


REVIEW OF HPP ZHUR FEASIBILITY STUDY

INCLUDING PREPARATION OF

PRELIMINARY EIA AND PRELIMINARY SA

elektroprojekt
Established 1949
Consulting Engineers

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REPUBLIKA E KOSOVËS
REPUBLIKA KOSOVA
REPUBLIC OF KOSOVO
Ministria e Energjisë dhe Minierave
Ministarstvo energije i rudarstva
Ministry of Energy and Mining
LPTAP Project Office

The World Bank

THE TASKS

Task 1: Review and update the existing hydrological, hydro-technical, and geological data for necessary for development of HPP Zhur.

Task 2: Review, update and optimize **plant installed capacity** and update/complete the existing **preliminary engineering design** of the HPP Zhur;

Task 3: Review and update/complete the existing **financial and economic feasibility** of the HPP Zhur, including analysis of financing options;

Task 4: Prepare a preliminary EIA (**Environmental Impact Assessment**), including trans-boundary impacts, impact on downstream irrigation and dam safety associated international requirements;

Task 5: Prepare a preliminary SA (**Social Assessment**), including a draft Resettlement Action Plan.

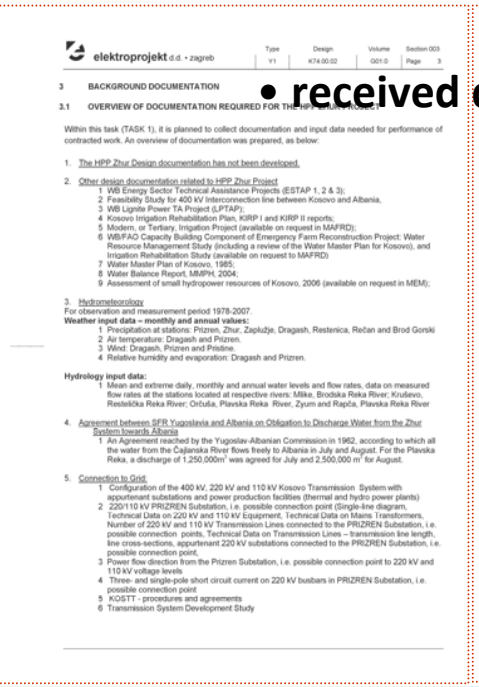
collecting of necessary documentation and input data

- **available documentation:**
  - ✓ Feasibility Study, Elektroprojekt Consulting Engineers, Zagreb 2001,
  - ✓ Zhur HPP, Preliminary Design, Kosovoprojekt Beograd 1970 – not complete,
  - ✓ HPP Zhur, The Plavë River Dam – Discharge Structures Selection, Elektroprojekt Consulting Engineers Zagreb 1986,
  - ✓ HPP Zhur I, Analysis and Selection of Cost Effective Surge Tank, Elektroprojekt Consulting Engineers Zagreb 1986,
  - ✓ HPP Zhur, The Brezna (Lopuško polje – *Fusha e Llopushnikut*) Reservoir Conceptual Design Update, Volumes I and II, Elektroprojekt Consulting Engineers, Zagreb 1983,
  - ✓ HPP Zhur Geological and Hydrogeological Relations at the Fusha e Llopushnikut Area,
  - ✓ Study on Engineering Geology and Hydrogeology of the Çaljane and Restelic Rivers Conveyance System and Dam Site and the Plavë Reservoir Dam Area, 1985,
  - ✓ HPP Zhur - Reinterpretation of Investigation Results, Volumes I and II, Elektroprojekt Consulting Engineers, Zagreb, 1984,
  - ✓ Basic Geological Map, Prizren sheet, scale 1:100,000,
  - ✓ HPP Zhur Final Design, Geology, Brod River Engineering Geology along the Conveyance System Route Zagreb, 1986,
  - ✓ Analysis of Seismic Hazards and Defining of Design Seismic Parameters for the HPP Zhur System Structures, IZIS, Skopje, 1986,
  - ✓ HPP Zhur Hydrological Input Data and Documentation, Elektroprojekt Consulting Engineers, Zagreb 1986,
  - ✓ Land surveying maps, scale 1:25,000

collecting of necessary documentation and input data

- **requested documentation** (2-3 November 2008) MEETINGS HELD AT:
  - Prizren Municipality,
  - Dragash/Sharr Municipality,
  - Ministry of Environment and Spatial Planning,
  - Ministry of Culture, Youth and Sports,
  - Ministry of Agriculture, Forestry and Rural Development,
  - Ministry of Labor and Social Welfare,
  - Hydro-meteorological Institute of Kosovo

- **received documenation is rather modest**



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3 BACKGROUND DOCUMENTATION

3.1 OVERVIEW OF DOCUMENTATION REQUIRED FOR THE HPP ZHUR PROJECT

Within this task (TASK 1), it is planned to collect documentation and input data needed for performance of contracted work. An overview of documentation was prepared, as below:

1. The HPP Zhur Design documentation has not been developed.

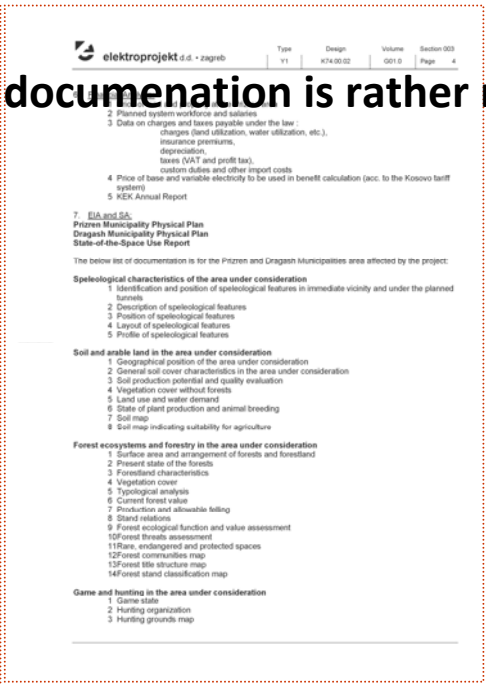
2. Other design documentation related to HPP Zhur Project
   1 WB Energy Sector Technical Assistance Projects (ESTAP 1, 2 & 3);
   2 Feasibility Study for 400 kV Interconnection line between Kosovo and Albania,
   3 WB Lignite Power TA Project (LPTAP);
   4 Kosovo Irrigation Rehabilitation Plan, KIRP I and KIRP II reports;
   5 Modern, or Tertiary, Irrigation Project (available on request in MAFRD);
   6 WB/FAO Capacity Building Component of Emergency Farm Reconstruction Project: Water Resource Management Study (including a review of the Water Master Plan for Kosovo), and Irrigation Rehabilitation Study (available on request to MAFRD)
   7 Water Master Plan of Kosovo, 1985;
   8 Water Balance Report, MMPH, 2004;
   9 Assessment of small hydropower resources of Kosovo, 2006 (available on request in MEM);

3. Hydrometeorology
For observation and measurement period 1978-2007.
Weather input data – monthly and annual values:
   1 Precipitation at stations: Prizren, Zhur, Zaplužje, Dragash, Resterica, Rečan and Brod Gorski
   2 Air temperature: Dragash and Prizren.
   3 Wind: Dragash, Prizren and Pristine.
   4 Relative humidity and evaporation: Dragash and Prizren.

Hydrology input data:
   1 Mean and extreme daily, monthly and annual water levels and flow rates, data on measured flow rates at the stations located at respective rivers: Mlike, Brodska Reka River; Kruševo, Restelička Reka River; Orbuša, Plavska Reka River, Zyum and Rapča, Plavska Reka River

4. Agreement between SFR Yugoslavia and Albania on Obligation to Discharge Water from the Zhur System towards Albania
   1 An Agreement reached by the Yugoslav-Albanian Commission in 1962, according to which all the water from the Čajlanska River flows freely to Albania in July and August. For the Plavska Reka, a discharge of 1,250,000m³ was agreed for July and 2,500,000 m³ for August.

5. Connection to Grid
   1 Configuration of the 400 kV, 220 kV and 110 kV Kosovo Transmission System with appurtenant substations and power production facilities (thermal and hydro power plants)
   2 220/110 kV PRIZREN Substation, i.e. possible connection point (Single-line diagram, Technical Data on 220 kV and 110 kV Equipment, Technical Data on Mains Transformers, Number of 220 kV and 110 kV Transmission Lines connected to the PRIZREN Substation, i.e. possible connection points, Technical Data on Transmission Lines – transmission line length, line cross-sections, appurtenant 220 kV substations connected to the PRIZREN Substation, i.e. possible connection point,
   3 Power flow direction from the Prizren Substation, i.e. possible connection point to 220 kV and 110 kV voltage levels
   4 Three- and single-pole short circuit current on 220 kV busbars in PRIZREN Substation, i.e. possible connection point
   5 KOSTT - procedures and agreements
   6 Transmission System Development Study



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   2 Planned system workforce and salaries
   3 Data on charges and taxes payable under the law :
      charges (land utilization, water utilization, etc.),
      insurance premiums,
      depreciation,
      taxes (VAT and profit tax),
      custom duties and other import costs
   4 Price of base and variable electricity to be used in benefit calculation (acc. to the Kosovo tariff system)
   5 KEK Annual Report

7. EIA and SA:
Prizren Municipality Physical Plan
Dragash Municipality Physical Plan
State-of-the-Space Use Report

The below list of documentation is for the Prizren and Dragash Municipalities area affected by the project:

Speleological characteristics of the area under consideration
   1 Identification and position of speleological features in immediate vicinity and under the planned tunnels
   2 Description of speleological features
   3 Position of speleological features
   4 Layout of speleological features
   5 Profile of speleological features

Soil and arable land in the area under consideration
   1 Geographical position of the area under consideration
   2 General soil cover characteristics in the area under consideration
   3 Soil production potential and quality evaluation
   4 Vegetation cover without forests
   5 Land use and water demand
   6 State of plant production and animal breeding
   7 Soil map
   8 Soil map indicating suitability for agriculture

Forest ecosystems and forestry in the area under consideration
   1 Surface area and arrangement of forests and forestland
   2 Present state of the forests
   3 Forestland characteristics
   4 Vegetation cover
   5 Typological analysis
   6 Current forest value
   7 Production and allowable felling
   8 Stand relations
   9 Forest ecological function and value assessment
   10Forest threats assessment
   11Rare, endangered and protected spaces
   12Forest communities map
   13Forest title structure map
   14Forest stand classification map

Game and hunting in the area under consideration
   1 Game state
   2 Hunting organization
   3 Hunting grounds map

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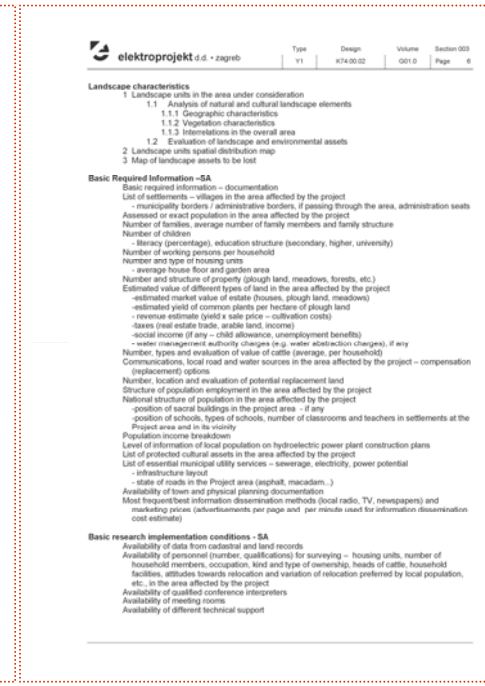
…inland fauna in the area under consideration
…auna
   1.1 Fish fund structure
   1.2 Ichthyoproduction
   1.3 Fishing area use
   1.4 Rare, endangered and protected spaces
2 Terrestrial fauna
   2.1 Invertebrate characteristics
      2.1.1 Extent of occurrence of main groups and systematic presentation
      2.1.2 Rare, endangered and protected spaces
   2.2 Vertebrata characteristics
      2.2.1 Characteristics of reptiles, amphibians, birds and mammals
         2.2.1.1 Extent of occurrence and systematic presentation
         2.2.1.2 Vertebrata habitats
         2.2.1.3 Rare, endangered and protected spaces

Characteristics of vegetation in the area under consideration
1 Presentation of diversity of habitats, vegetation and flora
   1.1 Exceptionally valuable habitats
   1.2 Spatial distribution of communities
      1.2.1 Wetland habitat communities
      1.2.2 Terrestrial habitat communities
2 Taxa diversity valuation
   2.1 Endemics (endangered and not endangered)
   2.2 Rare, endangered and protected spaces
   2.3 Endangered population
3 Area vegetation maps, scale 1: 100 000

Characteristics of land and aquatic ecosystems and terrestrial ecosystems
1 Physico-chemical characteristics
2 Biological and bacteriological characteristics, without ichthyofauna
3 Water quality assessment

Cultural and historical assets
1 General data
   1.1 Basic characteristics of the area
   1.2 Historical overview
2 Analysis of the present state
   2.1 Analysis of cultural and historical assets
      2.1.1 Archeological sites
      2.1.2 Settlements
      2.1.3 Individual monuments
      2.1.4 Other potential assets
   2.2 Degree of research
   2.3 Availability of documented area records
3 Identification of cultural and historical assets
      registered
      recorded
      assumed

Demographic aspects
1 Population rate trends
   1.1 Population distribution and density
2 Population rate trends projection by 2021
3 Biological and socioeconomic structure of population
4 Basic positive/negative determinants of demographic aspects



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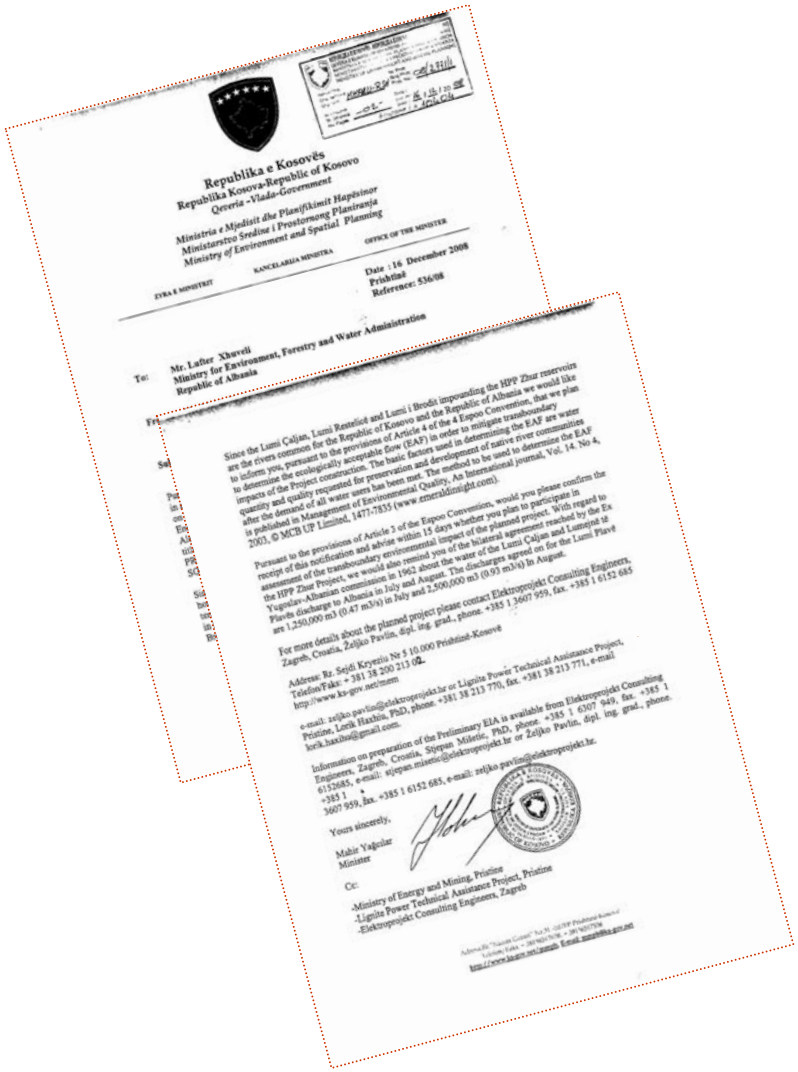
Landscape characteristics
1 Landscape units in the area under consideration
   1.1 Analysis of natural and cultural landscape elements
      1.1.1 Geographic characteristics
      1.1.2 Vegetation characteristics
      1.1.3 Interrelations in the overall area
   1.2 Evaluation of landscape and environmental assets
2 Landscape units spatial distribution map
3 Map of landscape assets to be lost

Basic Required Information –SA
Basic required information – documentation
List of settlements – villages in the area affected by the project
   - municipality borders / administrative borders, if passing through the area, administration seats
Assessed or exact population in the area affected by the project
Number of families, average number of family members and family structure
Number of children
   - literacy (percentage), education structure (secondary, higher, university)
Number of working persons per household
Number and type of housing units
   - average house floor and garden area
Number and structure of property (plough land, meadows, forests, etc.)
Estimated value of different types of land in the area affected by the project
   -estimated market value of estate (houses, plough land, meadows)
   -estimated yield of common plants per hectare of plough land
   - revenue estimate (yield x sale price – cultivation costs)
   -taxes (real estate trade, arable land, income)
   -social income (if any – child allowance, unemployment benefits)
   - water management authority charges (e.g. water abstraction charges), if any
Number, types and evaluation of value of cattle (average, per household)
Communications, local road and water sources in the area affected by the project – compensation (replacement) options
Number, location and evaluation of potential replacement land
Structure of population employment in the area affected by the project
National structure of population in the area affected by the project
   -position of sacral buildings in the project area - if any
   -position of schools, types of schools, number of classrooms and teachers in settlements at the Project area and in its vicinity
Population income breakdown
Level of information of local population on hydroelectric power plant construction plans
List of protected cultural assets in the area affected by the project
List of essential municipal utility services – sewerage, electricity, power potential
   - infrastructure layout
   - state of roads in the Project area (asphalt, macadam...)
Availability of town and physical planning documentation
Most frequent/best information dissemination methods (local radio, TV, newspapers) and marketing prices (advertisements per page and per minute used for information dissemination cost estimate)

Basic research implementation conditions - SA
Availability of data from cadastral and land records
Availability of personnel (number, qualifications) for surveying – housing units, number of household members, occupation, kind and type of ownership, heads of cattle, household facilities, attitudes towards relocation and variation of relocation preferred by local population, etc., in the area affected by the project
Availability of qualified conference interpreters
Availability of meeting rooms
Availability of different technical support


Republika e Kosovës
Republika Kosova-Republic of Kosovo
Qeveria -Vlada-Government
Ministria e Mjedisit dhe Planifikimit Hapësinor
Ministarstvo Sredine i Prostornog Planiranja
Ministry of Environment and Spatial Planning
OFFICE OF THE MINISTER
Date : 16 December 2008
Prishtinë
Reference: 536/08
To: Mr. Lefter Xhaveli
Ministry for Environment, Forestry and Water Administration
Republic of Albania
Since the Lumi Çaljan, Lumi Restelicë and Lumi i Brodit impounding the HPP Zhur reservoirs are the rivers common for the Republic of Kosovo and the Republic of Albania we would like to inform you, pursuant to the provisions of Article 4 of the 4 Espoo Convention, that we plan to determine the ecologically acceptable flow (EAF) in order to mitigate transboundary impacts of the Project construction. The basic factors used in determining the EAF are water quantity and quality requested for preservation and development of native river communities after the demand of all water users has been met. The method to be used to determine the EAF is published in Management of Environmental Quality, An International journal, Vol. 14 No 4, 2003, © MCB UP Limited, 1477-7835 (www.emeraldinsight.com).
Pursuant to the provisions of Article 3 of the Espoo Convention, would you please confirm the receipt of this notification and advise within 15 days whether you plan to participate in assessment of the transboundary environmental impact of the planned project. With regard to the HPP Zhur Project, we would also remind you of the bilateral agreement reached by the Ex Yugoslav-Albanian commission in 1962 about the water of the Lumi Çaljan and Lumzinë to Plav-ës discharge to Albania in July and August. The discharges agreed on for the Lumi Plavë are 1,250,000 m3 (0.47 m3/s) in July and 2,500,000 m3 (0.93 m3/s) in August.
For more details about the planned project please contact Elektroprojekt Consulting Engineers, Zagreb, Croatia, Željko Pavlin, dipl. ing. grad., phone. +385 1 3607 959, fax. +385 1 6152 685
Address: Rr. Sejdi Kryeziu Nr.5 10.000 Prishtinë-Kosovë
Telefon/Faks + 381 38 200 213 02.
http://www.ks-gov.net/msm
e-mail: zeljko.pavlin@elektroprojekt.hr or Lignite Power Technical Assistance Project, Pristine, Lorik Haxhiu, PhD, phone. +381 38 213 770, fax. +381 38 213 771, e-mail lorik.haxhiu@gmail.com.
Information on preparation of the Preliminary EIA is available from Elektroprojekt Consulting Engineers, Zagreb, Croatia, Stjepan Miletic, PhD, phone. +385 1 6307 949, fax. +385 1 6152685, e-mail: stjepan.miletic@elektroprojekt.hr or Željko Pavlin, dipl. ing. grad., phone. +385 1 3607 959, fax. +385 1 6152 685, e-mail: zeljko.pavlin@elektroprojekt.hr.
Yours sincerely,
Mahir Yağcılar
Minister
Cc:
-Ministry of Energy and Mining, Pristine
-Lignite Power Technical Assistance Project, Pristine
-Elektroprojekt Consulting Engineers, Zagreb

OBLIGATIONS TOWARDS ALBANIA

- water for power generation at the HPP Zhur is harnessed from the watercourses shared by Kosova and Albania
- in line with the Espoo Convention, the competent ministry of the Republic of Kosova notified the competent ministry of the Republic of Albania about the planned HPP Zhur Project
- the notification letter highlights the need for determination of the environmentally acceptable flow (EAF) in streams downstream from the water intakes
- **a contact has been established between the relevant authorities of the Republic of Kosova and the Republic of Albania regarding the transboundary issues. This is an ongoing cooperation.**

On several occasions, representatives of Elektroprojekt and LPTAP Project Office made a tour of an area planned for construction of the HPP Zhur. The site visits were organized for:

1. Determining the **on-site conditions** and their impact on technical concepts from the 2001 Feasibility Study,

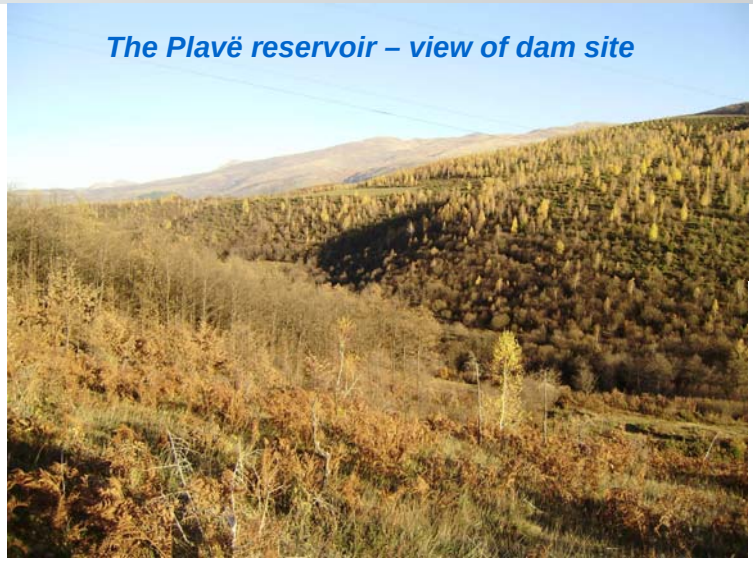
2. Checking **morphology of streams** to be harnessed and their catchments in order to assess hydrological parameters and data,

3. Checking the **ecological state** of the streams to be harnessed for assessment of the environmentally acceptable flow to be provided in the stream channel after the Project completion.

View of houses to be impounded from the Plavë reservoir

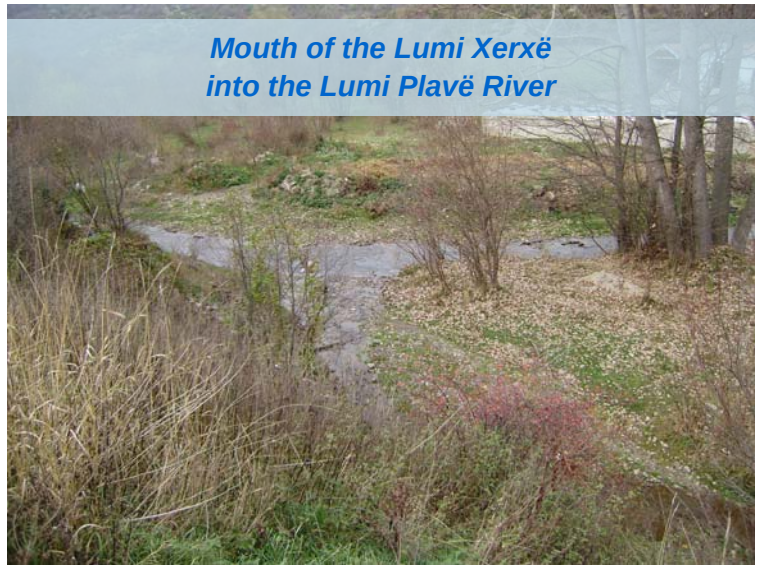
The Lumi Plavë River, downstream view from the former gauging station location

The Plavë reservoir – view of dam site



View of the Lumi Xerxë River upstream from the Zhur – Dragash/Sharr road bridge

Mouth of the Lumi Xerxë into the Lumi Plavë River



The Lumi Radeshë River – state of the environment

The Lumi Leshtani river – state of the environment

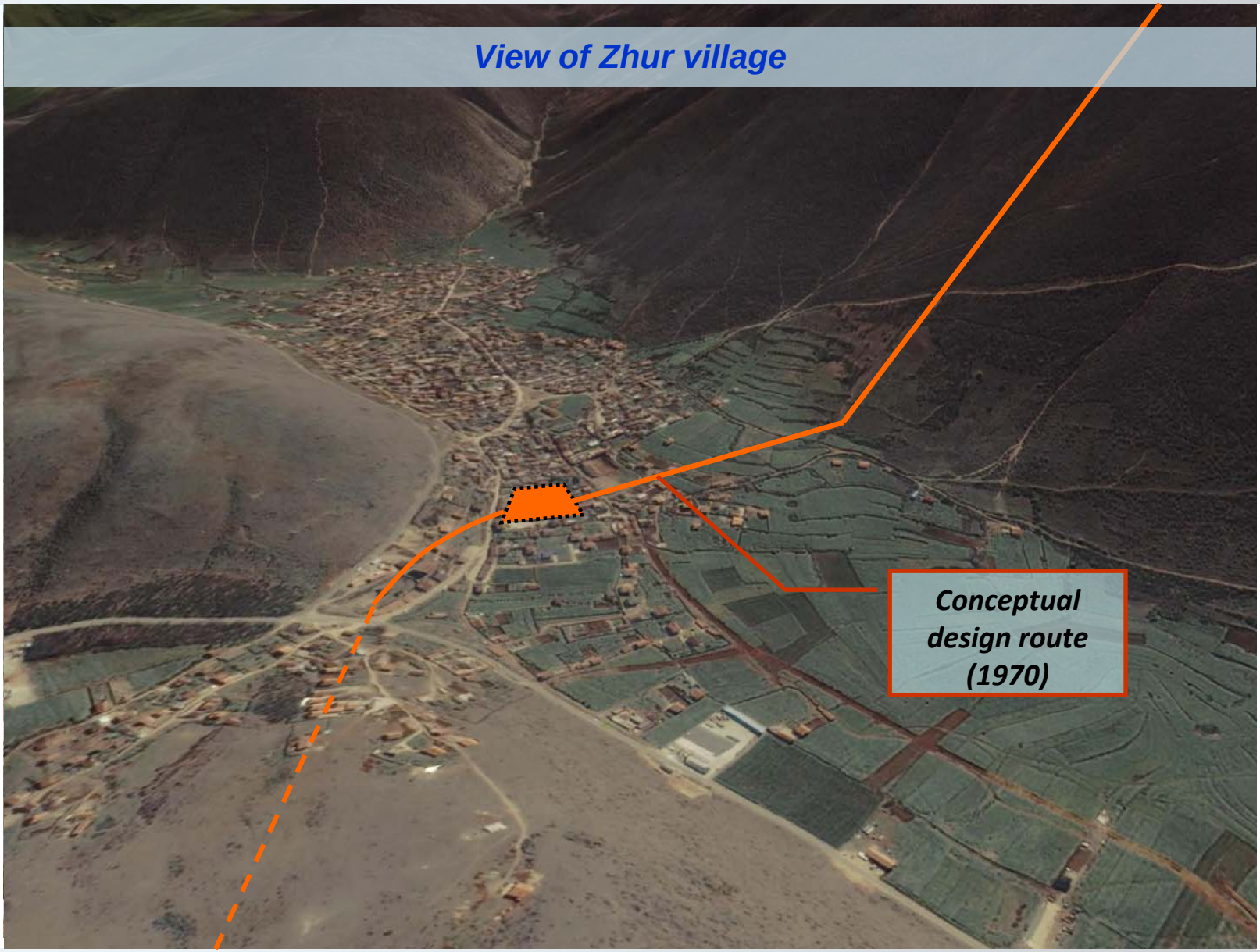
The Lumi Brod River – downstream view from the road with the Lugina Marinit stream mouth

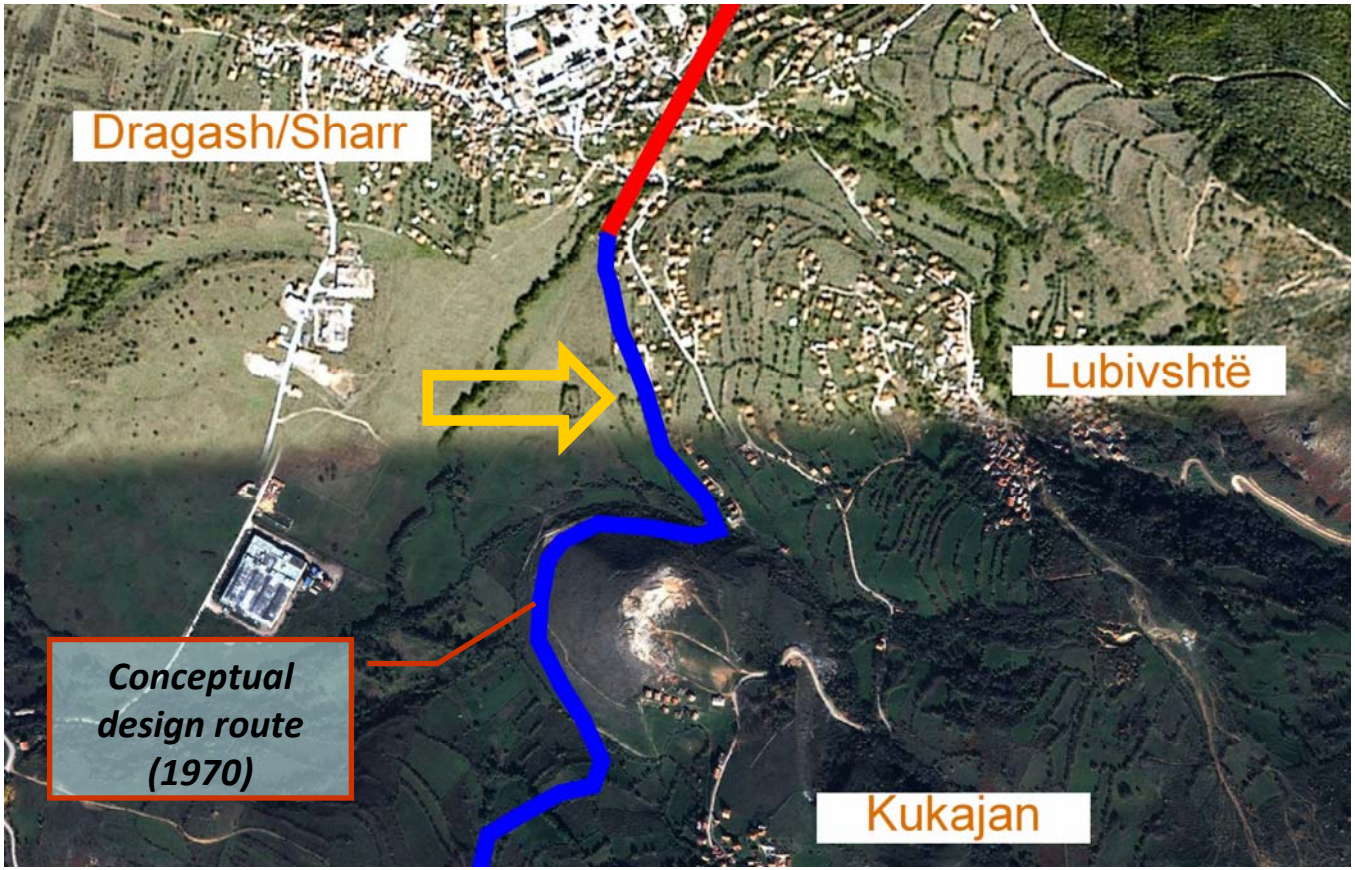
The Lumi Restelic River near Krushevë

View of Fusha e Llopushnikut field – Brezna settlement in the back

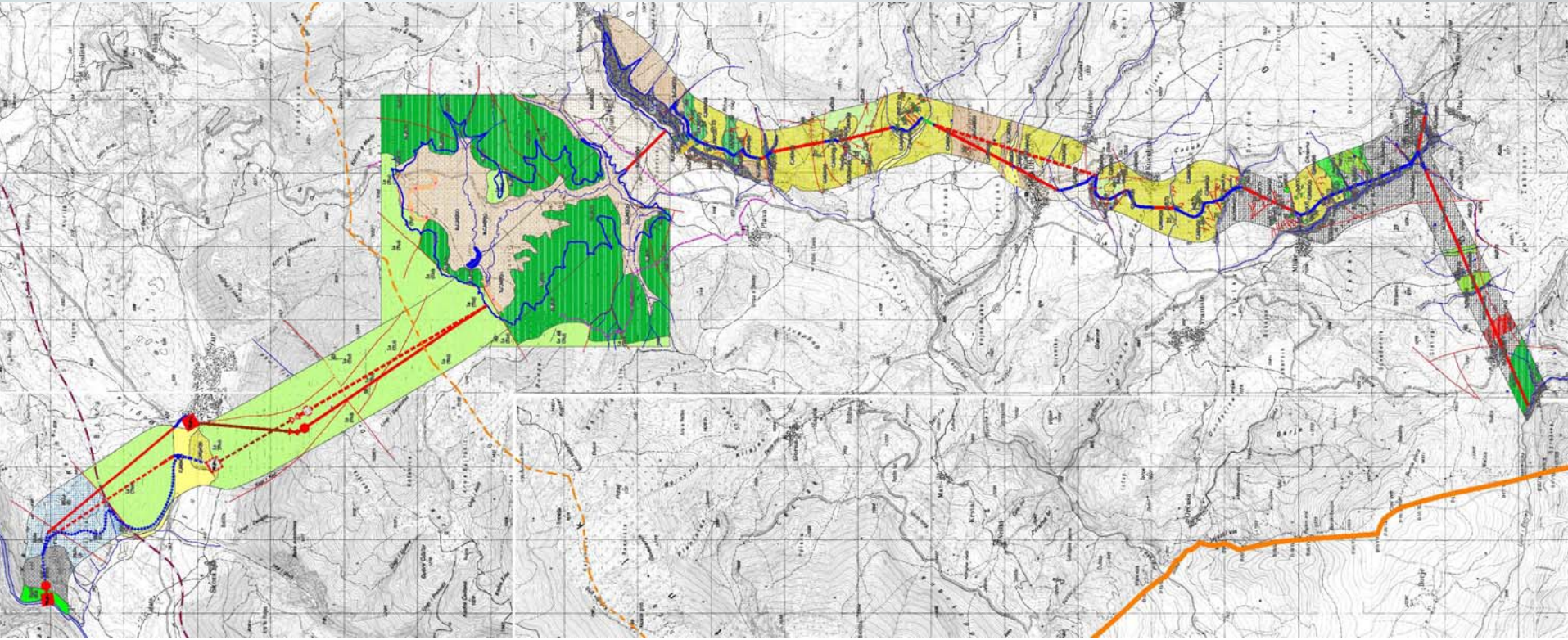
The **Fusha e Llopushnikut** area suffered considerable changes in space compared to the situation described in design documentation from 1983 (???). **The settlement of Brezna expanded in direction of the Fusha e Llopushnikut** planned to be occupied by the reservoir. The site survey also revealed expansion of the settlement of **Hani i Llopushnikut,** all of which will be impounded.

View of Zhur village





The conveyance system could come into **conflict with the recently built houses and structures** in a section near Dragash/Sharr

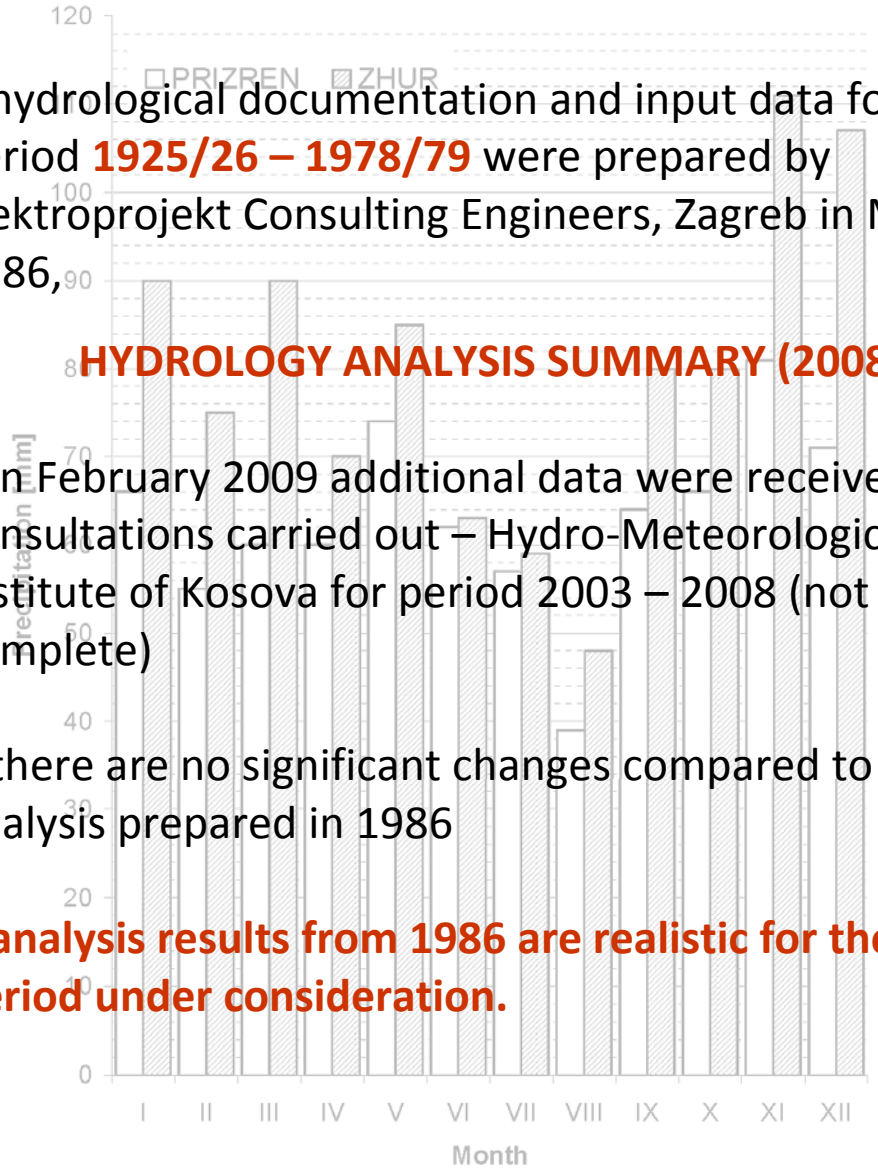


- HPP Zhur project will be situated in a location with **different lithological and engineering geology characteristics**,
- there are **no reasons for relocation** of the planned conveyance system route,
- the **Plavë and Breznа reservoirs are feasible.**
- preparation of the final designs requires **additional investigations and tests EUROCODE 8**

"Analysis of Seismic Hazards and Defining of Design Seizmic Parameters for the HPP Zhur System Structures", IZIS, Skopje, 1986:

- detailed review of seismicity and
- design seismic parameters

IZIS study + supporting documentation → structural calculation according to



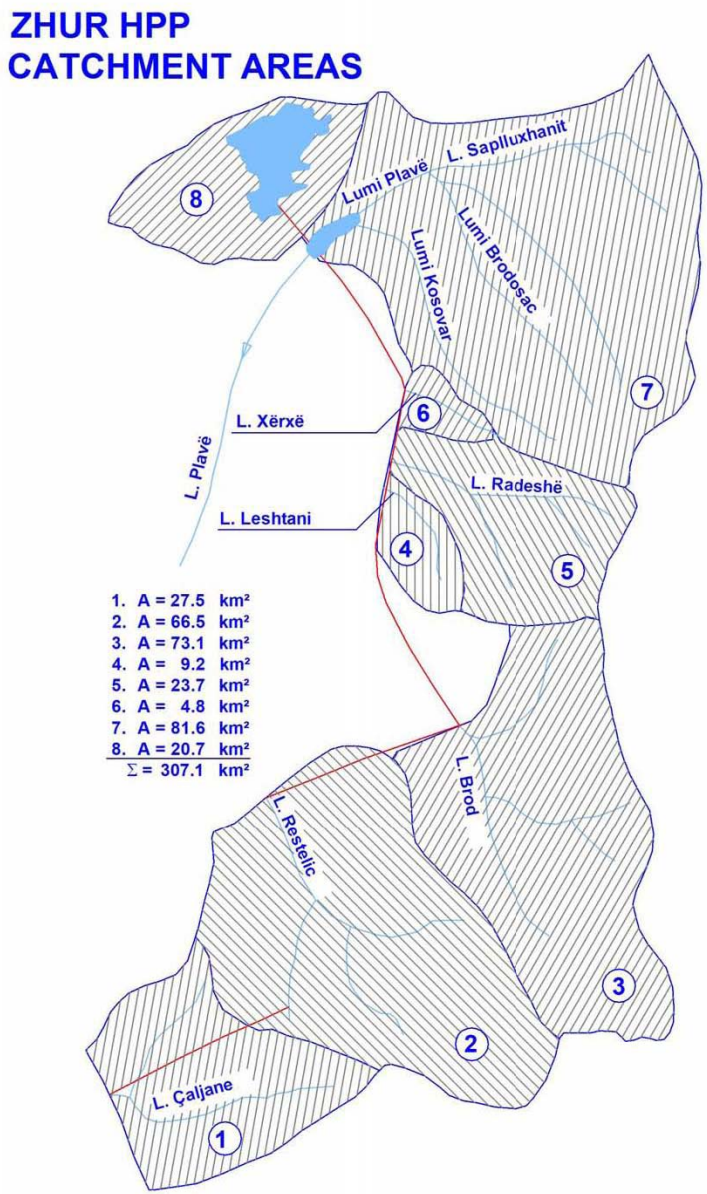
- hydrological documentation and input data for the period **1925/26 – 1978/79** were prepared by Elektroprojekt Consulting Engineers, Zagreb in May 1986,

HYDROLOGY ANALYSIS SUMMARY (2008)

- in February 2009 additional data were received and consultations carried out – Hydro-Meteorological Institute of Kosova for period 2003 – 2008 (not complete)

- there are no significant changes compared to the analysis prepared in 1986

- **analysis results from 1986 are realistic for the period under consideration.**



- **all the conclusions are made on the basis of analyses given in the documentation under consideration** (1925/26 – 1978/79)
  - ***maximum flow rates of different recurrence periods***
  - ***mean annual flows:***
    - **Lumi Çaljane River** Q_{mean} = 0.854 m³/s
    - **Lumi Restelic River** Q_{mean} = 2.320 m³/s
    - **Lumi Brod River** Q_{mean} = 2.380 m³/s
      - **Procka Baç** Q_{mean} = 0.042 m³/s
      - **Lugina Veliut** Q_{mean} = 0.024 m³/s
      - **Lugina Marinit** Q_{mean} = 0.054 m³/s
      - **Procka Lubivie** Q_{mean} = 0.027 m³/s
    - **Lumi Leshtani River** Q_{mean} = 0.159 m³/s
    - **Lumi Radeshe River** Q_{mean} = 0.731 m³/s
    - **Lumi Xërxë River** Q_{mean} = 0.048 m³/s

  1986

  - ***minimum flow rates of different recurrence periods*** → *2008*

- recommendations:
  - **set up hydrological stations** in points where water intakes are located
  - **urgently initiate systematic hydrological observations and measurements**

The only land surveying documentation available are **topographic maps (scale 1:25,000)** prepared **during the seventies of the 20th century.**

Those are good orientational maps for assessment of set up concepts.

For preparation of design documentation it will be necessary to survey:

- the Brezna Reservoir site
- the Plavë Reservoir site
- the Plavë River dam site, conveyance route, the sites planned for implementation of ground sealing, the sites planned for the HPP Zhur I and HPP Zhur II powerhouses, and the sites planned for the penstock and conveyance system route section from the HPP Zhur I to the HPP Zhur II
- the tunnel entries and exits, aqueducts, siphons, and the headrace canal route entry into and exit from the tunnel connecting the Plavë River reservoir and the Brezna Reservoir, the entrance into the headrace tunnel facing the HPP Zhur I powerhouse
- the Zym/Qollopek and Brezna settlements and all the houses and structures to be impounded need to be surveyed separately.

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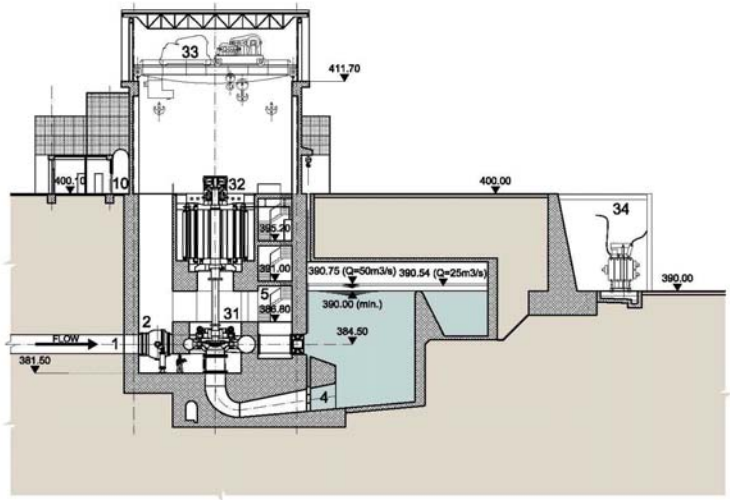
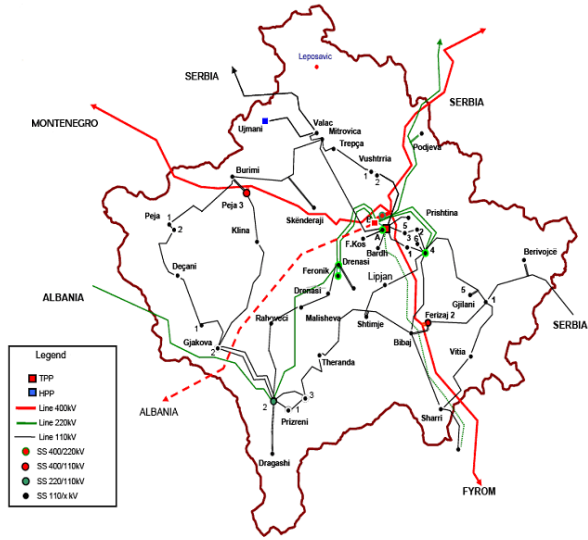
Task 2 Report includes results of review, evaluation and modification of the HPP Zhur concept with rated discharge of Q_i = 50 m³/s, as envisaged by the Conceptual Design by Kosovoprojekt in 1970 and Feasibility Study prepared by Elektroprojekt Consulting Engineers in 2001, and it presents:

- **a review of the earlier concepts, possible improvements/optimization and proposal for the concept modifications due to current site state;**
- **summary description** of the proposed technical concepts **with system basic drawings;**
- **cost estimate** and **plant output update.**

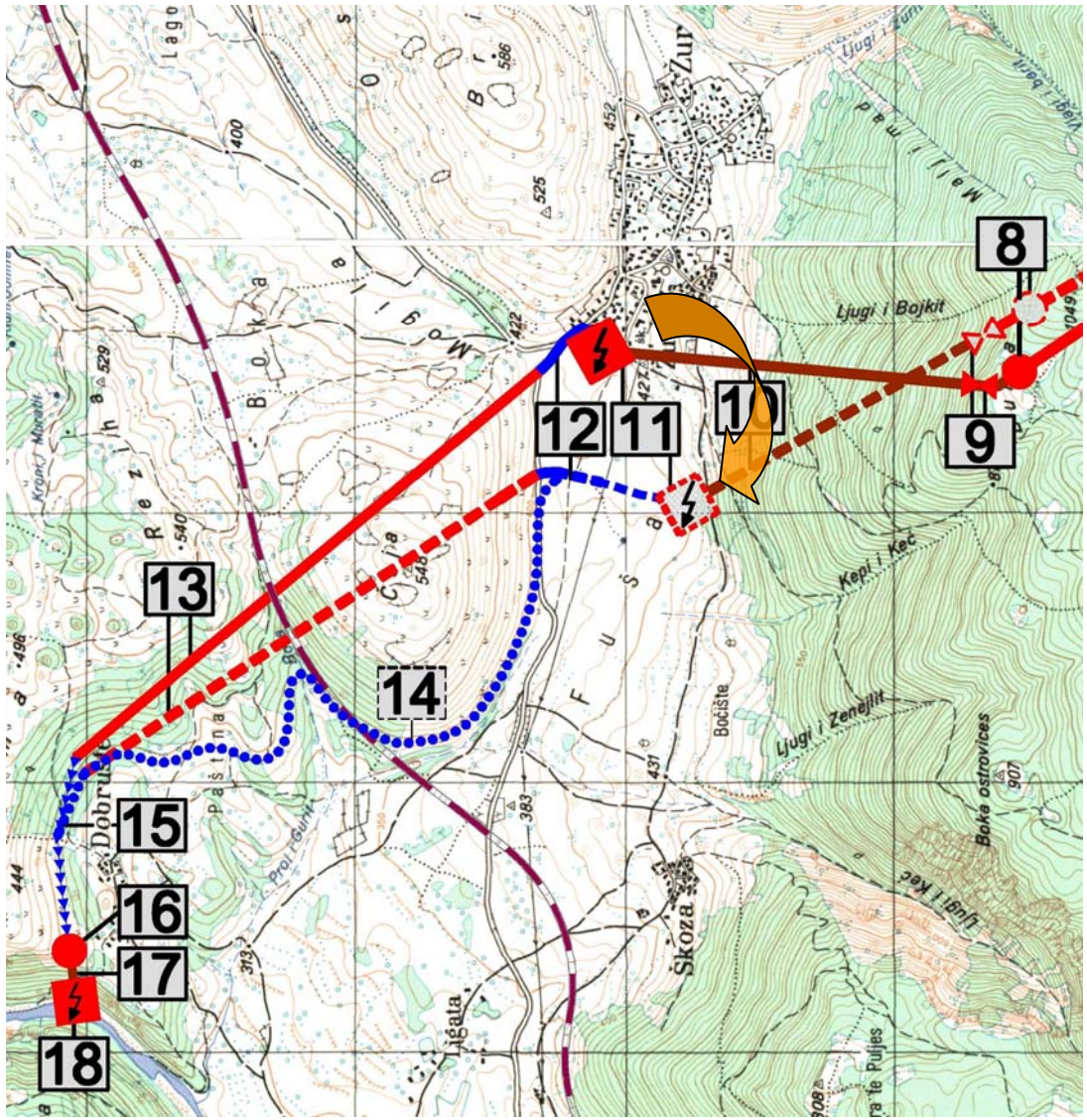




1. **Change in the HPP Zhur I location**

- considerable changes have happened at the HPP Zhur I powerhouse site compared to the ones described in the Conceptual Design from 1970 – **a new powerhouse site needed to be determined**

  (An idea to relocate the HPP Zhur I powerhouse in order to optimize the Project concept was considered in the eighties.)
- the HPP Zhur I powerhouse site proposed in the eighties is still **suitable**
- it is necessary to place the powerhouse at an **elevation which is approx. 13 m lower** than the elevation from the 1970 Conceptual Design.

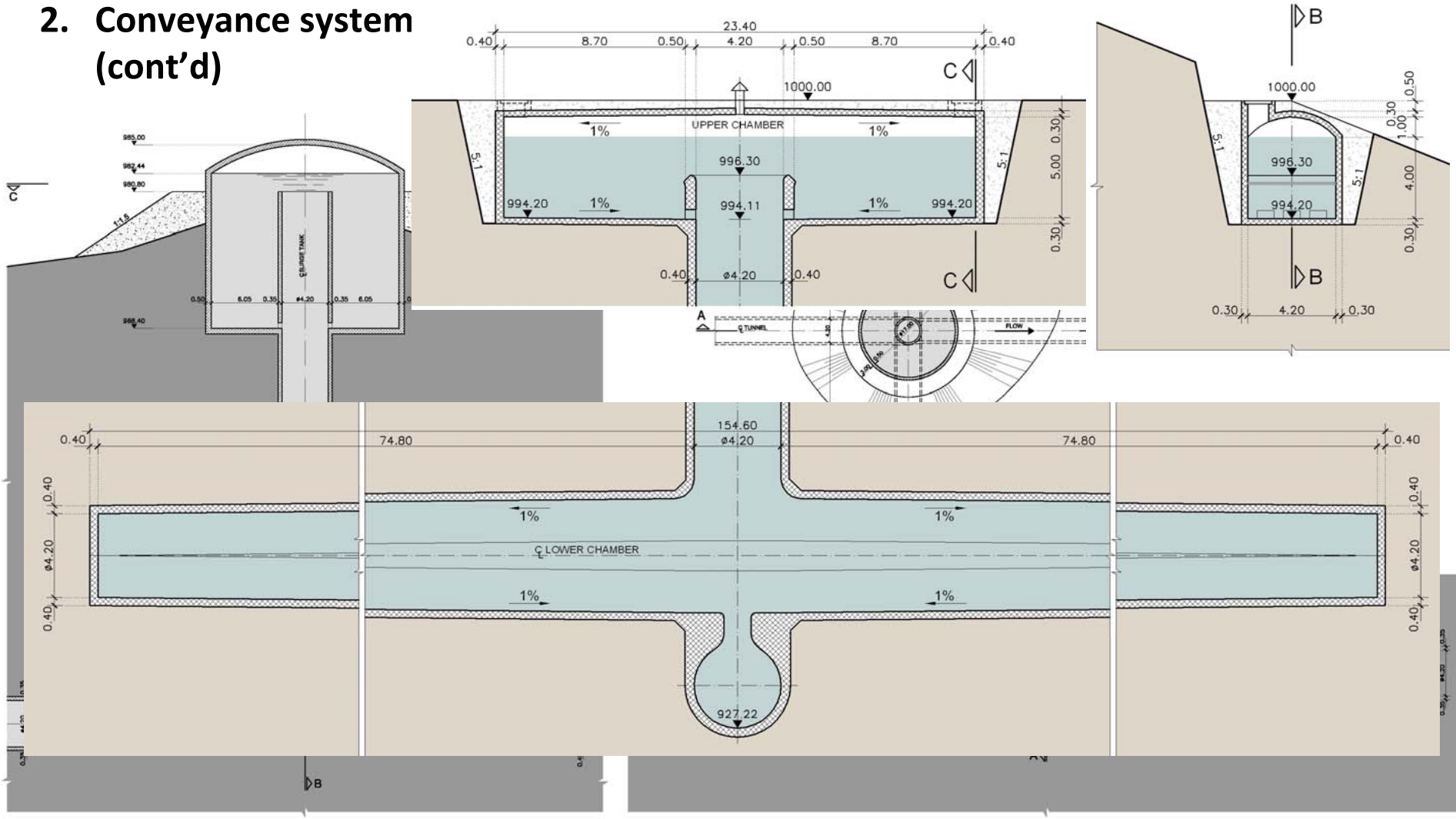


2. Conveyance system

- Having in mind the new powerhouse site which was found adequate even in the present conditions, **two conveyance system routes** from the Brezna Reservoir were considered – the so called **"old"** and **"new" route**
- in order **to reduce the surge tank size** and, consequently, **investment costs** the conveyance system route was moved towards south ("old"→"new"), so that the upper chamber could be located at higher elevation (approx. 1000 m a.s.l.). The inlet structure and powerhouse of the HPP Zhur I would remain in the same position
- The study considered different types of upper chamber (**four upper chamber alternatives at the old route** and **six upper chamber alternatives at the new route**), while the lower chamber was planned to be shaped as horizontal tunnel

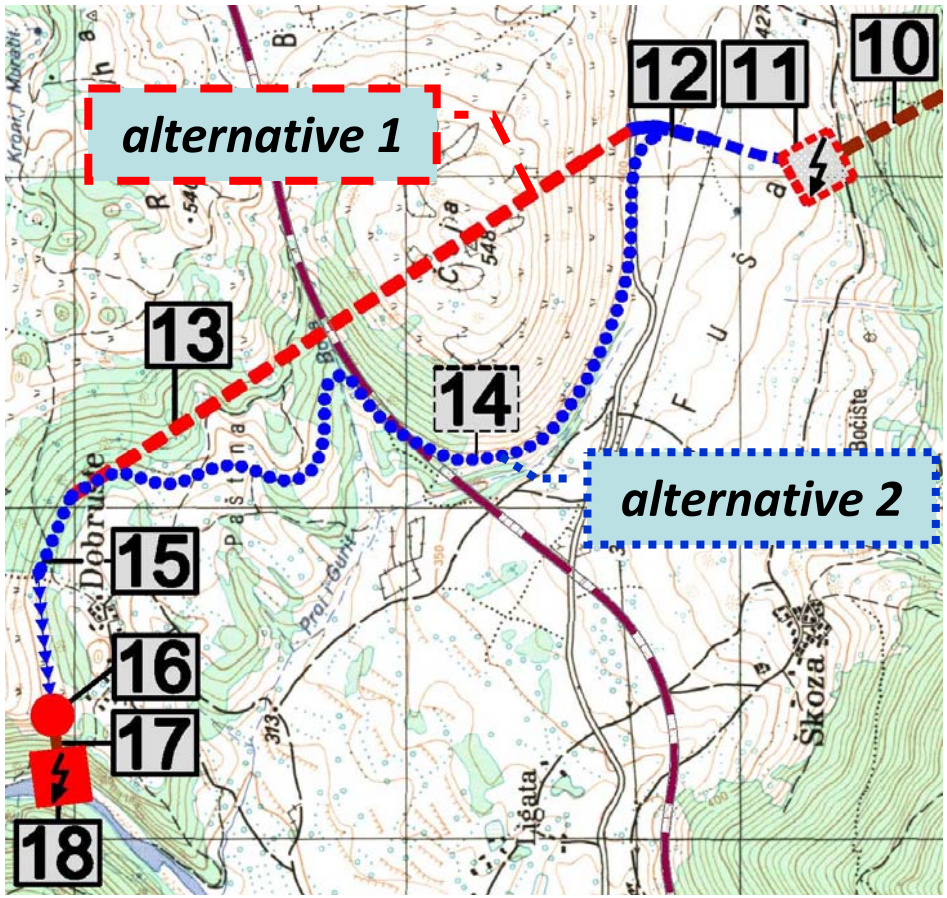
Route	**"Old" route**				**"New" route**					
Surge tank alternative	"a"	"b"	"c"	"d"	"a"	"b"	"c"	"d"	"e"	**"f"**
% of cost	100.00	100.22	100.76	100.15	99.10	99.14	100.26	100.18	99.84	**99.14**
Ranking	5th	8th	10th	6th	1st	2nd/3rd	9th	7th	4th	**2nd/3rd**

2. Conveyance system (cont'd)



animals into the shaft and only slightly more expensive than the alternative "a".

1. HPP Zhur I – HPP Zhur II conveyance system



Water harnessed at the HPP Zhur I could be conveyed to the HPP Zhur II surge tank by **canals, tunnels and combination of these structures.**

Analysis of possible solutions resulted in **two alternative conveyance systems for the HPP Zhur II:**

Alternative 1 ("tunnel") envisages a connection between the HPP Zhur I discharge basin and the HPP Zhur II surge tank by:

- **closed canal,** 520 m long
- **tunnel,** 1835 m long
- **open canal,** 560 m long

Alternative 2 ("canal") envisages a connection between the HPP Zhur I discharge basin and HPP Zhur II surge tank by:

- **closed canal,** 520 m long
- **open canal,** 3210 m long

1. Conveyance system (cont'd)

	Alternative 1 – "Tunnel"	*Alternative 2 – "Canal"*
Disadvantages	N/A	• limited availability of space because of the road running on the left side of the canal, • integration of the discharge system into the environment is much less successful than for the tunnel system, • as regards possible geotechnical risks, the canal is less reliable technical solution than the tunnel, • groundwater occurrence could cause uplift and any modifications would result in increase in price of this alternative, • open canal is exposed to unfavorable conditions.
Cost	**€ 9,359,000.00**	**€ 10,890,000.00 ***

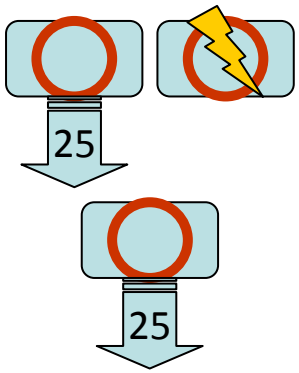
* the above costs need to be added:
• the costs of construction of an access road to be built along the canal for its maintenance **(≈€ 450,000),**
• the land expropriation cost **(≈€ 25,000),**
• concession, compensation for query closing, if necessary, or communication across the canal if the query will continue to work **(€ ??)!**

2. TG sets number analysis

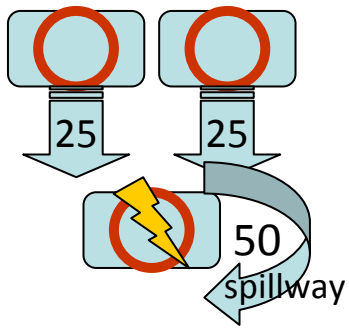
Since the HPP Zhur II operation is in direct relation with operation of the HPP Zhur I, which has two TG sets Q_i = 25 m^3/s each, an question is raised of **whether installation of two TG sets in the HPP Zhur II powerhouse is justified.**

As a peaking power plant, the HPP Zhur will successfully:
- shave variable parts of the daily load diagram and/or
- intervene providing safe supply to the customers in case of thermal power plants outages.

If only one TG set is installed in HPP Zhur II the losses in generation would happen in case it needs to operate during the overhaul periods. There are two options:



The HPP Zhur I and HPP Zhur II operate at 25 m^3/s while an overhaul of the other HPP Zhur I TG set is in progress.



HPP Zhur I operates while the overhaul of the HPP Zhur II is in progress.

2. TG sets number analysis (cont'd)

In case ***alternative 2*** (HPP Zhur II with two TG sets (2 × 25 m^3/s)) is selected, costs are higher than the Alternative 1 costs for **€ 1,590,300 (≈1% of Total Investment)**

In order to obtain the cost-benefit ratio for such investment of C/B = 1.00:

+ some other reasons (concessionaire!)

For energy price of…	*…it is necessary to get a difference in production of…*	*…which in turn demands that the operation duration in mode with 25 m^3/s be…*
0.084 €/kWh	1.581 GWh/yr	**484 hours** (34% of the HPP Zhur operating time)
0.110 €/kWh	1.207 GWh/yr	370 hours (26% of the HPP Zhur operating time)
≥0.290 €/kWh	0.460 GWh/yr	142 hours (10% of the HPP Zhur operating time)

HPP Zhur II with two TG sets would be **an acceptable solution** since the power generation with two TG sets compared to generation with one TG set is lower by only 3 ‰ (η)

The investment into the HPP Zhur II powerhouse with two TG sets would be justified either if:

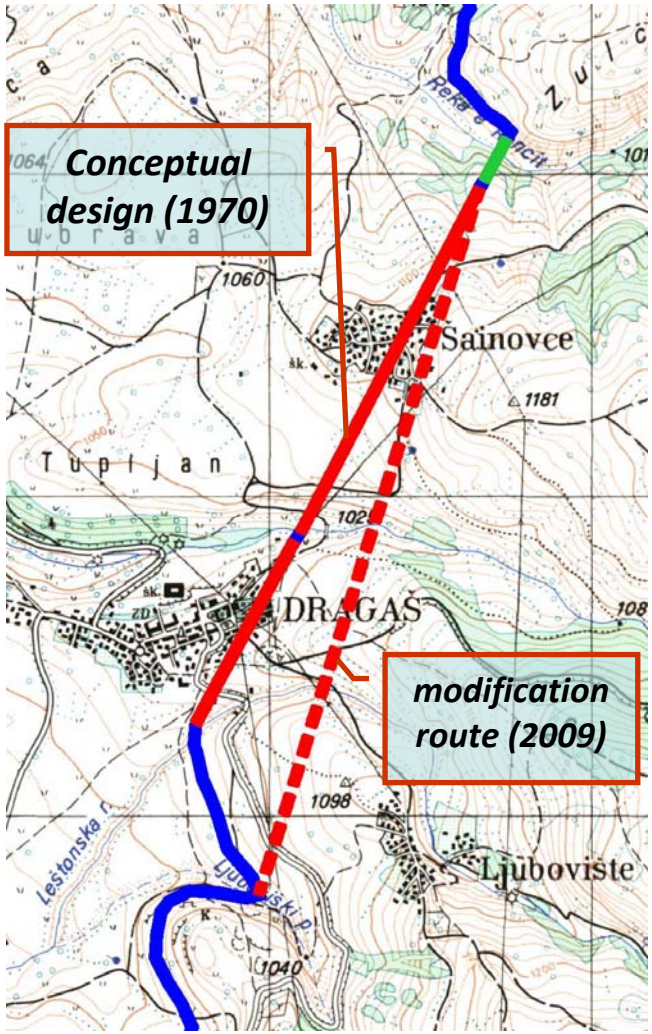
1. time of operation in the mode with 25 m^3/s would be considerable, **which is not highly probable,** or

2. the price of energy during its operation in this mode is very high, **which is also not probable**

The alternative with HPP Zhur II with one TG set, Q_i = 50 m^3/s, will be selected.

project modifications and optimization – the lumi çaljane – plavë reservoir conveyance system

• review of technical concepts from available volume of the 1970 Conceptual Design and their feasibility (site survey 15 Nov 2008), satellite images and available maps)



• the only **route change** that might be needed is a **section near Dragash/Sharr,** in order to avoid the conveyance system passage through the developed area

• the modified route costs are € 822,000 higher

• **the Feasibility Study revision uses the route from the Conceptual Design** and increases the costs by € 822,000, which is maximum increase that might result form conflicts with the existing structures

Conveyance System Concept Analysis

	Conceptual design (1970)	*Feasibility Study Revision (2009)*
The tunnel capacity is determined on the basis of	**15-day** discharge duration	**5-day** discharge duration *(15-day discharge duration is analyzed!)*
Lumi Çaljane River – Lumi Restelic River Tunnel	D = 2.00 m	D = 2.90 m (technological reasons!)
	• 20 cm thick plain concrete lining (category I – IV rock)	• 30 cm thick lining (cat. I – III: plain; cat. IV: reinforced); • the excavation protection: (**cat. I & II** – 5 cm shotcrete, **cat. III** – 10 cm shotcrete + rock bolts, **cat. IV** – 15 cm shotcrete + rock bolts)

Conveyance System Concept Analysis (cont'd)

	Conceptual design (1970)	*Feasibility Study Revision (2009)*
Lumi Restelic River – Lumi Brod River Tunnel	D = 2.20 m	D = 2.90 m (tech. reasons!)
	• 20 cm thick plain concrete lining (category I – III)	• 30 cm thick plain concrete lining • the excavation protection: (**cat. I & II** – 5 cm shotcrete, **cat. III** – 10 cm shotcrete + rock bolts)

Conveyance System Concept Analysis (cont'd)

	Conceptual design (1970)	*Feasibility Study Revision (2009)*
Lumi Brod River – Plavë Reservoir Conv. System	D = 2.00, 2.80, 2.85, 2.90 m	D = 2.90, 3.00, 3.00, 3.20 m (respectively) for **5-day** d. d. *(D = 2.90 m for 15-day d. d.)*
Lumi Brod River – Plavë Reservoir Conveyance System	• 20, 25, 30 cm thick plain concrete lining (category I – V rock)	• 30 cm thick lining (cat. I – III: plain; cat. IV & V: reinforced); • the excavation protection: (**cat. I & II** – 5 cm shotcrete, **cat. III** – 10 cm shotcrete + rock bolts, **cat. IV** – 15 cm shotcrete + rock bolts **cat. V** – 25 cm shotcrete + rock bolts + steel arches)

- increase in the conveyance system (due to 5-day d. d. harnessing) → **increase the investment** by € 2,500,000, **but also increase the HPP Zhur output** by 7.45 GWh/yr
- this project benefit ratio of C/B = 1.00 is reached only if the energy price decreases to 0.028 €/kWh
- the analysis results shows that **it is justified to increase the conveyance system and tailor its capacity to five-day discharge intake and conveyance**

The most significant changes (seventies – today) are those caused by the **Brezna settlement growth in direction of the Fusha e Llopushnikut field,** which had been planned for impoundment for the future reservoir. Rough assessment shows that **about 200 houses** would have to be sacrificed for the reservoir creation.

Brezna Reservoir's elevation		979.40 m a.s.l.	970.00 m a.s.l.
Houses impounding (Brezna+Zym)	Number	≈ 200 + 25 = 225	≈ 180 + 20 = 200
Plavë River dam cost save		€ ±0.00	€ +1,200,000.00
Average annual output	W	398 GWh	391 GWh
Brezna reservoir active capacity		112 hm^3	65 hm^3
Uninterrupted operation		26 days	15 days

Is lowering of the reservoir pool elevation possible and what would be the effects?

In order to collect information on possible effects, the pool elevation lowering by **about 10 m was assumed**, i.e. from 979.40 m a.s.l. to approx. 970 m a.s.l.

Therefore, the pool elevation to be used for the Brezna Reservoir will be 979.40 m a.s.l., namely the planned reservoir capacity will be the one needed for the annual flow regulation.

The HPP Zhur is the only energy source capable of fully compensating for outage of any Kosovo A and B TPP units, and partly of the Kosovo C1 new unit. This is the source that will play a key role in tertiary regulation of the Kosova Power System and in the electricity market by ensuring guaranteed power supply.

The HPP Zhur can be interconnected with either 110 kV or 220 kV network.

The nearest network connection point in both cases is the 220/110 kV Prizreni 2 Substation.

The interconnection length in both cases is 10 km. The conductor length between the HPP Zhur I and HPP Zhur II is 2.3 km.

HPP ZHUR IS INTERCONNECTED TO...

...THE 110 kV NETWORK	...THE 220 kV NETWORK
• two two-circuit conductors ("barrel-type") with conductors of sufficient cross-section ACSR 240/40	• one two-circuit conductor ("barrel-type") with conductors ACSR 490/60 cross-section
• the investment price for the 2×110 kV HPP Zhur I–Prizreni 2 OHL is 3,520,000 €	• the HPP Zhur II connection price to 220 kV network is 3,800,000 €
• the investment price for 110 kV OHL, 2.3 km, ACSR 240/40, between the HPP Zhur I and HPP Zhur II is 253,000 €	• OHL 220 kV, 2.3 km, ACSR 490/60, between HPP Zhur I and HPP Zhur II – 460,000 €
• it is necessary to add ten 110 kV transformer bays – 4,000,000 €	• it is necessary to add six 220 kV transformer bays – 3,300,000 €
• TOTAL INVESTMENT: **7,773,000 €**	• TOTAL INVESTMENT: **7,560,000 €**

The price difference between the connection to the 110 kV and 220 kV networks **is not significant**

HPP ZHUR IS INTERCONNECTED TO…	
…THE 110 kV NETWORK	**…THE 220 kV NETWORK**
• design losses on the power system model: 22.4 MW **ADVANTAGES:** • releaving of the transformation load at the 220/110 kV Prizreni 2 Substation • better maintenance of the voltage profile • reduction in network losses	• design losses on the power system model: 20.3 MW **ADVANTAGES:** • a logical connection level for a power plant of this capacity • enables its minimum effect on possible shallow connections • enables its operation as the peaking plant
According to the KOSTT expectations, **the 220 kV network will not develop further, and a 400 kV ring with transformations of 400/110 kV would be closed.** This would resolve the supply of the 110 kV network, so **connecting of the HPP Zhur to the 220 kV is justified.**	

- In request for the HPP Zhur connection in transmission power system of Kosova, according the Energy Regulatory Office and KOSTT rules will have to met:

1. **Rule on General Conditions of Energy Supply** (2008)
2. **Grid Code — Connection Code** (2008)
3. **Transmission Connection Charging Methodology** (2008) and **UCTE rules**

		Zhur 1 HPP	Zhur 2 HPP
Gross head [m]	max.	589.40	94.15
	min.	555.25	87.94
Net head [m]	max.	583.93	93.52
	min.	533.38	85.41
No. of TG sets		2	1
Rated discharge [m^3/s]		2 × 25	1 × 50
Installed capacity [MW]		2 × 131	1 × 43
Average annual output [GWh]		342.20	55.39
		397.59	

Item	Costs [€]
Land (Site)	29,824,000
Civil structures	126,890,000
Hydromechanical equipment	33,441,000
Electromechanical equipment	70,071,000
Transmission and distribution lines	6,196,000
Other investment	20,593,000
Total capital assets	**287,017,000**