Annex 24

Technical Report on the Hydrology of the Drini River Basin

Institutional support to the Ministry of Environment and
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Institutional Support to the Ministry of Environment and Spatial Planning (MESP) and River Basin Authorities

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Technical Report on the Hydrology of the Drini River Basin

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Institution Support to the Ministry of Environment and Spatial Planning (MESP)

And River Basin Authorities

REPORT COVER PAGE

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DEM	Digital Elevation Model
DRB	Drini i Bardhë/Beli Drim River basin
ECLO	European Commission Liaison Office
GIS	Geographical Information System
KEPA	Kosovo Environmental Protection Agency
MESP	Ministry of Environment and Spatial Planning
MTC	Ministry of Transport and Communications
RBMP	River Basin Management Project
RBDA	River Basin District Authority
HMIK	Hydro-meteorological Institute of Kosovo

1 INTRODUCTION

1.1 Relevant country background

1.2 Objective aimed by the hydrological assessment

The hydrological characteristics are ones of the most important data for environment management.

Reminding the procedure of preparation of the river basin plan prescribed by WFD (Article 13 and Annex VII), there are 5 elementary stages for each plan:

- Stage 1 – Assessment of current stage
- Stage 2 – Appraisal of environmental objectives
- Stage 3 – Establish monitoring programmes
- Stage 4 – Gap analysis and identification of significant water management issues
- Stage 5 – Implement programme of measures, evaluating and reporting

Most of the environmental parameters are correlated with flow. Without reliable flow information, it is not possible to assess the environment.

The objective aimed by this study is to carry out a baseline hydrological analysis of the River Drini Basin in Kosovo. This will provide a reference for the characterization of the river basin districts as required by the EU Water Directive Framework.

Another application will be to support water resource assessment and planning. The result would contribute to definition of the future river basin plan always referring to the prescription by WFD for:

- Catchment abstraction management strategy
- Catchment flood risk management strategy
- Regulation of abstraction quantities
- Regulation of discharge quantities
- Protection of minimum flow permissible standards

The validated hydrological data will also constitute of the basis for water resource modelling and flood modelling (Result 3 of the present project).

The main tasks are defined as follow:

- Review the available reports and documentation concerning the hydrology of the Drini River basin in Kosovo and elsewhere in the basin
- To the extent possible, identify the current land use by type and extent using available satellite imagery
- Assess the quality and consistency of the available hydro-meteorological data taking into account the status of the existing monitoring network focusing on hydrological relevance, technical and effectiveness and operational adequacy
- Calculate a long-term basin-wide hydrological water balance based on assessed rainfall/runoff relations and potential evapotranspiration in the basin and sub-basin
- Carry out a plausibility analysis of river basin hydrology statistics focusing on the consistency of annual and seasonal indicators and patterns

The main references used for this study are:

– Institut Za Vodoprivredu "Jaroslav Ĉerni" – Vodoprivredna Osnova sap Kosova (Water Masterplan for Kosovo) Part I, Book 1, Volume (1) Climate Data, Volume (2) River Hydrological Data, 1982.
– Hydrological year books
– Pilot water supply project in Gjakova Rahovec region – Component 2: Water resources and water allocation study, Brian Faulkner 2004.

2 GENERALITIES OF THE DRINI RIVER BASIN

2.1 The Basin

The White Drini River Basin is located in the west of Kosovo. It is the largest river in the territory of Kosovo.

The main sub-basins are:

- Bistrica Pëjë (503 km²), Bistrica Deçani (273 km²) et Erenik (516 km²) in the west,
- Istog (447 km²) in the north
- Klina (439 km²) in the north-east,
- Mirusha (335 km²) and Toplluha (500 km²) in the east
- Bistrica e Prizren (266 km²) and Plavës (309 km²) in the south-east

The total surface of the Drini basin controlled by the hydrometric station at Vermicë near the border with Albania is 4320 km² representing about 40% of Kosovo's territory.

The two later tributaries and the White Drini itself flow into Albania. A small part (about 45 km²) of the Bistrica Pëjë is also situated outside of Kosovo (in Serbia). The other sub-basins are entirely located within Kosovo. In fact most parts of the watershed limit constituent borders with the neighbouring countries (Serbia, Montenegro, Albania and Macedonia).

2.2 Geomorphology

The Drini river basin is surrounded with relatively high mountains apart from an opening in the east where the relief is less important.

Table 1: Morphological parameters of the main sub-basins

Station	River	Superficie (km^2)	Highest elevation *(m)*	Outlet elevation *(m)*	Length of flow path *(m)*	Watershed slope *(%)*
Berkovë	Istogut	438.4	620	389	17480	1.32%
Drelaj	Bistrica e Pejës	166.1	1840	940	17300	5.20%
Grykë	Bistrica e Pejës	254.2	940	540	11260	3.55%
Klinë	Klina	430.1	1390	359	70890	1.45%
Mirushë	Kpuzaj	332.5	860	330	37470	1.41%
Deçani	Bistrica e Deqanit	118.9	2080	670	21050	6.70%
Gjakovë	Ereniku	355.0	2310	310	39850	5.02%
Ura e Terzive	Erenik	510.5	315	298	1060	1.60%
Piranë	Toplluha	501.0	910	300	33230	1.84%
Prizren	Bistrica e Prizrenit	167.9	2050	490	19360	8.06%
Vllashnje	Bistrica e Prizrenit	247.5	490	320	12700	1.34%
Orqush	Plava	253.4	1400	769	19530	3.23%
Radavc	Drini i Bardhë	142.6	620	460	3670	4.36%
Kepuz	Drini i Bardhë	2050	460	340	43980	0.27%
Gjonaj	Drini i Bardhë	3904	340	300	52180	0.08%
Vermicë	Drini i Bardhë	4320	300	276	13600	0.18%

2.3 Land cover

According to the data in the Master Plan, the forest surface is following for each sub basin:

Table 2: Land covered by forest (source: Master Plan)

Station	River	Surface basin (km²)	Forrest cover (km²)	%
Berkovë	Istogut	438.4	96.6	22%
Drelaj	Bistrica PejÙs	166.1	50.9	31%
Grykë	Bistrica PejÙs	254.2	100.4	39%
Klinë	Klina	430.1	218.5	51%
Mirushë	Kpuzaj	332.5	195.6	59%
Deçani	Bistrica e Deqanit	118.9	65.2	55%
Gjakovë	Ereniku	355	120.9	34%
Piranë	Toplluha	501.0	184.3	37%
Gjonaj	Drini BardhÙ	3904.0	1761.8	45%
Prizren	Bistrica Prizrenit	167.9	**32.7**	19%
Vllashnje	Bistrica Prizrenit	247.5	**46.4**	19%
Orqush	Plava	253.4	**20.1**	8%
Vermicë	Drini BardhÙ	4320.0	**5398.2**	125%
Radavc	Drini BardhÙ	142.6	69.3	49%
Ura e Terez	Erenik	510.5	213.6	42%
Kepuz	Drini BardhÙ	2050.0	1004.3	49%

These data will be actualized by analysis of satellite imagery.

2.4 General climatic conditions

The precipitation is very heterogeneous. In the North-West monotonous region it reaches 1,500 mm per year. In plain regions it is near 800 mm and can exceptionally decrease to 650 mm per year.

This heterogeneity constitutes one of the difficulties in hydrological analysis, in particular when the rainfall data are very scarce.

The mean temperature varies from 9 °C to 11 °C.

There are two typical patterns for monthly inflow distribution. For the most humid region (North-west Mountains) the peak is normally observed in May and resulted mainly from snowmelt.

For the lower regions, the most important inflows are observed in winter (December – February).

3 HYDROLOGICAL DATA INVESTIGATIONS

3.1 Hydrometric network in Drini river basin

The hydrometric stations are listed in following table and located in the map (next page).

Table 3: Hydrometric stations in Drini river basin

River	Station	X	Y	Surface master plan (km²)	Surface GIS (km²)
ISTOG	Berkovë	460855.0	4725267.0	432	438.4
BISTRICA E PEJÓS-STATION	Drelaj	429730.0	4727908.0	120	166 (120 km² in Kosovo)
BISTRICA E PEJÓS	Grykë	438634.0	4723526.0	264	254.2
BISTRICA E DECANIT	Deçan	438298.0	4711160.0	114	118.9
ERENIK	Gjakova	452286.0	4690940.0	455	455 or 280[1]
ERENIK	Ura e Terezive	459402.4	4689782.0	519	510.5
KLINA	Klinë	465254.0	4718136.0	423	430.1
MIRUSHA	Mirusha			126.5	
MIRUSHA	Kpuzaj	464237.0	4707808.0	336	332.5
MLIKA	Brod	473487.0	4650410.0	75.3	75.3
TOPLLUHA	Piranë	473403.0	4681841.0	512	501
TOPLLUHA	Zoiq				
WHITE DRINI	Radavc	445847.8	4731044.2	18.5	142.6
WHITE DRINI	Rakovinë	459980.0	4704400.0		2347
WHITE DRINI	Vërmico	463646.8	4668718.6	4368	4320
WHITE DRIN	Gjonaj	471050.0	4678040.0	3904	3904
WHITE DRINI	Kpuzë	463233.6	4707269.4	2116	2050
WHITE DRINI	Krajk		3391	3391	3391
WHITE DRINI	Ura e Fshej	462514.5	4688745.8		
BISTRICA E PRIZERENIT	Prizren	481305.0	4671363.0	158	167.9
BISTRICA E PRIZERENIT	Vllashnje	471225.0	4671466.0		247.5
PLLAVA	Orqusha	466673.1	4655980.7	252	253.4

[1] The location of this station is to be reviewed.

Amongst these stations, that at Gjonaj is a primary station of international importance, and that at Kpuzë is secondary of national importance.

The station at Vërmico has been removed since influenced by the reservoir de Liqueni I Fierzes in Albania.

Ten other stations are within the 2007 rehabilitated network: Drelaj, Pejë/Grykë, Deçan, Berkovë, Klinë, Mirusha, Gjakovë, Piranë, Vllashnje and Prizren.

The surfaces of the sub-basins were recalculated with digital data existing in the GIS database.

Four stations are influenced by irrigation abstractions: Berkovë by Istog scheme, Kpuz by two major schemes (Istog and Pejë), Gjonaj by three schemes (Istog, Pejë and Decan) and Vermicë by all irrigation schemes including Dugagini irrigation perimeter situated in the Prizren sub-basin.

The station at Radavcë was located on extreme upstream of Drini river, it seemingly be influenced by abstractions for Pejë perimeter.

The inflows measured at other stations are relatively natural.

Figure 1: Drini river sub-basin and hydrometric monitoring network

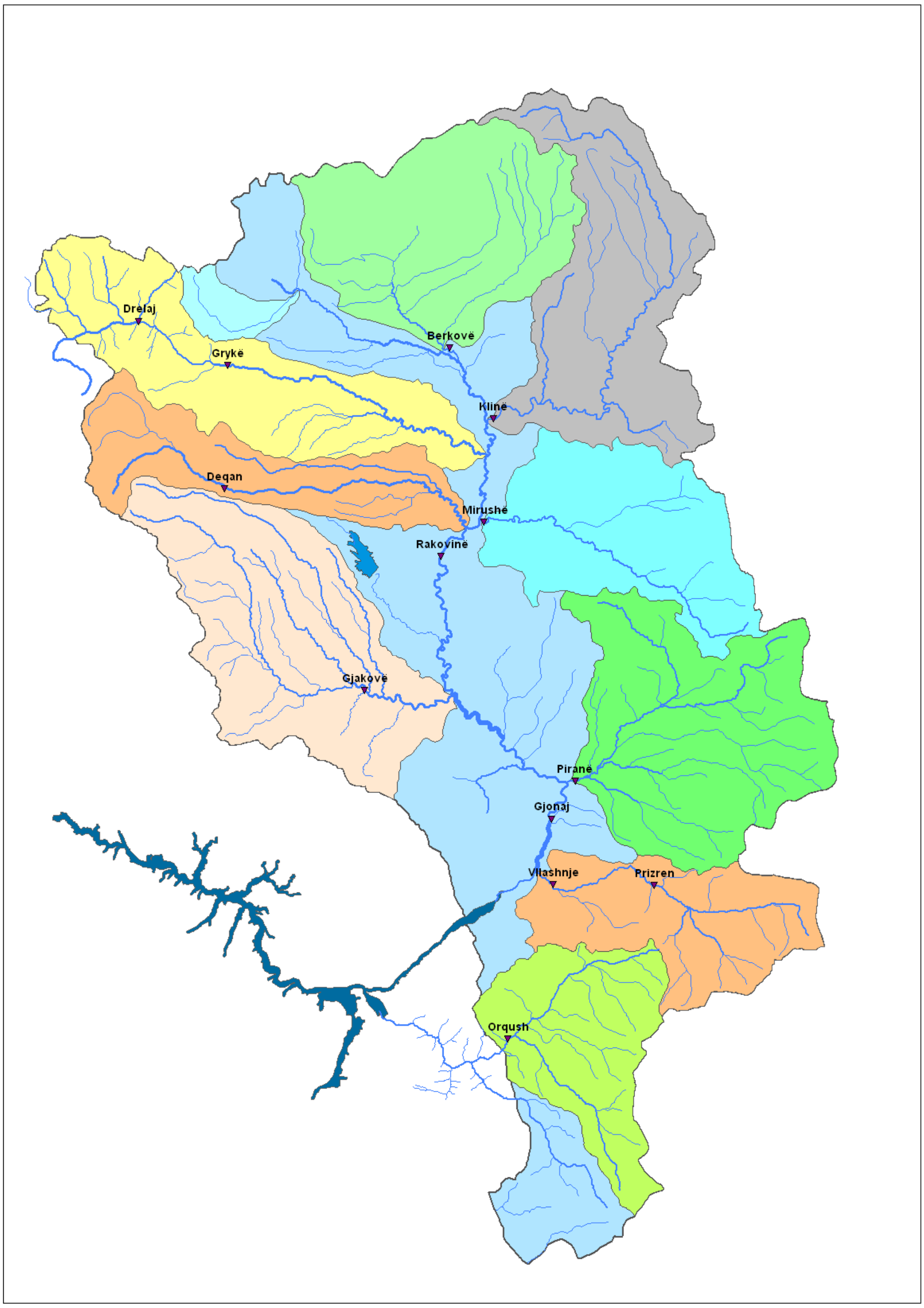
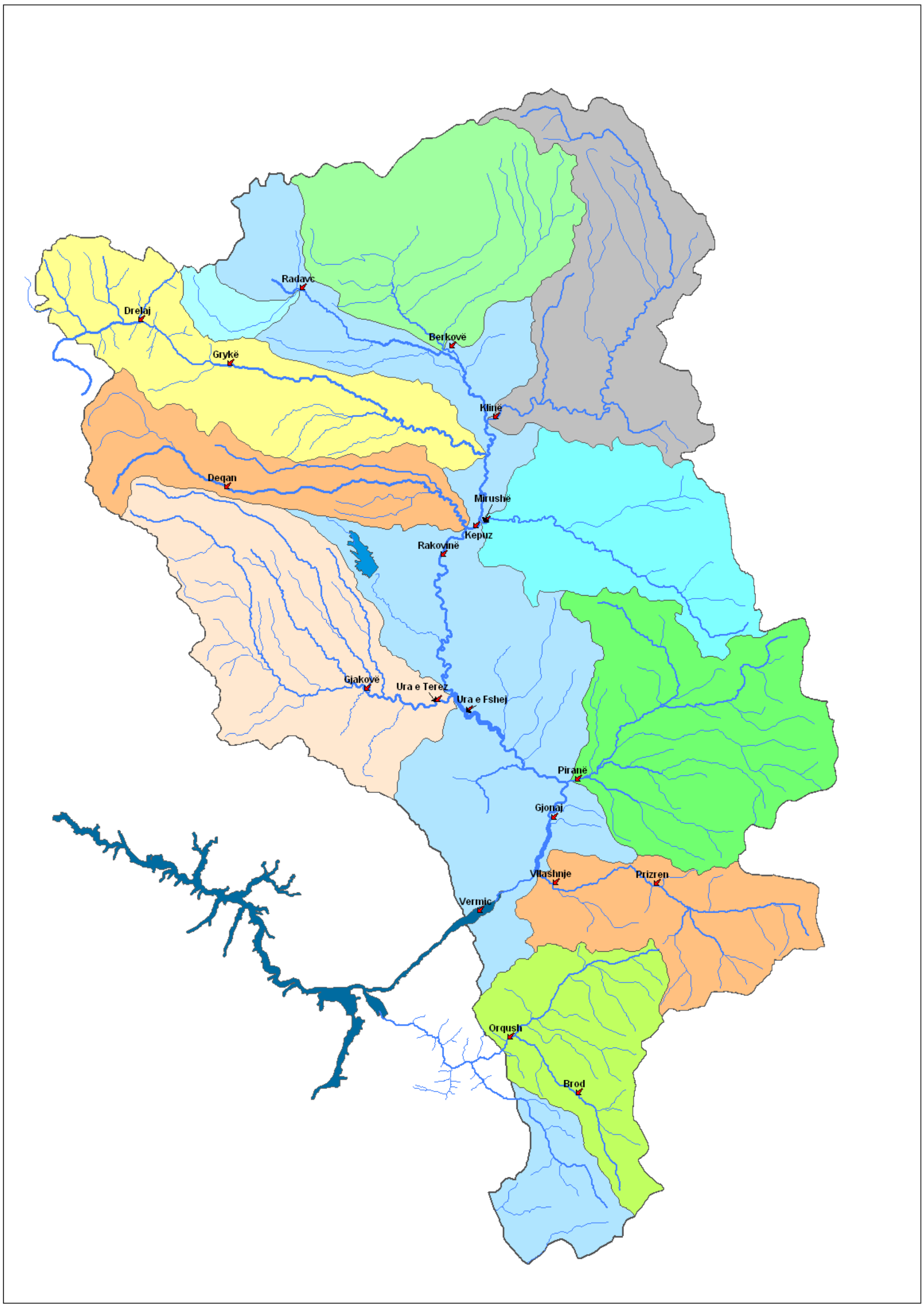


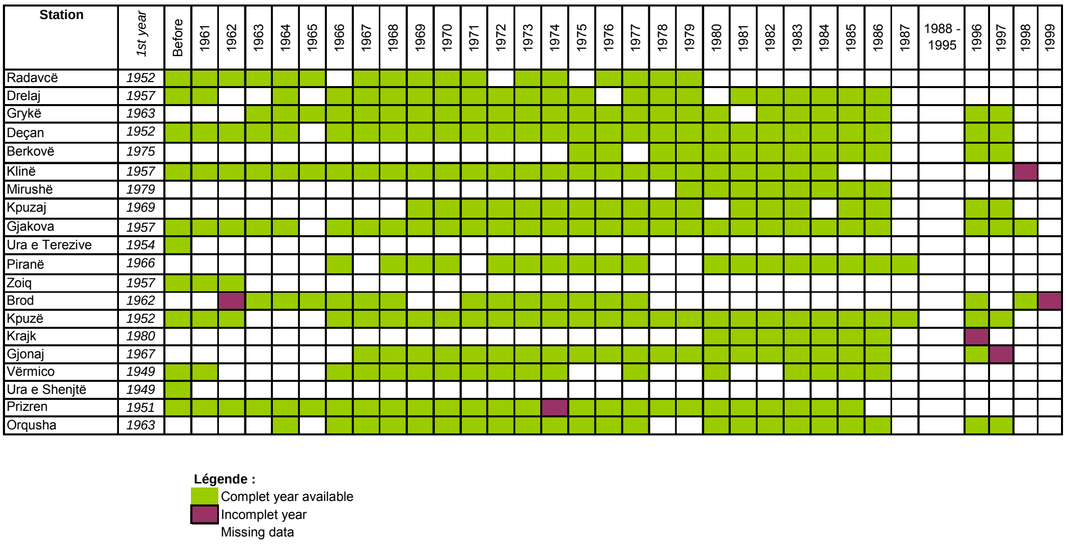
Figure 2: Existing and removed hydrometric stations



3.2 Daily flow data

Some digital times series are available in the database. They have seemly been transferred from the printed Hydrological Year Books held in KHMI, Prishtina. For unknown reasons flow data are only provided 1961, whilst water levels have been measured since 1952 at some stations.

Table 4: Available data of daily water levels



The flow series, although very incomplete and terminated in 1986, constitute an interesting basis for hydro-statistical analysis.

Some typing errors were corrected during our analysis.

Normally the water levels should be measured at 12 stations since the EAR Hydrometric Network Rehabilitation Project of 2002-2003, but some stations were vandalised. We have not yet got any flow data for recent period.

Table 5: Available data of daily discharges

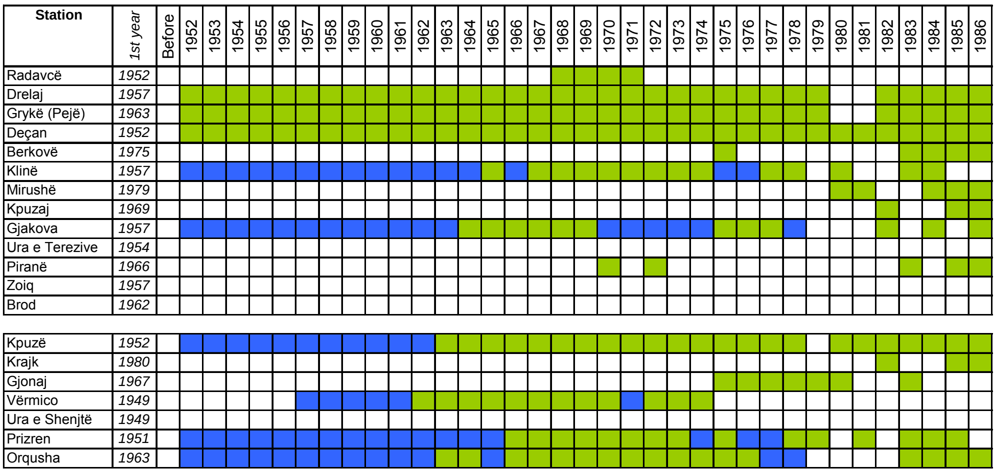
Station	1st year	Before	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Radavcë	*1952*									X	X	X	X															
Drelaj	*1957*		X	X	X	X		X	X	X	X	X	X		X	X	X			X	X			X	X	X	X	X
Grykë	*1963*				X		X		X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
Deçan	*1952*		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Berkovë	*1975*																X								X	X	X	X
Klinë	*1957*						X		X	X	X	X	X	X	X	X			X	X		X			X	X		
Mirushë	*1979*																					X	X			X	X	X
Kpuzaj	*1969*																							X			X	X
Gjakova	*1957*					X	X	X	X	X	X						X	X	X					X		X		X
Ura e Terezive	*1954*																											
Piranë	*1966*											X		X											X		X	X
Zoiq	*1957*																											
Brod	*1962*																											
Kpuzë	*1952*				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Krajk	*1980*																							X			X	X
Gjonaj	*1967*																X	X	X	X	X	X			X			
Vërmico	*1949*			X	X	X	X	X	X	X	X	X		X	X	X												
Ura e Shenjtë	*1949*																											
Prizren	*1951*							X	X	X	X	X	X	X	X		X			X	X		X		X	X	X	
Orqusha	*1963*				X	X		X	X	X	X	X	X	X	X	X	X	X							X	X	X	X

Légende :
- (green) Complet year available
- (purple) Incomplet year
- (white) Missing data

3.3 Monthly flow data

By combing the data from the three sources referred above (Master plan, Hydrological Year Books and Brian Faulkner's work), several monthly series were reconstructed for the period 1952-1986. These data sets, significantly longer than the daily flow series, are more adequate to achieve good statistical estimates of water resource reliability.

Table 6: Available data of monthly discharges



Légende :
- Complet year available
- Data from Master Plan, to be validated
- Missing data

The following table is the correlation matrix representing the correlation coefficient between each couple of stations.

Table 7: Correlation coefficient – flow data (R)

	Radavcë	Drelaj	Peje -Grykë	Deçani	Berkovë	Klinë	Mirusha	Mirushë Kpuzë	Gjakovë	Piranë	Drini Kpuz	Krajk	Gjonaj	Vermicë	Prizeren	Orqhusha
Radavcë	1.00															
Drelaj	**0.92**	1.00														
Peje -Grykë	**0.92**	**0.97**	1.00													
Deçani	**0.94**	**0.87**	**0.87**	1.00												
Berkovë		0.30	0.31	0.23	1.00											
Klinë	0.12	0.35	0.41	0.23	0.31	1.00										
Mirusha		0.13	0.13	0.04	0.69	**0.87**	1.00									
Mirushë Kpuzë		0.43	0.42	0.33	**0.83**		**0.91**	1.00								
Gjakovë	-0.10	0.21	0.18	0.16	0.73	0.68	0.83	0.46	1.00							
Piranë	0.70	0.37	0.37	0.29	0.64	0.66	**0.88**	**0.84**	**0.88**	1.00						
Drini Kpuz	0.62	0.72	0.73	0.62	0.63	0.80	0.56	0.70	0.58	0.68	1.00					
Krajk		0.67	0.66	0.56	0.89		0.79	0.81	0.49	0.85	**0.95**	1.00				
Gjonaj		0.77	0.76	0.55	0.20	0.78	0.72		0.73	0.59	**0.95**		1.00			
Vermicë	0.38	0.47	0.44	0.34		0.89			0.83	0.69	**0.92**			1.00		
Prizeren	**0.84**	0.42	0.41	0.32	0.21	0.52	0.71	0.45	0.52	0.51	0.43	0.56	0.70	0.50	1.00	
Orqhusha	**0.83**	**0.80**	0.77	0.75	0.38	0.44	0.25	0.48	0.20	0.50	0.75	0.76	0.54	0.65	0.34	1.00

While there a reasonable correlation (R >0.80 or $R^2 > 0.7$) between two stations, we can apply the corresponding regression equation to fill the gaps in the time series each other, such as:

- Q Drelaj = 1.361 Q Gryke + 0.151
- Q Gryke = 0.694 Q Drelaj + 0.13
- Q Drelaj = 0.962 Q Decani + 0.15
- Q Gryke = 1.352 Q Deçani + 0.41
- Q Mirushe = 0.534 Q Mirusha_Kpuz+0.12
- Q Kline = 1.506 Q Mirushe + 0.825
- Q Kline = 0.073 Q Kpuz - 0.332 (applied for only 1979)
- Q Gjakove = 10.62 Q Mirushe - 1.262
- Q Gjakove = 0.461 Q Kpuz + 1.835
- Q Kpuz = 0.483 Q Krajk + 1.382

- Q Vermice = 2.175 Q Kpuz + 3.34
- Q Gjonaj = 1.647 Q Kpuz + 4.975
- Q Gjonaj = 1.731 Q Kpuz + 7.78 for natural discharge (Jan-Avr and Oct-Dec)
- Q Gjonaj = 1.654 Q Kpuz + 1.692 Q Kpuz for influenced discharge (May-Sep)
- Q Orcusha = 0.166 Q Kpuz + 0.663
- Q Prizren = 0.616 Q Orcusha + 1.3 (beside flood)
- Q Orcusha = 1.101 Q Prizren + 0.211 (beside flood)

Note: it seems that the flood regime is quite different between the two latest sub basins (Prizren and Orcusha).

3.4 Rainfall data

According to the Director of the KHMI, most of the rainfall data were moved to Belgrade or destroyed, some of them may eventually be found in Montenegro. However it is not possible to obtain historical rainfall time series in Kosovo at this time.

Since 2004 some rainfall gauging stations have been progressively put into service, and some data are collected from following stations:

Table 8: Available daily rainfall from KHMI

STATION	2004	2005	2006	2007
BESIJANE		Nov-Dec	complete	complete
DARDANE		Oct-Dec	complete	complete
DEQAN			complete	
DRENAS	May-Dec	Nov-Dec	Jul-Dec	
FERIZAJ		Oct-Dec	complete	complete
GJAKOVE		Jul-Dec	complete	Jan-Sep
GJILAN		Oct-Dec	complete	complete
ISTOG		Oct-Dec	complete	complete
KAQANIK		Sep-Nov	complete	complete
KIEV		Oct-Dec	complete	complete
KLINA		Nov-Dec	complete	complete
LIPJAN		Oct-Dec	Jan-Aug	Jan-Jul
MALISHEVE	May-Dec	Jul, Nov-Dec	complete	
MITROVICE		Nov-Dec	complete	complete
NOVOBERD		Oct-Dec	complete	complete

PEJE		Oct-Dec	complete	complete
PRISHTINA		Oct-Dec	complete	complete
PRIZREN		Oct-Dec	complete	Jan-Oct
RAHOVEC		Oct-Dec	complete	
SKENDERAJ		Nov-Dec	complete	Jun-Dec
THERAND		Oct-Dec	complete	complete
VITI		Jul, Nov-Dec	complete	complete
VUSHTRRI		Aug-Dec	complete	Jan-Nov
OBLIQ	Apr-Sep			

Compared to 105 (108) gauging stations existing in Kosovo before the 1990's conflict, the density of current rainfall monitoring network is quite insufficient. The data sets covering 3 years in maximum can't be used for long-term water resources assessment. But they may be interesting for analysing some specific events (floods).

Two other sources of rainfall data can be used:

1) Isohyets of annual rainfall covering the total Drini basin in the Master Plan.

The isohyets were seemly established from the measured data during the same period as the flow data (1952-1981?). They are then appropriate for estimating the water balance in the basin.

We digitalised these isohyets in order to estimate the average annual rainfall in each of the principal sub-basins (see map below).

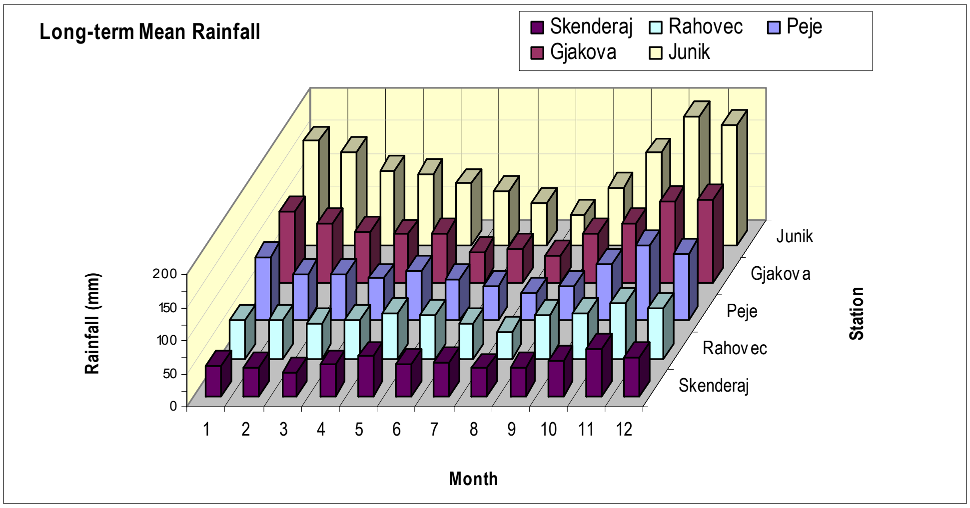
2) Mean monthly rainfall at key stations

We have also taken some basic monthly data from the Master Plan at 5 key stations (1948-1978), as presented in following table.

Table 9: Regional Rainfall Data (1948-1978) reviewed by Brian Faulkner

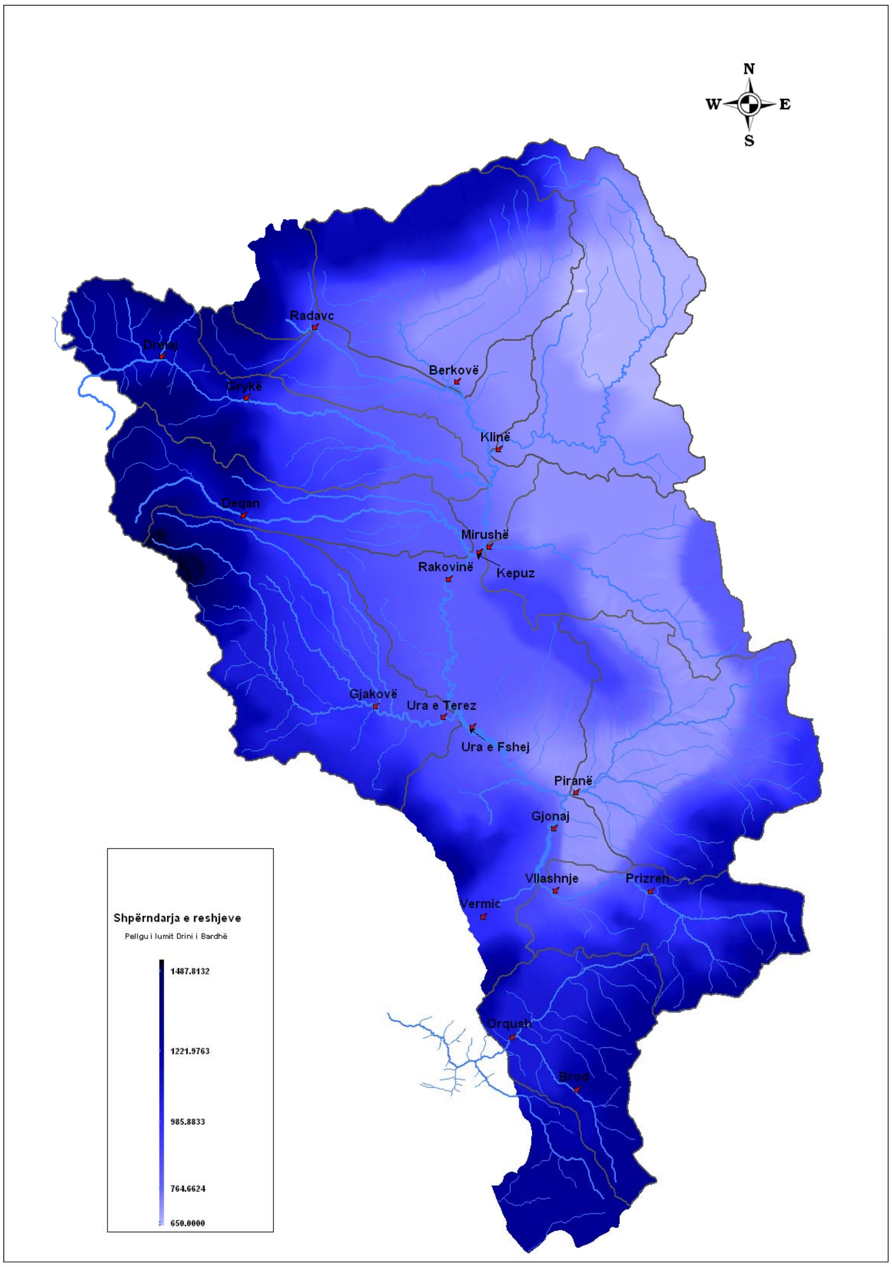
Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Skenderaj	45	43	35	47	60	49	52	42	43	54	71	59	600
Rahovec	59	58	53	58	69	65	54	40	67	68	84	77	752
Peje	97	71	71	64	76	63	53	42	53	85	114	101	890
Gjakova	108	90	78	74	75	47	52	43	75	90	123	127	982
Junik	158	142	113	107	94	83	64	46	88	140	194	183	1412
Mean	93	81	70	70	75	61	55	43	65	87	117	109	927
Regime	Snow Period			Snowmelt		Irrigation Season				Rainfall Recharge			

Figure 3: Long-term rainfall distribution at five stations of the Drini River Basin



It can be seen that the average rainfall for Drini river, estimated from the 5 stations, is 927 mm per year. In fact the annual rainfall varies from about 650 mm in the northern-eastern part to about 1500 mm in the mountains regions in the south-west and north-west. The spatial variations are substantial.

Table 10: Annual precipitation (mm)



3.5 Other climatologic data

There is no historic climatic data in Kosovo, except the evaporation data collected at the Water Plant at Radoniqi Dam in 2005 and 2007 (two years not complete). In fact the data are collected at the Dam for daily rainfall (snow and rain), water abstraction, evaporation, and storage variation in order to evaluate mass-balance of inflow and outflow into Radoniqi.

The data from the Dam are logged onto spreadsheets.

In his precedent study, the professor Brian Faulkner has found useful data from the Climate Atlas provided by the International Water Management Institute. This provides coarse but reliable long-term data for any selected world location for many key variables, including rainfall, evaporation, number of days with rain etc.

We retake these data for the present project. They are provided in following tables (source: IWMI).

Table 11: Deçani – Junik (Lat 42° 28' 34" N Long 20° 16' 41""E)

	P50	Rainfall (P75)	Days with rain	Temp (mean)	Days with frost	Wind Run	MAI	Penman (ET0)
	mm/ month	mm/ month	days/ month	deg. C	days/ month	m/s		mm/day
Jan	94.39	61.1	12.5	-0.7	24.3	3.1	2.9	0.68
Feb	76.87	45.92	11.9	1.1	18.9	3.6	1.48	1.07
Mar	83.92	53.65	12.9	4.7	13.5	3.5	0.97	1.79
Apr	85.91	59.11	13.9	9.1	4.1	3.2	0.74	2.68
May	80.09	51.57	13.1	13.9	1.1	2.6	0.47	3.55
Jun	64.32	38.39	11.5	17.1	0.5	2.5	0.3	4.22
Jul	51.45	30.71	8.2	19.5	0.3	2.5	0.2	4.87
Aug	46.23	22.15	8.1	19.4	0.3	2.3	0.17	4.29
Sep	70.73	54.06	8.5	15.9	0.6	2.3	0.62	2.93
Oct	85.56	54.06	9.6	10.7	2.7	2.7	0.98	1.78
Nov	122.2	80.08	13.2	5.5	7.7	3	2.64	1.01
Dec	114.63	77.88	13.1	1.2	18.3	3.1	3.69	0.68

Table 12: Gjakova (Lat 42° 23' 06" N Long 20° 26' 02"" E)

	P50	Rainfall (P75)	Days with rain	Temp (mean)	Days with frost	Wind Run	MAI	Penman (ET0)
	mm/ month	mm/ month	days/ month	deg. C	days/ month	m/s		mm/day
Jan	85.14	54.29	12.2	-0.5	24.1	2.9	2.58	0.68
Feb	68.47	40.52	11.6	1.5	18.9	3.4	1.29	1.08
Mar	77.72	50.44	12.5	5.2	12.9	3.3	0.88	1.84
Apr	78.87	55.09	13.5	9.7	3.1	3	0.67	2.75
May	73.19	45.87	12.9	14.5	0.8	2.5	0.41	3.62
Jun	57.36	33.56	11.1	17.7	0.3	2.3	0.26	4.31
Jul	45.52	26.2	7.8	20.1	0.2	2.4	0.17	4.99
Aug	42.63	20.57	7.8	19.9	0.2	2.2	0.15	4.38
Sep	63.6	49.14	8.3	16.4	0.5	2.2	0.55	2.96
Oct	78.26	49.14	9.3	11.1	2.2	2.5	0.9	1.77
Nov	112.62	73.02	12.8	5.9	6.9	2.8	2.34	1.04
Dec	104.94	70.57	12.9	1.5	17.9	2.9	3.35	0.68

Table 13: Rahovec (Lat 42° 23' 55" N Long 20° 38' 46"" E)

	P50	Rainfall (P75)	Days with rain	Temp (mean)	Days with frost	Wind Run	MAI	Penman (ET0)
	mm/ month	mm/ month	days/ month	deg. C	days/ month	m/s		mm/day
Jan	75.75	48.3	11.9	-0.5	24.1	2.8	2.33	0.67
Feb	60.89	36.24	11.3	1.7	18.9	3.2	1.17	1.07
Mar	70.55	46.27	12.2	5.5	12.5	3.2	0.81	1.85
Apr	72.64	51.46	13.2	10.1	2.5	3	0.61	2.82
May	69.35	43.39	12.8	14.9	0.5	2.5	0.38	3.68
Jun	55.11	32.46	11	18.1	0.2	2.3	0.25	4.38
Jul	43.34	24.78	7.7	20.4	0.1	2.3	0.16	5.03
Aug	40.59	20.04	7.6	20.3	0.1	2.1	0.15	4.42
Sep	57.97	44.09	8.1	16.7	0.3	2.1	0.49	2.98
Oct	70.66	44.09	9	11.3	1.9	2.4	0.81	1.76
Nov	101.71	65.95	12.5	6	6.8	2.7	2.2	1
Dec	94.31	63.15	12.7	1.5	18	2.8	3.04	0.67

Table 14: Skenderaj (Lat 42° 44' 49" N Long 20° 47' 20"" E)

	P50	Rainfall (P75)	Days with rain	Temp (mean)	Days with frost	Wind Run	MAI	Penman (ET0)
	Mm/ month	mm/ month	days/ month	deg. C	days/ month	m/s		mm/day
Jan	68.82	44.47	11.6	-0.9	24.7	2.9	2.28	0.63
Feb	57.07	34.84	11.1	1.3	19.3	3.4	1.13	1.06
Mar	64.99	42.89	12.1	5.3	13	3.3	0.75	1.84
Apr	70.21	50.4	13.1	9.9	3.1	3.1	0.6	2.78
May	72.75	46.89	13.1	14.6	0.5	2.5	0.42	3.63
Jun	63.21	38.87	11.4	17.7	0.2	2.4	0.3	4.26
Jul	48.98	29.45	8.2	19.9	0.1	2.4	0.2	4.87
Aug	42.57	21.74	7.9	19.8	0.1	2.3	0.16	4.38
Sep	58.06	39.72	8.1	16.3	0.3	2.3	0.44	2.99
Oct	64.24	39.72	8.9	11	2.5	2.6	0.72	1.77
Nov	92.09	61.04	12.2	5.4	7.9	2.8	2.08	0.98
Dec	85.66	57.56	12.4	1.1	19.1	2.9	2.95	0.63

Table 15: Pejë (Lat 42° 39' 32" N Long 20° 17' 53"" E)

	P50	Rainfall (P75)	Days with rain	Temp (mean)	Days with frost	Wind Run	MAI	Penman (ET0)
	mm/ month	mm/ month	days/ month	deg. C	days/ month	m/s		mm/day
Jan	89.03	57.37	13	-2.4	27	3.8	2.89	0.64
Feb	74.73	44.85	12.5	-0.9	21.7	4.2	1.61	0.96
Mar	81.81	52.58	13.6	2.4	16.9	4	1.07	1.59
Apr	85.61	59.36	14.81	6.8	6.8	3.8	0.82	2.42
May	89.45	60.21	14.2	11.5	2.2	3.1	0.6	3.24
Jun	77.96	50.2	12.6	14.6	0.9	2.9	0.44	3.82
Jul	63.29	40.28	9.2	16.9	0.5	2.9	0.29	4.48
Aug	52.03	25.72	9	16.9	0.5	2.7	0.21	4.01
Sep	72.26	51.92	9	13.6	1.1	2.8	0.63	2.75
Oct	82.32	51.92	10	8.7	4.3	3.3	0.98	1.71
Nov	115.55	75.58	13.4	3.6	10.7	3.7	2.52	1
Dec	107.8	72.87	13.6	-0.5	21.6	3.8	3.67	0.64

Note that the rainfall P50 denotes the median (not average) annual value: they are presented in terms of P – probability of annual occurrence.

Pemman ET0 represents the reference evapotranspiration calculated by Penman-Monteith method. Real evapotranspiration can thus be obtained by application of crop coefficient values (K_c) for different types of land cover.

4 HYDRO-STATISTICS

4.1 Water balance

Water balance assessment is very important for an efficient water resources management. It can provide basic information for planning of energy, irrigation, water supply, even prevention against floods.

The water balance of each territory depends on natural factors, as its relief, climate, geological conditions, soil nature, and vegetation. It also can be affected by human activities.

The following table shows the inter-annual summary at each hydrometric station for that sufficient historic data are available.

Table 16: Water balance calculated for ten hydro-metric stations

River	Station	Period	Surface (km²)	Mean annual flow (m3/s)	Run-off (mm)	Annual precipitation (mm)	E=P-R (mm)
BISTRICA E PEJÓS	Drelaj	1952-1986	166.1	4.33	822	1332	510
BISTRICA E PEJÓS	Grykë	1952-1986	254.7	6.21	769	1320	551
BISTRICA E DECANIT	Deçan	1952-1986	114	4.64	1284	1334	50
KLINA	Klinë	1952-1986	423	2.04	152	697	545
ERENIK	Gjakova	1952-1986	455	12.25	849	1132	283
WHITE DRINI	Kpuzë		2116	26.1	389	892	503
WHITE DRIN	Gjonaj	1975-1986	3904	45.07	364	913	549
WHITE DRINI	Vërmico	1952-1986	4368	59.34	428	932	504
BISTRICA E PRIZERENIT	Prizren	1952-1986	158	4.76	950	1153	203
PLLAVA	Orqusha	1952-1986	252	5.12	641	1195	554

At Deçan station the runoff is very important in comparison with the precipitation, what can be explained by the contribution of the important springs in the catchments. It seems that water could be transferred from Peje and other basins (out of Kosovo) to Deçan through underground network.

For some sub-basins the hydrological regime is dominated by groundwater and snow melting, especially for dry period, such as Deçani, Pejë, Prizren etc. In this case, the low water losses or deficit (E) are in fact influenced by groundwater and do not represent the real evapotranspiration.

Nevertheless for the Prizren sub-basin, the water losses (E) are anomaly low, eventually due to data mistakes.

A spatial runoff map and water deficit map are established with appropriate interpolation method. From this map, the annual mean flow can be easily estimated by:

$Q = (P – E) .S$

P is annual precipitation on the sub-basin (spatial average). E is the losses and S is the surface of the sub-basin.

A catalogue can be established as follows:

Water body	Description	Surf.	P	Deficit	P-D	Qm3/s	Q specific l/s/km²	Upstream unit	Q cumul	Surf. cumul

These data will be integrated into the GIS database allowing the users to quickly obtain the annual flow values at each strategic point of the river basin.

4.2 Statistic annual flows

The annual flows of different probabilities are estimated in following table.

Table 17: Statistic annual flows (m3/s)

				Dry years		Median	Wet years	
River	Station	Period	Surface (km²)	Q5%/T=20 years	Q10% /T=10 years	Q50%	Q90% /T=10 years	Q95 % /T=20 years
BISTRICA E PEJÓS	Drelaj	1952-1986	166.1	2.94	3.19	4.23	5.61	6.08
BISTRICA E PEJÓS	Grykë	1952-1986	254.2	4.06	4.44	6.04	8.22	8.97
BISTRICA E DECANIT	Deçan	1952-1986	118.9	2.88	3.17	4.48	6.32	6.97
KLINA	Klinë	1952-1986	430.1	0.77	0.93	1.80	3.48	4.20
ERENIK	Gjakova	1952-1986	455	5.59	6.53	11.26	19.43	22.67
WHITE DRINI	Kpuzë	1952-1986	2050	15.88	17.58	25.16	36.00	39.86
WHITE DRIN	Gjonaj	1975-1986	3904	31.31	33.89	44.84	59.32	64.21
WHITE DRINI	Vërmico	1952-1986	4320	37.55	41.25	57.49	80.11	88.02
BISTRICA E PRIZERENIT	Prizren	1952-1986	167.9	2.36	2.72	4.42	7.19	8.26
PLLAVA	Orqusha	1952-1986	253.4	3.21	3.53	4.95	6.94	7.64

It can be seen that the variations from dry years to wet years are not very important in comparison with other river basins. The contribution of groundwater and snow melting to base flows are clearly dominating.

4.3 Flow duration curves

As water balance assessment, Flow duration curves (FDC) is one of best information about water resources availability. Also the flow duration curves can offer necessary indictors for:

- Identification of Ecological Minimum Flow (EMF)
- setting of permits for water abstraction
- Estimation of dilution quantities for wastewater

We have therefore established the FDC for every gauging station in Drini river basin from ***daily historic data.*** Though most of the time series terminated in 1986, the result from available data should be acceptable for most of the stations.

The results are presented in the following figures. Note that for a typical FDC the X-axis is exceedance probability and the Y-axis is a logarithmic scale of flow.

Three flow values are indicated on each figure:

- 1/10 mean annual flow: 10% of the long-term annual flow
- Q90%: the flow which is equalled or exceeded 90% of the time (in a year)
- Q95%: the flow which is equalled or exceeded 95% of the time

Figure 4: Flow duration curve Drelaj

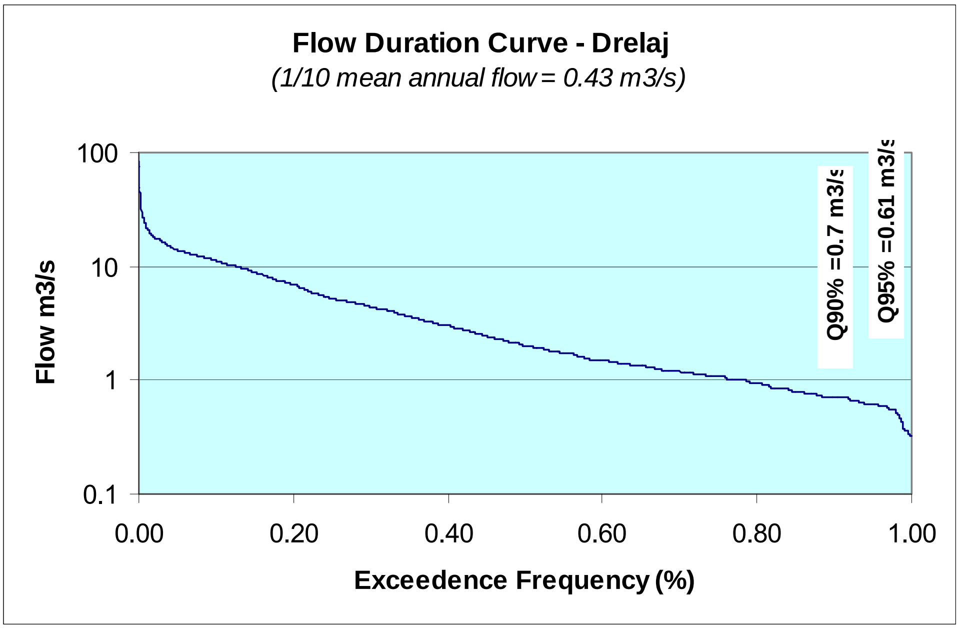


Figure 5: Flow duration curve Grykje

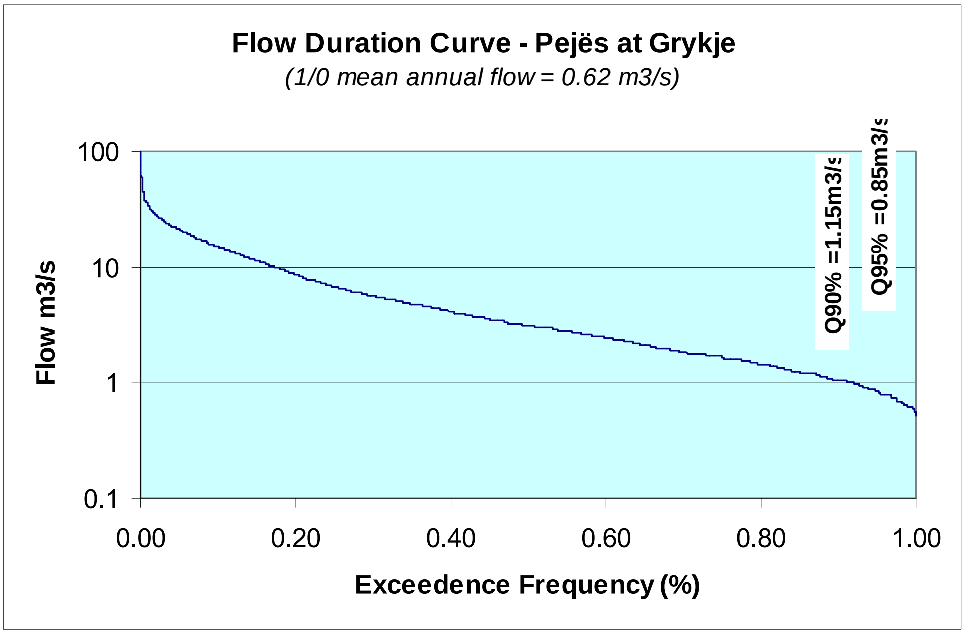


Figure 6: Flow duration curve Decan

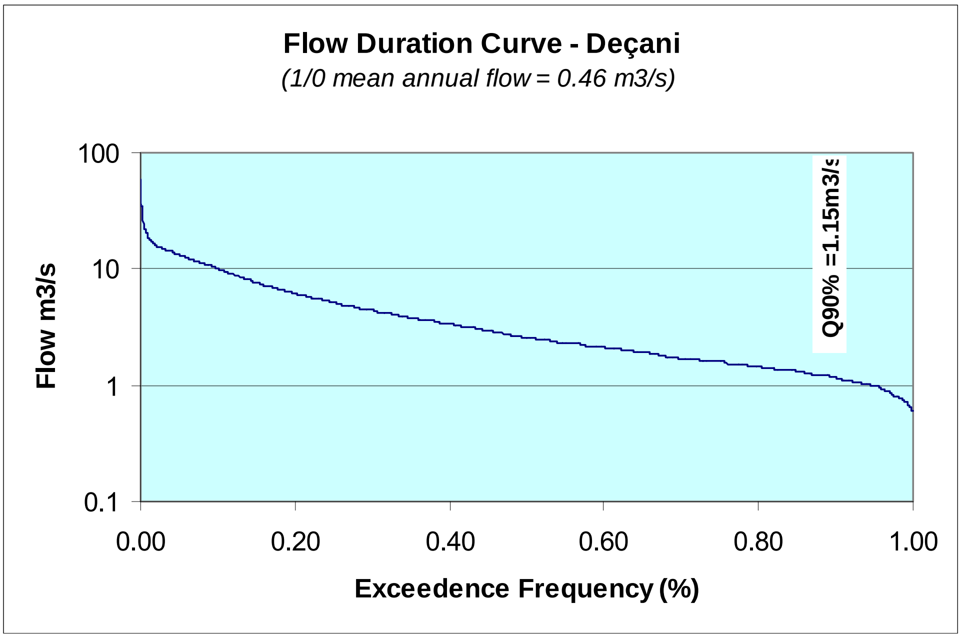


Figure 7: Flow duration curve Klina

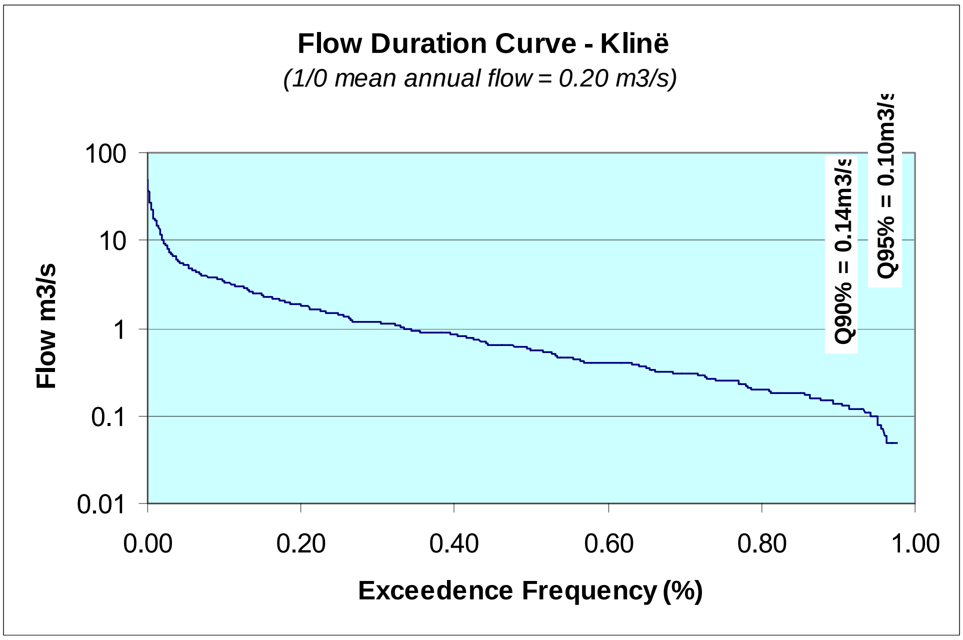


Figure 8: Flow duration curve Gjakova

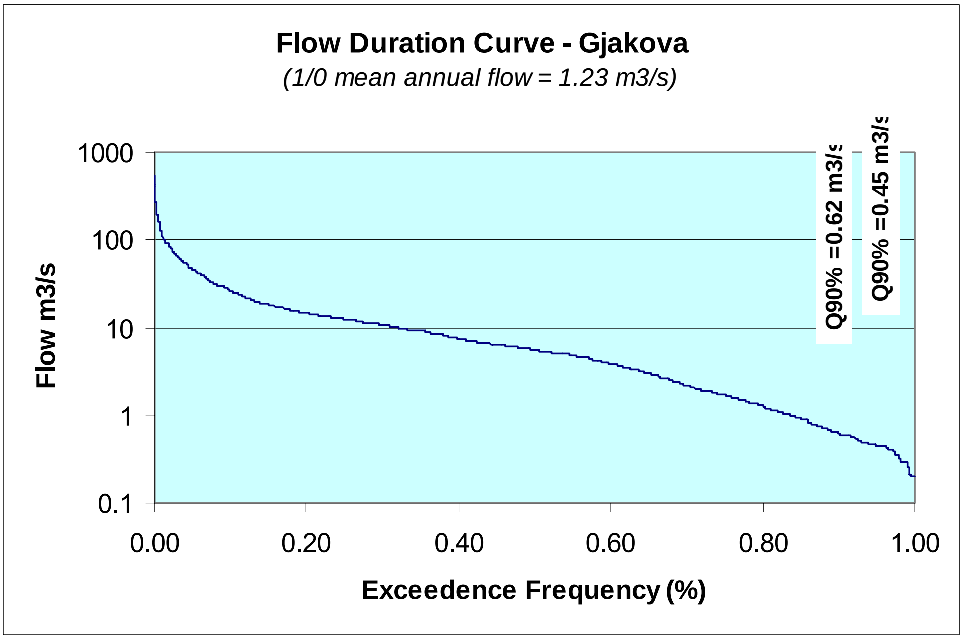


Figure 9: Flow duration curve Kapuz

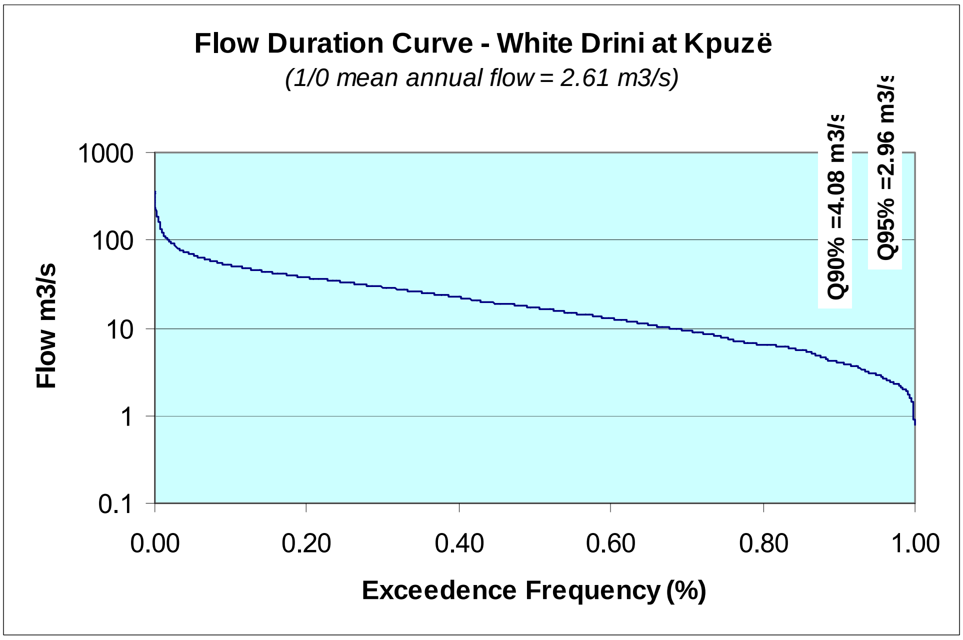


Figure 10: Flow duration curve Gjonaj

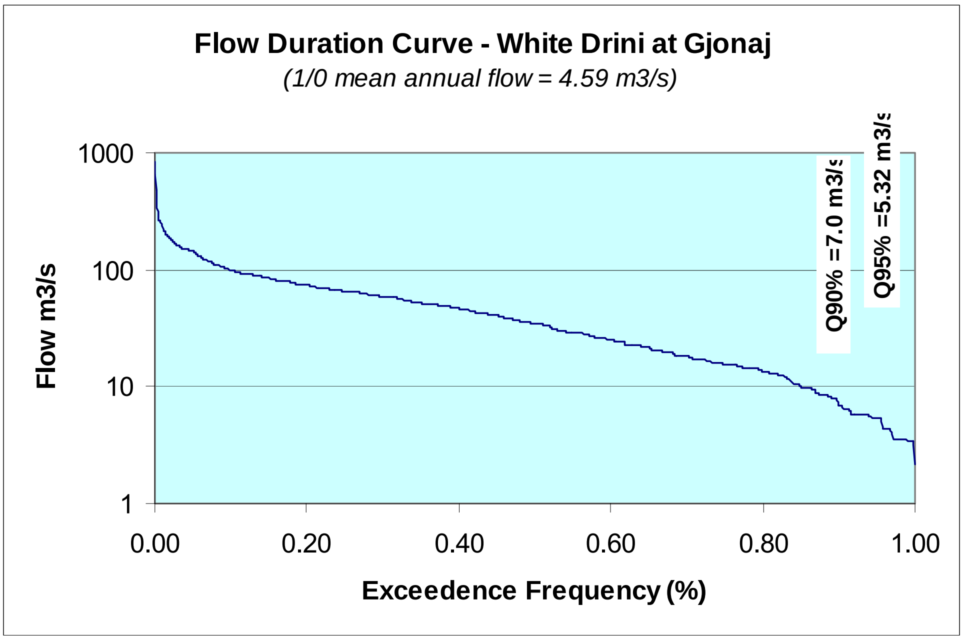


Figure 11: Flow duration curve Vermice

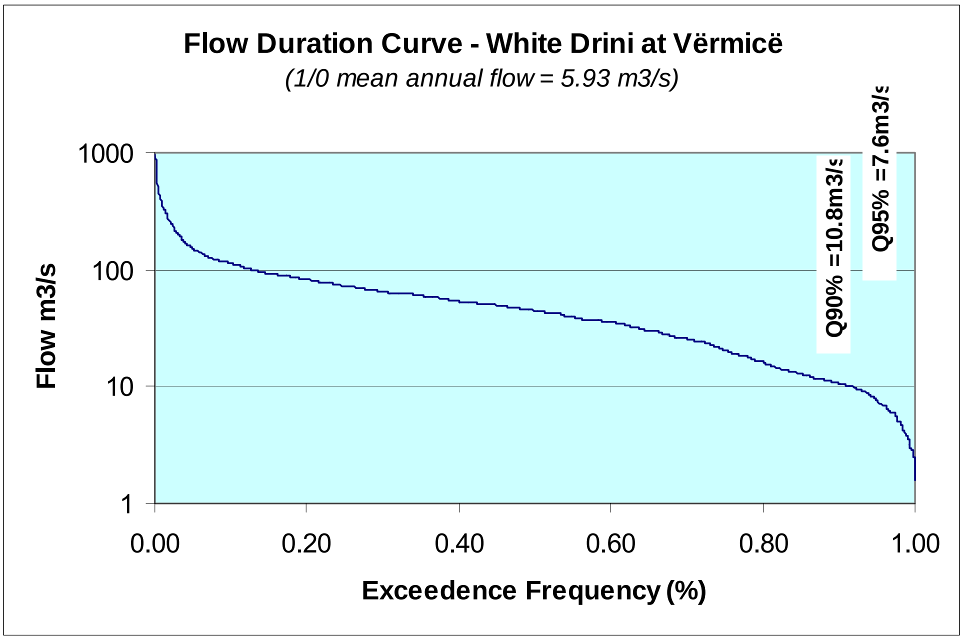


Figure 12: Flow duration curve Prizren

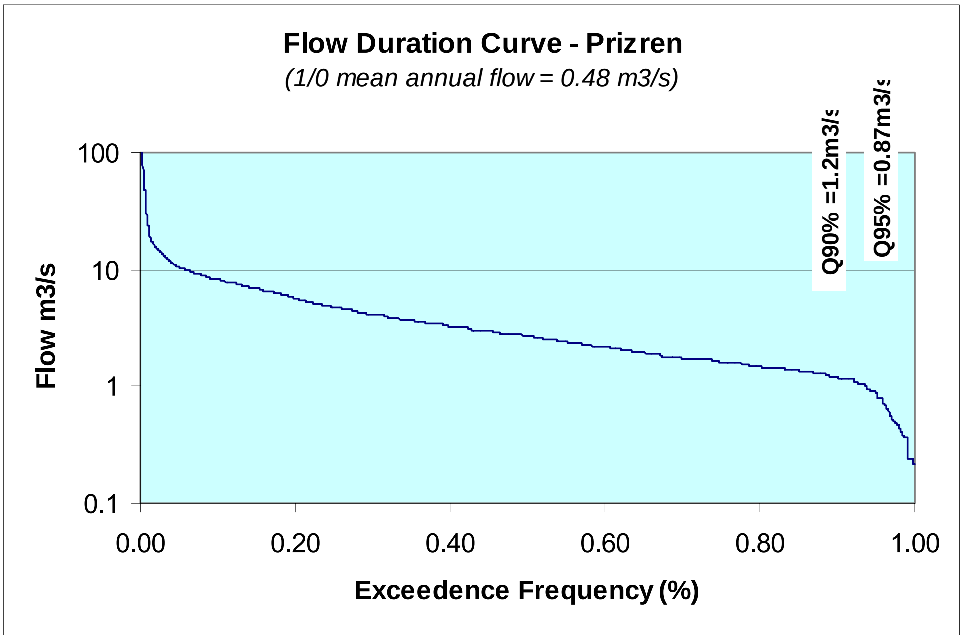
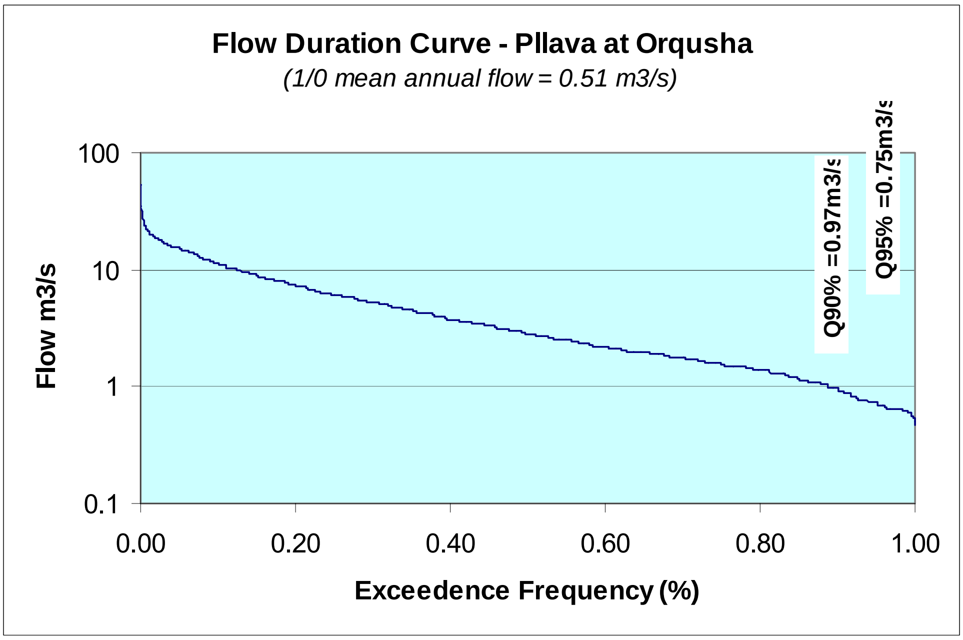


Figure 13: Flow duration curve Orqusha



Note that the low inflows at Kpuz, Gjonaj and Vermicë are influenced by irrigation abstractions.

4.4 Low flow indicators

From the above flow duration curves, three indicators can be proposed for the Ecological Minimum Flow:

- Q95%: flow value associate with 95% exceedance probability
- Q90%: flow value associate with 90% exceedance probability
- 1/10 Qmean: flow corresponding to 10% of the mean annual flow

Normally Q95 is used for rivers where surface runoff dominates with important variation of flow in a year.

Q90% is used as indicator of flow highly influenced by groundwater, which is relatively constant in a year.

The 1/10 Qmean indicator can be used by simplification.

Table 18: Low flow indicators (m3/s)

River	Station	Surface (km²)	Q95%	Q90%	1/10 Qmean
BISTRICA E PEJÓS	Drelaj	166.1	0.61	0.70	0.43
BISTRICA E PEJÓS	Grykë	254.7	0.85	1.15	0.62
BISTRICA E DECANIT	Deçan	114	0.98	1.15	0.46
KLINA	Klinë	423	0.10	0.14	0.20
ERENIK	Gjakova	455	0.45	0.62	1.23
WHITE DRINI	Kpuzë	2116	2.96	4.08	2.61
WHITE DRIN	Gjonaj	3904	5.32	7.00	4.59
WHITE DRINI	Vërmico	4368	7.60	10.80	5.93
BISTRICA E PRIZERENIT	Prizren	158	0.87	1.20	0.48
PLLAVA	Orqusha	252	0.75	0.97	0.51

We can see that Q95% is always higher than 1/10 Qmean except two stations: Klinë and Gjakova.

Contrary to the annual mean flow, the interpolation of these indicators beyond gauging stations is not easy. It's strongly recommended to measure the flow at different points of the river during a dry season in order to identify the odd points (springs, concentrated losses by infiltration….).

The objective is to establish the so called "hydrological profile of low flow", which will allow us to interpolate the above indicators (or another low flow indicator) to any segment of the river.

5 FLOOD FLOW ANALYSIS

The flood magnitude expected to occur with a certain return period is said design flood. Design floods are required for flood protection measures in a river basin and for design of hydraulic structures.

The choice of design flood return period depends on the project and the safety criteria. The following return periods are generally adopted:

- Urban storm water drainage: 10 to 30 years
- Small diversion structures and small storage dams: 50 - 100 years
- Urban protection against flooding: 100 years
- Large dams: 5000 – 10000 years or PMF (probable maximum flood).

International standards and guidelines defining safety criteria often differ from country to country. Definitely design floods and advanced design procedures provide a decisive input into a comprehensive flood risk management which includes flood damage prevention and disaster mitigation. Regarding the immense losses of life and property caused by worldwide flood catastrophes, the selection of appropriate design criteria and, consequently, suitable procedures to determine the corresponding design flood are essential for a functioning flood risk management (*Refer to the presentation of frequency analysis in Methodologies and tool Box prepared during this project).*

For Drini River the objectives are to:

- define a baseline for flood flow analysis for whole Drini River Basin
- and estimate flood flows for the area around Skenderaj city defined as pilot area for flood risk management

5.1 Maximum Rainfall

The daily maxima samples constituted from observed data in the Drini River basin are presented below:

Table 19: Daily maxima rainfall extracted from observed time series (in mm)

	Prizren		Prishtina		Peje		Kukes	
Elevation (m)	402		573		498		354	
1977		23/11/1977		30/12/1977		30/12/1977		
1978	45	19/3/1978	42	31/8/1978	52	14/2/1978		14/12/1978
1979	97	19/11/1979	53	19/11/1979	120	17/11/1979		19/11/1979
1980	33	10/10/1980	30	24/5/1980	84.5	10/12/1980	38	13/10/1980
1981	36	19/3/1981	39	24/10/1981	49.8	23/10/1981	40	24/10/1981
1982	98	10/05/1982	53	22/8/1982		10/07/1982	39	15/3/1982
1983	45	15/6/1983		31/1/1983		02/07/1983	28	02/07/1983

1984	38	06/12/1984		17/11/1984		20/11/1984	75	26/8/1984
1985	75	19/11/1985		13/12/1985	85	20/11/1985	36	05/03/1985
1986	82	08/02/1986	82	08/02/1986	28	02/02/1986	46	01/05/1986
1987	35	30/1/1987	27	18/11/1987	43	01/11/1987	46	12/09/1987
1988	52	04/07/1988	25	22/11/1988	39	12/02/1988	26	03/01/1988
1989	41	23/11/1989	50	25/11/1989	49	30/4/1989	62	03/02/1989
1990	27	04/10/1990		04/10/1990	59	04/10/1990	36	04/10/1990
1991	39	15/2/1991	25	21/10/1991	56	21/10/1991		01/02/1991

The highlighted values are quite uncertain. Some other values may be underestimated because the observations were not complete in many years.

Frequency analysis with Gumbel distribution gives the following results:

Table 20: Maxima annual rainfall (mm /day)

	Prizren	Prishtina	Pejë	Kukes
T2 years	49	40	56	41
T5 years	71	55	79	53
T10 years	85	66	95	62
T20 years	98	76	109	70
T50 years	116	89	128	80
T100 years	129	98	143	88

Observation data are available at only three stations. For other parts of the Drini river basin, some statistic data can be found in the Master Plan. They are estimated from the time series observed during 1948-1978, which are not available currently in Kosovo.

Table 21: Maxima annual rainfalls estimated in 1983 (mm/ day)

	Return period (years)					
Station	1000	100	50	10	4	2
Junik	199	156	143	112	93	76
Peje	185	139	124	90	70	52
Prizren	151	114	102	76	60	45
Prishtina	92	73	67	53	45	37
Ferizaj	151	113	102	74	58	43

Ribaric	95	75	69	55	46	38
Jazinc	110	94	87	68	58	48
Gjakova	162	125	114	87	71	56

So for three stations, Prizren, Prishtina and Pejë, we have two estimations using different data. The estimations in the first table are hereafter called by “updated” estimations because more recent data are used. Compared to 1983’s average, the updated rainfall is increased by about 15% for all the return periods and all the stations.

The above daily maxima are based on gauge-measured daily rainfalls (Pd) observed at fixed time each day (at 8 o’clock a.m. for example). Due to the difference between actual and observed maxima, fixed observation data may not yield true annual maxima for rainfall frequency analysis. In order to obtain the corresponding 24-hour rainfalls (P24h), a bias correction should be used (i.e. Weiss correction): P24h = 1.14 Pd.

Therefore to obtain the actual 24-hour maxima rainfall, the 1983’s estimation is increased by 15% for update purpose and 14% for Weiss correction.

Table 22: Maxima 24-hour annual rainfalls (mm)

	Return period (years)					
Station	1000	100	50	10	4	2
Junik	261	205	187	147	122	100
Peje	243	182	163	118	92	68
Prizren	198	149	134	100	79	59
Prishtina	121	96	88	69	59	49
Ferizaj	198	148	134	97	76	56
Ribaric	125	98	90	72	60	50
Jazinc	144	123	114	89	76	63
Gjakova	212	164	149	114	93	73

For durations shorter than 24 hours, some statistic data exist in Master Plan. For a given duration t the rainfall can be estimated from the 24-hour rainfall by following relationship (cf. presentation of Montana formula in Methodologies and tool box):

$$P_t = P_{24h}\left(\frac{t}{24}\right)^{0.21}$$

Where t is the duration expressed in hour (1 <t < 48h) and b=0.21 is called Montana coefficient.

The Montana formula allows calculating rainfall for any duration and any return period, provided that the 24-hour rainfall is known.

Table 23: Montana rainfall at Prizren

T (years)	1h	3h	6h	12h	24h	48h
100	68.7	86.6	100.2	115.8	134	155.0
10	51.3	64.6	74.7	86.5	100	115.7
4	38.5	48.5	56.1	64.8	75	86.8
2	30.3	38.1	44.1	51.0	59	68.2

Table 24: Montana rainfall at Pejë

T (years)	1h	3h	6h	12h	24h	48h
100	83.6	105.3	121.8	140.9	163	188.5
10	60.5	76.2	88.2	102.0	118	136.5
4	47.2	59.4	68.8	79.5	92	106.4
2	34.9	43.9	50.8	58.8	68	78.7

Table 25: Montana rainfall at Ribaric

T (years)	1h	3h	6h	12h	24h	48h
100	46.2	58.2	67.3	77.8	90	104.1
10	36.9	46.5	53.8	62.2	72	83.3
4	30.8	38.8	44.8	51.9	60	69.4
2	25.7	32.3	37.4	43.2	50	57.8

Table 26: Montana rainfall at Gjakova

T (years)	1h	3h	6h	12h	24h	48h
100	76.4	96.3	111.4	128.8	149	172.3
10	58.5	73.7	85.2	98.6	114	131.9
4	47.7	60.1	69.5	80.4	93	107.6
2	37.5	47.2	54.6	63.1	73	84.4

Table 27: Montana rainfall at Prishtina

T (years)	1h	3h	6h	12h	24h	48h
100	45.1	56.8	65.7	75.9	88	101.6
10	35.6	44.9	51.9	60.1	69	80.4
4	30.3	38.1	44.1	51.0	59	68.2
2	24.9	31.3	36.3	41.9	49	56.1

The Intensity- duration- frequency (IDF) curves can be plotted from these data. An IDF curve (cf. definition in “Methodologies and tool box”) indicates the rainfall intensity for a given duration and return period.

Figure 14: Intensity duration frequency curve Prizren

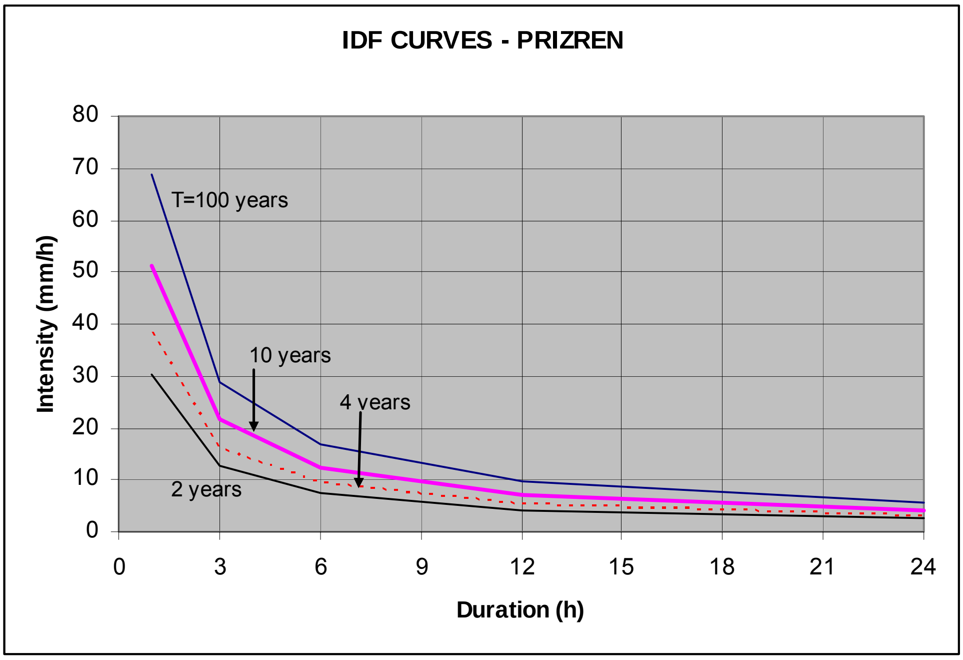


Figure 15: Intensity duration frequency curve Gjakova

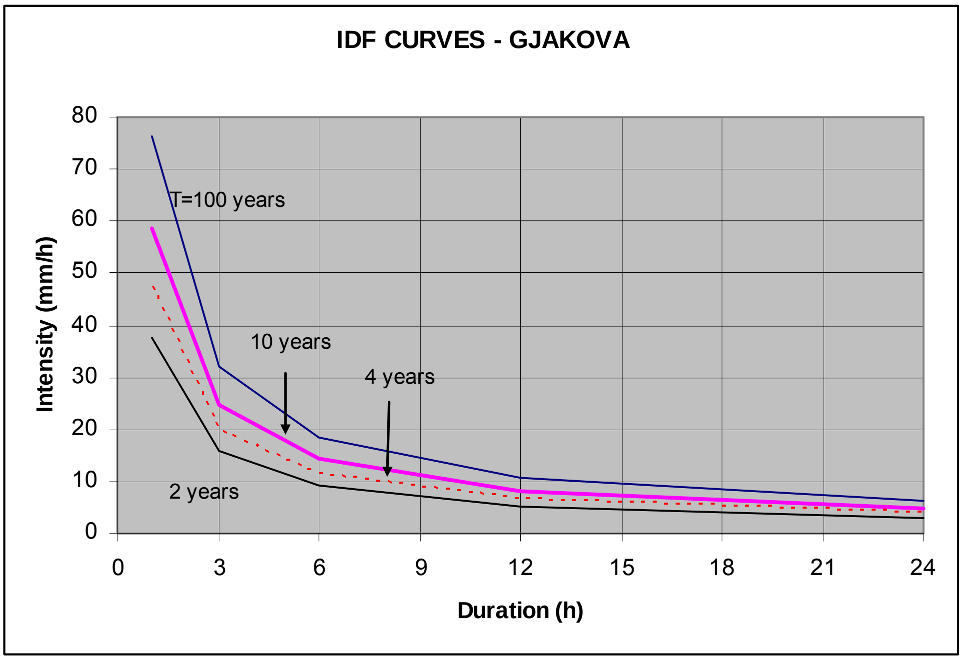
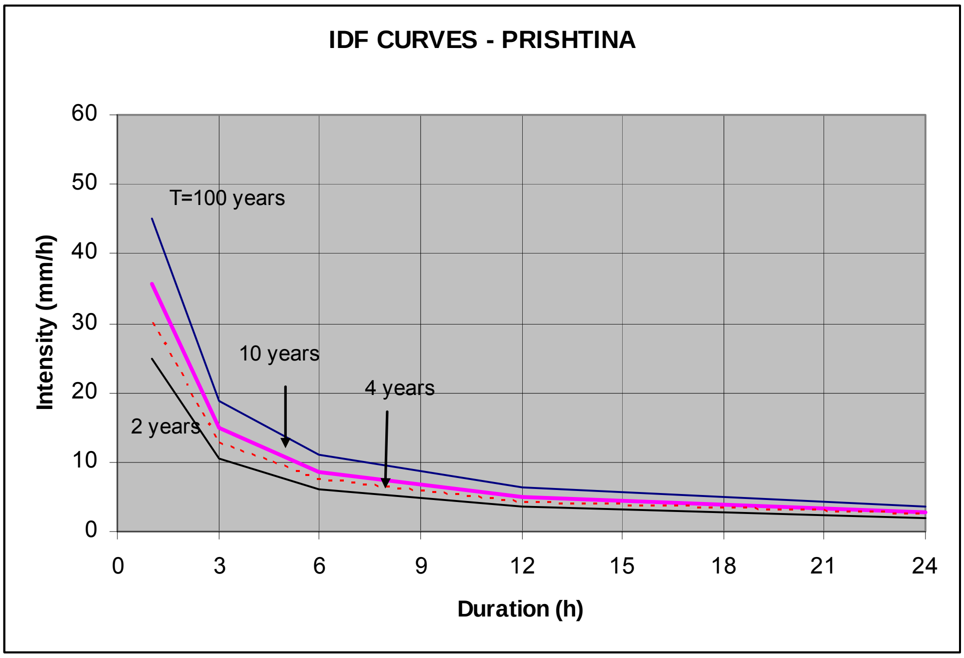


Figure 16: Intensity duration frequency curve Prishtina



5.2 Maximum flow

Some samples of annual daily maxima are constituted from daily flow observations.

Table 28: Annual maxima of daily flows

Station	Observation period	Number of years
Pejes at Drele	1959-1986	24
Pejes at Gryke	1954-1986	30
Decan	1955-1986	31
Gjakova	1958-1986	24
Istog at Berkov	1983-1986	5
Kline	1967-1983	10
Mirushe at Mirushe	1980-1986	5
Mirushe at Kpuz	1982-1986	3
Toplluha at Piran	1970-1986	5
Prizeren	1952-1985	32
Oqusha	1953-1978	26
Radavce	1968-1971	4
Kpuz	1953-1986	33
Krajk	1982-1986	3
Gjonaj	1975-1983	7
Vermice	1957-1974	18

Some of them are quite uncertain with evident incoherence, for example between Gjonaj and Vermicë. More analysis should be engaged in order to validate the observed data.

Maximum flows for 10 years return period are obtained by fitting log-Pearson distribution in the following table.

Table 29: Daily maximum flow for 10 years return period

Station	River	Watershed surface (km2)	Elevation difference (m)	Length of flow path (km)	Q10 log-Pearson (m3/s)
Berkovë	Istogut	438.4	231	17.5	
Drelaj	Bistrica e Pejës	166.1	900	17.3	55.3
Grykë	Bistrica e Pejës	254.2	1300	28.6	81.3
Klinë	Klina	430.1	1031	70.9	99
Mirushë	Mirushë	126.5			
Mirushë	Kpuzaj	332.5	530	37.5	64
Deçani	Bistrica e Deqanit	118.9	1410	21.1	54.4
Gjakovë	Ereniku	455	2000	39.9	453
Ura e Terzive	Erenik	510.5	2012	41.0	
Piranë	Toplluha	501	610	33.2	
Prizren	Bistrica e Prizrenit	167.9	1560	19.4	74.5
Vllashnje	Bistrica e Prizrenit	247.5	1730	32.1	
Orqush	Plava	253.4	631	19.5	94.1
Radavc	Drini i Bardhë	142.6	160	13.7	
Kepuz	Drini i Bardhë	2050	280	47.7	523.6
Gjonaj	Drini i Bardhë	3904	320	99.9	Sampling too uncertain
Vermicë	Drini i Bardhë	4320	344	113.5	Sampling too uncertain

The data presented in the above table, combined with the rainfall data of the precedent paragraph constitute the baselines for flood flow estimations. The classic methods such as Rational Method or SCS rainfall- runoff model can be used: their principles are presented in “Methodologies and tool box”.

5.3 Flood flow estimation for the Skenderaj pilot area

The city of Skenderaj is exposed to flooding risk from Kline River. The area is chosen as pilot area for flood risk management in this project.

The watershed of Kline River at Skenderaj has following morphological characteristics:

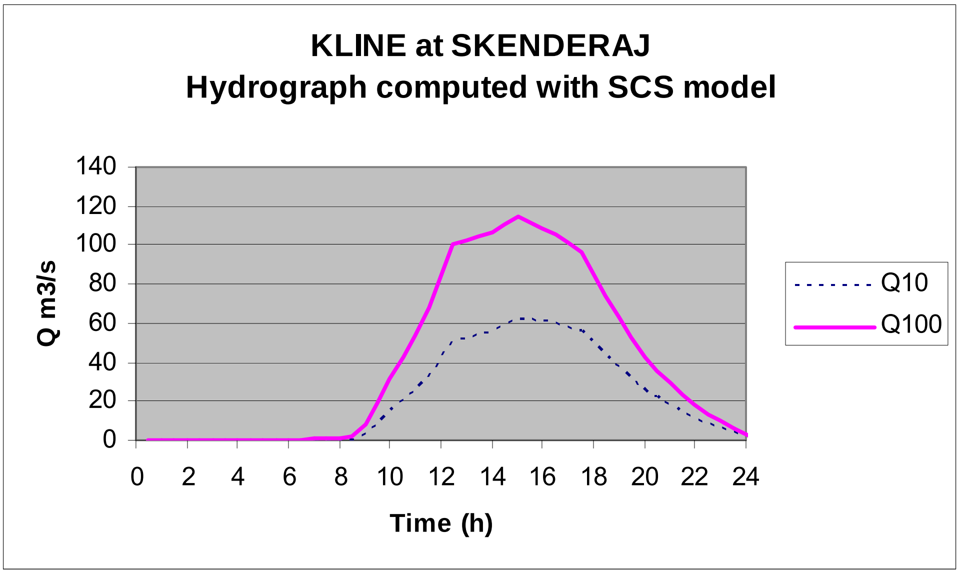
- Surface (km²) 93.2
- Elevation difference (m): 450
- Length (km): 30
- Curve number (N): 75

The hydrographs are computed by SCS rainfall – runoff model for 10 and 100 years return periods:

Table 30: Design floods of Kline River at Skenderaj

	Q10	Q100
24h precipitation (P24 in mm):	72	98
Effective rainfall duration D (h)	15	15
Rainfall in D hours (mm)	65.2	88.8
Kirpich Tc (h)	4.58	4.58
Peak flow (m3/s)	62.3	114.7
Volume of the hydrograph (Mm3)	1.9	3.5
Equivalent water depth (mm)	20.2	37.3
Runoff coefficient Cr	0.31	0.42
Runoff deficit (mm)	45.0	51.5

Figure 17: SCS Model Hydrograph Skenderaj



6 ESTIMATION OF THE INFLOWS FOR RIVER BASIN MODELLING (WEAP MODEL)

The IWRM model for Drini river basin is jointly constructed by the hydrologist and river basin planner. The modelling procedure and results are discussed in another more detailed report dressed by the river basin planning expert.

The objective here is to present the hydrological aspects.

6.1 Methodology for surface inflow estimation

For the Drini River basin all the hydrometric stations are installed on the up parts of sub-basins. They can only measure river flow in the mountainous regions. With the hydrometric information it is almost impossible to estimate the surface runoff from the low plain regions. That is one of the main difficulties for hydrological studies of the Drini River basin.

The rainfall data are also scarce: only one daily time series is available at Skyvjan (near Gjakovë) for the period 1950-1973. Another one at Prizren downloaded from Internet is very incomplete from 1978 to 1991. There is no information about precipitation from snow.

In this case it would be useless to test a rainfall- runoff model and anyway the flow estimation cannot be accurate.

However the best ways seems to estimate the inflow from annual rainfall by TURC formula, which can be validated from observed data in the Drini basin, and then distribute approximately the annual volume to monthly inflows.

Validity verification of the TURC formula

For TURC formula the water losses essentially dues to evaporation depend in the mean temperature and the precipitation:

$$D = \frac{P}{\sqrt{0.9 + \frac{P^2}{L^2}}}$$

Where:

D: deficit in mm

P: precipitation in mm

$L = 300 + 25\,T + 0.05\,T^3$

T: temperature in °C.

The formula of Coutagne giving similar result is as following:

$D = P - m.P^2$

Where:

D: deficit in m

P: precipitation in m

M: regional coefficient with M = 1/(0.8+ 0.14 T)

T: temperature in °C.

However, the TURC formula is here proposed.

Table 31: Verification of the Turc Formula with interannual average data

River	Annual P (mm)	Observed Runoff (mm)	Observed Eo=P-R (mm)	Mean T (°C)	L Turc (300+25T+ 0.05T3)	Ec Turc (mm)	Difference (Ec-Eo)/Eo
BISTRICA E PEJÓS/ Drelaj	1177	822	355	7.6	512	473	33%
BISTRICA E PEJÓS/ Grykë	1168	769	399	7.6	512	473	18%
BISTRICA E DECANIT/ Deçan	1530	1284	246	7.6	512	488	98%
KLINA/ Klinë	702	152	550	10.12	605	468	-15%
ERENIK/ Gjakova	1515	849	666	10.25	610	570	-14%
WHITE DRINI/ Kpuzë	831	389	442	9	561	473	7%
WHITE DRIN/ Gjonaj		364		10	600		
WHITE DRINI/ Vërmico	890	428	462	10	600	505	10%
BISTRICA E PRIZERENIT/ Prizren	1146	896	250	10.1	604	540	116%
PLLAVA/ Orqusha	1017	641	376	10.1	604	526	40%

At four of those stations calculated values differ far from the observations: Drelaj, Deçan, Prizren and Orqusha. All the four stations are influenced by important springs. So it can be considered that at these stations the catchment surfaces are different between ground water and surface water.

For other stations the TURC formula's accuracy is comprised in 10% to 20% in comparison with observed data. Note also that Kpuz, Gjonaj and Vermicë are influenced by irrigation abstractions.

For the two stations located in relatively low region, Klinë and Gjakova, the TURC formula underestimates the water losses, what is confirmed during WEAP model calibration. A correction factor will be proposed by increasing arbitrarily the temperature.

<u>Procedure for inflow estimation</u>

The procedure to estimate the inflow for a no gauged sub-basin is the following:

1) Estimation of the basic parameters: surface of the watershed, mean annual rainfall and mean temperature
2) Calculation of the rainfall correction factor: ratio = local precipitation /precipitation at Skyvian (for 1952-1973) or Prizren (for 1978-1986), since there is no data for local rainfall during the reference period 1952-1986 for WEAP modelling
3) Estimation of the local annual precipitation (=ratio x precipitation at Skyvian or Prizren)
4) Calculation of water losses by TURC formula for each year from 1952 to 1986. As explained above, since the formula underestimates the evaporation in plain region, the mean temperature is arbitrarily increased from about 11 °C to 14 °C. There are some uncertainties about the average precipitation in the plain. A reduction of the precipitation could give same results as those from increasing temperature. However an adjustment in temperature, precipitation or evaporation has been necessary to calibrate the WEAP model.
5) Calculation of the runoff for each year, which is the difference between the precipitation and water losses.
6) Distribution of annual discharge to monthly discharges by application of monthly coefficients.

For monthly flow distribution two typical patterns are observed in the Drini basin. In the up parts a very evident peak is normally observed in May due to snowmelt. In the low parts the peaks appear normally in winter (December – March), which result directly from runoff. For the low region the pattern is quite similar to that of precipitation.

By taking into account theses characters, different coefficients are proposed for up and low regions for monthly discharge distribution.

Figure 18: Monthly inflow distribution for mountainous areas

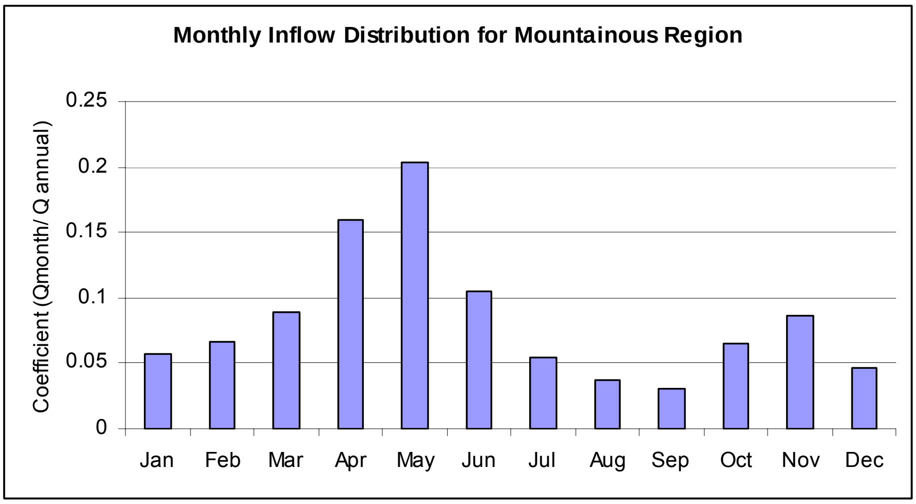
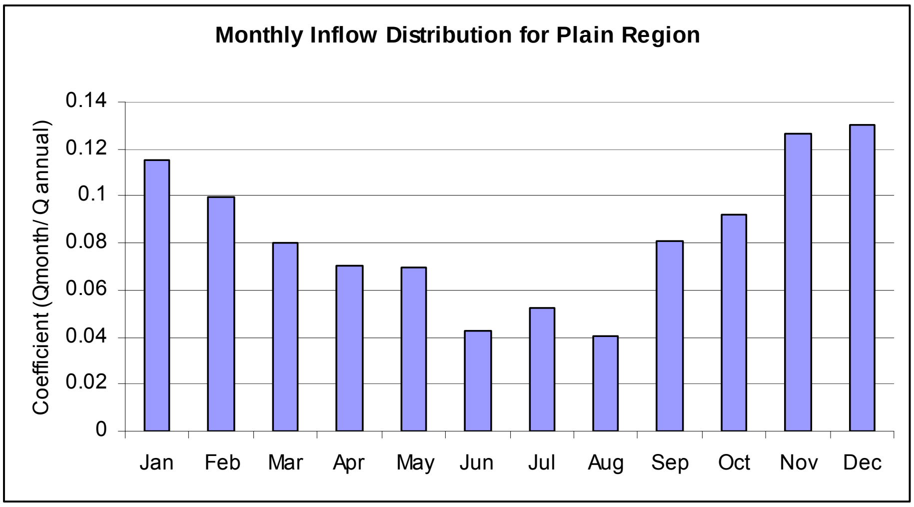


Figure 19: Monthly inflow distribution for inland areas



6.2 WEAP Modelling

A water resource management model is constructed in order to:

- Estimate and validate the inflows from different parts of the Drini river basin
- Analyse water balance at global scale and local scale
- Simulate water resource management scenarios
- Communicate with stakeholders
- Train local experts and counterparts especially by studding the pilot area (around Radoniq reservoir).

The software WEAP is used for the modelling.

Model structure

The Drini river and its main tributaries are represented in the model:

- Istog
- Pejë
- Klinë
- Mirushë
- Toplluha
- Deçanit
- Prue
- Erenika
- Prizren

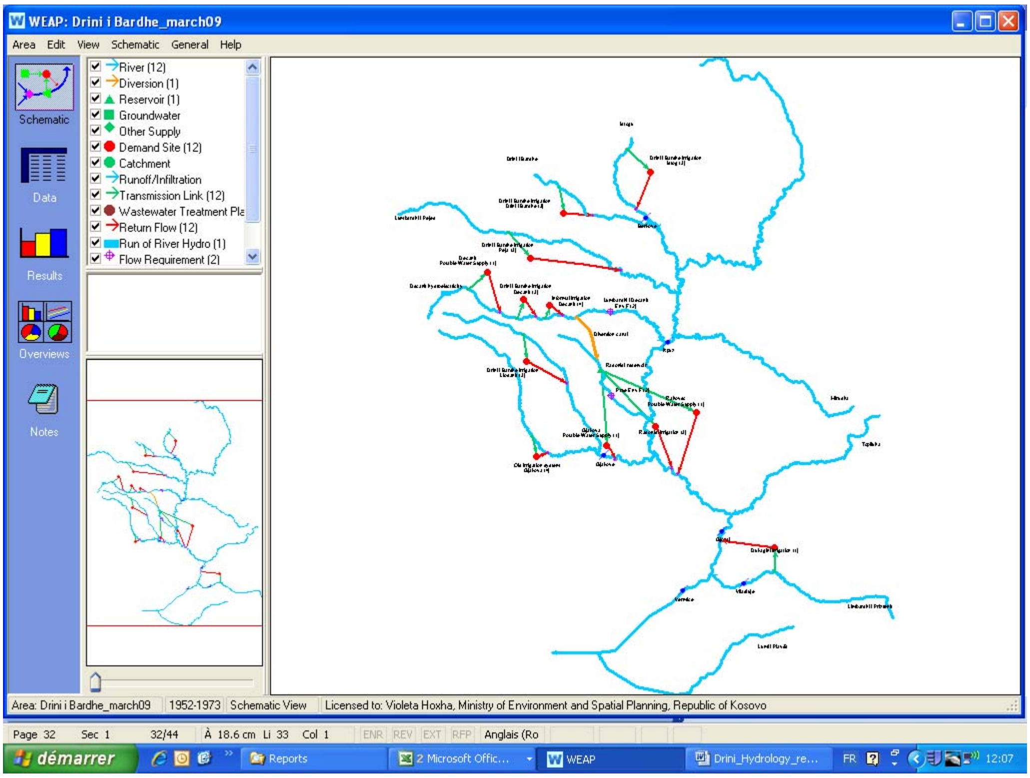
The four major irrigation schemes existing since 1952 are:

- Istog with intake at Istog
- Pejë with intakes on the Pejë tributary (down Grykë hydrometric station) and on the Drini river at Radavë

- Deçanit with intake just down the hydrometric station
- Prizren with intake just down the hydrometric station

The Radoniq reservoir and irrigation perimeter are more recent. They are represented in the WEAP model. For the model calibration and validation periods (1952-1973, 1978-1986) the irrigation abstractions from Radoniq reservoir are set to zero so that the reservoir has no effect. However the drinking water supplies for Gjakova and Rahovec cities are still attached to the reservoir even for these ancient periods, even in fact the potable water was taken from the Erenik in the past before the construction of the reservoir. The purpose of this consideration is to keep a same model structure for all periods (1952 to 1986 and forecast period in the future).

Figure 20: WEAP Model schematic view



Reference periods

The only reliable time series of precipitation (monthly and annual) is that at Skyvian from 1950 to 1973 which is used for both irrigation abstractions and surface inflows.

The precipitation at Prizren used for the same purposes is less reliable because of many gaps in the time series 1978-1990.

The time series of discharge at main hydrometric stations are from 1952 to 1986.

So it's decided to use:

- 1952-1973 as reference period for model calibration
- Data from 1978 – 1986 are used for model validation.

Inflows

The inflow points of the model are following:

Table 32: Inflows considered in WEAP

Sub-basin	Data source	Inflow type in WEAP	Remark
Istog up irrigation abstraction	Estimation by above method	Head flow	
Istog between irrigation canal intake and Berkovë	Estimation	Surface inflow	
Drini at Radavë	Observed discharge with gap filling	Head flow	
Pejë at Grykë	Observed discharge	Head flow	
Pejë between Grykë and the Drini confluent	Estimation	Surface inflow	
Klinë at Klinë station	Observed discharge	Head flow	
Mirushë at Kpuz	Correlation with Mishurë station	Head flow	
Deçanit at Deçan station	Observed discharge	Head flow	
Deçanit between Deçan and Drini confluent	Estimation	Surface inflow	Q =16.8 km²/159 km²
Prue up Radoniq	Estimation	Head flow	
Prue donwstream Radoniq	Estimation	Surface inflow	
Erenik at Gjakova (old station down Lloganit confluent)	Observed discharge	Head Flow	Q Lloqanit = Q Gjakova x141 km²/455 km²
Toplluha at Piranë	Observed data with gap filling	Head Flow	
Prizrenit at Prizren	Observed discharge	Head flow	
Prizrenit between Prizren and Drini confluent	Estimation	Surface inflow	

Abstractions

The irrigation command areas are estimated from different available documents and summarized as follows:

Table 33: Irrigated areas (ha) in different periods

Year	Ref.	ISTOG			PEJË			DEÇAN			PRIZREN/ Dukagini			GJAKOV Ë/ Radoniq		
		Plan	Constr.	Total	Plan	Constr.	Total	Plan	Constr.	Total	plan	Constr.	Total	Plan	Constr.	Total
1971	1		4500			12810			11524			3974			0	
1980	2	5670	5500	11170	3670	11560	15230	1180	11300	12480	5000	2340	7340	0	0	0
1982	3	11400	9800	21200	10315	15715	26030	835	11700	12535	13460	7060	20520	20520	0	20520
1990	4		10200			11435			5630			5000			5084	
2000	4		4580			3970			2790			900			4884	
2001	4	0	12440	12440	0	14249	14249	0	10517	10517	0	5000	5000	0	10250	10250

Information source:

1. Regional space plan of Kosovo, Basic study, Water management, Analysis of evaluation of situation possibility of development, Prishtinë, 1971
2. Monthly Magazine "Vodoprivreda" Nr. 67-68 (1980/5-6), Belgrade
3. Water Master Plan Part II, Book 4, Sheet 2 "Water supply of agriculture - irrigation, Belgrade, 1982
4. Proceedings of the workshop on water res. Utilisation & wat. Pol. Development in Kosovo, September, MAF&RD, 2001

For the model calibration period 1952-1973 the irrigation areas taken into account are those existing in 1970. Some informal irrigation areas are also considered (Lloganit, Deçanit) for which the abstractions are negligible.

The drinking water supplies are considered for Deçan, Gjakova and Rahovec, but they have little importance in the global water balance.

No ecological demand is considered for the model calibration.

Table 34: Water abstraction needs in Mm3 – averages for the period 1952-1973

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	**Sum**
Decanit Potable Water Supply	0.33	0.30	0.33	0.32	0.33	0.32	0.33	0.33	0.32	0.33	0.32	0.33	**3.9**
Drini i Bardhe irrigation Decanit	0.00	0.00	0.00	3.49	11.99	13.95	20.11	22.00	1.22	0.50	0.00	0.00	**73.3**
Drini i Bardhe irrigation Drini i Bardhe *	0.00	0.00	0.00	3.33	10.58	11.95	17.05	18.39	1.08	0.48	0.00	0.00	**62.9**
Drini i Bardhe irrigation Istog	0.00	0.00	0.00	2.59	7.21	7.80	10.98	11.62	0.76	0.39	0.00	0.00	**41.3**
Drini i Bardhe irrigation Lloqanit	0.00	0.00	0.00	0.00	0.18	0.51	0.49	0.22	0.07	0.01	0.00	0.00	**1.5**
Drini i Bardhe irrigation Peja *	0.00	0.00	0.00	1.71	5.45	6.16	8.78	9.48	0.55	0.25	0.00	0.00	**32.4**
Dukagini irrigation	0.00	0.00	0.00	2.38	6.85	7.48	10.56	11.22	0.71	0.35	0.00	0.00	**39.5**
Gjakova Potable Water Supply	0.95	0.86	0.95	0.92	0.95	0.92	0.95	0.95	0.92	0.95	0.92	0.95	**11.2**
Informal irrigation Decanit	0.00	0.00	0.00	0.00	0.09	0.26	0.26	0.12	0.04	0.01	0.00	0.00	**0.8**
Rahovec Potable Water Supply	0.45	0.40	0.45	0.43	0.45	0.43	0.45	0.45	0.43	0.45	0.43	0.45	**5.3**
Sum	1.73	1.56	1.73	15.17	44.08	49.79	69.96	74.77	6.10	3.74	1.67	1.73	**272**

* For Pejë irrigation perimeter, 66% of abstractions are from Drini River near Radavë, and 34% from Pejë tributary down Grykë, as already explained above.

Result of the model calibration

Three gauge stations are used for calibration: Drini River at Kpuz, Gjonaj and Vermicë. The comparisons between observed and simulated flow at these stations are made for:

- mean annual inflow during 1952-1973
- monthly distribution of the discharge
- frequency distribution of the monthly discharge

The results are shown below:

Table 35: Observed and simulated inflows in Mm3 - averages 1952-1973

	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	**Sum**
11 \ Kpuz obs.	78.8	91.1	96.6	114.3	131.5	66.7	31.4	15.4	27.6	43.2	69.5	89.0	855
12 \ Kpuz cal.	61.8	64.4	90.6	146.1	171.1	71.7	29.4	17.1	31.2	54.9	74.9	61.0	874
23 \ Gjonaj obs.	157.3	176.7	188.2	218.2	222.8	115.0	56.6	30.1	50.1	95.6	140.5	174.9	1626
24 \ Gjonaj cal.	184.6	194.6	202.6	241.7	265.5	111.5	55.9	33.4	66.9	105.0	155.1	168.8	1786
27 \ Vermice obs.	208.7	230.1	228.4	238.1	259.4	143.4	76.9	39.4	63.9	101.5	133.5	201.6	1925
28 \ Vermice cal.	210.9	217.9	229.1	273.3	305.4	133.9	67.7	41.4	82.8	127.7	184.8	197.1	2072

The inaccuracy is about 10% for annual inflow, up to 40% for some monthly inflow. However the frequency distributions are seemly more satisfying as shown by the following curves.

Figure 21: Frequency analysis of results simulated / measured at Kapuz

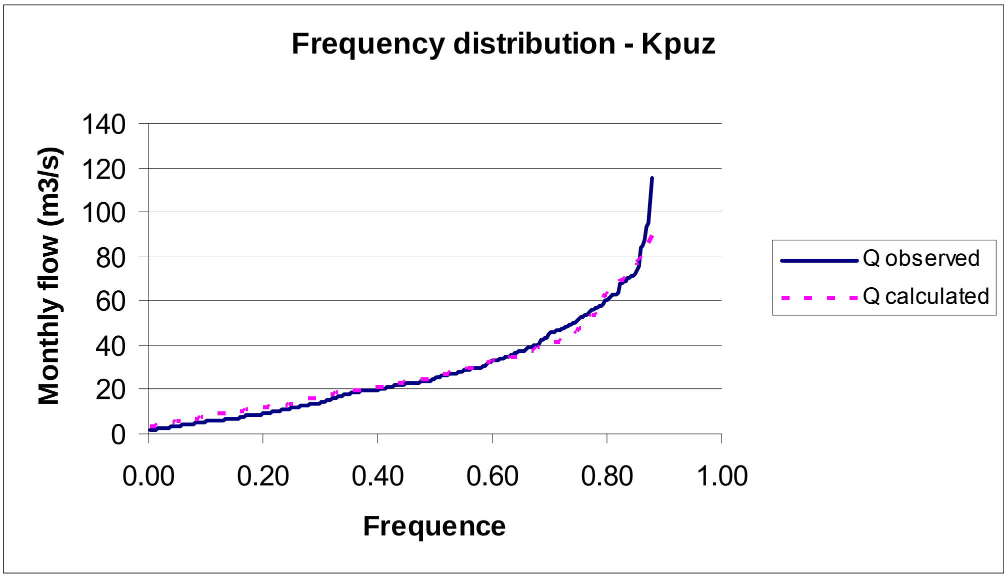


Figure 22: Frequency analysis of results simulated / measured at Gjonaj

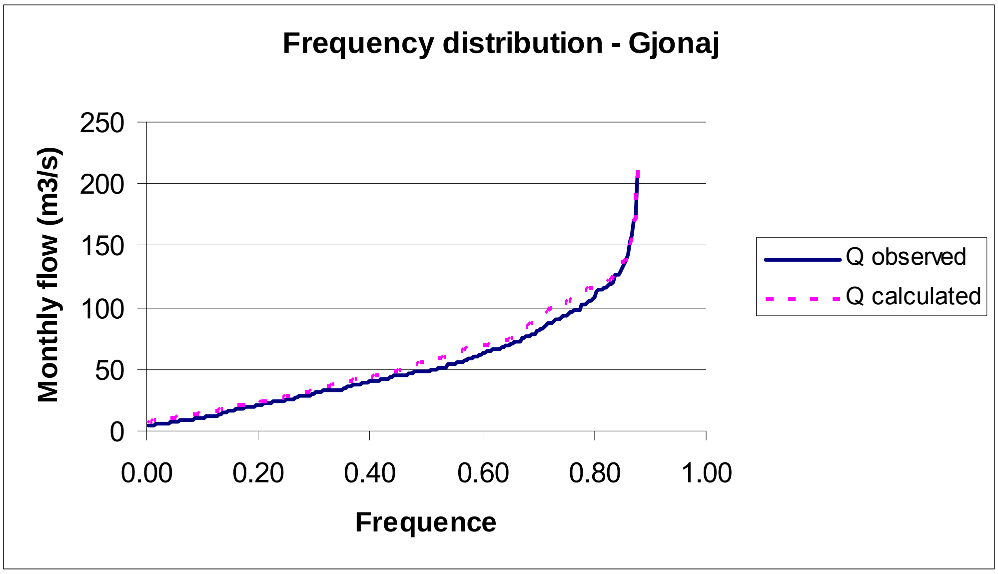
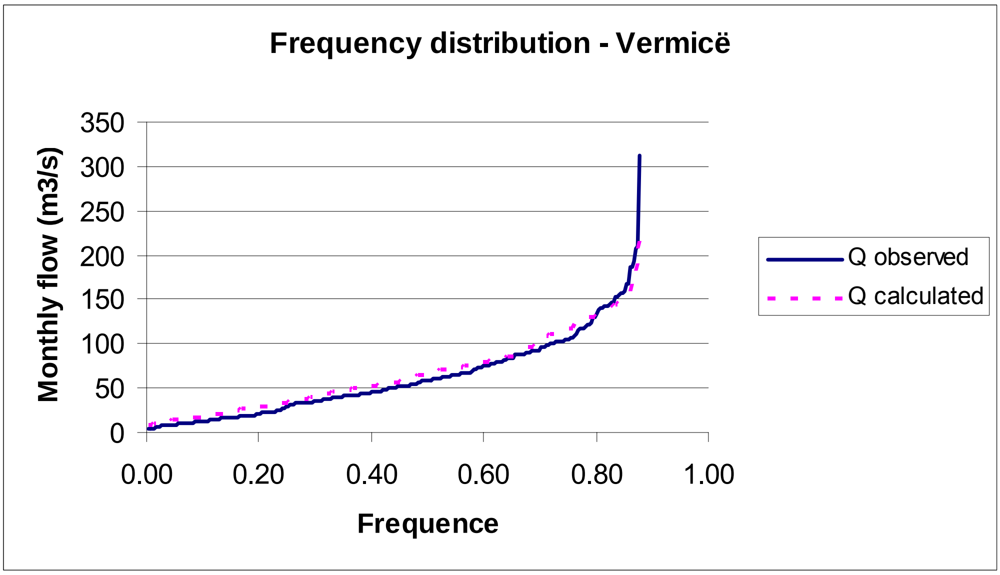


Figure 23: Frequency analysis of results simulated / measured at Vermice

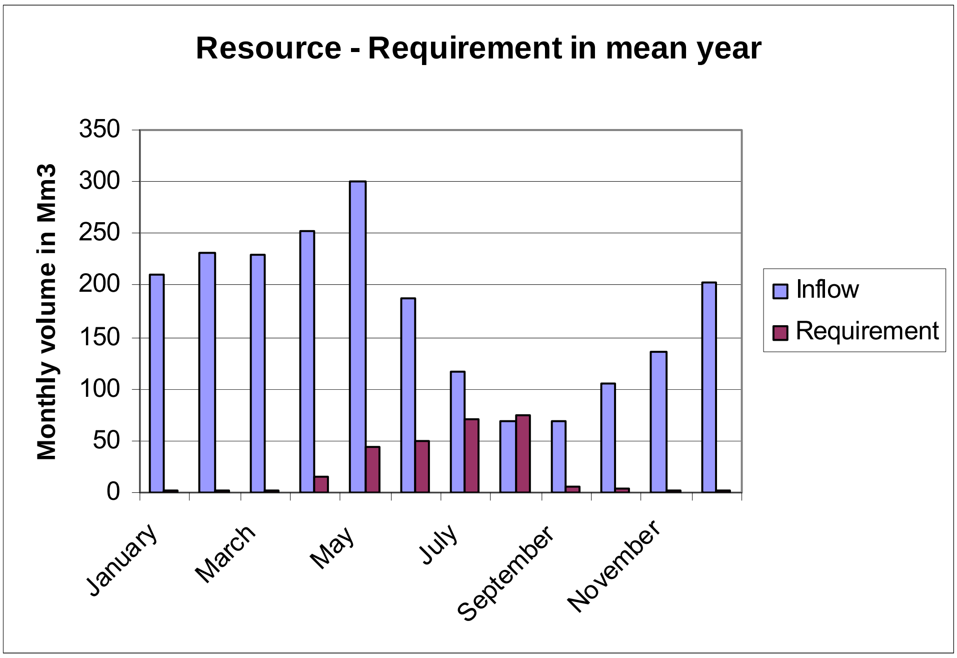


The calibration is not perfect because of the scarce data (only one time series for the entire Drini River basin, no flow data in the low region, no observed abstractions). The uncertainties remain in estimation of the surface inflows and their monthly distributions. Also most of the "observed" discharges at Gjonaj result in fact from gap filling, they are not accurate.

Water balance at global scale

Table 36: Comparison resource – requirement in average year for the entire Drini basin (up Vermicë)

	Year	August
Total inflow	2111 Mm3	69 Mm3
Total requirement (in calibration period without Radoniq)	272 Mm3	75 Mm3
Requirement/Inflow	13%	109% (deficit 8%)



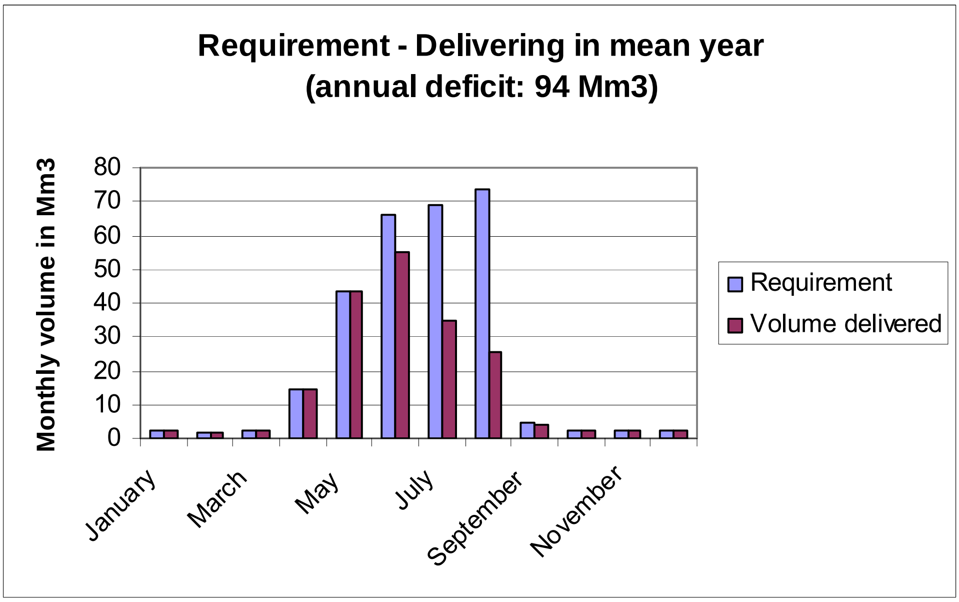
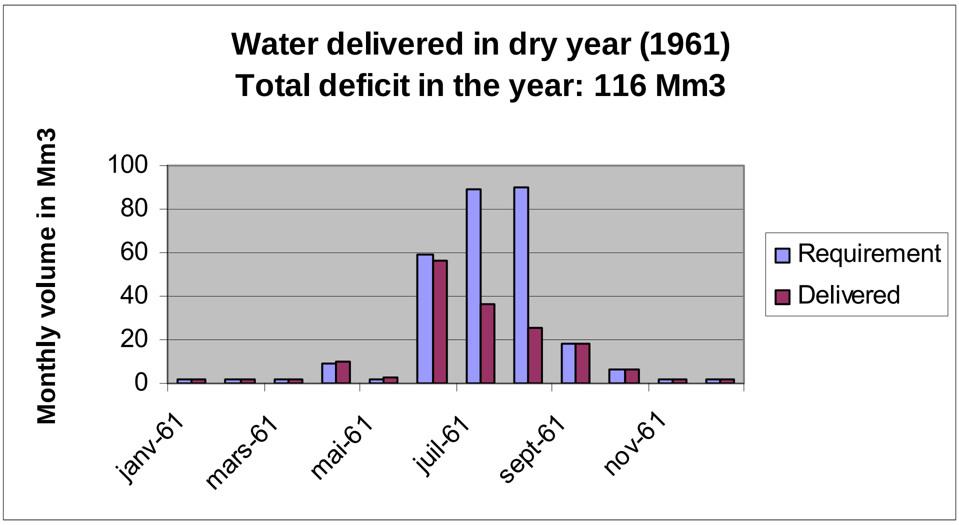


Table 37: Comparison resource – requirement in dry year (1961, F=1/10) for the entire Drini basin (up Vermicë)

	Year	August
Total inflow	1554 Mm3	32 Mm3
Total requirement (in calibration period without Radoniq)	282 Mm3	90 Mm3
Requirement/Inflow	18%	281% (deficit 64%)



7 GENERAL CONCLUSION AND RECOMMENDATIONS

Although the available hydro-meteorological data collected by now are considered as sufficient for the project, it would be necessary to integrate the most recent data. By now we have not succeeded to get any flow data for the period after 1986.

Recommendations have been made to Water Department and KHMI for rainfall monitoring network assessment and rehabilitation.

Following suggestions may be made for the progress of the present project:

- Contract with a professional society of satellite imagery analysis in order to obtain high quality maps for: land cover, delimitation of irrigation command areas and flood hazard areas by hydro-geomorphological method.
- Perform a flow measurement campaign during next dry season in order to establish “hydrological profiles” of the rivers, which will be useful for estimating the spatial distribution of low flow along the river.

The next step will consists in:

- Integration of recent data (if available) in hydro-meteorological data base
- Completing hydrological analysis of floods
- Starting the water resource management modelling
- Participation to the “Water resource management” work group
- Preparing a workshop on water resource management.

Appendix

Appendix 1: Monthly flow data series

- Principal source: hydrological year books
- Italic values denote data from the Master Plan
- Blue values denote data calculated by correlation

LUMI BISTRICA E PEJËS-STACIONI DRELË

Surface (km²): 120.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	1.95	2.40	3.85	11.45	5.40	4.18	1.20	0.80	0.70	1.85	3.30	3.45	3.37	106
1953	2.62	3.35	2.60	7.87	8.47	8.42	0.46	1.80	1.50	1.41	1.28	0.58	3.35	106
1954	1.18	0.50	4.13	8.52	11.50	3.21	1.45	1.10	1.00	1.80	7.05	8.20	4.16	131
1955	4.60	7.15	4.28	11.00	11.55	3.97	4.92	2.85	6.80	1.95	12.00	10.85	6.81	215
1956	3.10	3.00	3.40	11.22	12.18	4.85	1.60	0.72	0.65	0.30	0.68	1.15	3.57	112
1957	1.15	2.20	2.10	5.45	12.18	3.65	0.76	1.00	3.05	7.82	3.78	6.40	4.15	131
1958	1.90	2.50	6.05	12.05	17.05	5.95	1.25	0.80	0.95	3.02	2.50	2.80	4.75	150
1959	1.57	1.11	1.36	8.04	7.61	4.89	2.78	2.08	3.71	3.07	6.49	6.41	4.10	129
1960	3.29	8.03	5.78	9.63	15.50	8.35	2.56	1.23	0.99	3.50	10.80	6.40	6.31	199
1961	2.31	1.46	3.55	6.88	9.86	3.43	1.30	0.82	0.70	0.71	3.55	2.01	3.06	96
1962	1.49	2.18	5.24	11.96	14.96	4.07	1.77	0.91	0.73	1.60	6.88	3.58	4.62	146
1963	6.59	2.36	4.20	10.89	14.42	7.32	1.53	0.66	0.61	0.67	1.03	7.17	4.80	152
1964	1.27	1.18	4.05	8.34	11.17	4.34	2.57	1.94	3.25	6.63	5.72	4.24	4.58	144
1965	1.61	1.91	4.17	8.24	14.20	6.26	1.70	0.62	0.64	0.60	0.89	3.73	3.73	117
1966	1.51	5.56	4.23	8.82	12.44	7.45	1.90	0.74	0.66	1.82	6.14	6.77	4.82	152
1967	1.64	1.91	4.37	10.91	16.35	4.39	2.45	0.84	0.62	0.61	0.63	0.85	3.81	120
1968	0.93	2.43	3.35	9.91	8.44	3.82	0.78	0.83	1.88	1.25	5.43	3.91	3.57	113
1969	0.48	0.46	2.63	6.44	12.03	3.40	1.84	0.95	0.78	0.71	3.46	5.38	3.23	102
1970	7.03	3.62	5.35	16.12	13.81	10.16	3.22	1.33	1.07	2.06	3.44	3.59	5.90	186
1971	5.25	2.29	3.50	11.71	12.94	3.98	1.40	0.96	1.32	1.66	1.83	1.72	4.06	128
1972	1.13	1.24	3.91	8.98	5.92	1.80	6.14	2.80	7.12	5.81	6.08	2.87	4.49	142
1973	1.25	1.33	1.64	6.75	16.13	2.67	2.44	1.57	2.23	2.98	2.88	3.09	3.77	119
1974	3.01	2.35	4.51	5.43	12.60	6.94	2.27	1.23	1.68	10.82	5.19	2.89	4.93	155
1975	1.33	1.08	2.98	7.15	9.13	4.67	2.21	1.29	0.91	3.66	4.06	3.41	3.50	110
1976	1.19	2.00	2.40	10.35	10.75	9.78	3.50	1.70	1.72	1.92	5.60	8.60	4.96	157
1977	1.83	8.66	7.54	10.60	11.30	3.04	1.15	0.93	0.92	1.06	2.85	3.64	4.43	140
1978	2.35	4.64	6.25	7.62	14.64	8.48	1.82	1.07	2.93	2.24	1.07	4.57	4.80	152
1979	4.77	5.96	3.77	6.15	11.16	3.97	0.98	2.23	2.61	3.05	20.35	5.00	5.80	183
1980	2.91	2.54	2.83	4.72	12.48	14.46	4.17	2.03	1.67	5.73	7.46	3.54	5.38	170
1981	2.33	1.67	5.07	8.70	10.71	7.42	1.91	1.49	1.83	1.71	1.30	2.73	3.91	123
1982	2.65	1.08	2.33	11.51	12.08	4.41	1.01	0.95	0.73	1.07	0.83	1.17	3.32	105
1983	0.58	0.62	3.70	9.35	5.95	3.27	1.37	1.34	2.12	1.23	2.57	2.09	2.85	90
1984	2.73	1.77	2.94	10.95	23.23	6.01	1.23	1.05	1.80	1.41	1.60	0.92	4.65	147
1985	0.94	1.69	2.23	10.76	10.80	1.44	0.59	0.48	0.37	0.35	1.20	2.47	2.78	88
1986	5.13	4.62	6.46	13.61	16.50	8.19	3.42	1.10	0.81	0.83	0.79	0.76	5.18	163
Average	2.45	2.77	3.91	9.37	12.15	5.50	2.05	1.26	1.74	2.48	4.31	3.91	4.33	137
SD	1.65	2.08	1.43	2.49	3.56	2.73	1.23	0.59	1.56	2.32	3.98	2.45	0.97	31
Min	0.48	0.46	1.36	4.72	5.40	1.44	0.46	0.48	0.37	0.30	0.63	0.58	2.78	88
Max	7.03	8.66	7.54	16.12	23.23	14.46	6.14	2.85	7.12	10.82	20.35	10.85	6.81	215

LUMI BISTRICA E PEJËS-STACIONI GRYKË

Surface (km²): 264.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	3.02	3.71	5.96	17.72	8.36	6.47	1.86	1.24	1.08	2.86	5.11	5.34	5.21	164
1953	4.06	5.19	4.02	12.18	13.11	13.03	0.71	2.79	2.32	2.18	1.98	0.90	5.18	163
1954	1.07	1.43	7.43	11.70	17.70	6.00	1.92	1.11	1.19	2.78	4.05	3.64	5.02	158
1955	4.74	8.48	7.89	8.19	13.00	3.94	4.84	4.23	6.38	35.50	21.90	14.30	11.15	352
1956	10.10	6.66	7.98	22.90	19.00	6.17	2.21	1.52	1.47	1.11	23.50	3.20	8.78	277
1957	1.93	6.07	4.39	6.42	14.20	3.78	1.59	2.01	3.22	5.68	4.08	7.03	5.03	159
1958	4.82	6.64	6.37	12.60	24.80	7.30	3.15	2.16	1.94	2.04	4.30	3.06	6.60	208
1959	2.50	1.89	3.92	5.39	6.06	6.26	4.96	5.22	5.83	3.61	11.00	10.80	5.63	178
1960	5.70	9.57	7.88	11.30	18.60	10.20	4.02	1.79	1.70	4.02	12.30	8.45	7.94	250
1961	3.39	2.12	4.91	9.95	15.60	4.28	1.33	0.88	0.80	0.88	4.84	5.17	4.53	143
1962	4.87	4.30	8.82	17.50	21.20	5.85	3.04	1.47	1.40	1.99	7.01	3.95	6.79	214
1963	5.76	2.69	4.10	15.93	23.16	9.14	2.73	1.18	1.04	1.55	1.64	10.19	6.62	209
1964	1.45	1.84	6.44	11.40	15.00	7.84	4.48	2.72	3.43	6.16	6.74	7.40	6.27	198
1965	3.80	4.01	6.86	14.02	29.46	15.51	2.77	1.21	1.13	0.83	1.72	5.42	7.25	228
1966	2.81	8.18	6.03	17.50	16.40	12.80	2.61	1.23	0.74	3.44	7.30	9.45	7.34	232
1967	0.90	0.76	6.43	18.53	23.18	6.88	7.56	2.44	1.14	0.81	1.27	2.68	6.08	192
1968	2.75	4.96	7.17	14.07	11.18	6.50	1.65	1.52	2.86	1.64	6.71	5.07	5.49	173
1969	2.01	2.31	4.95	9.37	15.05	5.81	3.24	1.85	3.26	1.31	3.06	5.39	4.82	152
1970	9.31	5.02	7.05	20.29	17.90	11.26	4.47	1.54	1.42	2.88	4.72	4.68	7.54	238
1971	6.73	2.30	6.55	15.94	15.72	6.62	1.62	1.65	2.50	2.34	2.23	3.03	5.62	177
1972	1.85	2.16	5.28	12.47	7.47	1.75	12.28	5.22	12.90	7.13	6.57	3.84	6.59	208
1973	3.25	3.57	3.70	10.29	21.87	3.48	3.68	2.48	3.07	4.00	3.89	3.81	5.61	177
1974	3.54	3.25	5.25	5.48	14.55	7.22	2.74	2.04	1.55	10.51	5.23	2.49	5.34	168
1975	2.01	1.39	3.31	9.35	10.90	5.26	2.61	1.63	1.25	5.08	6.25	3.32	4.37	138
1976	1.82	2.13	3.80	12.07	18.24	10.96	4.18	4.22	2.31	3.08	5.68	6.63	6.28	198
1977	3.70	9.45	8.90	13.84	10.37	4.36	1.29	0.81	0.76	0.94	1.93	2.54	4.86	153
1978	2.56	6.28	7.65	12.24	21.33	10.96	2.08	1.19	3.56	2.85	1.35	4.48	6.37	201
1979	6.00	8.31	5.37	8.37	14.70	7.05	2.68	4.14	2.39	3.17	31.98	7.12	8.40	265
1980	4.29	3.77	4.18	6.83	17.75	20.53	6.06	3.05	2.55	8.26	10.69	5.18	7.77	245
1981	3.48	2.54	7.32	12.42	15.25	10.63	2.89	2.30	2.78	2.61	2.03	4.05	5.70	180
1982	3.87	2.01	3.71	12.10	12.25	5.06	1.47	1.05	0.98	1.45	1.33	2.73	4.01	126
1983	1.70	2.16	5.55	10.43	6.72	5.26	3.56	1.86	2.91	1.73	1.76	2.81	3.87	122
1984	3.66	2.78	3.82	15.02	30.71	8.55	1.40	1.13	1.94	2.24	1.59	0.93	6.17	195
1985	0.95	3.64	2.77	16.05	17.81	3.20	1.09	0.71	0.65	0.60	2.25	3.71	4.45	140
1986	6.13	7.48	11.05	24.11	27.69	15.58	6.46	2.10	1.15	1.21	1.30	0.86	8.75	276
Average	3.73	4.26	5.91	12.97	16.75	7.87	3.29	2.10	2.44	3.96	6.27	4.96	6.21	196
SD	2.15	2.52	1.90	4.55	6.08	4.05	2.24	1.20	2.25	5.93	6.84	2.95	1.57	49
Min	0.90	0.76	2.77	5.39	6.06	1.75	0.71	0.71	0.65	0.60	1.27	0.86	3.87	122
Max	10.10	9.57	11.05	24.11	30.71	20.53	12.28	5.22	12.90	35.50	31.98	14.30	11.15	352

LUMI BISTRICA E DEÇANIT-STACIONI DECANI

Surface (km²): 114.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	2.80	2.75	3.85	11.25	8.00	7.50	1.80	1.28	1.20	2.15	5.90	7.15	4.63	146
1953	4.05	3.68	2.60	11.15	13.35	11.50	3.52	2.48	2.12	2.42	2.25	2.40	5.12	161
1954	2.77	1.77	2.75	5.55	14.40	4.50	2.18	2.00	1.95	1.60	4.40	8.30	4.37	138
1955	3.99	6.87	6.52	7.52	16.90	7.51	4.77	3.30	6.52	28.20	15.00	5.58	9.41	297
1956	3.71	2.18	1.78	12.90	16.20	7.75	0.92	0.21	0.13	0.11	0.39	0.58	3.90	123
1957	0.25	2.35	2.75	5.82	13.00	7.24	1.12	0.59	3.75	5.70	4.05	5.78	4.37	138
1958	2.99	3.14	3.14	9.26	24.00	6.07	0.39	0.23	0.78	0.96	5.17	3.82	5.01	158
1959	3.34	2.20	5.78	9.98	11.30	8.83	5.68	3.74	4.70	2.33	4.72	6.40	5.76	182
1960	4.07	6.29	5.74	9.62	25.80	12.70	5.02	1.53	1.12	3.03	12.50	6.86	7.86	248
1961	3.98	3.20	3.79	5.90	9.34	5.82	3.33	2.56	1.91	1.68	4.31	4.97	4.24	134
1962	3.22	3.20	5.60	12.12	13.80	7.21	2.63	2.15	1.68	3.21	10.19	4.39	5.78	182
1963	3.16	3.55	3.93	8.01	16.70	10.45	3.93	2.34	2.39	3.01	2.59	5.50	5.47	173
1964	2.58	3.28	3.64	5.25	8.84	8.40	3.70	1.97	3.24	4.81	6.57	5.17	4.79	151
1965	5.67	4.76	7.38	10.03	14.30	10.80	3.17	0.70	0.95	0.77	1.29	1.99	5.15	162
1966	2.29	3.90	3.15	7.85	13.82	13.10	4.49	1.64	1.89	4.22	4.49	4.73	5.46	172
1967	2.21	2.07	3.45	7.47	12.80	8.45	5.34	2.16	1.15	1.20	1.67	1.43	4.13	130
1968	2.07	2.17	2.71	5.89	7.30	4.45	2.38	1.76	1.19	1.48	3.38	3.43	3.19	100
1969	2.00	2.17	2.82	4.43	9.33	5.48	1.91	2.04	3.25	1.79	2.12	2.38	3.31	104
1970	3.56	1.45	2.76	11.02	10.25	10.38	4.85	1.92	1.60	2.08	2.34	1.84	4.51	142
1971	1.72	1.23	2.22	7.26	13.79	4.29	1.32	1.43	1.69	2.55	1.30	1.01	3.33	105
1972	0.84	1.22	1.90	5.93	7.68	5.02	8.67	3.57	9.64	8.70	6.25	2.58	5.18	163
1973	2.31	2.63	2.47	6.03	14.98	3.78	1.94	1.74	2.05	2.55	2.35	2.62	3.80	120
1974	2.39	1.83	2.42	3.44	9.19	7.77	2.99	1.62	1.56	7.68	3.30	2.23	3.88	123
1975	1.31	1.15	1.40	3.73	5.27	2.89	1.76	1.16	1.07	1.96	2.10	1.63	2.12	67
1976	1.39	1.38	1.88	4.68	11.30	9.21	3.42	2.02	1.39	4.22	4.20	3.68	4.08	129
1977	2.36	5.18	5.35	10.40	9.21	5.38	1.87	1.48	1.30	1.33	1.72	1.67	3.92	124
1978	1.50	2.87	4.17	7.15	21.32	12.79	3.85	1.55	2.10	2.55	1.46	2.76	5.35	169
1979	3.34	4.47	3.25	5.34	12.10	9.15	3.14	2.03	1.73	2.01	10.60	2.68	4.97	157
1980	2.87	2.48	2.79	4.75	12.82	14.88	4.18	1.95	1.58	5.81	7.60	3.53	5.44	172
1981	2.27	1.58	5.11	8.88	10.98	7.56	1.84	1.40	1.75	1.63	1.20	2.69	3.92	123
1982	3.20	2.60	3.37	8.89	13.67	8.02	1.99	1.30	1.16	2.25	1.48	1.50	4.12	130
1983	1.40	1.34	3.48	9.04	10.06	6.64	4.35	1.87	1.85	1.46	1.49	1.66	3.73	118
1984	2.35	1.94	2.33	3.73	*21.26*	8.80	2.03	1.39	1.60	1.22	1.03	1.14	4.09	129
1985	0.78	1.23	1.39	8.34	12.15	4.02	0.93	0.77	0.70	0.64	2.13	1.87	2.92	92
1986	2.67	5.09	4.69	11.01	15.12	12.54	4.10	1.43	0.96	1.01	1.17	1.03	5.05	159
Average	2.61	2.83	3.50	7.70	13.15	8.02	3.13	1.75	2.10	3.38	4.08	3.34	4.64	146
SD	1.11	1.46	1.47	2.62	4.61	3.01	1.69	0.79	1.78	4.73	3.47	2.00	1.32	42
Min	0.25	1.15	1.39	3.44	5.27	2.89	0.39	0.21	0.13	0.11	0.39	0.58	2.12	67
Max	5.67	6.87	7.38	12.90	25.80	14.88	8.67	3.74	9.64	28.20	15.00	8.30	9.41	297

LUMI KLINA - STACIONI KLINË

Surface (km²): 423.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	4.69	3.23	5.56	2.92	0.87	0.75	0.86	0.42	0.30	0.30	0.87	4.35	2.09	66
1953	3.00	5.20	2.63	1.61	2.62	2.86	1.93	1.05	0.76	0.18	0.19	0.09	1.82	57
1954	2.74	1.50	7.13	5.05	5.15	4.15	1.01	0.93	1.40	0.30	5.50	5.85	3.40	107
1955	6.03	8.73	6.10	7.62	2.68	0.87	3.45	2.00	3.50	15.10	8.87	12.35	6.44	203
1956	6.50	7.25	5.47	8.65	6.27	2.97	0.82	0.55	0.04	0.06	0.19	0.30	3.23	102
1957	0.60	2.40	2.45	1.45	3.27	1.25	0.87	0.35	0.55	4.60	0.52	0.62	1.58	50
1958	4.79	2.28	10.10	6.82	4.54	1.82	0.82	0.55	0.55	0.55	0.67	0.55	2.85	90
1959	2.23	0.92	0.95	0.48	0.59	1.63	1.33	2.50	0.89	0.56	4.65	4.87	1.81	57
1960	4.65	8.75	5.55	5.27	5.43	1.33	0.58	0.52	0.20	1.01	5.60	6.56	3.75	118
1961	1.94	1.34	2.38	1.36	8.58	1.48	0.52	0.34	0.34	0.34	1.14	1.04	1.74	55
1962	0.97	2.76	7.60	6.92	3.09	0.63	0.37	0.24	0.15	0.21	0.70	2.84	2.20	69
1963	5.91	13.30	4.99	3.68	1.89	3.35	0.87	0.19	0.30	0.33	0.12	3.64	3.15	99
1964	0.28	0.61	2.38	1.48	1.42	0.80	1.74	0.22	0.30	0.86	2.42	4.56	1.43	45
1965	3.28	2.12	6.35	4.56	5.58	1.31	0.73	0.06	0.13	0.14	0.39	1.22	2.16	68
1966	1.82	8.26	2.18	1.86	2.06	1.35	0.47	0.34	0.40	0.45	1.28	5.68	2.14	67
1967	0.75	1.72	0.94	3.03	1.17	0.36	0.59	0.09	0.06	0.12	0.14	0.37	0.77	24
1968	0.78	1.68	0.52	0.47	0.24	0.27	0.10	0.38	0.21	0.28	0.95	1.94	0.65	20
1969	1.40	5.41	5.01	1.71	0.41	0.20	0.12	0.07	0.15	0.17	0.29	0.63	1.27	40
1970	5.31	4.72	3.99	4.42	2.31	1.35	1.18	0.21	0.67	0.23	0.29	0.43	2.07	65
1971	4.51	1.70	3.66	1.75	0.80	0.79	0.09	0.08	0.11	0.13	0.18	0.18	1.17	37
1972	0.26	0.66	0.49	0.41	0.95	0.23	1.21	0.34	3.92	1.53	2.68	1.08	1.14	36
1973	2.07	3.23	1.82	2.43	0.84	0.33	0.44	0.22	0.80	0.76	2.20	4.14	1.60	50
1974	1.07	2.80	0.91	1.00	3.90	1.67	0.39	0.16	0.23	1.04	2.51	1.04	1.38	44
1975	0.69	0.48	0.81	1.94	0.52	0.51	0.42	0.38	0.42	0.91	0.66	1.22	0.75	24
1976	0.65	2.05	2.28	4.53	1.22	1.97	0.88	0.54	0.54	0.63	3.86	4.52	1.96	62
1977	5.46	8.48	1.12	3.32	0.63	0.54	0.31	0.32	0.27	0.25	0.50	1.00	1.80	57
1978	1.38	3.05	2.22	1.57	4.20	0.88	0.36	0.38	1.44	0.53	0.44	1.65	1.50	47
1979	3.99	2.46	1.16	2.48	2.30	0.77	0.02	0.51	0.55	0.73	6.00	3.17	2.00	63
1980	4.88	2.78	2.37	1.83	3.75	1.67	0.55	0.55	0.59	1.12	2.29	5.45	2.32	73
1981	3.30	3.81	3.49	1.81	1.83	1.23	1.07	1.09	1.10	1.37	1.93	5.36	2.28	72
1982	1.73	1.68	2.68	2.80	2.00	1.69	1.12	1.09	1.24	1.27	1.29	1.56	1.68	53
1983	0.23	0.85	0.35	0.59	0.36	0.98	0.54	0.30	0.29	0.26	0.37	0.78	0.49	15
1984	5.31	5.22	5.21	4.74	4.07	1.77	0.74	0.17	0.76	0.59	0.80	0.45	2.47	78
1985	1.98	2.02	3.37	1.35	1.32	1.13	1.00	0.97	0.98	0.96	1.83	1.25	1.51	48
1986	6.18	4.85	5.29	2.79	2.28	2.84	2.20	1.48	1.39	1.54	1.22	1.26	2.77	87
Average	2.90	3.67	3.41	2.99	2.55	1.36	0.85	0.56	0.73	1.13	1.82	2.63	2.04	64
SD	2.04	2.96	2.37	2.14	1.98	0.94	0.67	0.54	0.85	2.56	2.07	2.62	1.09	34
Min	0.23	0.48	0.35	0.41	0.24	0.20	0.02	0.06	0.04	0.06	0.12	0.09	0.49	15
Max	6.50	13.30	10.10	8.65	8.58	4.15	3.45	2.50	3.92	15.10	8.87	12.35	6.44	203

LUMI MIRUSHA AT KPUZË														
Surface (km²):	333		*Q natural* = 1.549 Q Mirushe+0.059 (R^2=0.83) or 0.3796 Q Pirane - 0.0633 (R^2=0.70)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3)
1952	5.01	3.43	5.95	3.09	0.88	0.75	0.87	0.39	0.26	0.26	0.88	4.64	2.20	69
1953	3.18	5.56	2.78	1.68	2.77	3.03	2.02	1.07	0.76	0.13	0.14	0.03	1.91	60
1954	2.90	1.56	7.64	5.40	5.50	4.42	1.03	0.94	1.45	0.26	5.88	6.26	3.61	114
1955	6.46	9.37	6.53	8.17	2.83	0.88	3.67	2.10	3.72	16.26	9.53	13.29	6.89	217
1956	6.96	7.77	5.85	9.29	6.72	3.15	0.82	0.53	0.04	0.00	0.14	0.26	3.43	108
1957	0.59	2.53	2.59	1.50	3.47	1.29	0.88	0.32	0.53	4.91	0.50	0.61	1.64	52
1958	5.12	2.40	10.86	7.31	4.84	1.90	0.82	0.53	0.53	0.53	0.66	0.53	3.01	95
1959	2.35	0.93	0.96	0.46	0.58	1.70	1.37	2.64	0.90	0.54	4.96	5.20	1.89	60
1960	4.96	9.40	5.94	5.63	5.81	1.37	0.56	0.49	0.15	1.03	5.99	7.03	4.00	126
1961	2.03	1.39	2.51	1.41	9.21	1.54	0.49	0.31	0.30	0.30	1.17	1.06	1.82	57
1962	0.98	2.92	8.15	7.42	3.28	0.61	0.33	0.19	0.09	0.16	0.70	3.01	2.32	73
1963	6.33	14.32	5.33	3.92	1.98	3.56	0.87	0.14	0.26	0.29	0.07	3.87	3.34	105
1964	0.24	0.59	2.51	1.54	1.47	0.80	1.82	0.17	0.26	0.86	2.55	4.87	1.48	47
1965	3.48	2.23	6.80	4.87	5.97	1.36	0.73	0.00	0.07	0.09	0.36	1.25	2.28	72
1966	1.90	8.87	2.29	1.95	2.16	1.40	0.44	0.30	0.37	0.42	1.32	6.08	2.25	71
1967	0.74	1.80	0.96	3.21	1.20	0.32	0.58	0.03	0.00	0.07	0.09	0.33	0.77	24
1968	0.78	1.75	0.50	0.44	0.20	0.23	0.05	0.34	0.17	0.24	0.97	2.04	0.64	20
1969	1.45	5.78	5.35	1.78	0.38	0.15	0.07	0.01	0.10	0.12	0.25	0.62	1.31	41
1970	1.16	1.83	2.10	3.47	2.24	1.47	1.70	0.39	0.54	0.87	0.64	0.55	1.41	44
1971	4.81	1.78	3.89	1.83	0.80	0.79	0.03	0.02	0.06	0.08	0.13	0.13	1.20	38
1972	0.38	0.51	0.28	0.35	0.77	0.20	2.20	1.26	2.29	2.13	3.06	0.89	1.20	38
1973	2.17	3.43	1.91	2.57	0.85	0.29	0.41	0.18	0.80	0.75	2.32	4.41	1.66	52
1974	1.09	2.96	0.93	1.02	4.15	1.75	0.36	0.11	0.18	1.06	2.64	1.06	1.43	45
1975	0.68	0.46	0.81	2.03	0.50	0.49	0.39	0.34	0.39	0.92	0.65	1.26	0.74	23
1976	0.64	2.15	2.40	4.83	1.26	2.07	0.88	0.52	0.52	0.62	4.11	4.82	2.06	65
1977	5.84	9.10	1.15	3.52	0.62	0.52	0.27	0.28	0.23	0.21	0.48	1.02	1.89	60
1978	1.43	3.23	2.33	1.63	4.48	0.89	0.32	0.35	1.49	0.51	0.41	1.72	1.56	49
1979	4.25	2.60	1.19	2.61	2.42	0.77	0.02	0.49	0.53	0.73	6.43	3.37	2.11	66
1980	5.21	2.94	2.50	1.91	3.99	1.74	0.53	0.53	0.58	1.15	2.41	5.83	2.45	77
1981	3.51	4.05	3.71	1.89	1.91	1.27	1.09	1.11	1.13	1.42	2.03	5.73	2.40	76
1982	0.90	0.83	2.08	2.23	1.24	0.85	0.14	0.10	0.30	0.33	0.35	0.69	0.84	26
1983	0.20	1.54	0.28	0.27	0.03	1.79	1.46	0.81	0.47	0.74	0.34	2.34	0.85	27
1984	5.58	5.54	4.84	2.01	1.03	0.44	0.43	0.29	0.30	0.32	0.33	0.38	1.77	56
1985	0.96	0.80	2.32	1.00	1.07	0.39	0.14	0.08	0.16	0.26	1.04	0.63	0.74	23
1986	5.39	6.53	2.95	2.49	2.34	1.97	1.00	0.50	0.47	0.47	0.46	0.55	2.07	65
Average	2.85	3.80	3.41	2.99	2.54	1.32	0.82	0.51	0.58	1.12	1.83	2.75	2.03	64
SD	2.16	3.27	2.56	2.31	2.17	1.00	0.76	0.57	0.73	2.77	2.26	2.85	1.19	38
Min	0.20	0.46	0.28	0.27	0.03	0.15	0.02	0.00	0.00	0.00	0.07	0.03	0.64	20
Max	6.96	14.32	10.86	9.29	9.21	4.42	3.67	2.64	3.72	16.26	9.53	13.29	6.89	217

LUMI ERENIKË - STACIONI GJAKOVË

Surface (km²): 455.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	10.00	9.40	30.80	19.00	3.80	3.00	0.36	0.62	0.50	0.50	2.50	3.80	7.01	221
1953	39.00	65.00	4.40	5.20	7.00	8.20	3.85	1.50	1.78	0.60	0.65	0.40	11.11	350
1954	3.40	1.90	15.00	14.00	16.50	6.00	2.45	0.82	0.78	1.50	1.50	1.00	5.43	171
1955	34.30	130.00	60.50	15.30	9.00	3.00	4.50	3.97	8.25	2.60	5.60	11.70	23.36	737
1956	75.00	115.00	37.30	24.00	20.20	5.00	1.40	0.30	0.22	0.30	1.30	1.10	22.85	721
1957	1.00	2.50	4.00	4.30	18.50	3.70	1.35	1.50	4.17	1.90	0.90	0.60	3.72	117
1958	24.30	14.10	36.90	31.40	20.00	4.10	0.51	0.25	0.50	1.07	5.60	12.70	12.63	398
1959	32.20	5.76	7.98	4.42	5.59	2.38	3.31	0.33	2.96	0.58	17.50	40.70	10.38	327
1960	37.20	32.50	29.30	12.90	16.40	5.91	2.56	0.37	0.50	8.05	27.30	18.10	15.83	499
1961	9.30	7.99	9.81	6.73	22.50	5.34	1.33	0.63	0.65	1.09	6.88	8.40	6.73	212
1962	13.90	20.20	28.80	22.60	12.80	4.85	1.72	0.48	0.50	1.75	12.10	20.20	11.61	366
1963	42.90	61.90	15.30	13.60	13.10	8.30	2.08	1.27	1.38	2.41	3.45	37.10	16.64	525
1964	0.50	8.02	13.23	10.72	7.54	6.90	2.56	1.66	2.58	9.11	17.63	23.46	8.66	273
1965	13.83	6.77	34.71	31.32	21.11	9.59	1.67	0.31	0.43	0.63	11.05	23.36	12.95	408
1966	17.48	51.82	15.10	11.35	13.94	4.77	0.79	0.26	0.56	3.06	33.10	29.40	14.86	469
1967	10.88	12.77	7.12	11.09	10.86	3.50	3.61	0.75	0.55	1.61	1.77	8.80	6.08	192
1968	38.32	23.98	5.18	8.64	4.54	6.19	0.53	0.47	1.50	1.25	16.33	27.90	11.16	352
1969	12.16	35.10	25.24	19.51	12.76	4.02	1.67	0.91	2.74	1.14	3.66	25.93	11.93	376
1970	23.20	33.90	18.40	26.70	11.80	7.51	3.01	0.86	1.23	8.46	11.00	29.30	14.49	457
1971	85.60	8.49	29.40	10.30	8.35	4.36	1.27	0.95	2.11	2.25	4.40	10.40	14.13	446
1972	11.90	12.20	6.22	7.32	5.27	2.30	3.04	0.81	17.60	16.20	22.60	7.68	9.37	296
1973	20.40	34.20	15.70	15.30	12.90	7.50	8.04	0.90	22.80	12.80	17.50	27.40	16.14	509
1974	10.30	8.83	7.14	8.93	17.40	7.82	1.69	2.63	1.63	19.60	15.20	9.74	9.26	292
1975	5.38	4.88	6.23	6.93	3.08	2.02	0.95	0.92	1.01	9.08	13.75	11.70	5.50	173
1976	9.25	14.61	18.68	13.50	15.07	14.77	3.06	2.83	2.97	4.17	19.11	44.76	13.57	428
1977	19.55	26.91	5.79	27.31	5.20	3.44	0.96	1.17	1.55	2.42	9.78	45.39	12.36	390
1978	10.34	19.98	23.84	22.44	40.88	17.93	4.12	3.39	8.59	8.45	6.17	11.18	14.74	465
1979	29.12	19.47	11.24	19.57	18.46	8.81	4.04	7.15	7.38	8.54	41.85	23.97	16.58	523
1980	13.55	8.78	9.29	3.58	16.24	8.54	1.15	4.55	0.70	3.89	12.01	26.91	9.13	288
1981	16.20	19.76	17.56	5.68	5.82	1.63	0.43	0.60	0.68	2.62	6.56	30.71	8.99	284
1982	39.53	17.59	47.27	66.66	59.07	23.04	8.37	6.98	6.02	12.44	11.77	24.97	27.05	853
1983	6.66	14.25	14.74	17.98	11.45	14.50	11.86	4.73	6.90	6.39	7.19	10.85	10.58	334
1984	59.56	18.39	33.64	13.73	13.54	4.11	1.61	1.66	1.86	2.78	4.98	5.58	13.49	425
1985	5.87	24.10	15.68	19.98	18.33	6.48	3.17	2.60	2.92	3.13	18.85	10.46	10.84	342
1986	39.38	44.63	11.37	5.89	4.47	3.13	0.74	0.45	0.46	0.64	1.97	2.77	9.45	298
Average	23.47	26.73	19.22	15.94	14.39	6.65	2.68	1.70	3.34	4.66	11.24	17.96	12.25	386
SD	20.06	28.72	13.39	11.78	10.72	4.66	2.45	1.81	4.86	4.85	9.56	12.93	5.08	160
Min	0.50	1.90	4.00	3.58	3.08	1.63	0.36	0.25	0.22	0.30	0.65	0.40	3.72	117
Max	85.60	130.00	60.50	66.66	59.07	23.04	11.86	7.15	22.80	19.60	41.85	45.39	27.05	853

LUMI DRINI I BARDHË-STACIONI KPUZ

Surface (km²): 2116

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	14.00	9.00	18.00	31.00	16.00	13.01	5.00	3.50	3.00	6.00	15.00	19.00	12.71	401
1953	*33.50*	*87.10*	*24.70*	*38.90*	*45.70*	*53.60*	*23.60*	*6.23*	*7.59*	*9.53*	*12.20*	*10.50*	*28.97*	914
1954	*9.24*	*10.80*	*58.30*	*37.30*	*62.90*	*32.60*	*11.20*	*3.75*	*4.18*	*19.10*	*29.50*	*27.30*	*25.63*	808
1955	*29.30*	*71.70*	*47.30*	*35.60*	*28.60*	*14.00*	*28.60*	*19.70*	*26.20*	*93.60*	*63.70*	*75.20*	*44.34*	1398
1956	*51.60*	*44.90*	*68.70*	*84.10*	*70.90*	*38.60*	*9.99*	*2.34*	*1.72*	*5.63*	*13.90*	*21.40*	*34.39*	1085
1957	*10.70*	*33.10*	*23.10*	*25.10*	*46.40*	*17.90*	*4.36*	*5.48*	*18.70*	*31.90*	*21.60*	*51.00*	*24.07*	759
1958	*52.20*	*23.10*	*73.50*	*61.30*	*85.20*	*33.90*	*3.63*	*1.38*	*5.03*	*6.99*	*21.70*	*17.20*	*32.19*	1015
1959	*30.90*	*14.30*	*26.80*	*30.30*	*28.30*	*24.40*	*18.90*	*19.10*	*19.20*	*10.20*	*39.20*	*60.50*	*26.93*	849
1960	*42.10*	*64.20*	*36.10*	*50.00*	*70.30*	*26.20*	*6.81*	*1.32*	*2.63*	*14.60*	*94.90*	*68.30*	*39.55*	1247
1961	*26.60*	*27.20*	*24.10*	*27.70*	*57.20*	*19.30*	*5.76*	*2.43*	*2.78*	*4.64*	*23.10*	*17.40*	*19.81*	625
1962	*20.60*	*23.60*	*49.00*	*70.50*	*60.50*	*20.40*	*10.30*	*2.51*	*3.59*	*8.55*	*23.60*	*33.20*	*27.20*	858
1963	54.80	115.00	45.80	62.60	67.90	46.60	8.90	2.55	5.62	8.52	11.60	57.50	40.10	1265
1964	14.00	13.33	23.74	25.48	28.89	22.36	7.75	4.60	12.43	22.66	39.78	52.45	22.33	704
1965	29.97	19.67	55.71	54.25	71.14	39.22	9.86	4.71	6.71	6.61	12.43	22.70	27.81	877
1966	25.05	62.59	27.53	39.55	47.95	29.71	6.27	2.66	4.70	9.10	29.94	34.17	26.31	830
1967	17.97	19.29	18.67	46.31	53.14	20.83	23.09	6.26	4.66	7.04	7.59	12.77	19.80	625
1968	21.77	24.13	16.91	28.80	22.09	22.23	1.90	4.15	8.53	8.11	22.72	27.03	17.27	545
1969	20.02	47.24	40.79	36.68	37.52	13.92	8.83	6.18	13.75	6.69	9.06	29.62	22.37	705
1970	56.65	45.80	42.93	68.38	57.77	39.87	16.34	4.99	8.42	12.08	14.27	16.91	31.91	1006
1971	48.66	21.65	35.07	49.71	42.38	19.41	4.04	3.29	6.58	6.85	9.23	12.23	21.60	681
1972	10.99	15.86	16.25	33.23	24.17	5.90	27.93	11.44	49.36	35.13	37.29	19.55	23.91	754
1973	26.56	35.30	20.58	33.65	55.61	11.94	14.86	8.29	18.63	21.22	37.42	44.83	27.36	863
1974	21.67	26.30	22.17	27.63	55.78	29.77	9.09	3.23	5.05	41.40	42.24	22.48	25.56	806
1975	13.84	9.92	14.41	30.10	28.24	19.39	7.14	3.84	3.98	13.99	19.52	17.01	15.12	477
1976	13.86	27.07	25.91	49.84	50.53	47.32	20.93	15.78	10.47	16.23	38.60	60.78	31.43	991
1977	42.20	75.77	33.43	58.48	36.99	17.10	3.98	2.63	4.27	6.39	9.04	12.70	24.87	784
1978	18.45	39.37	47.73	44.69	84.70	34.92	4.95	3.38	14.65	14.34	9.40	20.27	28.00	883
1979	59.18	38.25	20.40	38.47	36.05	15.13	4.79	11.53	12.02	14.55	86.79	48.03	31.98	1009
1980	47.35	40.37	34.22	34.80	61.39	38.30	6.60	5.42	4.98	28.31	44.83	56.14	33.53	1058
1981	22.73	23.58	48.15	47.54	41.25	16.34	2.72	4.06	9.61	13.25	12.08	40.89	23.54	742
1982	19.75	10.04	21.35	41.14	36.45	14.10	4.04	4.01	4.09	7.55	6.94	11.31	15.09	476
1983	10.46	26.93	27.99	35.02	20.85	27.47	21.74	6.29	10.99	9.89	11.62	19.55	18.98	598
1984	47.25	31.68	30.84	48.90	81.19	23.67	5.99	5.03	8.91	6.79	10.51	8.07	25.72	811
1985	8.76	48.29	30.03	39.35	35.78	10.08	2.89	1.65	2.36	2.82	36.90	18.71	19.54	616
1986	39.93	45.60	36.97	43.39	46.63	26.80	17.72	4.71	4.32	6.32	7.34	5.96	23.67	746
Average	28.93	36.34	33.92	43.14	48.47	25.32	10.59	5.67	9.42	15.33	26.44	30.65	26.10	823
SD	15.62	24.02	15.02	14.00	18.73	11.58	7.64	4.57	9.01	16.40	21.23	19.23	7.13	225
Min	8.76	9.00	14.41	25.10	16.00	5.90	1.90	1.32	1.72	2.82	6.94	5.96	12.71	401
Max	59.18	115.00	73.50	84.10	85.20	53.60	28.60	19.70	49.36	93.60	94.90	75.20	44.34	1398

LUMI DRINI I BARDHË-STACIONI GJONAJ														
Surface (km²):	3904		Q Gjonaj =1.7311*Q Kpuz+7.78 R²=0.83 for Janv-Avr & Oct-Dec, Q=1.6543Q Kpuz+1.692 Q Kpuz R²=0.96 for Summe											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3)
1952	32.03	23.37	38.96	61.47	28.21	23.25	9.95	7.46	6.63	18.17	33.76	40.69	26.98	851
1953	65.80	158.64	50.56	75.15	77.52	90.63	40.83	12.00	14.25	24.29	28.91	25.97	54.56	1721
1954	23.78	26.49	108.76	72.38	106.07	55.77	20.25	7.88	8.59	40.86	58.87	55.06	48.91	1542
1955	58.53	131.96	89.70	69.44	49.13	24.89	49.13	34.36	45.15	169.90	118.11	138.03	81.30	2564
1956	97.15	85.55	126.77	153.44	119.35	65.73	18.24	5.54	4.51	17.53	31.85	44.84	64.04	2019
1957	26.31	65.11	47.79	51.25	78.68	31.37	8.89	10.75	32.70	63.03	45.19	96.11	46.35	1462
1958	98.19	47.79	135.08	113.95	143.09	57.93	7.68	3.94	10.00	19.89	45.36	37.57	60.18	1898
1959	61.30	32.55	54.20	60.26	48.63	42.16	33.03	33.36	33.53	25.45	75.67	112.57	51.19	1614
1960	80.70	118.97	70.31	94.38	118.35	45.15	12.96	3.85	6.02	33.07	172.15	126.08	73.06	2304
1961	53.85	54.89	49.52	55.76	96.61	33.69	11.22	5.69	6.27	15.82	47.79	37.92	38.99	1230
1962	43.46	48.66	92.65	129.89	102.08	35.52	18.75	5.82	7.61	22.59	48.66	65.28	51.73	1631
1963	102.69	206.96	87.11	116.20	114.37	79.01	16.43	5.89	10.98	22.54	27.87	107.37	73.88	2330
1964	32.03	30.87	48.90	51.91	49.61	38.77	14.52	9.30	22.29	47.03	76.68	98.62	43.44	1370
1965	59.70	41.85	104.27	101.74	119.75	66.76	18.02	9.48	12.79	19.23	29.31	47.09	52.59	1658
1966	51.17	116.18	55.46	76.27	81.26	50.97	12.06	6.07	9.46	23.54	59.64	66.97	50.23	1584
1967	38.91	41.18	40.12	87.99	89.86	36.23	39.98	12.04	9.39	19.97	20.92	29.89	38.86	1225
1968	45.48	49.58	37.07	57.66	38.32	38.56	4.80	8.54	15.82	21.82	47.13	54.59	34.77	1097
1969	42.46	89.59	78.42	71.31	63.94	24.76	16.31	11.91	24.47	19.36	23.47	59.08	43.46	1371
1970	105.90	87.11	82.13	126.21	97.55	67.83	28.78	9.93	15.63	28.71	32.49	37.07	59.72	1883
1971	92.07	45.27	68.52	93.88	72.01	33.87	8.37	7.11	12.57	19.65	23.77	28.97	42.16	1330
1972	26.82	35.25	35.93	65.34	41.77	11.45	48.03	20.65	83.59	68.62	72.37	41.64	45.91	1448
1973	53.78	68.91	43.42	66.07	93.97	21.48	26.32	15.41	32.59	44.53	72.60	85.42	51.94	1638
1974	45.31	53.34	46.19	55.64	94.24	51.07	16.75	7.02	10.04	79.48	80.93	46.72	48.85	1541
1975	29.33	19.64	25.62	53.18	46.10	28.01	11.93	5.61	6.38	29.13	40.76	41.52	28.13	887
1976	39.95	54.92	57.11	77.44	88.72	73.39	29.38	24.85	19.16	22.08	70.09	115.48	56.01	1766
1977	88.63	114.75	87.42	96.62	51.35	28.03	5.17	4.67	7.47	9.68	26.39	46.05	46.71	1473
1978	51.15	94.50	88.51	78.73	124.92	58.66	12.09	3.50	21.37	18.48	14.42	59.70	51.92	1637
1979	108.99	70.45	37.58	70.86	66.41	27.87	8.82	21.25	22.14	26.80	159.84	88.45	58.91	1858
1980	102.31	67.43	64.24	53.82	103.91	73.57	13.70	9.28	8.50	55.87	94.93	80.02	60.61	1911
1981	47.15	48.61	91.18	90.13	70.12	28.78	6.17	8.39	17.60	30.73	28.70	78.61	45.54	1436
1982	45.80	19.46	49.46	77.65	66.01	27.49	9.26	8.08	6.77	13.74	13.18	35.31	31.11	981
1983	16.53	77.88	36.45	59.50	31.61	57.08	44.74	12.90	16.90	13.85	19.06	56.12	36.53	1152
1984	89.63	62.64	61.20	92.47	136.44	40.95	11.59	10.00	16.45	19.54	25.98	21.77	49.00	1545
1985	34.26	80.62	92.78	73.34	65.87	23.32	5.33	2.10	4.57	6.73	74.62	27.24	40.54	1278
1986	111.56	106.04	102.84	81.38	96.76	69.08	33.08	8.55	8.00	10.80	12.43	12.89	54.16	1708
Average	60.08	70.77	68.18	80.36	82.07	44.66	19.22	10.66	16.86	32.07	52.97	61.33	49.78	1570
SD	28.63	41.35	27.94	24.64	30.70	19.65	12.97	7.65	15.04	29.32	37.99	32.24	12.23	386
Min	16.53	19.46	25.62	51.25	28.21	11.45	4.80	2.10	4.51	6.73	12.43	12.89	26.98	851
Max	111.56	206.96	135.08	153.44	143.09	90.63	49.13	34.36	83.59	169.90	172.15	138.03	81.30	2564

LUMI DRINI I BARDHË-STACIONI VËRMICË

Surface (km²): 4368

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	33.79	22.92	42.49	70.77	38.14	31.64	14.22	10.95	9.87	16.39	35.97	44.67	30.98	977
1953	76.20	192.78	57.06	87.95	102.74	119.92	54.67	16.89	19.85	24.07	29.88	26.18	66.35	2092
1954	23.44	26.83	130.14	84.47	140.15	74.25	27.70	11.50	12.43	44.88	67.50	62.72	59.09	1863
1955	67.07	159.29	106.22	80.77	65.55	33.79	65.55	46.19	60.33	206.92	141.89	166.90	99.78	3147
1956	115.57	101.00	152.76	186.26	157.55	87.30	25.07	8.43	7.08	15.59	33.57	49.89	78.15	2465
1957	*18.80*	*91.20*	*53.30*	*58.80*	*100.40*	*43.50*	*11.30*	*9.34*	*40.00*	*92.20*	*59.20*	*103.00*	*56.54*	1783
1958	*118.00*	*59.70*	*186.00*	*155.00*	*140.00*	*51.00*	*11.70*	*4.45*	*8.56*	*14.00*	*30.90*	*34.90*	*67.99*	2144
1959	*105.00*	*50.50*	*64.20*	*62.60*	*64.60*	*60.30*	*42.60*	*38.60*	*34.50*	*23.70*	*73.10*	*103.00*	*60.33*	1903
1960	*98.70*	*150.00*	*101.00*	*103.00*	*142.00*	*78.60*	*39.00*	*17.40*	*11.20*	*60.00*	*17.50*	*96.80*	*75.92*	2394
1961	45.30	41.10	53.90	41.20	157.00	56.00	14.20	3.63	4.33	9.40	53.30	54.00	44.54	1405
1962	37.23	52.32	120.92	133.47	106.26	43.21	22.53	8.89	9.38	17.07	53.30	88.39	57.77	1822
1963	210.24	312.23	76.88	87.91	92.02	69.50	18.80	4.05	9.86	15.75	19.35	122.53	85.18	2686
1964	34.27	36.85	61.37	72.10	63.68	59.08	19.50	11.13	21.12	41.55	102.64	104.85	52.35	1651
1965	84.09	52.63	146.36	117.46	152.46	84.81	42.28	33.70	36.08	35.20	50.67	79.84	76.54	2414
1966	89.34	168.02	59.91	66.08	81.31	53.21	17.68	6.82	12.39	18.18	59.67	91.41	59.59	1879
1967	89.68	64.21	63.35	88.51	91.91	33.27	47.93	12.29	9.94	12.91	13.43	32.92	46.67	1472
1968	67.88	75.24	41.81	47.23	39.95	41.76	5.92	8.66	18.18	16.11	46.95	74.81	40.11	1265
1969	54.36	122.81	97.04	90.94	75.05	33.67	16.07	8.55	21.91	11.76	21.82	68.07	51.36	1620
1970	143.08	130.00	104.53	145.72	101.41	76.76	37.89	9.31	14.48	32.84	39.37	43.61	72.83	2297
1971	109.19	50.42	79.61	111.47	95.52	45.55	12.14	10.49	17.64	18.25	23.42	29.95	50.31	1587
1972	30.60	44.22	24.04	49.16	46.38	15.15	40.23	19.16	116.86	67.19	75.56	38.76	47.12	1486
1973	62.66	88.30	52.87	79.85	77.08	25.31	44.69	23.25	46.54	39.50	84.35	139.06	63.47	2002
1974	60.04	79.43	49.74	60.89	123.53	67.07	26.31	6.14	11.66	87.49	84.11	64.56	59.97	1891
1975	33.44	24.92	34.69	68.81	64.77	45.51	18.87	11.70	12.00	33.76	45.80	40.34	36.24	1143
1976	33.48	62.22	59.70	111.75	113.25	106.27	48.87	37.67	26.12	38.64	87.30	135.54	71.69	2261
1977	95.13	168.14	76.06	130.53	83.79	40.54	12.00	9.05	12.62	17.23	23.01	30.96	57.42	1811
1978	43.46	88.97	107.16	100.54	187.57	79.30	14.12	10.68	35.20	34.53	23.79	47.44	64.25	2026
1979	132.05	86.53	47.71	87.01	81.76	36.25	13.75	28.43	29.48	34.99	192.11	107.79	72.90	2299
1980	106.32	91.15	77.77	79.02	136.87	86.65	17.68	15.13	14.17	64.91	100.85	125.45	76.28	2406
1981	52.78	54.62	108.08	106.75	93.05	38.88	9.26	12.17	24.24	32.16	29.61	92.28	54.54	1720
1982	46.30	25.19	49.77	92.83	82.61	34.00	12.12	12.06	12.24	19.75	18.42	27.94	36.16	1140
1983	26.09	61.90	64.22	79.50	48.69	63.09	50.61	17.02	27.24	24.84	28.62	45.86	44.62	1407
1984	106.12	72.24	70.42	109.70	179.94	54.82	16.36	14.27	22.73	18.10	26.20	20.90	59.28	1869
1985	22.40	108.37	68.65	88.93	81.17	25.26	9.63	6.93	8.47	9.47	83.61	44.04	45.84	1446
1986	90.19	102.53	83.75	97.71	104.75	61.64	41.89	13.59	12.73	17.09	19.31	16.30	54.81	1729
Average	73.21	89.11	79.24	92.42	100.37	55.91	26.38	14.82	22.61	36.18	54.17	70.16	59.34	1871
SD	42.21	59.17	36.15	31.28	38.88	23.91	15.96	10.32	20.61	36.34	38.71	38.98	14.97	472
Min	18.80	22.92	24.04	41.20	38.14	15.15	5.92	3.63	4.33	9.40	13.43	16.30	30.98	977
Max	210.24	312.23	186.00	186.26	187.57	119.92	65.55	46.19	116.86	206.92	192.11	166.90	99.78	3147

LUMI BISTRICA - STACIONI PRIZEREN

Surface (km²): 158.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	*3.91*	*4.31*	*6.39*	*6.27*	*5.37*	*5.49*	*2.77*	*1.47*	*1.24*	*3.60*	*7.05*	*7.70*	*4.63*	146
1953	*5.93*	*7.65*	*2.96*	*6.84*	*9.80*	*9.45*	*4.86*	*3.28*	*2.16*	*2.05*	*1.96*	*1.81*	*4.87*	154
1954	*1.79*	*1.88*	*5.81*	*6.39*	*15.60*	*7.29*	*1.55*	*1.94*	*2.51*	*3.50*	*3.80*	*3.87*	*4.68*	148
1955	*4.70*	*6.36*	*5.31*	*6.26*	*7.35*	*6.17*	*6.15*	*4.57*	*9.31*	*23.40*	*21.20*	*15.40*	*9.70*	306
1956	*8.11*	*8.09*	*8.61*	*13.96*	*14.50*	*9.35*	*4.52*	*2.70*	*2.33*	*1.94*	*2.06*	*2.04*	*6.50*	205
1957	*1.52*	*2.54*	*2.41*	*3.82*	*9.94*	*9.76*	*4.07*	*2.71*	*3.92*	*5.14*	*4.07*	*4.27*	*4.52*	143
1958	*4.66*	*3.19*	*6.79*	*6.11*	*12.80*	*6.04*	*3.32*	*2.13*	*1.49*	*1.32*	*2.72*	*1.89*	*4.38*	138
1959	*2.18*	*1.41*	*2.90*	*3.33*	*5.77*	*6.12*	*7.17*	*8.38*	*3.54*	*2.47*	*2.66*	*5.29*	*4.30*	135
1960	*5.07*	*5.56*	*4.30*	*4.43*	*11.70*	*9.84*	*3.57*	*2.00*	*2.94*	*5.18*	*6.65*	*6.29*	*5.62*	177
1961	*3.49*	*3.04*	*4.06*	*3.80*	*6.57*	*3.80*	*3.31*	*1.94*	*1.58*	*1.13*	*5.60*	*4.70*	*3.59*	113
1962	*3.75*	*3.74*	*8.27*	*8.77*	*7.32*	*3.91*	*2.91*	*1.55*	*1.13*	*1.29*	*9.74*	*6.06*	*4.87*	154
1963	*10.40*	*10.80*	*6.75*	*7.40*	*12.20*	*11.30*	*5.51*	*1.89*	*1.97*	*2.45*	*2.41*	*4.97*	*6.48*	204
1964	*4.28*	*3.36*	*2.60*	*4.30*	*6.10*	*5.83*	*4.95*	*4.80*	*4.37*	*7.15*	*7.82*	*6.63*	*5.19*	164
1965	*5.34*	*5.53*	*5.82*	*6.59*	*17.10*	*10.50*	*3.62*	*1.94*	*1.52*	*1.27*	*1.63*	*3.69*	*5.38*	170
1966	4.08	5.64	4.59	8.03	10.52	9.32	3.49	2.01	1.60	1.23	1.89	2.73	4.58	144
1967	2.51	2.32	5.55	11.53	14.43	7.94	5.15	2.76	2.12	1.77	1.56	1.76	4.96	156
1968	1.75	2.22	2.71	3.50	4.62	3.89	1.75	2.04	2.70	2.04	3.42	3.86	2.87	91
1969	2.29	2.57	2.87	5.10	7.06	3.85	2.17	1.58	1.50	1.35	1.21	2.39	2.83	89
1970	4.44	5.20	5.43	9.84	8.55	8.94	5.45	1.67	1.06	1.14	1.60	2.05	4.60	145
1971	4.31	2.33	3.25	4.25	6.79	7.14	2.86	1.66	1.84	1.29	1.50	1.45	3.22	102
1972	1.29	1.42	1.56	3.95	5.67	3.35	1.75	1.41	2.02	3.04	4.68	3.15	2.78	88
1973	3.03	3.31	3.74	6.38	9.48	4.82	5.01	3.49	3.53	3.49	3.98	6.21	4.72	149
1974	*4.14*	*4.04*	*3.30*	*3.44*	*11.10*	*12.30*	*4.58*	*1.95*	*1.57*	*2.67*	*3.01*	*2.94*	*4.59*	145
1975	2.62	1.99	4.04	6.72	10.49	7.76	3.51	2.16	0.98	3.23	1.82	1.32	3.90	123
1976	*2.43*	*2.56*	*2.55*	*5.82*	*9.34*	*8.68*	*3.92*	*2.94*	*3.02*	*3.82*	*9.06*	*6.81*	*5.08*	160
1977	*3.14*	*6.54*	*3.41*	*4.43*	*4.83*	*2.52*	*1.33*	*1.21*	*0.95*	*1.32*	*1.84*	*1.91*	*2.76*	87
1978	2.17	4.13	4.77	6.53	10.46	6.50	2.01	0.97	2.09	1.50	1.46	3.88	3.87	122
1979	4.60	4.37	2.04	3.22	7.28	4.94	2.53	2.05	1.80	1.54	30.29	7.19	5.96	188
1980	6.55	5.84	5.21	5.27	7.99	5.63	2.38	2.26	2.22	4.60	6.29	7.45	5.14	162
1981	2.58	4.09	5.93	3.79	7.08	5.66	2.47	1.94	2.68	4.05	4.62	6.84	4.31	136
1982	3.73	2.74	3.89	5.92	5.44	3.15	2.12	2.12	2.13	2.48	2.42	2.86	3.25	103
1983	0.79	1.47	2.08	2.88	2.83	2.86	2.47	1.43	1.24	1.24	1.35	1.71	1.86	59
1984	59.56	18.39	33.64	13.73	13.54	4.14	1.61	1.66	1.86	2.78	4.98	5.58	13.49	426
1985	1.14	0.99	2.43	4.36	7.73	2.29	0.73	0.44	0.37	0.23	2.38	1.37	2.04	64
1986	5.09	5.88	6.37	7.46	9.16	7.68	6.19	3.12	2.27	2.20	2.32	2.52	5.01	158
Average	5.35	4.44	5.21	6.13	9.04	6.52	3.48	2.35	2.27	3.11	4.89	4.30	4.76	150
SD	9.64	3.26	5.26	2.75	3.41	2.69	1.58	1.38	1.51	3.82	5.79	2.80	2.09	66
Min	0.79	0.99	1.56	2.88	2.83	2.29	0.73	0.44	0.37	0.23	1.21	1.32	1.86	59
Max	59.56	18.39	33.64	13.96	17.10	12.30	7.17	8.38	9.31	23.40	30.29	15.40	13.49	426

LUMI PLLAVA - STACIONI ORQUSHA

Surface (km²): 252.00

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	V (Mm3
1952	3.77	4.77	8.32	11.17	7.12	4.35	1.25	0.82	0.75	1.58	6.10	10.30	5.02	158
1953	4.16	8.92	3.96	9.34	14.40	11.60	3.50	1.94	1.88	1.78	1.61	1.48	5.34	169
1954	1.80	2.59	5.86	4.41	15.20	7.45	1.89	1.13	1.38	2.88	6.66	7.05	4.88	154
1955	8.53	15.70	7.47	10.70	15.10	7.07	3.92	3.84	5.93	13.00	10.90	11.30	9.41	297
1956	7.35	6.40	6.18	20.00	19.50	10.20	2.55	0.83	0.56	0.79	2.41	1.35	6.49	205
1957	0.95	3.05	2.86	3.44	10.40	6.26	3.71	2.27	3.95	6.85	3.25	4.51	4.30	136
1958	4.88	3.51	8.81	12.90	24.20	8.10	1.99	0.90	0.86	1.09	2.10	1.92	5.96	188
1959	4.70	2.39	5.42	4.81	8.43	5.01	7.14	2.35	4.17	1.90	4.91	4.46	4.66	147
1960	3.38	9.72	5.80	8.48	16.00	12.30	3.37	0.97	1.34	4.16	16.10	5.07	7.18	226
1961	2.84	2.40	7.84	7.26	13.00	5.02	1.56	0.64	0.32	0.76	4.94	2.92	4.14	130
1962	1.61	3.43	11.80	11.50	14.60	6.19	2.97	0.76	0.64	1.45	9.23	6.25	5.88	185
1963	14.16	13.58	6.41	12.86	19.76	13.31	2.94	1.08	1.05	1.16	1.40	4.70	7.66	242
1964	2.28	4.18	3.06	6.97	9.86	8.71	2.88	1.97	1.65	4.35	8.11	5.02	4.91	155
1965	3.41	1.81	8.40	10.10	21.40	11.30	1.71	0.90	0.13	0.65	1.56	4.76	5.54	175
1966	6.46	8.03	4.64	10.35	12.64	8.82	2.50	0.83	0.83	0.79	1.65	4.62	5.15	163
1967	3.07	2.84	7.95	13.55	15.20	6.00	4.97	1.24	0.95	0.70	0.72	1.60	4.91	155
1968	1.99	3.82	2.74	5.56	5.63	3.88	1.32	1.28	1.69	1.15	2.19	2.88	2.83	89
1969	2.50	3.84	4.79	9.34	13.01	4.11	1.65	0.82	0.93	0.72	0.87	1.89	3.70	117
1970	5.89	8.67	10.03	12.32	14.07	12.80	5.05	0.89	0.72	1.54	2.97	4.59	6.61	208
1971	6.75	2.94	7.32	6.03	11.25	7.06	2.18	1.24	1.43	0.99	1.07	0.89	4.11	130
1972	1.48	1.52	1.75	5.65	7.23	3.16	2.02	1.54	3.64	7.51	7.24	3.72	3.88	122
1973	2.28	3.00	3.86	9.72	13.15	3.13	2.67	2.28	2.65	2.25	4.20	9.67	4.92	155
1974	4.10	5.17	4.66	5.69	19.19	14.41	2.32	0.81	0.78	2.48	3.62	2.49	5.47	173
1975	2.51	1.87	6.09	9.05	13.63	5.47	1.97	0.99	0.61	4.58	2.91	4.72	4.55	144
1976	1.92	1.60	2.07	5.92	8.94	10.70	2.73	1.76	2.31	1.42	4.15	5.83	4.12	130
1977	3.90	9.24	5.94	9.67	6.87	2.46	1.19	1.00	0.87	0.88	2.44	4.65	4.05	128
1978	2.20	5.06	10.30	9.90	19.40	7.94	1.85	0.93	2.56	2.71	2.56	7.28	6.07	191
1979	10.49	7.01	4.05	7.05	6.65	3.17	1.46	2.58	2.66	3.08	15.07	8.64	5.97	188
1980	8.52	7.36	6.34	6.44	10.85	7.02	1.76	1.56	1.49	5.36	8.11	9.98	6.23	196
1981	3.05	4.72	6.74	4.38	8.01	6.44	2.93	2.34	3.16	4.67	5.30	7.74	4.96	156
1982	3.94	2.33	4.21	7.49	6.71	3.00	1.33	1.33	1.34	1.92	1.81	2.54	3.17	100
1983	2.52	3.52	3.93	5.24	5.10	4.82	4.63	1.48	1.30	1.49	1.96	2.43	3.20	101
1984	3.09	2.50	3.85	4.77	12.91	2.89	1.24	1.57	1.58	1.53	1.58	1.29	3.25	102
1985	3.40	5.90	7.48	9.13	12.25	4.47	2.37	1.75	1.90	1.15	2.69	4.30	4.72	149
1986	6.15	7.44	8.23	9.99	12.76	10.35	7.94	2.95	1.57	1.46	1.65	1.99	6.03	190
Average	4.29	5.17	5.98	8.60	12.70	7.11	2.78	1.47	1.70	2.59	4.40	4.71	5.12	162
SD	2.83	3.37	2.42	3.40	4.79	3.37	1.58	0.73	1.25	2.53	3.79	2.82	1.37	43
Min	0.95	1.52	1.75	3.44	5.10	2.46	1.19	0.64	0.13	0.65	0.72	0.89	2.83	89
Max	14.16	15.70	11.80	20.00	24.20	14.41	7.94	3.84	5.93	13.00	16.10	11.30	9.41	297