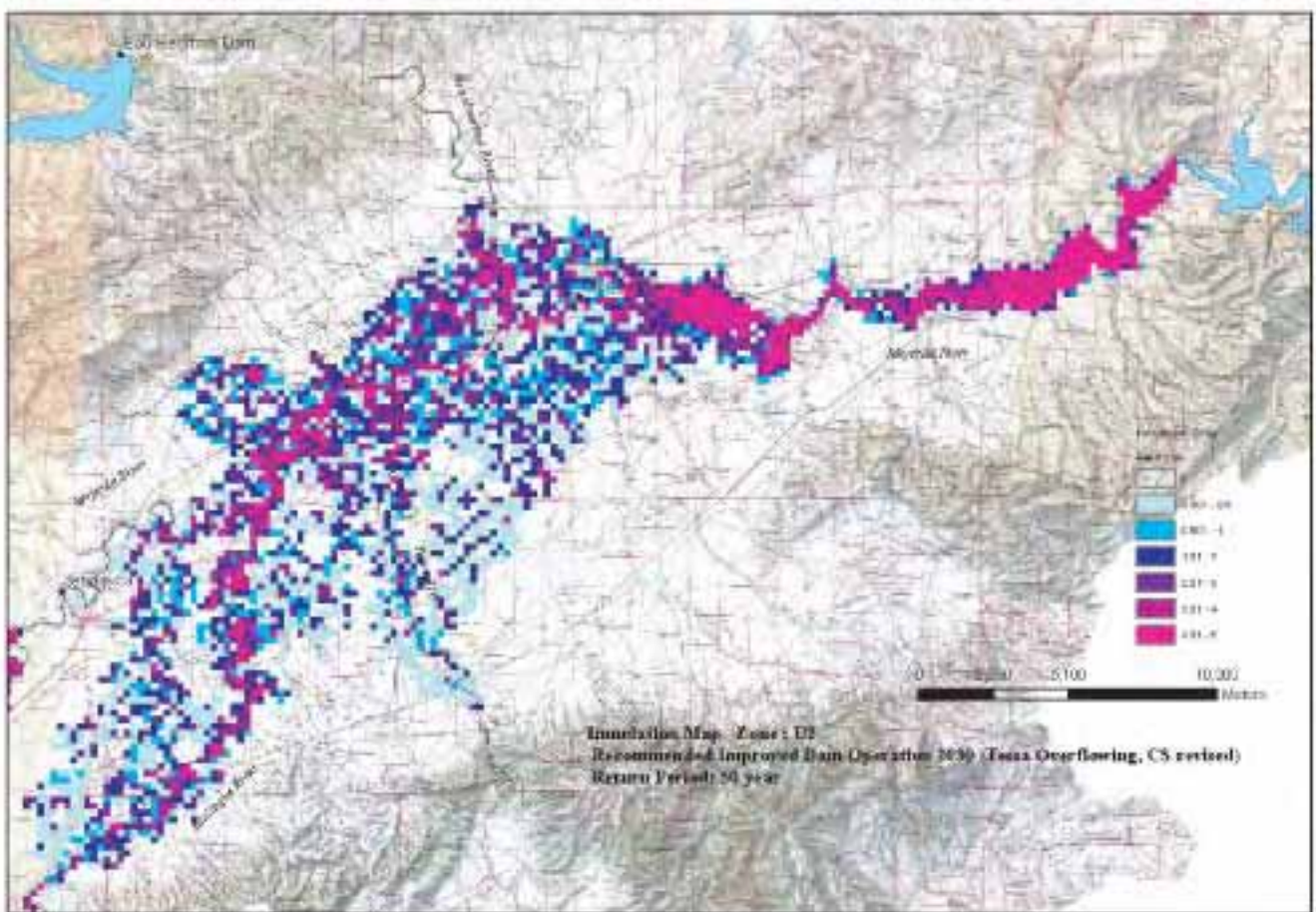
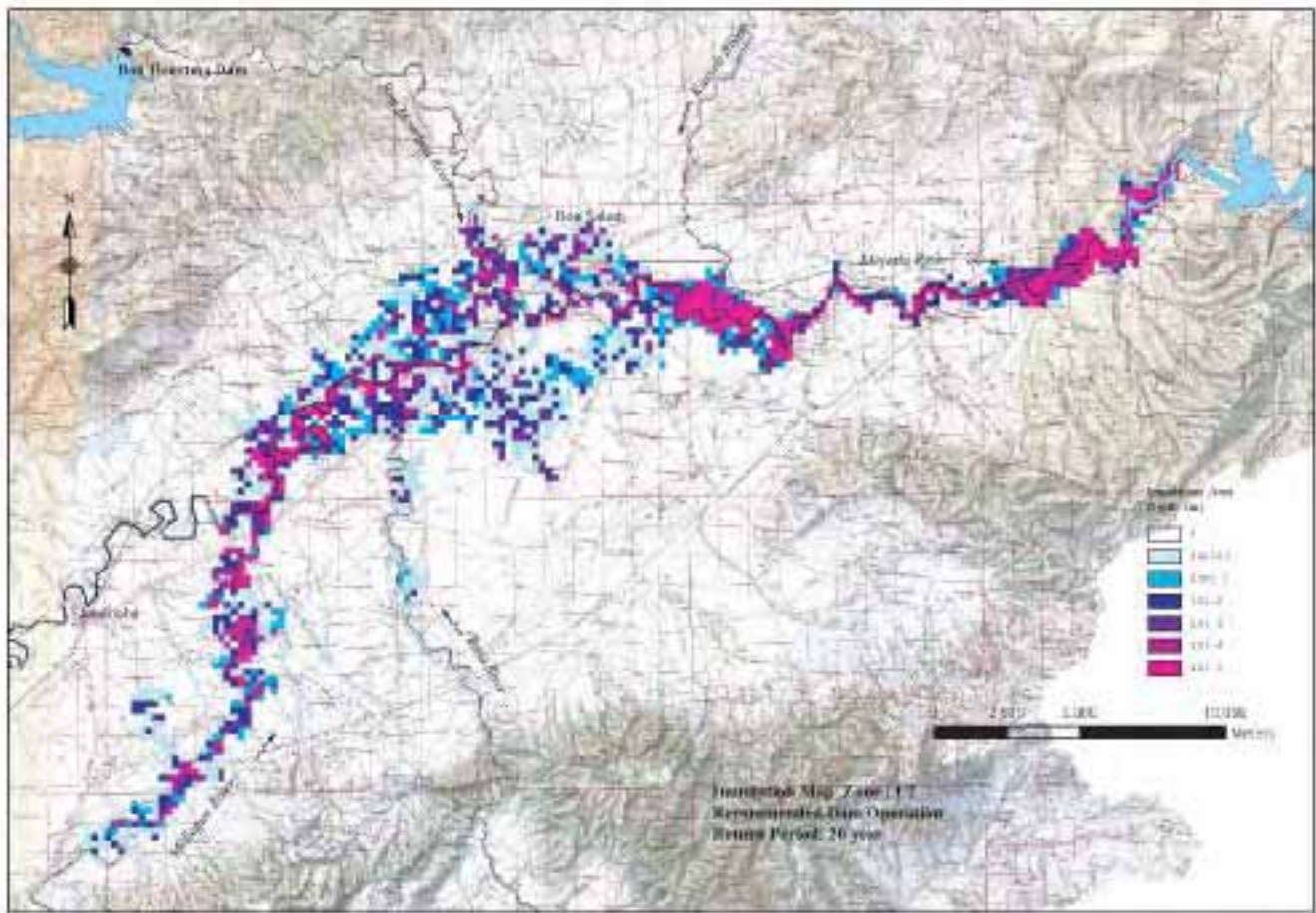
Inundation Simulation Result
Present Condition: Zone U2 (1/2)



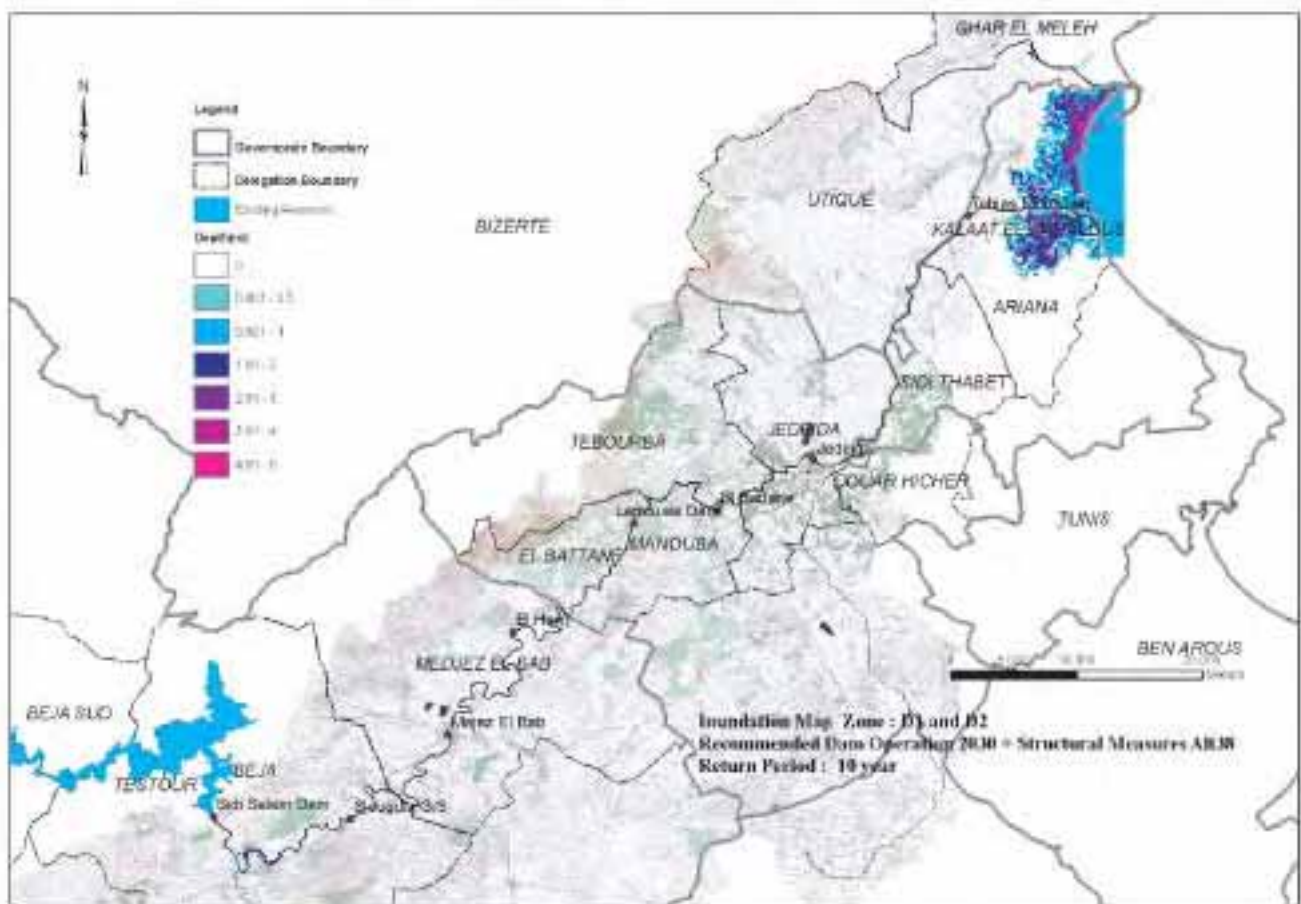
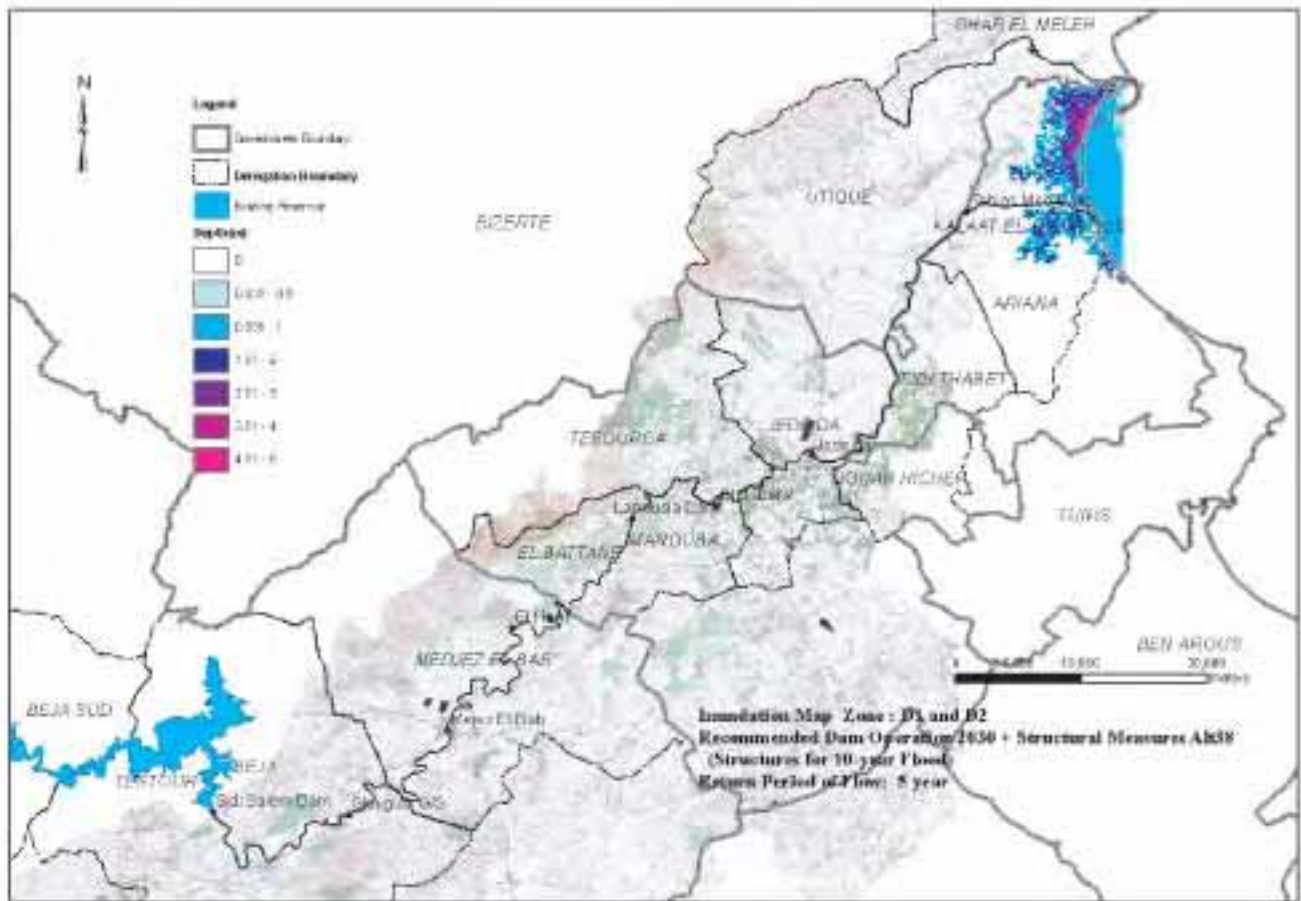
Inundation Simulation Result
Present Condition: Zone U2 (2/2)



Inundation Simulation Result
Recommended Dam Operation 2030: Zone U2 (1/2)



Inundation Simulation Result
Recommended Dam Operation 2030: Zone U2 (2/2)

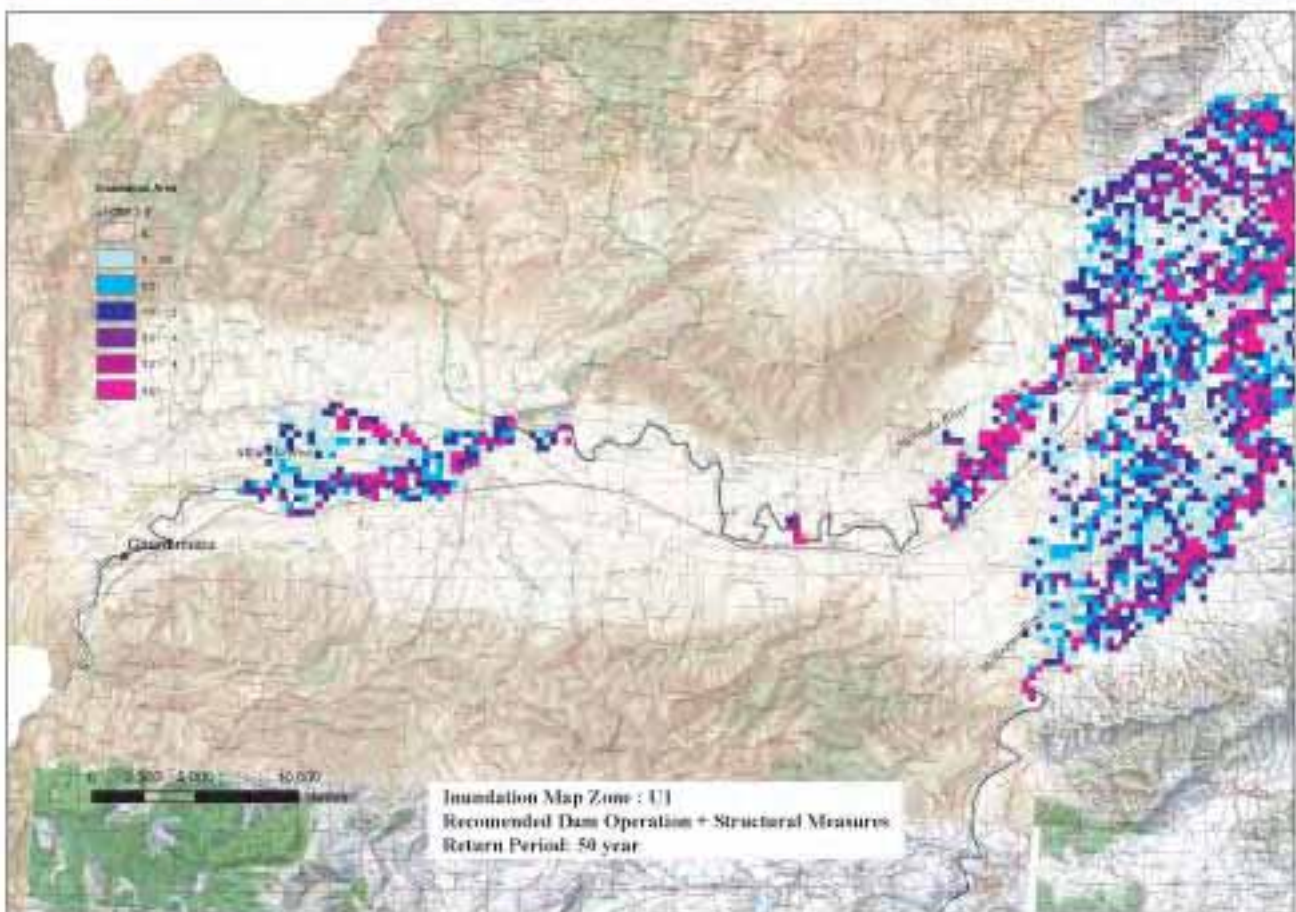
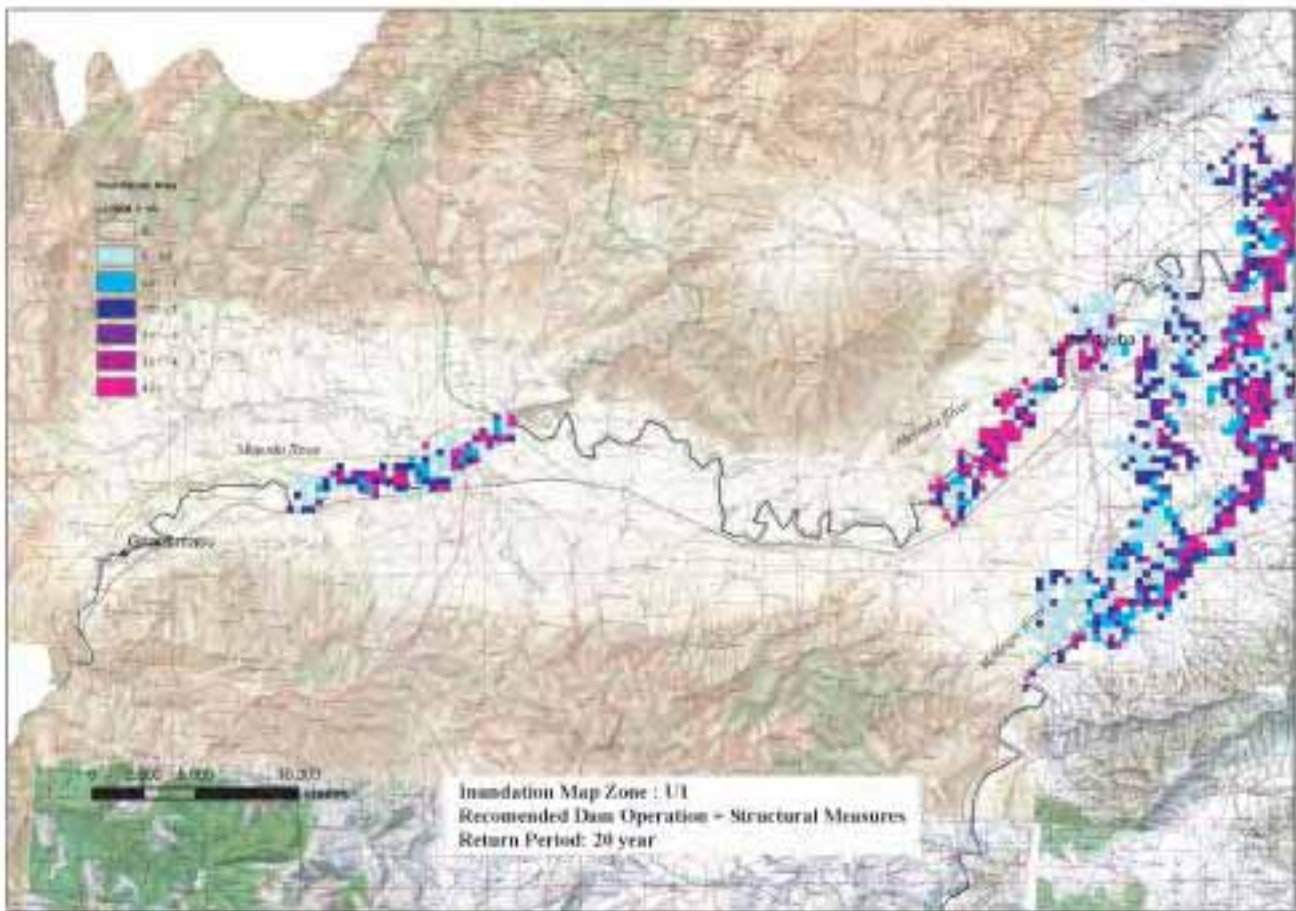


Inundation Simulation Result Recommended Dam Operation 2030 + River Improvement: Zone D1 and D2 (1/2)

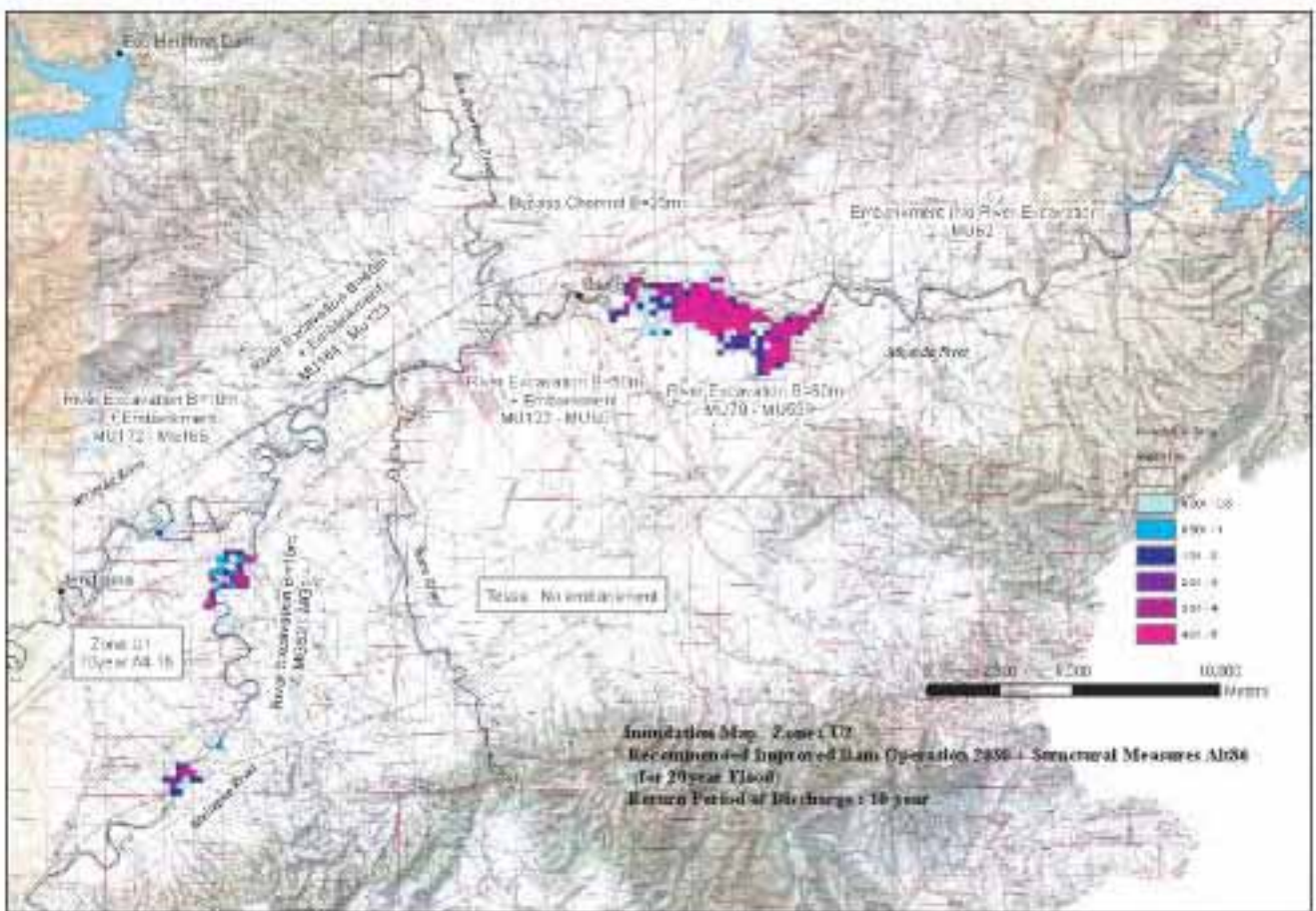
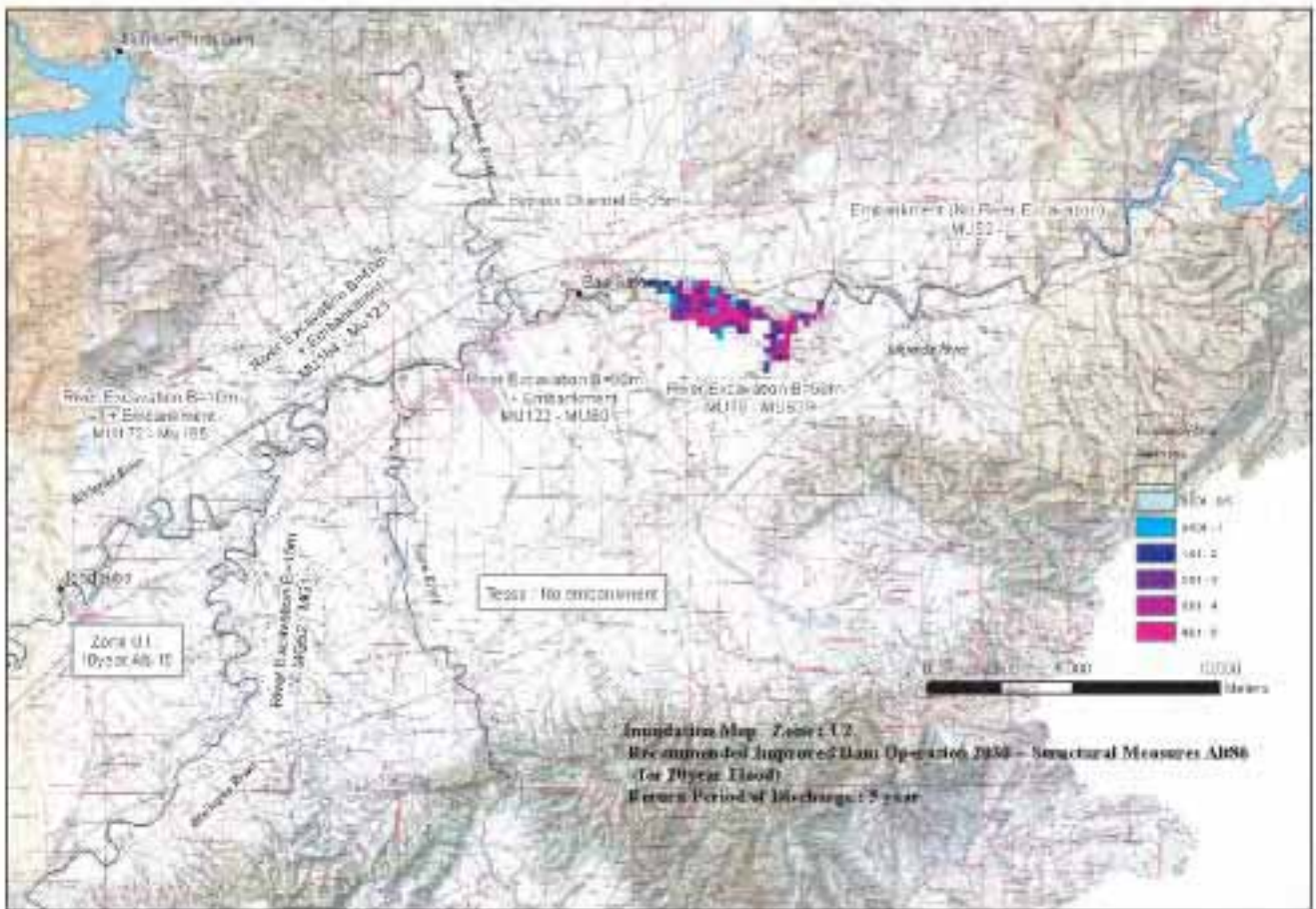
5 year
"No Inundation"



**Inundation Simulation Result Recommended Dam Operation 2030
+ River Improvement: Zone U1 (1/2)**



**Inundation Simulation Result Recommended Dam Operation 2030
+ River Improvement: Zone U1 (2/2)**



**Inundation Simulation Result Recommended Dam Operation 2030
 + River Improvement: Zone U2 (1/2)**

Data B

**WATER SUPPLY
OPERATIONS**

Data B1 Calculation of Active Storage Volumes

Region	Name of dam	Year	2010			2020			2030			Siltation rate (10 ⁶ m ³ per year)	
		Storage Volume at HWL (Mm3)	Storage Volume at NWL (Mm3)	Dead Storage (Mm3)	Active Storage (Mm3)	Storage Volume at NWL (Mm3)	Dead Storage (Mm3)	Active Storage (Mm3)	Storage Volume at NWL (Mm3)	Dead Storage (Mm3)	Active Storage (Mm3)		
Extreme North	Kebir	65.7	64.40	10.60	53.80	64.40	12.70	51.70	64.40	14.80	49.60	0.21	Eau2000
	Zerga	34.8	22.00	2.00	20.00	22.00	3.28	18.72	22.00	4.56	17.44	0.13	Eau2000
	El Moula	26.3	26.30	7.40	18.90	26.30	9.40	16.90	26.30	11.40	14.90	0.20	Eau2000
	Sidi Barrak	325.0	264.50	39.16	225.34	264.50	57.66	206.84	264.50	76.16	188.34	1.85	Eau2000
	Ziatine	42.0	33.00	9.60	23.40	33.00	11.50	21.50	33.00	13.40	19.60	0.19	Eau2000
	Gangoum	21.2	-	-	-	18.30	4.90	13.40	18.30	5.07	13.23	0.02	Eau2000
	Harka	45.5	-	-	-	30.30	10.00	20.30	30.30	11.20	19.10	0.12	Eau2000
	Sejnane	165.7	137.50	23.92	113.58	137.50	34.42	103.08	137.50	44.92	92.58	1.05	Eau2000
	Douimis	58.0	-	-	-	45.60	4.60	41.00	45.60	5.52	40.08	0.09	Eau2000
	Melah	43.0	-	-	-	41.00	8.70	32.30	41.00	10.40	30.60	0.17	Eau2000
	Joumine	165.8	129.90	8.39	121.51	129.90	11.99	117.91	129.90	15.59	114.31	0.36	DBGTH actual
Ghezala	16.5	11.70	0.97	10.73	11.70	1.17	10.53	11.70	1.37	10.33	0.02	DBGTH actual	
Tine	54.5	-	-	-	34.00	3.20	30.80	34.00	3.84	30.16	0.06	Eau2000	
Mejerda River Basin Study Area	Zouitina	132.7	74.82	15.64	59.18	74.82	16.84	57.98	74.82	18.04	56.78	0.12	Eau2000
	Sarrath	48.53	20.95	0.47	20.48	20.95	4.57	16.38	20.95	8.67	12.28	0.41	study report DGB
	Mellegue	147.5	44.40	16.87	27.53	44.40	44.40	-	44.40	44.40	-	2.81	DBGTH actual
	Mellegue2	334.0	-	-	-	195.00	34.00	161.00	195.00	68.00	127.00	3.40	Eau2000
	Tessa	125.0	-	-	-	44.43	10.10	34.33	44.43	15.30	29.13	0.52	Eau2000
	Ben Metir	73.4	57.20	5.92	51.28	57.20	7.32	49.88	57.20	8.72	48.48	0.14	DBGTH actual
	Bou Heurtma	164.0	117.50	7.70	109.80	117.50	8.90	108.60	117.50	10.10	107.40	0.12	DBGTH actual
	Kasseb	92.6	81.88	19.86	62.02	81.88	21.86	60.02	81.88	23.86	58.02	0.20	DBGTH actual
	Beja	46.0	-	-	-	26.40	3.70	22.70	26.40	7.40	19.00	0.37	Eau2000
	Sidi Salem	959.5	814.00	170.90	643.10	814.00	215.90	598.10	814.00	260.90	553.10	4.50	Eau2000
	Khalled	37.0	-	-	-	34.00	9.50	24.50	34.00	12.70	21.30	0.32	Eau2000
	Lakhmes	8.4	7.22	0.18	7.04	7.22	1.30	5.92	7.22	1.60	5.62	0.03	Eau2000
Siliana	125.1	70.00	20.14	49.86	70.00	30.74	39.26	70.00	41.34	28.66	1.06	DBGTH actual	
Rmil	6.0	4.00	-	4.00	4.00	0.50	3.50	4.00	1.00	3.00	0.35	Note 1	

Note 1: The sedimentation rate reported by Eau2000 would fill the complete reservoir shortly after 2020.

R'Mil does not contribute to downstream demands therefore sedimentation rate has been assumed for clarity of presentation.

Data B2 List of Demand centers and codes

Code	Description	Name
BA01	Agricultural demand	Mornag CMCB
BE01	Agricultural demand	Testour
BE02	Agricultural demand	Tebourba Mjez
BE05	Agricultural demand	Goubellat
BE07	Agricultural demand	Sidi Ismail
BE08	Agricultural demand	Nefza Ouechtata
BE10	Agricultural demand	Skhira
BE11	Agricultural demand	El-Herri
BI02	Agricultural demand	Utique
BI03	Agricultural demand	Tobias Bizerte
BI04	Agricultural demand	El Aalia Menzel Jmil
BI05	Agricultural demand	Cap Serrat
BI06	Agricultural demand	Ghezela
BI07	Agricultural demand	Teskraya
BI09	Agricultural demand	Sejenane (Sidi Barak)
BI10	Agricultural demand	Mateur
BI11	Agricultural demand	Ras Jebel - Ousja
BI12	Agricultural demand	Zouaouine
JE01	Agricultural demand	Bouhertma sect I et II
JE03	Agricultural demand	Bouhertma sect IV
JE04	Agricultural demand	Badrouna
JE07	Agricultural demand	Bouhertma sect VI
JE08	Agricultural demand	Sidi Shili
JE09	Agricultural demand	Tabarka Mekna
JE11	Agricultural demand	Bouhertma phase III
JE12	Agricultural demand	Hammam Bourguiba Fernana
KF02	Agricultural demand	Sidi Khiar
KF10	Agricultural demand	Nebeur
LA03	Agricultural demand	Kalaat Landlous
LA09	Agricultural demand	Borj Toumi Nouveau
LA34	Agricultural demand	Basse Vallée (ancien)
LA35	Agricultural demand	Tobias Ariana
NA03	Agricultural demand	Grombalia
NA04	Agricultural demand	Nouvelle Sauvegarde
NA06	Agricultural demand	Soliman-MI Bouzelfa
NA07	Agricultural demand	Korba Menzel Temim
NA08	Agricultural demand	Ancienne Sauvegarde
SL01	Agricultural demand	Lakhmes
SL02	Agricultural demand	Gaafour-Laroussia
SL09	Agricultural demand	Rmil
AG01	Agregated agricultural demand	BA01,NA03,NA04,NA06,NA07,NA08
AG02	Agregated agricultural demand	JE11, JE14, KF02, KF10
AG03	Agregated agricultural demand	KF13, KF14, KF15
AG04	Agregated agricultural demand	JE01, JE07, JE11
AG05	Agregated agricultural demand	BE07, JE03, JE04, JE08
AG06	Agregated agricultural demand	BE01, BE02, BE05, BE11
AG07	Agregated agricultural demand	LA03, LA09, LA34, LA35, BI02, BI03, BI04, BI11, BI12
UBER	Urban water demand	Towns along the pipeline (Ben M'Tir)
UBIZ	Urban water demand	Bizerte
UCTU	Urban water demand	Tunis
UNAB	Urban water demand	Cap Bon (Nabeul)
USFA	Urban water demand	Sfax & Sidi Bouzid
USAK	Urban water demand	Sahel (Sousse, Monastir, Mahdia) & Kairouan
UAG1	Agregated urban water demand	USFA, USAK
UAG2	Agregated urban water demand	UNAB, USFA, USAK
EN02	Environmental demand	Lac Ichkeul

Data B3 Irrigation and Environmental Water demand (1/3)

Year: 2010

Reservoir	Gouvernorat	Perimeter	Code	Area (ha)	sep	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	Yearly Total	Total by source
Zerga	Jendouba	Tabarka Mekna	JE09	2700	2.37	0.12	-	-	-	-	-	0.36	1.72	3.22	4.38	3.83	16.00	16.0
Sidi Barrak	Beja	Nefza Ouechtata	BE08	2260	1.95	0.07	-	-	-	-	-	0.45	1.45	2.49	3.20	2.90	12.50	-
Sidi Barrak	Bizerte	Sejenane (Sidi Barrak)	BI09	3325	2.10	0.13	-	-	-	-	-	0.16	1.49	3.05	4.36	3.72	15.00	27.5
Ziatine	Bizerte	Cap Serrat	BI05	2000	0.77	0.45	0.26	-	-	0.13	0.66	1.26	2.20	1.35	1.47	1.45	10.00	10.0
Sejnane	Bizerte	Teskraya	BI07	684	0.31	0.18	0.10	-	-	0.05	0.26	0.50	0.88	0.54	0.59	0.58	4.00	-
Sejenane	Bizerte	Lake Ichkeul	EN02	-	-	-	6.00	6.00	6.00	6.00	6.00	-	-	-	-	-	30.00	34.0
Ghezala	Bizerte	Ghezala	BI06	900	0.82	0.04	-	-	-	-	-	0.12	0.59	1.11	1.51	1.32	5.50	5.5
Joumine	Bizerte	Mateur	BI10	1643	1.29	0.06	-	-	-	-	-	0.20	0.93	1.75	2.38	2.08	8.70	8.7
Mejerda River	Beja	Sidi Ismail	BE07	3,000	0.83	0.49	0.28	-	-	0.14	0.72	1.37	2.38	1.46	1.60	1.57	10.83	-
Mejerda River	Jendouba	Sidi Shili	JE08	500	0.17	0.10	0.06	-	-	0.03	0.15	0.28	0.48	0.30	0.32	0.32	2.20	-
Mejerda River	Jendouba	Badrouna	JE04	3,200	0.54	0.31	0.18	-	-	0.09	0.46	0.88	1.54	0.94	1.03	1.02	7.00	-
Mejerda River	Jendouba	Bouhertma sect IV	JE03	2700	1.42	0.83	0.47	-	-	0.24	1.22	2.33	4.06	2.49	2.72	2.68	18.47	38.5
Zouitina	Jendouba	Hamnam Bourguiba Fernana	JE12	2070	0.82	0.82	-	0.41	0.41	0.44	0.41	0.41	0.82	0.82	0.82	0.82	7.00	7.0
Bouhertma	Jendouba	Bouhertma phase III	JE11	-	1.31	0.76	0.44	-	-	0.22	1.13	2.14	3.74	2.29	2.51	2.47	17.00	-
Bouhertma	Jendouba	Bouhertma sect I et II	JE01	10000	5.24	3.06	1.75	-	-	0.87	4.51	8.59	14.99	9.17	10.04	9.89	68.10	-
Bouhertma	Jendouba	Bouhertma sect VI	JE07	5300	2.27	1.32	0.76	-	-	0.38	1.95	3.72	6.49	3.97	4.35	4.29	29.50	114.6
Mellegue	Jendouba	Bouhertma phase III	JE11	3,000	0.77	0.45	0.26	-	-	0.13	0.66	1.26	2.20	1.35	1.47	1.45	10.00	-
Mellegue	Le Kef	Nebeur	KF10	400	0.09	0.05	0.03	-	-	0.02	0.08	0.15	0.26	0.16	0.18	0.17	1.20	-
Mellegue	Le Kef	Sidi Khair	KF02	800	0.23	0.13	0.08	-	-	0.04	0.20	0.38	0.66	0.40	0.44	0.44	3.00	14.2
Sidi Salem	Ariana	Basse Vallée(ancien)	LA34	29000	7.69	4.49	2.56	-	-	1.28	6.62	12.61	22.01	13.46	14.74	14.53	100.00	-
Sidi Salem	Ariana	Borj Toumi Nouveau	LA09	871	0.22	0.13	0.07	-	-	0.04	0.19	0.35	0.62	0.38	0.41	0.41	2.80	-
Sidi Salem	Ariana	Kalaat Landlous	LA03	2905	1.48	0.86	0.49	-	-	0.25	1.27	2.42	4.22	2.58	2.83	2.79	19.18	-
Sidi Salem	Ariana	Tobias Ariana	LA35	700	0.36	0.21	0.12	-	-	0.06	0.31	0.58	1.02	0.62	0.68	0.67	4.62	-
Sidi Salem	Beja	El-Herri	BE11	2,900	1.27	0.74	0.42	-	-	0.21	1.09	2.08	3.63	2.22	2.43	2.40	16.50	-
Sidi Salem	Beja	Goubellat	BE05	2,800	0.77	0.45	0.26	-	-	0.13	0.66	1.26	2.20	1.35	1.47	1.45	10.00	-
Sidi Salem	Beja	Skhira	BE10	150	0.06	0.03	0.02	-	-	0.01	0.05	0.09	0.17	0.10	0.11	0.11	0.75	-
Sidi Salem	Beja	Tebourba Mjez	BE02	3800	2.20	1.28	0.73	-	-	0.37	1.89	3.61	6.29	3.85	4.22	4.16	28.60	-
Sidi Salem	Beja	Testour	BE01	1,400	0.81	0.47	0.27	-	-	0.13	0.70	1.32	2.31	1.41	1.55	1.53	10.50	-
Sidi Salem	Bizerte	El Aalia Menzel Jmil	BI04	2678	0.85	0.49	0.28	-	-	0.14	0.73	1.39	2.42	1.48	1.62	1.60	11.00	-
Sidi Salem	Bizerte	Ras Jebel - Ousja	BI11	1900	1.93	1.12	0.64	-	-	0.32	1.66	3.16	5.51	3.37	3.69	3.64	25.03	-
Sidi Salem	Bizerte	Tobias Bizerte	BI03	1400	0.71	0.41	0.24	-	-	0.12	0.61	1.17	2.03	1.24	1.36	1.34	9.24	-
Sidi Salem	Bizerte	Utique	BI02	1000	0.38	0.22	0.13	-	-	0.06	0.33	0.63	1.10	0.67	0.74	0.73	5.00	-
Sidi Salem	Bizerte	Zouaouine	BI12	294	0.15	0.09	0.05	-	-	0.02	0.13	0.24	0.42	0.26	0.28	0.28	1.93	245.2
Lakhmes	Siliana	Lakhmes	SL01	1270	0.27	0.39	0.38	0.07	-	0.09	0.20	-	0.30	0.82	1.20	0.88	4.60	4.6
Siliana	Siliana	Gaafour-Laaroussia	SL02	4250	1.33	1.96	1.89	0.37	-	0.46	0.99	-	1.52	4.12	5.98	4.39	23.00	23.0
Rmil	Siliana	Rmil	SL09	872	0.20	0.30	0.29	0.06	-	0.07	0.15	-	0.23	0.63	0.91	0.67	3.50	3.5
Canal Cap Bon	Nabeul	Solimani-MI Bouzalfa	NA06	3720	0.85	0.49	0.28	-	-	0.14	0.73	1.39	2.42	1.48	1.62	1.60	11.00	-
Canal Cap Bon	Nabeul	Ancienne Sauvegarde	NA08	3680	0.88	0.52	0.29	-	-	0.15	0.76	1.45	2.53	1.55	1.70	1.67	11.50	-
Canal Cap Bon	Nabeul	Grombalia	NA03	5610	3.15	1.84	1.05	-	-	0.53	2.72	5.17	9.02	5.52	6.04	5.96	41.00	-
Canal Cap Bon	Nabeul	Korba Menzel Temim	NA07	1500	0.27	0.16	0.09	-	-	0.04	0.23	0.44	0.77	0.47	0.52	0.51	3.50	-
Canal Cap Bon	Ben Arous	Mornag CMCB	BA01	4783	1.08	0.63	0.36	-	-	0.18	0.93	1.76	3.08	1.88	2.06	2.03	14.00	-
Canal Cap Bon	Nabeul	Nouvelle Sauvegarde	NA04	2800	1.00	0.58	0.33	-	-	0.17	0.86	1.64	2.86	1.75	1.92	1.89	13.00	94.0
Beja (future)	Beja		BE12	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Khaled (future)	Beja		BE13	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mellegue2 (future)	Jendouba		JE14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sarrat (future)	Le Kef	Sarrat	KF11	3200	0.92	0.54	0.31	-	-	0.15	0.80	1.51	2.64	1.62	1.77	0.17	10.43	10.4
Tessa (future)	Le Kef		KF13	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tessa (future)	Le Kef		KF14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tessa (future)	Le Kef		KF15	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chafrou (future)	Manouba		MA25	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				127,965	52.11	27.78	22.20	6.91	6.41	13.89	43.02	68.82	126.23	89.67	103.23	96.41	656.68	656.683

Source: MARH, DGBGTH 2006, Mr. Louati

DB3-1

Data B3 Irrigation water demand (2/3)

Year: 2020

Reservoir	Gouvernerat	Perimeter	Code	Area (ha)	sep	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	Yearly Total	Total by source
Zergua	Jendouba	Tabarka Mekna	JE09	2700	2.15	0.11	0.00	0.00	0.00	0.00	0.00	0.33	1.55	2.91	3.96	3.47	14.48	14.5
Sidi Barrak	Beja	Nefza Ouechtata	BE08	2260	1.77	0.07	0.00	0.00	0.00	0.00	0.00	0.40	1.31	2.25	2.89	2.63	11.32	
Sidi Barrak	Bizerte	Sejenane (Sidi Barrak)	BI09	3325	1.90	0.12	0.00	0.00	0.00	0.00	0.00	0.14	1.35	2.76	3.95	3.36	13.58	24.9
Ziatine	Bizerte	Cap Serrat	BI05	2000	0.70	0.41	0.23	0.00	0.00	0.12	0.60	1.14	1.99	1.22	1.33	1.32	9.05	9.1
Sejenane	Bizerte	Teskraya	BI07	684	0.28	0.16	0.09	0.00	0.00	0.05	0.24	0.46	0.80	0.49	0.53	0.53	3.62	
Sejenane	Bizerte	Lake Ichkeul	EN02		0.00	0.00	6.00	6.00	6.00	6.00	6.00	0.00	0.00	0.00	0.00	0.00	30.00	33.6
Ghezala	Bizerte	Ghezala	BI06	900	0.74	0.04	0.00	0.00	0.00	0.00	0.00	0.11	0.53	1.00	1.36	1.19	4.98	5.0
Joumine	Bizerte	Mateur	BI10	1643	1.17	0.06	0.00	0.00	0.00	0.00	0.00	0.18	0.85	1.58	2.16	1.89	7.88	7.9
Mejerda River	Beja	Sidi Ismail	BE07	3,000	0.75	0.44	0.25	0.00	0.00	0.13	0.65	1.24	2.16	1.32	1.45	1.42	9.81	
Mejerda River	Jendouba	Sidi Shili	JE08	500	0.15	0.09	0.05	0.00	0.00	0.03	0.13	0.25	0.44	0.27	0.29	0.29	1.99	
Mejerda River	Jendouba	Badrouna	JE04	3,200	0.49	0.28	0.16	0.00	0.00	0.08	0.42	0.80	1.39	0.85	0.93	0.92	6.34	
Mejerda River	Jendouba	Bouhertma sect IV	JE03	2700	1.29	0.75	0.43	0.00	0.00	0.21	1.11	2.11	3.68	2.25	2.47	2.43	16.72	34.9
Zouitina	Jendouba	Hammam Bourguiba Fernana	JE12	2070	0.74	0.74	0.00	0.37	0.37	0.40	0.37	0.37	0.74	0.74	0.74	0.74	6.34	6.3
Bouhertma	Jendouba	Bouhertma phase III	JE11	-	1.18	0.69	0.39	0.00	0.00	0.20	1.02	1.94	3.39	2.07	2.27	2.24	15.39	
Bouhertma	Jendouba	Bouhertma sect I et II	JE01	10000	4.74	2.77	1.58	0.00	0.00	0.79	4.08	7.77	13.57	8.30	9.09	8.96	61.65	
Bouhertma	Jendouba	Bouhertma sect VI	JE07	5300	2.05	1.20	0.68	0.00	0.00	0.34	1.77	3.37	5.88	3.60	3.94	3.88	26.71	103.7
Mellegue	Jendouba	Bouhertma phase III	JE11	3,000	0.70	0.41	0.23	0.00	0.00	0.12	0.60	1.14	1.99	1.22	1.33	1.32	9.05	
Mellegue	Le Kef	Nebeur	KF10	400	0.08	0.05	0.03	0.00	0.00	0.01	0.07	0.14	0.24	0.15	0.16	0.16	1.09	
Mellegue	Le Kef	Sidi Khiar	KF02	800	0.21	0.12	0.07	0.00	0.00	0.03	0.18	0.34	0.60	0.37	0.40	0.39	2.72	12.9
Sidi Salem	Ariana	Basse Vallée(ancien)	LA34	29000	6.96	4.06	2.32	0.00	0.00	1.16	6.00	11.41	19.92	12.19	13.35	13.15	90.53	
Sidi Salem	Ariana	Borj Toumi Nouveau	LA09	871	0.19	0.11	0.06	0.00	0.00	0.03	0.17	0.32	0.56	0.34	0.37	0.37	2.53	
Sidi Salem	Ariana	Kalaat Landlous	LA03	2905	1.34	0.78	0.45	0.00	0.00	0.22	1.15	2.19	3.82	2.34	2.56	2.52	17.36	
Sidi Salem	Ariana	Tobias Ariana	LA35	700	0.32	0.19	0.11	0.00	0.00	0.05	0.28	0.53	0.92	0.56	0.62	0.61	4.18	
Sidi Salem	Beja	El-Herri	BE11	2,900	1.15	0.67	0.38	0.00	0.00	0.19	0.99	1.88	3.29	2.01	2.20	2.17	14.94	
Sidi Salem	Beja	Goubellat	BE05	2,800	0.70	0.41	0.23	0.00	0.00	0.12	0.60	1.14	1.99	1.22	1.33	1.32	9.05	
Sidi Salem	Beja	Skhira	BE10	150	0.05	0.03	0.02	0.00	0.00	0.01	0.04	0.09	0.15	0.09	0.10	0.10	0.68	
Sidi Salem	Beja	Tebourba Mjez	BE02	3800	1.99	1.16	0.66	0.00	0.00	0.33	1.72	3.26	5.70	3.49	3.82	3.76	25.89	
Sidi Salem	Beja	Testour	BE01	1,400	0.73	0.43	0.24	0.00	0.00	0.12	0.63	1.20	2.09	1.28	1.40	1.38	9.51	
Sidi Salem	Bizerte	El Aalia Menzel Jmil	BI04	2678	0.77	0.45	0.26	0.00	0.00	0.13	0.66	1.26	2.19	1.34	1.47	1.45	9.96	
Sidi Salem	Bizerte	Ras Jebel - Ousja	BI11	1900	1.74	1.02	0.58	0.00	0.00	0.29	1.50	2.86	4.99	3.05	3.34	3.29	22.66	
Sidi Salem	Bizerte	Tobias Bizerte	BI03	1400	0.64	0.38	0.21	0.00	0.00	0.11	0.55	1.05	1.84	1.13	1.23	1.22	8.37	
Sidi Salem	Bizerte	Utique	BI02	1000	0.35	0.20	0.12	0.00	0.00	0.06	0.30	0.57	1.00	0.61	0.67	0.66	4.53	
Sidi Salem	Bizerte	Zouaouine	BI12	294	0.13	0.08	0.04	0.00	0.00	0.02	0.12	0.22	0.38	0.23	0.26	0.25	1.75	221.9
Lakhmes	Siliana	Lakhmes	SL01	1270	0.24	0.35	0.34	0.07	0.00	0.08	0.18	0.00	0.27	0.75	1.08	0.80	4.16	4.2
Siliana	Siliana	Gaafour-Laaroussia	SL02	4250	1.21	1.77	1.71	0.33	0.00	0.42	0.90	0.00	1.37	3.73	5.41	3.98	20.82	20.8
Rmil	Siliana	Rmil	SL09	872	0.18	0.27	0.26	0.05	0.00	0.06	0.14	0.00	0.21	0.57	0.82	0.61	3.17	3.2
Cap Bon Canal	Nabeul	Soliman-MI Bouzelfa	NA06	3720	0.77	0.45	0.26	0.00	0.00	0.13	0.66	1.26	2.19	1.34	1.47	1.45	9.96	
Cap Bon Canal	Nabeul	Ancienne Sauvegarde	NA08	3680	0.80	0.47	0.27	0.00	0.00	0.13	0.69	1.31	2.29	1.40	1.53	1.51	10.41	
Cap Bon Canal	Nabeul	Grombalia	NA03	5610	2.86	1.67	0.95	0.00	0.00	0.48	2.46	4.68	8.17	5.00	5.47	5.39	37.12	
Cap Bon Canal	Nabeul	Korba Menzel Temim	NA07	1500	0.24	0.14	0.08	0.00	0.00	0.04	0.21	0.40	0.70	0.43	0.47	0.46	3.17	
Cap Bon Canal	Ben Arous	Mornag CMCB	BA01	4783	0.97	0.57	0.32	0.00	0.00	0.16	0.84	1.60	2.79	1.71	1.87	1.84	12.67	
Cap Bon Canal	Nabeul	Nouvelle Sauvegarde	NA04	2800	0.91	0.53	0.30	0.00	0.00	0.15	0.78	1.48	2.59	1.58	1.74	1.71	11.77	85.1
Beja (future)	Beja		BE12	1534	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Khalled (future)	Beja		BE13	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Mellegue2 (future)	Jendouba		JE14	29451	7.38	4.31	2.46	0.00	0.00	1.23	6.36	12.10	21.13	12.92	14.15	13.95	96.00	96.0
Sarrath	Le Kef	Sarrath	KF11	3200	0.84	0.49	0.28	0.00	0.00	0.14	0.72	1.37	2.39	1.46	1.60	0.16	9.44	9.4
Tessa (future)	Le Kef		KF13	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Tessa (future)	Le Kef		KF14	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Tessa (future)	Le Kef		KF15	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Chafrou (future)	Manouba		MA25	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
				158,950	54.56	29.46	23.13	6.82	6.37	14.37	45.87	74.40	135.41	94.10	107.61	101.22	693.33	693.3

Source: MARH, DGBGTH 2006

Data B3 Irrigation water demand (3/3)

Year: 2030

Reservoir	Gouvernerat	Perimeter	Code	Area (ha)	sep	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	Yearly Total	Total by source
Zergua (future)	Jendouba	Tabarka Mekna	JE09	2700	1.94	0.10	-	-	-	-	-	0.30	1.41	2.64	3.59	3.14	13.11	13.11
Sidi Barrak	Beja	Nefza Ouechtata	BE08	2260	1.60	0.06	-	-	-	-	-	0.37	1.19	2.04	2.62	2.38	10.24	
Sidi Barrak	Bizerte	Sejenane (Sidi Barrak)	BI09	3325	1.72	0.11	-	-	-	-	-	0.13	1.22	2.50	3.57	3.05	12.29	22.54
Ziatine (future)	Bizerte	Cap Serrat	BI05	2000	0.63	0.37	0.21	-	-	0.11	0.54	1.03	1.80	1.10	1.21	1.19	8.20	8.20
Sejnane	Bizerte	Teskraya	BI07	684	0.25	0.15	0.08	-	-	0.04	0.22	0.41	0.72	0.44	0.48	0.48	3.28	
Sejnane	Bizerte	Lake Ichkeul	EN02		-	-	6.00	6.00	6.00	6.00	6.00	-	-	-	-	-	30.00	33.28
Ghezala	Bizerte	Ghezala	BI06	900	0.67	0.03	-	-	-	-	-	0.10	0.48	0.91	1.23	1.08	4.51	4.51
Joumine	Bizerte	Mateur	BI10	1643	1.06	0.05	-	-	-	-	-	0.16	0.77	1.43	1.95	1.71	7.13	7.13
Mejerda River	Beja	Sidi Ismail	BE07	3,000	0.68	0.40	0.23	-	-	0.11	0.59	1.12	1.95	1.20	1.31	1.29	8.88	
Mejerda River	Jendouba	Sidi Shili	JE08	500	0.14	0.08	0.05	-	-	0.02	0.12	0.23	0.40	0.24	0.27	0.26	1.80	
Mejerda River	Jendouba	Badrouna	JE04	3,200	0.44	0.26	0.15	-	-	0.07	0.38	0.72	1.26	0.77	0.85	0.83	5.74	
Mejerda River	Jendouba	Bouhertma sect IV	JE03	2700	1.16	0.68	0.39	-	-	0.19	1.00	1.91	3.33	2.04	2.23	2.20	15.14	31.56
Zouitina	Jendouba	Hammam Bourguiba Fernana	JE12	2070	0.67	0.67	-	0.34	0.34	0.36	0.34	0.34	0.67	0.67	0.67	0.67	5.74	5.74
Bouhertma	Jendouba	Bouhertma phase III	JE11	-	1.07	0.63	0.36	-	-	0.18	0.92	1.76	3.07	1.88	2.05	2.02	13.93	
Bouhertma	Jendouba	Bouhertma sect I et II	JE01	10000	4.29	2.50	1.43	-	-	0.72	3.70	7.04	12.28	7.51	8.23	8.11	55.81	
Bouhertma	Jendouba	Bouhertma sect VI	JE07	5300	1.86	1.08	0.62	-	-	0.31	1.60	3.05	5.32	3.25	3.56	3.51	24.18	93.92
Mellegue	Jendouba	Bouhertma phase III	JE11	3,000	0.63	0.37	0.21	-	-	0.11	0.54	1.03	1.80	1.10	1.21	1.19	8.20	
Mellegue	Le Kef	Nebeur	KF10	400	0.08	0.04	0.03	-	-	0.01	0.07	0.12	0.22	0.13	0.14	0.14	0.98	
Mellegue	Le Kef	Sidi Khair	KF02	800	0.19	0.11	0.06	-	-	0.03	0.16	0.31	0.54	0.33	0.36	0.36	2.46	11.64
Sidi Salem	Ariana	Basse Vallée(ancien)	LA34	29000	6.30	3.68	2.10	-	-	1.05	5.43	10.33	18.04	11.03	12.08	11.91	81.95	
Sidi Salem	Ariana	Borj Toumi Nouveau	LA09	871	0.18	0.10	0.06	-	-	0.03	0.15	0.29	0.51	0.31	0.34	0.33	2.29	
Sidi Salem	Ariana	Kalaat Landlous	LA03	2905	1.21	0.71	0.40	-	-	0.20	1.04	1.98	3.46	2.12	2.32	2.28	15.72	
Sidi Salem	Ariana	Tobias Ariana	LA35	700	0.29	0.17	0.10	-	-	0.05	0.25	0.48	0.83	0.51	0.56	0.55	3.79	
Sidi Salem	Beja	El-Herri	BE11	2,900	1.04	0.61	0.35	-	-	0.17	0.90	1.70	2.98	1.82	1.99	1.96	13.52	
Sidi Salem	Beja	Goubellat	BE05	2,800	0.63	0.37	0.21	-	-	0.11	0.54	1.03	1.80	1.10	1.21	1.19	8.20	
Sidi Salem	Beja	Skhira	BE10	150	0.05	0.03	0.02	-	-	0.01	0.04	0.08	0.14	0.08	0.09	0.09	0.61	
Sidi Salem	Beja	Tebourba Mjez	BE02	3800	1.80	1.05	0.60	-	-	0.30	1.55	2.95	5.16	3.16	3.46	3.41	23.44	
Sidi Salem	Beja	Testour	BE01	1,400	0.66	0.39	0.22	-	-	0.11	0.57	1.08	1.89	1.16	1.27	1.25	8.61	
Sidi Salem	Bizerte	El Aalia Menzel Jmil	BI04	2678	0.69	0.40	0.23	-	-	0.12	0.60	1.14	1.98	1.21	1.33	1.31	9.01	
Sidi Salem	Bizerte	Ras Jebel - Ousja	BI11	1900	1.58	0.92	0.53	-	-	0.26	1.36	2.59	4.51	2.76	3.02	2.98	20.51	
Sidi Salem	Bizerte	Tobias Bizerte	BI03	1400	0.58	0.34	0.19	-	-	0.10	0.50	0.95	1.67	1.02	1.12	1.10	7.58	
Sidi Salem	Bizerte	Utique	BI02	1000	0.32	0.18	0.11	-	-	0.05	0.27	0.52	0.90	0.55	0.60	0.60	4.10	
Sidi Salem	Bizerte	Zouaouine	BI12	294	0.12	0.07	0.04	-	-	0.02	0.10	0.20	0.35	0.21	0.23	0.23	1.58	200.91
Lakhmes	Siliana	Lakhmes	SL01	1270	0.22	0.32	0.31	0.06	-	0.08	0.16	-	0.25	0.67	0.98	0.72	3.77	3.77
Siliana	Siliana	Gaafour-Laaroussia	SL02	4250	1.09	1.60	1.55	0.30	-	0.38	0.81	-	1.24	3.37	4.90	3.60	18.85	18.85
Rmil	Siliana	Rmil	SL09	872	0.17	0.24	0.24	0.05	-	0.06	0.12	-	0.19	0.51	0.75	0.55	2.87	2.87
Cap Bon Canal	Nabeul	Solimane-Mi Bouzefla	NA06	3720	0.69	0.40	0.23	-	-	0.12	0.60	1.14	1.98	1.21	1.33	1.31	9.01	
Cap Bon Canal	Nabeul	Ancienne Sauvegarde	NA08	3680	0.72	0.42	0.24	-	-	0.12	0.62	1.19	2.07	1.27	1.39	1.37	9.42	
Cap Bon Canal	Nabeul	Grombalia	NA03	5610	2.58	1.51	0.86	-	-	0.43	2.23	4.24	7.40	4.52	4.95	4.88	33.60	
Cap Bon Canal	Nabeul	Korba Menzel Temim	NA07	1500	0.22	0.13	0.07	-	-	0.04	0.19	0.36	0.63	0.39	0.42	0.42	2.87	
Cap Bon Canal	Ben Arous	Mornag CMCB	BA01	4783	0.88	0.51	0.29	-	-	0.15	0.76	1.45	2.53	1.54	1.69	1.67	11.47	
Cap Bon Canal	Nabeul	Nouvelle Sauvegarde	NA04	2800	0.82	0.48	0.27	-	-	0.14	0.71	1.34	2.34	1.43	1.57	1.55	10.65	77.04
Beja (future)	Beja		BE12	1534	0.38	0.22	0.13	-	-	0.06	0.33	0.63	1.10	0.67	0.74	0.73	5.00	5.00
Khalled (future)	Beja		BE13	1994	0.50	0.29	0.17	-	-	0.08	0.43	0.82	1.43	0.88	0.96	0.94	6.50	6.50
Mellegue2 (future)	Jendouba		JE14	29451	6.69	3.90	2.23	-	-	1.11	5.76	10.96	19.13	11.70	12.81	12.63	86.91	86.91
Sarrat (future)	Le Kef	Sarrat	KF11	3200	0.76	0.44	0.25	-	-	0.13	0.65	1.24	2.16	1.32	1.45	0.14	8.55	8.55
Tessa (future)	Le Kef		KF13	2603	0.05	-	-	0.01	0.10	0.59	0.89	0.82	0.67	1.79	2.57	1.01	8.48	
Tessa (future)	Le Kef		KF14	905	0.03	-	-	0.00	0.03	0.17	0.26	0.27	0.29	0.66	0.89	0.36	2.95	
Tessa (future)	Le Kef		KF15	2557	0.03	-	-	0.01	0.11	0.67	1.01	0.87	0.60	1.68	2.44	0.92	8.34	19.77
Chafrou (future)	Manouba		MA25	1534	0.38	0.22	0.13	-	-	0.06	0.33	0.63	1.10	0.67	0.74	0.73	5.00	5.00
				168,543	50.77	27.41	21.93	6.77	6.57	15.21	45.34	71.40	127.76	91.54	105.74	96.32	666.77	667
																	661.77	

Source: MARH, DGBGTH 2006

Data B4 Potable Water Demand Projections for Master Planning Study (1/4)

1. Greater Tunis (UCTU)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	100.3	0.83	120.4
2010	2.6%	114.2	0.85	133.6
2015	2.4%	128.3	0.85	150.1
2020	2.1%	142.6	0.85	166.8
2025	1.8%	155.9	0.85	182.4
2030	1.8%	170.2	0.85	199.1

Basis for demand estimate

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
million m3	growth	year	million m3	growth	year
108		2006	2005		100.3
123	2.6%	2011	2010	2.6%	114.2
135	2.4%	2015	2015	2.4%	128.3
150	2.1%	2020	2020	2.1%	142.6
164	1.8%	2025	2025	1.8%	155.9
179	1.8%	2030	2030	1.8%	170.2

2.1%

2. Towns along Pipeline (Beja, Mejez El Bab, Bou Salem, Ain Draham and Jendouba) UBER

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	13.5	0.83	16.2
2010	2.0%	14.9	0.85	17.4
2015	2.0%	16.4	0.85	19.2
2020	1.9%	18.0	0.85	21.1
2025	1.5%	19.5	0.85	22.8
2030	1.4%	20.9	0.85	24.5

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
million m3	growth	year	million m3	growth	year
13.5		2006	2005		13.5
14.9	2.0%	2011	2010	2.0%	14.9
16.1	2.0%	2015	2015	2.0%	16.4
17.7	1.9%	2020	2020	1.9%	18.0
19.1	1.5%	2025	2025	1.5%	19.5
20.5	1.4%	2030	2030	1.4%	20.9

3. Bizerte (UBIZ)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	16.2	0.80	20.3
2010	2.3%	18.2	0.85	21.3
2015	2.3%	20.3	0.85	23.8
2020	1.9%	22.4	0.85	26.2
2025	1.8%	24.5	0.85	28.7
2030	1.6%	26.5	0.85	31.1

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
million m3	growth	year	million m3	growth	year
17.1		2006	2005		16.2
19.2	2.3%	2011	2010	2.3%	18.2
21	2.3%	2015	2015	2.3%	20.3
23.1	1.9%	2020	2020	1.9%	22.4
25.3	1.8%	2025	2025	1.8%	24.5
27.4	1.6%	2030	2030	1.6%	26.5

Consumption growth forecast by SONED 2004 revised on the basis of actual 2005 consumption data
Efficiency ratios provided by SONED as reported in 2003 SAPROF

Data B4 Potable Water Demand Projections for Master Planning Study (2/4)

4. Cap Bon (Nabeul) UNAB

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	19.3	0.83	23.2
2010	2.9%	22.3	0.85	26.1
2015	2.0%	24.6	0.85	28.8
2020	2.1%	27.3	0.85	31.9
2025	2.1%	30.3	0.85	35.4
2030	1.7%	32.9	0.85	38.5

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
million m3	growth	year	million m3	growth	year
26		2006	2005		19.3
30	2.9%	2011	2010	2.9%	22.3
32.5	2.0%	2015	2015	2.0%	24.6
36	2.1%	2020	2020	2.1%	27.3
40	2.1%	2025	2025	2.1%	30.3
43.5	1.7%	2030	2030	1.7%	32.9

5. Sfax (USFA)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	31.0	0.88	35.4
2010	3.4%	36.6	0.85	42.9
2015	2.9%	42.3	0.85	49.5
2020	2.6%	48.1	0.85	56.2
2025	2.1%	53.3	0.85	62.4
2030	2.1%	59.2	0.85	69.2

Greater Sfax including Sidi Bouzid

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
million m3	growth	year	million m3	growth	year
35.5		2006	2005		35.4
42	3.4%	2011	2010	3.4%	41.9
47	2.9%	2015	2015	2.9%	48.2
53.5	2.6%	2020	2020	2.6%	54.9
59.5	2.1%	2025	2025	2.1%	61.0
66	2.1%	2030	2030	2.1%	67.7

6. Sidi Bouzid (USFA)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	4.4	0.83	5.3
2010	3.4%	5.2	0.85	6.1
2015	2.9%	6.0	0.85	7.0
2020	2.6%	6.8	0.85	8.0
2025	2.1%	7.6	0.85	8.9
2030	2.1%	8.4	0.85	9.8

Consumption growth forecast by SONEDE 2004 revised on the basis of actual 2005 consumption data
Efficiency ratios provided by SONEDE as reported in 2003 SAPROF

Data B4 Potable Water Demand Projections for Master Planning Study (3/4)

7. Sousse (USAK)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	25.5	0.88	28.9
2010	3.3%	30.0	0.85	35.1
2015	2.7%	34.3	0.85	40.1
2020	2.6%	39.0	0.85	45.6
2025	2.1%	43.2	0.85	50.6
2030	2.1%	48.0	0.85	56.1

Gt. Kairouan & G.Sahel

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
million m3	growth	year	million m3	growth	year
66.7		2006	2005		56.6
78.5	3.3%	2011	2010	3.3%	66.6
87.3	2.7%	2015	2015	2.7%	76.1
99.3	2.6%	2020	2020	2.6%	86.5
110.3	2.1%	2025	2025	2.1%	96.1
122.3	2.1%	2030	2030	2.1%	106.6

includes Sousse, Monastir, Mahdia, Kairouan

8. Monastir (USAK)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	12.1	0.90	13.5
2010	3.3%	14.2	0.85	16.7
2015	2.7%	16.3	0.85	19.0
2020	2.6%	18.5	0.85	21.6
2025	2.1%	20.5	0.85	24.0
2030	2.1%	22.8	0.85	26.6

9. Mahdia (USAK)

Year	Consumption growth forecast	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
	(Avg per year)			
2005	actual	11.3	0.86	13.2
2010	3.3%	13.3	0.85	15.6
2015	2.7%	15.2	0.85	17.8
2020	2.6%	17.3	0.85	20.2
2025	2.1%	19.2	0.85	22.4
2030	2.1%	21.3	0.85	24.9

Data B4 Potable Water Demand Projections for Master Planning Study (4/4)

10. Kairouan (USAK)

Year	Consumption growth forecast (Avg per year)	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
2005	actual	7.7	0.78	9.9
2010	3.3%	9.1	0.81	11.2
2015	2.7%	10.3	0.83	12.4
2020	2.6%	11.8	0.85	13.8
2025	2.1%	13.1	0.85	15.3
2030	2.1%	14.5	0.85	16.9

Consumption growth forecast by SONEDE 2004 revised on the basis of actual 2005 consumption data
Efficiency ratios provided by SONEDE as reported in 2003 SAPROF

Total Demand

Year	Consumption growth forecast (Avg per year)	Consumption (C) (million m3)	Efficiency ratio C/P	Production (P) (million m3)
2005	actual	241.3	0.84	286.3
2010	2.9%	278.0	0.85	325.9
2015	2.5%	314.0	0.85	367.7
2020	2.3%	351.6	0.85	411.4
2025	1.9%	387.0	0.85	452.8
2030	1.9%	424.6	0.85	496.7

2005-30 2.3%

Consumption growth forecast by SONEDE 2004 revised on the basis of actual 2005 consumption data
Efficiency ratios provided by SONEDE as reported in 2003 SAPROF

Consumption estimate SONEDE 2004			Consumption estimate 2005 actuals		
266.8		2006	2005		241.3
307.6	2.9%	2011	2010	2.9%	278.1
338.9	2.5%	2015	2015	2.5%	314.0
379.6	2.3%	2020	2020	2.3%	351.7
418.2	2.0%	2025	2025	1.9%	387.3
458.7	1.9%	2030	2030	1.9%	424.8

2.3%

2.3%

Data B5 Sample of Water Balance Calculation Sheet

2010 Aug Canal Mejerda Cap-Bon

Input Salinity in MCBC downstream of Bejaoua	1.35	g/liter
Salinity Ratio	0.45	
Demand Downstream of Bejaoua	40.14	m ³ x10 ⁶
Volume required from Mejerda River	22.14	m ³ x10 ⁶
Volume required from the Extreme North	18.00	m ³ x10 ⁶

SECOND YEAR OF DROUGHT CYCLE

Salinity of water supplied to Tunis 1.10 g/liter
m³ x 10⁶

Resources (m3 x 10 ⁶)										Withdrawals (m3 x 10 ⁶)				Check values		Operations (m3 x 10 ⁶)									
Node	name	Salinity	I _i	E _i	L _i	Tr _{in}	S _{max}	S _{min}	S _{i-1}	Code	Irrigation	Ichkeul	Water Supply	Net volume before transfer	Transfer capacity	Tr _{out}	Check pipeline	Check Storage	R _{i-1}	DS _i	S _i	S _i	Sp _i	R _i	D _i
		g/liter			10%			0%	100%											15%	Trial	Final			
MCBC	at Laroussia					22.14									42.85	22.14	OK							-	-
MCBC	at Bejaoua					40.14									42.85	40.14	OK							-	-
MCBC	to Tunis	1.35	-	-		40.14	-	-	-	UCTU	-		11.77	100%	14.73	11.77	OK							-	-
MCBC	to Cap Bon					28.36	-	-	-	AG01, UAG2	13.66	100%	13.70	100%	23.57	23.57	deficit								3.79

2010 Aug Mejerda River Basin

m³ x 10⁶

Resources (m3 x 10 ⁶)										Withdrawals (m3 x 10 ⁶)				Check values		Operations (m3 x 10 ⁶)										
Node	name	Salinity	I _i	E _i	L _i	Tr _{in}	S _{max}	S _{min}	S _i	Code	Irrigation	Ichkeul	Water Supply	Net volume before transfer	Pipeline capacity	Tr _{out}	Check pipeline	Check Storage	R _{i-1}	DS _i	S _i	S _i	Sp _i	R _i	D _i	
		g/liter			10%			0%	100%											15%	Trial	Final				
	Barbara	1.30	0.05	0.49	0.01		59.18	-	16.00	JE12	0.82	100%	-	14.73	18.75	5.00	OK	OK	-	0.01	9.73	9.73	-	0.01	-	
	Sarrath	-	0.88	0.49	0.09		20.48	-	4.10	KF11	0.17	100%	-	4.22					-	0.13	4.09	4.09	-	0.13	-	
	Mellegue	1.86 1.84	5.02	1.98	0.50	0.13	27.53	-	12.23	AG02	2.06	100%	-	12.83		-				4.00	-	8.83	8.83	-	4.00	-
	Tessa	1.06	-	-	-			-	-	AG03	-	100%														
	Ben M'Tir	0.31	0.19	0.57	0.02		51.28	-	11.77 9.26	UBER UCTU	- -		2.09 0.59	100% 100%	11.37 9.26	2.68 2.68	2.09 0.59	OK OK	OK OK	- -	0.03 8.67	9.26 8.67	- -	0.03	-	
	Bou Heurtma	0.34 0.58	0.32	1.14	0.03	5.03	109.80	-	14.86	AG04	16.65	100%	-	2.38												
										BE07,JE03 JE04,JE08 at P3																
	Kasseb	0.28	1.03	0.82	0.10		62.02	-	13.32	UCTU	-		2.95	100%	13.43	2.95	2.95	OK	OK	-	0.15	10.33	10.33	-	0.15	-
	Beja	1.26	-	-	-			-	-	BE12	-	100%														
	P3	1.45	-	-		5.78		-	-	AG05	5.59	100%											0.18	0.18	0.18	
	Sidi Salem	0.43 0.46	9.90	7.83	0.99	0.18	579.35	-	98.96	BE10	0.11	100%		100.11										57.57	-	
	Khalled	3.17	-	-	-			-	-	BE13	-	100%														
	Lakhmes	3.14	-	0.17	-		7.04	-	-	SL01	0.88	100%		(1.05)											1.05	
	Siliana	0.70 0.70	0.45	1.07	0.05		49.86	-	9.73	SL02	4.39	100%		4.67											0.07	
	R'Mil	1.74	0.05	0.10	0.01		4.00	-	-	SL09	0.67	100%		(0.72)											0.01	
	P2	0.46	-	-		57.65		-	-	AG06	9.53	100%												48.12	48.12	
	El Aroussia	1.99 0.46	-	-		48.12		-	-	AG07	25.98	100%			42.85	22.14										

970.54

98.83 0.10

Data B5 Sample of Water Balance Calculation Sheet

2010 Aug Canal Mejerda Cap-Bon

Input Salinity in MCBC downstream of Bejaoua	1.35	g/liter
Salinity Ratio	0.45	
Demand Downstream of Bejaoua	40.14	m ³ x10 ⁶
Volume required from Mejerda River	22.14	m ³ x10 ⁶
Volume required from the Extreme North	18.00	m ³ x10 ⁶

SECOND YEAR OF DROUGHT CYCLE

Salinity of water supplied to Tunis 1.10 g/liter
m3 x 106

Resources (m3 x 10 ⁶)										Withdrawals (m3 x 10 ⁶)				Check values		Operations (m3 x 10 ⁶)									
Node	name	Salinity	I _i	E _i	L _i	Tr _{in}	S _{max}	S _{min}	S _{i-1}	Code	Irrigation	Ichkeul	Water Supply	Net volume before transfer	Transfer capacity	Tr _{out}	Check pipeline	Check Storage	R _{i-1}	DS _i	S _i	S _i	Sp _i	R _i	D _i
		g/liter			10%			0%	100%											15%	Trial	Final			
MCBC	at Laroussia					22.14									42.85	22.14	OK							-	-
MCBC	at Bejaoua					40.14									42.85	40.14	OK							-	-
MCBC	to Tunis	1.35	-	-		40.14	-	-	-	UCTU	-		11.77	100%	14.73	11.77	OK							-	-
MCBC	to Cap Bon					28.36	-	-	-	AG01, UAG2	13.66	100%	13.70	100%	23.57	23.57	deficit								3.79

Pump from Sidi Barrak when volume at Sejnane is < 40% Maximum normal storage volume
m3 x 106

2010 Aug Bizerte and Extreme North

Resources (m3 x 10 ⁶)										Withdrawals (m3 x 10 ⁶)				Check values		Operations (m3 x 10 ⁶)									
Node	name	Salinity	I _i	E _i	L _i	Tr _{in}	S _{max}	S _{min}	S _{i-1}	Code	Irrigation	Ichkeul	Water Supply	Net volume before transfer	Pipeline capacity	Tr _{out}	Check pipeline	Check Storage	R _{i-1}	DS _i	S _i	S _i	Sp _i	R _i	D _i
		g/liter			10%			0%	100%											15%	Trial	Final			
	El Kebir	0.63	0.01	0.30	0.00		53.80	-	53.09		-	-	-	52.81	3.75	-	OK	OK	-	0.00	52.81	52.81	-	0.00	-
	Zerga	0.18	-	0.32	-		20.00	-	0.97	JE09	3.83	100%	-	(3.18)					-	-	(3.18)	-	-	-	3.18
	El Moula	0.90	0.01	0.16	0.00		18.90	-	8.67		-	-	-	8.52	5.36	3.00	OK	OK	-	0.00	5.52	5.52	-	0.00	-
	Sidi Barrak	1.83 1.80	0.12	4.34	0.01	(0.18)	225.34	-	87.56	BE08, BI09	6.62	100%	-	76.52	22.50	22.50	OK	OK	-	0.02	54.01	54.01	-	0.02	-
	Ziatine	0.92	0.01	0.48	0.00		23.40	-	10.89	BI05	1.45	100%	-	8.96	1.82	-		OK	-	0.00	8.96	8.96	-	0.00	-
	Gamgoum	0.65	-	-	-		-	-	-		-	-	-	-	1.07	-			-	-	-	-	-	-	-
	El harka	0.89	-	-	-		-	-	-		-	-	-	-	6.29	-			-	-	-	-	-	-	-
	Sejnane	0.56 0.56	-	1.29	-	22.50	113.58	-	26.44 29.07	BI07 EN02	0.58	100%	- 100%	47.07	31.18	18.00	OK	OK	-	-	29.07 29.07	29.07 29.07	-	-	-
	Douimis	0.87	-	-	-		-	-	-		-	-	-	-	10.71	-			-	-	-	-	-	-	-
	Melah	8.32	-	-	-		-	-	-		-	-	-	-	3.35	-			-	-	-	-	-	-	-
	Joumine	0.70	-	1.03	-		121.51	-	25.10 21.36	UBIZ BI10	2.08	100%	1.36	22.72 23.44	2.68 10.71	1.36	OK	OK	-	-	21.36 19.28	21.36 19.28	-	-	-
	Ghezala	0.98	-	0.22	-		10.73	-	3.52	BI09	1.32	100%	-	1.98	0.80	-	OK	OK	-	-	1.98	1.98	-	-	-
	Tine	1.34	-	-	-		-	-	-		-	-	-	-	2.33	-			-	-	-	-	-	-	-
	Mateur	0.57 0.56	-	-	-	18.00	-	-	-		-	-	-	-	32.14	18.00	OK								

587.26

222.05 0.38

Data C
RESERVOIR OPERATION

Data C1
Simulation Result of "no dams"
Condition in the Mejerda River Basin

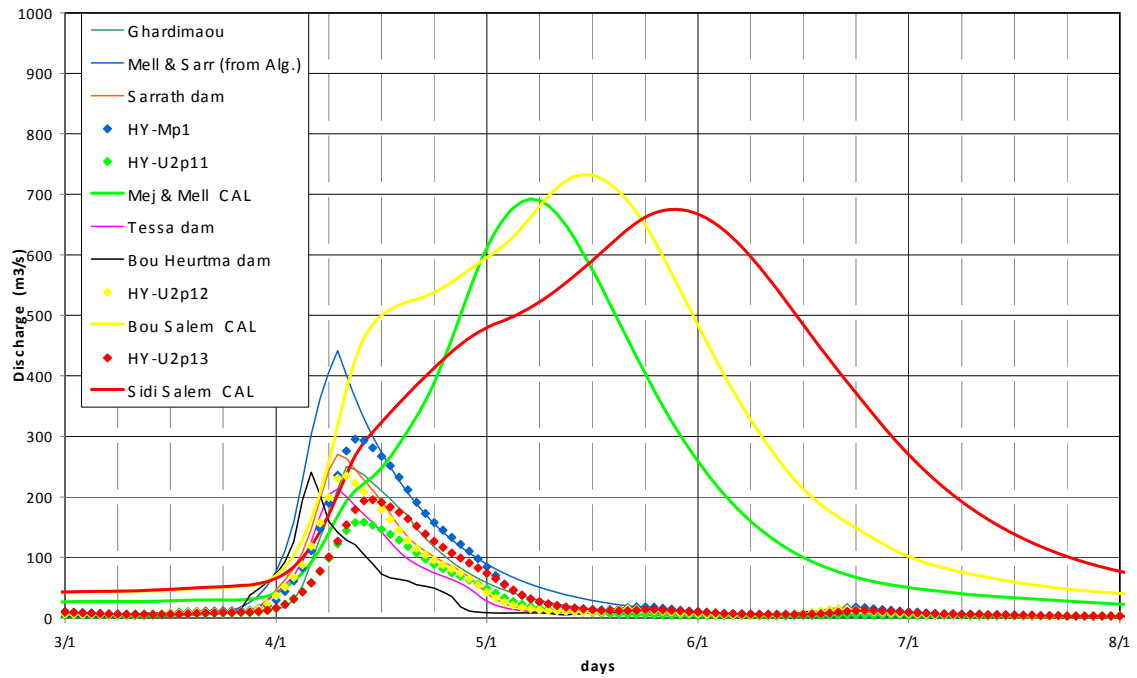


Figure C1-1 Zone U2 2 year flood “no dams”

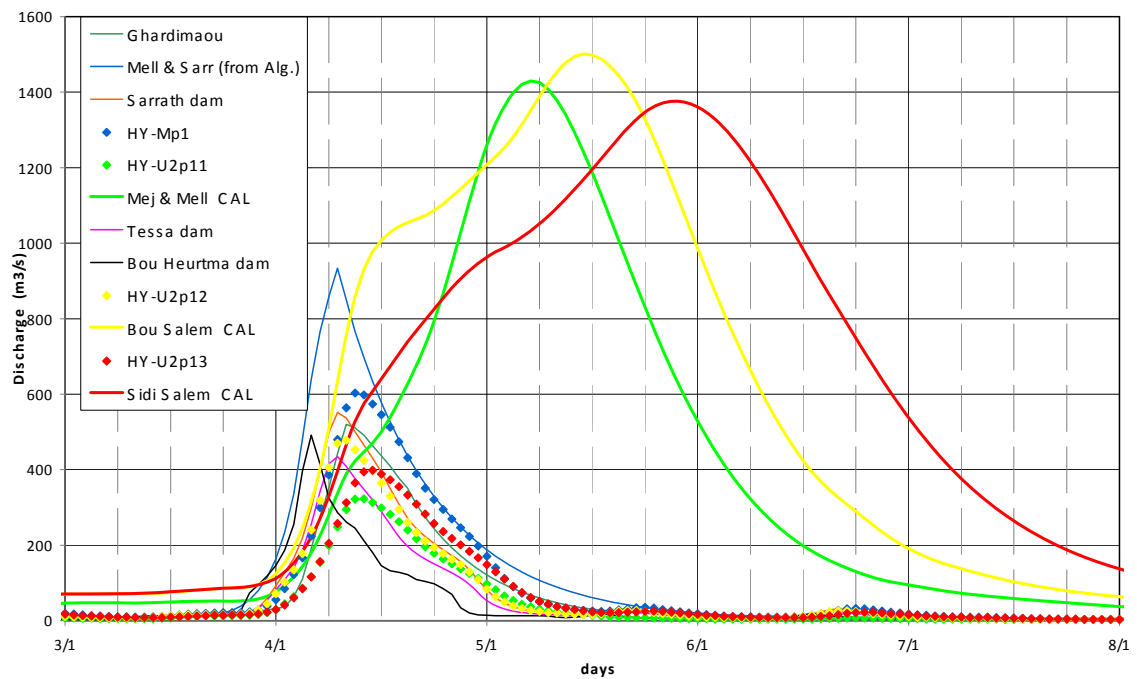


Figure C1-2 Zone U2 5 year flood “no dams”

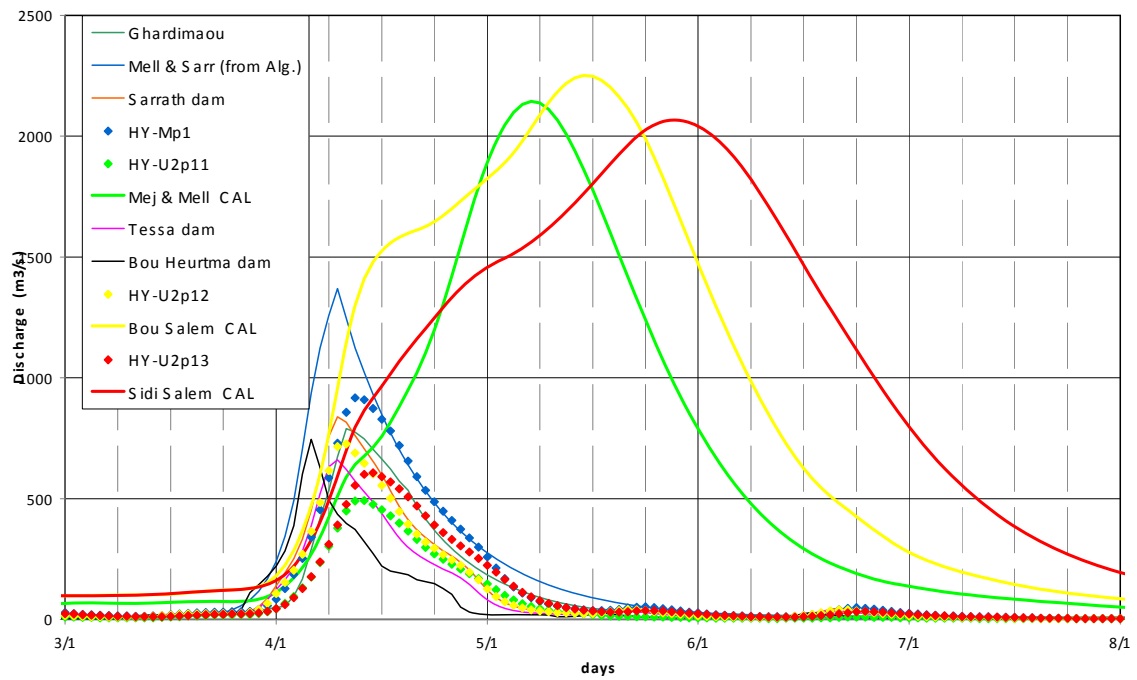


Figure C1-3 Zone U2 10 year flood “no dams”

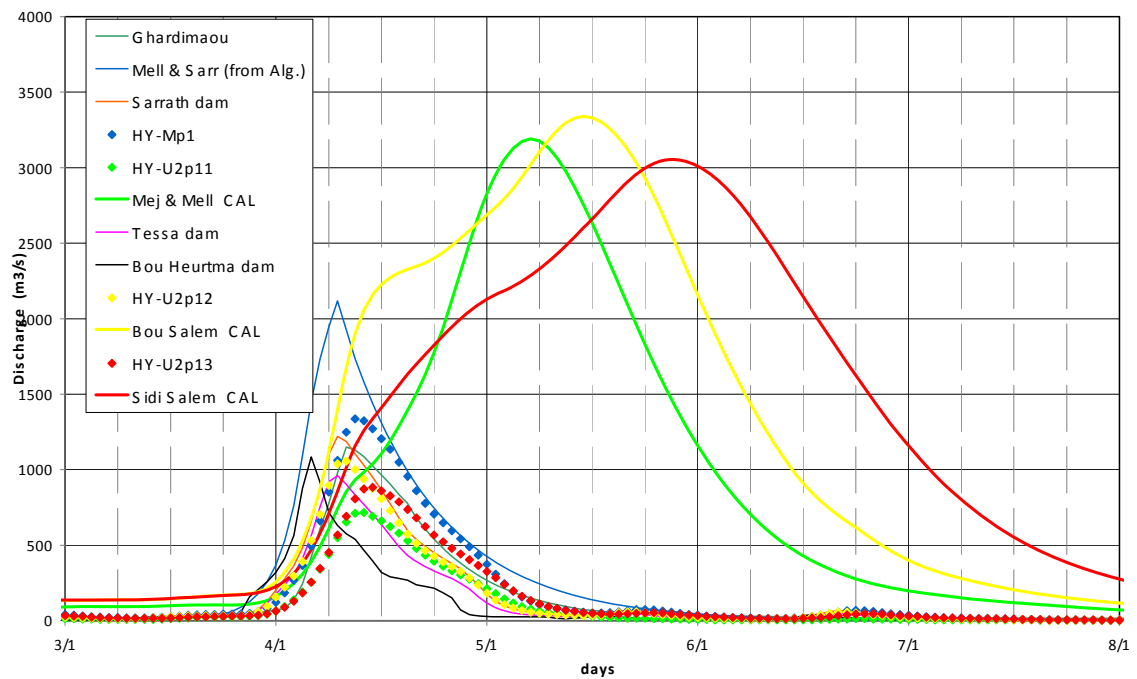


Figure C1-4 Zone U2 20 year flood “no dams”

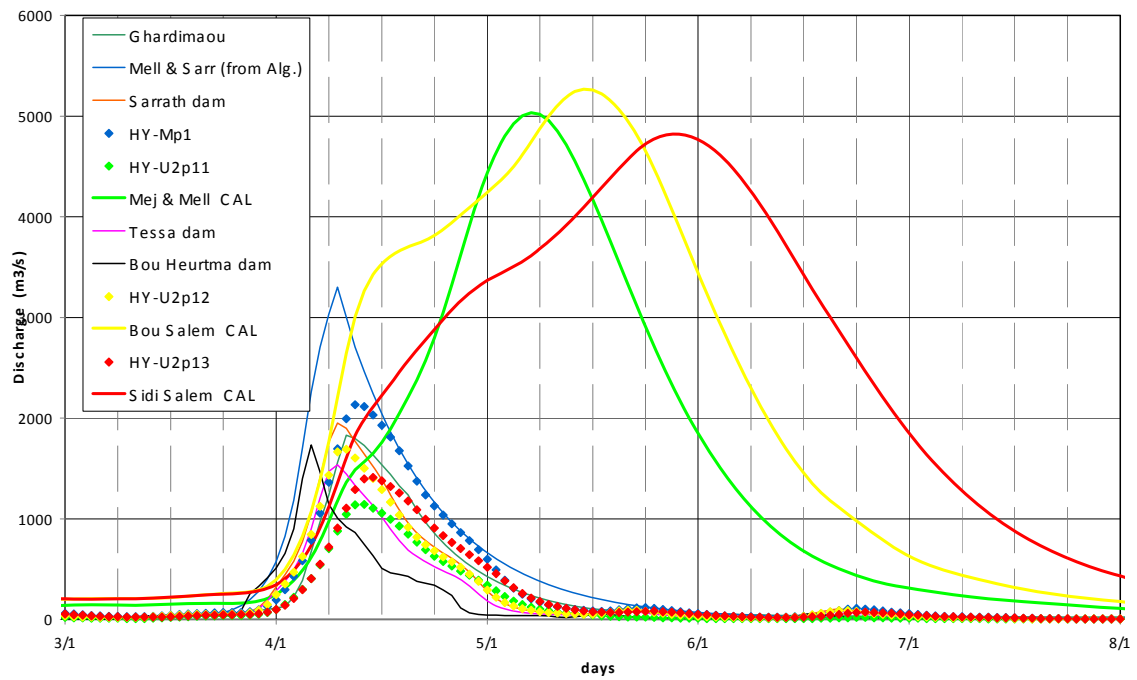


Figure C1-5 Zone U2 50 year flood “no dams”

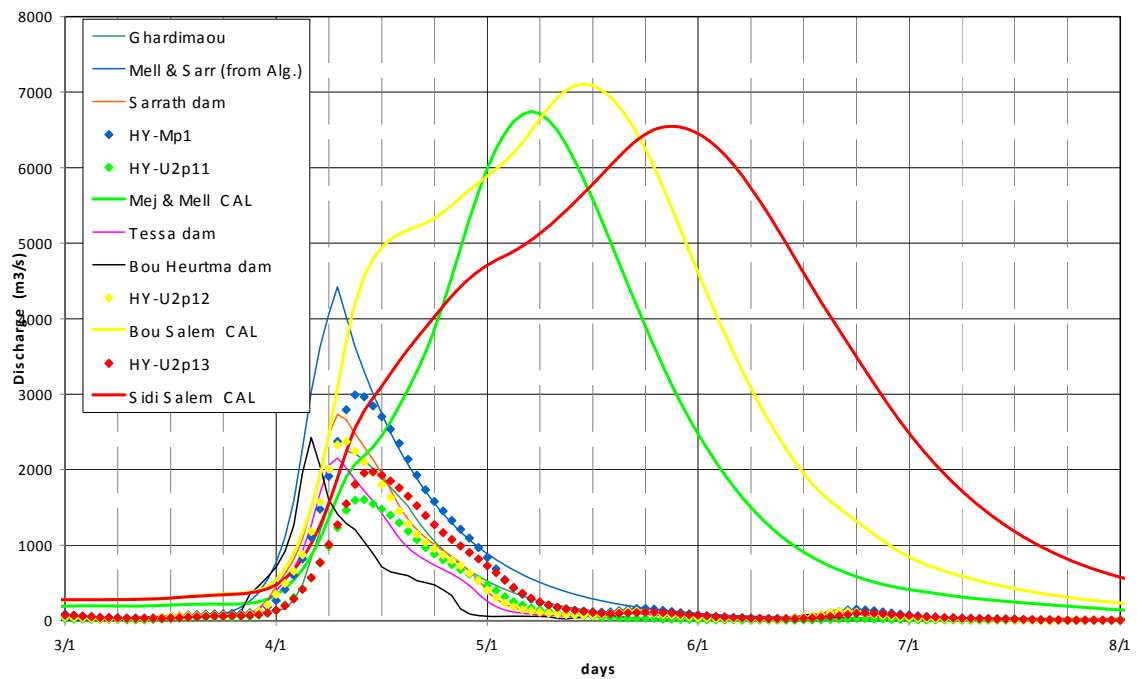


Figure C1-6 Zone U2 100 year flood “no dams”

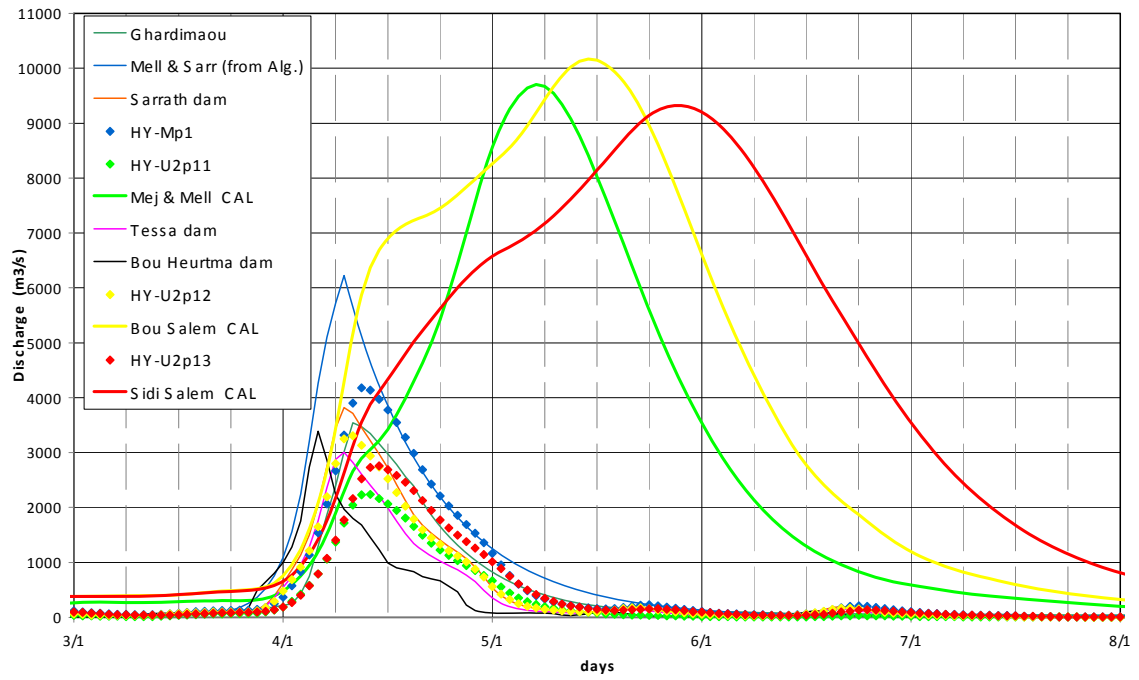


Figure C1-7 Zone U2 200 year flood “no dams”

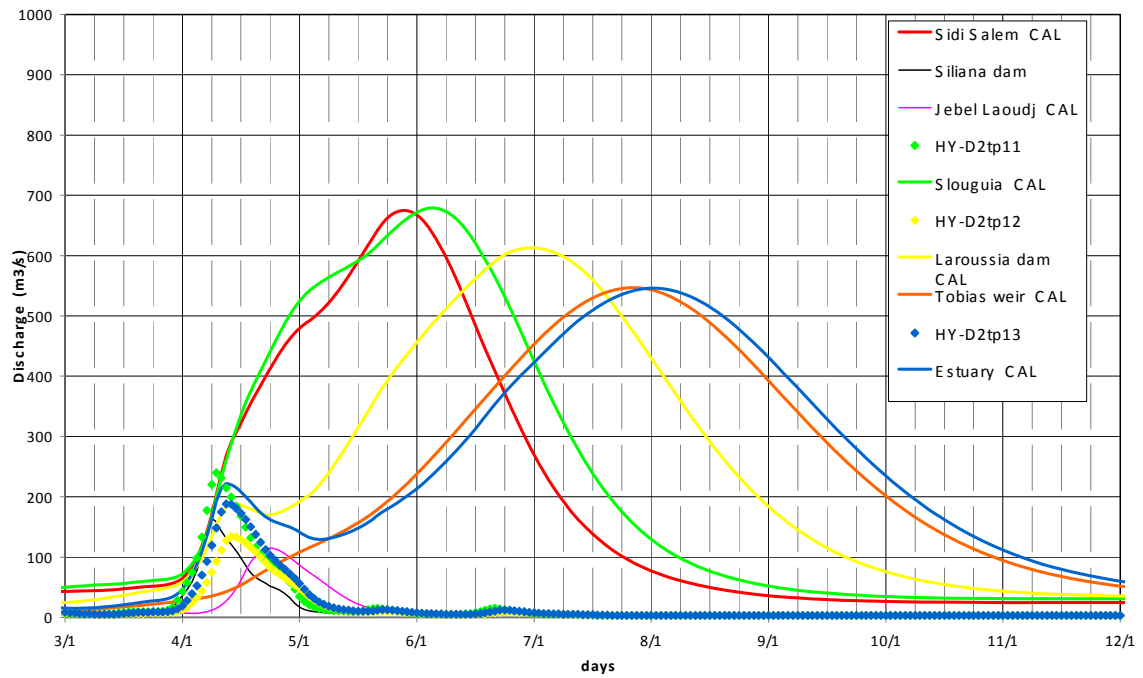


Figure C1-8 Zone Dt2 2 year flood “no dams”

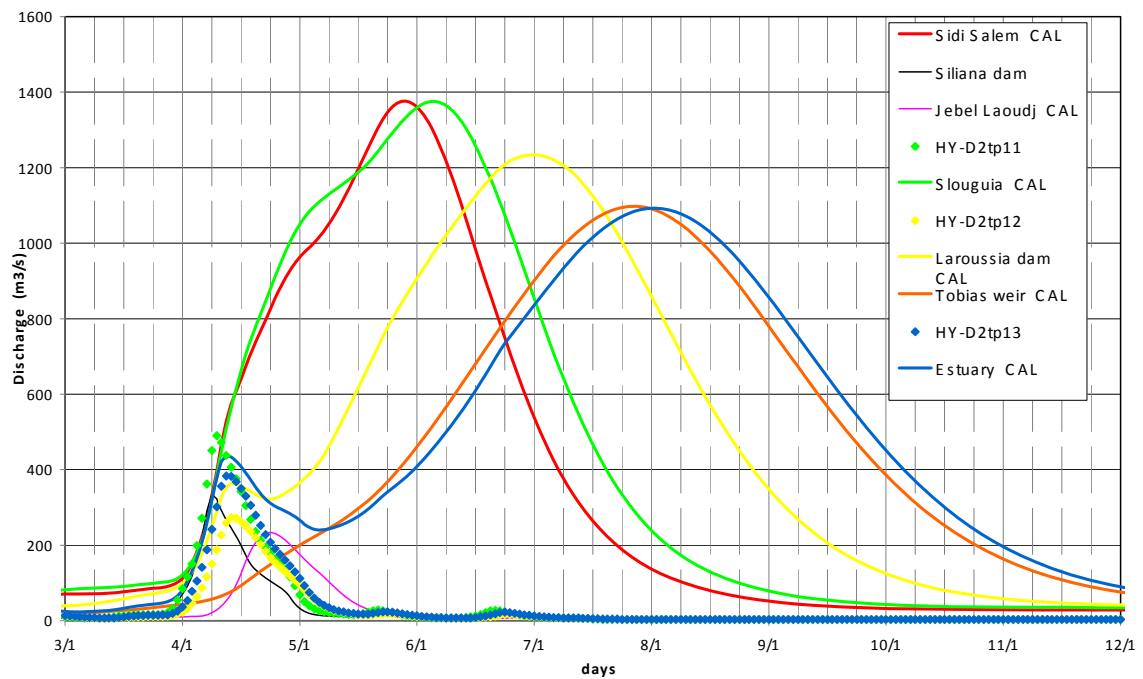


Figure C1-9 Zone Dt2 5 year flood “no dams”

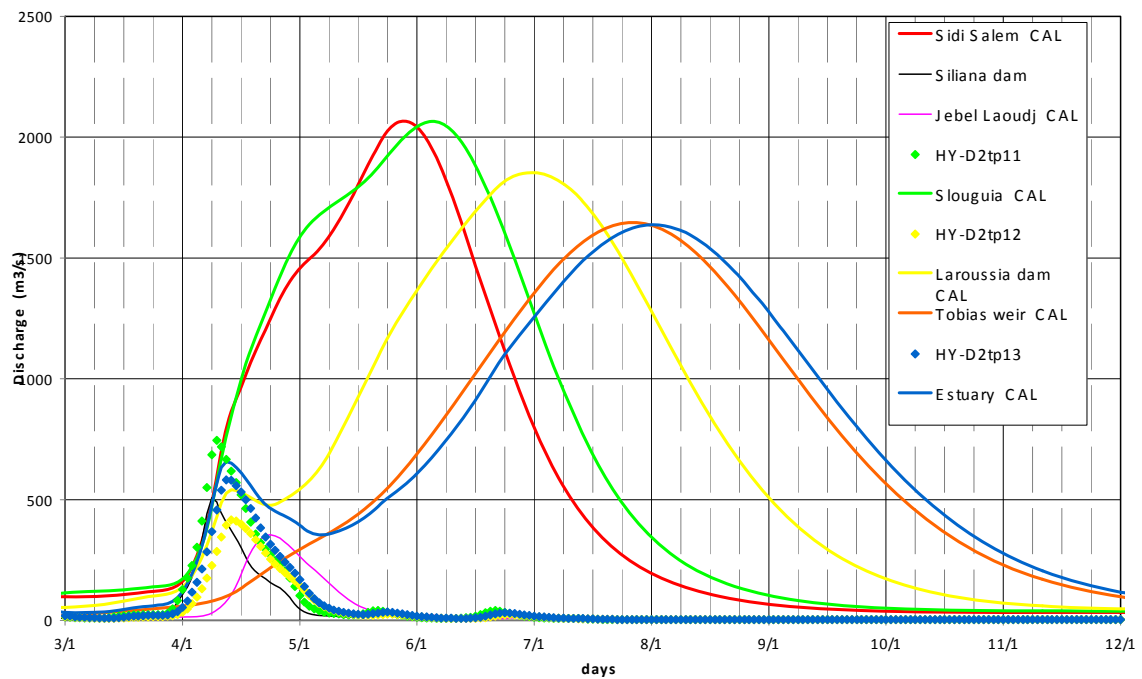


Figure C1-10 Zone Dt2 10 year flood “no dams”

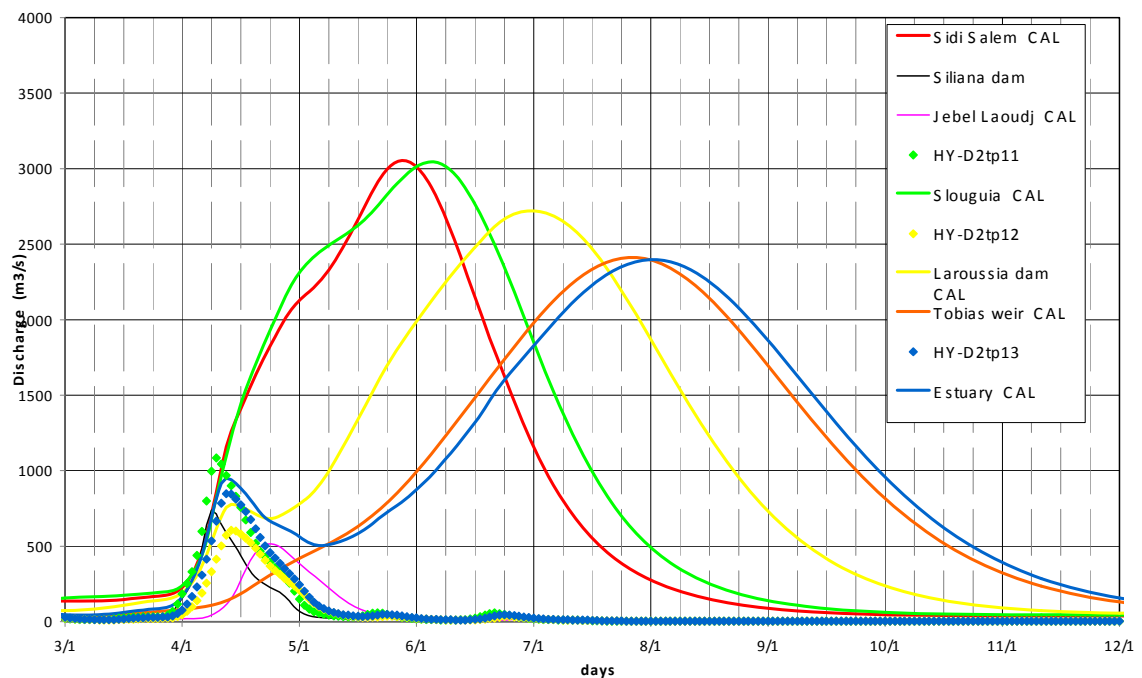


Figure C1-11 Zone Dt2 20 year flood “no dams”

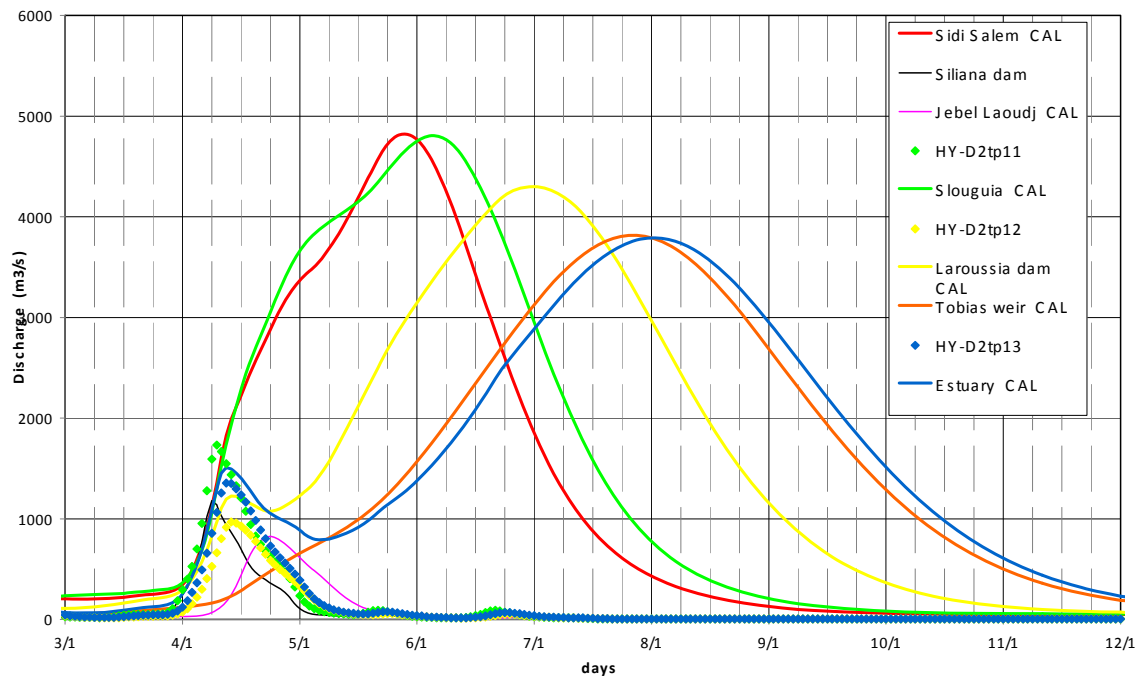


Figure C1-12 Zone Dt2 50 year flood “no dams”

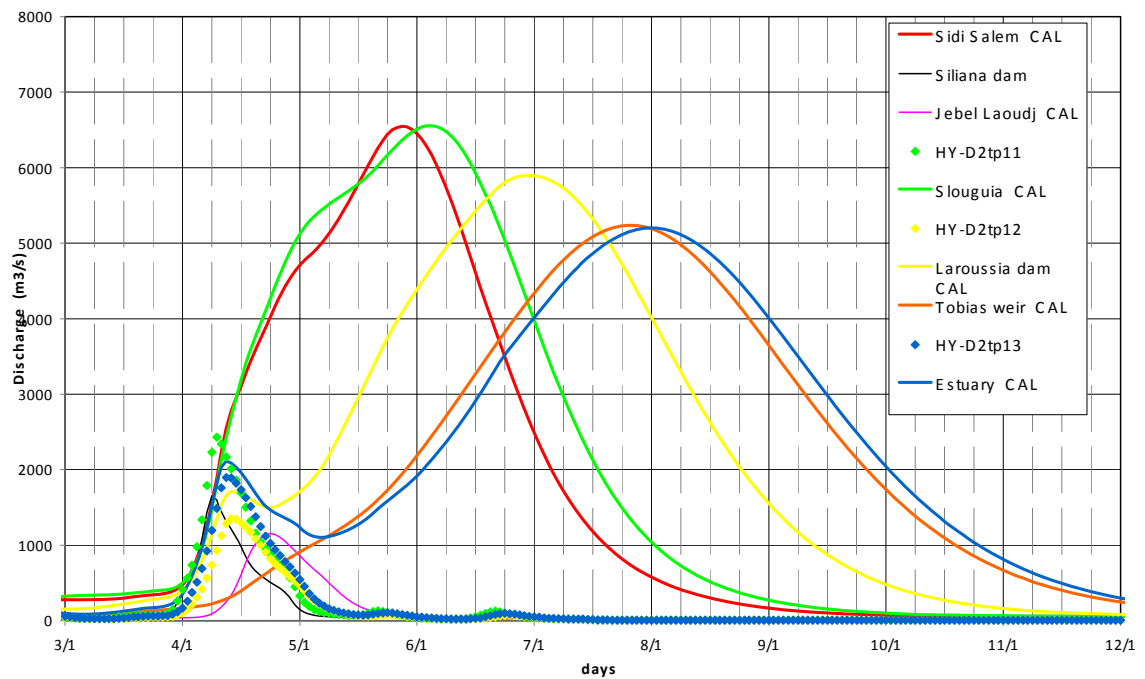


Figure C1-13 Zone Dt2 100 year flood “no dams”

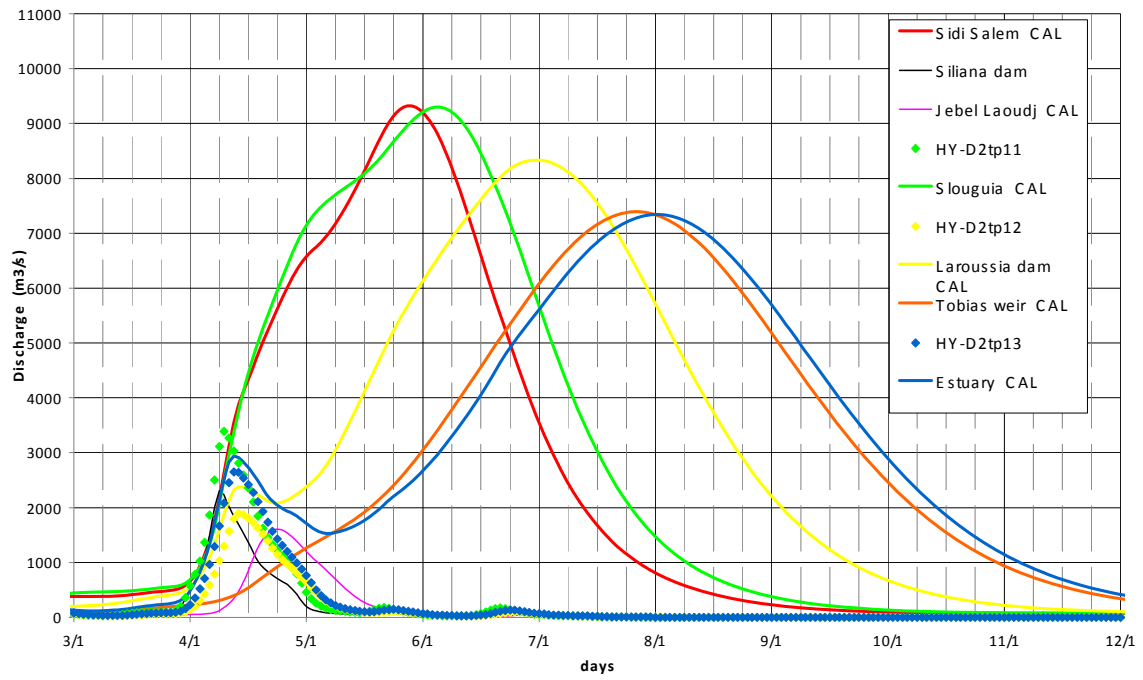


Figure C1-14 Zone Dt2 200 year flood “no dams”

Data C2

Operation Sheet of 7 Selected Dams

SIDI SALEM Dam and Reservoir

Structure basic parameters

Dam crest level	122.00 m
Maximum high water level (PHE)	119.50 m
Bottom outlet	
Number of bottom outlets	2
Level of bottom outlet intake	72.50 m
Maximum discharge capacity of bottom outlet at PHE	550 m ³ /s
Spillway	
Circle uncontrolled spillway and main controlled spillway with 3 sluices	
Level of circle spillway crest	115.00 m
Maximum discharge capacity of circle spillway at PHE	694 m ³ /s
Level of main spillway crest (gated)	105.00 m
Maximum discharge capacity of main spillway at PHE	4,176 m ³ /s
Consumption discharge of power station	100 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)	Water level (m)	Volume (mil. m ³)	Area (ha)
72.00	0.00005	3.90	103.00	215	2800
73.00	0.0001	5.85	103.50	228	2885
74.00	0.00015	8.78	104.00	241	2970
75.00	0.000225	13.17	104.50	255	3060
76.00	0.000653	19.75	105.00	269	3150
77.00	0.001433	29.63	105.50	284	3245
78.00	0.002671	44.44	106.00	299	3340
79.00	0.004557	66.67	106.50	314	3450
80.00	0.007404	100	107.00	330	3560
81.00	0.011539	160	107.50	347	3680
82.00	0.017287	250	108.00	364	3800
83.00	0.025332	340	108.50	381	3920
84.00	0.045656	380	109.00	399	4040
85.00	0.099487	420	109.50	418	4160
86.00	0.23302	510	110.00	437	4280
87.00	0.621657	710	110.50	456	4405
88.00	1.52	820	111.00	477	4530
88.50	2.33	880	111.50	499	4660
89.00	3.14	940	112.00	521	4790
90.00	5.96	1080	112.50	545	4932
90.50	8.48	1150	113.00	569	5099
91.00	11.4	1220	113.50	595	5243
91.50	14.9	1290	114.00	621	5387
92.00	19.5	1360	114.50	647	5522
92.50	24.6	1420	115.00	674	5656
93.00	30.1	1480	115.50	706	5868
93.50	35.9	1540	116.00	738	6080
94.00	42.0	1600	116.50	769	6240
94.50	48.5	1660	117.00	800	6400
95.00	55.3	1720	117.50	830	6560
95.50	62.5	1775	118.00	860	6720
96.00	70.2	1830	118.50	901	6885
96.50	78.3	1890	119.00	926	7050
97.00	86.7	1950	119.50	959	7225
97.50	95.4	2010	120.00	992	7400
98.00	104.5	2070	120.50	1031.4	7608
98.50	114	2135	121.00	1068.6	7782
99.00	124	2200	121.50	1106.8	7953
99.50	134	2265	122.00	1145.8	8122
100.00	144	2330			
100.50	155	2405			
101.00	166	2480			
101.50	178	2555			
102.00	190	2630			
102.50	202	2715			

Maximum bottom outlet capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
80.0	0.0	100.0	409.3
81.0	175.0	102.0	425.3
82.0	214.0	104.0	440.9
84.0	263.0	106.0	456.1
86.0	285.8	108.0	470.9
88.0	304.7	110.0	485.3
90.0	323.1	112.0	499.2
92.0	341.2	114.0	512.8
94.0	358.8	116.0	525.9
96.0	376.1	118.0	538.6
98.0	392.9	120.0	550.9

Maximum circle spillway capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
115.0	0	118.0	536.6
115.1	3.2	118.1	555.8
115.2	8.0	118.2	573.8
115.3	14.4	118.3	590.5
115.4	22.2	118.4	605.9
115.5	31.4	118.5	620.1
115.6	41.9	118.6	632.9
115.7	53.6	118.7	644.4
115.8	66.5	118.8	654.5
115.9	80.4	118.9	663.5
116.0	95.4	119.0	671.1
116.1	111.3	119.1	677.6
116.2	128.1	119.2	683.0
116.3	145.6	119.3	687.4
116.4	163.9	119.4	690.9
116.5	182.8	119.5	693.5
116.6	202.3	119.7	696.8
116.7	224.8	120.0	699.2
116.8	249.0	122.0	700.0
116.9	273.8		
117.0	299.1		
117.1	324.7		
117.2	350.2		
117.3	375.6		
117.4	400.7		
117.5	425.3		
117.6	449.3		
117.7	472.5		
117.8	494.9		
117.9	516.2		

Maximum main spillway (3 sluices) capacity as function of water level

Water level (m)	Discharge (m ³ /s)
105.0	0
105.5	34.7
106.0	98.1
106.5	180.2
107.0	277.4
107.5	387.6
108.0	509.6
108.5	642.1
109.0	784.5
109.5	936.2
110.0	1096.4
110.5	1264.9
111.0	1441.3
111.5	1625.2
112.0	1816.2
112.5	2014.3
113.0	2219.0
113.5	2430.3
114.0	2647.8
114.5	2871.5
115.0	3101.2
115.5	3289.4
116.0	3410.0
116.5	3527.5
117.0	3642.0
117.5	3753.7
118.0	3862.9
118.5	3969.6
119.0	4074.1
119.5	4176.4
120.0	4276.6

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	97.40	94.7
year 2010	97.40	94.7
year 2020	99.78	139.7
year 2030	101.80	184.7

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	97.40 – 115.00	579.3
year 2010	97.40 – 111.83	418.8
year 2020	99.78 – 113.54	456.9
year 2030	101.80 – 114.46	460.3

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	115.00 – 119.50	285.5
year 2010	111.83 – 119.50	446.1
year 2020	113.54 – 119.50	363.0
year 2030	114.46 – 119.50	314.6

Global reservoir characteristics

in water level range	from 65.00 to 119.50 m
Total volume at PHE	959.5 mil. m ³
Area at PHE	7,225 ha

Hydrological conditions

Mejerda River – Sidi Salem Dam cross section

Catchment area 18,191 km²

Probable flood discharges with N-years return period of flood $Q (m^3/s)$

N (years)	5	10	20	50	100	200
current stage	844	1,337	2,266	4,128	5,932	8,627
target year 2010	815	1,323	2,147	3,994	5,739	8,421
target year 2020	730	1,148	1,809	3,527	5,234	7,972
target year 2030	672	1,092	1,761	3,582	5,356	8,160

Authoritative discharges

Minimum ecological discharge: This discharge must be **always** released as minimum (sum of all released outflows from reservoir). Value of this minimum ecological discharge could be decreased during critical situation only.

Value of this minimum ecological discharge for Mejerda River downstream of Sidi Salem Dam has not been determined yet

	current stage	target year 2030
Maximum river channel capacity discharge for Mejerda River downstream of Sidi Salem Dam during flood (not overbanking river channel) $Q (m^3/s)$	250	420
Mitigation of released discharge from Sidi Salem Dam to value which does not exceed maximum river channel capacity discharge – roughly up to floods with exceedance probability <i>return period of flood (years)</i>	5 year	10 year
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	20 year	20 year

Sidi Salem Reservoir Operation during Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow actual hydrological and meteorological situation in the whole Mejerda River basin and also forecasted one.

During floods, the water level in the Sidi Salem Reservoir is operated within the range of “flood control storage” – see the table above. Detailed reservoir operation can follow nomogramms in Guidelines entitled “Flood management of the main rivers in Tunisia and the operation to hydraulic facilities; DG/BGTH, 1988”.

Operation of Sidi Salem Reservoir is coordinated especially with the operation of the Mellegue, the Bou Heurtma and the Siliana Reservoirs. If the actual water level in the Sidi Salem Reservoir is at the normal water level (or very close to this level) and the discharge upstream of the Sidi Salem Dam (e.g. outflow from the Mellegue Dam, at Jendouba or Bou Salem GS) is higher than the maximum river channel capacity downstream of the Sidi Salem Dam, it is recommended to pre-release the Sidi Salem Reservoir – by releasing the maximum river channel capacity.

Pre-release of the Sidi Salem Reservoir is limited by the inflow from the Khaled River and especially from the Siliana River. Pre-release of the Sidi Salem Reservoir must be coordinated with actual discharge at Jebel Laoudj GS, if a flood comes from the upper part of the Siliana River catchment, outflow from the Sidi Salem Dam must be coordinated with the outflow from the Siliana Dam.

If the outflow from the Mellegue Dam or the discharge at Ghardiamou, Jendouba or Bou Salem stations increases $3,000 \text{ m}^3/\text{s}$, it is recommended to immediately and completely open both bottom outlets and one sluice of main spillway.

If the outflow from the Mellegue Dam or the discharge at Ghardiamou, Jendouba or Bou Salem stations increases $5,000 \text{ m}^3/\text{s}$ and the discharge tendency at such a check point is still increasing, it is recommended to immediately and completely open both bottom outlets and all 3 sluices of main spillway and release as possible much outflow as from to Sidi Salem Dam.

The reservoir water level **may not increase maximum water level PHE = 119.50 m**. As soon as the water level in the reservoir reaches the elevation of PHE = 119.50 m, it is obligatory to immediately open as many outlets or spillway gates as necessary for stopping in crease of the water level.

After culmination of flood wave (reaching a peak inflow into the reservoir), it is necessary to release flood control storage by releasing the maximum river channel capacity downstream of the Sidi Salem Dam. Flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the whole Mejerda River basin.

MELLEQUE Dam and Reservoir

Structure basic parameters

Dam crest level	270.00 m
Maximum high water level (PHE)	269.00 m
Bottom outlet	
Number of bottom outlets	2
Level of bottom outlet intake	212.00 m
Maximum discharge capacity of bottom outlet at PHE	594 m ³ /s
Spillway	
Main controlled spillway with 3 sluices	
Level of main spillway crest (gated)	255.20 m
Maximum discharge capacity of main spillway at PHE	5,261 m ³ /s
Consumption discharge of power station	25 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)	Water level (m)	Volume (mil. m ³)	Area (ha)
210.00	0.000	0.00	244.60	1.229	185.8
212.00	0.005	0.20	244.70	1.276	188.7
214.00	0.010	0.50	244.80	1.323	191.7
216.00	0.015	1.00	244.90	1.371	194.6
218.00	0.020	1.60	245.00	1.418	197.5
220.00	0.025	2.50	245.50	1.743	212.3
222.00	0.030	3.80	246.00	2.069	227
224.00	0.035	6.00	246.50	2.489	244
226.00	0.040	9.00	247.00	2.909	262
228.00	0.050	13.00	247.50	3.425	279
230.00	0.060	19.00	248.00	3.941	296
232.00	0.080	26.00	248.50	4.570	316
234.00	0.110	34.00	249.00	5.199	335
236.00	0.150	44.00	249.50	5.972	355
238.00	0.200	56.00	250.00	6.745	374
240.00	0.270	70.25	250.50	7.648	400
240.50	0.303	82.65	251.00	8.550	421
240.60	0.31	85.16	251.50	9.604	445
240.70	0.322	87.66	252.00	10.658	493
240.80	0.329	90.18	252.50	11.914	493
240.90	0.337	92.70	253.00	13.170	517
241.00	0.341	95.23	253.50	14.664	564
241.10	0.352	97.76	254.00	16.157	584
241.20	0.363	100.30	254.50	17.862	617
241.30	0.374	103.5	255.00	19.567	650
241.40	0.385	107.9	255.50	21.495	685
241.50	0.396	110.4	256.00	23.424	721
241.60	0.407	112.7	256.50	25.627	756
241.70	0.418	115.4	257.00	27.830	791
241.80	0.429	117.6	257.50	30.281	828
241.90	0.440	119.8	258.00	32.733	864
242.00	0.451	122.0	258.50	35.471	901
242.10	0.469	124.2	259.00	38.210	937
242.20	0.487	126.4	259.50	41.278	974
242.30	0.505	128.6	260.00	44.347	1010
242.40	0.523	130.8	260.50	47.780	1043
242.50	0.541	133.0	261.00	51.214	1076
242.60	0.560	135.4	261.50	55.079	1109
242.70	0.578	137.8	262.00	58.945	1142
242.80	0.596	140.2	262.50	63.463	1300
242.90	0.614	142.6	263.00	67.981	1400
243.00	0.632	145.0	263.50	73.445	1500
243.10	0.663	147.3	264.00	78.909	1600
243.20	0.695	149.6	264.50	84.947	1700
243.30	0.726	151.9	265.00	90.984	1880
243.40	0.758	154.2	265.50	97.486	1900
243.50	0.789	156.5	266.00	103.988	2000
243.60	0.820	159.1	266.50	110.880	2101
243.70	0.852	161.7	267.00	117.772	2200
243.80	0.883	164.3	267.50	125.049	2250
243.90	0.914	166.9	268.00	132.327	2300
244.00	0.946	169.5	268.50	139.935	2400
244.10	0.993	172.2	269.00	147.543	2500
244.20	1.040	174.8	270.00	163.430	2851
244.30	1.087	177.5			
244.40	1.135	180.2			
244.50	1.182	182.9			

Maximum bottom outlet capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
212.00	302	246.00	476
213.00	307	247.00	481
214.00	312	248.00	486
215.00	317	249.00	491
216.00	323	250.00	496
217.00	328	251.00	502
218.00	333	252.00	507
219.00	338	253.00	512
220.00	343	254.00	517
221.00	348	255.00	522
222.00	353	256.00	527
223.00	358	257.00	532
224.00	363	258.00	537
225.00	369	259.00	542
226.00	374	260.00	548
227.00	379	261.00	553
228.00	384	262.00	558
229.00	389	263.00	563
230.00	394	264.00	568
231.00	399	265.00	573
232.00	404	266.00	578
233.00	409	267.00	583
234.00	415	268.00	589
235.00	420	269.00	594
236.00	425	270.00	599
237.00	430		
238.00	435		
239.00	440		
240.00	445		
241.00	450		
242.00	456		
243.00	461		
244.00	466		
245.00	471		

Maximum main spillway (3 sluices) capacity as function of water level

Water level (m)	Discharge (m ³ /s)
255.20	0
255.50	24
256.00	78
256.50	147
257.00	229
257.50	325
258.00	433
258.50	554
259.00	688
259.50	833
260.00	989
260.50	1156
261.00	1334
261.50	1522
262.00	1719
262.50	1925
263.00	2141
263.50	2365
264.00	2596
264.50	2836
265.00	3082
265.50	3335
266.00	3595
266.50	3860
267.00	4131
267.50	4407
268.00	4688
268.50	4972
269.00	5261
269.50	5553
270.00	5848

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	254.20	16.9
year 2010	254.20	16.9
year 2020	---	---
year 2030	---	---

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	254.20 – 260.00	27.5
year 2010	254.20 – 259.48	24.1
year 2020	---	---
year 2030	---	---

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	260.00 – 269.00	103.1
year 2010	259.48 – 269.00	106.6
year 2020	260.00 – 269.00	103.1
year 2030	260.00 – 269.00	103.1

Global reservoir characteristics

in water level range	from 205.00 to 269.00 m
Total volume at PHE	147.5 mil. m ³
Area at PHE	2,500 ha

Hydrological conditions

Mellegue River – Mellegue Dam cross section

Catchment area 10,309 km²

Probable flood discharges with N-years return period of flood Q (m³/s)

N (years)	5	10	20	50	100	200
current stage	1,262	1,884	2,821	4,452	6,103	8,558
target year 2010	1,055	1,657	2,575	4,167	5,783	8,209
target year 2020	1,017	1,655	2,616	4,015	5,780	8,391
target year 2030	1,039	1,671	2,631	4,025	5,789	8,391

Authoritative discharges

Minimum ecological discharge: This discharge must be **always** released as minimum (sum of all released outflows from reservoir). Value of this minimum ecological discharge could be decreased during critical situation only.

Value of this minimum ecological discharge for Mellegue River downstream of Mellegue Dam has not been determined yet

	current stage	target year 2030
Maximum river channel capacity discharge for Mellegue River downstream of Mellegue Dam during flood (not overbanking river channel) Q (m ³ /s)	250	250
Mitigation of released discharge from Mellegue Dam to value which does not exceed maximum river channel capacity discharge – roughly up to floods with exceedance probability <i>return period of flood (years)</i>	5 year	5 year
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	10 year	20 year

Mellegue Reservoir Operation during the Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow actual hydrological and meteorological situation in the whole Mejerda River basin and also forecasted one.

During floods, the water level in the Mellegue Reservoir is operated within the range of “flood control storage” – see table above. Detailed reservoir operation can follow nomogramms in Guidelines entitled “Flood management of the main rivers in Tunisia and the operation of hydraulic facilities; DG/BGTH, 1988”.

Operation of the Mellegue Reservoir is coordinated especially with the operation of the Bou Heurtma and the Tessa Reservoirs. If the actual water level in the Mellegue Reservoir is at the normal water level (or very close to this level) and the discharge upstream of Mellegue Dam (e.g. inflow from Algeria, measured discharge on the Sarrath River or in K 13 Gauging Station) is higher than maximum river channel capacity downstream of the Mellegue Dam, it is recommended to pre-release the the Mellegue Reservoir – by releasing the maximum river the channel capacity.

Pre-release of Mellegue Reservoir must be coordinated with the actual discharge at Jendouba GS and according to flood situation on the Bou Heurtma and the Tessa Rivers, so that the maximum river channel capacity in the Mejerda River reach as from Jendouba to the Sidi Salem Reservoir is not exceeded.

If the discharge upstream of the Mellegue Dam (the Mellegue River at Algerian border, the Sarrath River, etc.) exceeds $1,500 \text{ m}^3/\text{s}$, it is recommended to immediately and completely open both bottom outlets, i.e. to release up to $600 \text{ m}^3/\text{s}$.

The reservoir water level **may not increase the maximum water level PHE = 269.00 m**. As soon as the water level in the reservoir reaches the elevation of PHE = 269.00 m, it is obligatory to immediately open as many outlets or spillway gates as necessary for stopping in crease of the water level.

After culmination of flood wave (reaching a peak inflow into the reservoir), it is necessary to release flood control storage by releasing maximum river channel capacity in the Mellegue River downstream of the Mellegue Dam. The flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the whole Mejerda River basin, especially in the situation when the Sidi Salem Dam still routes flood flows (significant inflow from other subcatchments – the Tessa, the Bou Heurtma, the Kasseb Rivers, etc.)

BOU HEURTMA Dam and Reservoir

Structure basic parameters

Dam crest level	228.00 m
Maximum high water level (PHE)	226.00 m
Bottom outlet	
Number of bottom outlets	1
Level of bottom outlet intake	186.00 m
Maximum discharge capacity of bottom outlet at PHE	163 m ³ /s
Spillway	
Lateral uncontrolled spillway	
Level of spillway crest	221.00 m
Maximum discharge capacity of main spillway at PHE	2,500 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)	Water level (m)	Volume (mil. m ³)	Area (ha)
184.00	1.7	76.6	210.00	44.5	494
185.00	1.9	64.5	210.50	46.75	507
186.00	2.2	55.3	211.00	49	520
187.00	2.4	49.0	211.50	51.5	540
188.00	2.7	45.4	212.00	54	560
189.00	3.0	44.5	212.50	56.5	578
190.00	3.4	46.3	213.00	59	596
191.00	3.7	50.5	213.50	62	616
192.00	4.2	57.2	214.00	65	636
193.00	4.6	66.2	214.50	68.1	656
194.00	5.3	77.4	215.00	71.2	676
195.00	6.4	90.7	215.50	74.6	693
196.00	7.7	110	216.00	78	710
197.00	9.2	124	216.50	81.25	730
198.00	10.3	144	217.00	84.5	750
199.00	12.5	164	217.50	88.4	767
199.50	13.5	176	218.00	92.3	784
200.00	14.5	188	218.50	97	802
200.50	15.5	202	219.00	101.7	820
201.00	16.5	216	219.50	106.85	837
201.50	17.5	226	220.00	112	854
202.00	18.5	236	220.50	114.75	874
202.50	19.75	251	221.00	117.5	894
203.00	21	266	221.50	121.7	917
203.50	22.1	278	222.00	125.9	940
204.00	23.2	290	222.50	130.35	956
204.50	24.475	306	223.00	134.8	972
205.00	25.75	322	223.50	139.5	988
205.50	27.125	336	224.00	144.2	1004
206.00	28.5	350	224.50	149.1	1024
206.50	30.125	367	225.00	154	1044
207.00	31.75	384	225.50	159	1065
207.50	33.625	400	226.00	164	1084
208.00	35.5	416	226.50	168	1097
208.50	37.5	433	227.00	173	1114
209.00	39.5	450	227.50	178	1131
209.50	42	472	228.00	183	1148

Maximum bottom outlet capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
186.00	36.1	210.00	126.3
187.00	41.3	211.00	128.9
188.00	46.4	212.00	131.4
189.00	51.3	213.00	133.9
190.00	56.0	214.00	136.4
191.00	60.6	215.00	138.8
192.00	65.1	216.00	141.1
193.00	69.4	217.00	143.4
194.00	73.6	218.00	145.7
195.00	77.7	219.00	148.0
196.00	81.7	220.00	150.2
197.00	85.5	221.00	152.4
198.00	89.2	222.00	154.6
199.00	92.8	223.00	156.8
200.00	96.3	224.00	159.0
201.00	99.7	225.00	161.2
202.00	103.0	226.00	163.3
203.00	106.2	227.00	165.5
204.00	109.3	228.00	167.7
205.00	112.3	224.00	159.0
206.00	115.3	225.00	161.2
207.00	118.2	226.00	163.3
208.00	120.9	227.00	165.5
209.00	123.7	228.00	167.7

Maximum lateral spillway capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
221.00	0	224.50	1470
221.10	15	224.60	1534
221.20	30	224.70	1598
221.30	55	224.80	1662
221.40	80	224.90	1726
221.50	105	225.00	1790
221.60	130	225.10	1861
221.70	155	225.20	1932
221.80	180	225.30	2003
221.90	205	225.40	2074
222.00	230	225.50	2145
222.10	268	225.60	2216
222.20	306	225.70	2287
222.30	344	225.80	2358
222.40	382	225.90	2429
222.50	420	226.00	2500
222.60	458	226.10	2575
222.70	496	226.20	2650
222.80	534	226.30	2725
222.90	572	226.40	2800
223.00	610	226.50	2875
223.10	664	226.60	2950
223.20	718	226.70	3025
223.30	772	226.80	3100
223.40	826	226.90	3175
223.50	880	227.00	3250
223.60	934	227.10	3325
223.70	988	227.20	3400
223.80	1042	227.30	3475
223.90	1096		
224.00	1150		
224.10	1214		
224.20	1278		
224.30	1342		
224.40	1406		

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	196.00	7.7
year 2010	196.00	7.7
year 2020	196.80	8.9
year 2030	197.80	10.1

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	196.00 – 221.00	109.8
year 2010	196.00 – 221.00	109.8
year 2020	196.80 – 218.38	87.2
year 2030	197.80 – 216.77	72.7

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	221.00 – 226.00	46.5
year 2010	221.00 – 226.00	46.5
year 2020	218.38 – 226.00	67.9
year 2030	216.77 – 226.00	81.2

Global reservoir characteristics

in level range	from 184.00 to 226.00 m
Total volume at PHE	164.0 mil. m ³
Area at PHE	1,084 ha

Hydrological conditions

Bou Heurtma River – Bou Heurtma Dam cross section

Catchment area 390 km²

Probable flood discharges with N-years return period of flood Q (m³/s)

N (years)	5	10	20	50	100	200
Discharge (m ³ /s)	491	745	1,083	1,732	2,426	3,390

Authoritative discharges

Minimum ecological discharge: This discharge must be **always** released as minimum (sum of all released outflows from reservoir). Value of this minimum ecological discharge could be decreased during critical situation only.

Value of this minimum ecological discharge for Bou Heurtma River downstream of Bou Heurtma Dam has not been determined yet

	current stage	target year 2030
Maximum river channel capacity discharge for Bou Heurtma River downstream of Bou Heurtma Dam during flood (not overbanking river channel) Q (m ³ /s)	100	100
Mitigation of released discharge from Bou Heurtma Dam to value which does not exceed maximum river channel capacity discharge – roughly up to floods with exceedance probability <i>return period of flood (years)</i>	impossible	20 year
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	20 year	200 year

Bou Heurtma Reservoir Operation during the Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow actual hydrological and meteorological situation in the whole Mejerda River basin and their estimated development.

During the flood water level in the Bou Heurtma Reservoir is operated within the range of “flood control storage” – see the table above.

Operation of the Bou Heurtma Reservoir is coordinated especially with operation of the Mellegue, the Tessa and the Ben Metir Reservoirs. If the actual water level in the Bou Heurtma Reservoir is at the normal water level (or very close to this level) and the discharge upstream of the Bou Heurtma Dam (e.g. outflow from the Ben Metir Reservoir or at Fernana GS) is higher than the maximum river channel capacity downstream of the Bou Heurtma Dam it is recommended to pre-release the Bou Heurtma Reservoir – by releasing the maximum river channel capacity through the bottom outlet.

Pre-release of the Bou Heurtma Reservoir must be coordinated with the actual discharge at Jendouba GS, releasing of the Mellegue Reservoir and according to flood situation on the Tessa River so that the maximum river channel capacity in the Mejerda River reach as from Jendouba to the Sidi Salem Reservoir is not exceeded.

As soon as the water level in reservoir reaches the uncontrolled spillway crest (221.00 m) , the bottom outlet of the Bou Heurtma Dam is gradually closed to release a constant outflow (equal to maximum river channel capacity downstream of Bou Heurtma Dam) as long as possible. The bottom outlet is completely closed during culmination of flood wave.

The reservoir water level **may not increase the maximum water level PHE = 226.00 m**. As soon as the water level in the reservoir reaches the elevation of PHE = 226.00 m, it is obligatory to immediately open bottom outlets (partly or completely) as necessary for stopping in crease of the water level.

After culmination of flood wave (reaching a peak inflow into the reservoir), it is necessary to release flood control storage. During the first releasing period, water automatically spills over the uncontrolled spillway. After storage decreasing through the spillway, the water level in the Bou Heurtma Reservoir is released maximum river channel capacity discharge in Bou Heurtma River downstream with the Bou Heurtma Dam. During this second period the bottom outlet is gradually opened and releasing of reservoir water continues until the actual normal water level in the Bou Heurtma Reservoir is reached (i.e. the flood control storage of the Bou Heurtma Reservoir is empty).

The flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the whole Mejerda River basin, especially in the situation when the flood situation upstream of the Sidi Salem Dam is still critical (due to inflow from the Mejerda, the Mellegue or the Tessa Rivers).

SILIANA Dam and Reservoir

Structure basic parameters

Dam crest level	398.00 m
Maximum high water level (PHE)	395.50 m
Bottom outlet	
Level of bottom outlet intake	357.00 m
Maximum discharge capacity of bottom outlet at PHE	183 m ³ /s
Spillway	
Circle uncontrolled spillway and main uncontrolled spillway	
Level of both spillways crests	388.50 m
Maximum discharge capacity (sum of both spillways) at PHE	3,200 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)	Water level (m)	Volume (mil. m ³)	Area (ha)
356.00	0	0	382.00	36	392.5
360.50	0.5	32.5	382.50	38	407.5
361.00	0.75	37.5	383.00	40	425
362.00	1.5	42.5	383.50	42	440
363.00	2	55	384.00	44.5	455
364.00	2.5	62.5	384.50	47	472.5
365.00	3.5	72.5	385.00	50	487.5
366.00	4.5	82.5	385.50	52	500
367.00	5.5	90	386.00	55	517.5
368.00	6.5	102.5	386.50	57	532.5
369.00	7.5	112.5	387.00	60	550
370.00	8.5	125	387.50	63	567.5
371.00	10	142.5	388.00	66.5	585
372.00	11.5	157.5	388.50	70	600
373.00	13	176	389.00	72.5	622.5
373.50	14	185	389.50	75.5	642.5
374.00	15	195	390.00	79.5	657.5
374.50	16	205	390.50	83	680
375.00	17	216	391.00	86.25	700
375.50	18	227.5	391.50	89.5	720
376.00	19	239	392.00	93.5	740
376.50	20	251	392.50	97.5	762
377.00	21.5	264	393.00	102	785
377.50	22.5	274	393.50	106.5	810
378.00	23.5	285	394.00	111	837.5
378.50	25	297.5	394.50	116	865
379.00	26.5	310	395.00	120.5	900
379.50	28	322.5	395.50	125	908
380.00	29.5	335	396.00	130	932
380.50	31	347.5	396.50	135	958
381.00	32.5	360	397.00	140	983
381.50	34.25	375			

Maximum spillway capacity (both of circle and main spillways) as function of water level

Water level (m)	Discharge (m ³ /s)
388.50	0
389.20	100
389.60	200
389.85	300
390.10	400
390.30	500
390.50	600
390.85	800
391.20	1000
391.55	1200
391.85	1400
392.15	1600
392.43	1800
392.73	2000
393.10	2200
393.50	2400
393.90	2600
394.38	2800
394.80	3000
395.50	3200

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	376.55	20.1
year 2010	376.55	20.1
year 2020	380.38	30.7
year 2030	383.08	41.3

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	376.55 – 388.50	49.9
year 2010	376.55 – 388.50	49.9
year 2020	380.38 – 388.50	39.3
year 2030	383.08 – 388.50	28.7

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	388.50 – 395.50	55.05
year 2010	388.50 – 395.50	55.05
year 2020	388.50 – 395.50	55.05
year 2030	388.50 – 395.50	55.05

Global reservoir characteristics

in level range	from 356.00 to 395.50 m
Total volume at PHE	125.05 mil. m ³
Area at PHE	908 ha

Hydrological conditions

Siliana River – Siliana Dam cross section

Catchment area 1040 km²

Probable flood discharges with N-years return period of flood Q (m³/s)

N (years)	5	10	20	50	100	200
Discharge (m ³ /s)	334	508	738	1,180	1,654	2,312

Authoritative discharges

Minimum ecological discharge: This discharge must be **always** released as minimum (sum of all released outflows from reservoir). Value of this minimum ecological discharge could be decreased during critical situation only.

Value of this minimum ecological discharge for Siliana River downstream of Siliana Dam has not been determined yet

	current stage	target year 2030
Maximum river channel capacity discharge for Siliana River downstream of Siliana Dam during flood (not overbanking river channel) Q (m ³ /s)	N/A	N/A
Mitigation of released discharge from Siliana Dam to value which does not exceed maximum river channel capacity discharge – roughly up to floods with exceedance probability <i>return period of flood (years)</i>	---	---
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	5 year	5 year

Siliana Reservoir Operation during the Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow the actual hydrological and meteorological situation in the whole Mejerda River basin and also forecasted one.

During floods the water level in the Siliana Reservoir is operated within the range of “flood control storage” – see the table above.

Operation of the Siliana Reservoir is coordinated especially with operation of the Sidi Salem Reservoir. If the actual water level in the Siliana Reservoir is at a normal water level (or very close to this level) and the discharge upstream of the Siliana Dam (e.g. the outflow from the Lakhmes Reservoir or at the Oussafa GS) is higher than the maximum river channel capacity downstream of the Siliana Dam, it is recommended to pre-release the Siliana Reservoir – by releasing the maximum river channel capacity through the bottom outlet.

Pre-release of the Siliana Reservoir must be coordinated with the actual discharge at the Slouguia GS and releasing of the Sidi Salem Reservoir, so that maximum river channel capacity in the Mejerda River downstream of the Sidi Salem Dam is not exceeded.

As soon as the water level in the reservoir reaches the uncontrolled spillway crest (388.50 m), the bottom outlet of the Siliana Dam is gradually closed to release a constant outflow (equal to the maximum river channel capacity downstream of the Siliana Dam) as long as possible. The bottom outlet is completely closed during culmination of flood wave.

The reservoir water level **may not increase the maximum water level PHE = 395.50 m**. As soon as the water level in the reservoir reaches elevation of PHE = 395.50 m, it is obligatory to immediately open bottom outlets (partly or completely) as necessary for stopping increase of the water level.

After culmination of flood wave (reaching a peak inflow into the reservoir), it is necessary to release the flood control storage. During the first releasing period, water automatically spills over the uncontrolled spillway. After storage decreasing through the spillway, the water level in the Siliana Reservoir is released with the maximum river channel capacity in Siliana River downstream of the Siliana Dam. During this second period, the bottom outlet is gradually opened and releasing of reservoir water continues until the actual, normal water level in the Siliana Reservoir is reached (i.e. the flood control storage of the Siliana Reservoir is empty).

The flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the whole Mejerda River basin, especially in the situation when the flood situation downstream of the Sidi Salem Dam is still critical (due to necessity of the relatively high outflow from the Sidi Salem Reservoir).

MELLEGUE 2 Dam and Reservoir

Structure basic parameters

Dam crest level	305.00 m
Maximum high water level (PHE)	304.00 m
Bottom outlet	
Level of bottom outlet intake	260.00 m
Maximum discharge capacity of bottom outlet at PHE	1,113 m ³ /s
Spillway	
Main uncontrolled spillway	
Level of main spillway crest	295.00 m
Maximum discharge capacity of main spillway at PHE	7,938 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)	Water level (m)	Volume (mil. m ³)	Area (ha)
258.00	0	0	285.00	99	820
260.00	1	40	287.50	115	890
263.00	3	90	289.00	134	970
265.00	5	140	292.50	163	1130
267.00	10	200	295.00	195	1280
270.00	17	300	297.50	235	1430
275.00	36	450	304.00	334	1764
280.00	60	620	305.00	350	1820

Maximum bottom outlet capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
270.00	469	298.00	1023
275.00	587	298.50	1031
280.00	695	299.00	1038
285.00	796	299.50	1046
290.00	889	300.00	1054
292.00	924	300.50	1061
293.00	941	301.00	1069
294.00	958	301.50	1076
294.50	966	302.00	1084
295.00	974	302.50	1091
295.50	983	303.00	1098
296.00	991	303.50	1106
296.50	999	304.00	1113
297.00	1007	304.50	1120
297.50	1015	305.00	1127

Maximum main uncontrolled spillway capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
295.00	0	301.00	4321
295.50	104	301.50	4872
296.00	294	302.00	5445
296.50	540	302.50	6039
297.00	832	303.00	6652
297.50	1162	303.50	7286
298.00	1528	304.00	7938
298.50	1925	304.50	8609
299.00	2352	305.00	9297
299.50	2807		
300.00	3287		
300.50	3797		

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	---	---
year 2020	274.70	34.0
year 2030	281.20	68.0

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	---	---
year 2020	274.70 – 294.67	156.7
year 2030	281.20 – 294.82	124.6

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	---	---
year 2020	294.67 – 304.00	143.3
year 2030	294.82 – 304.00	141.4

Global reservoir characteristics

in water level range	from 254.50 to 304.00 m
Total volume at PHE	334.0 mil. m ³
Area at PHE	1,764 ha

Hydrological conditions

Mellegue River – Mellegue 2 Dam cross section

Catchment area 10,100 km²

Probable flood discharges with N-years return period of flood $Q (m^3/s)$

N (years)	5	10	20	50	100	200
target year 2020	1,293	1,983	3,022	4,830	6,675	9,434
target year 2030	1,317	2,005	3,041	4,846	6,688	9,434

Authoritative discharges

	current stage	target year 2030
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	---	< 5 year

Mellegue 2 Reservoir Operation during the Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow actual hydrological and meteorological situation in the whole Mejerda River basin and also forecasted one.

During floods, the water level in the Mellegue 2 Reservoir is operated within the range of “flood control storage” – see the table above.

The Mellegue 2 and the Mellegue Reservoirs are operated as cascade reservoirs. It is recommended to fill the upper reservoir at first and during the descending flood period to empty also the upper reservoir at first.

If it is necessary to release big outflow from the Mellegue Reservoir (e.g. in case of huge flood in the Mellegue River catchment), the bottom outlet of the Mellegue 2 Reservoir can be open (event. up to the maximum capacity) during the ascending flood period to support higher releasing discharge from the Mellegue Reservoir. In such a case, it is recommended to completely close the bottom outlet of the Mellegue 2 Reservoir again at the moment of peak inflow into the Mellegue 2 Reservoir. This operation enables to use the maximum volume of flood control storage and decrease and postpone a peak outflow from the Mellegue 2 Reservoir.

The reservoir water level **may not increase the maximum water level PHE = 304.00 m.** As soon as the water level in the reservoir reaches the elevation of PHE = 304.00 m, it is obligatory to immediately open bottom outlets (partly or completely) as necessary for stopping increase of the water level. During this operation, it is obligatory to consider safety risks of both dams – Mellegue 2 and Mellegue, as well.

After culmination of flood wave (reaching a peak inflow into the reservoir), it is necessary to release flood control storage. During the first releasing period, water automatically spills over the uncontrolled spillway into the Mellegue Reservoir and the Mellegue Reservoir is used as a buffer reservoir. After strage decreasing through the spillway, the water level in the Mellegue 2 Reservoir is released with the maximum river channel capacity in the Mellegue River downstream of the Mellegue Dam. During this second period, water level in the Mellegue Reservoir remains stable – only the Mellegue 2 Reservoir is released. Releasing of Mellegue Reservoir continues after the Mellegue 2 Reservoir reaches the actual normal water level (i.e. the flood control storage of the Mellegue 2 Reservoir is empty).

The flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the whole Mejerda River basin, especially in the situation when the Sidi Salem still routes flood flow (significant inflow from other subcatchments – the Tessa, the Bou Heurtma, the Kasseb, etc.).

SARRATH Dam and Reservoir

Structure basic parameters

Dam crest level	556.00 m
Maximum high water level (PHE)	552.00 m
Bottom outlet	
Level of bottom outlet intake	525.00 m
Maximum discharge capacity of bottom outlet at PHE	93.4 m ³ /s
Spillway	
Uncontrolled spillway	
Level of spillway crest	546.00 m
Maximum discharge capacity of main spillway at PHE	5,800 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)
523.00	0	0
525.00	0.2	3.08
530.00	0.75	24.10
535.00	3.6	65
536.00	4.55	83
538.00	6.23	102
540.00	8.87	130
542.00	11.73	170
544.00	15.65	226
546.00	20.95	299
548.00	27.96	393
550.00	37.04	511
552.00	48.53	650
554.00	63.08	808
556.00	80.95	992

Maximum bottom outlet capacity as function of water level

Water level (m)	Discharge (m ³ /s)
525.00	0.0
530.00	40.2
535.00	56.9
540.00	69.7
545.00	80.5
546.00	82.5
550.00	90.0
555.00	98.6

Maximum spillway capacity as function of water level

Water level (m)	Discharge (m ³ /s)	Water level (m)	Discharge (m ³ /s)
546.00	0	551.00	4200
546.50	100	551.50	5000
547.00	400	552.00	5800
547.50	700	552.50	6600
548.00	1000	553.00	7400
548.50	1400	553.50	8300
549.00	1900	554.00	9400
549.50	2400		
550.00	2950		
550.50	3600		

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	527.00	0.5
year 2020	536.02	4.6
year 2030	539.85	8.7

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	527.00 – 544.10	15.4
year 2020	536.02 – 545.51	15.0
year 2030	539.85 – 545.80	11.7

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	544.10 – 552.00	32.7
year 2020	545.51 – 552.00	29.0
year 2030	545.80 – 552.00	28.2

Global reservoir characteristics

in level range	from 523.00 to 552.00 m
Total volume at PHE	48.5 mil. m ³
Area at PHE	650 ha

Hydrological conditions

Sarrath River – Sarrath Dam cross section

Catchment area 1,850 km²

Probable flood discharges with N-years return period of flood Q (m³/s)

N (years)	5	10	20	50	100	200
Discharge (m ³ /s)	551	838	1,220	1,951	2,734	3,818

Authoritative discharges

Minimum ecological discharge: This discharge must be **always** released as minimum (sum of all released outflows from reservoir). Value of this minimum ecological discharge could be decreased during critical situation only.

Value of this minimum ecological discharge for Sarrath River downstream of Sarrath Dam has not been determined yet

	current stage	target year 2030
Maximum river channel capacity discharge for Sarrath River downstream of Sarrath Dam during flood (not overbanking river channel) Q (m ³ /s)	N/A	N/A
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	---	negligible efficiency

Sarrath Reservoir Operation during Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow actual hydrological and meteorological situation in the whole Mejerda River basin and also forecasted one.

During floods, the water level in the Sarrath Reservoir is operated within the range of “flood control storage” – see the table above.

If the actual water level in the Sarrath Reservoir is at the normal water level (or very close to this level) and the discharge upstream of the Sarrath Dam (e.g. at Sidi Abdelkader GS or Sarrath Pont Route GS) is higher than the maximum river channel capacity downstream of the Sarrath Dam, it is recommended to pre-release the Sarrath Reservoir – by releasing the maximum river channel capacity through the bottom outlet.

Pre-release of the Sarrath Reservoir must be coordinated with the actual Mellegue inflow from Algeria or according to the actual discharge or the discharge forecasted for K 13 Gauging Station and also according to actual situation of the Mellegue (event. Mellegue 2) Reservoir.

As soon as the water level in the reservoir reaches the uncontrolled spillway crest (546.00 m), the bottom outlet of the Sarrath Dam is gradually closed to release a constant outflow (equal to maximum river channel capacity downstream of the Sarrath Dam) as long as possible. The bottom outlet is completely closed during culmination of flood wave.

The reservoir water level **may not increase the maximum water level PHE = 552.00 m**. As soon as the water level in the reservoir reaches elevation of PHE = 552.00 m, it is obligatory to immediately open bottom outlets (partly or completely) as necessary for stopping increase of the water level.

After culmination of flood wave (reaching peak inflow into the reservoir), it is necessary to release flood control storage. During the first releasing period, water automatically spills over the uncontrolled spillway. After storage decreasing through the spillway, the water level in the Sarrath Reservoir is released with the maximum river channel capacity in the Sarrath River downstream of the Sarrath Dam. During this second period, the bottom outlet is gradually opened and releasing of reservoir continues until the actual normal water level in the Sarrath Reservoir is reached (i.e. the flood control storage of the Sarrath Reservoir is empty).

The flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the Mellegue River basin, especially in situation when flood situation on the Mellegue River and the Mellegue Reservoir operation are still critical.

TESSA Dam and Reservoir**Structure basic parameters**

Dam crest level	371.50 m
Maximum high water level (PHE)	369.00 m
Bottom outlet	
Level of bottom outlet intake	341.00 m
Maximum discharge capacity of bottom outlet at PHE	75 m ³ /s
Spillway	
Uncontrolled spillway	
Level of spillway crest	361.00 m
Maximum discharge capacity of main spillway at PHE	5,079 m ³ /s

Reservoir volume and Area as function of water level

Water level (m)	Volume (mil. m ³)	Area (ha)	Water level (m)	Volume (mil. m ³)	Area (ha)
335.00	0	0	365.00	83	1330
340.00	0.5	10	366.00	93	1551
345.00	3	50	367.00	103	1798
350.00	6	100	368.00	114	2076
352.50	9	160	369.00	125	2387
355.00	15	210	370.00	137	2734
357.50	24	400	371.00	150	3119
360.00	35	570			
362.50	60	900			

Maximum spillway capacity as function of water level

Water level (m)	Discharge (m ³ /s)		
361.00	0	367.00	3219
361.50	98	367.50	3654
362.00	238	368.00	4109
362.50	410	368.50	4585
363.00	612	369.00	5079
363.50	844	369.50	5591
364.00	1105	370.00	6121
364.50	1394	370.50	6666
365.00	1710	371.00	7226
365.50	2051	371.50	7800
366.00	2417		
366.50	2807		

Subdivision of reservoir storages

Dead storage

Target year	up to water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	---	---
year 2020	---	---
year 2030	355.10	15.3

Storage for water supply

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	---	---
year 2020	---	---
year 2030	355.10 – 360.80	27.5

Flood control storage

Target year	range of water level (m)	volume (mil. m ³)
present (designed)	---	---
year 2010	---	---
year 2020	---	---
year 2030	360.80 – 369.00	82.2

Global reservoir characteristics

in level range	from 330.00 to 369.00 m
Total volume at PHE	125.0 mil. m ³
Area at PHE	2,387 ha

Hydrological conditions

Tessa River – Tessa Dam cross section

Catchment area 1,420 km²

Probable flood discharges with N-years return period of flood Q (m³/s)

N (years)	5	10	20	50	100	200
Discharge (m ³ /s)	434	660	960	1,535	2,150	3,006

Authoritative discharges

Minimum ecological discharge: This discharge must be **always** released as minimum (sum of all released outflows from reservoir). Value of this minimum ecological discharge could be decreased during critical situation only.

Value of this minimum ecological discharge for Tessa River downstream of Tessa Dam has not been determined yet

	current stage	target year 2030
Maximum river channel capacity discharge for Tessa River downstream of Tessa Dam during flood (not overbanking river channel) Q (m ³ /s)	250	250
Mitigation of released discharge from Tessa Dam to value which does not exceed maximum river channel capacity discharge – roughly up to floods with exceedance probability <i>return period of flood (years)</i>	---	5 year
Significant peak discharge reduction (by 50 % as minimum, compared as “outflow/inflow”) roughly up to floods with exceedance probability <i>return period of flood (years)</i>	---	10 year

Tessa Reservoir Operation during Floods

The reservoir is operated during flood events based on decision by the control center.

The operation regime must follow actual hydrological and meteorological situation in the whole Mejerda River basin and also forecasted one.

During floods, the water level in the Tessa Reservoir is operated within the range of “flood control storage” – see the table above.

Operation of the Tessa Reservoir is coordinated especially with operation of the Mellegue, and the Bou Heurtma Reservoirs. If the actual water level in the Tessa Reservoir is at the normal water level (or very close to this level) and the discharge upstream of the Tessa Dam (e.g. Sers Ville GS) is higher than the maximum river channel capacity downstream of the Tessa Dam, it is recommended to pre-release the Tessa Reservoir – by releasing the maximum river channel capacity through the bottom outlet.

Pre-release of the Tessa Reservoir must be coordinated with actual discharge at Jendouba GS, releasing of Mellegue and Bou Heurtma Reservoirs so that the maximum river channel capacity in the Mejerda River reaches from Jendouba to the Sidi Salem Reservoir is not exceeded.

As soon as the water level in the reservoir reaches the uncontrolled spillway crest (361.00 m), the bottom outlet of the Tessa Dam is gradually closed to release a constant outflow (equal to the maximum river channel capacity downstream of the Tessa Dam) as long as possible. The bottom outlet is completely closed during culmination of flood wave.

The reservoir water level **may not increase the maximum water level PHE = 369.00 m**. As soon as the water level in the reservoir reaches the elevation of PHE = 369.00 m, it is obligatory to immediately open the bottom outlets (partly or completely) as necessary for stopping increase of the water level.

After culmination of flood wave (reaching peak inflow into the reservoir), it is necessary to release the flood control storage. During the first releasing period, water automatically spills over uncontrolled spillway. After storage decreasing through the spillway, water level in the Tessa Reservoir is released with the maximum river channel capacity in the Tessa River downstream of the Tessa Dam. During this second period, the bottom outlet is gradually opened and releasing of reservoir water continues until the actual normal water level in the Tessa Reservoir is reached (i.e. the flood control storage of the Tessa Reservoir is empty).

The flood control storage can be released eventually by a smaller discharge after evaluation of hydrological and meteorological situation and forecasted progress in the whole Mejerda River basin, especially in the situation when flood situation upstream of the Sidi Salem Dam is still critical (due to inflow from the Mejerda, the Mellegue or the Bou Heurtma Rivers).

REFERENCES

- [1] JBIC Special Assistance for Project Formation (SAPROF). Final report, October 2003
- [2] Gestion des crues des principaux oueds en Tunisie et fonctionnement des ouvrages hydrauliques. MARH, DG/EGTH, 1988

Data D

***RIVER IMPROVEMENT AND
FLOOD PLAIN MANAGEMENT***

Data D1

Computation of Benefit - Cost Ratio

Table DD1-1 Computation of Benefit - Cost Ratio (Zone U1)

Zone:		U1		(Unit: TND Million)			
Return period:		10-Year					
Year	Year	Cost		Benefit		B-C	
		Project Cost	NPV	Project Benefit	NPV		
-3	1	4.25	3.79	0.00		-3.79	
-2	2	6.37	5.08	0.00		-5.08	
-1	3	6.37	4.54	0.00		-4.54	
0	4	4.25	2.70	0.00		-2.70	
1	5	0.00	3.25	1.84	1.84		
2	6	0.00	3.25	1.64	1.64		
3	7	0.00	3.25	1.47	1.47		
4	8	0.00	3.25	1.31	1.31		
5	9	0.00	3.25	1.17	1.17		
6	10	0.00	3.25	1.05	1.05		
7	11	0.00	3.25	0.93	0.93		
8	12	0.00	3.25	0.83	0.83		
9	13	0.00	3.25	0.74	0.74		
10	14	0.00	3.25	0.66	0.66		
11	15	0.00	3.25	0.59	0.59		
12	16	0.00	3.25	0.53	0.53		
13	17	0.00	3.25	0.47	0.47		
14	18	0.00	3.25	0.42	0.42		
15	19	0.00	3.25	0.38	0.38		
16	20	0.00	3.25	0.34	0.34		
17	21	0.00	3.25	0.30	0.30		
18	22	0.00	3.25	0.27	0.27		
19	23	0.00	3.25	0.24	0.24		
20	24	0.00	3.25	0.21	0.21		
21	25	0.00	3.25	0.19	0.19		
22	26	0.00	3.25	0.17	0.17		
23	27	0.00	3.25	0.15	0.15		
24	28	0.00	3.25	0.14	0.14		
25	29	0.00	3.25	0.12	0.12		
26	30	0.00	3.25	0.11	0.11		
27	31	0.00	3.25	0.10	0.10		
28	32	0.00	3.25	0.09	0.09		
29	33	0.00	3.25	0.08	0.08		
30	34	0.00	3.25	0.07	0.07		
31	35	0.00	3.25	0.06	0.06		
32	36	0.00	3.25	0.05	0.05		
33	37	0.00	3.25	0.05	0.05		
34	38	0.00	3.25	0.04	0.04		
35	39	0.00	3.25	0.04	0.04		
36	40	0.00	3.25	0.03	0.03		
37	41	0.00	3.25	0.03	0.03		
38	42	0.00	3.25	0.03	0.03		
39	43	0.00	3.25	0.02	0.02		
40	44	0.00	3.25	0.02	0.02		
41	45	0.00	3.25	0.02	0.02		
42	46	0.00	3.25	0.02	0.02		
43	47	0.00	3.25	0.02	0.02		
44	48	0.00	3.25	0.01	0.01		
45	49	0.00	3.25	0.01	0.01		
46	50	0.00	3.25	0.01	0.01		
47	51	0.00	3.25	0.01	0.01		
48	52	0.00	3.25	0.01	0.01		
49	53	0.00	3.25	0.01	0.01		
50	54	0.00	3.25	0.01	0.01		
Total		21.24	16.11	159.05	17.12	1.02	

Zone:		U1		(Unit: TND Million)			
Return period:		20-Year					
Year	Year	Cost		Benefit		B-C	
		Project Cost	NPV	Project Benefit	NPV		
-3	1	9.67	8.63	0.00		-8.63	
-2	2	14.50	11.56	0.00		-11.56	
-1	3	14.50	10.32	0.00		-10.32	
0	4	9.67	6.14	0.00		-6.14	
1	5	0.00	3.69	2.09	2.09		
2	6	0.00	3.69	1.87	1.87		
3	7	0.00	3.69	1.67	1.67		
4	8	0.00	3.69	1.49	1.49		
5	9	0.00	3.69	1.33	1.33		
6	10	0.00	3.69	1.19	1.19		
7	11	0.00	3.69	1.06	1.06		
8	12	0.00	3.69	0.95	0.95		
9	13	0.00	3.69	0.85	0.85		
10	14	0.00	3.69	0.76	0.76		
11	15	0.00	3.69	0.67	0.67		
12	16	0.00	3.69	0.60	0.60		
13	17	0.00	3.69	0.54	0.54		
14	18	0.00	3.69	0.48	0.48		
15	19	0.00	3.69	0.43	0.43		
16	20	0.00	3.69	0.38	0.38		
17	21	0.00	3.69	0.34	0.34		
18	22	0.00	3.69	0.30	0.30		
19	23	0.00	3.69	0.27	0.27		
20	24	0.00	3.69	0.24	0.24		
21	25	0.00	3.69	0.22	0.22		
22	26	0.00	3.69	0.19	0.19		
23	27	0.00	3.69	0.17	0.17		
24	28	0.00	3.69	0.15	0.15		
25	29	0.00	3.69	0.14	0.14		
26	30	0.00	3.69	0.12	0.12		
27	31	0.00	3.69	0.11	0.11		
28	32	0.00	3.69	0.10	0.10		
29	33	0.00	3.69	0.09	0.09		
30	34	0.00	3.69	0.08	0.08		
31	35	0.00	3.69	0.07	0.07		
32	36	0.00	3.69	0.06	0.06		
33	37	0.00	3.69	0.06	0.06		
34	38	0.00	3.69	0.05	0.05		
35	39	0.00	3.69	0.04	0.04		
36	40	0.00	3.69	0.04	0.04		
37	41	0.00	3.69	0.04	0.04		
38	42	0.00	3.69	0.03	0.03		
39	43	0.00	3.69	0.03	0.03		
40	44	0.00	3.69	0.03	0.03		
41	45	0.00	3.69	0.02	0.02		
42	46	0.00	3.69	0.02	0.02		
43	47	0.00	3.69	0.02	0.02		
44	48	0.00	3.69	0.02	0.02		
45	49	0.00	3.69	0.01	0.01		
46	50	0.00	3.69	0.01	0.01		
47	51	0.00	3.69	0.01	0.01		
48	52	0.00	3.69	0.01	0.01		
49	53	0.00	3.69	0.01	0.01		
50	54	0.00	3.69	0.01	0.01		
Total		48.34	36.66	184.50	19.87	-16.79	

Zone:		U1		(Unit: TND Million)			
Return period:		30-Year					
Year	Year	Cost		Benefit		B-C	
		Project Cost	NPV	Project Benefit	NPV		
-3	1	11.23	10.03	0.00		-10.03	
-2	2	16.85	13.43	0.00		-13.43	
-1	3	16.85	11.99	0.00		-11.99	
0	4	11.23	7.14	0.00		-7.14	
1	5	0.00	4.11	2.33	2.33		
2	6	0.00	4.11	2.08	2.08		
3	7	0.00	4.11	1.86	1.86		
4	8	0.00	4.11	1.66	1.66		
5	9	0.00	4.11	1.48	1.48		
6	10	0.00	4.11	1.32	1.32		
7	11	0.00	4.11	1.18	1.18		
8	12	0.00	4.11	1.05	1.05		
9	13	0.00	4.11	0.94	0.94		
10	14	0.00	4.11	0.84	0.84		
11	15	0.00	4.11	0.75	0.75		
12	16	0.00	4.11	0.67	0.67		
13	17	0.00	4.11	0.60	0.60		
14	18	0.00	4.11	0.55	0.55		
15	19	0.00	4.11	0.48	0.48		
16	20	0.00	4.11	0.43	0.43		
17	21	0.00	4.11	0.38	0.38		
18	22	0.00	4.11	0.34	0.34		
19	23	0.00	4.11	0.30	0.30		
20	24	0.00	4.11	0.27	0.27		
21	25	0.00	4.11	0.24	0.24		
22	26	0.00	4.11	0.22	0.22		
23	27	0.00	4.11	0.19	0.19		
24	28	0.00	4.11	0.17	0.17		
25	29	0.00	4.11	0.15	0.15		
26	30	0.00	4.11	0.14	0.14		
27	31	0.00	4.11	0.12	0.12		
28	32	0.00	4.11	0.11	0.11		
29	33	0.00	4.11	0.10	0.10		
30	34	0.00	4.11	0.09	0.09		
31	35	0.00	4.11	0.08	0.08		
32	36	0.00	4.11	0.07	0.07		
33	37	0.00	4.11	0.06	0.06		
34	38	0.00	4.11	0.06	0.06		
35	39	0.00	4.11	0.05	0.05		
36	40	0.00	4.11	0.04	0.04		
37	41	0.00	4.11	0.04	0.04		
38	42	0.00	4.11	0.04	0.04		
39	43	0.00	4.11	0.03	0.03		
40	44	0.00	4.11	0.03	0.03		
41	45	0.00	4.11	0.03	0.03		
42	46	0.00	4.11	0.02	0.02		
43	47	0.00	4.11	0.02	0.02		
44	48	0.00	4.11	0.02	0.02		
45	49	0.00	4.11	0.02	0.02		
46	50	0.00	4.11	0.01	0.01		
47	51	0.00	4.11	0.01	0.01		
48	52	0.00	4.11	0.01	0.01		
49	53	0.00	4.11	0.01	0.01		
50	54	0.00	4.11	0.01	0.01		
Total		56.15	42.58	205.35	22.12	-20.47	

Zone:		U1		(Unit: TND Million)			
Return period:		40-Year					
Year	Year	Cost		Benefit		B-C	
		Project Cost	NPV	Project Benefit	NPV		
-3	1	12.79	11.42	0.00		-11.42	
-2	2	19.19	15.30	0.00		-15.30	
-1	3	19.19	13.66	0.00		-13.66	
0	4	12.79	8.13	0.00		-8.13	
1	5	0.00	4.52	2.57	2.57		
2	6	0.00	4.52	2.29	2.29		
3	7	0.00	4.52	2.05	2.05		
4	8	0.00	4.52	1.83	1.83		
5	9	0.00	4.52	1.63	1.63		
6	10	0.00	4.52	1.46	1.46		
7	11	0.00	4.52	1.30	1.30		
8	12	0.00	4.52	1.16	1.16		
9	13	0.00	4.52	1.04	1.04		
10	14	0.00	4.52	0.93	0.93		
11	15	0.00	4.52	0.83	0.83		
12	16	0.00	4.52	0.74	0.74		
13	17	0.00	4.52	0.66	0.66		
14	18	0.00	4.52	0.59	0.59		
15	19	0.00	4.52	0.53	0.53		
16	20	0.00	4.52	0.47	0.47		
17	21	0.00	4.52	0.42	0.42		
18	22	0.00	4.52	0.37	0.37		
19	23	0.00	4.52	0.33	0.33		
20	24	0.00	4.52	0.30	0.30		
21	25	0.00	4.52	0.27	0.27		
22	26	0.00	4.52	0.24	0.24		
23	27	0.00	4.52	0.21	0.21		
24	28	0.00					

Table DD1-2 Computation of Benefit - Cost Ratio (Zone U2)

Zone:		U2		(Unit: TND Million)				
Return period:	5-Year	Cost		Benefit			B-C	
Year	Year	Project Cost	NPV	Project Benefit	NPV	(NPV)		
-3	1	4.99	4.45	0.00	0.00	-4.43		
-2	2	7.48	5.96	0.00	0.00	-5.96		
-1	3	7.48	5.33	0.00	0.00	-5.33		
0	4	4.99	3.17	0.00	0.00	-3.17		
1	5	0.00	4.92	2.79	2.79	0.00		
2	6	0.00	4.92	2.49	2.49	0.00		
3	7	0.00	4.92	2.23	2.23	0.00		
4	8	0.00	4.92	1.99	1.99	0.00		
5	9	0.00	4.92	1.77	1.77	0.00		
6	10	0.00	4.92	1.58	1.58	0.00		
7	11	0.00	4.92	1.41	1.41	0.00		
8	12	0.00	4.92	1.26	1.26	0.00		
9	13	0.00	4.92	1.13	1.13	0.00		
10	14	0.00	4.92	1.01	1.01	0.00		
11	15	0.00	4.92	0.90	0.90	0.00		
12	16	0.00	4.92	0.80	0.80	0.00		
13	17	0.00	4.92	0.72	0.72	0.00		
14	18	0.00	4.92	0.64	0.64	0.00		
15	19	0.00	4.92	0.57	0.57	0.00		
16	20	0.00	4.92	0.51	0.51	0.00		
17	21	0.00	4.92	0.46	0.46	0.00		
18	22	0.00	4.92	0.41	0.41	0.00		
19	23	0.00	4.92	0.36	0.36	0.00		
20	24	0.00	4.92	0.32	0.32	0.00		
21	25	0.00	4.92	0.29	0.29	0.00		
22	26	0.00	4.92	0.26	0.26	0.00		
23	27	0.00	4.92	0.23	0.23	0.00		
24	28	0.00	4.92	0.21	0.21	0.00		
25	29	0.00	4.92	0.18	0.18	0.00		
26	30	0.00	4.92	0.16	0.16	0.00		
27	31	0.00	4.92	0.15	0.15	0.00		
28	32	0.00	4.92	0.13	0.13	0.00		
29	33	0.00	4.92	0.12	0.12	0.00		
30	34	0.00	4.92	0.10	0.10	0.00		
31	35	0.00	4.92	0.09	0.09	0.00		
32	36	0.00	4.92	0.08	0.08	0.00		
33	37	0.00	4.92	0.07	0.07	0.00		
34	38	0.00	4.92	0.07	0.07	0.00		
35	39	0.00	4.92	0.06	0.06	0.00		
36	40	0.00	4.92	0.05	0.05	0.00		
37	41	0.00	4.92	0.05	0.05	0.00		
38	42	0.00	4.92	0.04	0.04	0.00		
39	43	0.00	4.92	0.04	0.04	0.00		
40	44	0.00	4.92	0.03	0.03	0.00		
41	45	0.00	4.92	0.03	0.03	0.00		
42	46	0.00	4.92	0.03	0.03	0.00		
43	47	0.00	4.92	0.02	0.02	0.00		
44	48	0.00	4.92	0.02	0.02	0.00		
45	49	0.00	4.92	0.02	0.02	0.00		
46	50	0.00	4.92	0.02	0.02	0.00		
47	51	0.00	4.92	0.02	0.02	0.00		
48	52	0.00	4.92	0.01	0.01	0.00		
49	53	0.00	4.92	0.01	0.01	0.00		
50	54	0.00	4.92	0.01	0.01	0.00		
Total		24.94	18.91	246.00	25.97	7.05		

Zone:		U2		(Unit: TND Million)				
Return period:	10-Year	Cost		Benefit			B-C	
Year	Year	Project Cost	NPV	Project Benefit	NPV	(NPV)		
-3	1	8.79	7.85	0.00	0.00	-7.85		
-2	2	13.19	10.51	0.00	0.00	-10.51		
-1	3	13.19	9.38	0.00	0.00	-9.38		
0	4	8.79	5.59	0.00	0.00	-5.59		
1	5	0.00	11.92	6.76	6.76	0.00		
2	6	0.00	11.92	6.04	6.04	0.00		
3	7	0.00	11.92	5.39	5.39	0.00		
4	8	0.00	11.92	4.81	4.81	0.00		
5	9	0.00	11.92	4.30	4.30	0.00		
6	10	0.00	11.92	3.84	3.84	0.00		
7	11	0.00	11.92	3.43	3.43	0.00		
8	12	0.00	11.92	3.06	3.06	0.00		
9	13	0.00	11.92	2.73	2.73	0.00		
10	14	1.40	0.29	11.92	2.44	2.15		
11	15	1.40	0.26	11.92	2.18	1.92		
12	16	0.00	11.92	1.94	1.94	0.00		
13	17	0.00	11.92	1.74	1.74	0.00		
14	18	0.00	11.92	1.55	1.55	0.00		
15	19	0.00	11.92	1.38	1.38	0.00		
16	20	0.00	11.92	1.24	1.24	0.00		
17	21	0.00	11.92	1.10	1.10	0.00		
18	22	0.00	11.92	0.98	0.98	0.00		
19	23	0.00	11.92	0.88	0.88	0.00		
20	24	1.40	0.09	11.92	0.79	0.69		
21	25	1.40	0.08	11.92	0.70	0.62		
22	26	0.00	11.92	0.63	0.63	0.00		
23	27	0.00	11.92	0.56	0.56	0.00		
24	28	0.00	11.92	0.50	0.50	0.00		
25	29	0.00	11.92	0.45	0.45	0.00		
26	30	0.00	11.92	0.40	0.40	0.00		
27	31	0.00	11.92	0.36	0.36	0.00		
28	32	0.00	11.92	0.32	0.32	0.00		
29	33	0.00	11.92	0.28	0.28	0.00		
30	34	1.40	0.03	11.92	0.25	0.22		
31	35	1.40	0.03	11.92	0.23	0.20		
32	36	0.00	11.92	0.20	0.20	0.00		
33	37	0.00	11.92	0.18	0.18	0.00		
34	38	0.00	11.92	0.16	0.16	0.00		
35	39	0.00	11.92	0.14	0.14	0.00		
36	40	0.00	11.92	0.13	0.13	0.00		
37	41	0.00	11.92	0.11	0.11	0.00		
38	42	0.00	11.92	0.10	0.10	0.00		
39	43	0.00	11.92	0.09	0.09	0.00		
40	44	1.40	0.01	11.92	0.08	0.07		
41	45	1.40	0.01	11.92	0.07	0.06		
42	46	0.00	11.92	0.06	0.06	0.00		
43	47	0.00	11.92	0.06	0.06	0.00		
44	48	0.00	11.92	0.05	0.05	0.00		
45	49	0.00	11.92	0.05	0.05	0.00		
46	50	0.00	11.92	0.04	0.04	0.00		
47	51	0.00	11.92	0.04	0.04	0.00		
48	52	0.00	11.92	0.03	0.03	0.00		
49	53	0.00	11.92	0.03	0.03	0.00		
50	54	0.00	11.92	0.03	0.03	0.00		
Total		55.15	34.12	595.80	62.89	28.77		

Zone:		U2		(Unit: TND Million)				
Return period:	20-Year	Cost		Benefit			B-C	
Year	Year	Project Cost	NPV	Project Benefit	NPV	(NPV)		
-3	1	14.88	13.29	0.00	0.00	-13.29		
-2	2	22.33	17.80	0.00	0.00	-17.80		
-1	3	22.33	15.89	0.00	0.00	-15.89		
0	4	14.88	9.46	0.00	0.00	-9.46		
1	5	0.00	21.02	11.92	11.92	0.00		
2	6	0.00	21.02	10.65	10.65	0.00		
3	7	0.00	21.02	9.51	9.51	0.00		
4	8	0.00	21.02	8.49	8.49	0.00		
5	9	0.00	21.02	7.58	7.58	0.00		
6	10	0.00	21.02	6.77	6.77	0.00		
7	11	0.00	21.02	6.04	6.04	0.00		
8	12	0.00	21.02	5.39	5.39	0.00		
9	13	0.00	21.02	4.82	4.82	0.00		
10	14	0.00	21.02	4.30	4.30	0.00		
11	15	0.00	21.02	3.84	3.84	0.00		
12	16	0.00	21.02	3.43	3.43	0.00		
13	17	0.00	21.02	3.06	3.06	0.00		
14	18	0.00	21.02	2.73	2.73	0.00		
15	19	0.00	21.02	2.44	2.44	0.00		
16	20	0.00	21.02	2.18	2.18	0.00		
17	21	0.00	21.02	1.95	1.95	0.00		
18	22	0.00	21.02	1.74	1.74	0.00		
19	23	0.00	21.02	1.55	1.55	0.00		
20	24	2.23	0.15	21.02	1.38	1.24		
21	25	2.23	0.13	21.02	1.24	1.11		
22	26	0.00	21.02	1.10	1.10	0.00		
23	27	0.00	21.02	0.99	0.99	0.00		
24	28	0.00	21.02	0.88	0.88	0.00		
25	29	0.00	21.02	0.79	0.79	0.00		
26	30	0.00	21.02	0.70	0.70	0.00		
27	31	0.00	21.02	0.63	0.63	0.00		
28	32	0.00	21.02	0.56	0.56	0.00		
29	33	0.00	21.02	0.50	0.50	0.00		
30	34	0.00	21.02	0.45	0.45	0.00		
31	35	0.00	21.02	0.40	0.40	0.00		
32	36	0.00	21.02	0.36	0.36	0.00		
33	37	0.00	21.02	0.32	0.32	0.00		
34	38	0.00	21.02	0.28	0.28	0.00		
35	39	0.00	21.02	0.25	0.25	0.00		
36	40	0.00	21.02	0.23	0.23	0.00		
37	41	0.00	21.02	0.20	0.20	0.00		
38	42	0.00	21.02	0.18	0.18	0.00		
39	43	0.00	21.02	0.16	0.16	0.00		
40	44	2.23	0.02	21.02	0.14	0.13		
41	45	2.23	0.01	21.02	0.13	0.11		
42	46	0.00	21.02	0.11	0.11	0.00		
43	47	0.00	21.02	0.10	0.10	0.00		
44	48	0.00	21.02	0.09	0.09	0.00		
45	49	0.00	21.02	0.08	0.08	0.00		
46	50	0.00	21.02	0.07	0.07	0.00		
47	51	0.00	21.02	0.06	0.06	0.00		
48	52	0.00	21.02	0.06	0.06	0.00		
49	53	0.00	21.02	0.05	0.05	0.00		
50	54	0.00	21.02	0.05	0.05	0.00		
Total		83.32	56.74	1,050.75	110.91	54.17		

Zone:		U2		(Unit: TND Million)				
Return period:	30-Year	Cost		Benefit			B-C	
Year	Year	Project Cost	NPV	Project Benefit	NPV	(NPV)		
-3	1	16.89	15.08	0.00	0.00	-15.08		
-2	2	25.34	20.20	0.00	0.00	-20.20		
-1	3	25.34	18.04	0.00	0.00	-18.04		
0	4	16.89	10.74	0.00	0.00	-10.74		
1	5</							

Table DD1-3 Computation of Benefit - Cost Ratio (Zone M)

Zone:		M		(Unit: TND Million)				
Return period:		10-Year						
Year	Year	Cost		Benefit		B-C		
		Project Cost	NPV	Peroproject Benefit	NPV	(NPV)		
-1	1	1.46	1.30		0.00		-1.30	
0	2	1.46	1.16		0.00		-1.16	
1	3		0.00	1.53	1.09		1.09	
2	4		0.00	1.53	0.97		0.97	
3	5		0.00	1.53	0.87		0.87	
4	6		0.00	1.53	0.78		0.78	
5	7		0.00	1.53	0.69		0.69	
6	8		0.00	1.53	0.62		0.62	
7	9		0.00	1.53	0.55		0.55	
8	10		0.00	1.53	0.49		0.49	
9	11		0.00	1.53	0.44		0.44	
10	12		0.00	1.53	0.39		0.39	
11	13		0.00	1.53	0.35		0.35	
12	14		0.00	1.53	0.31		0.31	
13	15		0.00	1.53	0.28		0.28	
14	16		0.00	1.53	0.25		0.25	
15	17		0.00	1.53	0.22		0.22	
16	18		0.00	1.53	0.20		0.20	
17	19		0.00	1.53	0.18		0.18	
18	20		0.00	1.53	0.16		0.16	
19	21		0.00	1.53	0.14		0.14	
20	22		0.00	1.53	0.13		0.13	
21	23		0.00	1.53	0.11		0.11	
22	24		0.00	1.53	0.10		0.10	
23	25		0.00	1.53	0.09		0.09	
24	26		0.00	1.53	0.08		0.08	
25	27		0.00	1.53	0.07		0.07	
26	28		0.00	1.53	0.06		0.06	
27	29		0.00	1.53	0.06		0.06	
28	30		0.00	1.53	0.05		0.05	
29	31		0.00	1.53	0.05		0.05	
30	32		0.00	1.53	0.04		0.04	
31	33		0.00	1.53	0.04		0.04	
32	34		0.00	1.53	0.03		0.03	
33	35		0.00	1.53	0.03		0.03	
34	36		0.00	1.53	0.03		0.03	
35	37		0.00	1.53	0.02		0.02	
36	38		0.00	1.53	0.02		0.02	
37	39		0.00	1.53	0.02		0.02	
38	40		0.00	1.53	0.02		0.02	
39	41		0.00	1.53	0.01		0.01	
40	42		0.00	1.53	0.01		0.01	
41	43		0.00	1.53	0.01		0.01	
42	44		0.00	1.53	0.01		0.01	
43	45		0.00	1.53	0.01		0.01	
44	46		0.00	1.53	0.01		0.01	
45	47		0.00	1.53	0.01		0.01	
46	48		0.00	1.53	0.01		0.01	
47	49		0.00	1.53	0.01		0.01	
48	50		0.00	1.53	0.01		0.01	
49	51		0.00	1.53	0.00		0.00	
50	52		0.00	1.53	0.00		0.00	
Total		2.91	2.46	76.55	10.14		7.68	

Zone:		M		(Unit: TND Million)				
Return period:		20-Year						
Year	Year	Cost		Benefit		B-C		
		Project Cost	NPV	Peroproject Benefit	NPV	(NPV)		
-1	1	3.57	3.18		0.00		-3.18	
0	2	3.57	2.84		0.00		-2.84	
1	3		0.00	3.03	2.15		2.15	
2	4		0.00	3.03	1.92		1.92	
3	5		0.00	3.03	1.72		1.72	
4	6		0.00	3.03	1.53		1.53	
5	7		0.00	3.03	1.37		1.37	
6	8		0.00	3.03	1.22		1.22	
7	9		0.00	3.03	1.09		1.09	
8	10		0.00	3.03	0.97		0.97	
9	11		0.00	3.03	0.87		0.87	
10	12		0.00	3.03	0.78		0.78	
11	13		0.00	3.03	0.69		0.69	
12	14		0.00	3.03	0.62		0.62	
13	15		0.00	3.03	0.55		0.55	
14	16		0.00	3.03	0.49		0.49	
15	17		0.00	3.03	0.44		0.44	
16	18		0.00	3.03	0.39		0.39	
17	19		0.00	3.03	0.35		0.35	
18	20		0.00	3.03	0.31		0.31	
19	21		0.00	3.03	0.28		0.28	
20	22		0.00	3.03	0.25		0.25	
21	23		0.00	3.03	0.22		0.22	
22	24		0.00	3.03	0.20		0.20	
23	25		0.00	3.03	0.18		0.18	
24	26		0.00	3.03	0.16		0.16	
25	27		0.00	3.03	0.14		0.14	
26	28		0.00	3.03	0.13		0.13	
27	29		0.00	3.03	0.11		0.11	
28	30		0.00	3.03	0.10		0.10	
29	31		0.00	3.03	0.09		0.09	
30	32		0.00	3.03	0.08		0.08	
31	33		0.00	3.03	0.07		0.07	
32	34		0.00	3.03	0.06		0.06	
33	35		0.00	3.03	0.06		0.06	
34	36		0.00	3.03	0.05		0.05	
35	37		0.00	3.03	0.05		0.05	
36	38		0.00	3.03	0.04		0.04	
37	39		0.00	3.03	0.04		0.04	
38	40		0.00	3.03	0.03		0.03	
39	41		0.00	3.03	0.03		0.03	
40	42		0.00	3.03	0.03		0.03	
41	43		0.00	3.03	0.02		0.02	
42	44		0.00	3.03	0.02		0.02	
43	45		0.00	3.03	0.02		0.02	
44	46		0.00	3.03	0.02		0.02	
45	47		0.00	3.03	0.01		0.01	
46	48		0.00	3.03	0.01		0.01	
47	49		0.00	3.03	0.01		0.01	
48	50		0.00	3.03	0.01		0.01	
49	51		0.00	3.03	0.01		0.01	
50	52		0.00	3.03	0.01		0.01	
Total		7.13	6.03	151.30	20.03		14.01	

Zone:		M		(Unit: TND Million)				
Return period:		30-Year						
Year	Year	Cost		Benefit		B-C		
		Project Cost	NPV	Peroproject Benefit	NPV	(NPV)		
-1	1	4.43	3.96		0.00		-3.96	
0	2	4.43	3.53		0.00		-3.53	
1	3		0.00	3.63	2.58		2.58	
2	4		0.00	3.63	2.31		2.31	
3	5		0.00	3.63	2.06		2.06	
4	6		0.00	3.63	1.84		1.84	
5	7		0.00	3.63	1.64		1.64	
6	8		0.00	3.63	1.46		1.46	
7	9		0.00	3.63	1.31		1.31	
8	10		0.00	3.63	1.17		1.17	
9	11		0.00	3.63	1.04		1.04	
10	12		0.00	3.63	0.93		0.93	
11	13		0.00	3.63	0.83		0.83	
12	14		0.00	3.63	0.74		0.74	
13	15		0.00	3.63	0.66		0.66	
14	16		0.00	3.63	0.59		0.59	
15	17		0.00	3.63	0.53		0.53	
16	18		0.00	3.63	0.47		0.47	
17	19		0.00	3.63	0.42		0.42	
18	20		0.00	3.63	0.38		0.38	
19	21		0.00	3.63	0.34		0.34	
20	22		0.00	3.63	0.30		0.30	
21	23		0.00	3.63	0.27		0.27	
22	24		0.00	3.63	0.24		0.24	
23	25		0.00	3.63	0.21		0.21	
24	26		0.00	3.63	0.19		0.19	
25	27		0.00	3.63	0.17		0.17	
26	28		0.00	3.63	0.15		0.15	
27	29		0.00	3.63	0.14		0.14	
28	30		0.00	3.63	0.12		0.12	
29	31		0.00	3.63	0.11		0.11	
30	32		0.00	3.63	0.10		0.10	
31	33		0.00	3.63	0.09		0.09	
32	34		0.00	3.63	0.08		0.08	
33	35		0.00	3.63	0.07		0.07	
34	36		0.00	3.63	0.06		0.06	
35	37		0.00	3.63	0.05		0.05	
36	38		0.00	3.63	0.05		0.05	
37	39		0.00	3.63	0.04		0.04	
38	40		0.00	3.63	0.04		0.04	
39	41		0.00	3.63	0.03		0.03	
40	42		0.00	3.63	0.03		0.03	
41	43		0.00	3.63	0.03		0.03	
42	44		0.00	3.63	0.02		0.02	
43	45		0.00	3.63	0.02		0.02	
44	46		0.00	3.63	0.02		0.02	
45	47		0.00	3.63	0.02		0.02	
46	48		0.00	3.63	0.02		0.02	
47	49		0.00	3.63	0.01		0.01	
48	50		0.00	3.63	0.01		0.01	
49	51		0.00	3.63	0.01		0.01	
50	52		0.00	3.63	0.01		0.01	
Total		8.87	7.49	181.35	24.01		16.52	

Zone:		M		(Unit: TND Million)				
Return period:		40-Year						
Year	Year	Cost		Benefit		B-C		
		Project Cost	NPV	Peroproject Benefit	NPV	(NPV)		
-1	1	3.18	2.84		0.00		-2.84	
0	2	4.24	3.38		0.00		-3.38	
1	3	3.18	2.26	4.23	3.01		0.75	
2	4		0.00	4.23	2.69		2.69	
3	5		0.00	4.23	2.40		2.40	
4	6		0.00	4.23	2.14		2.14	
5	7		0.00	4.23	1.91		1.91	
6	8		0.00	4.23	1.71		1.71	
7	9		0.00	4.23	1.52		1.52	
8	10		0.00	4.23	1.36		1.36	
9	11		0.00	4.23	1.22		1.22	
10	12		0.00	4.23	1.09		1.09	
11	13		0.00	4.23	0.97		0.97	
12	14		0.00	4.23	0.87		0.87	
13	15		0.00	4.23	0.77		0.77	
14	16		0.00	4.23	0.69		0.69	
15	17		0.00	4.23	0.62		0.62	
16	18		0.00	4.23	0.55		0.55	
17	19		0.00	4.23	0.49		0.49	
18	20		0.00	4.23	0.44		0.44	
19	21		0.00	4.23	0.39		0.39	
20	22		0.00	4.23	0.35		0.35	
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Table DDI-4 Computation of Benefit - Cost Ratio (Zone D1)

Zone:		D1		(Unit: TND Million)				
Return period:	5-Year	Year	Year	Cost	Benefit	B-C		
Year	Year	Project Cost	NPV	Project Cost	NPV	(NPV)		
-3	1	5.64	5.03	0	-5			
-2	1	8.46	6.74	0.00	-6.74			
-1	2	8.46	6.02	0.00	-6.02			
0	3	5.64	3.58	0.00	-3.58			
1	4	0.00	4.01	2.27	2.27			
2	5	0.00	4.01	2.03	2.03			
3	6	0.00	4.01	1.81	1.81			
4	7	0.00	4.01	1.62	1.62			
5	8	0.00	4.01	1.44	1.44			
6	9	0.00	4.01	1.29	1.29			
7	10	0.00	4.01	1.15	1.15			
8	11	0.00	4.01	1.03	1.03			
9	12	0.00	4.01	0.92	0.92			
10	13	0.00	4.01	0.82	0.82			
11	14	0.00	4.01	0.73	0.73			
12	15	0.00	4.01	0.65	0.65			
13	16	0.00	4.01	0.58	0.58			
14	17	0.00	4.01	0.52	0.52			
15	18	0.00	4.01	0.47	0.47			
16	19	0.00	4.01	0.42	0.42			
17	20	0.00	4.01	0.37	0.37			
18	21	0.00	4.01	0.33	0.33			
19	22	0.00	4.01	0.30	0.30			
20	23	0.00	4.01	0.26	0.26			
21	24	0.00	4.01	0.24	0.24			
22	25	0.00	4.01	0.21	0.21			
23	26	0.00	4.01	0.19	0.19			
24	27	0.00	4.01	0.17	0.17			
25	28	0.00	4.01	0.15	0.15			
26	29	0.00	4.01	0.13	0.13			
27	30	0.00	4.01	0.12	0.12			
28	31	0.00	4.01	0.11	0.11			
29	32	0.00	4.01	0.10	0.10			
30	33	0.00	4.01	0.08	0.08			
31	34	0.00	4.01	0.08	0.08			
32	35	0.00	4.01	0.07	0.07			
33	36	0.00	4.01	0.06	0.06			
34	37	0.00	4.01	0.05	0.05			
35	38	0.00	4.01	0.05	0.05			
36	39	0.00	4.01	0.04	0.04			
37	40	0.00	4.01	0.04	0.04			
38	41	0.00	4.01	0.03	0.03			
39	42	0.00	4.01	0.03	0.03			
40	43	0.00	4.01	0.03	0.03			
41	44	0.00	4.01	0.02	0.02			
42	45	0.00	4.01	0.02	0.02			
43	46	0.00	4.01	0.02	0.02			
44	47	0.00	4.01	0.02	0.02			
45	48	0.00	4.01	0.02	0.02			
46	49	0.00	4.01	0.01	0.01			
47	50	0.00	4.01	0.01	0.01			
48	51	0.00	4.01	0.01	0.01			
49	52	0.00	4.01	0.01	0.01			
50	53	0.00	4.01	0.01	0.01			
50	54	0.00	4.01	0.01	0.01			
Total		28.19	21.38	196.29	21.13	-0.23		

Zone:		D1		(Unit: TND Million)				
Return period:	10-Year	Year	Year	Cost	Benefit	B-C		
Year	Year	Project Cost	NPV	Project Cost	NPV	(NPV)		
-3	1	8.97	8.01	0.00	-8.01			
-2	2	13.46	10.73	0.00	-10.73			
-1	3	13.46	9.58	0.00	-9.58			
0	4	8.97	5.70	0.00	-5.70			
1	5	0.00	6.56	3.72	3.72			
2	6	0.00	6.56	3.32	3.32			
3	7	0.00	6.56	2.97	2.97			
4	8	0.00	6.56	2.65	2.65			
5	9	0.00	6.56	2.37	2.37			
6	10	0.00	6.56	2.11	2.11			
7	11	0.00	6.56	1.89	1.89			
8	12	0.00	6.56	1.68	1.68			
9	13	0.00	6.56	1.50	1.50			
10	14	0.00	6.56	1.34	1.34			
11	15	0.00	6.56	1.20	1.20			
12	16	0.00	6.56	1.07	1.07			
13	17	0.00	6.56	0.96	0.96			
14	18	0.00	6.56	0.85	0.85			
15	19	0.00	6.56	0.76	0.76			
16	20	0.00	6.56	0.68	0.68			
17	21	0.00	6.56	0.61	0.61			
18	22	0.00	6.56	0.54	0.54			
19	23	0.00	6.56	0.48	0.48			
20	24	0.00	6.56	0.43	0.43			
21	25	0.00	6.56	0.39	0.39			
22	26	0.00	6.56	0.34	0.34			
23	27	0.00	6.56	0.31	0.31			
24	28	0.00	6.56	0.27	0.27			
25	29	0.00	6.56	0.25	0.25			
26	30	0.00	6.56	0.22	0.22			
27	31	0.00	6.56	0.20	0.20			
28	32	0.00	6.56	0.17	0.17			
29	33	0.00	6.56	0.16	0.16			
30	34	0.00	6.56	0.14	0.14			
31	35	0.00	6.56	0.12	0.12			
32	36	0.00	6.56	0.11	0.11			
33	37	0.00	6.56	0.10	0.10			
34	38	0.00	6.56	0.09	0.09			
35	39	0.00	6.56	0.08	0.08			
36	40	0.00	6.56	0.07	0.07			
37	41	0.00	6.56	0.06	0.06			
38	42	0.00	6.56	0.06	0.06			
39	43	0.00	6.56	0.05	0.05			
40	44	0.00	6.56	0.04	0.04			
41	45	0.00	6.56	0.04	0.04			
42	46	0.00	6.56	0.04	0.04			
43	47	0.00	6.56	0.03	0.03			
44	48	0.00	6.56	0.03	0.03			
45	49	0.00	6.56	0.03	0.03			
46	50	0.00	6.56	0.02	0.02			
47	51	0.00	6.56	0.02	0.02			
48	52	0.00	6.56	0.02	0.02			
49	53	0.00	6.56	0.02	0.02			
50	54	0.00	6.56	0.01	0.01			
Total		44.86	34.02	327.95	34.62	0.60		

Zone:		D1		(Unit: TND Million)				
Return period:	20-Year	Year	Year	Cost	Benefit	B-C		
Year	Year	Project Cost	NPV	Project Cost	NPV	(NPV)		
-3	1	11.88	10.61	0.00	-10.61			
-2	2	17.82	14.21	0.00	-14.21			
-1	3	17.82	12.68	0.00	-12.68			
0	4	11.88	7.55	0.00	-7.55			
1	5	0.00	8.10	4.60	4.60			
2	6	0.00	8.10	4.10	4.10			
3	7	0.00	8.10	3.66	3.66			
4	8	0.00	8.10	3.27	3.27			
5	9	0.00	8.10	2.92	2.92			
6	10	0.00	8.10	2.61	2.61			
7	11	0.00	8.10	2.33	2.33			
8	12	0.00	8.10	2.08	2.08			
9	13	0.00	8.10	1.86	1.86			
10	14	0.00	8.10	1.66	1.66			
11	15	0.00	8.10	1.48	1.48			
12	16	0.00	8.10	1.32	1.32			
13	17	0.00	8.10	1.18	1.18			
14	18	0.00	8.10	1.05	1.05			
15	19	0.00	8.10	0.94	0.94			
16	20	0.00	8.10	0.84	0.84			
17	21	0.00	8.10	0.75	0.75			
18	22	0.00	8.10	0.67	0.67			
19	23	0.00	8.10	0.60	0.60			
20	24	0.00	8.10	0.53	0.53			
21	25	0.00	8.10	0.48	0.48			
22	26	0.00	8.10	0.43	0.43			
23	27	0.00	8.10	0.38	0.38			
24	28	0.00	8.10	0.34	0.34			
25	29	0.00	8.10	0.30	0.30			
26	30	0.00	8.10	0.27	0.27			
27	31	0.00	8.10	0.24	0.24			
28	32	0.00	8.10	0.22	0.22			
29	33	0.00	8.10	0.19	0.19			
30	34	0.00	8.10	0.17	0.17			
31	35	0.00	8.10	0.15	0.15			
32	36	0.00	8.10	0.14	0.14			
33	37	0.00	8.10	0.12	0.12			
34	38	0.00	8.10	0.11	0.11			
35	39	0.00	8.10	0.10	0.10			
36	40	0.00	8.10	0.09	0.09			
37	41	0.00	8.10	0.08	0.08			
38	42	0.00	8.10	0.07	0.07			
39	43	0.00	8.10	0.06	0.06			
40	44	0.00	8.10	0.06	0.06			
41	45	0.00	8.10	0.05	0.05			
42	46	0.00	8.10	0.04	0.04			
43	47	0.00	8.10	0.04	0.04			
44	48	0.00	8.10	0.04	0.04			
45	49	0.00	8.10	0.03	0.03			
46	50	0.00	8.10	0.03	0.03			
47	51	0.00	8.10	0.03	0.03			
48	52	0.00	8.10	0.02	0.02			
49	53	0.00	8.10	0.02	0.02			
50	54	0.00	8.10	0.02	0.02			
Total		59.40	45.05	405.10	42.76	-2.29		

Zone:		D1		(Unit: TND Million)				
Return period:	30-Year	Year	Year	Cost	Benefit	B-C		
Year	Year	Project Cost	NPV	Project Cost	NPV	(NPV)		
-3	1	13.04	11.64	0.00	-11.64			
-2	2	19.56	15.59	0.00	-15.59			
-1	3	19.56	13.92	0.00	-13.92			
0	4	13.04	8.29	0.00	-8.29			
1	5	0.00	8.26	4.69	4.69			
2	6	0.00	8.26	4.19	4.19			
3	7	0.00	8.26	3.74	3.74			
4	8	0.00	8.26	3.34	3.34			
5	9	0.00	8.26	2.98	2.98			
6	10	0.00	8.26	2.66	2.66			
7	11	0.00	8.26	2.38	2.38			
8	12	0.00	8.26	2.12	2.12			
9	13	0.00	8.26	1.89	1.89			
10	14	0.00	8.26	1.69	1.69			
11	15	0.00	8.26	1.51	1.51			
12	16	0.00	8.26	1.35	1.35			
13	17	0.00	8.26	1.20	1.20			
14	18	0.00	8.26	1.07</				

Table DD1-5 Computation of Benefit - Cost Ratio (Zone D2)

Zone:		D2		(Unit: TND Million)					
Return period:		5-Year		Benefit		Benefit		B-C	
Year	Year	Project Cost	NPV	Perojekt Benefit	NPV	NPV	(NPV)	Year	Year
-3	1	5.00	4.47	0.00	-4.47	0.00	-4.47	-3	1
-2	2	6.67	5.32	0.00	-5.32	0.00	-5.32	-2	2
-1	3	5.00	3.56	0.00	-3.56	0.00	-3.56	-1	3
0	4	0.00	0.00	0.00	0.00	0.00	0.00	0	4
1	5	0.00	9.17	5.20	5.20	0.00	23.04	1	5
2	6	0.00	9.17	4.65	4.65	0.00	23.04	2	6
3	7	0.00	9.17	4.15	4.15	0.00	23.04	3	7
4	8	0.00	9.17	3.70	3.70	0.00	23.04	4	8
5	9	0.00	9.17	3.31	3.31	0.00	23.04	5	9
6	10	0.00	9.17	2.95	2.95	0.00	23.04	6	10
7	11	0.00	9.17	2.64	2.64	0.00	23.04	7	11
8	12	0.00	9.17	2.35	2.35	0.00	23.04	8	12
9	13	0.00	9.17	2.10	2.10	0.00	23.04	9	13
10	14	0.00	9.17	1.88	1.88	0.00	23.04	10	14
11	15	0.00	9.17	1.68	1.68	0.00	23.04	11	15
12	16	0.00	9.17	1.50	1.50	0.00	23.04	12	16
13	17	0.00	9.17	1.34	1.34	0.00	23.04	13	17
14	18	0.00	9.17	1.19	1.19	0.00	23.04	14	18
15	19	0.00	9.17	1.06	1.06	0.00	23.04	15	19
16	20	0.00	9.17	0.95	0.95	0.00	23.04	16	20
17	21	0.00	9.17	0.85	0.85	0.00	23.04	17	21
18	22	0.00	9.17	0.76	0.76	0.00	23.04	18	22
19	23	0.00	9.17	0.68	0.68	0.00	23.04	19	23
20	24	0.00	9.17	0.60	0.60	0.00	23.04	20	24
21	25	0.00	9.17	0.54	0.54	0.00	23.04	21	25
22	26	0.00	9.17	0.48	0.48	0.00	23.04	22	26
23	27	0.00	9.17	0.43	0.43	0.00	23.04	23	27
24	28	0.00	9.17	0.38	0.38	0.00	23.04	24	28
25	29	0.00	9.17	0.34	0.34	0.00	23.04	25	29
26	30	0.00	9.17	0.31	0.31	0.00	23.04	26	30
27	31	0.00	9.17	0.27	0.27	0.00	23.04	27	31
28	32	0.00	9.17	0.24	0.24	0.00	23.04	28	32
29	33	0.00	9.17	0.22	0.22	0.00	23.04	29	33
30	34	0.00	9.17	0.19	0.19	0.00	23.04	30	34
31	35	0.00	9.17	0.17	0.17	0.00	23.04	31	35
32	36	0.00	9.17	0.16	0.16	0.00	23.04	32	36
33	37	0.00	9.17	0.14	0.14	0.00	23.04	33	37
34	38	0.00	9.17	0.12	0.12	0.00	23.04	34	38
35	39	0.00	9.17	0.11	0.11	0.00	23.04	35	39
36	40	0.00	9.17	0.10	0.10	0.00	23.04	36	40
37	41	0.00	9.17	0.09	0.09	0.00	23.04	37	41
38	42	0.00	9.17	0.08	0.08	0.00	23.04	38	42
39	43	0.00	9.17	0.07	0.07	0.00	23.04	39	43
40	44	0.00	9.17	0.06	0.06	0.00	23.04	40	44
41	45	0.00	9.17	0.06	0.06	0.00	23.04	41	45
42	46	0.00	9.17	0.05	0.05	0.00	23.04	42	46
43	47	0.00	9.17	0.04	0.04	0.00	23.04	43	47
44	48	0.00	9.17	0.04	0.04	0.00	23.04	44	48
45	49	0.00	9.17	0.04	0.04	0.00	23.04	45	49
46	50	0.00	9.17	0.03	0.03	0.00	23.04	46	50
47	51	0.00	9.17	0.03	0.03	0.00	23.04	47	51
48	52	0.00	9.17	0.03	0.03	0.00	23.04	48	52
49	53	0.00	9.17	0.02	0.02	0.00	23.04	49	53
50	54	0.00	9.17	0.02	0.02	0.00	23.04	50	54
Total		16.67	13.34	458.45	48.39	35.05			

Basic Condition
Discount rate: 12%
Benefit enhancement: Not considered
Note: NPV, Net present value

B-C 35.05
B/C 3.63

Basic Condition
Discount Rate 12%
Benefit enhancement: Not considered
Note: NPV, Net present value

B-C 95.51
B/C 4.66

Basic Condition
Discount Rate 12%
Benefit enhancement: Not considered
Note: NPV, Net present value

B-C 107.80
B/C 3.85

Basic Condition
Discount Rate 12%
Benefit enhancement: Not considered
Note: NPV, Net present value

B-C 108.47
B/C 3.40

Basic Condition
Discount Rate 12%
Benefit enhancement: Not considered
Note: NPV, Net present value

B-C 109.13
B/C 3.09

Basic Condition
Discount Rate 12%
Benefit enhancement: Not considered
Note: NPV, Net present value

B-C 109.80
B/C 2.84