



# REPORT

## Measurement of Shushica headwaters flow

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© EcoAlbania  
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*Special acknowledgement to Tirana University – Faculty of Natural Sciences for providing the measuring instrument. Acknowledgements also to Mr. Asllan Lala for undertaking measurement on site on periodic basis*

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## Abbreviations

<b>ADCP</b>	Acoustic Doppler Current Profiler
<b>ADF</b>	Albanian Development Fund
<b>CSO</b>	Civil Society Organization
<b>EIA</b>	Environmental Impact Assessment
<b>KfW</b>	German Credit Institute for Reconstruction
<b>NEA</b>	National Environment Agency
<b>NGO</b>	Non-Governmental Organization
<b>RAT</b>	Regional Action Plan
<b>RWSP IV</b>	4 <sup>th</sup> Rural Water Supply Program 4
<b>WBIF</b>	Western Balkans Investment Framework
<b>WRNP</b>	Vjosa Wild River National Park
<b>WTP</b>	Wastewater Treatment Plant

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## Assessment Background and Objective

The assessment of the waterflow on Shushica river headwaters is an alternative study based on the data gathered on site, to evaluate the waterflow during the dry period. The assessment is particularly linked with the Himara water supply project. In this context the aim is to confront the outcomes with the ones gathered and presented by the developer of Himara project.

Taking into account that the study area represents the integral part of the recently established Vjosa wild river national park, the outcomes of the assessment can serve to understand the effect of the diversion project of Himara water supply, on the aquatic wildlife and on ecological integrity of the National Park.

This research provides valuable insights on the potential consequences of the diversion project on the activities of the local community linked with the utilization of Shushica water.

## Executive Summary

This waterflow assessment aims to evaluate the current waterflow at the headwaters of Shushica River and identify potential and the impact on local ecosystems from the planned diversion for the construction of Himara water supply system.

The waterflow measurement has been conducted in 4 different stations in the first 6 km of the river flow. These monitoring stations have been chosen adoringly with the potential intakes and impact measuring points of the Himara water supply on the river.

Based on the Velocity-Area methodology the assessment brings alternative data on the waterflow for the period from 27th of July 2024 until 31st of August 2024. This period is included to the dry trimester season of the area although that the annual driest peak for the Shushica river, which is considered to be September – October. The instruments used for the measurement of the water velocity are the Vernier LabQuest® that are used by the Faculty of Natural Sciences at Tirana University for research purposes.

The measurements have been conducted in a regular frequency every 5 days on all 4 chosen stations and the data are processed and analyzed via MS Excel spreadsheet also prepared for this purpose.

Amongst the key findings of this assessment is that the water flow trend from the first measurement to the last one shows a significant decrease that which ranges from twofold to three times less water. In most of the stations the values measured are close to the multiannual average. This is a clear indicator that even though measurement have taken place 2 months ahead of the driest peak, the waterflow appears to be significantly low.

During the measurement period the authors of the study have also monitored the confluence of Shushica and Vjosa rivers and since the 20th of June 2024 there is eventually no water flowing to the natural riverbed. This is due to several diversion schemes along the river that are operational for the irrigation purposes. This means that the longitudinal ecological connectivity between the Vjosa and Shushica is temporary lost even without the diversion at the spring that is planned in the frame of the Himara water supply project. The diversion of the Lëpusha and potentially also of Buronja springs will surely contribute to the extension of the disconnection period between the Vjosa and Shushica.

This study brings first handed insights on the current situation as regards the waterflow in Shushica's headwaters and highlights the importance of residual flow since the area belongs to the recently established Vjosa wild river national park.

Finally, the biggest limitation of this assessment is the short period of the measurement conduction. This cannot guarantee reaching conclusions to judge the negative impact that the diversion project may have on the ecosystem. For this reason, the monitoring period will have to be extended for at least two months in order to include the monitoring throughout the duration of the dry period for the study area. This would mean that the monitoring should include the period from September to November as well.

# Introduction

## About the Himara Municipality Water Supply Project

### 1.1. Project Context

Although Albania is a rich country in water resources, the urban areas, especially the big cities suffer from the poor infrastructure of the water supply systems. There are very few towns that have the 24/7 drinkable water supply for the population.

Since 2007, the overall coverage of water supply has remained the same, at the level of 77.7% until 2021. Compared to 2016, this indicator has suffered a slight decrease as a result of the RAT<sup>1</sup>, as this led to the expansion of Water Supply and Sewage service area including rural areas with lower coverage. This result highlights the large difference between urban and rural areas. Based on 2019, 2020 and 2021 data from the Monitoring Unit, water supply coverage reaches 94.7% (2019), 93.5% (2020) and 92% (2021) in urban areas while coverage in rural areas reaches 58.3 % (2019), 57.8% (2020) and 57.9% (2021). These values are still far from the objective defined in the Water Supply and Sewage National Strategy, 2011-2017, which aimed at 85% coverage in rural areas by 2017. While in the new Strategy for Water 2020-2030, the objective is to supply 90% of the territory with the 24/7 drinkable water supply service. In this respect there have been enormous programs and projects towards construction and reconstruction of the water supply systems in Albania in the last 30 years, but the problem appears to be unsolved due to multiple reasons.

This problem becomes more evident in the urban areas along the coastline especially during the summer months where the water resources are lower and the demand for it are increasing due to tourism bloom. Thus, Municipalities like, Durrësi, Vlora, Himara or Saranda are facing significant challenges as regards the drinkable water supply.

In this regard “Water 24/7” has been the latest initiative undertaken by Albanian Government that aimed to provide drinkable water to all 61 Municipalities at least on the urban areas in an uninterrupted service of 24/7 within 2025. The Programme of the rehabilitation of the rural water supply systems comes also within the frame of the objective set in the Water Strategy 2020-2030.

### 1.2. Project Details

The Rural Water Supply IV program is applied in the municipalities of Himara & Oriku and for the development of tourism in this area of the Albanian Riviera.

The project is supposed to serve over 80,000 residents and tourists that will benefit from the 24-hour supply of drinking water according to hygienic and sanitary standards and from the construction of water supply lines, distribution systems, as well as reservoirs and pumping stations.

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<sup>1</sup> Regional Action Plan

According to the project developer ADF, it is mentioned also, that this project will have a positive impact on the environment thanks to the construction of two small HPPs in Himara, contributing to the production of renewable energy and environmental protection.

The project has started the planning phase in 2019 with the feasibility study and it has continued with a series of closed consultation meetings mainly with the relevant authorities. The first presentation meeting has taken place in Tirana<sup>2</sup> in the premises of NEA on May 20<sup>th</sup>, 2020, where the EIA Department experts within NEA, ADF and CES Salzgitter GmbH Consultant. The meeting minutes of this meeting are requested. However, it appears that the project has been issued a “green light” by NEA as it has continued further. During 2020 the EIA has been prepared and also according to the EIA Report there has been developed a “Stakeholder Engagement Plan” through which the EIA report and its outcomes have been consulted with the relevant stakeholders. The minutes of these meetings have been requested but to the date there is no document sent by NEA.

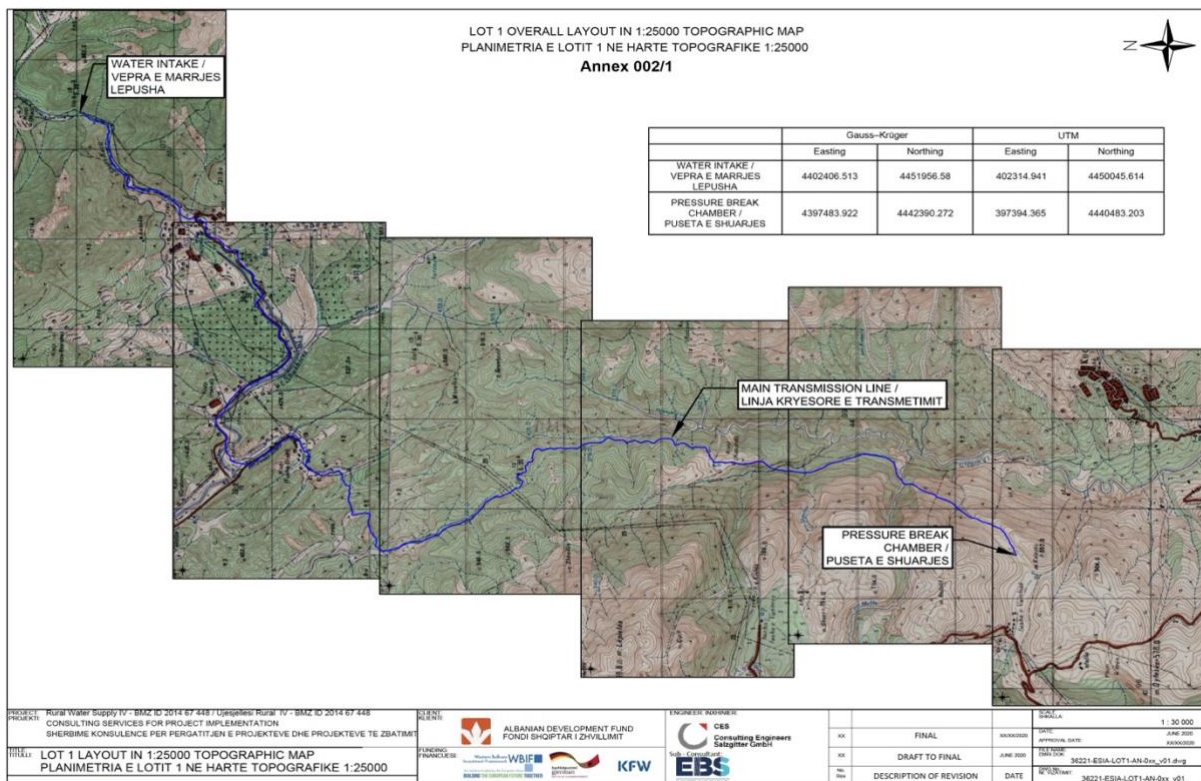
On May 5<sup>th</sup>, 2021 NEA issued the Environmental Permit based on the Preliminary EIA. This would mean that the project has been issued the right to continue with the development without a thorough EIA. All Permits Including the Water Use Permit and Construction Permit have been issued during 2022. After permitting process the project has entered into the advanced phase of the construction.

The Construction has officially started on January 10<sup>th</sup>, 2023 and it is expected to last 18 months, meaning that the Project is expected to finish in August 2024. The Project consists of a 17.35 km pipeline with the 500 mm diameter, that will divert the water from the headwaters of Shushica River towards Himara Municipality (along the Ionian Coastline). In order to construct this pipeline about 8.5 km new access roads will be constructed. These new roads will serve as access roads and lines main broadcast. In addition to the access roads, 5 storage locations will be used along the pipeline. After the work is completed, the new access roads will be maintained by the authority.

Water pipes and will be used for maintenance and other services needed for the main pipeline. The project footprint is shown on the figure 1 below.

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<sup>2</sup> Environmental Impact Assessment Report



**Figure 1: The footprint of the Himara water Supply System © EIA Report of the Project**

- This project is developed by CES Salzgitter GmbH Consultant
- It is financed jointly by Albanian Government and KfW and WBIF
- The ADF is responsible for the project Implementation.
- The construction company is a joint venture between Austrian J.V STRABAG AG and TREMA Engineering 2.
- Total Investment of the water supply is estimated around 9.5 Mio EUR while the entire programme that includes the construction of the sewage water treatment is about 45 Mio Euro.

### 1.3. State of Affairs

The project has started the construction phase in early 2023 and within 10 months' time it has advanced significantly. One of the 5 spots identified for the project as storage locations is located directly by the Shushica River in the spot known as Lasko Bridge between Kuç and Kallarat villages. This is mainly used as the spot for the pipe's storage.

Being fairly exposed by the river and by the main road, this station has been the first source of information to local community of Shushica valley towards the project. Before the establishment of this storage location, they had no information as regards the diversion of the water from Shushica. The local community has never been asked about the project during the planning phase that includes the consultation. Along Shushica river there are located around 30 villages where half of them (upstream Shushica) belong to Himara municipality, and the other half downstream belong to Selenica Municipality. It is interesting to be emphasized that none of the people from these communities has ever been asked or consulted regarding the project for the Himara water supply.



**Figure 2:** Satellite image of the Storage Location at Lasko Bridge © Google Earth 2023

Thus, 8-9 months after the construction start, they realized that this project would divert the water from the Shushica main spring towards Himara town and other villages along the coastline. In this context they raised their concerns in June-July 2023 by sending letters of concerns to Himara and Vlora Municipality as well as to their representative in the Parliament and other relevant authorities. In early August 2023 the locals blocked the construction site of the intake upstream of Kuç village, while a second protest took place in mid-August 2023 at Lasko Bridge where people also blocked temporarily the main road.



**Figure 3:** The Storage Location at Lasko Bridge by the Shushica River © U. Eichelmann



**Figure 4:** Local community of Shushica protesting against the diversion project, August 2023 © O. Nika

Since the protests the construction works have stopped at the intake location, but it is continued on the side of Himara and Kudhësi stream with the opening of the new road of access and distribution of the pipeline.



**Figure 5:** The construction of the pipeline route in the middle of the oak forest © U. Eichelmann

After the August protests, the local community has been mobilized and coordinated to increase the opposition towards the project. During September more than 2.000 signatures have been gathered from people in the Shushica river valley community, to support a petition that opposes the diversion of the Shushica water in the frame of the water supply system of Himara Municipality.



**Figure 6:** The distribution of the pipes along the pipeline route © U. Eichelmann

The community expressed their opposition also during a consultation meeting for the preparation of the Vjosa Wild River National Park Management Plan that took place in Vlora on September 9<sup>th</sup>, 2023.

In addition to that the community and EcoAlbania are working towards initiating judicial proceedings in the Administrative Court to oppose even legally this project that is not in line with the environmental legislation as well as not in line with the public consultation legal framework.

To the date the construction is ongoing on the side of Kudhësi stream, and it has stopped at the intake location since the last protest of the local community. In the picture 7 below it is shown the intake location where the intervention aside the Shushica headwaters (right side of Shushica) has been dug for 20 meters a 5-6 meters deep channel that will serve as the intake well. This channel goes below the level of Shushica river, and it sinks all the water to the right side, leaving the main river dry already for few hundred meters.



**Figure 7:** The 5-6 meters deep channel of the intake on the left side of the Shushica © U. Eichelmann

The Rural Water Supply Program 4 (RWSP IV) aimed at improving water supply and wastewater treatment, consists of four main components, where the Entrepreneurs and the physical progress for each lot are presented as follows:

- **LOT 1** includes the construction of the intake works at the water source in Lepushë, Kuç, the main transmission line from Lëpusha to the Himara branch of 17.5 km. JV **"Strabag & Trema Engineering2", progress of works 75%**
- **LOT 2** includes the expansion of the main line and distribution systems in Himara, Kuç, Pilur, Kudhës, Himara Fshat, Livadh, Jalë, the construction of new reservoirs and the rehabilitation of existing ones. **"Akelik", progress of works about 70%**
- **LOT 3** includes the rehabilitation and expansion of the sewage system of Himara. Construction of the Wastewater Treatment Plant (WTP) in Himare. **"PWT", work progress about 70%**
- **LOT 4** includes the rehabilitation and expansion of the sewage network, the rehabilitation of pumping stations as well as the rehabilitation/expansion and commissioning of ITUN in Orikum. **"Akelik", progress of works about 60%**

*Referring to Lot 1, following the request of KfW sent to the implementing agency (ADF) on 17.11.2023, the construction works of the reception work at the source of Lepusha and the delivery line in the first 5.2 km from the source (which are laid in the area of the Vjosa national park) **are suspended**. Works on the entire RWSP IV program are expected to be completed in 2025.*

## Save the Blue Heart of Europe

The campaign “Save the Blue Heart of Europe” is a campaign that aims to preserve the Balkan Rivers by the overexploitation for the purpose of urban development, where the uncontrolled construction of the hydropower has been identified as the main threat. The campaign is being implemented since 2013 by a wide coalition of NGOs who have been raising awareness and opposing the imminent dam craze on the Balkan peninsula and to spare the most valuable rivers and river stretches from destruction.



**Figure 8:** The mid-section of the Vjosa River National Park near Kalivaç © G. Subič

The two leading organizations of the campaign EuroNatur and RiverWatch have been coordinating the actions over the last decade, while the local partner organizations have been focused on the specific areas. In Albania the key focus area has been the Vjosa River basin which it has been considered as the last big free-flowing river of Europe. For years, the entire river system has been under threat by dam projects. If constructed, they would have destroyed this natural environment – flooding some parts of the valley while leaving others dry. In the whole Vjosa catchment, 45 hydropower plants were planned, 8 on the Vjosa itself and 37 on its tributaries.

Three tributaries, the Langarica, the Shtika and the Çarshova river were already affected by dams when the campaign started, but the major threat that Vjosa was facing for the last 24 years has been the plan for the construction of 2 large dams in the middle section of the river, namely: Kalivaç and Poçëm hydropower dams.

Despite the hydropower construction upstream, also the lower part of the Vjosa is in danger. Near the mouth of the Vjosa into the Adriatic, the Albanian government is implementing the plan to build an airport inside a protected area and tourist resorts are foreseen to be built near Narta lagoon.

In September 2020, Albanian Prime Minister Edi Rama announced his intent to make the Vjosa a national park. This has been the breakthrough on the Vjosa campaign as regarding the determination of its future. The battle for the preservation of the Vjosa has been one of the success stories for the campaign, because after almost 10 years of intensive campaigning the Government of Albania decided to proclaim the Vjosa and its free-flowing tributaries as National Park.

### The Vjosa Wild River National Park

The Vjosa/Aoós River is one of the last big wild rivers in Europe outside of Russia. It flows from the mountains in Greece, where it is called Aoós, to the Adriatic Sea in Albania. Together with its tributaries, the Vjosa/Aoós forms an ecosystem with a considerable level of biodiversity of both national and global significance. Yet the region also offers economic prospects. Ecotourism along the River and its tributaries is continuously growing, particularly over the last few years when the potential for activities such as rafting has been recognized and developed.

After almost 10 years of persistent efforts by the CSOs and wide group of stakeholders, the Albanian Government decided to declare the Vjosa Wild River National Park on March 13<sup>th</sup>, 2023. This decision is considered as the culmination of a significant chapter of the Save the Blue Heart of Europe campaign as regards the Vjosa. The park includes around 400 km of free-flowing rivers in an area of 12.000 hectares, which is a unique initiative not only for Albania but for Europe and the world. The National Park includes the Vjosa river in Albania and its 3 major tributaries: the Drino, the Bënça and the Shushica Rivers.

The addition of Wild River reflects the character of the protected area. This is a national park that exclusively protects rivers and does so over a large area, i.e. entire river systems. Rivers are among the most threatened habitat types worldwide. The example of migratory fish species in Europe shows how endangered they are. Since 1970, their populations (e.g. eel, grayling, river herring, sturgeon) have declined by 94 percent, mainly as a result of river straightening and dam construction.



**Figure 9:** During the ceremony of declaration of the Vjosa WRNP. From right to left: Prime Minister Edi Rama, Ryan Gellert CEO of Patagonia and Minister for Tourism and Environment Mirela Kumbaro © E. Baxhaku

After the declaration the National Park is still considered “a park on the making” because yet no Management plan or structure is in place to ensure the long terms preservation of its biodiversity, conservation values and ecological integrity. In addition, inherited threats to nature conservation are still active while new ones are popping up such as the construction of the Vlora Airport, the touristic infrastructure and the massive energy projects at the Vjosa delta or the Shushica river issue explained in the previous chapter. These are the challenges that the newborn Europe’s first Wild River National Park is currently facing.

## Methodology

### Sampling methodology

#### Velocity-Area Method

In order to assess the waterflow in a river section there are already know serval methodologies such as container method, floater measurement, flowmeter measurement or ADCP - Acoustic Doppler Current Profiler. Each of the methods has its advantages and weaknesses related to the efforts while measuring, resources and precision of the results. In all cases the uncertainty of the waterflow measurement in a river section, is relatively high because of the dynamic of the flow and of the bathymetry of the riverbed.



**Figure 10:** Demonstration of velocity-area method. Measuring the area of river section profile © A. Lala

In this assessment the method which appears to be most convenient is the flowmeter measurement or the Velocity-Area Method.

The velocity-area method has been used for many decades, with the aid of a handheld mechanical current meter. Current meters come in different sizes, depending on the size of the river. They work by measuring the rotations of propellers and calculate the speed (velocity) of the water. The flow is obtained by measuring the velocity for several vertical subsections across the river and calculating the flow in each. The overall flow is the combined flow from each of these subsections. In this respect by using a flow meter and simple other materials is only needed to calculate two parameters: the water velocity on the given river section and the area of the transect. The velocity is measured with a current meter while the area is calculated on mathematic formulas depending on the shape of the profile of the given river section.

This is the most convenient method, uses an instrument with a propeller in an extremity. Propeller stays underwater and pointed to opposite direction of river current. Propeller's rotation is directly proportional to flow speed, which is indicated in other extremity. Of course, that must make measurements in many points and different depths to obtain average. Flow rate  $Q$  formula is:

$$Q = \sum A_i * V_i$$

$A_i$  is area of each section, where speed is  $V_i$ . While  $\sum$  is the sum of multiplication area times velocity. This method has high precision.

### Velocity

In this assessment the water velocity is measured with the LabQuest instrument. LabQuest is a standalone and computer interface for Vernier sensors. The instrument is made of two parts: the computer and the current meter with fractionable stick with a helix in the extreme. The stick is connecting to the computer with the Ethernet cable, and it provides the data on the water velocity on real time.



**Figure 11:** Photo of a velocity measure instrument LabQuest. a) The computer; b) current meter stick

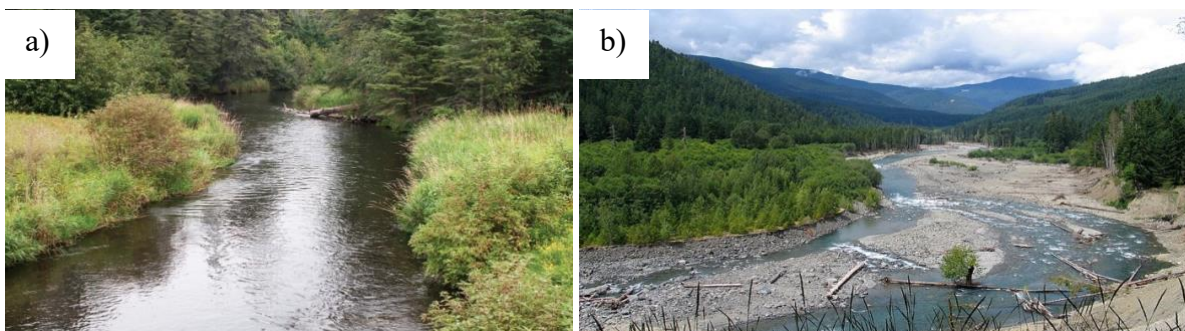
There is a simple technique to use the instrument. One needs to stand against the current on the river section and keep the stick vertically to create and  $90^\circ$  angle with the water surface



**Figure 12:** Demonstration photo of a measuring technique on a given river section

### Area

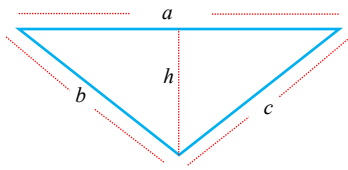
The area of the river section at a given location or sampling station is very much depending on the river physiognomy and bathymetry. Usually, it is recommended that the stations should be chosen in the river section that are not diverse and dynamic. It is also important that the measuring locations represents a section of the river where the water flows all in one channel and it is not divided or creating islands



**Figure 13:** Photo of a) straight river sections and b) dynamic section with islands

The section area of a river can represent a triangular, a trapezoid or rectangle shape. Thus, in each of the cases the different formulas are used to calculate the area of the section.

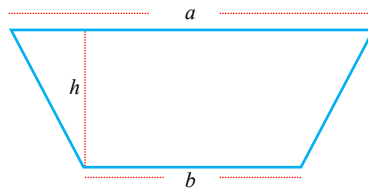
a) Triangular Shape



Formula

$$A = \frac{a * h}{2}$$

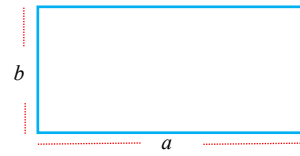
b) Trapezoidal Shape



Formula

$$A = \frac{(a + b) * h}{2}$$

c) Rectangular shape



Formula

$$A = a * b$$

**Figure 14:** The potential shapes of the river section and the formula for area calculation.

In all cases one of the parameters that stays the same is “a” length parameter which is in all cases the river width, while the “h” or “b” parameter represents the depth of the given river section. The river width can be easily measured with a metric line like in the picture 14 above, while the depth of the river section can be measured at the same time with the velocity by using the current meter stick as a metric stick.

Once having the figures for the two parameters, the calculation of the river profile area in the given section can be done by applying any of the formulas above depending on the shape of the river section.

### Sampling techniques and instructions

Beside the standard methodology used explained above; while conducting measurement for the waterflow on a given river section it is important to follow also some technical instructions in order to have as much reliable results as possible. These are minor actions that have an impact on the data accuracy.

- **Marked stations on site:** It is important that once being on the defined station for the measurement to mark stable object (i.e tree’s trunk, big stones on the river sides etc.) with a permanent marker or sign. This allows to conduct measurements on exactly the same spot so the data generated can be used for comparative analysis then after.
- **Mapping with GPS:** While being on site is important to mark the location with a GPS device and note the coordinates and elevation on the fieldwork sheet. The location can be checked with the GPS device each time that the measurements are conducted.
- **Conduct 3-5 measurements sets per site:** As the measuring of the waterflow is highly uncertain, it is recommendable to conduct the same measurement 3-5 for each of the parameter. Thus, an average of the set of measurements can be used for the calculation afterwards.
- **Frequency of measurement:** the frequency of the measurement is significantly important. It is recommendable to choose a regular frequency for conducting the

measurements within a given timeframe. This way the results can be better analyzed and compared.

- Keep notes on the sounding environment: While being on site for conducting measurement, it is very important to keep notes on the environment around the sampling station. On the notebook information related to recent rainfall, flood, fire, construction works etc. is always important to be noted down. This may help the analysis during the desk work afterwards.
- Have talks with locals where possible: It is always recommendable to get the first handed information while being on site. Thus, a talk with locals where possible is always recommended.

## Sampling sites

In this assessment, 4 water flow monitoring points are defined. All points are in the upper part of the Shushica river, starting from the source in Lepusha to the Lasko bridge.

At Lepusha spring there are set 2 sampling stations: Lepusha 1 and Lepusha 2 while the other two stations are located at Thomare Bridge and Lasko Bridge.

No	Station	Name	Location	Elevation
1	Station 1	Lepusha 1	40.195574, 19.852465	541m a.s.l
2	Station 2	Lepusha 2	40.194683, 19.852033	531m a.s.l
3	Station 3	Thomare Bridge	40.178557, 19.829112	377m a.s.l
4	Station 4	Thomare Bridge	40.181115, 19.806031	327m a.s.l

**Table 1:** Table: Coordinates of the sampling stations

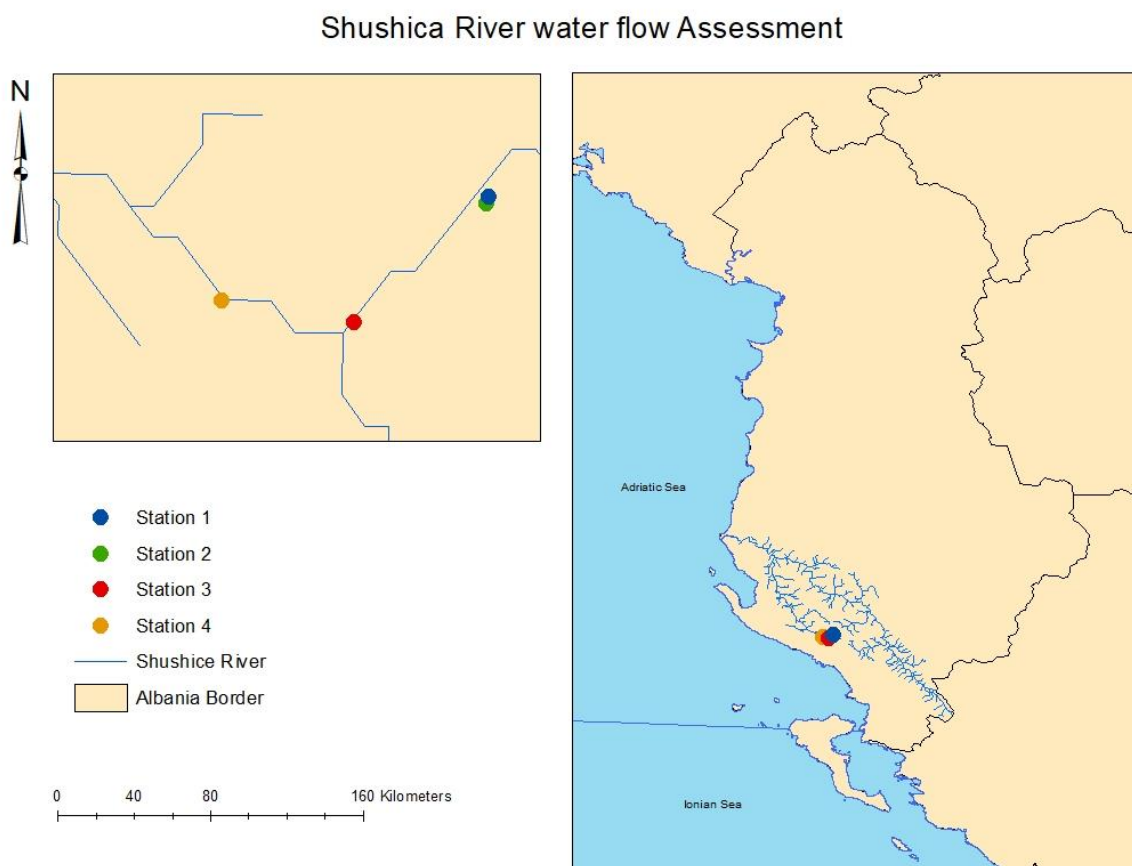
**Station 1 – Lepusha 1:** The 1<sup>st</sup> station at the Lepusha spring is located just at the outlet of the excavated crater from the ADF construction works in June 2023. This location represents the official Shushica main spring because it the further far upstream spring along the river where the water flows constantly all year long. This is considered as the main intake for the Himara water supply project as well. The water flows all-in-one single channel; therefore, it is very much appropriate to be chosen as sampling location for conduction waterflow measurement.

**Station 2 – Lepusha 2:** A few meters downstream the Lepusha 1 station, the water passes underneath a little bridge, while the river changes the flow to the right side of the road. The bridge represents a concrete rectangular tube. From the main spring to the bridge and especially, at the outlet from the bridge, the river has other springs to carry. It is evident that the water flow is increased the more downstream it flows. This station is situated just at the outlet of the bridge, because it is expected to serve as the potential intake for the Himara water supply project. Being uncertain which will be the exact location of the intake and in order to be sure that the assessment will serve to the main objective, there has been chosen 2 stations in Lepusha spring that could more likely be used as the intake spot for the Himara water supply project.

**Station 3 – Thomare Bridge:** The 3<sup>rd</sup> station chosen for the sampling has been the river section downstream of the Buronja of Kuç. The spot is located some few meters upstream of Thomare Bridge. This has been chosen because in the feasibility study of the Himara water supply project, another intake has been planned to be utilized as a

secondary alternative during if the water from the Lepusha would not be sufficient. The station is located few hundred meters downstream of Lepusha and there is a difference in altitude of around 150 m - 170 m. This would mean that potentially it could be a need for pumping the water up in order to reach the highest peak near Pilur village. However, this spot is considered as a secondary potential intake for the project, and this has been the reason why it has been chosen as a sampling station in our Assessment.

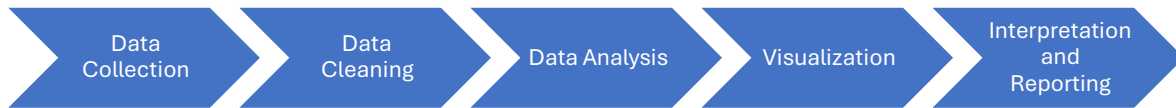
**Station 4 – Lasko Bridge:** The last station set is the Lasko Bridge. This station is chosen mainly as a reference point to compare the water loss, before any significant diversion. IN addition, the Lasko Bridge represents the final meeting point of the pipeline and the Shushica river before the water is finally diverted to another basin, the Himara coastal area in this case. The waterflow at the 4<sup>th</sup> station it appears to be relatively lower than at Thomare Bridge. Although that potentially could be lateral springs to feed in the river system, the waterflow is lower because the river is shaping more, and it is widening up. Thus, the evaporation rate is increased leading to a water loss. In addition, the filtering down of the water due to the gravel limestone substrate of the river bottom is another factor for the water loss along the way.



**Figure 15:** Map of the sampling stations © I. Metani / EcoAlbania

## Data Analysis

Analyzing waterflow measurements involves several steps to ensure accurate and meaningful results. Here's a general outline of the process:



**Figure 16:** The methodological steps of the data analysis of the waterflow in Shushica

**Data Collection:** The data are gathered based on the methodology described under the chapter “Methodology” above, using the Area-Velocity method. The parameters that has been measured in a every 5-days frequency are the water velocity in the given section /station, the river section width, and the river section depth. All data gathered are noted in the fieldwork notebook and then are digitalized for further processing. The final goal would be the calculation of the waterflow, which represents the volume of water passing through a point over time.

**Data Cleaning:** Once the data are digitalized, the next process which is important, is the data cleaning. It is very likely that during the measuring on site, some of the data can be wrongly noted or can even note twice. In this respect it is essential to make sure that the data is free from errors, duplicates, and inconsistencies. This step is crucial for accurate analysis.

**Data Analysis:** the collected and cleaned data from site, once they are digitalized can be easily processed via excel spreadsheet. The calculation of the profile area in the given river section, mean of the water velocity as well as the waterflow is simple and accurate by integrating the formulas in the MS Excel. In this regard the results after processing can also serve for the visualization process that follow.

**Visualization:** From the processed data in MS Excel are prepared the graphs shown under the “Results” chapter below.

**Interpretation and Reporting:** The last step of the data analysis is to draw conclusions from the analysis and present the findings in a clear and concise manner. This consists of writing this assessment reports, and the creation of dashboards, or power point presentation.

## Results

The assessment of the waterflow in the headwaters of the Shushica river includes the period 27<sup>th</sup> July – 5<sup>th</sup> December 2024. The measurement has taken place in 8 set of with the frequency every 5 days in all 4 pre-determined stations.

The period chosen is relatively significant because it represents the dry period of the year although that it does not include the extreme lower peak of the water flow, which referring to the feasibility study of the Himara water supply project is the September – October. After processing all 8 sets of measurements the results are as follows:

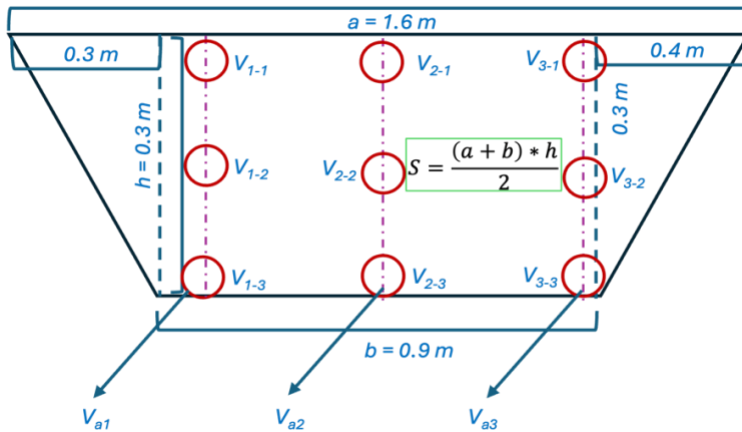
No. Measurement	Code	Date conducted	Stations measured
1 <sup>st</sup> Measurement	M0	July 27 <sup>th</sup> 2024	All stations
2 <sup>nd</sup> Measurement	M1	August 1 <sup>st</sup> 2024	All stations
3 <sup>rd</sup> Measurement	M2	August 5 <sup>th</sup> 2024	All stations
4 <sup>th</sup> Measurement	M3	August 10 <sup>th</sup> 2024	All stations
5 <sup>th</sup> Measurement	M4	August 15 <sup>th</sup> 2024	All stations
6 <sup>th</sup> Measurement	M5	August 20 <sup>th</sup> 2024	All stations
7 <sup>th</sup> Measurement	M6	August 25 <sup>th</sup> 2024	All stations
8 <sup>th</sup> Measurement	M7	August 31 <sup>st</sup> 2024	All stations
9 <sup>th</sup> Measurement	M8	September 5 <sup>th</sup> 2024	All stations
10 <sup>th</sup> Measurement	M9	September 11 <sup>st</sup> 2024	All stations
11 <sup>th</sup> Measurement	M10	September 17 <sup>th</sup> 2024	All stations
12 <sup>th</sup> Measurement	M11	September 21 <sup>st</sup> 2024	All stations
13 <sup>th</sup> Measurement	M12	September 26 <sup>th</sup> 2024	All stations
14 <sup>th</sup> Measurement	M13	October 1 <sup>st</sup> 2024	All stations
15 <sup>th</sup> Measurement	M14	October 5 <sup>th</sup> 2024	All stations
16 <sup>th</sup> Measurement	M15	October 10 <sup>st</sup> 2024	All stations
17 <sup>th</sup> Measurement	M16	October 15 <sup>th</sup> 2024	All stations
18 <sup>th</sup> Measurement	M17	October 20 <sup>th</sup> 2024	All stations
19 <sup>th</sup> Measurement	M18	October 25 <sup>th</sup> 2024	All stations
20 <sup>th</sup> Measurement	M19	October 30 <sup>th</sup> 2024	All stations
21 <sup>st</sup> Measurement	M20	November 5 <sup>th</sup> 2024	All stations
22 <sup>nd</sup> Measurement	M21	November 10 <sup>th</sup> 2024	All stations
23 <sup>rd</sup> Measurement	M22	November 15 <sup>th</sup> 2024	All stations
24 <sup>th</sup> Measurement	M23	November 21 <sup>st</sup> 2024	All stations
25 <sup>th</sup> Measurement	M24	November 25 <sup>th</sup> 2024	All stations
26 <sup>th</sup> Measurement	M25	November 30 <sup>th</sup> 2024	All stations
27 <sup>th</sup> Measurement	M26	December 5 <sup>th</sup> 2024	All stations

**Table 2:** The measurement sets and the period when they have been conducted

### Station 1 – Lepusha 1

The river section at Lepusha 1 represents a trapezoidal shape. In this case the formula for the calculation of the area is second case es explained above. While for the calculation of the water velocity with the flow meter in this case 9 measurements have been conducted and each of them has been repeated 3 times in order to achieve more precise results.

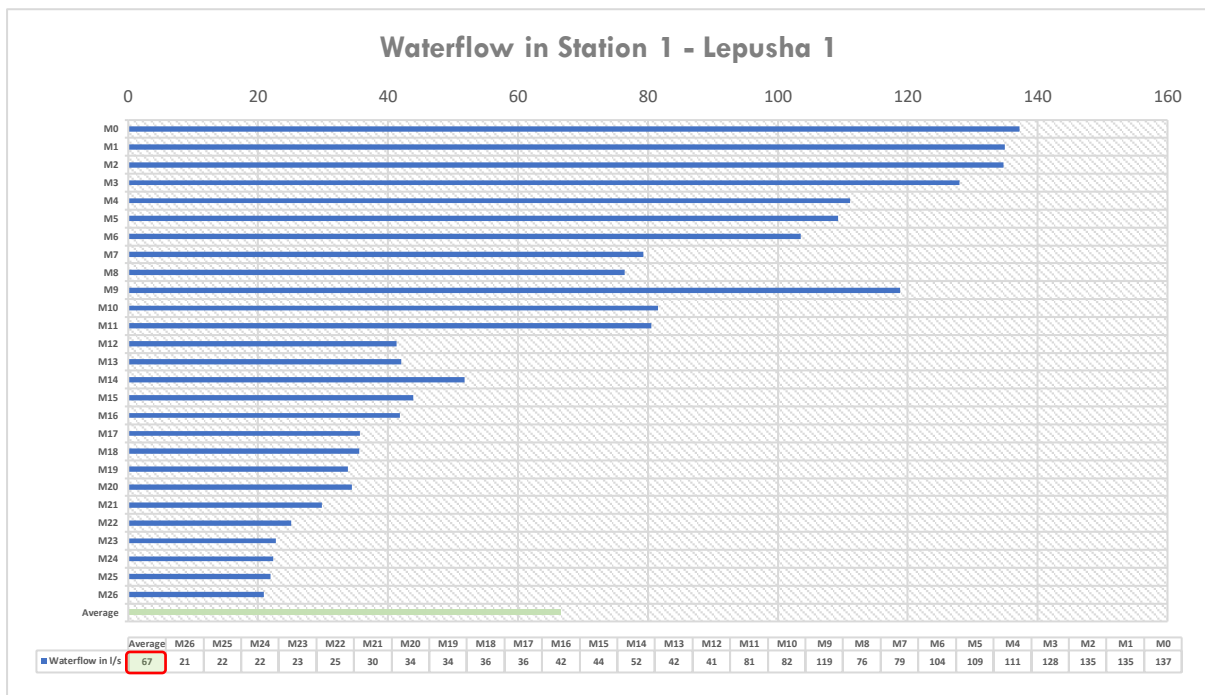
The velocity has been measured each 0.5 m along the river width on a transect and every 0.1 m along the river depth on each of the points. The “V<sub>a</sub>” value of the velocity used to calculate the waterflow which is Q=V<sub>a</sub> \* A represents the average value of all 27 measurements of the velocity conducted on site.



$$A = \frac{(a + b) * h}{2}$$

**Figure 17:** Trapezoidal profile of the river section at Lepusha 1 Station on measurement M1

At Lepusha 1 there have been conducted 27 set of measurement to assess the water flow. The waterflow data are presented in the chart of the Graphic 1 below. The results show a decreasing trend of the waterflow after August 1<sup>st</sup>, 2024. The average waterflow appears to be 67 l/s which is close below to the multiannual average of 104 l/s.



**Graph 1:** The waterflow in Lepusha 1 station after 27 measurements

### Station 2 – Lepusha 2

The river section at Lepusha 2 represents a rectangular shape. In this case the formula for the calculation of the area is second case es explained above. While for the

calculation of the water velocity with the flow meter in this case 12 measurements have been conducted and each of them has been repeated 3 times in order to achieve more precise results.

The velocity has been measured each 0.7 m along the river width on a transect and every 0.1 m along the river depth on each of the points. The “ $V_a$ ” value of the velocity used to calculate the waterflow which is  $Q=V_a * A$  represents the average value of all 36 measurements of the velocity conducted on site.

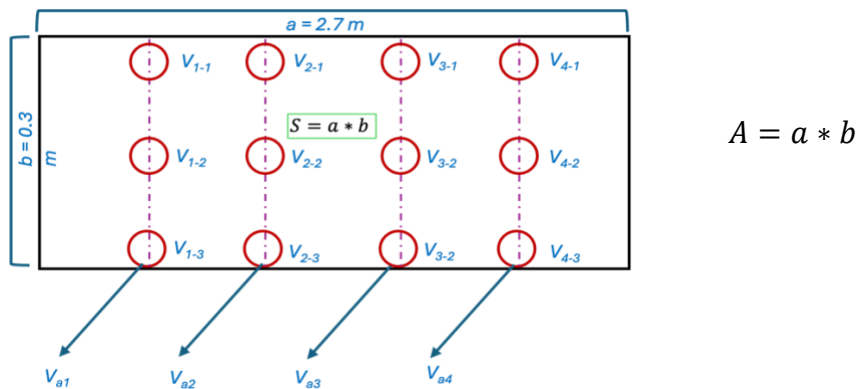
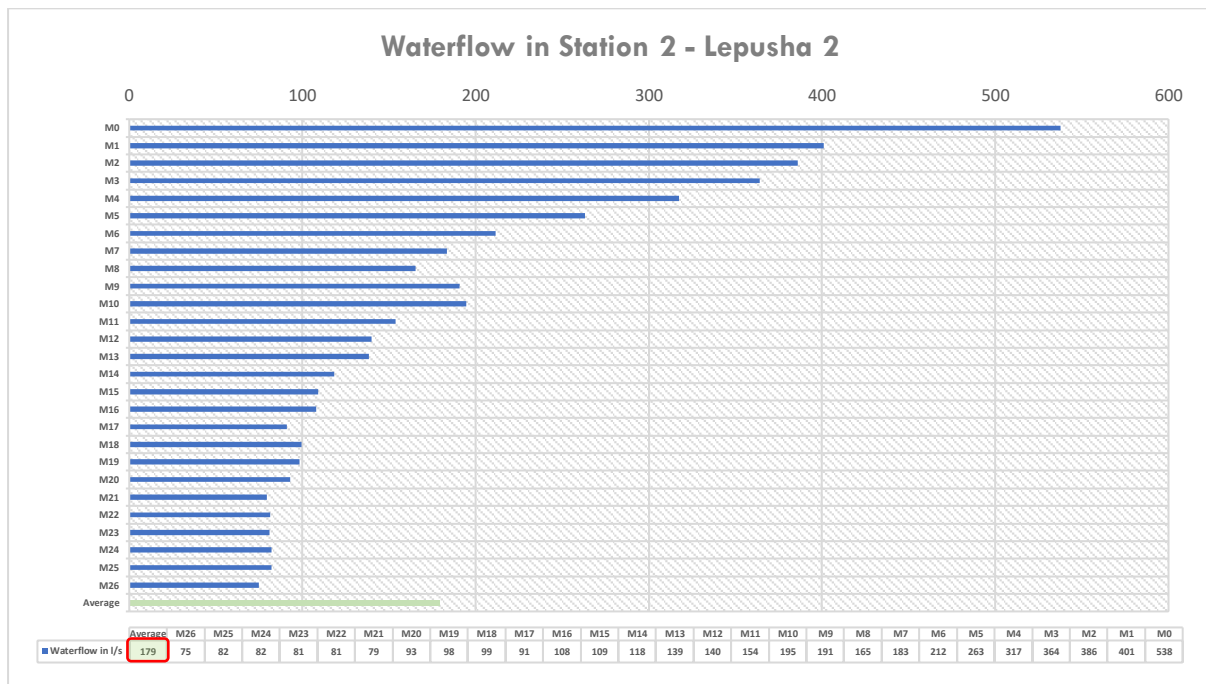


Figure 18: Rectangular profile of the river section at Lepusha 2 Station on measurement M1

At Lepusha 2 there have been conducted 27 set of measurement to assess the water flow. The waterflow data are presented in the chart of the Graphic 2 below. The results show a significant decreasing trend of the waterflow from 538 l/s on July 27<sup>th</sup> to 75 l/s on December 5<sup>th</sup>, 2024. The average waterflow in this station for the given period is approximately 179 l/s.

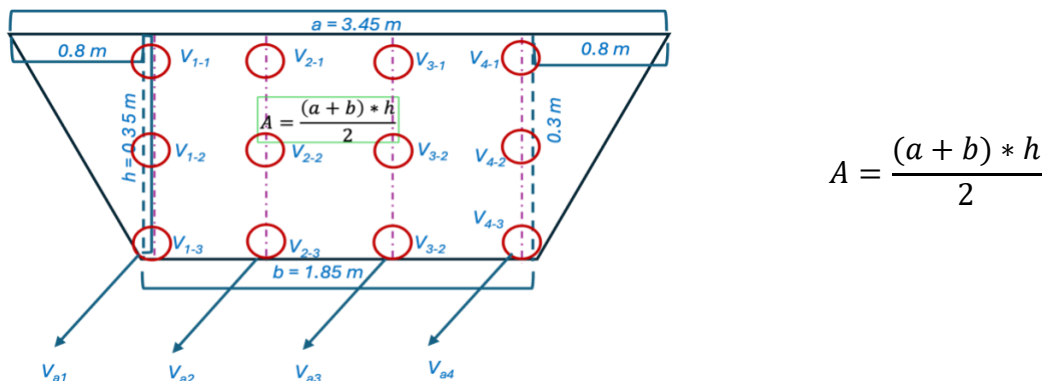


Graph 2: The waterflow in Lepusha 2 station after 27 measurements

Station 3 – Thomare Bridge

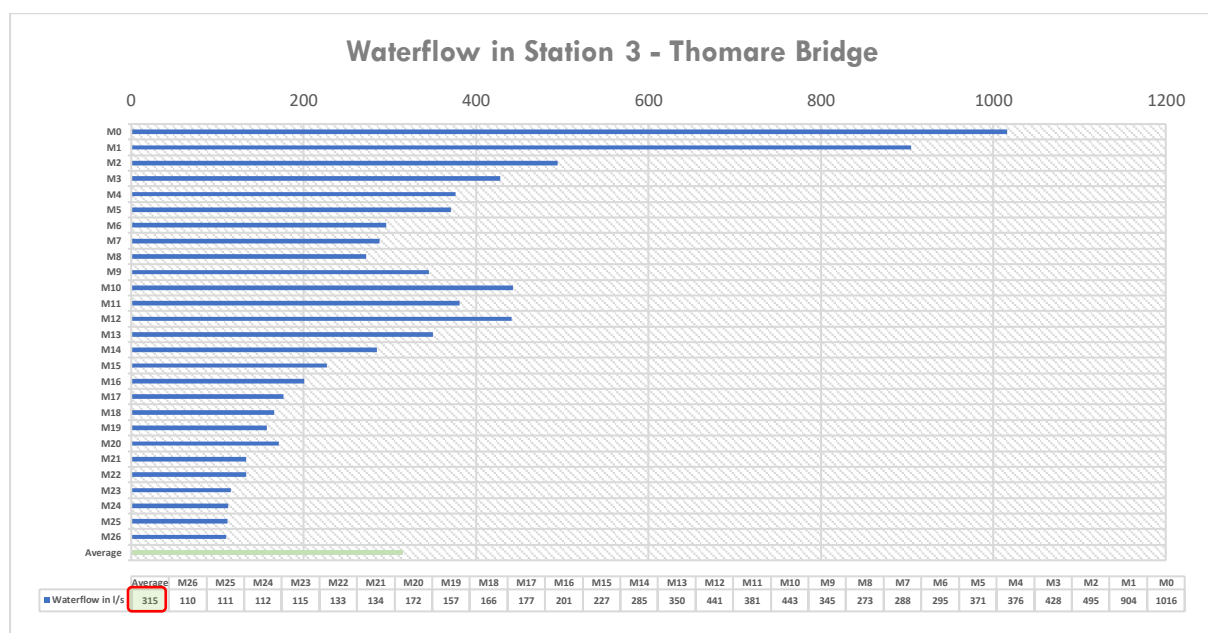
The river section at Thomare Bridge represents a trapezoidal shape. In this case the formula for the calculation of the area is second case es explained above. While for the calculation of the water velocity with the flow meter in this case 12 measurements have been conducted and each of them has been repeated 3 times in order to achieve more precise results.

The velocity has been measured each 0.8 m along the river width on a transect and every 0.1 m along the river depth on each of the points. The “V<sub>a</sub>” value of the velocity used to calculate the waterflow which is Q=V<sub>a</sub> \* A represents the average value of all 36 measurements of the velocity conducted on site.



**Figure 19:** Trapezoidal profile of the river section at Thomare Bridge Station 3 on measurement M1

At Thomare Bridge the river is more defined and it changes physiognomy from spring to a river. At this location the river has several other springs to carry, the named Buronja of Kuç. In this station there have been conducted 27 set of measurement to assess the water flow. The waterflow data are presented in the chart of the Graphic 3 below. Similarly like in the other 2 stations although the water flow is significantly higher, the results show a decreasing trend of the waterflow. From July 27<sup>th</sup> until the 5<sup>th</sup> of December the waterflow has been decreased at 90%. Thus, from 1016l/s recorded in July there is only 110 l/s recorded on December 5<sup>th</sup>, 2024. The average waterflow is 315 l/s/.



**Graph 3:** The waterflow in Thomare Bridge station after 27 measurements

### Station 3 – Lasko Bridge

The river section at Thomare Bridge represents a trapezoidal shape. In this case the formula for the calculation of the area is second case es explained above. While for the calculation of the water velocity with the flow meter in this case 12 measurements have been conducted and each of them has been repeated 3 times in order to achieve more precise results. The velocity has been measured each 0.8 m along the river width on a transect and every 0.1 m along the river depth on each of the points. The “ $V_a$ ” value of the velocity used to calculate the waterflow which is  $Q=V_a * A$  represents the average value of all 36 measurements of the velocity conducted on site.

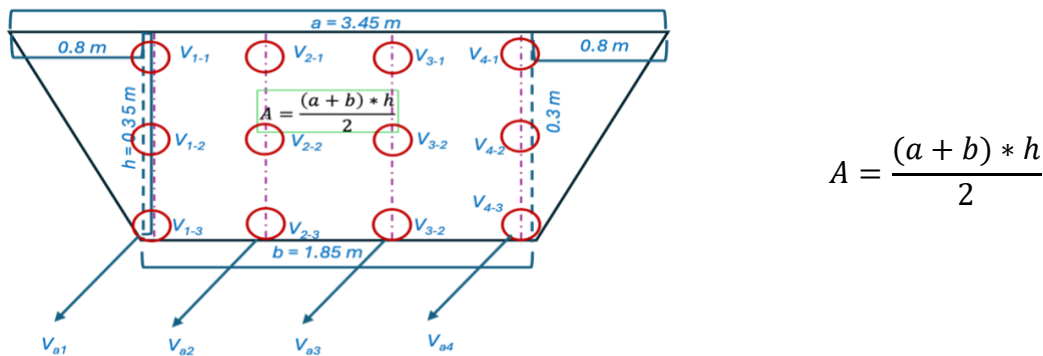
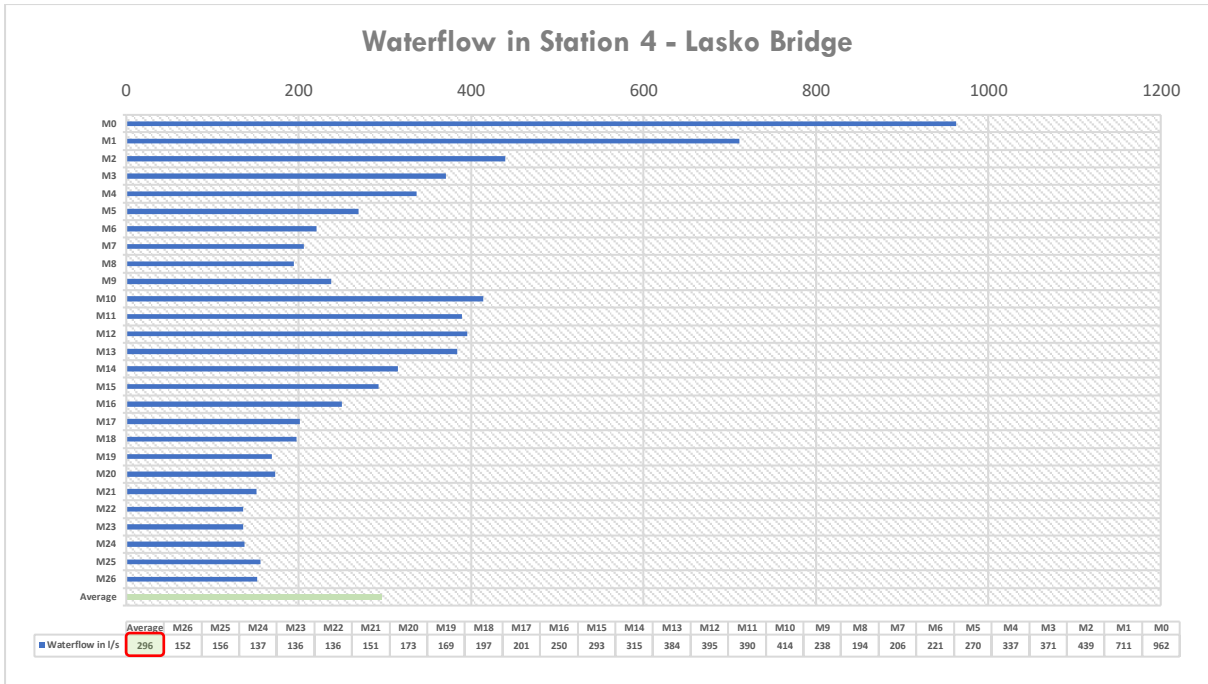


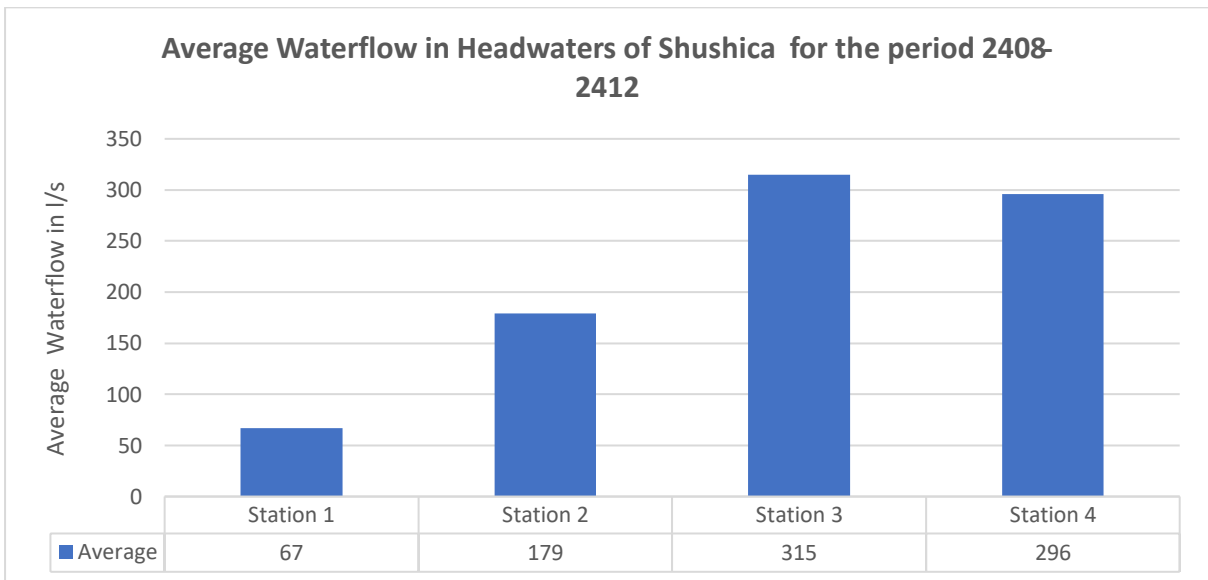
Figure 20: Trapezoidal profile of the river section at Lasko Bridge – Station 4 on measurement M1

At Lasko Bridge the river is finally looks like a river. It is widening up and it creates a gravel riverbed with few riparian vegetation on both sides. At this location the river is under the effect of filtering down and evaporation as the exposed area is 3 times more than at the spring. In this station there have been conducted 27 set of measurement to assess the water flow. The waterflow data are presented in the chart of the Graphic 4 below. As expected, the waterflow is significantly decreased compared to the station 2 at Thomare bridge. However, the decreasing trend is higher on this station as the water flow is around 80% less water on December 5<sup>th</sup> compared to the first set of measurement conducted on July 27<sup>th</sup>, 2024. Thus, from 962 l/s recorded in July, there is only 152 l/s recorded on December 5<sup>th</sup>, 2024. The average waterflow appears to be 296 l/s/.



**Graph 4:** The waterflow in Lasko Bridge station after 27 measurements

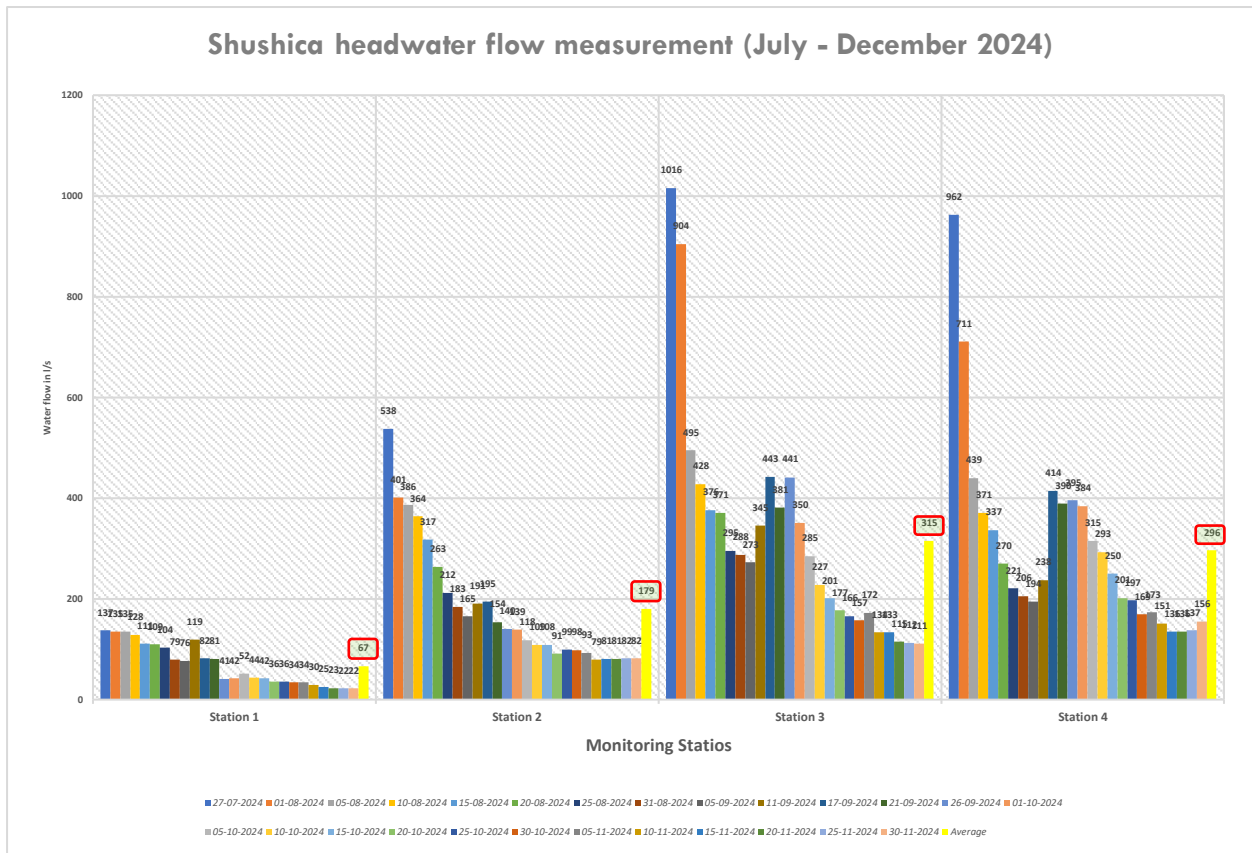
At the Graph 5 below are shown the values of the average waterflow measured in all 4 stations for all the 27 set of measurement. As seen the average waterflow does not exceed 350 l/s, while at the intake appears to be of the multiannual average (103 l/s) and almost half of the flow that is foreseen into the water use permit for the project (193.5 l/s).



**Graph 5:** The average waterflow in all stations of Shushica headwaters after 27 measurements

At the Graph 6 below are shown the comprehensive results of the waterflow measured in all 4 stations for all the 27 set of measurement. The decreasing trend is evident in all stations while the Lepusha 1 that represents the main spring of the river and one of the 2 potential intake sites for the Himara water supply project even that the measuring period

is 2 months ahead of the lowest peak, appear waterflow values that are close to the multiannual average.



**Graph 6:** The waterflow in all stations of Shushica headwaters after 27 measurements

## Conclusions and Recommendations

Based on the field measurements conducted along the headwaters of the Shushica River, this assessment provides important empirical insights into the current hydrological regime and its vulnerability, particularly in the context of the planned diversion for the Himara water supply project.

The results clearly indicate that waterflow in all 4 monitoring stations follows a consistent and pronounced declining trend during the measurement period (late July to early December 2024). This decrease ranges from approximately twofold to up to 90% reduction depending on the station, reflecting both seasonal variability and the sensitivity of the system to dry-period conditions. Notably, even before reaching the historically lowest flow period (September–October), measured values at Lepusha spring, the primary source of Shushica River, are already close to or below the multiannual average. This suggests that the river operates under relatively low baseline flows during much of the dry season.

At the source level (Lepusha 1 and 2), average discharge values (approximately 67 l/s and 179 l/s respectively) highlight a limited hydrological capacity compared to the volumes anticipated in project planning documents. This discrepancy raises concerns about the sustainability of abstraction levels foreseen under the Himara water supply scheme, particularly during prolonged dry periods. The data suggest that any significant diversion at the spring could reduce downstream flow to critically low levels.

Further downstream, although tributary inputs (e.g., Buronja of Kuç) temporarily increase discharge, the overall trend remains declining, with substantial losses observed between Thomare Bridge and Lasko Bridge. These reductions are attributed to natural factors such as infiltration into the karstic substrate and evaporation, but also indicate a system already operating near hydrological stress thresholds. The cumulative effect is a fragile balance between available water and existing uses.

An additional critical finding is the observed loss of hydrological connectivity between the Shushica and the Vjosa River during the dry season, even in the absence of the planned diversion. Since June 2024, the confluence has intermittently dried due to existing upstream abstractions for irrigation. This indicates that the river system is already experiencing fragmentation pressures. Any additional diversion, particularly at the main spring, would likely prolong and intensify this disconnection.

From an ecological perspective, such disruptions pose significant risks. The interruption of longitudinal connectivity directly affects aquatic habitats and migratory pathways, especially for species dependent on free-flowing river systems. Given that the Shushica is an integral component of the Vjosa Wild River National Park, these impacts extend beyond local scale and threaten the ecological integrity of one of Europe's last free-flowing river systems.

In socio-economic terms, reduced water availability downstream may directly affect local communities whose livelihoods depend on agriculture, livestock, and small-scale irrigation systems. The existing use of river water along the valley already places pressure on available resources, and further reductions could exacerbate conflicts over water use.

Finally, while this assessment provides valuable first-hand data, its temporal limitation must be acknowledged. Although the monitoring period extends into the dry season, longer-term data covering multiple years and full seasonal cycles would be necessary to fully quantify variability and establish reliable environmental flow thresholds.

In conclusion, the findings indicate that the Shushica River headwaters have limited hydrological resilience during dry periods, and that the planned diversion carries a high risk of exacerbating ecological degradation, hydrological disconnection, and socio-economic impacts. Any future decision regarding water abstraction should therefore be based on a precautionary approach, incorporating extended monitoring, strict environmental flow requirements, and a comprehensive reassessment of the project's sustainability within the protected area context.

### Recommendations:

Based on the findings of this assessment, the following recommendations are presented in a descriptive and integrated form, reflecting both field evidence and international best practices for protected area management.

#### **Reccomendation 1: *Prioritizing avoidance through alternative water sources***

The most effective and sustainable course of action is to avoid water abstraction from the Shushica River headwaters, particularly at the Lepusha springs. The collected data clearly demonstrate that the river already experiences low-flow conditions during the dry season, with a strong decreasing trend even before reaching peak drought months. Under such conditions, any diversion at the source would likely result in critically reduced downstream flows, exacerbating existing hydrological stress and further disrupting ecological connectivity. In line with IUCN guidance, priority should therefore be given to identifying and developing alternative water sources for the Himara water supply system. Such alternatives would provide a more resilient long-term solution, minimizing environmental risks while ensuring reliable water supply.

#### **Reccomendation 2: *Establishing and enforcing environmental flow regimes***

In the event that water abstraction from Shushica is still considered, it is essential to establish a scientifically grounded environmental flow regime that ensures the maintenance of ecological processes and river functionality. This should include clearly defined minimum flow thresholds that account for seasonal variability, particularly during the critical dry period. The environmental flow must be legally enforced and supported by a monitoring system capable of informing adaptive management decisions in real time. Maintaining sufficient flow is particularly important given the already observed temporary disconnection between Shushica and the Vjosa River, which highlights the vulnerability of the system and the importance of preserving longitudinal connectivity for aquatic species and ecosystem services.

#### **Reccomendation 3: *Strengthening hydrological knowledge through long-term monitoring***

Although this assessment provides valuable insights into the hydrological dynamics of the Shushica headwaters, it also highlights the need for more comprehensive and long-term data. This study emphasize that current knowledge is insufficient to support high-impact decisions such as water diversion. It is therefore recommended to implement an extended monitoring program covering at least one full hydrological year, including both surface and groundwater components. Detailed hydrogeological investigations of the Lepusha springs should be conducted to better understand aquifer characteristics, seasonal variability, and climate change implications. Such efforts are critical for defining sustainable abstraction limits and reducing uncertainty in future planning.

#### **Reccomendation 4: *Reducing existing pressures and restoring ecological integrity***

The findings indicate that the Shushica River is already subject to multiple pressures, particularly from irrigation abstractions, which contribute to seasonal drying and loss of connectivity with the Vjosa River. Addressing these existing pressures is a necessary step toward improving the overall resilience of the system. Measures should focus on increasing water use efficiency in irrigation, reducing losses in existing infrastructure, and optimizing water allocation among users. At the same time, efforts should be made to restore degraded river sections and enhance floodplain functionality, thereby improving habitat quality and ecological processes. Ensuring continuous river connectivity should be a key objective, given its importance for biodiversity and ecosystem health.

**Reccomendation 5: *Implementing integrated river basin management and strengthening governance***

A long-term and sustainable solution requires moving beyond a project-specific perspective toward an integrated river basin management approach. This should be closely aligned with the objectives of the Vjosa Wild River National Park and consistent with IUCN standards for protected areas. Implementation of the National Park Management Plan should be prioritized, alongside the development of a comprehensive water management strategy that balances environmental protection with human needs. Stakeholder engagement, including local communities, should be transparent and inclusive, ensuring that their water needs and livelihoods are adequately considered. Furthermore, aligning national policies and permitting processes with international conservation standards will be essential to safeguard the ecological integrity of the Shushica River and the wider Vjosa basin.

These recommendations collectively emphasize a precautionary and ecosystem-based approach, recognizing that the long-term sustainability of water supply solutions must be compatible with the preservation of ecological integrity, biodiversity, and community livelihoods.

## Literature

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# Annexes

## Annex 1 Photos from on-site measurements

