Figures

Stations in the Mejerda River Basin (Stations dans le bassin versant de la Medjerda)

ST_ID1	ST_NAME
50078	AIN BEYA OUED RHEZALA
50138	AIN DEBBA
50177	AIN JEMMALA
50197	AIN FAOUAR ST HERESE
50244	AIN GUESIL
50260	AIN HAMRAYA
50276	AIN KERMA 1
50282	AIN KERMA FME D'ETAT
50350	AIN MERJA
50421	AIN S'KOUM
50422	AIN SALLEM
50467	AIN TABIA
50511	AIN TOUNGA SE
50522	AIN ZARGA RETENUE
50523	AIN ZARGA RUINE ROMAINE
50535	AIN ZANA
50543	AIN ZEBDA
50553	AIN ZELIGUA
50567	AIN ZRIBA
50568	AIN ZRIGUE
50591	AKHOUAT GARE
50630	AMDOUN CTV
50692	AROUSSIA BARRAGE
50738	BADROUNA BOUSALEM
50752	BALTA CTV
50764	BARRAGE KASSEB
50767	BARRAGE LAKHMES
50772	BARRAGE SIDI SALEM
50791	BATANE ECOLE
50792	BATANE OMVVM
50799	BEAUCE TUNISIENNE
50852	BERBOUKH
50854	BEN JABALLAH
50881	BESSOUAGUI PF
51009	BORJ EL AMRI
51092	BORJ DIOUANA EP
51103	BORJ EL AIFA
51133	BORDJ HAMDOUNA
51190	BJ TOUMI STE BARAK
51226	BEN ARAR
51268	BEN METIR 2 SM
51403	BOU HEURTMA BGE
51432	BOU SALEM DELEGATION SM
52521	EL ALIA SERS UCP
52545	EL GUANTRA
52551	EL MGASSEL C,R,A
52554	ELLES ECOLE SERS
52603	FATH TESSA
52619	FEJ KHEMAKHEM
52651	FELTA EP
52659	FERNANA
52665	FEIJA EL SM
52783	GAAFOUR DELEG
52864	GARDIMAOU DRE
52872	GHAR EL MELH NOUVEAU SM
52874	GHANIMA TESTOUR
52905	GOUBELLAT
52906	GOUBELLAT CRA
53046	HAIDRA RE
53057	HAMMAM BAYADHA SUD
53096	EL HERY
53097	HAOUEM
53311	HIR MAZDOUR
53430	HAOUD
53446	JAMA DRE
53508	KALAA KHASBA DELEGATION
53520	KALAAT ANDALOUS
53525	KALAAT ESSENAM DELEGATION
53554	KHARROUBA
53603	KEF EN NESOUR
53605	KEF.B.I.R.H
53612	KEF HELIOPOLIS
53619	KEF CMA
53754	KOUDIAT INRAT
53778	KRIB FERME COSSEM
53797	KSAR BOU KHRIS
53803	KSAR BOU KLEIA
53810	KSAR HDID
53839	KSOUR ECOLE
53875	KSAR TYR LES ALLOBROGES
53922	LABAR ECOLE SERS
53943	LAAROUSSA
53944	LAKSAB
53964	LORBEUS CTV
54052	MAHASSEN EL MGHASSEL
54102	MAKTHAR P.F
54292	MEJEZ EL BAB PF
54297	MEJEZ EL BAB PV
54345	MEHRINE CRA
54500	MKHACHBIA AVAL
54524	MONTARNAUD 1
54611	MUNCHAR ECOLE
54639	NEBEUR DELEGATION
54671	NMAIRIA
54900	OUED EL LEBEN
54981	OUED MLIZ INRAT
54990	OUED MELLEGUE K 13
55053	OUED RMIL
55080	OUED TINE
55086	OUED ZARGA 12 MAI
55087	OUED ZARGA RHAYET
55089	OUED ZARGA EX FME RURAL
55091	OUED ZARGA FME DENGUEZLI
55095	OUED ZARGA CTV
55135	EL OUATIA HIR EL BEHI
55145	PARC CRDA BEJA
55193	PORTO FARINA GHAR EL MELEH
55288	RAGHAY SUPERIEUR
55335	REBAIEB
55482	SAIDA SIDI THABET
55483	SADINE RESERVE
55502	SAKIET SIDI YOUSSEF SM
55505	SAKIET SIDI YOUSSEF PF
55862	SENED EL HADDED
55887	SERS AGRICOLE
55888	SERS DELEGATION
55974	SIDI ACHOUR
55991	SIDI AHMED SALAH CRA
55992	SIDI AHMED SALAH STATION
56250	SIDI BOU ROUIS SM
56257	SIDI BOUROUIS DELEG
56380	SIDI HAMADA
56485	SIDI M'BAREK BEJA
56528	SIDI MTIR
56595	SIDI SAHBI ABIDA
56670	SIDI THABET DOMAINE HARAS
56673	SIDI THABET OMVVM
56757	SILIANA BARRAGE
56763	SILIANA II SM
56764	SILIANA AGRICOLE
56765	SILIANA LAOUJ
56804	SKHIRA BOU SALEM
56832	SLOUGUIA
56906	SODGA
56988	SK EL ARBA(JENDOUBA)SE
56990	SK EL ARBA(JENDOUBA)SM
57018	BOU SALEM DRE
57022	SK EL KHEMIS B.S.CFPA
57030	SOUK ESSEBT
57122	MORNAGUIA EX SI CYPRIEN
57122	MORNAGUIA EX SI CYPRIÈN
57328	TAJEROUINE AIN ZOUAGHA
57332	TAJEROUINE Fme D'ETAT
57338	TAJEROUINE AGRICOLE
57539	TEBOURBA
57558	TEBOURSOUK SM
57643	TESSA SIDI MEDIEN
57646	TESTOUR SM
57678	TALA SM
57690	THIBAR SM
57731	TOUNGAR CRA
57742	TOUIREF CTV
57752	TOUKEBER
57966	UTIQUE OMVVM
58059	ZAAFRANE UCP
58090	ZEBIDA UCP ENNAJAT
58158	ZAOUEM SM
58261	ZHANA CTV
58270	ZOUARINE CTV
58272	ZOUARINE GARE

Stations in the Adjacent Area
(Stations dans le bassin versant voisines)

ST_ID	ST_NAME
30188	AIN DRAHAM
31824	DEKHILA
32388	DAR FATMA
32424	DAR ECHFA
32920	GOUSSAT EL BEY
33542	KHANGUET
33688	KHAZEM
34638	NEFET
34745	OULED MFADDA
34890	OUED BARBARA
35101	OUED ZEEN P.F
41058	BORJ CHAKIR
41290	BOUCHA ECOLE
41307	BOU ARADA II
41311	BOU ARADA DRE
41697	COOP GHORBANE
45416	ROBAA GN
46108	SIDI ARFA
47620	TELLET ERRAIB
63325	HIR MNIHLA
63664	KESRA B9
63666	KESRA FORET
63936	LADJERED PF
64069	MAJBAR
64768	OUM JDOUR
65064	OUSLATIA FORET
65431	ROHIA DELEGATION SM
65478	SAADIA DU BARGOU SM
67614	TELLA
68094	BIR CHAABEN EX ZELF

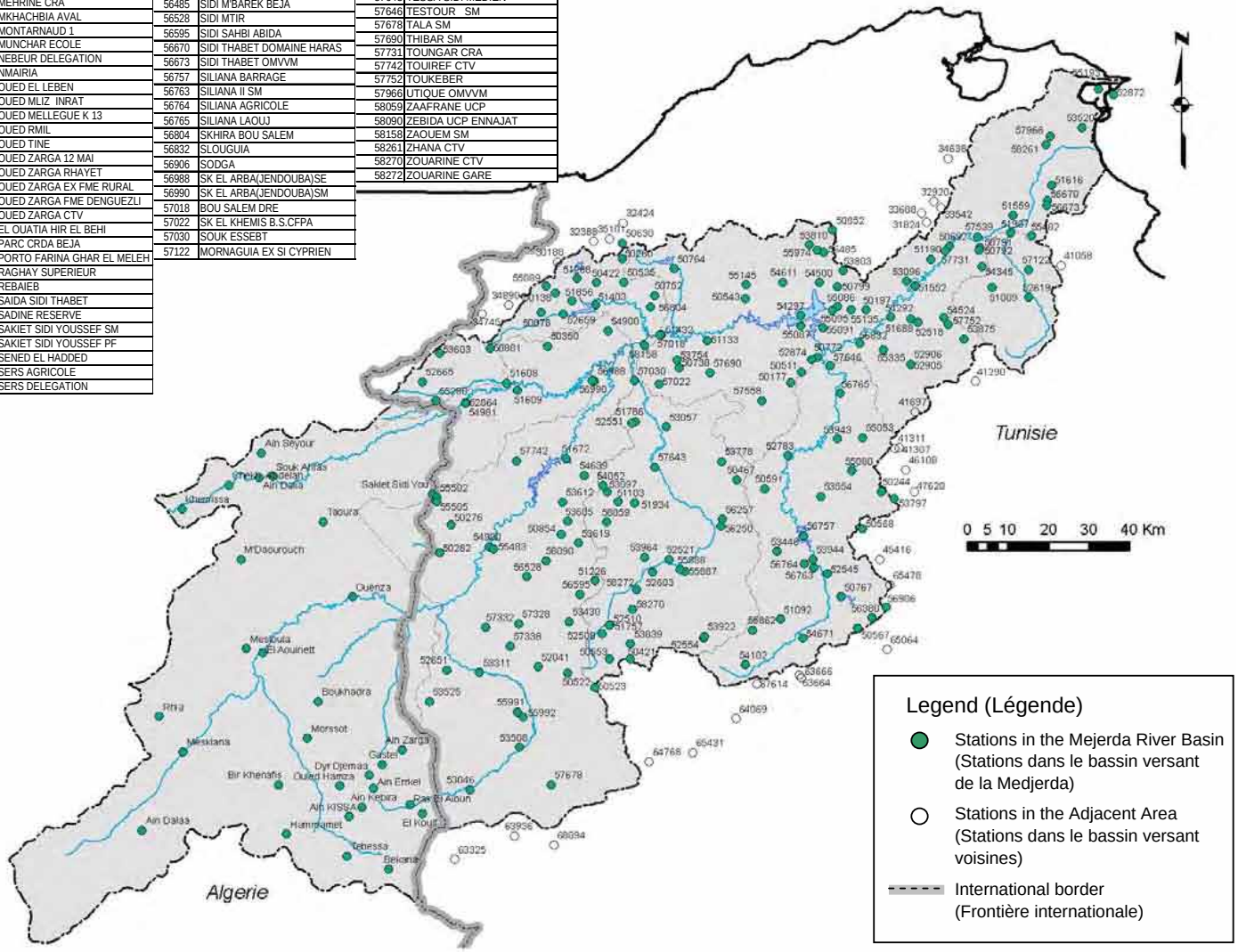


Figure A1.1.1 Location Map of Rainfall Gauging Stations

Stations in the Mejerda River Basin (Stations dans le bassin versant de la Medjerda)

ST_ID	ST_NAME
5001110	Rarai Superieur
5001160	Rarai Plaine
5003245	Bains Romains
5101210	Mellegue K13
5101222	K22 Moyen Dans Barrage
5101230	Muthul
5104060	Melah K13
5104170	Khol K13
5104272	Guettar E1 Ksar
5104380	Rmel_ Pont Route
5105020	Amont Confluentce Secca
5105060	Sarreath_ Pont Route
5105080	Amor Ben Salem
5106120	Ruines Romains
5106125	Sidi Abdelkader
5106130	Cassis Khasba
5106290	Amont Sarrath
5201310	Zouarine
5201320	Khanguet Afres
5201330	Sers Ville
5201340	Ain El Beida
5201345	Sidi Bou Rouis
5201348	Jebel Guessia
5201350	Pont Krib G.P.5
5201355	Sidi Medienne
5201360	Entree Plaine Sidi Abid
5202110	Pont Route Souani
5203780	Izid Barrage
5204050	Krib Gare
5204890	Arkou_ Aval
8301480	Miliz_ Pont Route Gp6
5302020	Kef Rhira
5303510	Fernana
5303520	Gherib_ Pont Route
5305030	Bou Salem Pr. Rt.Gp6
5400105	Frontiere Pvf
5400110	Ghardimaou
5400130	Chemtou
5400140	Sidi Meskine
5400160	Jendouba
5400180	Bou Salem Gp6
5501610	Pont Gp4 Robaa
5501620	Gaafour

ST_ID	ST_NAME
5501630	Laroussa
5501710	Pt Entree De Siliana
5501635	Jebel Laoudj Cote 140
5504670	Entree Plaine Siliana
5505090	Laroussa
5602240	Beja_ Pont Gp6
562230	Viaduc Sncft
5602260	Beja_ Amont
5702310	Zarga_ Amont
5793040	Mkhachbia_ Amont
5793050	Mkhachbia_ Aval
5794010	Bazina
5801850	Sidi Bou Draouia
5801880	Khalled_ Amont
5801890	Aval El Mektla
5802230	Cassis
5802270	Lakmar_ Pont Route Gp5
5802590	Chafrou_ Pont Route No.7

ST_ID	ST_NAME
5900110	Pont Trajan
5900130	Slouguia
5900140	Mejez El Bab (Pont GP5)
5900141	El Herri
5900147	Borj Toumi
5900160	El Bathan
5900170	Jedeida Route Mateur
5900175	Jedeida Ville
5900180	Jedeida Pvf
5900187	Henchir Tobias
5900140	Mejez El Bab (Pont Andaro)

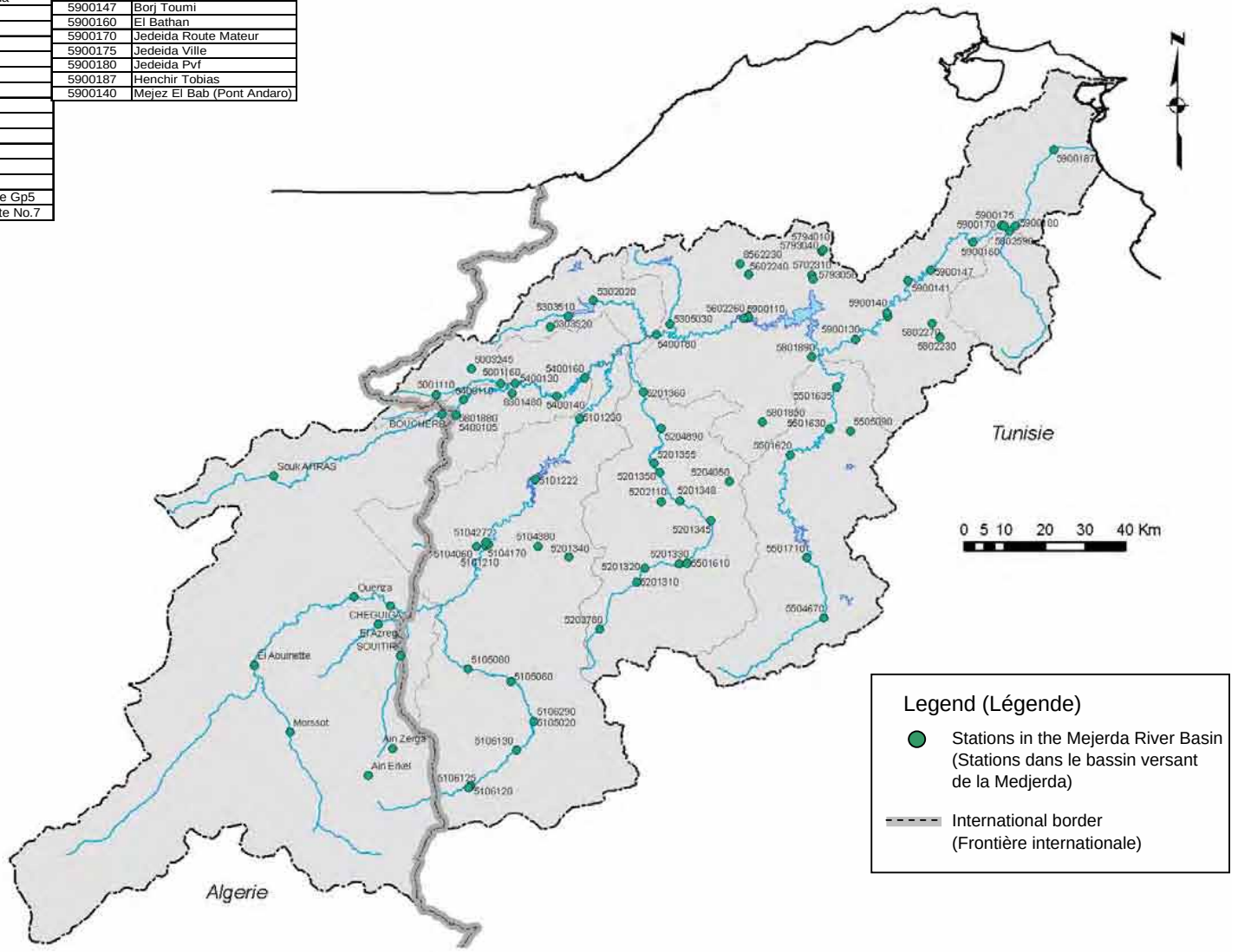


Figure A1.1.2 Location Map of Stream Gauging Stations

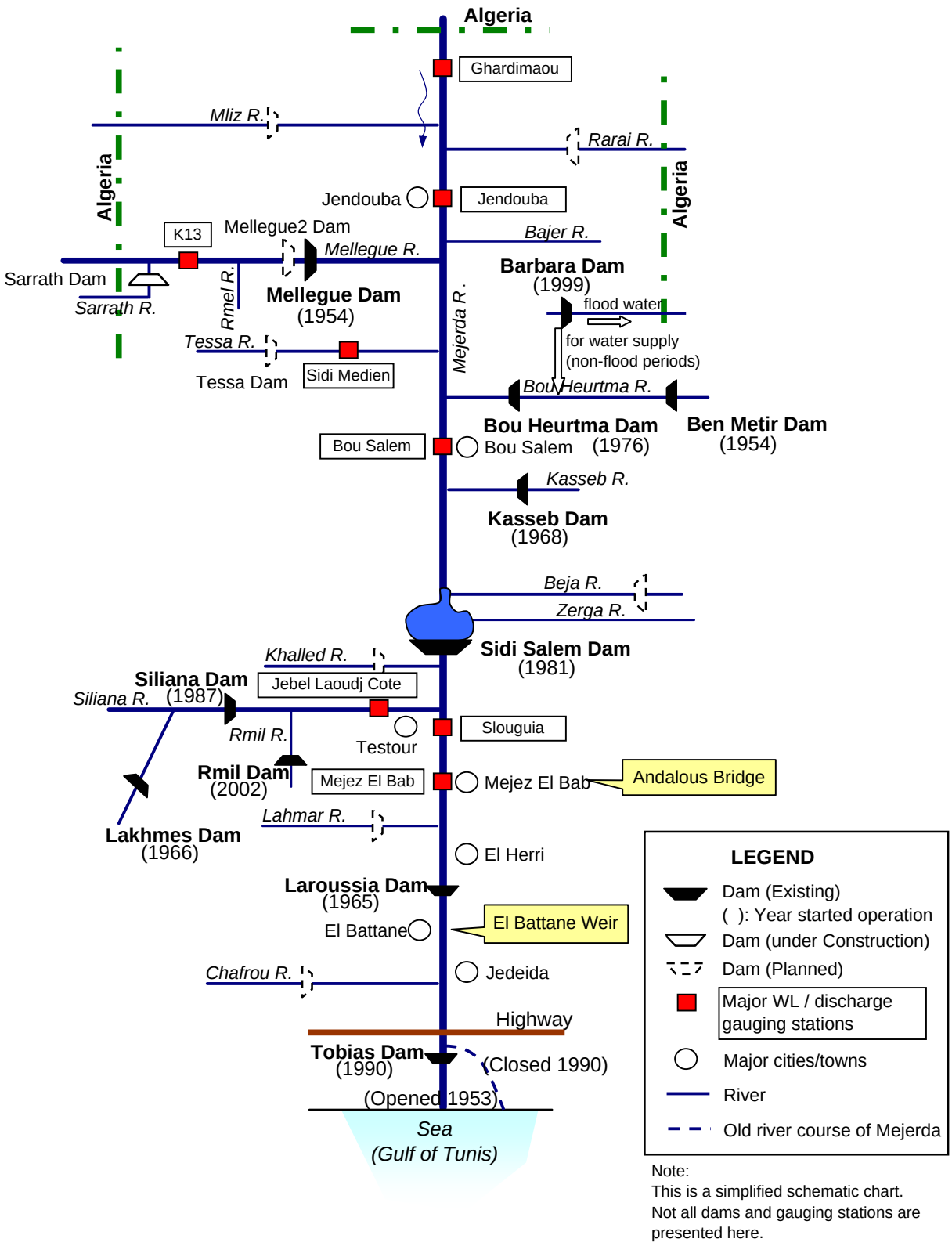


Figure A1.1.3 Schematic Locations of Major Stream Gauging Stations, Tributaries, Dams and Cities/Towns

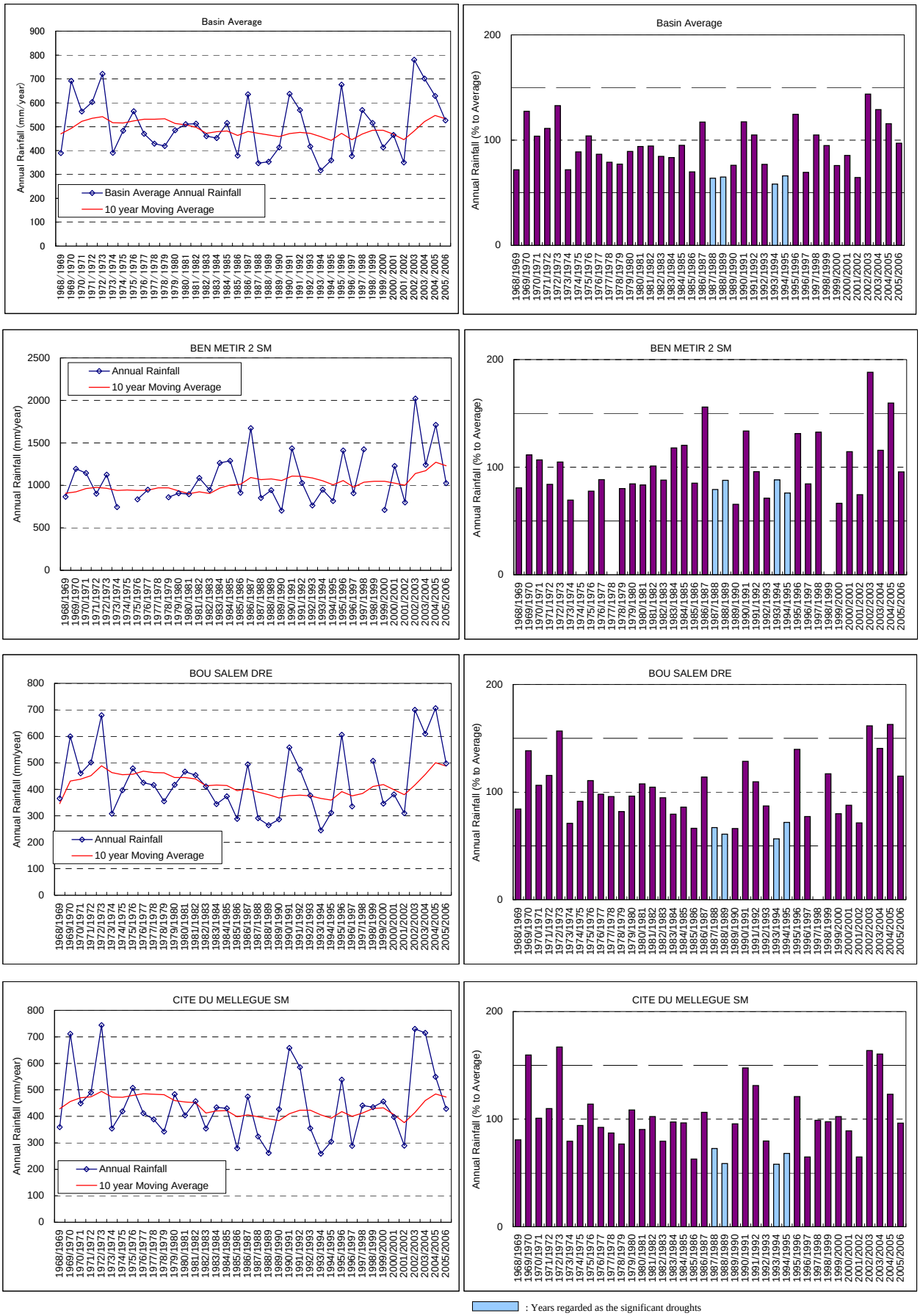


Figure A1.4.1 Annual Rainfall

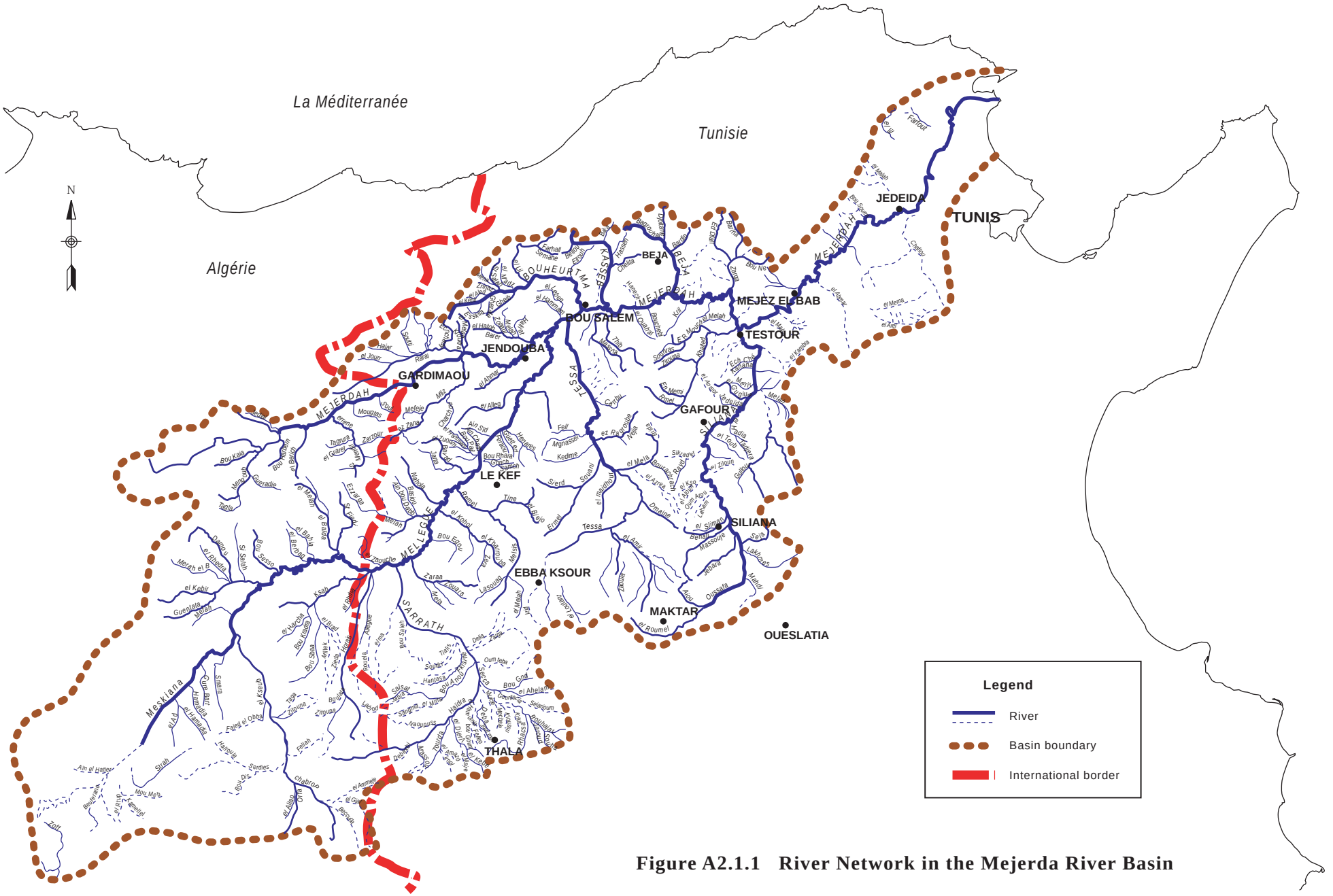
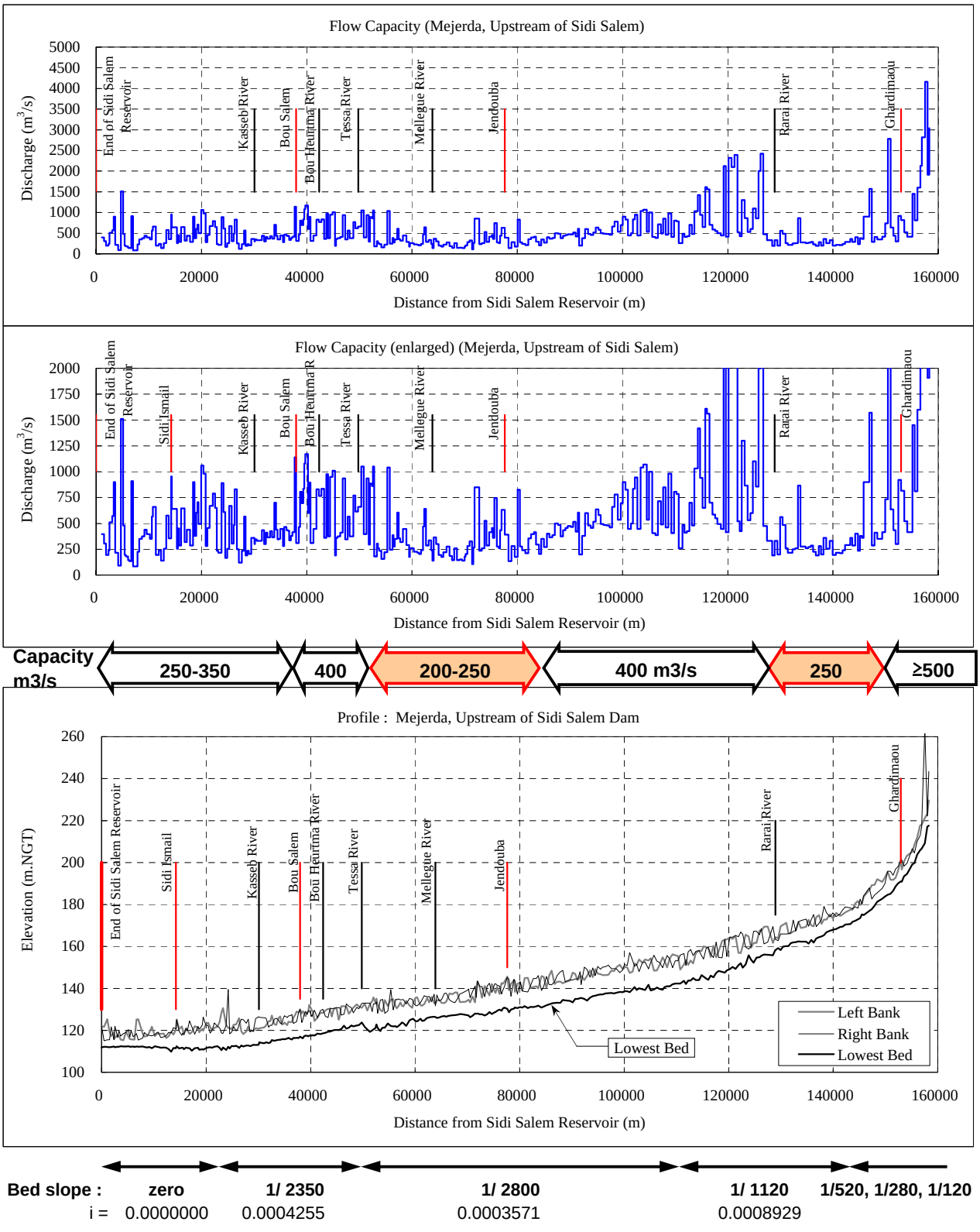


Figure A2.1.1 River Network in the Mejerda River Basin



Topographic Survey Applied : Survey in 2007 by the Study Team

Figure A2.1.2 Present Riverbed Profile and Flow Capacity (1/6) (Mejerda, Upstream of Sidi Salem)

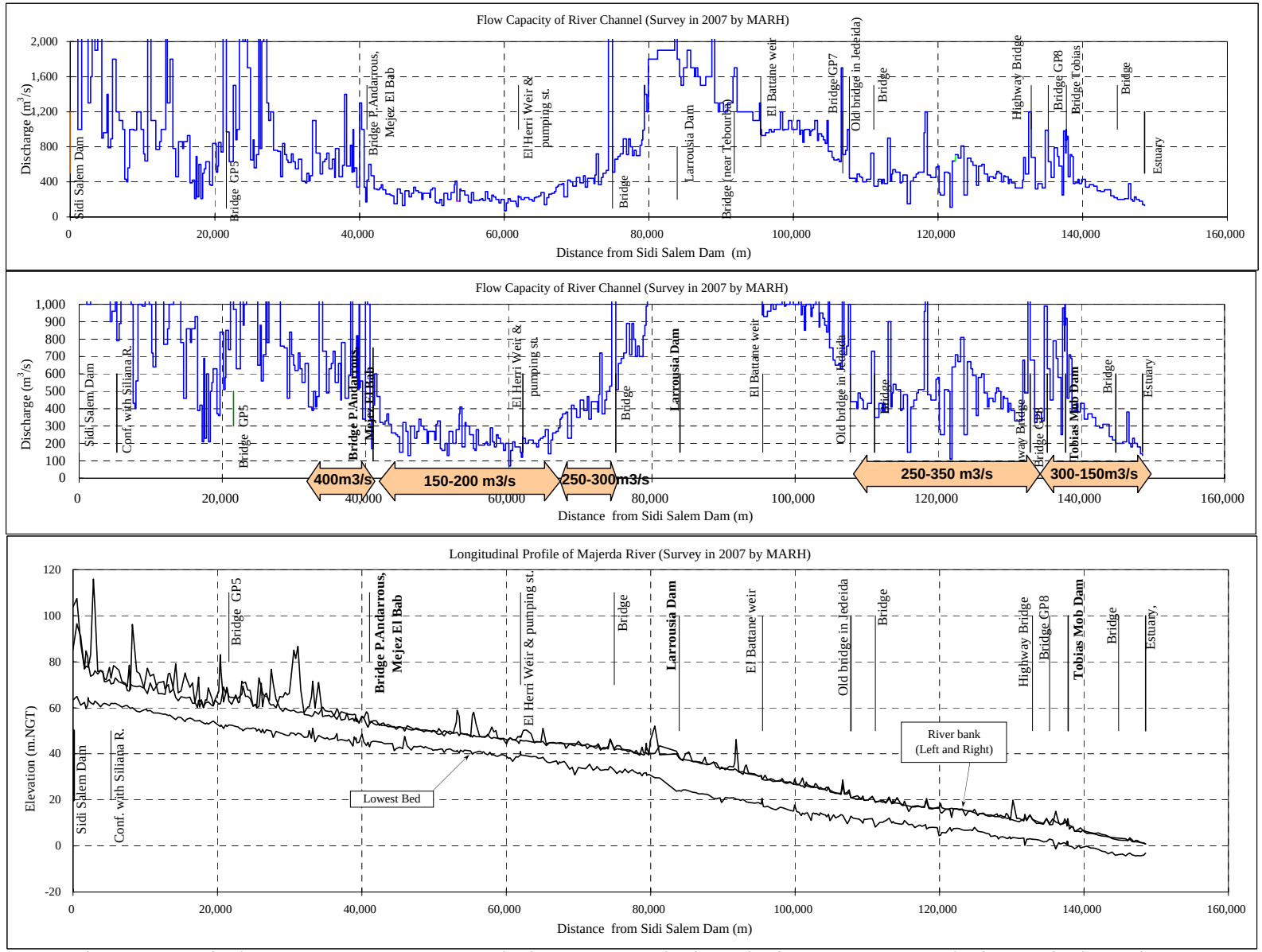
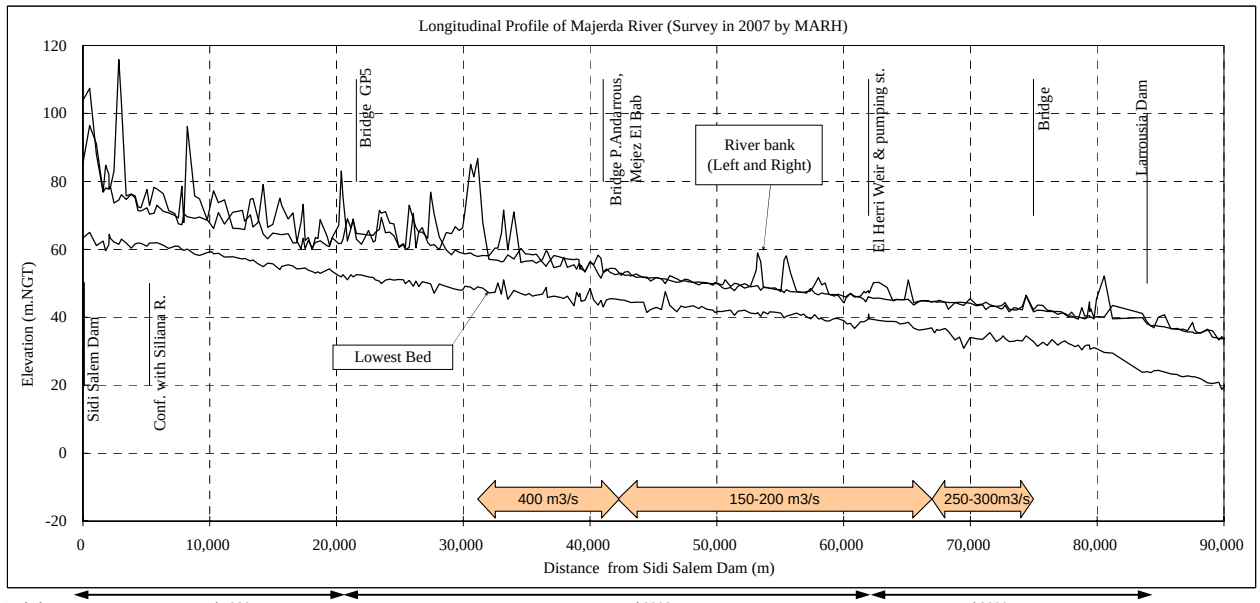
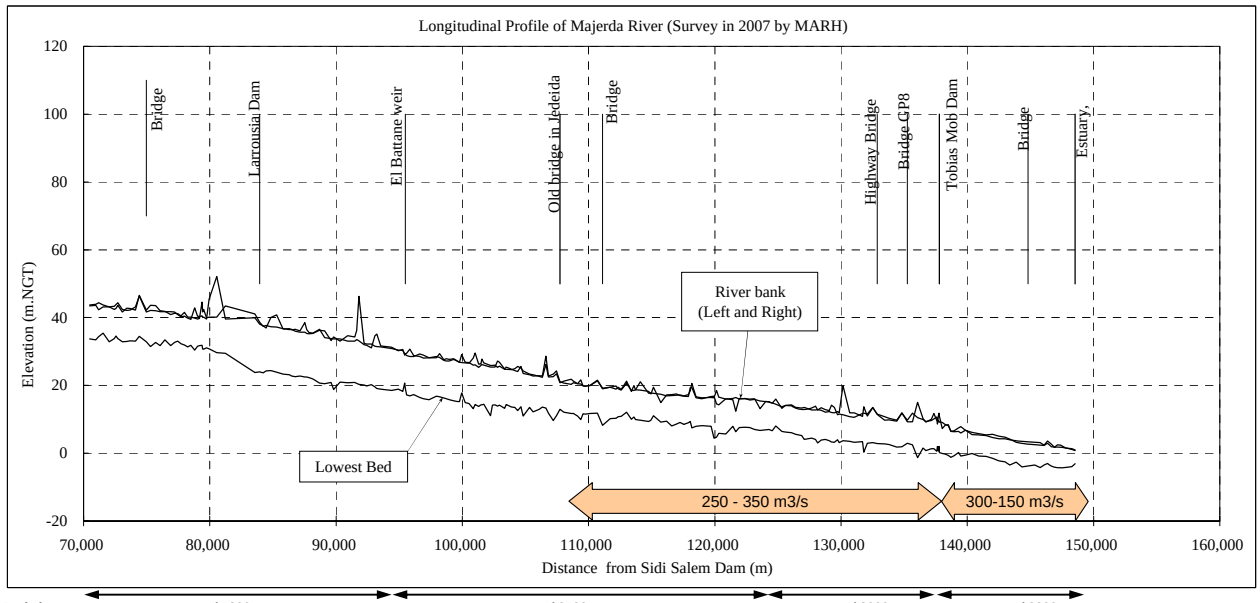


Figure A2.1.2 Present Riverbed Profile and Flow Capacity (2/6) (Mejerda, Downstream of Sidi Salem)



Bed slope :	1/ 1900	1/ 3000	1/ 2200
i =	0.0005263	0.0003333	0.0004545

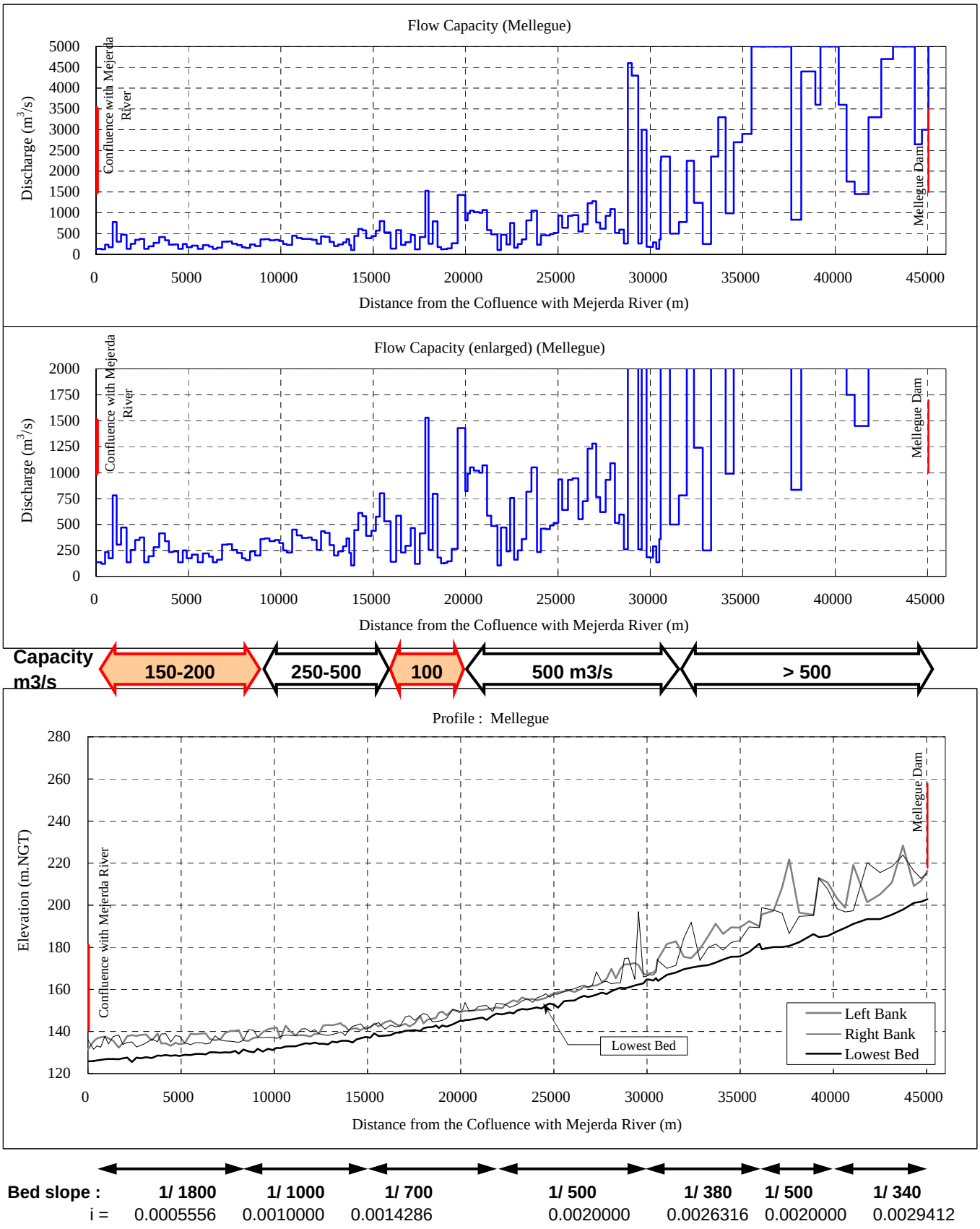
(a) Sidi Salem Dam - Larrousia Dam



Bed slope :	1/ 1800	1/ 2500	1/ 2300	1/ 2200
i =	0.0005556	0.0004000	0.0004348	0.0004545

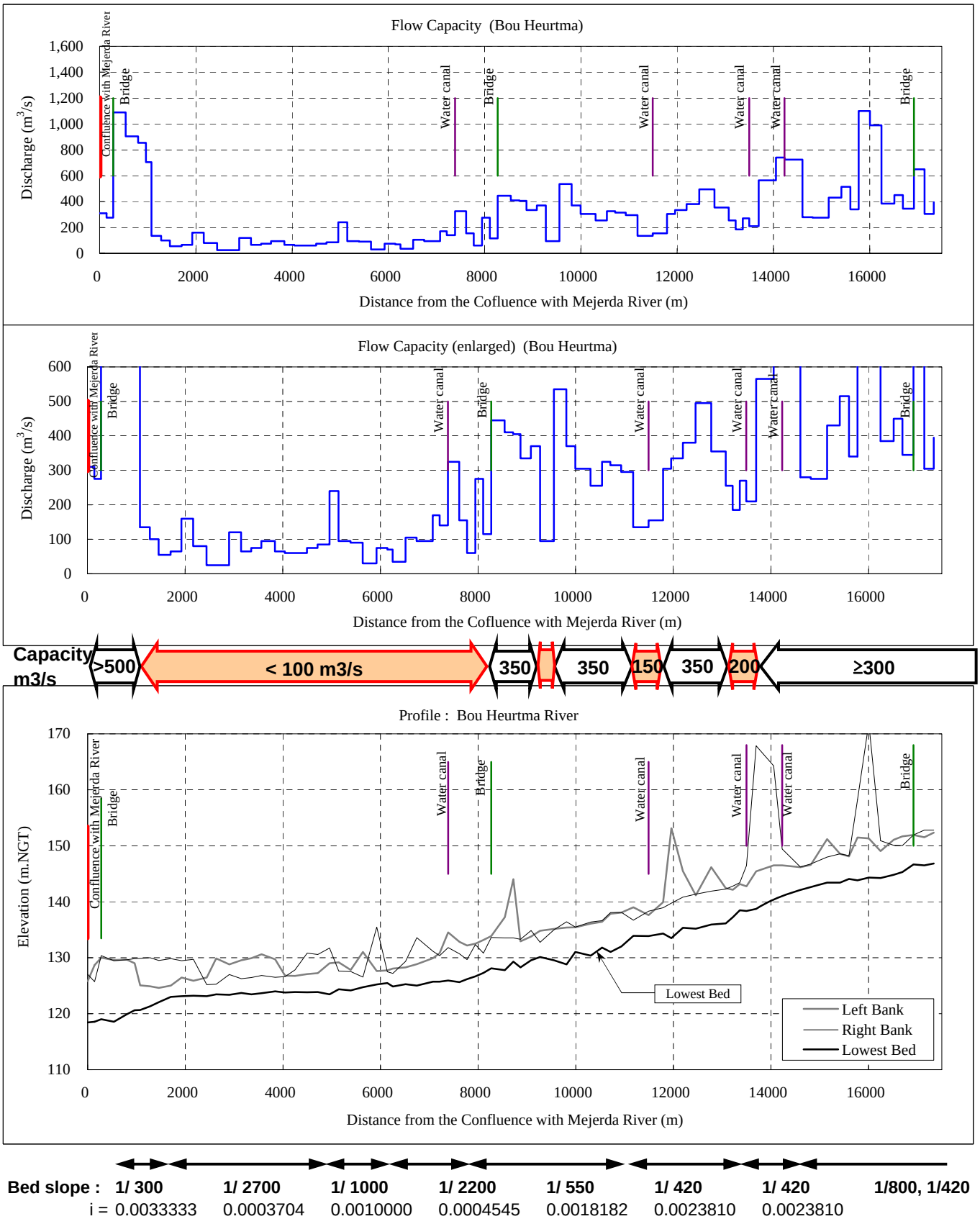
(b) Larrisia Dam - Estuary

Figure A2.1.2 Present Riverbed Profile and Flow Capacity (3/6) (Mejerda, Downstream of Sidi Salem)



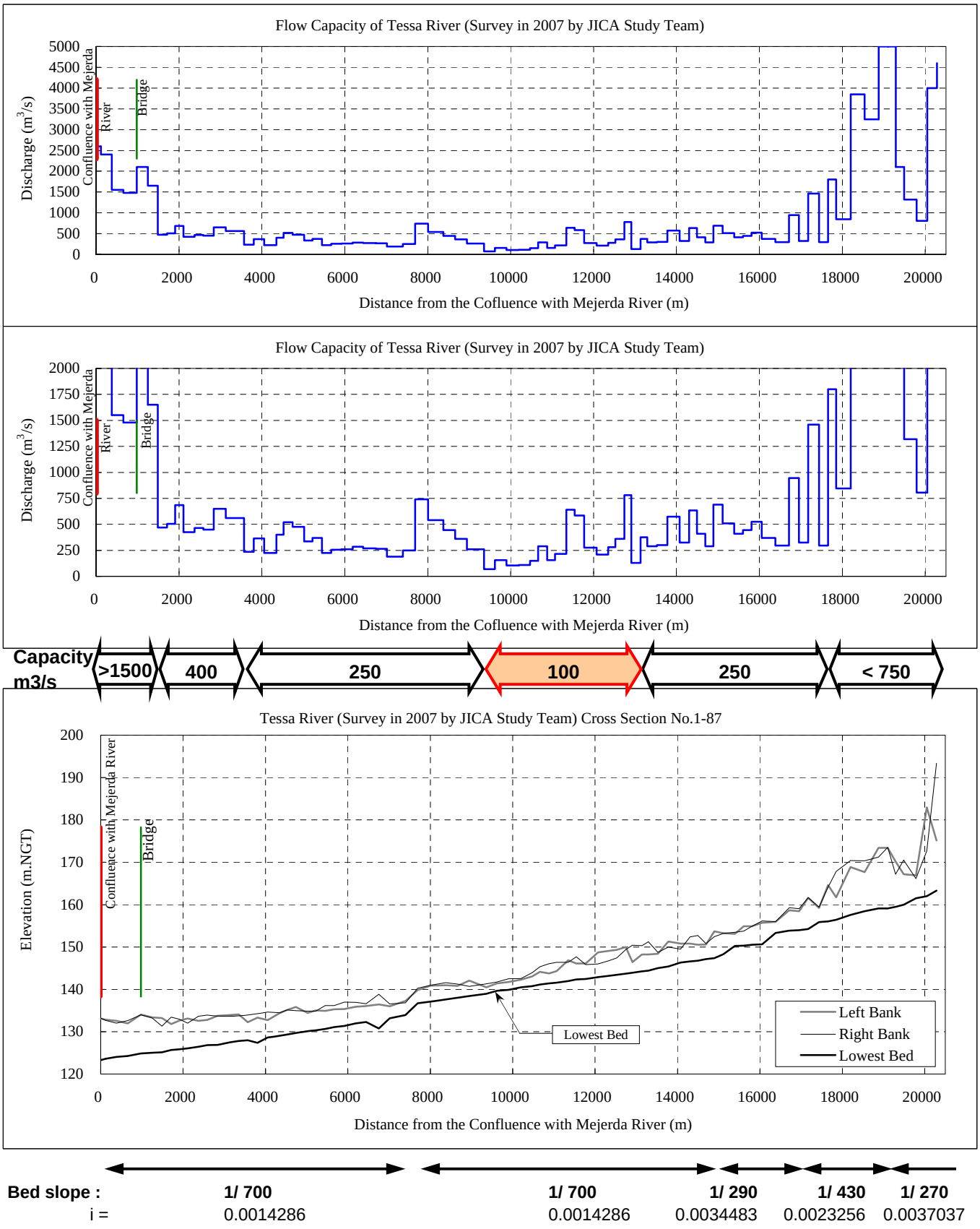
Topographic Survey Applied : Survey in 2007 by the Study Team

Figure A2.1.2 Present Riverbed Profile and Flow Capacity (4/6) (Mellegue)



Topographic Survey Applied : Survey in 2007 by the Study Team

Figure A2.1.2 Present Riverbed Profile and Flow Capacity (5/6) (Bou Heurtma)



Topographic Survey Applied : Survey in 2007 by the Study Team

Figure A2.1.2 Present Riverbed Profile and Flow Capacity (6/6) (Tessa)

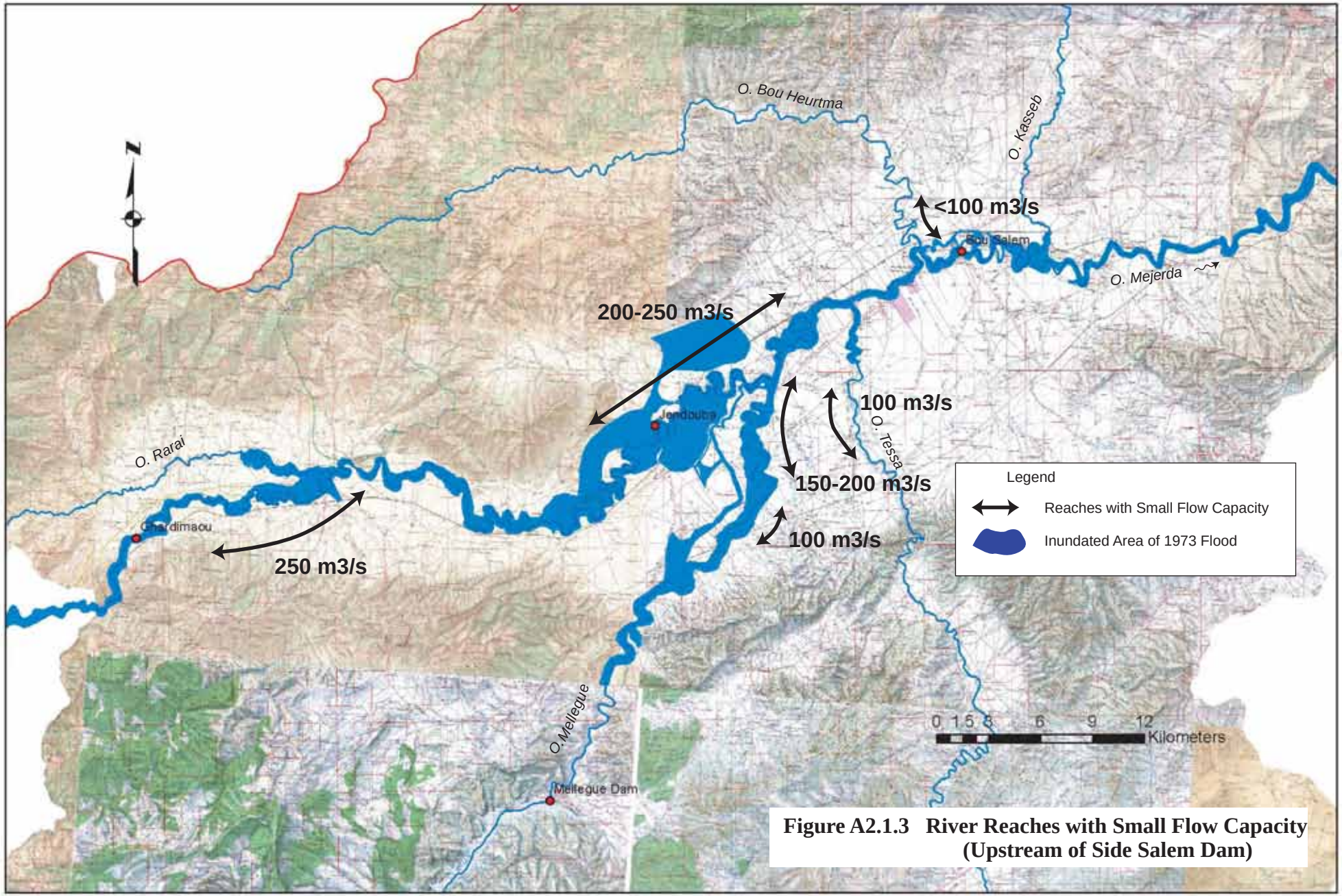
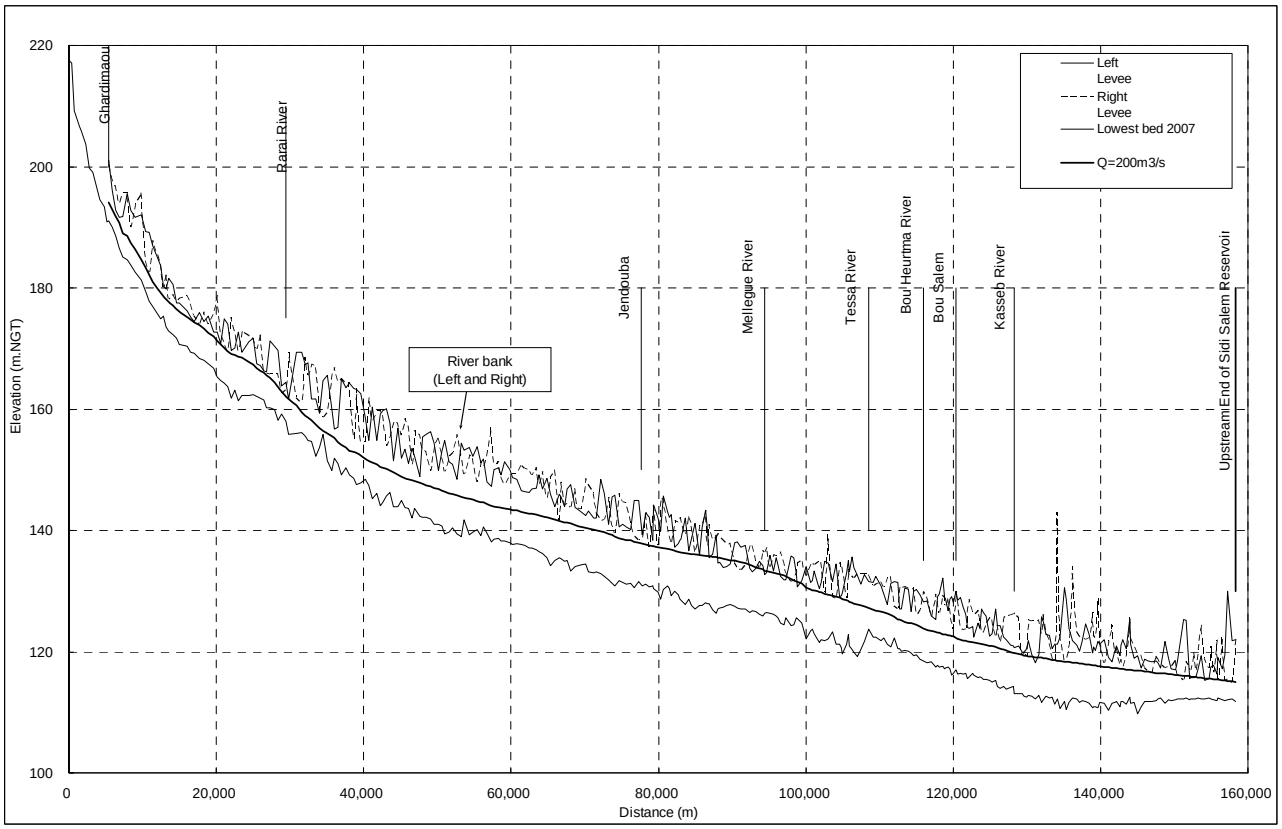
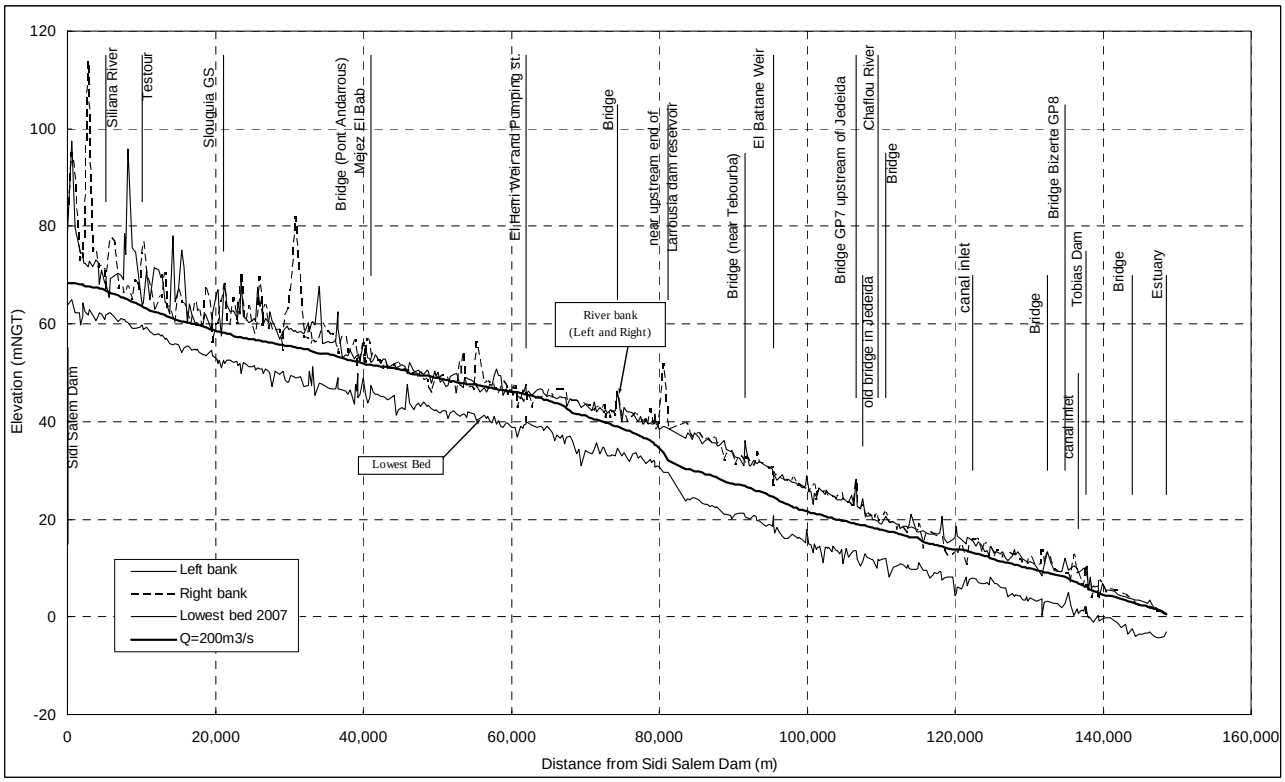


Figure A2.1.3 River Reaches with Small Flow Capacity (Upstream of Side Salem Dam)



(1) Upstream of Sidi Salem Dam



(2) Downstream of Sidi Salem Dam)

Figure A2.1.4 Water Surface Profile, Q=200m^3/s

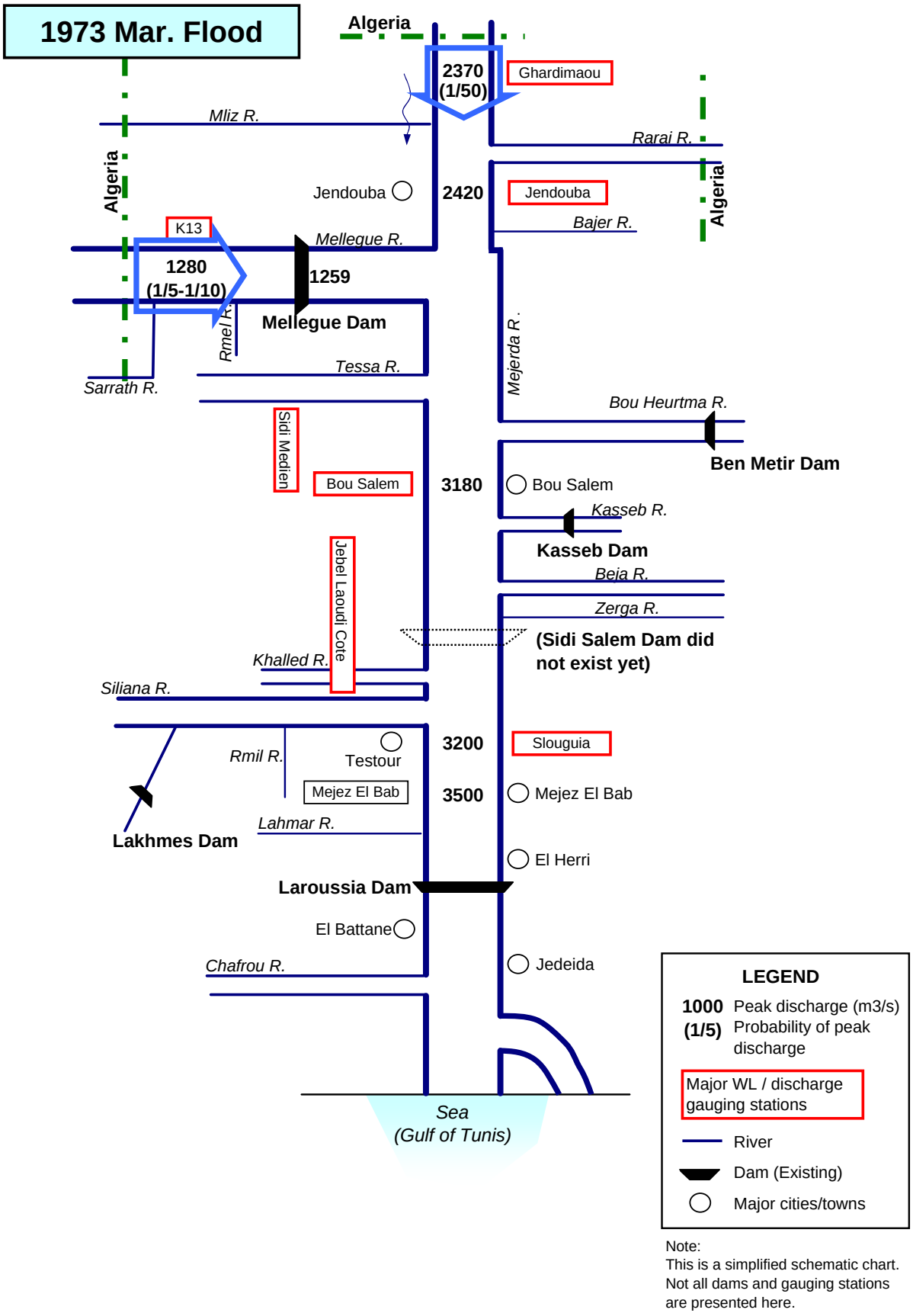


Figure A3.1.1 Peak Discharges at Major Stations and Dam Outflows (1/5) (1973 Mar Flood)

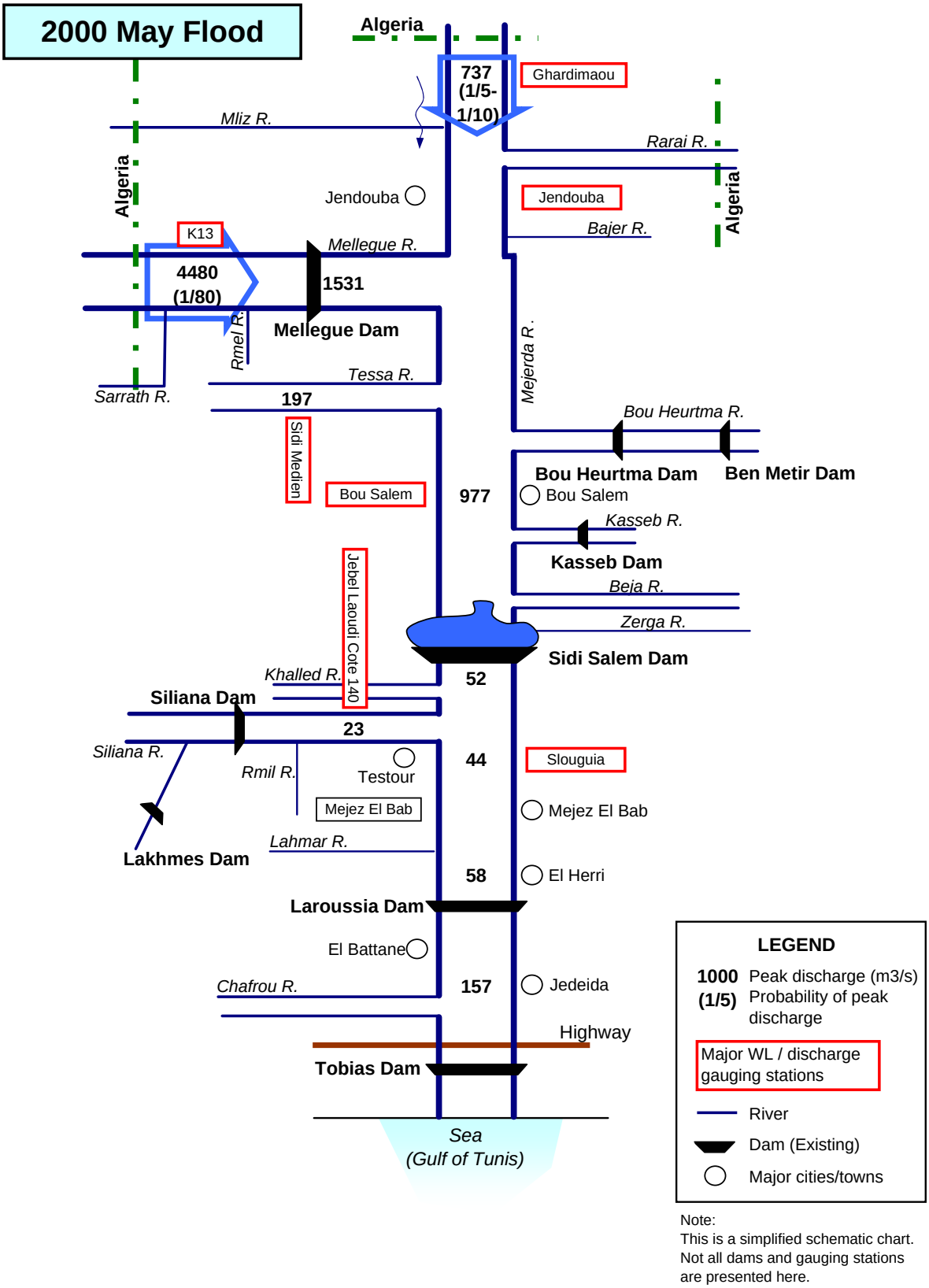


Figure A3.1.1 Peak Discharges at Major Stations and Dam Outflows (2/5) (2000 May Flood)

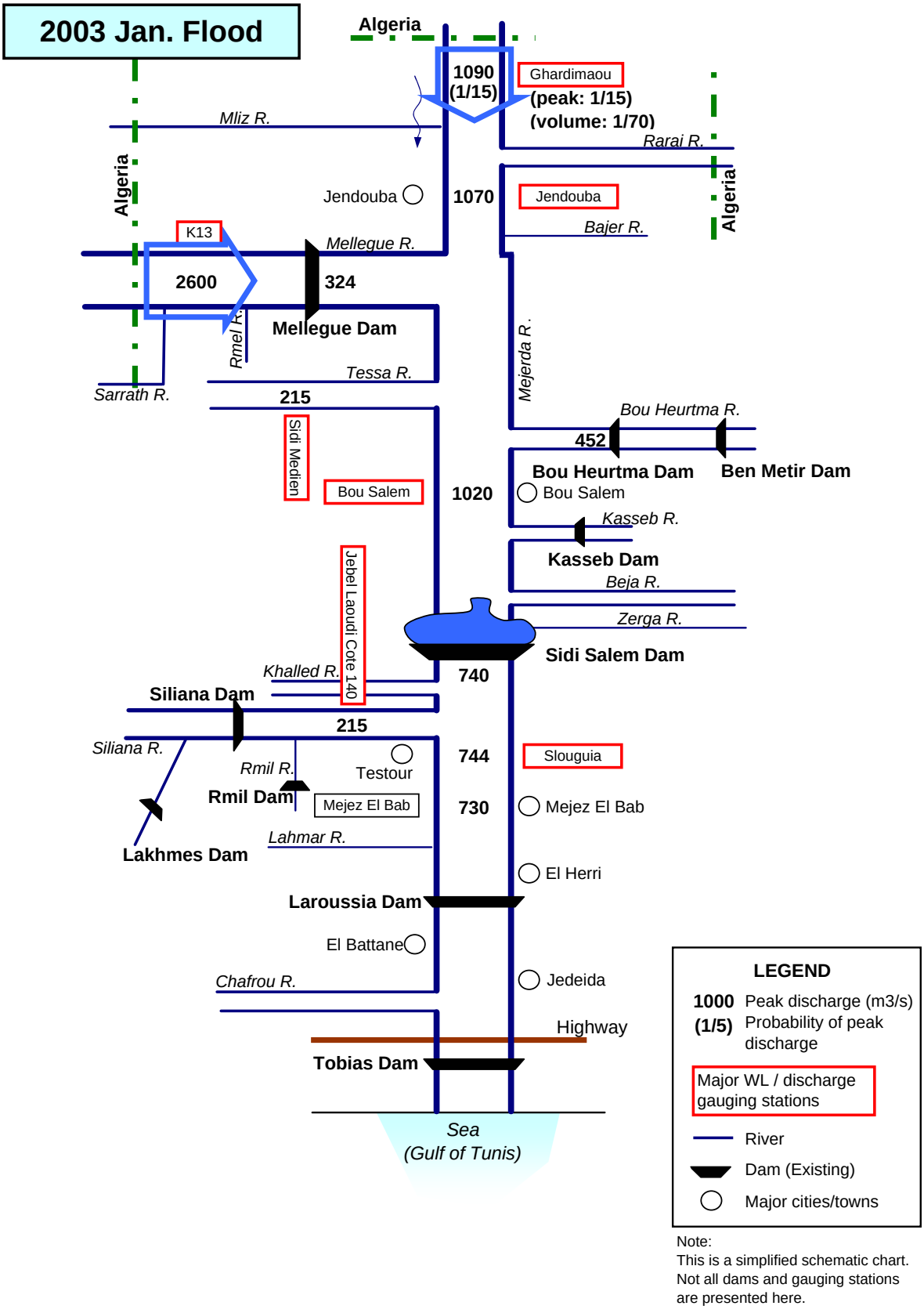


Figure A3.1.1 Peak Discharges at Major Stations and Dam Outflows (3/5) (2003 Jan. Flood)

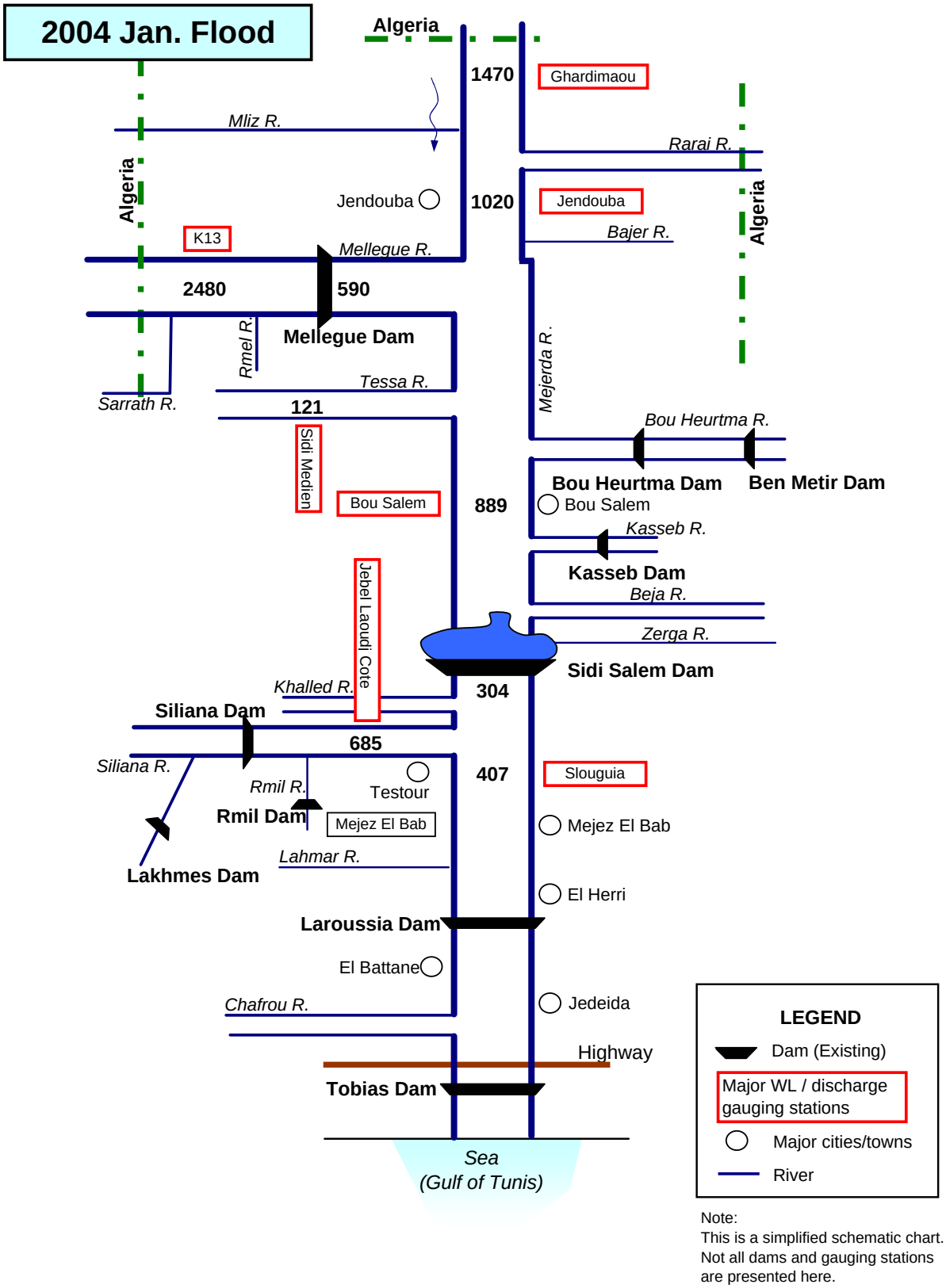


Figure A3.1.1 Peak Discharges at Major Stations and Dam Outflows (4/5) (2004 Jan Flood)

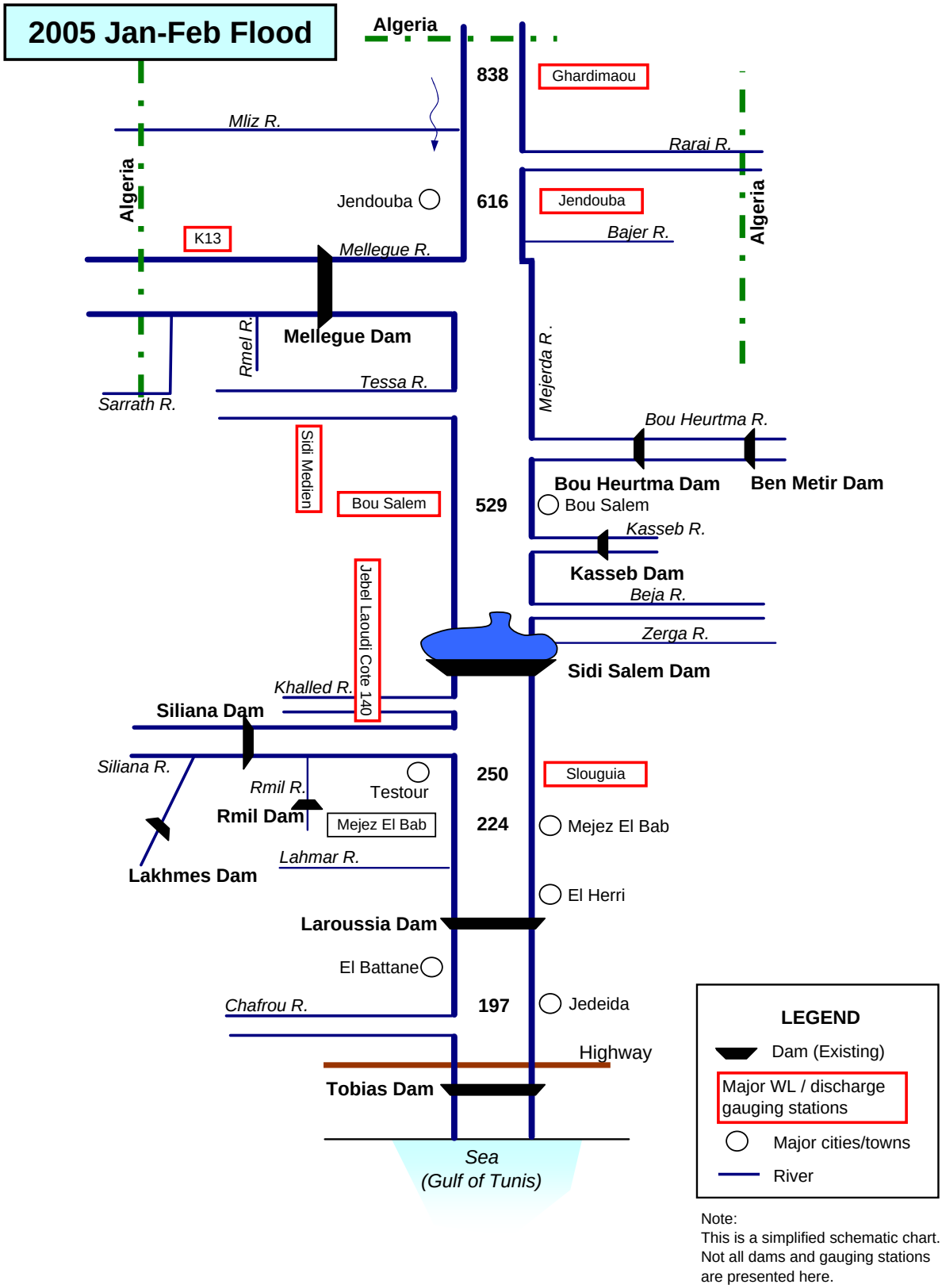


Figure A3.1.1 Peak Discharges at Major Stations and Dam Outflows (5/5) (2005 Jan-Feb Flood)

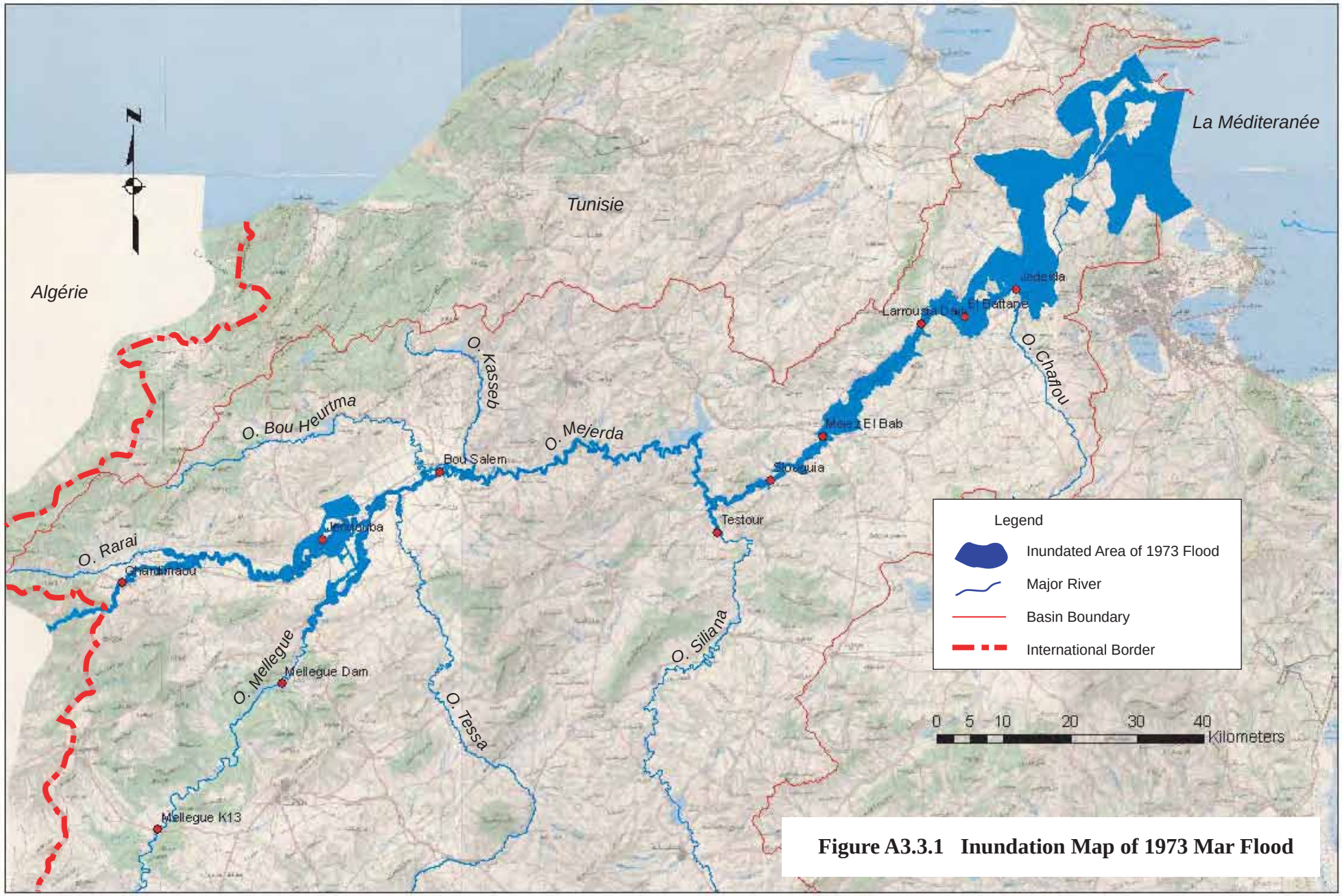
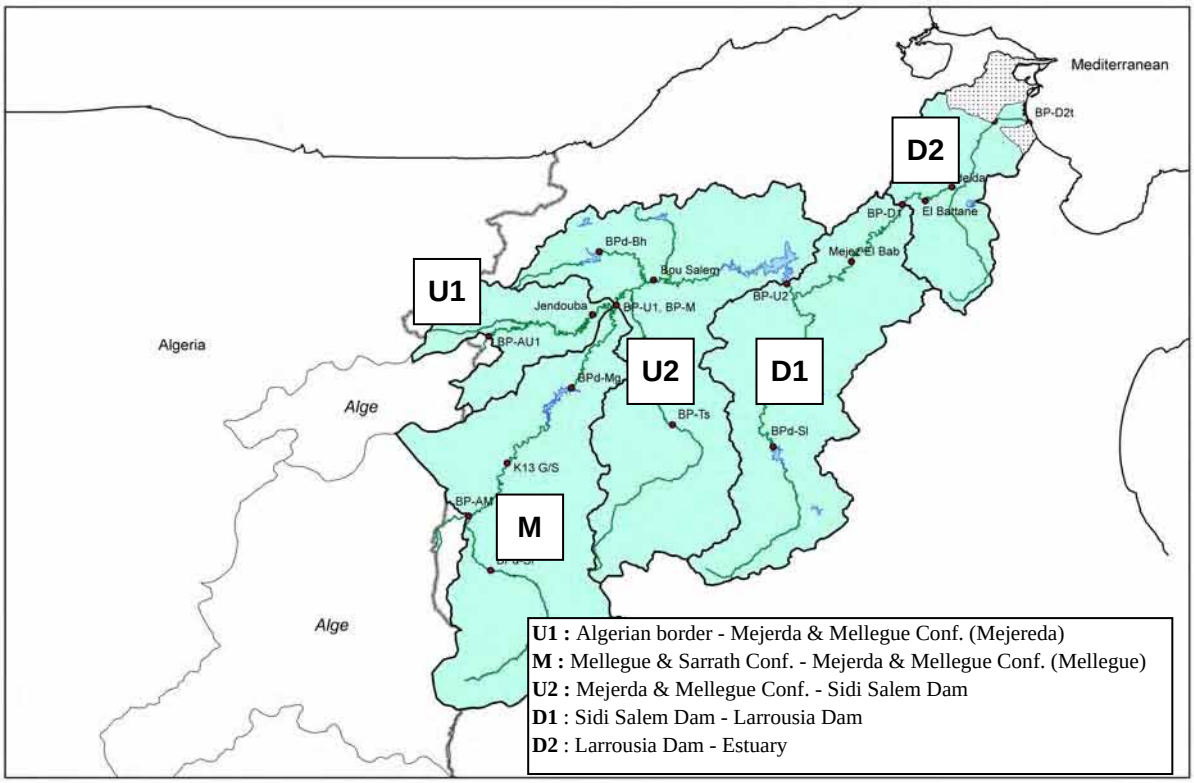
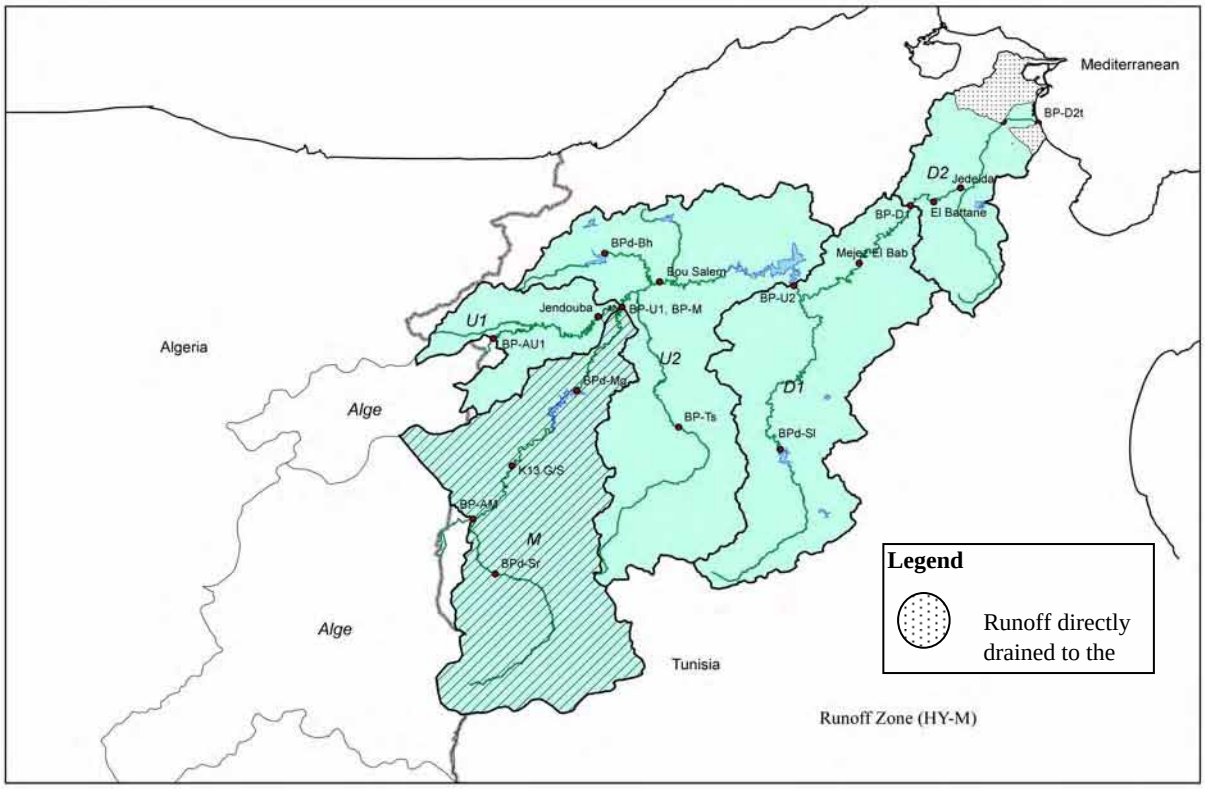


Figure A3.3.1 Inundation Map of 1973 Mar Flood

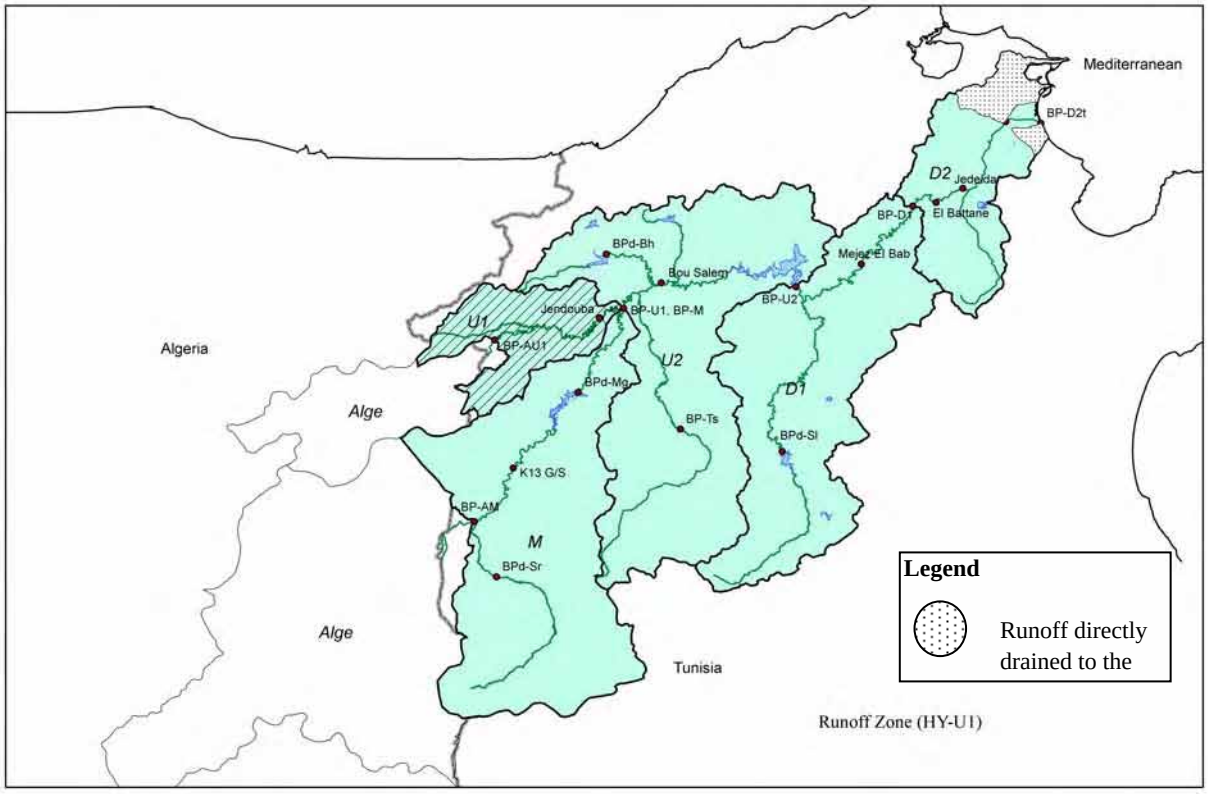


Overall Division of Study Area for Flood Control Planning

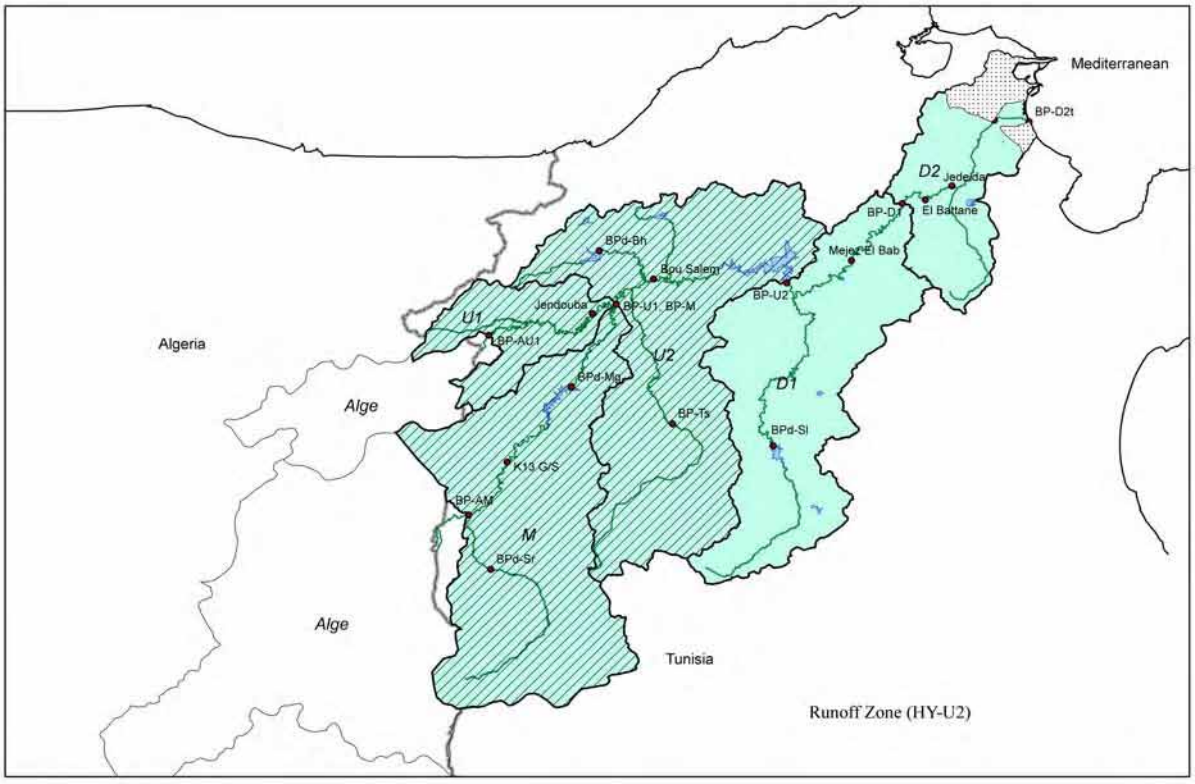


Runoff Zone: HY-M (4561 km2)
Base Point: BP-M Mejerda & Mellegue Conf.

Figure A5.1.1 Zone Divisions for Estimate of Basin Average Rainfall (1/3)

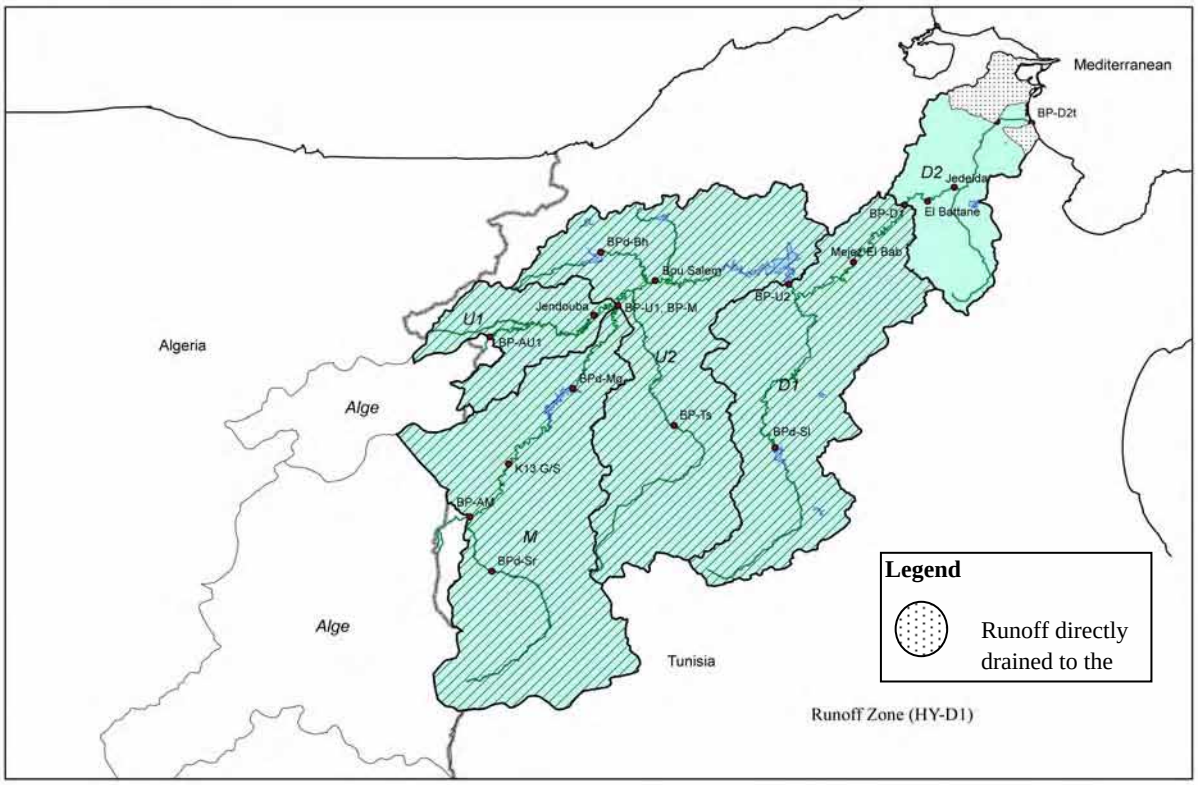


Runoff Zone: HY-U1 (1154 km^2)
Base Point: BP-U1 Mejerda & Mellegue Conf.

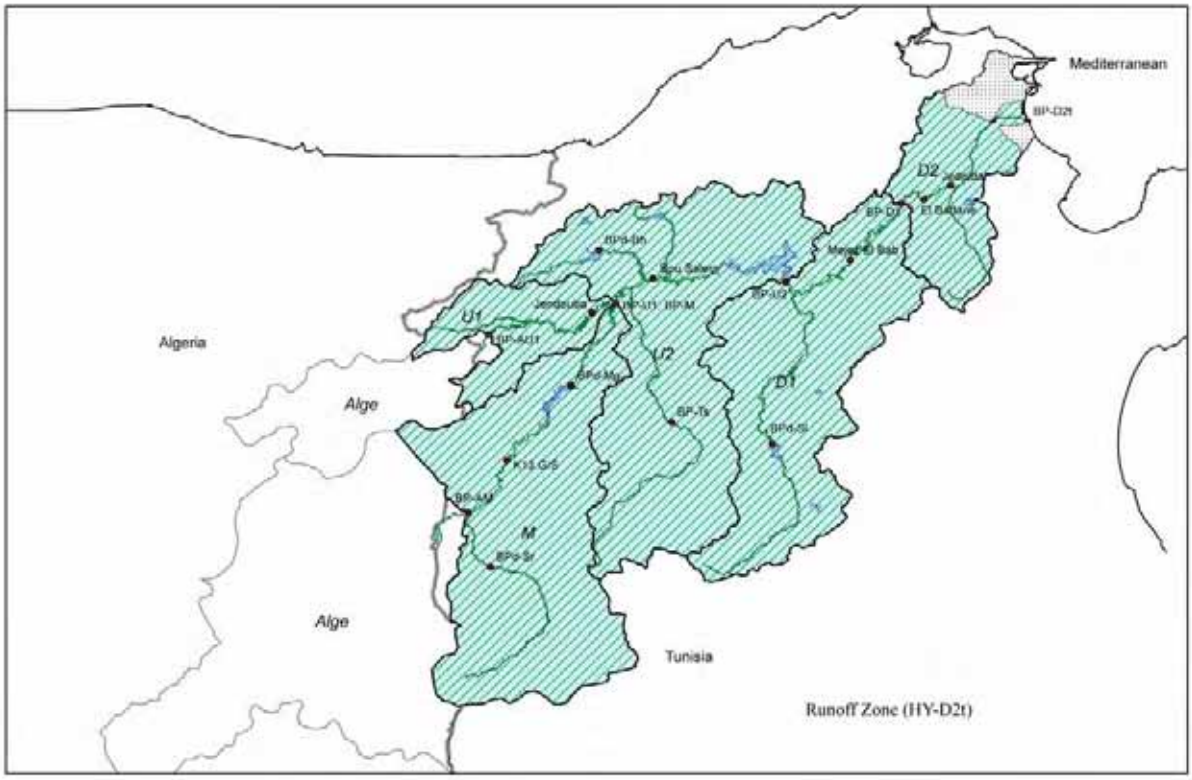


Runoff Zone: HY-U2 (10414 km^2)
Base Point: BP-U2 Sidi Salem Dam

Figure A5.1.1 Zone Divisions for Estimate of Basin Average Rainfall (2/3)



Runoff Zone: HY-D1 (14172 km^2)			
Base Point:	BP-D1	Larrousia	Dam



Runoff Zone: HY-D2t (15645 km^2)			
Base Point:	BP-D2	Estuary	

Figure A5.1.1 Zone Divisions for Estimate of Basin Average Rainfall (3/3)

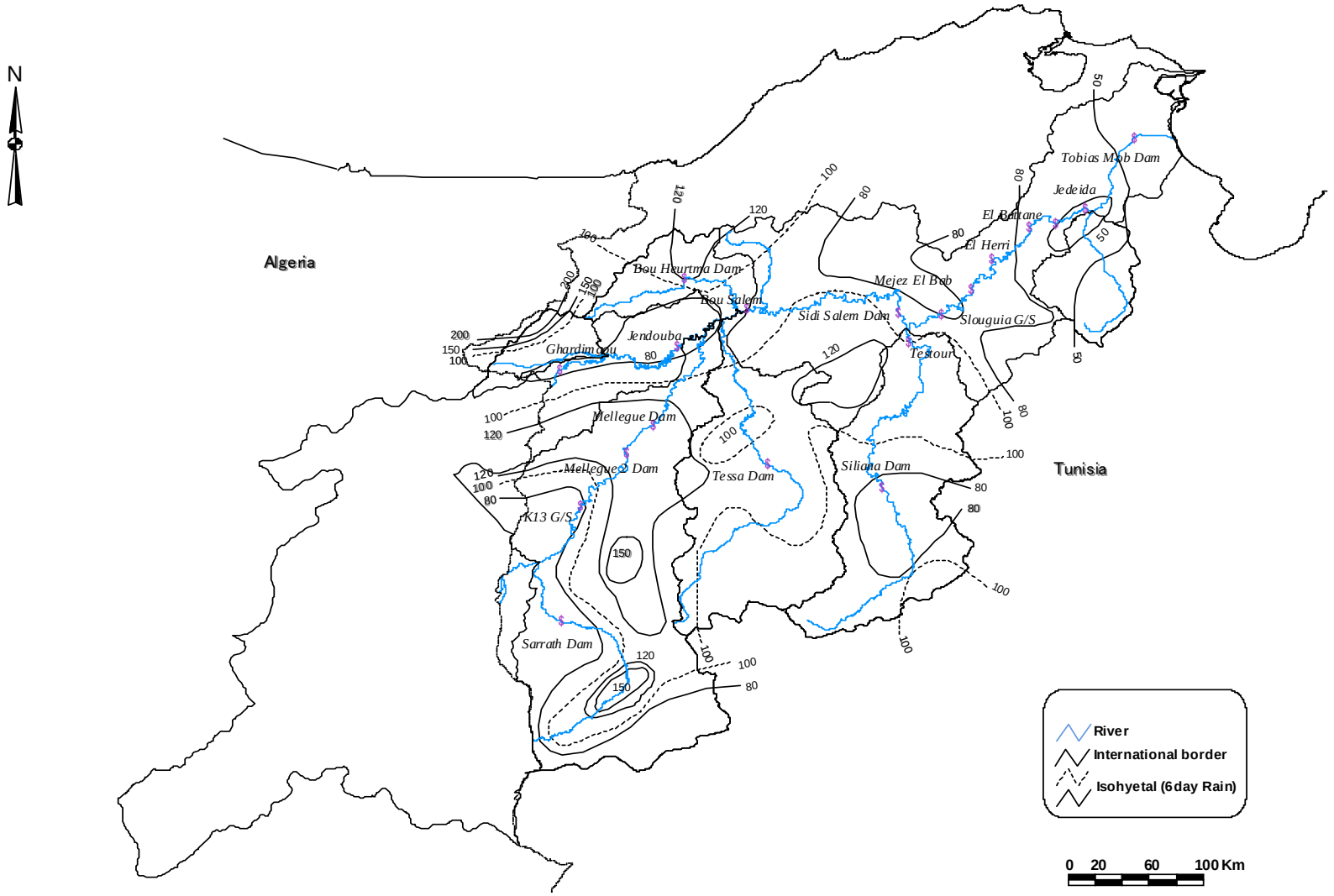
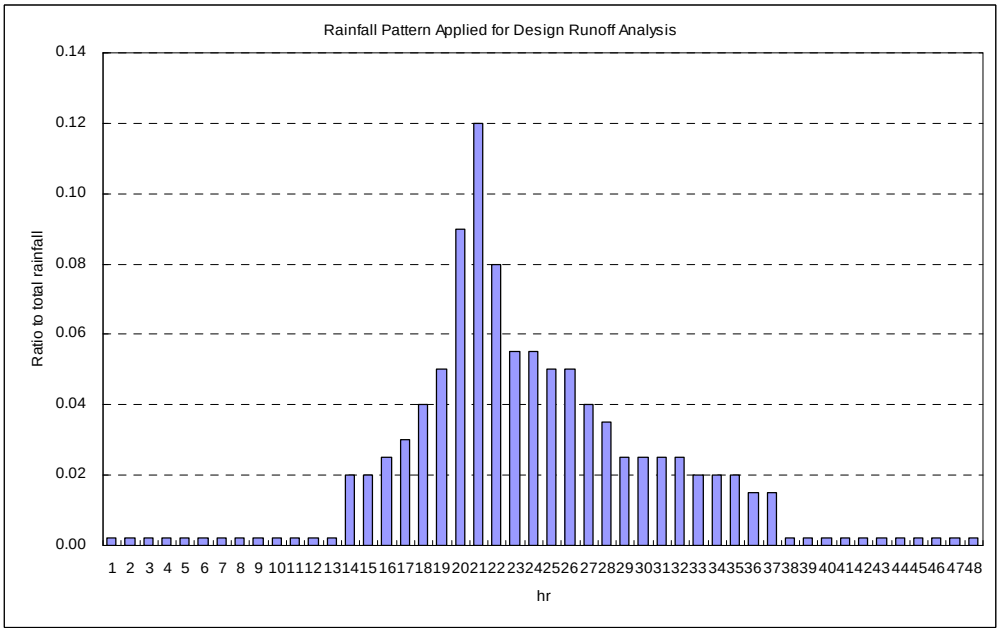
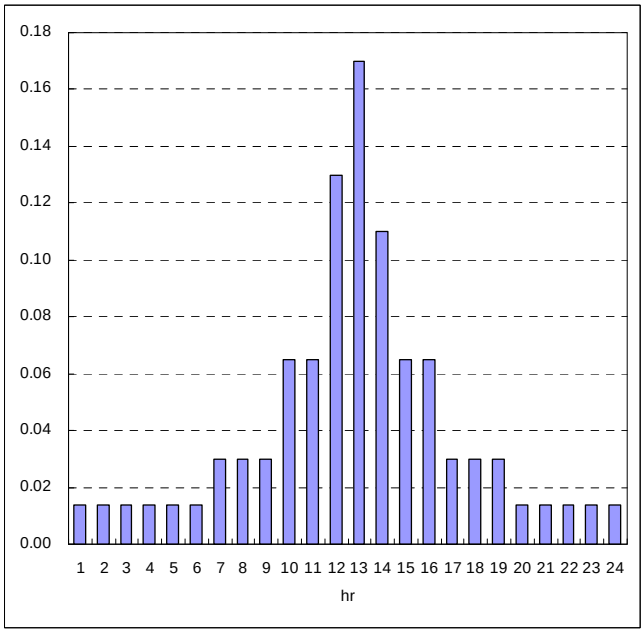


Figure A5.1.2 Isohyetal Map (2003 Flood, 6 days from 8 Jan. To 13 Jan.)



(1) Hyetograph 1 : One peak in two days (Two days from the day with the largest rain in six days)



(2) Hyetograph 2 : One peak in one day (Other days in 6 days)

Figure A5.2.1 Design Hyetograph

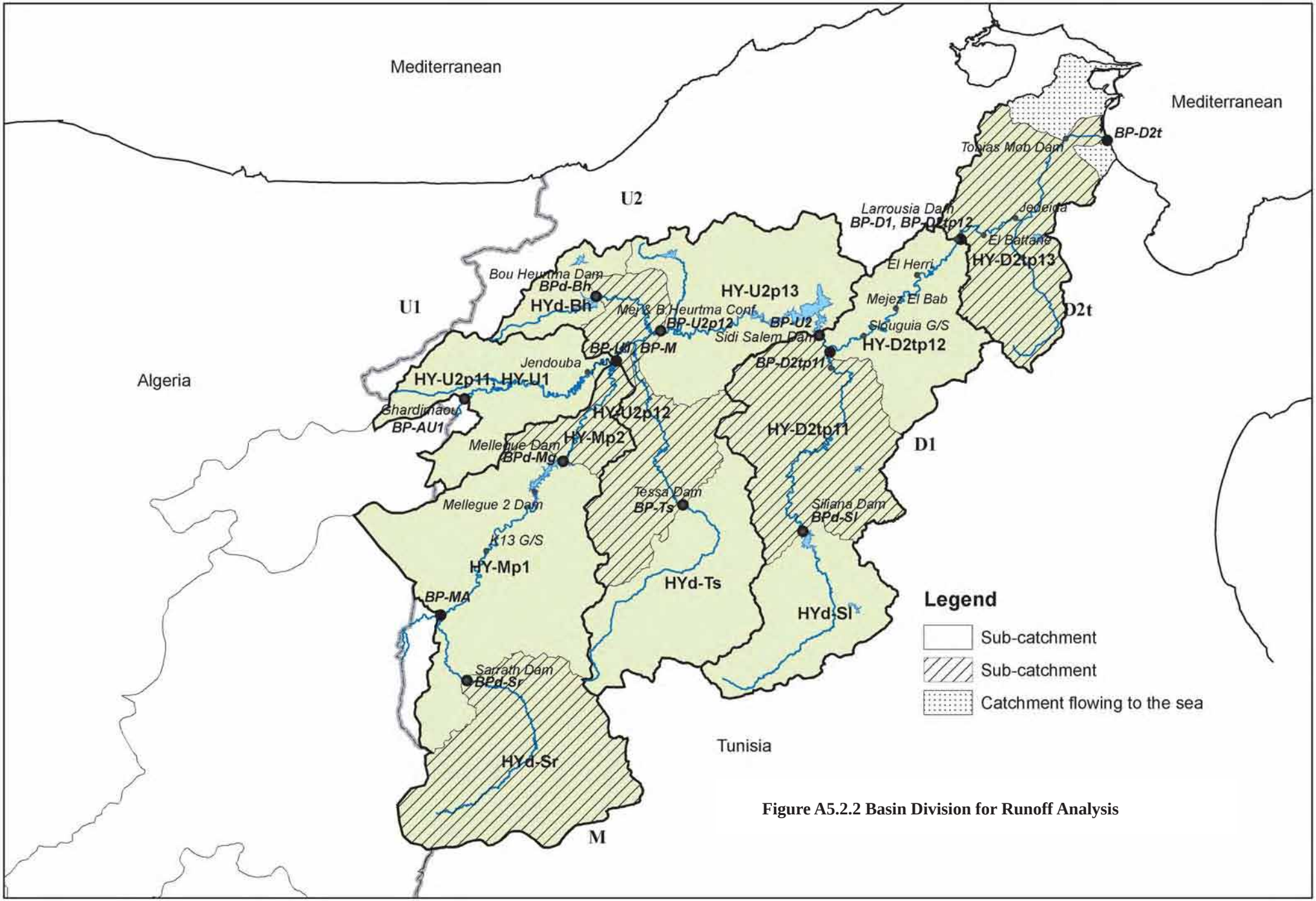
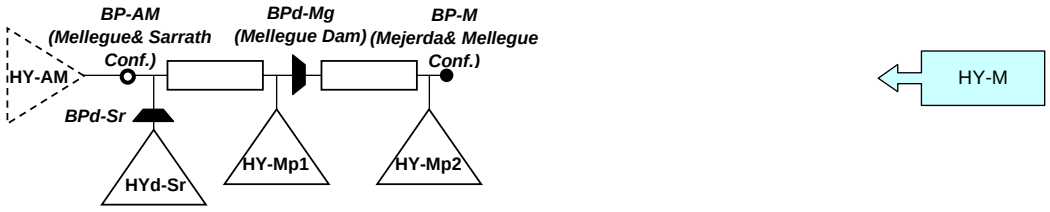
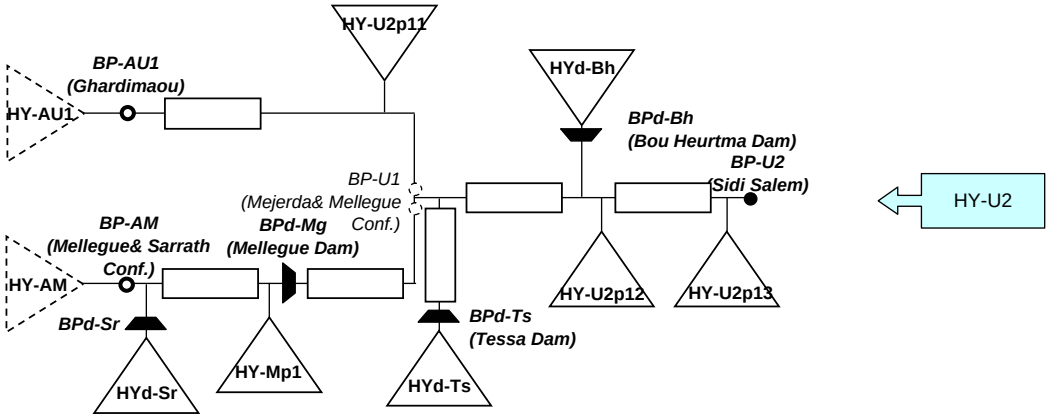


Figure A5.2.2 Basin Division for Runoff Analysis

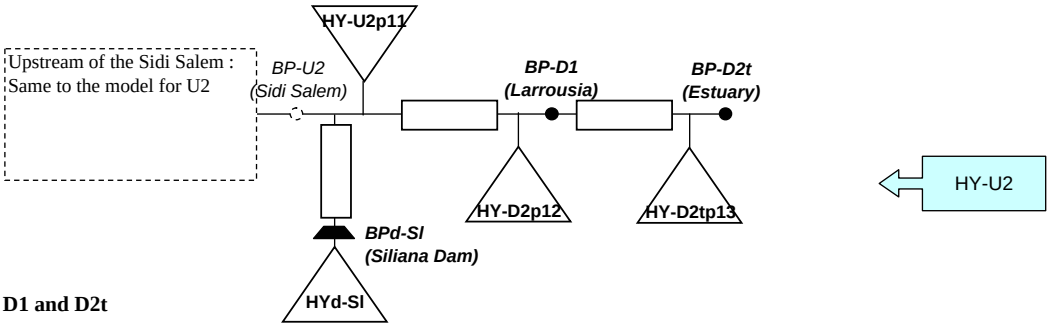
Probable Flood for U1



Design Flood for M



Design Flood for U2



Design Flood for D1 and D2t

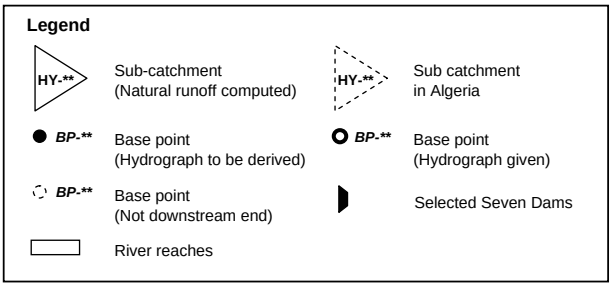
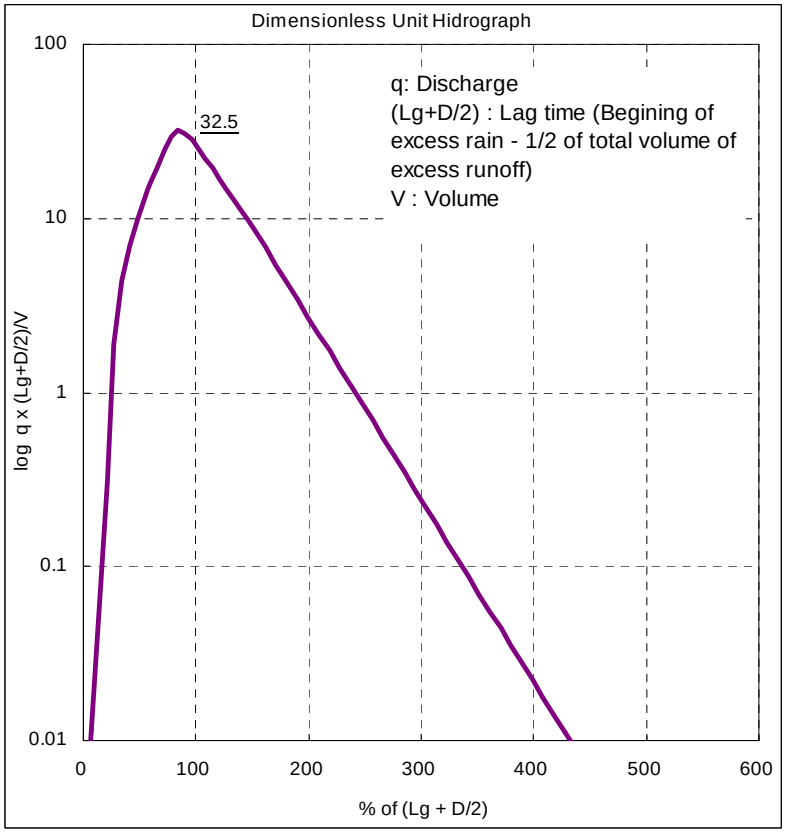
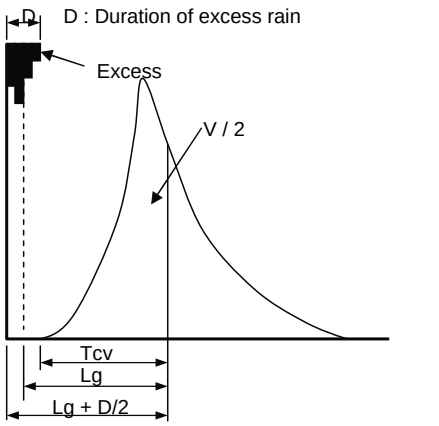


Figure A5.2.3 Schematic Diagram of River Network for Probable Flood Computation



(1) Dimensionless unit hydrograph applied



Lg+D/2 can be taken equal to Tcv when rainfall data availability is limited.

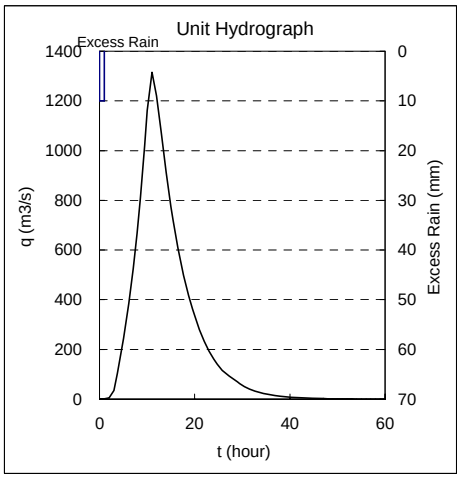
Instead of Lg+D/2 (Time from the centre of the excess rain to time of occurrence of on-half volume of hydrograph, Tcv (time from the beginning of rise of net hydrograph to time of occurrence of on-half volume of hydrograph) can be applied . The lag time can be explained by the following equation.

$Tcv = C \times (L \times Lca / \sqrt{Sst})^{0.38}$

where; Tcv: Lag time. Time from the beginning of rise of net hydrograph to time of occurrence of on-half volume of hydrograph .
C: Constant, 0.72 for foothill drainage area
L: Mainstream length from outlet to watershed
Lca: Mainstream length from outlet to watershed centroid
Sst: Overall slope of mainstream

(2) Definition of Tcv and (Lg+D/2)

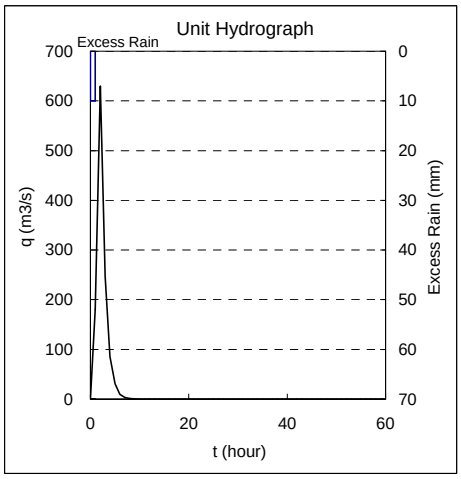
Figure A5.2.4 Dimensionless Unit Hydrograph



Unit Excess Rain : 10 mm
Unit rainfall duration: 1 hr
qmax : 527 m3/s

Runoff Zone : HY-U1 (1154 km2)

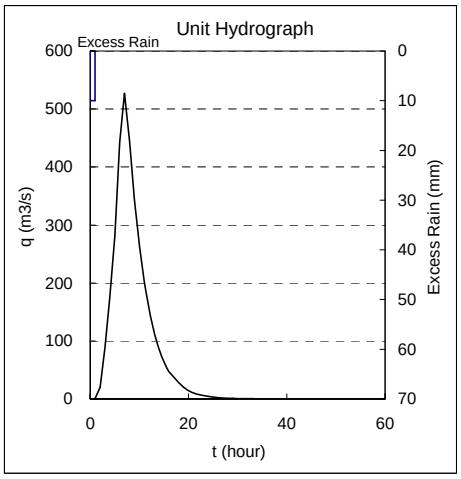
Base point : BP-U1 Mejerda & Mellgue Conf.



Unit Excess Rain : 10 mm
Unit rainfall duration: 1 hr
qmax : 983 m3/s

Runoff Zone : HY-U2p12 (1664 km2)

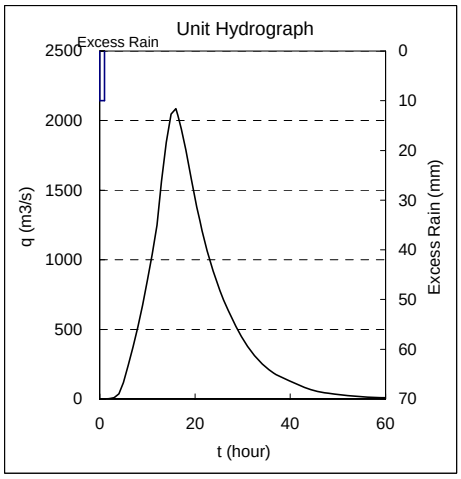
Base point : BP-U2up Mejerda & BouH. Conf.



Unit Excess Rain : 10 mm
Unit rainfall duration: 1 hr
qmax : 653 m3/s

Runoff Zone : HY-U2p13 (1630 km2)

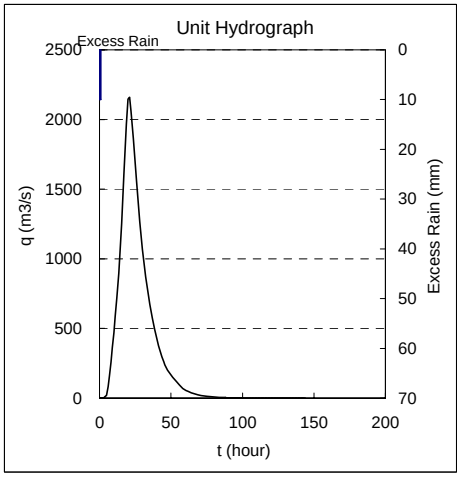
Base point : BP-D2 Sidi Salem Dam



Unit Excess Rain : 10 mm
Unit rainfall duration: 1 hr
qmax : 1053 m3/s

Runoff Zone : HY-D2tp11 (1626 km2)

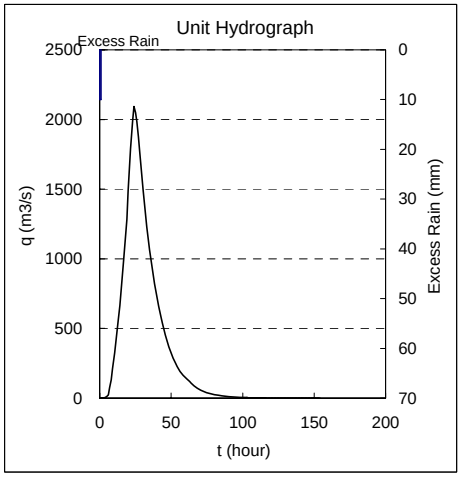
Base point : BP-D1up2 Mejerda & Siliana Conf.



Unit Excess Rain : 10 mm
Unit rainfall duration: 1 hr
qmax : 441 m3/s

Runoff Zone : HY-D2tp12 (1092 km2)

Base point : BP-D1 Larrousia Dam



Unit Excess Rain : 10 mm
Unit rainfall duration: 1 hr
qmax : 678 m3/s

Runoff Zone : HY-D2tp13 (1473 km2)

Base point : BP-D2 Estuary

Figure A5.2.5 Examples of Unit Hydrographs for Sub-catchment

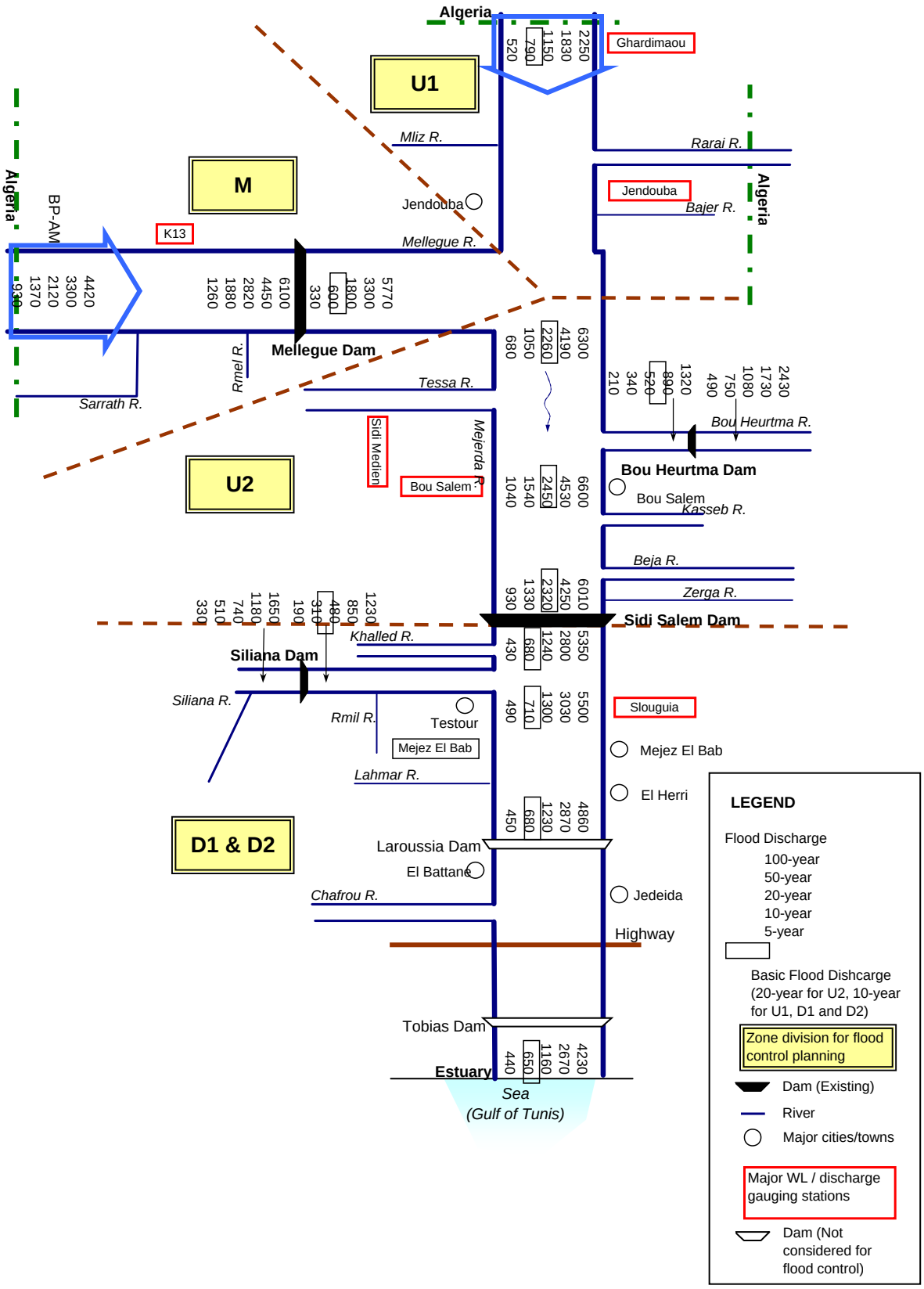


Figure A5.2.6 Probable Discharge Distribution (1/3)
Present Condition : Standard Dam Operation)

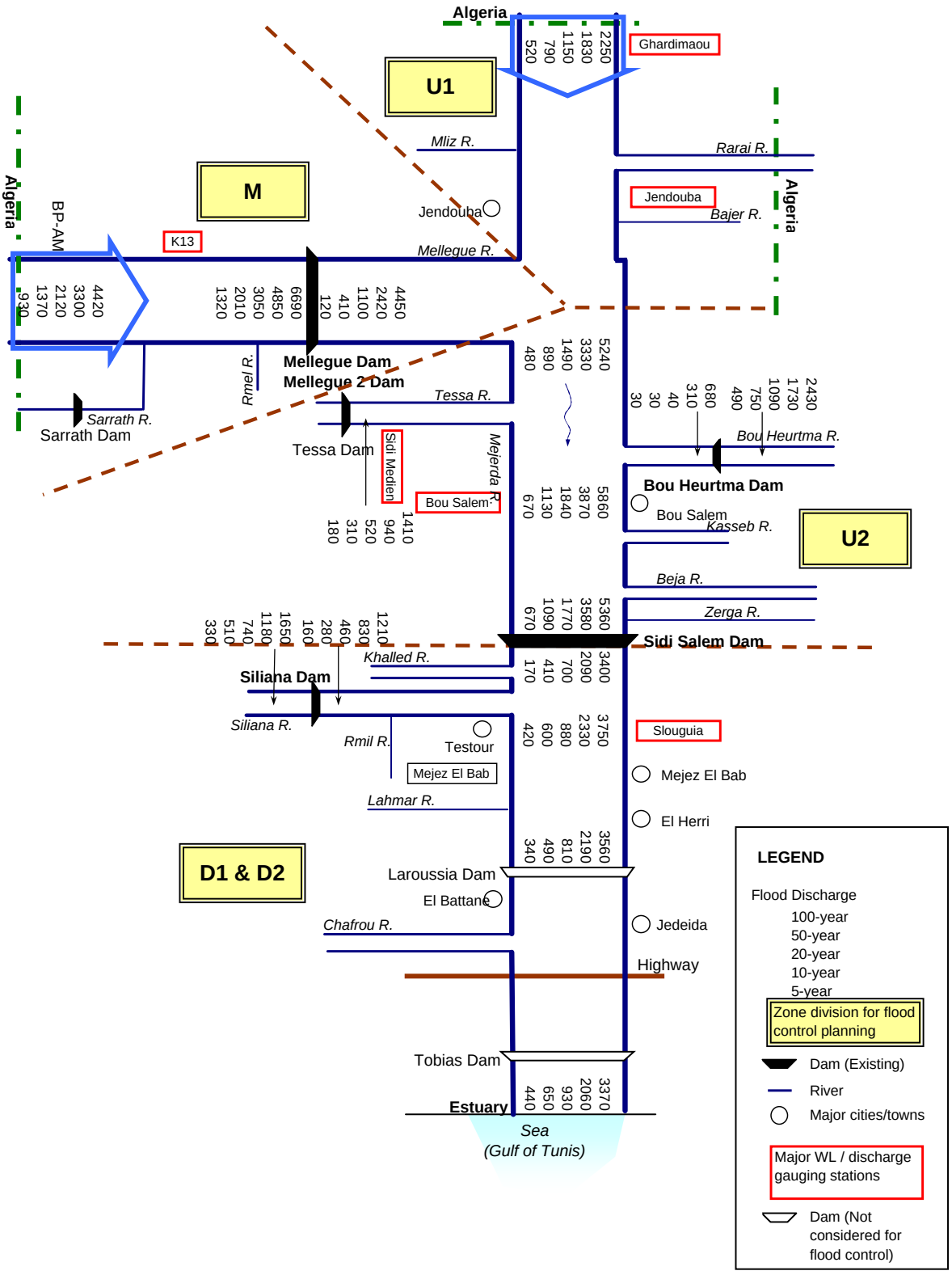


Figure A5.2.6 Probable Discharge Distribution (2/3)
(After Project : Recommended Improved Dam Operation 2030)

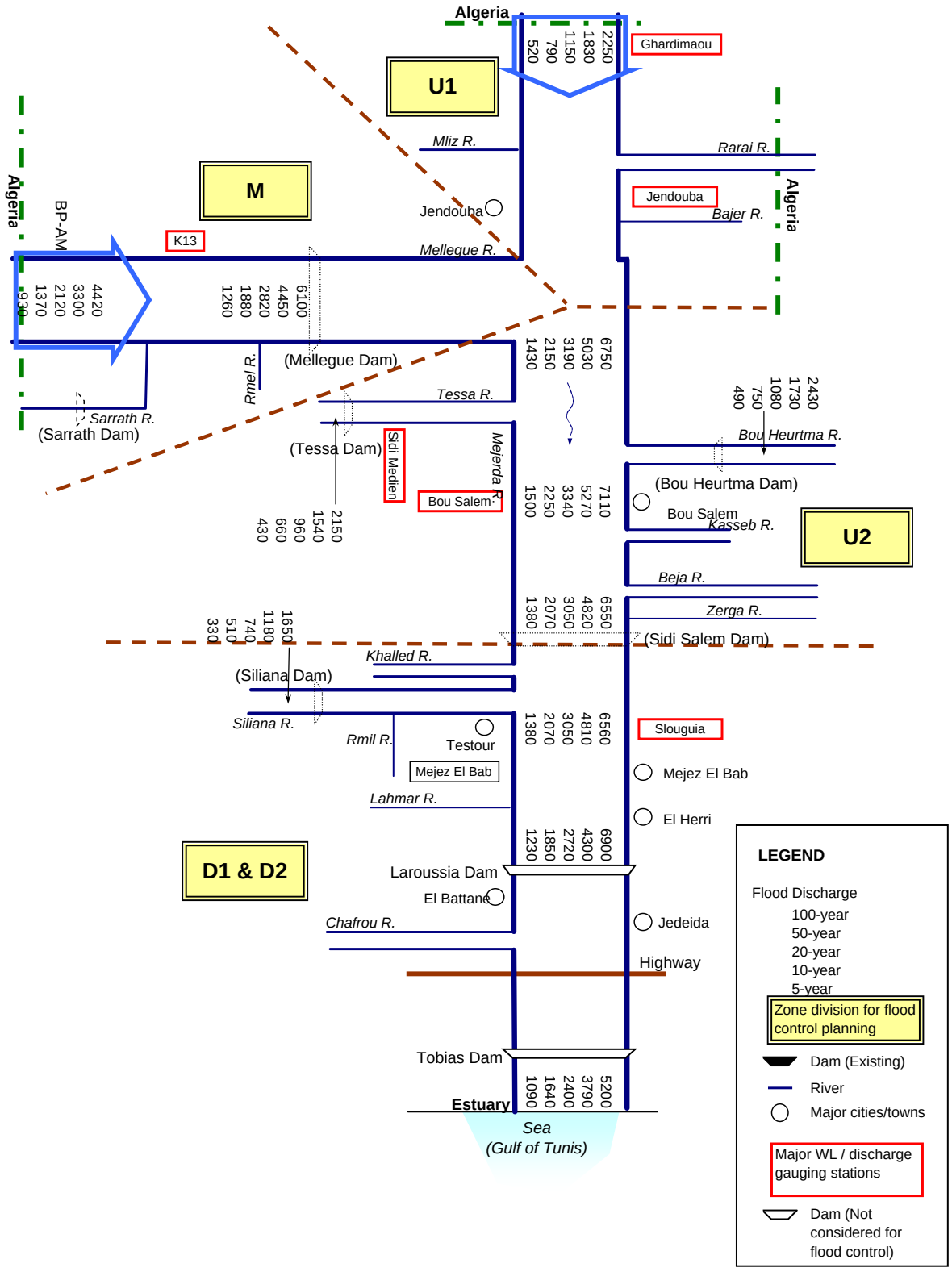


Figure A5.2.6 Probable Discharge Distribution (3/3)
(Assumed to be without Dam)

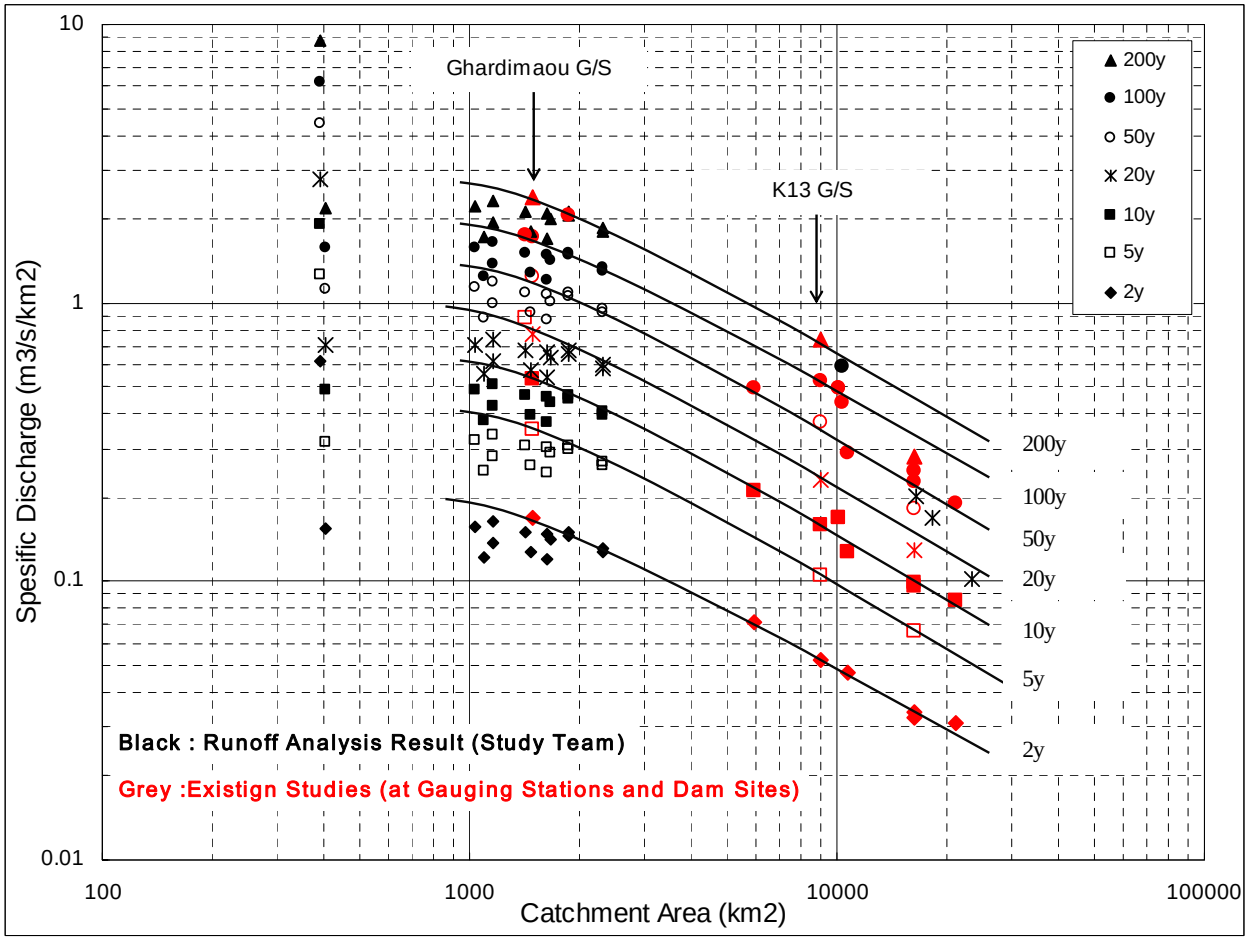


Figure A5.2.7 Specific Discharge

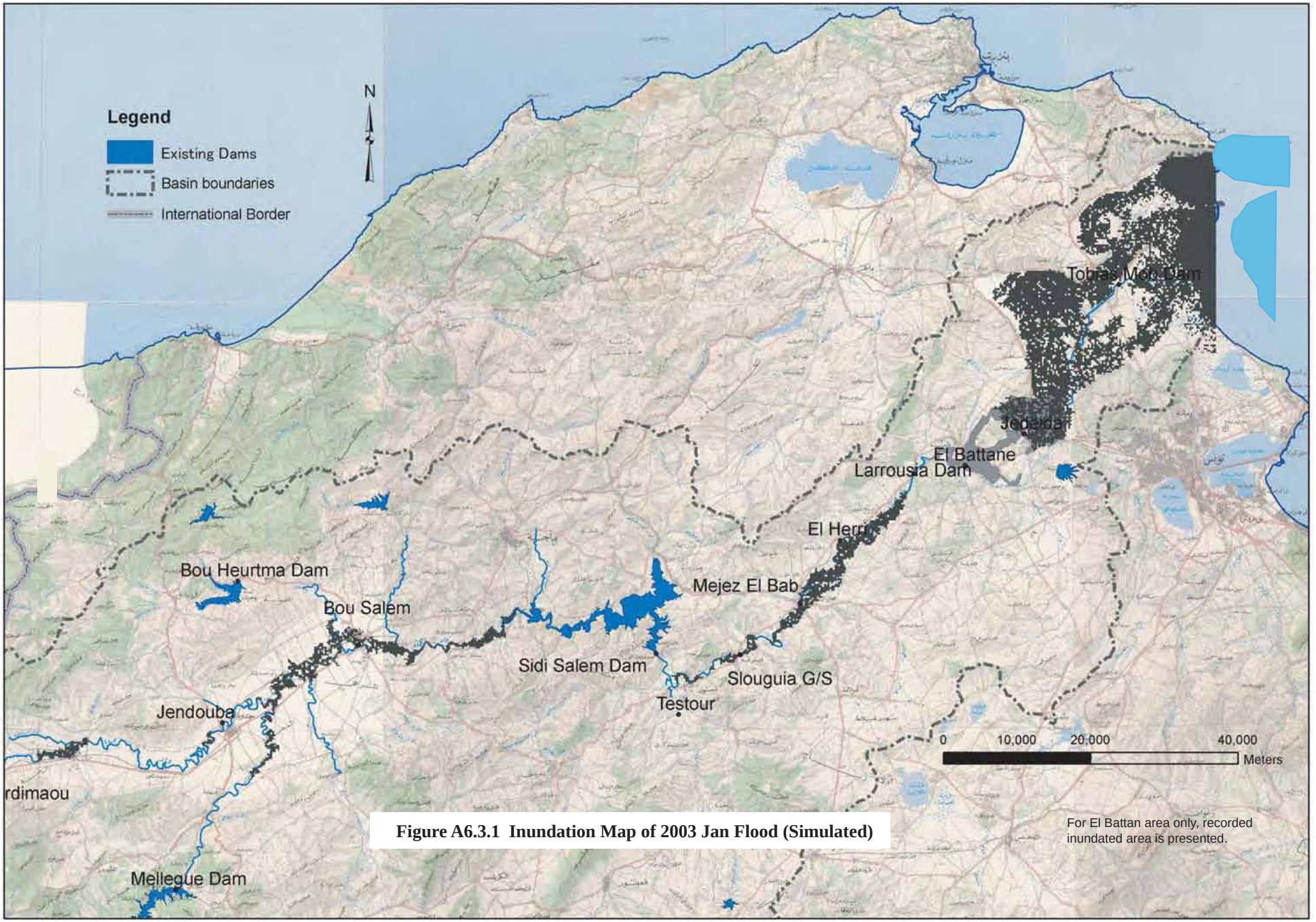
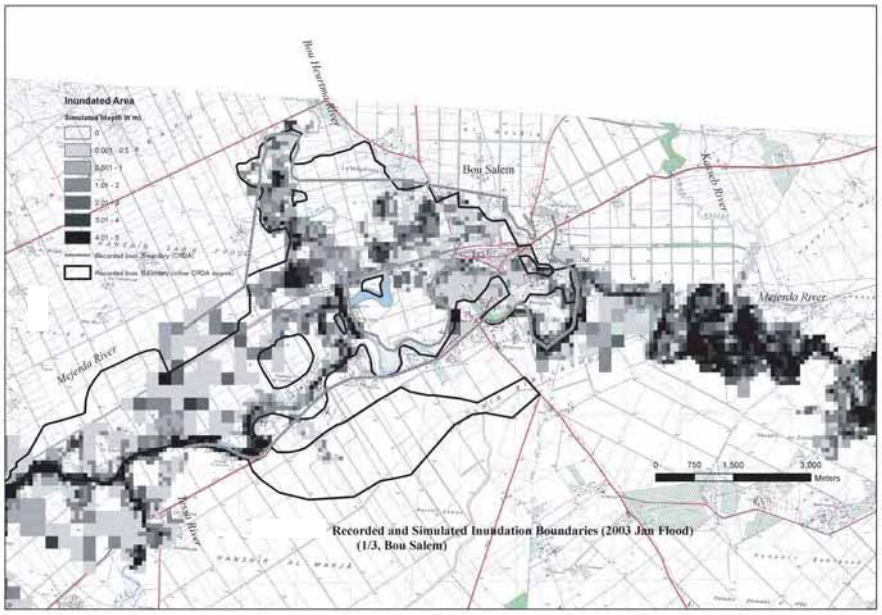
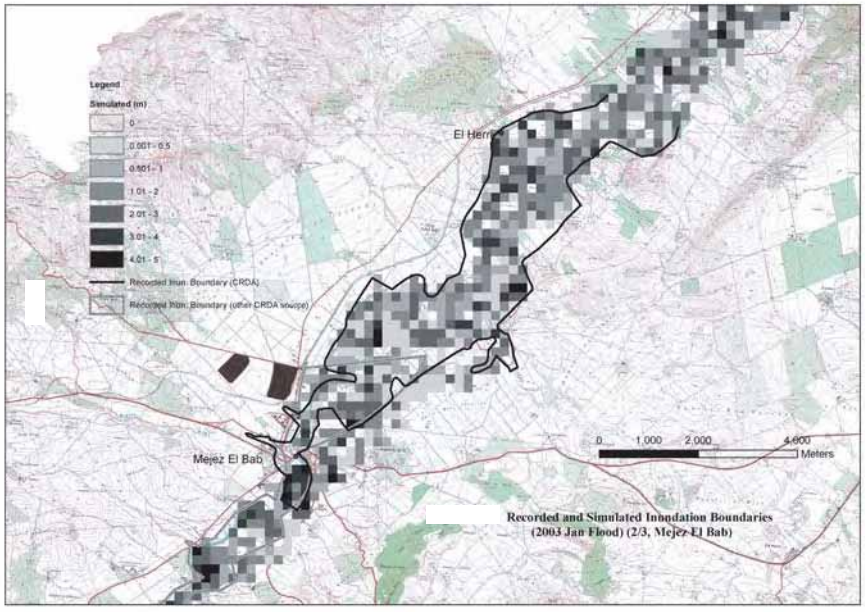


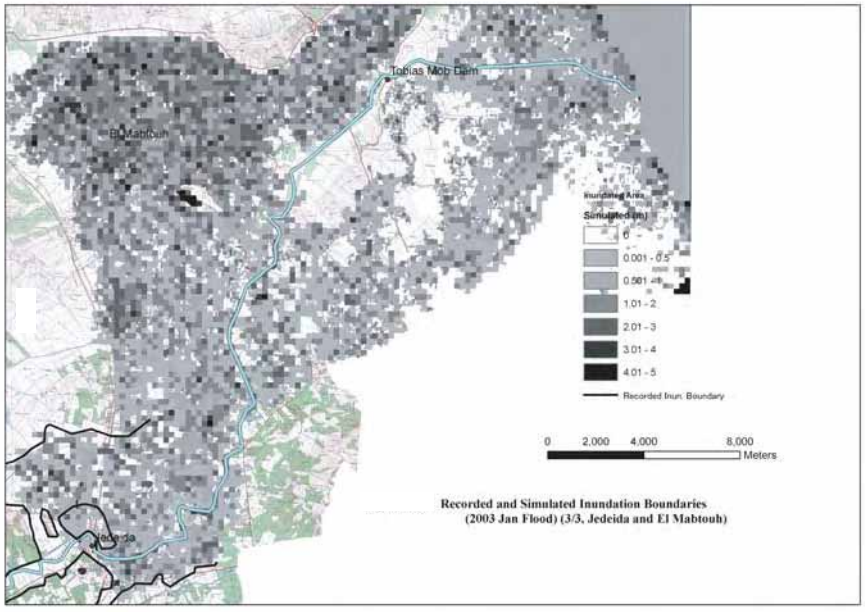
Figure A6.3.1 Inundation Map of 2003 Jan Flood (Simulated)



Bou Salem

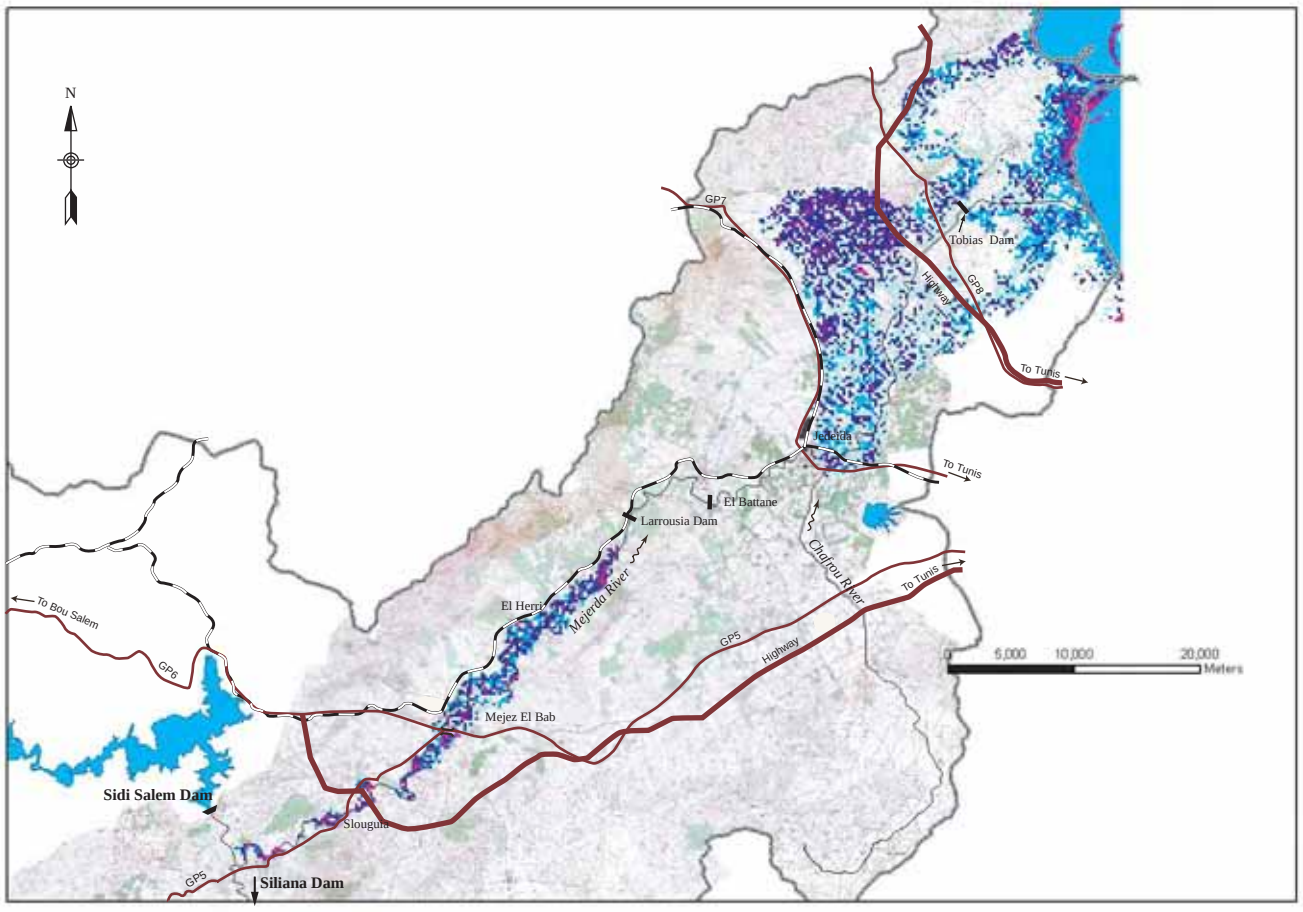


Mejez El Bab



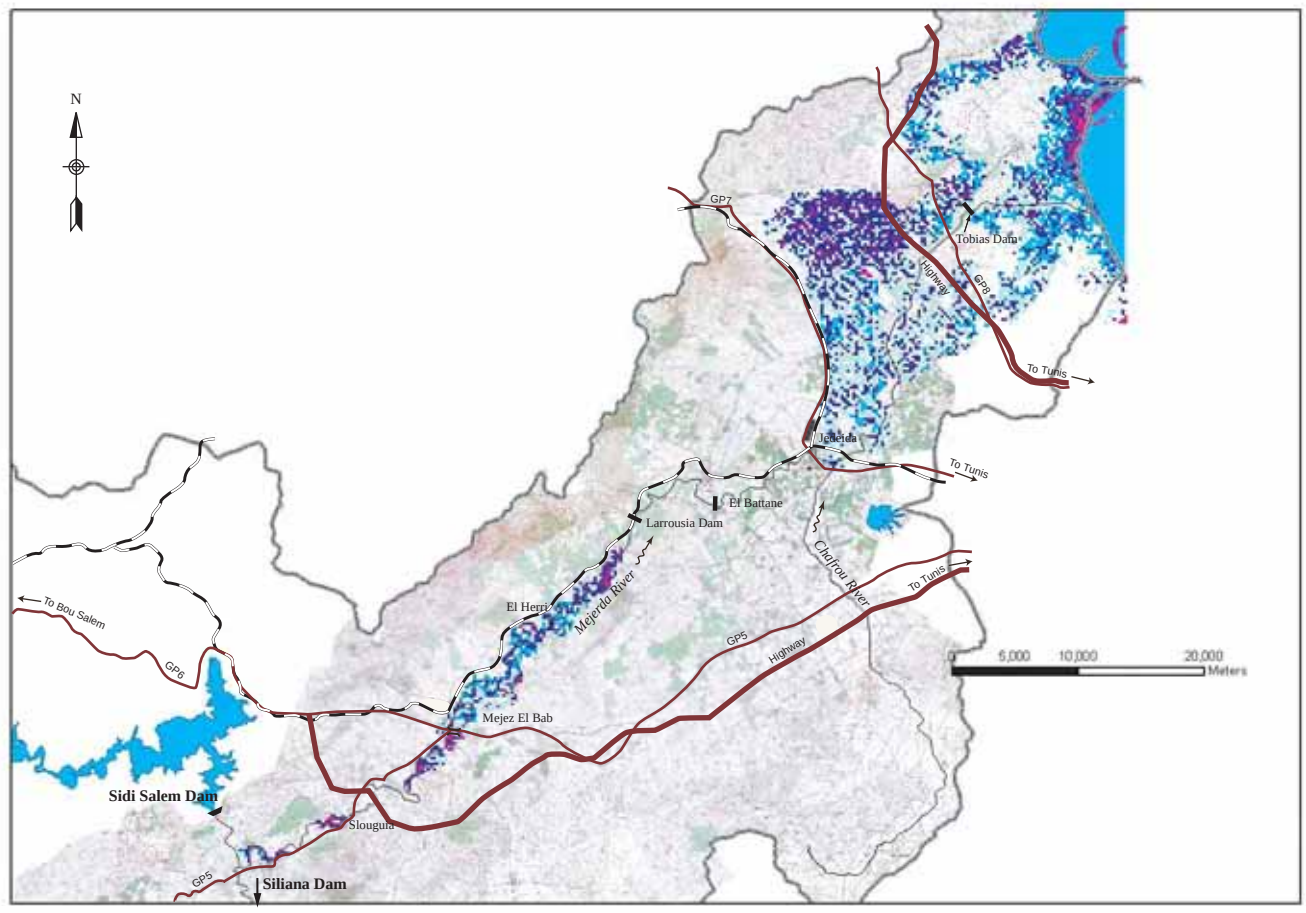
Jedeida and
El Mabtouh

Figure A6.3.2 Recorded and Simulated Inundation Boundaries (2003 Jan Flood)



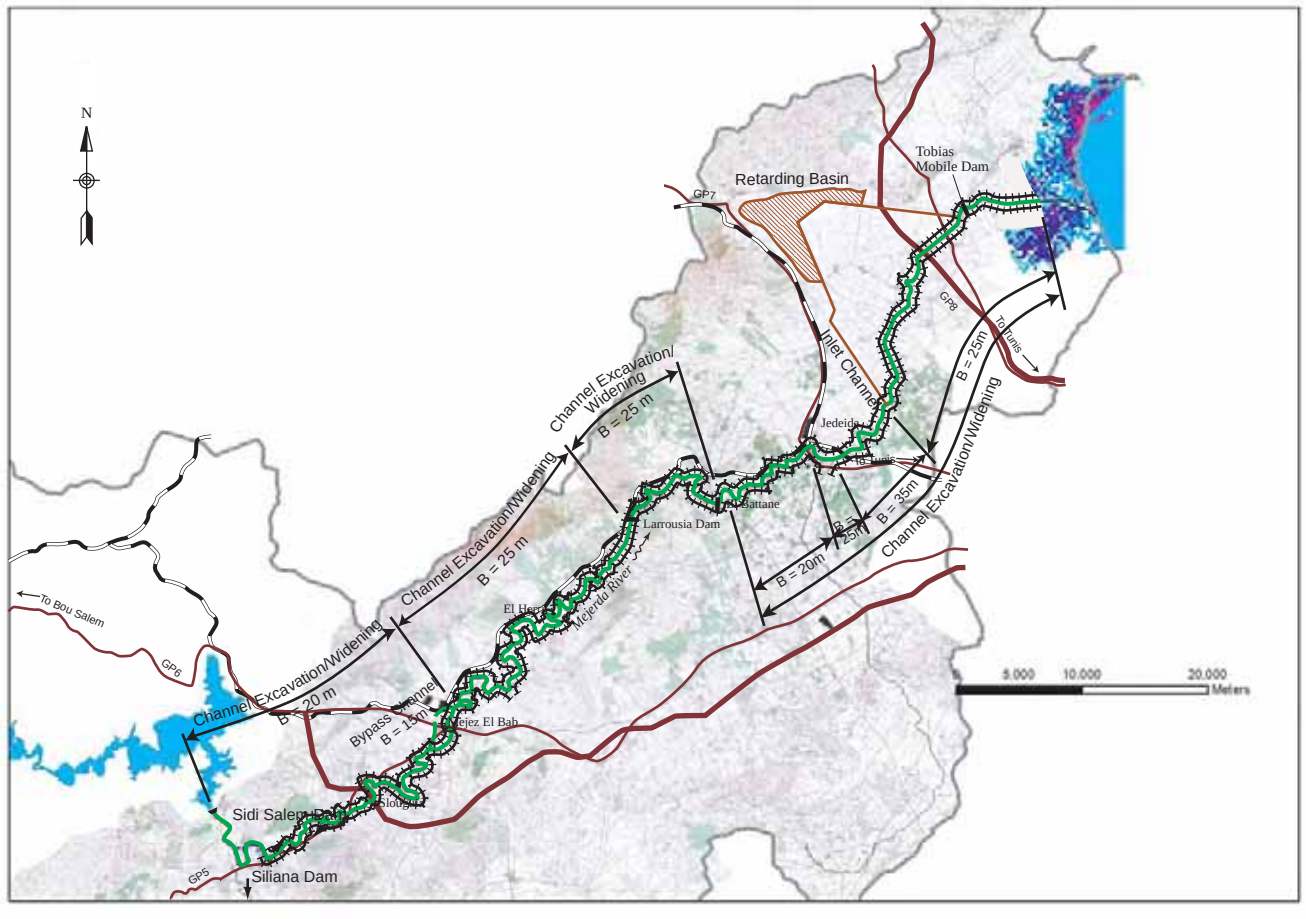
BEFORE PROJECT
(Present Condition)

With
Present standard dam operation of selected existing dams :
- Sidi Salem Dam
- Siliana Dam



AFTER PROJECT (Step 1)
(Improved Dam Operation)

With
Improved Dam Operation (2030) of selected dams :
- Sidi Salem Dam
- Siliana Dam



Inundation Depth (m)
- 0
- 0.001-0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 or more

Legend
Proposed River Improvement
- Channel Excavation/ Widening (B: Bottom width)
- Embankment *
- Bypass Channel
- Retarding Basin
- Railway
- Major Road

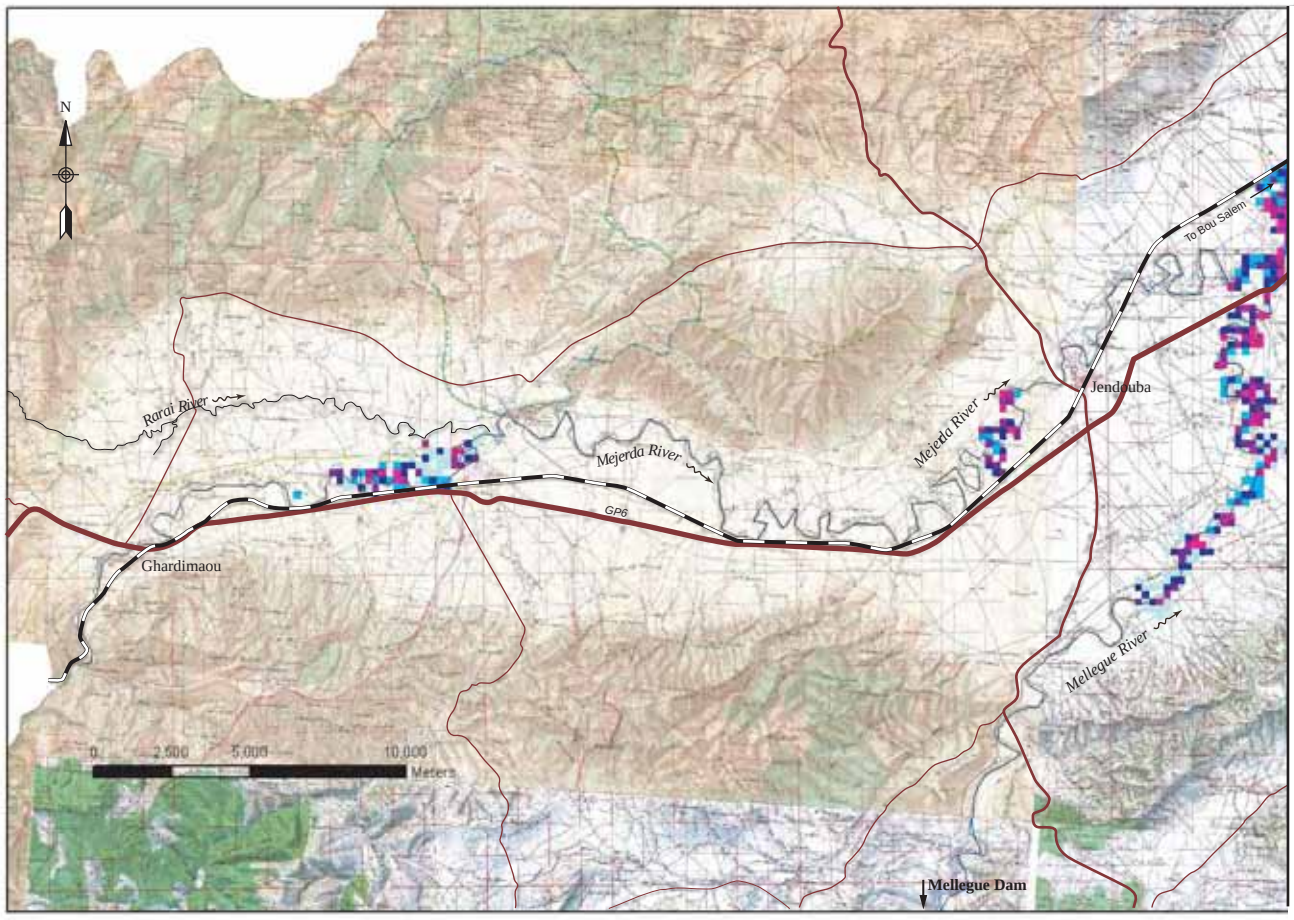
* : Not all reaches along this symbol require embankment. Embankments are to be partially installed on reaches whose bank elevation is lower than design water level.

AFTER PROJECT (Step 2)
(Improved Dam Operation + River Improvement)

With
Improved Dam Operation (2030) of selected dams :
- Sidi Salem Dam
- Siliana Dam

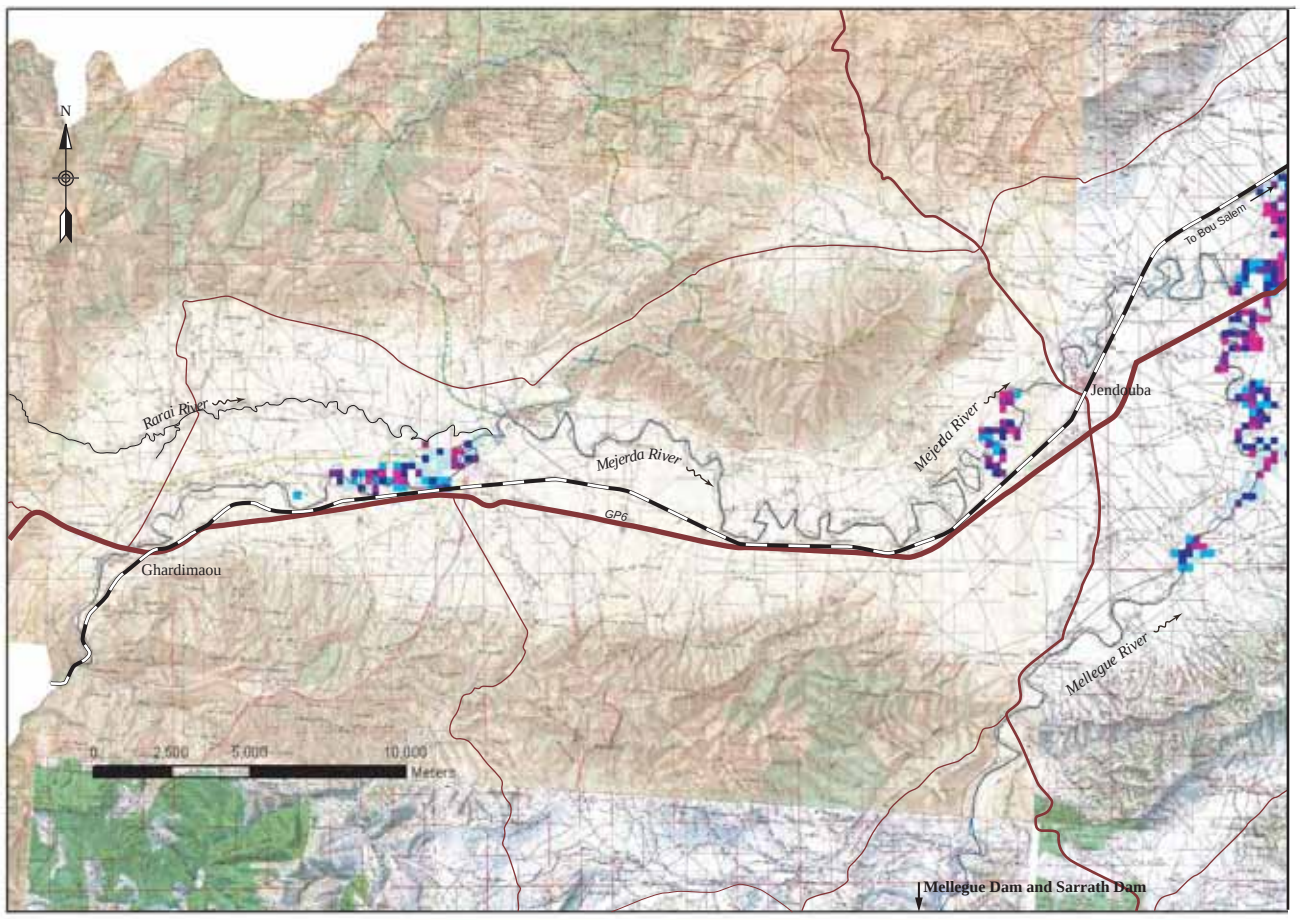
River Improvement :
- Channel excavation/widening
- Embankment
- Bypass channel
- Retarding basin

Figure A6.4.1 Inundation before and after Project (1/3) : Zone D1 and D2 (for Selected Flood Protection Level : 10 year probability)



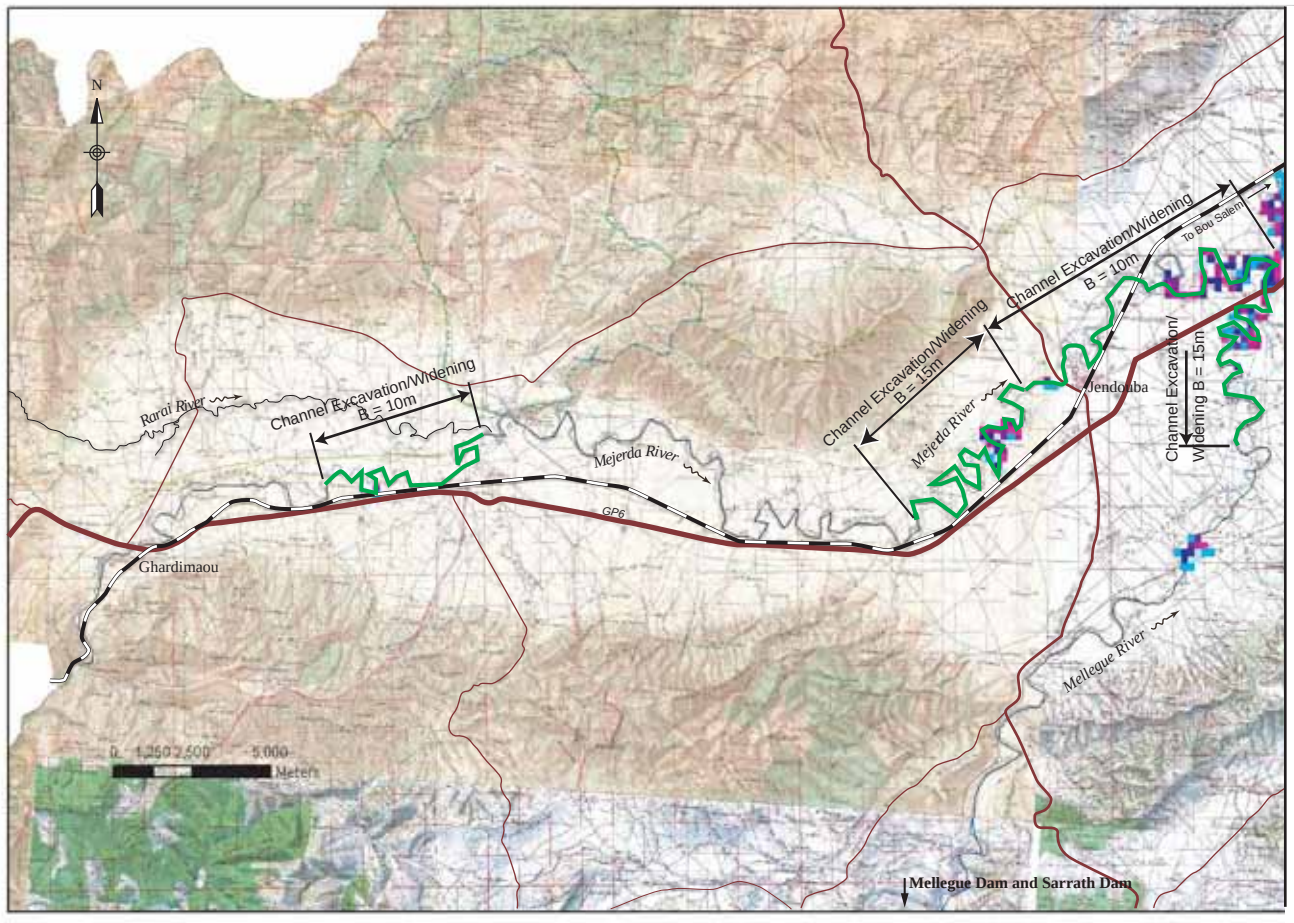
BEFORE PROJECT
(Present Condition)

With
Present standard dam operation of selected existing dams :
Mellegue Dam



AFTER PROJECT (Step 1)
(Improved Dam Operation)

With
Improved Dam Operation (2030) of selected dams :
Mellegue Dam
Sarrath Dam



Inundation Depth (m)
- 0
- 0.001-0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 or more

Legend

Proposed River Improvement
- Channel Excavation/ Widening (B: Bottom width)
- Embankment *
- Bypass Channel

Railway

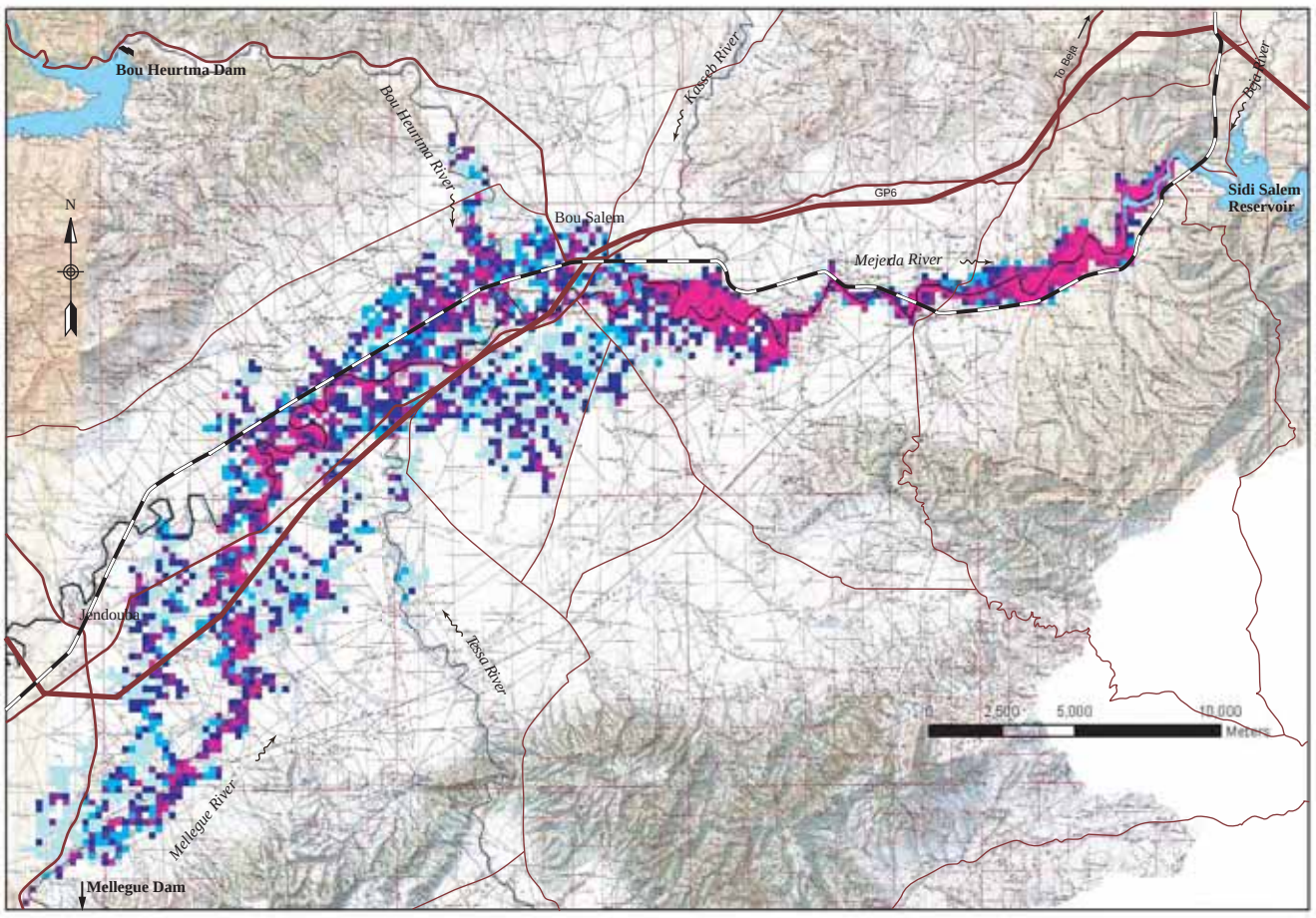
Major Road

* : Not all reaches along this symbol require embankment. Embankments are to be partially installed on reaches whose bank elevation is lower than design water level.

AFTER PROJECT (Step 2)
(Improved Dam Operation + River Improvement)

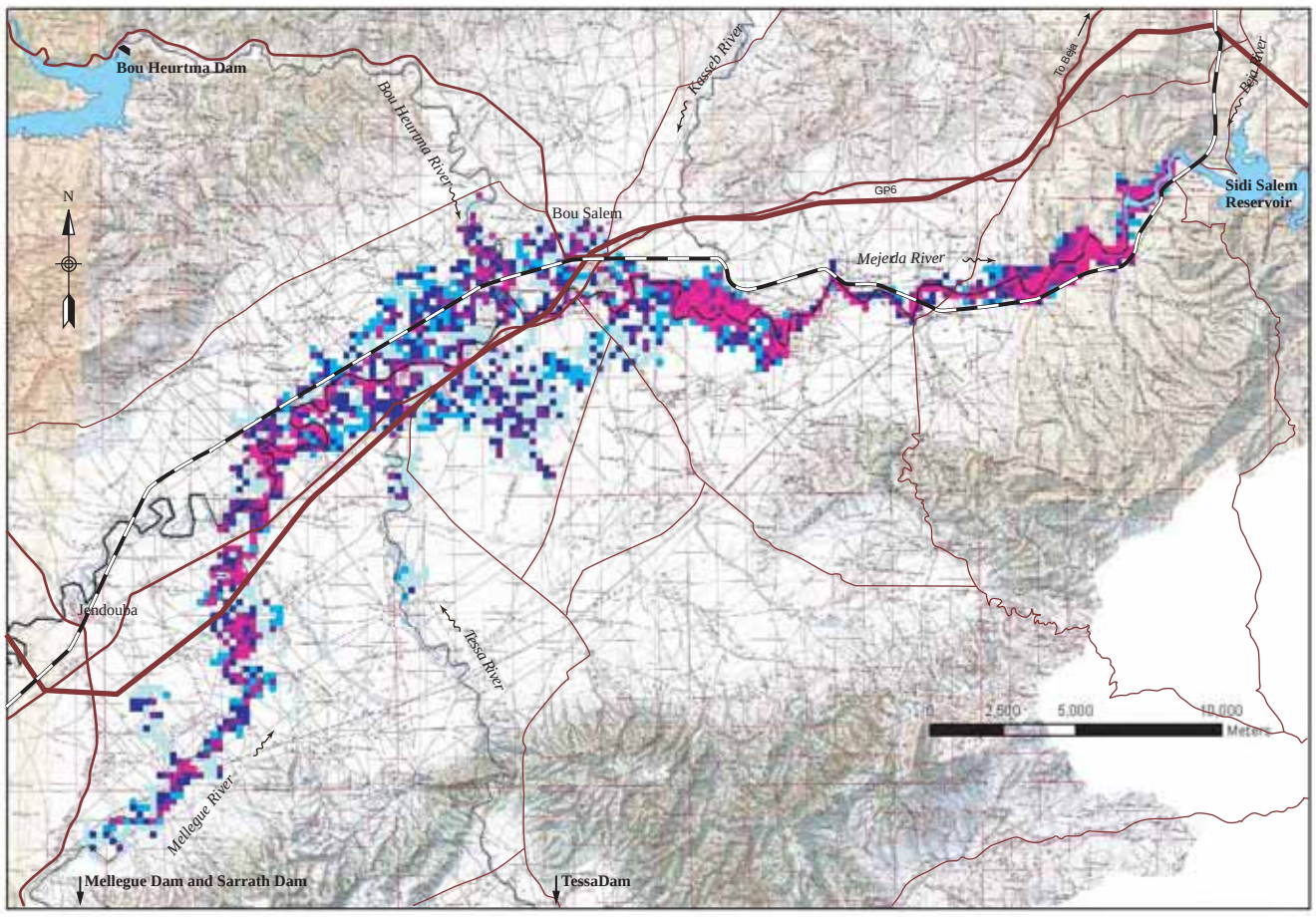
With
Improved Dam Operation (2030) of selected dams :
Mellegue Dam
Sarrath Dam
River Improvement :
Channel excavation/widening

Figure A6.4.1 Inundation before and after Project (2/3) : Zone U1 and M (for Selected Flood Protection Level : 10 year probability)



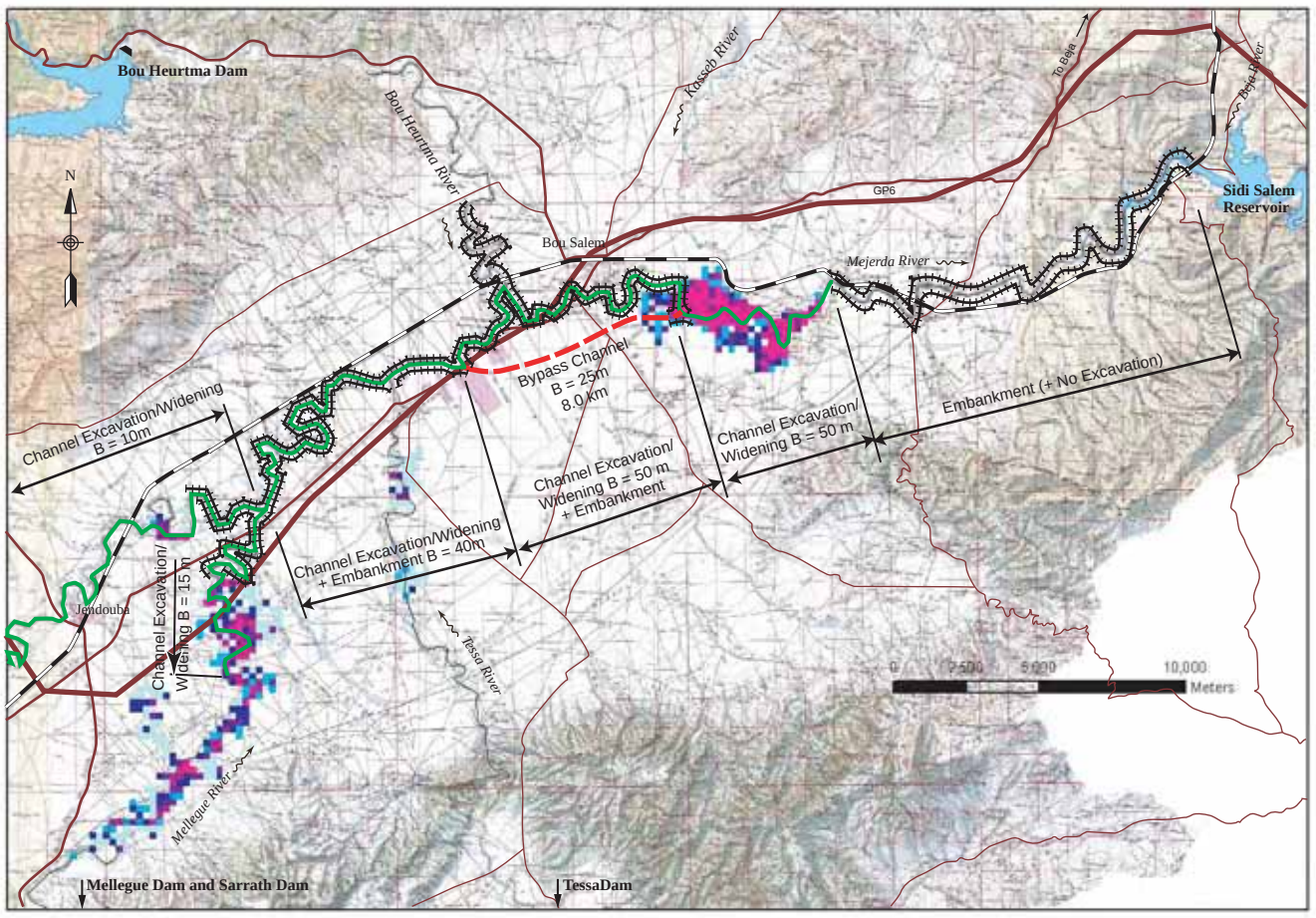
BEFORE PROJECT
(Present Condition)

With
Present standard dam operation of selected existing dams :
- Mellegue Dam
- Bou Heurtma Dam



AFTER PROJECT (Step 1)
(Improved Dam Operation)

With
Improved Dam Operation (2030) of selected dams :
- Mellegue Dam
- Bou Heurtma Dam
- Tessa Dam
- Sarrath Dam

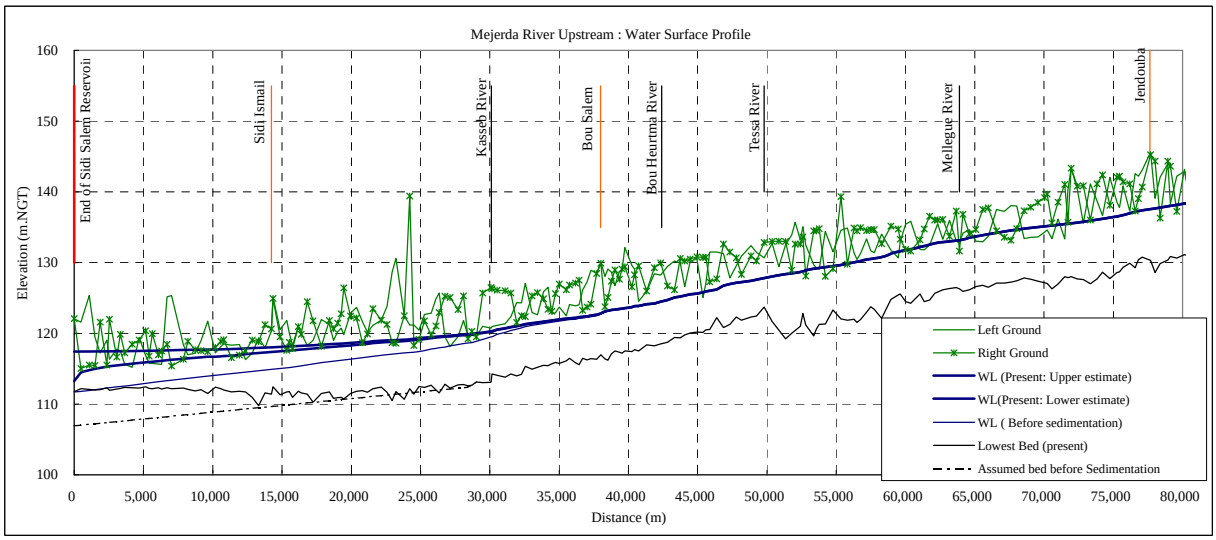


AFTER PROJECT (Step 2)
(Improved Dam Operation + River Imrovement)

With
Improved Dam Operation (2030) of selected dams :
- Mellegue Dam
- Bou Heurtma Dam
- Tessa Dam
- Sarrath Dam

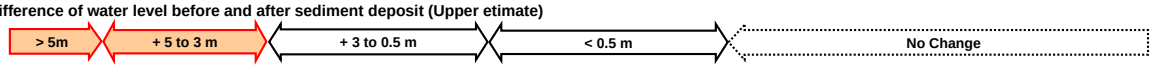
River Improvement :
- Channel excavation/widening
- Embankment
- Bypass channel

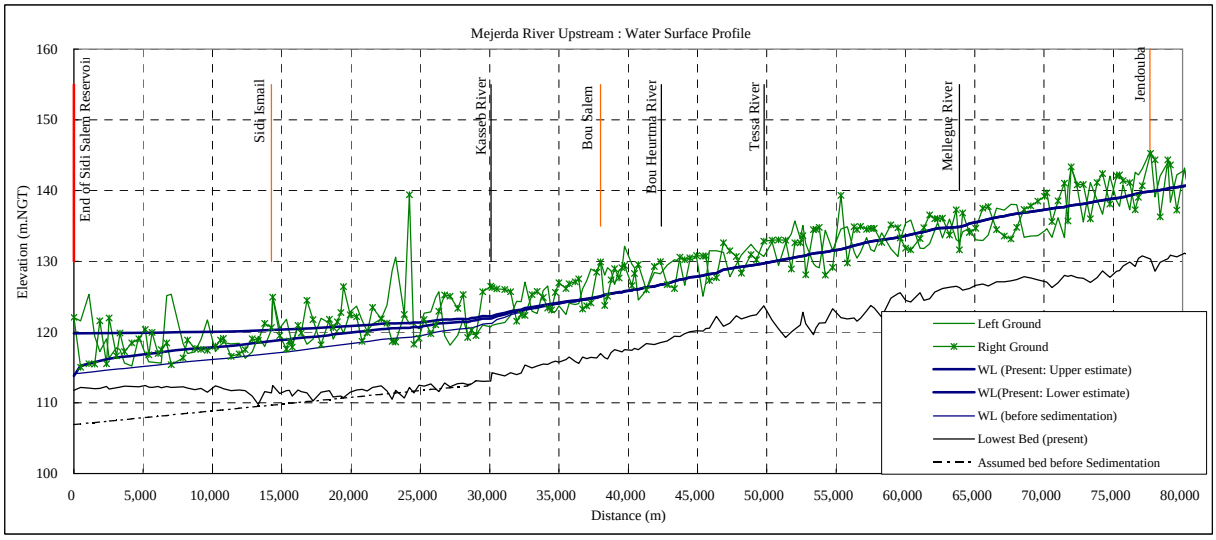
Figure A6.4.1 Inundation before and after Project (3/3) : Zone U2 (for Selected Flood Protection Level : 20 year probability)



Condition : **Q = 250 m3/s**
Reservoir Water Level : 110 mNGT

Difference of water level before and after sediment deposit (Upper etimate)





Condition : **Q = 500 m3/s**
Reservoir Water Level : 110 mNGT

Difference of water level before and after sediment deposit (Upper etimate)

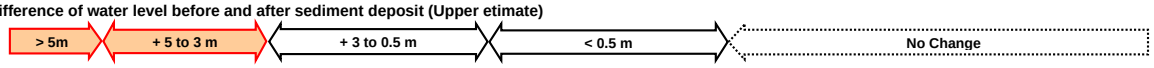
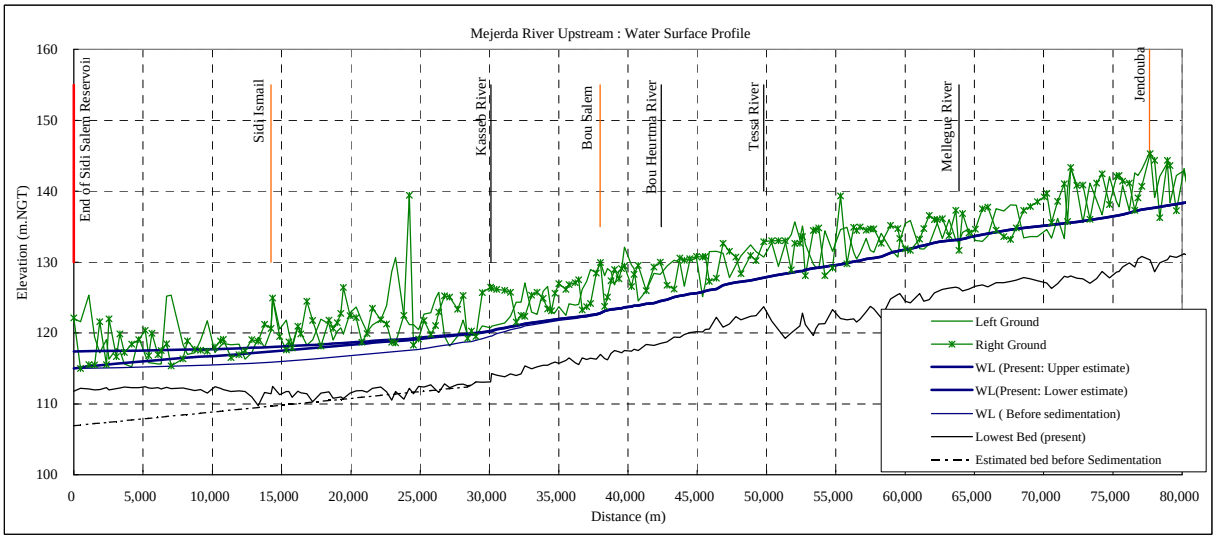
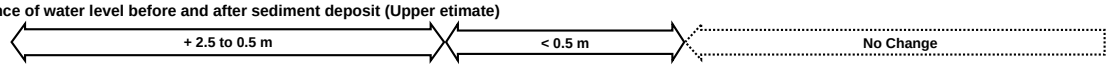


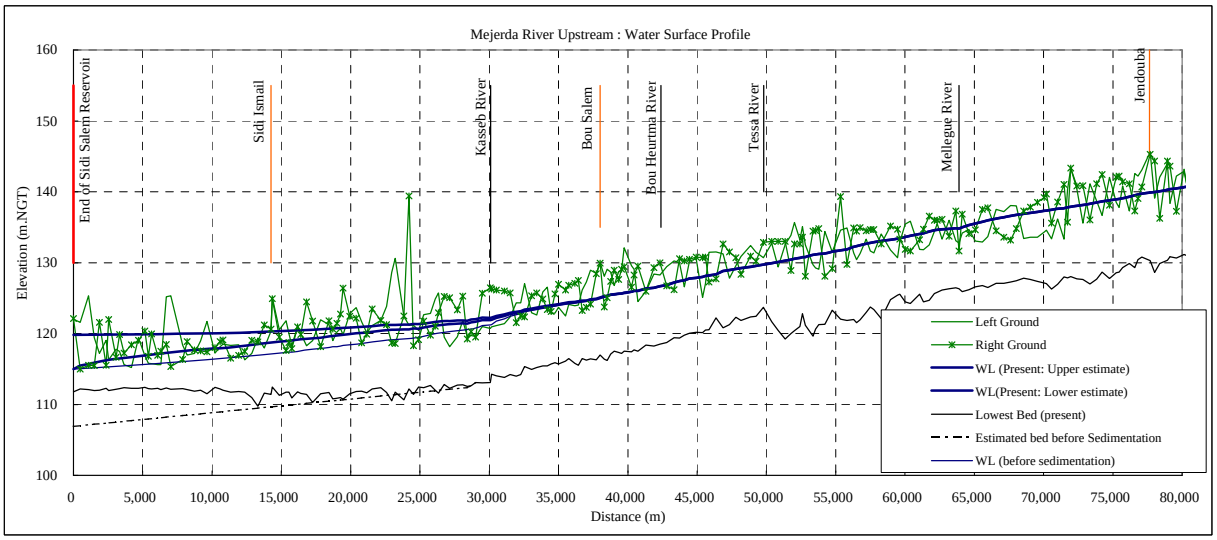
Figure A7.3.1 Water Surface Profile on Upstream of Sidi Salem Dam before and after Sedimentation (1/2, Reservoir Water Level 110mNGT)



Condition : **Q = 250 m3/s**
Reservoir Water Level : 115 mNGT

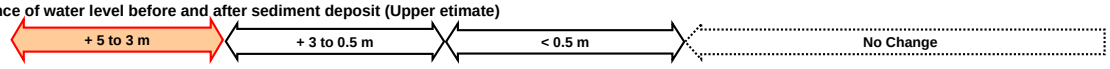
Difference of water level before and after sediment deposit (Upper etimate)





Condition : **Q = 500 m3/s**
Reservoir Water Level : 115 mNGT

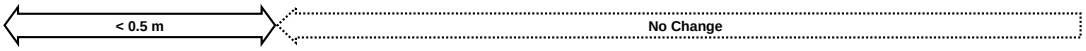
Difference of water level before and after sediment deposit (Upper etimate)



Differences between Reservoir WL 110 and 115 Cases:

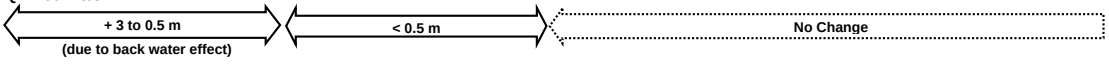
Present Upper Estimate Water Surface

Present Lower Estimate Water Surface



Before Sedimentation

Q = 250 m3/s



Q = 500 m3/s

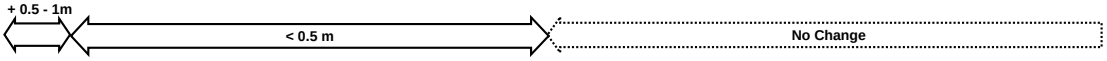


Figure A7.3.1 Water Surface Profile on Upstream of Sidi Salem Dam before and after Sedimentation (2/2, Reservoir Water Level 115mNGT)