MOTT MACDONALD

Neretvica River Small Hydropower Plants Project Supplementary ESIA

Scoping Report

March 2017

European Bank for Reconstruction and Development

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Issue and revision record

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B	20 January 2017	Various	L Morton	L Morton	Draft report
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Contents

1 Introduction

1.1 Overview

PE Elektroprivreda Bosne i Hercegovine (“EPBiH” or “the Company”), a public utility responsible for generation, distribution and sale of electricity in Bosnia and Herzegovina is planning to construct and operate 15 small hydropower plants (“sHPP”) on the Neretvica river in the Konjic Municipality in the Bosnian Federation (the Project). The combined installed capacity of these run-of-river plants will be approximately 26MW.

As part of the Federation of Bosnia and Herzegovina (“FBiH”) permitting process the Project was subject to separate environmental impact assessments (“EIA”) undertaken in November 2009 for each of the 15 sHPP. The environmental permits were received in the period from 2010 to 2013 for all plants and have since been renewed in October 2016 for the first four sHPP to be constructed. The environmental permits for other plants will be renewed in 2017 and 2018. The Project is now seeking finance from the European Bank for Reconstruction and Development (“EBRD”). As part of the financing requirements of EBRD, a review of the Project and its EIA documentation was undertaken which determined that a further environmental and social impact assessment (“ESIA”) was required to fully meet EBRD’s Environmental and Social Policy requirements. As such, a supplementary ESIA report (“Supplementary ESIA”) will need to be completed in line the EBRD Performance Requirements (“EBRD PRs”). Mott MacDonald, Enova and Blue Rivers have been engaged to undertake the scoping report for the Supplementary ESIA on behalf of EPBiH. This will take into account the assessment and conclusions of the national EIAs and, where required, any supplementary studies to address gaps between the national EIAs and EBRD requirements.

1.2 Objectives of this scoping report

As national approvals have been obtained for the Project, the Supplementary ESIA is being prepared to meet EBRD PR and the requirements of the European Union EIA Directive. The scope of the Supplementary ESIA is set out in this report. The purpose of this scoping report is to identify the main potentially significant adverse and beneficial impacts associated with the Project that will require further consideration and more detailed assessment during the Supplementary ESIA process and to set out the scope for any primary or secondary baseline data requirements and the assessment methodologies for determining the extent of those impacts. Scoping also provides an opportunity to inform stakeholders about a project, and for stakeholders to review and comment on the proposed approach to undertaking the assessment to ensure it will address their concerns appropriately.

1.3 Disclosure and consultation on the scoping report

This scoping report will be disclosed on the EPBiH Project website (www.elektroprivreda.ba) and will also be made available to the affected local communities and Municipality of Konjic (see section 3.10) to provide them with updated information on the Project and the proposed approach to further environmental and social assessments. The public will be invited and encouraged to provide comments and recommendations to the scoping report.

Comments on this Supplementary ESIA scoping report are welcome and should be sent to the address below.

Attention:	Project Implementation UnitPE “Elektroprivreda BiH” Sarajevo
Address:	Vilsonovo Šetalište 15
	71 000 Sarajevo
	Bosnia and Herzegovina
Telephone:	0387 33 75 1866
Website:	www.elektroprivreda.ba
Email:	mheneretvica@elektroprivreda.ba

2 Project Description

2.1 Project location and description

The Project is located in the Federation of Bosnia and Herzegovina, in the seventh canton of Herzegovina-Neretva, near to the town and municipality of Konjic, approximately 43km southwest of the capital Sarajevo.

The Project is a proposed 26MW infrastructure consisting of 15 run-of-river hydropower schemes which will extend over 27km of the Neretvica river, and the various tributaries of the Neretvica river, which drain the slopes of the Zec mountain (altitude 1792m) and discharged into Jablanicko lake, a large water reservoir. The Neretvica river is a tributary on the upper course of the Neretva river, a 230km karst river with a watershed of 10,380km^2.

Draining a catchment area of approximately 136km^2 over its total length of 27km, the Neretvica river has a channel gradient of 61‰, total fall of 1645m and an average elevation of 376m above sea level. Four large tributaries, the Obascica, Prolaz, Mala Neretvica, and Crni potok, enter the middle reaches of the Neretvica river whilst the Gorovnik joins the river in the lower reaches. The mountainous nature of the river dictates that during the year, the Neretvica river and its tributaries will have uneven flow (snow melt or intense rain will result in sudden short bursts of high water levels).

The majority of the Neretvica river is a single type channel which flows through a V-shape valley and opens up in to a U-shape valley in the lower course of the river. Approximately 60% of the basin is covered with forest and shrub vegetation, resulting in a large amount of woody debris being found in the river, while the river banks are primarily rocky. There are several waterfalls on the Neretvica river, some of which would be close to proposed project infrastructure. The river sediment near to the proposed project infrastructure is dominated by gravel (30-60% of river substrate).

Figure 1 shows the Neretvica river and Project location in the FBiH.

The Project will include construction and operation of 15 sHPPs and supporting and associated infrastructure, which are further described in Section 2.2. The construction will be organised in three phases, each including the construction of four to six plants, as outlined in Table 1 below.

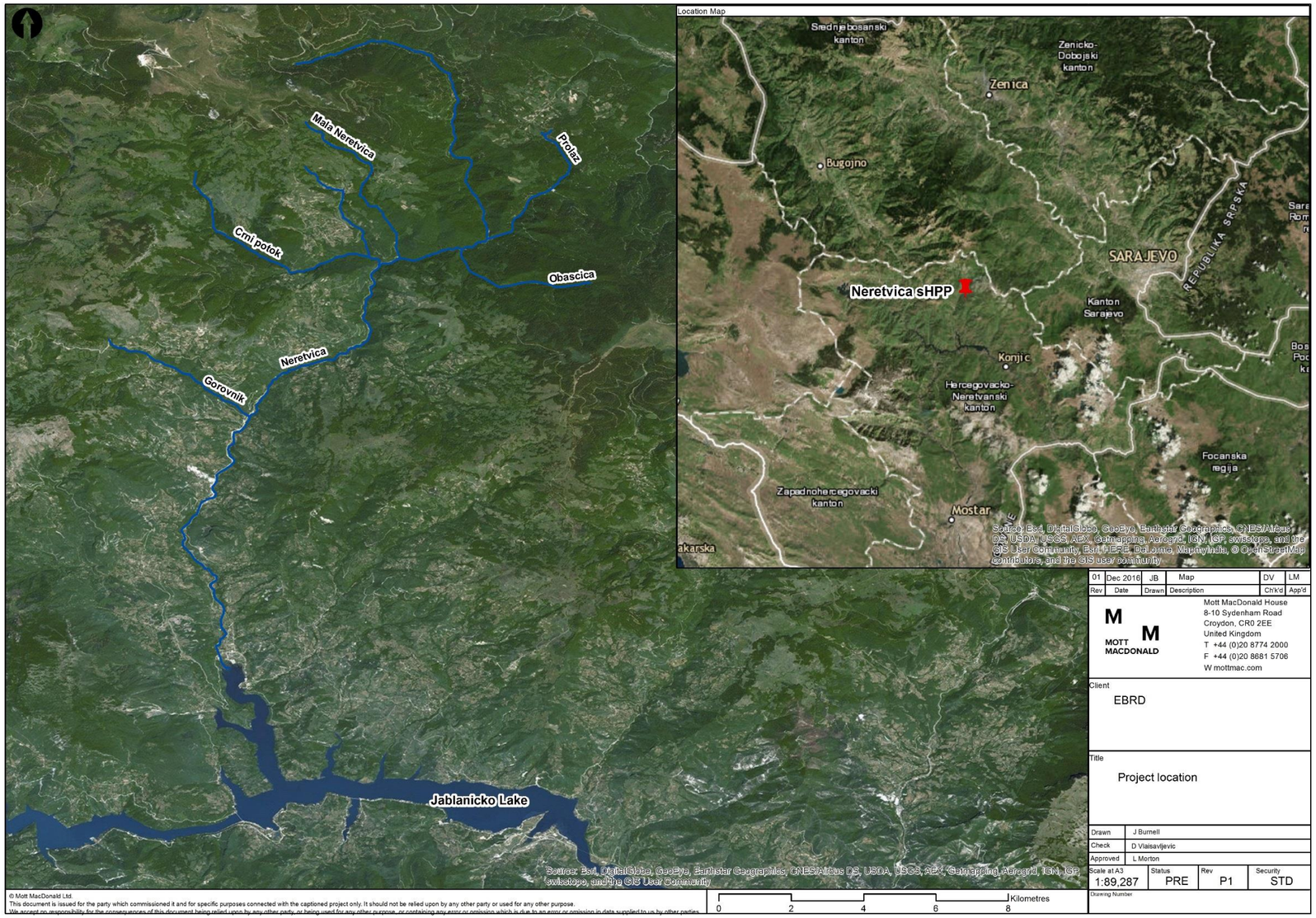
Table 1: Construction phases and estimated start/end dates (estimated in January 2017)

Construction phase	sHPP to be constructed	Estimated start/end date
Phase Ia	Srijanski Most and Gorovnik Usce	March 2017 – March 2018
Phase Ib	Crna Rijeka and Gorovnik	October 2017 – October 2018
Phase II	Podhum 1, Podhum 2, Donji Obalj, Pozelevka and Mala Nertevica – usce	May 2018 – May 2019
Phase III	Obascica, Duboki Potok 2, Ruste, Plavuzi, Prolaz, Duboki Potok 1	May 2019 – May 2020

Source: Mott MacDonald

The estimated time for construction of each plant is one year and the operational life is 50 years.

Figure 1: Project location



2.2 Project components

2.2.1 Overview

A run-of-river scheme differs to traditional large hydropower projects in that run of river generally does not involve storing large volumes of river water as in traditional hydropower. A dam or weir is used to create enough water storage behind the dam or weir to allow the intake to have sufficient water and head before entering the headrace (tunnel, channel or pipeline) to the powerhouse at a lower elevation. Run-of-river schemes rely on having a good height difference (head) between an area suitable for the intake upstream and an area suitable for the powerhouse downstream and a good sized catchment area (watershed) from which water will drain into the river. A sample plan for the design of the weir and powerhouse for one of the Phase I sHPP (Srijanski most) is included within Appendix E.

Key Project components are defined in the following subsections and their locations are illustrated in Figure 2.

2.2.2 Weir and intake

The Project will consist of 15 Tyrolean (mountainous) type weirs, which can be described as a structure that is built into the river bed and acts to abstract water from the main flow through a screen which then drops down into a surge shaft and is diverted to the powerhouse. Weirs will range between 0.9m and 3.1m in height and will increase the head available for the Project.

Intakes are situated behind each of the 15 weirs and there will be surge shafts between the intake site to the powerhouse.

2.2.3 Headrace/pipeline

As part of this Project, the headrace structures will be underground pipelines carrying water from the intakes to the powerhouses. In total, approximately 34 km of pipelines are anticipated for this Project, with diameters ranging from 500mm to 1800mm. At one section of river near Srijanski Most where the pipelines cross the Neretvica river, it has been deemed necessary to include a 17m section of overground pipeline to limit the construction and operational impacts associated with this project component. For this section, a pipeline “bridge” will be built across the river.

2.2.4 Powerhouse

The powerhouse contains the turbines and generators for the production of electrical power as well as ancillary equipment. For this Project, 15 powerhouses made up of either two Francis type turbines or one Pelton type turbine will be built, with the capacities ranging from 0.4 to 3.8MW.

2.2.5 Electrical components

It is anticipated that the Project will include the construction of the following electrical components:

- approximately 10km of underground cables for connecting the Phase I plants to the existing substation in Buturovic Polje and approximately 15km of underground cables for connecting the Phase II and III plants to the new on-site substation. At this stage the route of the underground cables has not been finalised however it is anticipated that the cables will follow existing access roads as much as is possible.
- new on-site 110/35kV substation which is envisaged to be built as part of construction Phases II and III for connection of Phase II and III plants to the grid (location yet to be identified)
- minor rehabilitation works at three existing sub-stations (Buturovic Polje, Jablanica and Ostrozac)

2.2.6 Access roads

Approximately 5km of new access roads will be built and 10km of existing local roads will be upgraded for the Project to support the delivery of equipment to site and access the different site components such as the powerhouses, pipelines and weirs.

2.2.7 Spoil and borrow pits

Borrow pits to provide aggregate for construction works and spoil pits for significant amounts of material to be excavated for pipelines are anticipated for the Project but the sites are yet to be identified. It is anticipated that these spoil areas will not be located along the pipeline routes and instead will be located away from the Neretvica river.

2.3 Associated facilities

A new transmission 110kV overhead line ("OHL") will connect the new on-site substation in the proximity of Gorovnik-usce to the existing 110kV Jablanica-Sarajevo OHL. This transmission line route is not yet known although it is expected to be approximately 12km in length. The OHL will be financed and constructed by Elektroprenos[1] and operated and maintained by NOS BiH[2] (TSO).

A separate EIA will be required for the new OHL which will be developed by Elektroprenos. The construction of the new OHL is expected to take place at the same time as Phases II and III of this Project. Therefore, the Supplementary ESIA for this project will not assess the impacts associated with the new transmission line with the exception of consideration of cumulative impacts which may arise where the construction of the new OHL overlaps with the construction of Phases II and III of this Project, and any ongoing cumulative impacts during operation of both schemes.

2.1 Alternative solutions

The following alternative solutions were considered for the Project:

1. Alternative locations - building the weirs, intakes and powerhouses at different locations along the Neretvica river
2. Alternative designs- building two large dams instead of 15 sHPP
3. 'No Project' alternative - do nothing

2.1.1 Alternative locations

Run-of-river hydropower projects are highly site specific as, in addition to being located in areas with adequate hydrological flow, they are dependent on a sufficient change in head between the intake and powerhouse to generate significant quantities of electricity. A variety of options were considered for alternative layouts and the spatial distributions of the different project components, including moving weirs further upstream and downstream.

The current configuration of weirs, intakes and powerhouses for the Project was considered to be the most suitable locations for project components as it maximises utilization of head whilst also minimising the impact on the environment.

[1] The transmission network in BiH is owned by the transmission company *Elektroprenos BiH* in charge of connection, transmission of electricity, metering, maintenance and development.
[2] The transmission network in BiH is operated by the state enterprise *Nezavisni Operator Sistema Bosne i Hercegovine (NOS BiH)* responsible for dispatching the loads, balancing the system and allocating the interconnection capacities.

2.1.2 Alternative design

In addition to considering different locations for the Project, alternative hydropower schemes were considered. Instead of constructing 15 run-of-river sHPPs, two large dams would be constructed at Srijanski Most and Podhum 1. This would have the benefit over a run-of-river scheme as it would generate greater quantities of energy. However, this design would have a much larger environmental footprint as it would flood large areas of land during the creation of reservoirs behind the dams and require the relocation of the regional road between Ostrozac and Fojnica. A run-of-river scheme was therefore considered the better alternative as it would allow significant quantities of electricity to be generated with a smaller environmental impact.

2.1.3 No Project Alternative

The no project alternative scenario would be that the 15 sHPP would not be built. If the Project is not built, the negative impacts associated with this type of project would not occur (for example the impact on aquatic ecology). However, the area would not benefit from the wider benefits the Project would provide. If the do nothing alternative was pursued, any financial benefits which might occur as a result of the proposed development, for example opportunities for employment of local people (albeit short-term in most cases), as well as indirect employment, would not be realised.

From a national perspective, if the Project did not go ahead, the Federation of Bosnia would be more reliant upon alternative sources of electricity, predominantly coal-fired power plants[3].Furthermore, the Project would not contribute to the FBiH's commitment as a Contracting Party of the Energy Community to increase the contribution from renewables. By signing the Energy Community Treaty, FBiH made legally binding commitments to adopt core EU energy legislation, among which also Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. As a Contracting Party, FBiH also adopted a National Renewable Energy Action Plan in 2016 which contains objectives for the FBiH on the participation of energy from renewable sources in gross final energy consumption by sector and measures to achieve these goals. If the no project alternative is pursued the FBiH's contribution to these objectives would need to be achieved elsewhere.

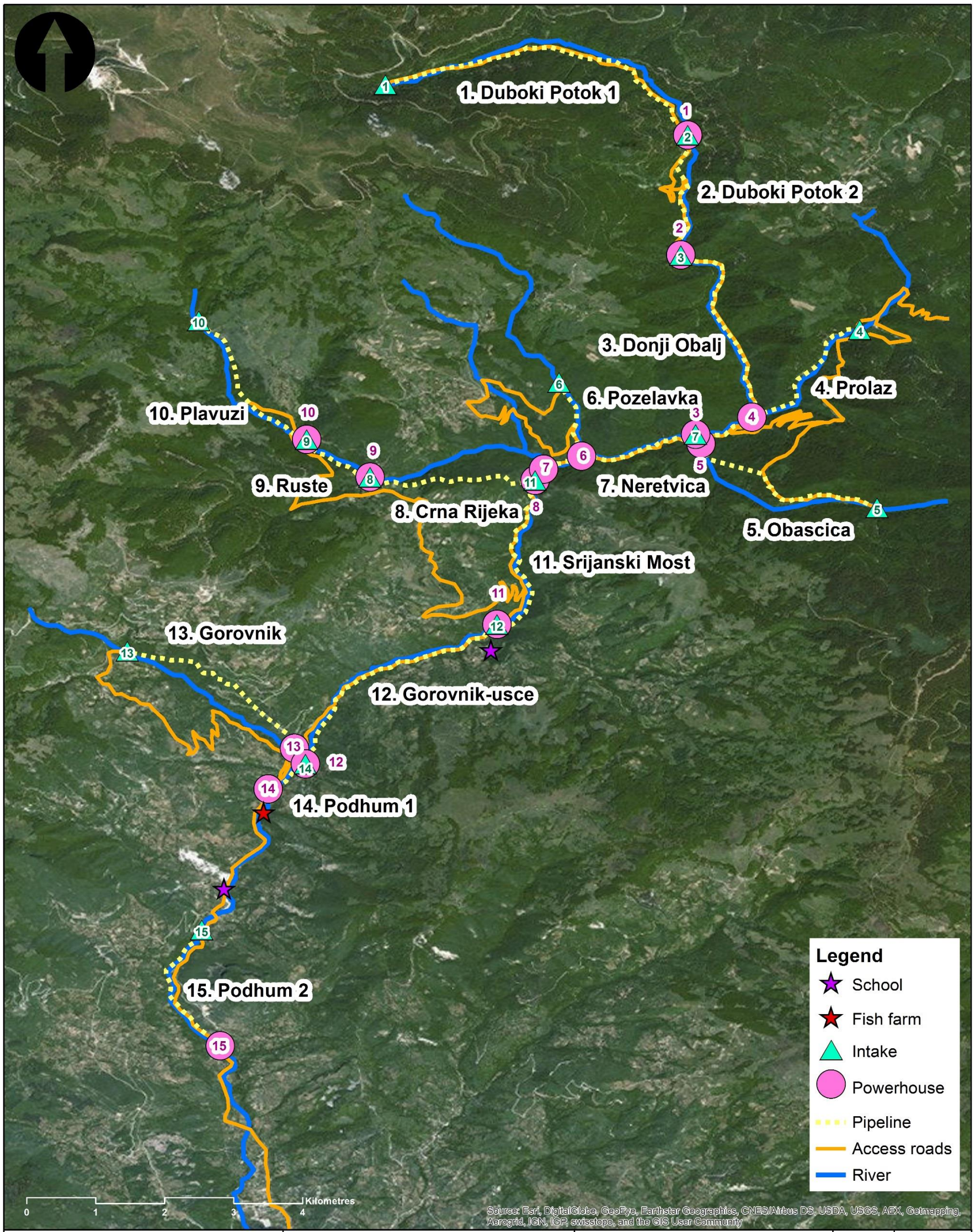
Additionally, if the Project did not go ahead, it would not be able to contribute to the aims of the Climate Change Adaptation and Low Emission Development Strategy for FBiH, which was adopted by the Council of Ministers in 2013. Among other goals, the strategy aims to develop low-emission economy, which can be achieved through the wider utilization of renewable energy resources, including hydro.

Finally, this project has been included within key national and regional strategic plans, most notably the Strategic Plan and Program of the Energy Sector Development of FBiH (SPP) (adopted by the Parliament of FBiH in March 2009), the draft Spatial Plan of the Municipality of Konjic developed for the period of 2013-2033 and the draft Cantonal Spatial Plan. Therefore, if the Project did not go ahead, it would not contribute to the strategy of the FBiH to increase use of existing hydropower potential and development plans of the Municipality of Konjic.

Further analysis of alternatives in accordance with the EBRD Environmental and Social Guidance note for Hydropower Projects will be undertaken as part of the Supplementary ESIA in cooperation between environmental and technical teams.

[3] According to the Energy Community Annual Implementation Report for 2016, coal-fired power plants contributed with 46,3% to total generation capacity in 2015

Figure 2: Project components



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Client: EBRD

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	Nov 2016	JB	Map	DV	LM

Title: Neretvica sHPP-
Key Project Components

Drawing Number: -

Drawn	J Burnell
Checked	D Vlaisavljevic
Approved	L Morton
Scale at A3	1:48,897

Security	Status	Rev
STD	PRE	P1

3 Project Setting

3.1 Introduction

This section provides an overview of the setting for the Project and the natural and human baseline environment. The study area considered for defining the Project setting is up to 5km from the areas where the Project components described in Section 2.2 will be located.

3.2 Biodiversity and nature conservation

3.2.1 Protected areas

The Project components will not be located within any Natura 2000, legally protected or other internationally recognised areas (Emerald Sites, Ramsar Sites, Important Plan Areas, Important Bird Areas and Prime Butterfly Areas) . The closest legally protected areas to the Project are located at Blidinje and Prokosko Lake. Blidinje is a 35,800ha protected landscape located approximately 10.5km southwest of the Podhum 2 powerhouse while Prokosko Lake is a 2,119ha nature monument located approximately 10km northwest of the intake for Duboki Potok 1. See Figure 3 for the locations of these protected areas relative to the Project site.

In BiH there are no officially designated Natura 2000 sites as these have not yet been established as Bosnia and Herzegovina is not an EU candidate or associated member that is committed to establishing this conservation sites network. To date the country has identified potential Natura 2000 sites, i.e. s proposed list of 122 Emerald sites[4].

The closest proposed Natura 2000 site is the mountain Vranica (3.5km north of Neretvica river) which currently has no official status of protection but is proposed to become a national park and protected landscape. The canyon of the Neretva river has no official status of protection. It should be noted that it is being proposed to become a protected landscape on the national level in the FBiH Draft Spatial Plan for 2008-2028 but this document is still at the draft stage and it has not yet been defined which parts of the Neretva river basin will be protected, if any. No reference to the Neretvica river was made in this document.

3.2.2 Aquatic ecology

Initial literature review and basic aquatic ecology surveys (including hydrology and baseline morphology, fish and reference conditions based on macroinvertebrates), were conducted in the Neretvica River as part of the Scoping study in October 2016. The areas surveyed included 22km of the Neretvica river from Jablanicko lake to the proposed Duboki potok 1 power house; downstream reaches of the Obascica, Prolaz, Mala Neretvica and Gorovnik tributaries; and, all the proposed sHPP locations.

Eight fish species were recorded, including two salmonid species (Brown Trout *Salmo trutta m. fario* and Marble Trout *S. marmoratus,* (both Habitats Directive Annex II species)) and two IUCN Red List threatened species (Adriatic Minnow *Phoxinellus alepidotus*, (Endangered) and Neretvian spined loach *Cobitis narentana*, (Vulnerable)). The Neretvian spined loach is also a Habitats Directive Annex II species. The Neretvian spined loach is also a Habitats Directive

[4] USAID Country Biodiversity Analysis: Bosnia and Herzegovina, July 2016, produced by Enova

Annex II species. These IUCN protected species were both found at the mouth of the Neretvica river. Spawning habitats (for both salmonids and cyprinids species) were also recorded within the ZoI of the Project.

Invasive fish species have been recorded in the Neretvica river and reservoir (Jablanicko lake), including the Crucian Carp *Carassius auratus gibelio* and the Pumpkinseed *Lepomis gibbosus*.

More than 20 taxonomic groups of invertebrates were also observed in the upper to lower reaches of the Neretvica River, the most dominant of which were Insects. Further details are included in Appendix F. While studies[5] in the area have found the presence of the IUCN Red List threatened and European protected (under the EC Habitats Directive Annex II and V). White-clawed Crayfish *Austropotamobius pallipes*, (Endangered), this species of crayfish was not found during sampling. Further information on these studies is included in Appendix F.

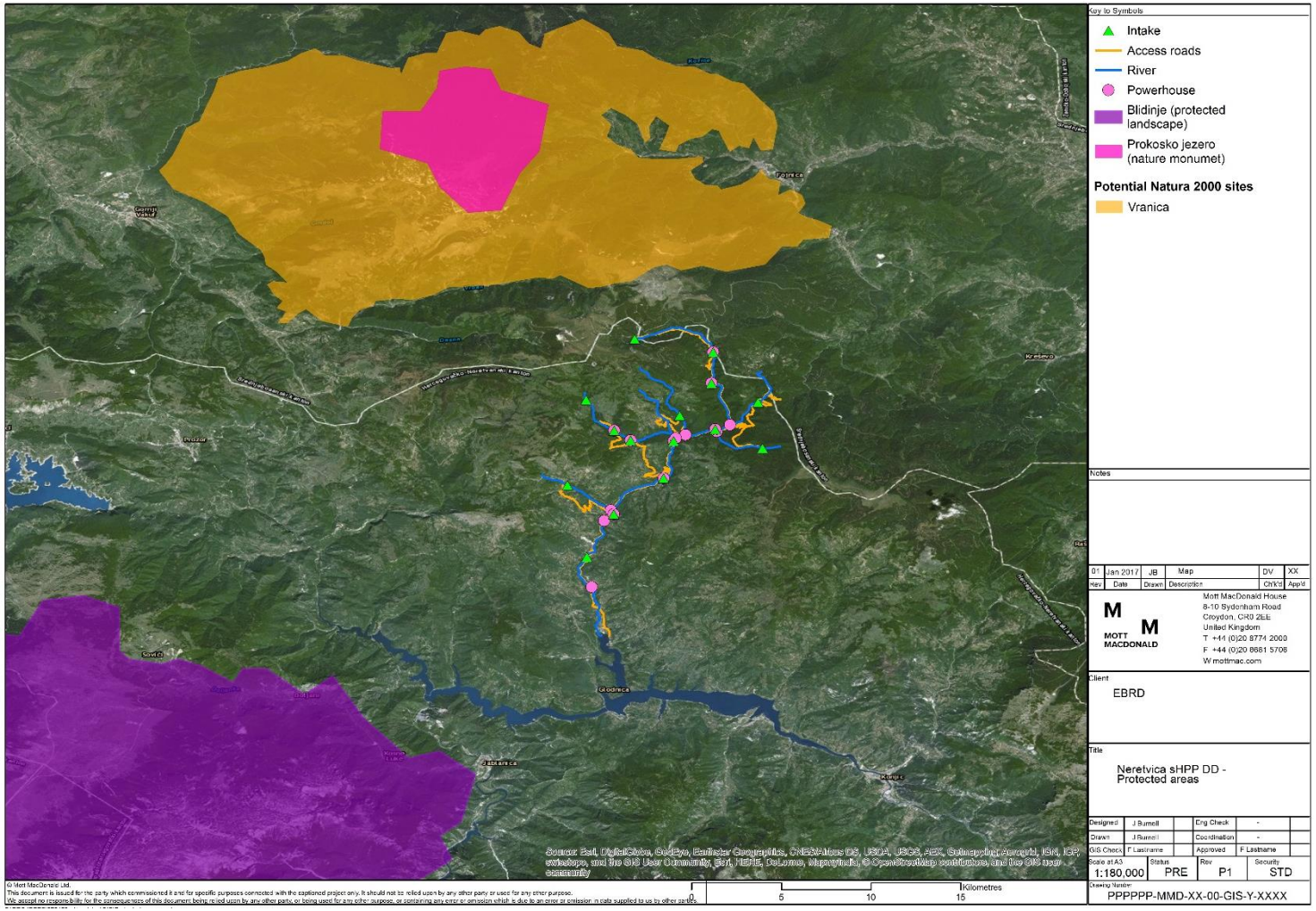
The macroinvertebrate community was found to be dominated by *Trichoptera* (caddisfly), *Ephemeroptera* (mayfly) and *Plecoptera* (stonefly). The survey results show that the Neretvica river and its tributaries had high reference condition values based on the Trent Biotic Index (TBI) and Belgian Biotic Index (BBI), corresponding to “very clean” water quality and high biological status. The results largely indicate the natural, almost pristine, character of the river.

It was also noted that there is a rich diversity of habitats in the study area, which is favourable for aquatic organisms, the most common element of which is riffles, rapids, step/pools.

For more details on aquatic ecology, please see Appendix F.

[5] Sadbera Trožić-Borovac, Armin Macanović, Rifat Škrijelj. The morphometric characteristics and condition index of *Austropotamobius pallipes* in the Neretva river basin. // Works of the Faculty of Forestry University of Sarajevo No. 2, 2012 (13 -30).

Figure 3: Current and proposed protected sites near the project



Note: the location of these protected sites are approximate.

3.2.3 Terrestrial ecology

The landscape comprises of sub-Mediterranean evergreen forest at lower elevations extending to sub-montane deciduous forest to approximately 1200m above sea level. The primary tree species found in the area are beech (*Fagus sylvatica*), oak (*Quercus petraea*), hornbeam (*Carpinus betulus*), field maple (*Acer campestre*), silver fir (*Abies alba*), Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*). The extent of anthropogenic effects on existing habitats varies between sites.

Various plant and animal species were identified as part of the national EIAs, including two species considered priority biodiversity features for their inclusion on Annex II of the EU Habitats Directive: grey wolf (*Canis lupus*) and brown bear (*Ursus arctos*).

The habitats within and adjacent to the Project area, such as riparian and deciduous forest, have the potential to support IUCN and European Red List threatened species as well as those listed on the Annex II and IV of EU Habitats Directive.

Following a review undertaken as part of this scoping assessment the following additional priority biodiversity features which are included in the ICUN Red List were also identified.

- Saker falcon (*Falco cherrug*) Endangered
- Click beetle (*Ampedus quadrisignatus*[1]) Endangered
- Goldstreifiger *(Buprestis splendens*[1]) Endangered
- Greater spotted eagle (*Aquila clanga*) Vulnerable
- Long-fingered bat (*Myotis capaccinii*) Vulnerable
- Mosor rock lizard (*Dinarolacerta mosorensis*) Vulnerable
- Meadow viper (*Vipera ursinii*) Vulnerable
- *Ropalopus ungaricus*[1] Endangered
- Balkan Heath (*Coenonympha orientalis)* Vulnerable

A further review is required of the European Red List and EU Habitats Directive to determine if other species not previously identified may also be present. This will include all species of European bats which are listed on Annex IV. Some of these species may also trigger critical habitat requirements under EBRD PR6.

Further assessment and survey work will be required to determine the suitability of habitats for all priority biodiversity features which may be affected by the Project (see Chapter 5).

3.3 Hydrology

All watercourses within the Neretvica River basin are typical karst geology mountainous watercourses with annually variable flow rates dependent on precipitation. Snow-melt and rain during the respective spring and autumn months result in maximum discharge during these periods. Summer and winter months have low flows. The hydraulic regime is characterised by short periods of very high flows following rapid snow melt or after intense rain events. Throughout most of its length, the river flows through a V-shaped valley, whilst in the lower reaches, this changes to a U-shaped valley. The river banks are rocky. 60% of the basin is covered by forest and shrub vegetation. The river is largely single channel, although it is braided in several short reaches. There are a few waterfalls (around 3.5m in height) that present natural barriers in the river.

3.4 Climate

The Neretvica basin has a humid climate, and the wider area is characterized as a sub-Mediterranean-mountainous area, which extends in altitude between 750 and 1200m above sea level. The average annual temperature is 10.8 °C, the monthly minimum is -8.0 °C and the monthly maximum is 20.1 °C. The absolute maximum temperature is 39.0 °C and the absolute minimum temperature is -21.5°C. Wind speeds are weak, and generally around 2-3 m/s.

3.5 Air quality

The area surrounding the project is relatively remote and sparsely populated so it is expected that the air quality will be good, with no exceedance of the EU Ambient Air Quality Standards or national air quality limit values. There is no air quality data available for the study area, however, based on a review of local emission sources there is no industry or large combustion plants in the area and there are very few roads. The area has a low population density so there would be a limited number of vehicles using existing roads resulting in low vehicle emissions. Therefore, as vehicle emissions would be low and there are no large combustion sources, baseline concentrations of air pollutants such as nitrogen dioxide and particulate matter are expected to also be low.

3.6 Greenhouse gases

National statistics show that the energy sector is considered to be the single largest source of greenhouse gas (GHG) emissions in Bosnia and Herzegovina (76%) followed by the agricultural sector (10%), industrial processes (7%) and waste (7%). Statistics of GHG emissions and power production are also released on an annual basis by the International Energy Agency (IEA). For the latest available year (2014) total GHG emissions from fuel combustion in Bosnia and Herzegovina were estimated to be 21.62 Mt CO_2. According to data published by the IEA, the emissions rate of the electricity grid is over 800gCO_2/kWh reflecting a heavy reliance on coal generation. The development of hydropower over fossil-fuel power projects has the potential to avoid emissions of GHG typically associated with fossil-fuel combustion.

The development of hydropower over fossil-fuel power projects has the potential to avoid emissions of GHG typically associated with fossil-fuel combustion. In the national EIAs, it was estimated that the combined effect of all 15 sHPPs would result in a reduction of 80,000 tonnes of CO_2 (tCO2) per year. The greatest reduction was associated with the Srijanski Most sHPP, which is estimated to result in a reduction of 11,729 tCO_2 per year or 392,784 tCO_2 over a 30 year period. However, these values do not take in to account future changes in the electricity generation mix, nor the initial emissions associated with the construction of the sHPP.

3.7 Transport and traffic

The road network of the Project area consists primarily of local roads (the R437 and R418b). The closest main road to the Project area is the E73 which is located 7.1km south of the Podhum 2 powerhouse.

No traffic counts have been undertaken in the Project area. However, following a site visit, it was found that these local roads had only small number of vehicles travelling on them which are likely to only be used by the local population.

3.8 Landscape and visual

The Project is located in an area of highland-mountainous relief which is primarily covered with forest and shrub vegetation and cut with streams and natural cascades. The landscape

surrounding the site is sparsely populated with a number of small settlements. Details of the nearest settlements to the site and the numbers of people living in these settlements can be found in Table 2 below. There are no landscape designations within the vicinity of the Project; the nearest nationally protected site is Prokosko Lake, a nature monument located approximately 10km to the north west of the project.

In total, approximately 24.7ha of vegetation will be cleared to build the powerhouses, weirs and access roads as well as to install the pipelines for all 15 sHPPs.

3.9 Cultural heritage and archaeology

There are no recorded cultural or historical heritage sites in the area where construction of sHPPs is planned, as indicated in the national EIAs and confirmed during a site walkover at all planned sHPP sites in October 2016 for the purposes of the Scoping report. The nearest sites identified are in the City of Konjic which is located over 16km south west of the closest Project component (Podhum 2 powerhouse).

As part of the national permitting requirements, the Ministry of Culture and Sports (Institute for Protection of Monuments) was consulted which confirmed there are no recorded cultural or archaeological sites in Project area and issued no objection for Phase Ia plants. This is subject to undertaking preventive archaeological field surveys with the aim of protecting any unknown archaeological sites. Findings of these surveys will be included in the Supplementary ESIA.

3.10 Socio-economic uses of the river

The national EIAs for each sHPP assessed the socio-economic uses of the river in terms of water abstraction, water sports and recreational uses. It was concluded that the river is not suitable for water sports, and not used for irrigation or livestock watering. The national EIA studies did not identify significant socio-economic impacts, with the exception of impacts on fishermen as the sHPP are expected to impact the quantity of available fish and thus impact the activities of fishermen.

The socio-economic uses of the river were also evaluated as part of the supplementary E&S analysis conducted in October and November 2016 based on consultations with stakeholders (during stakeholder meetings) and discussions with local residents. According to the information obtained, the river is not used for water abstraction and irrigation. It is used for wastewater dilution only in one part of the river (at the location of the private fishpond and restaurant, but in this part of the river there is no project infrastructure or water intake). The local residents use septic tanks.

The water is also not suitable for commercial water sports, as confirmed by the local rafting organisation. The identified uses of the Neretvica River and its tributaries are:

- Natural fish hatchery by Fishermen’s Association “Konjic”, who actively undertake measures for increasing the population of autochthonous trout (upper parts of Neretvica River basin),
- Fishing by fishermen / members of Fishermen’s Association “Konjic” (lower part of Neretvica River basin),
- Swimming to a very small extent by the local population (approximately 20 people in a season),
- One privately owned fish farm and restaurant (negative economic impacts on this business are not expected since there are no planned project interventions on this part of the river),

- Although the rivers are not suitable for water sports (in particular rafting and kayaking), there have been few isolated cases noted (mostly foreign tourists) who have used the rivers for those purposes (max. 20 people in the last 5 years).

The Neretvica River basin does not have significant socio-economic (e.g. tourism) or amenity (e.g. recreation) value for the local population but does have significant value for Fishermen's Association "Konjic" who are the main beneficiary of fishing rights for all waters in the Municipality of Konjic.

3.11 Local communities in the wider Project area

The immediate vicinity of the Project is uninhabited and there is no active use of the land needed for the Project for agricultural or other purposes.

Data on the number of people in the nearest villages to each sHPP are provided in Table 2. All houses in each village are at higher altitudes than the Project infrastructure and the nearest house is at 150 metres in the Village Ruste (point to point distance) to planned Project infrastructure of sHPP Crna Rijeka (but at higher altitudes). Most of the houses are at considerable distance from Project infrastructure; thus impacts on local communities (e.g. noise) would be limited, taking into consideration planned locations of water intakes, pipelines and powerhouses. The proximity of project infrastructure to nearby villages is shown in Figure 4 below.

Table 2 below provides an overview of the estimated number of land plots to be expropriated. According to the list of cadastral parcels in national EIAs, approximately 10% of all land plots are meadows and pastures that are in private ownership (the remainder of land plots are forests, roads and water bodies that are in public ownership, except eight non-agricultural land plots which are in private ownership). The national EIAs listed all the land plots to be potentially affected for the purposes of all 15 sHPP, based on data from the cadastre of Municipality of Konjic. They include six arable land plots (with total surface area of 5,532m^2), 20 pastures (with total surface area of 192,786m^2) and 18 orchards (with total surface area of 25,034m^2). However, the national EIAs also stated, based on field visits, that these land plots are not used for any agricultural (any form of farming) or other purposes. Therefore, the factual situation with regard to use of land does not correspond to the registered situation (in the cadastre), due to the fact that owners or users of land plots do not report such changes to the competent municipal authority in cases of changes in the culture or class of plots due to complicated procedures or financial costs. In reality, the majority of these listed land plots are abandoned and overgrown with forest and undergrowth, as stated in national EIAs and confirmed by field visits. According to the findings from the site visits undertaken by consultants engaged for the purpose of the Scoping report, there is no evidence of active land use for any agricultural (any form of farming) or other purposes.

In total, 245 land plots are expected to be affected by land acquisition. There are no households living on these land plots. It should be noted that only small parts of the majority of these land plots along the river will be affected (to the extent needed for the pipeline[6]) – thus, people will not lose their entire plots and all of the plots are unused. Additionally, no land plots used for agriculture or other purposes will be affected by construction of power houses, as confirmed by EPBiH, based on its practice of selecting non-agricultural land for installation of permanent structures.

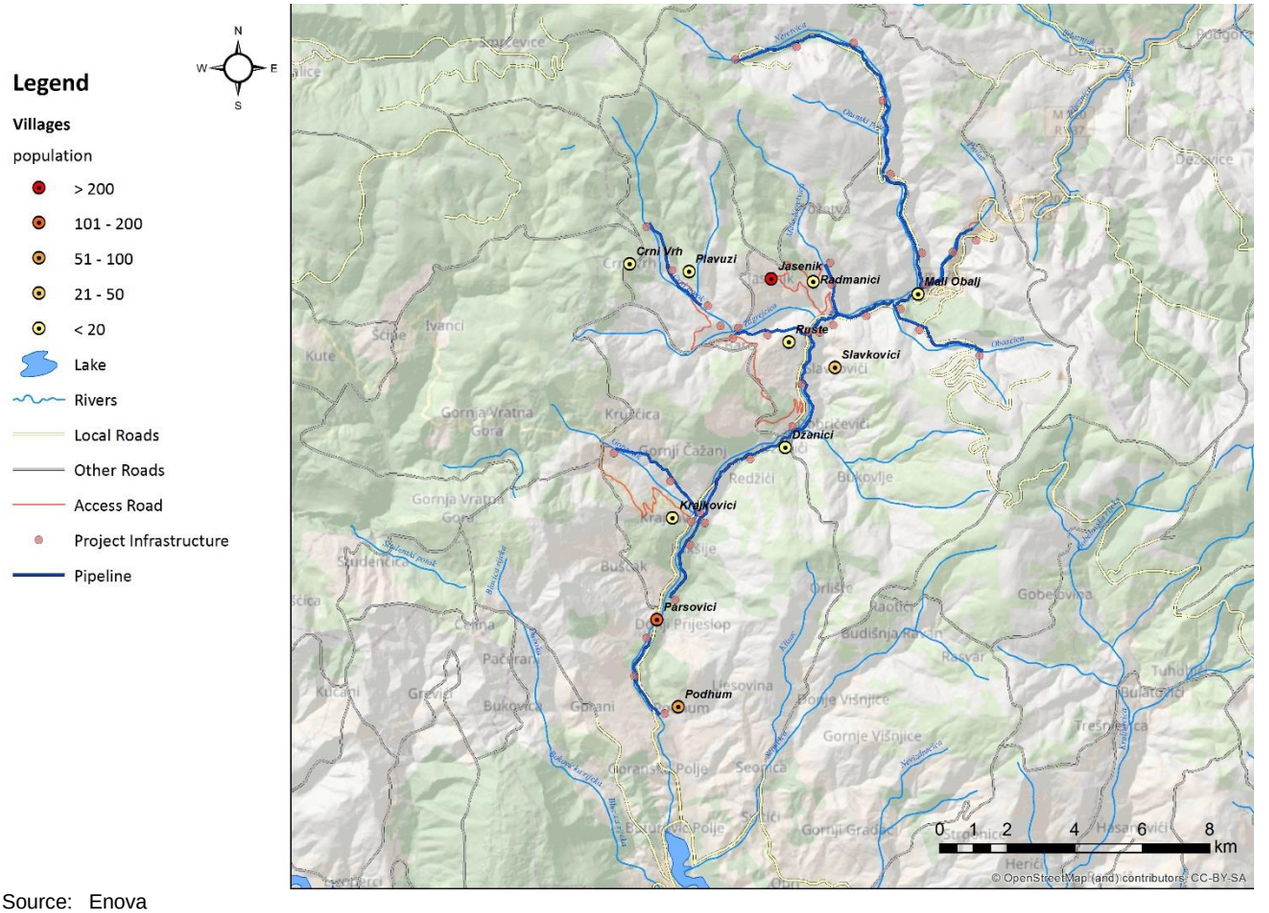
[6] The size of land to be needed is currently not known, as the expropriation studies as required by national law have not been developed to date for all 15 sHPP.

There is no official data on the socio-economic and demographic status of the population in the wider Project area, as the full results of the 2013 Census in BiH relating to the socio-economic data in smaller settlements (villages) have not yet been published (they are expected by the end of 2017). In addition, no such data has been included in the national EIAs. According to the findings from the site visits (in particular, consultations with the Municipality of Konjic and the representatives of the Local Community Offices), the majority of the population in the nearby villages consists of elderly people, in poor socio-economic situations (similar to other remote rural areas in FBiH). The local labour market is underdeveloped, and the majority of the working age population work in larger nearby cities (such as Konjic, Mostar and Jablanica). The number of school-aged children has been decreasing in the recent years. The area is characterized by an increasing trend of out-migration from rural to urban areas. Information on vulnerable people is provided below under section 3.13.

Table 2: Nearest villages to Project infrastructure

sHPP	Nearest villages	Distance to the nearest house (m)	Estimated no. of land plots to be expropriated	No of people living in nearest village
Crna Rijeka	Ruste	150	6	15
Donji Obalj	Mali Obalj	350	26	0
Duboki potok 1	No villages within 1,000m	n/a	6	0
Duboki potok 2	No villages within 1,000m	n/a	8	0
Gorovnik Ušće	Parsovići	›500	44	178
Gorovnik	Parsovići Krajkovi	200 400	23	178
Mala Neretvica	Slavkovići	350	5	21
Plavuzi	Plavuzi Crni vrh Ruste	300 500 ‹1000	12	0
Podhum 1	Parsovići Krajkov	300 300	59	178 10
Podhum 2	Parsovići Podhum	500 300	23	178 82
Poželavka	Radmanići Jasenik	300 ‹1000	3	0 204
Prolaz	No villages within 1,000m	n/a	7	0
Ruste	Plavuzi Ruste	700 200	1	0
Srijanski most	Džanići	300	18	13
Obašćica	No villages within 1,000m	n/a	4	0
TOTAL			**245**	**523**

Figure 4: Map of nearest villages to Project infrastructure



Source: Enova

3.12 Affected people

People potentially directly and indirectly affected by the Project are listed below.

Directly affected:

- People affected by land acquisition (land owners)[7]
- An unknown number of people who will be employed temporarily for the construction phase
- Up to 30 people employed permanently during operations

Indirectly affected:

- Approximately 523 residents in two local communities named Neretvica and Jasenjik which include the smaller settlements Ruste, Mali Obalj, Parovići, Slavkovići, Plavuzi, Crni Vrh, Krajkov, Podhum, Radmanići, Jasenik, Džanići.
- People travelling through the Neretvica Valley from Konjic to Fojnica

[7] As the land is not actively used, land users are not listed among the affected people.

Impacts on the above mentioned indirectly affected population may include negative impacts during preparation of the sites for construction or during construction works, for example, transportation of materials to construction sites, influx of workers and generation of waste.

3.13 Vulnerable Groups

The surrounding villages are inhabited by a mixture of Croats and Bosniaks. No minorities or vulnerable groups by virtue of gender identity, sexual orientation, religion, ethnicity, indigenous status and disability have been identified to date (December 2016).

According to discussions with representatives of Local Community Offices and other stakeholders during the field visits, the majority of population in the nearby villages (in the wider Project area) is elderly people which may be considered as a vulnerable group. The socio-economic and demographic structure of the population of the smaller settlements is not available in national statistics and the full results of the 2013 Census in BiH relating to the socio-economic data in smaller settlements (villages) have not yet been published, but are expected by the end of 2017.

However, no particular impacts on vulnerable groups are expected taking into consideration general scope of impacts explained in the section above. It could be expected that passing of ambulances can be slowed down due to heavy traffic during the construction phase but the risk is assessed as minimal (local roads have lay-bys at different sections).

It should also be noted that it cannot currently be assessed whether any land owners who will be affected by land acquisition (living outside of the Project area) belong to a vulnerable group, e.g. people with disabilities, single mothers, etc. This will be known after the Municipality of Konjic initiates the expropriation procedure for all 15 sHPP and invites all land owners for consultations and negotiations. For this reason, vulnerable groups have been added as a stakeholder in SEP, and communication and engagement requirements have been defined for this category.

4 Legal, institutional and planning framework

4.1 Introduction

The Project was subject to separate EIAs undertaken for each of the 15 sHPPs, which were submitted and approved following the national EIA process. As national approvals have been obtained for the Project and the Supplementary ESIA is being prepared only to meet EBRD PR, the Project will not be subject to further national approvals. As such, only the EBRD framework will be followed as presented in the section 4.2.2 below. However, all relevant national legislation and international legislation will be taken into account to inform the additional assessments undertaken for the Supplementary ESIA. This chapter provides a brief overview of the applicable international lender standards.

4.2 International standards and guidelines

4.2.1 Overview

As the Project is being considered for financing by the EBRD, the Supplementary ESIA will be undertaken in accordance with EBRD standards described below.

4.2.2 EBRD project categorisation

Under the EBRD Environmental and Social Policy (ESP) 2014 the EBRD categorises each project to determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required as outlined below. The categorisation of each project depends on the nature, location, sensitivity and scale of the project, and the significance of its potential adverse future environmental and social impacts

Category A: A project is categorised A when it could result in potentially significant adverse future environmental and/or social impacts which, at the time of categorisation, cannot readily be identified or assessed, and which, therefore, require a formalised and participatory environmental and social impact assessment process.

Category B: A project is categorised B when its potential adverse future environmental and/or social impacts are typically site-specific, and/or readily identified and addressed through mitigation measures. Environmental and social appraisal requirements may vary depending on the project and will be determined by the EBRD on a case-by-case basis.

Category C: A project is categorised C when it is likely to have minimal or no potential adverse future environmental and/or social impacts, and can readily be addressed through limited environmental and social appraisal.

The EBRD ESP 2014, lists the criteria by which a project is classified as being a Category A project. Based on assessment review of the Project against these criteria the Project is classified as **Category A**, a project that is likely to have a perceptible impact on sensitive locations such as critical habitat or ecosystem which supports priority biodiversity features

(Article 27 of EBRD ESP 2014). Key considerations in the determination of this categorisation are:

- the presence of IUCN Red list Endangered White-clawed Crayfish *Austropotabmbius pallipes* in Neretvica river which is also listed under the EU Habitats Directive Annex II and V, requiring the designation of special areas of conservation for its protection in the EU member states;
- the presence of two other IUCN listed species with high protection status which have been identified in the mouth of the river, namely: Adriatic Minnow *Phoxinellus alepidotus* (status Endagered) and Neretvian Spined Loach *Cobitis narentana* (status Vulnerable). Although these species are expected to be present predominantly in downstream parts of the river, there is a potential that the scheme may have adverse impact on these species;
- the presence of the above listed species classified as Endangered under the IUCN Red list means that the Project may affect critical habitats;
- there is a potential for significant cumulative impact of 15 sHPPs on the ecological receptors and water resources, in particular the endangered and endemic species present in the river.

Further assessment of impact on these species and their habitats, including critical habitat assessment, as well as cumulative impact assessment, will be undertaken as part of the Supplementary ESIA to determine impact significance and mitigation measures.

4.2.3 EBRD Performance Requirements

EBRD has adopted a comprehensive set of specific PRs that projects are expected to meet. The EBRD PRs and their applicability to this Project are given in Table 3 below.

Table 3: EBRD PRs applicable to the Project

Performance Requirement	Applicable to the Project?
PR1: Assessment and Management of Environmental and Social Impacts and Issues	Yes
PR2: Labour and Working Conditions	Yes
PR3: Resource Efficiency and Pollution Prevention and Control	Yes
PR4: Health and Safety	Yes
PR5: Land Acquisition, Involuntary Resettlement, Economic Displacement	Yes
PR6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Yes
PR7: Indigenous Peoples	No - There are no indigenous peoples that will be affected by the Project
PR8: Cultural Heritage	Yes
PR9: Financial Intermediaries	No
PR10: Information Disclosure and Stakeholder Engagement	Yes

4.2.4 Other international guidelines

In addition to the EBRD PRs, the following EBRD and other guidelines are applicable to the Project:

- EBRD Environmental and Social Guidance Note for Hydropower Projects
- EBRD Good Practices for the Collection of Biodiversity Baseline Data and Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning
- World Bank Environmental Health and Safety (EHS) Guidelines: General (2007)

- International Finance Corporation Good Practice Guidance for Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets
- Relevant international conventions and protocols relating to environmental and social issues and / or guidance notes on Good Industry Practice

4.3 National legislation

4.3.1 Strategic Framework

The key strategic document in the energy sector is the Strategic Plan and Program of the Energy Sector Development of FBiH (SPP), adopted by the Parliament of FBiH in March 2009. The SPP aims to determine the needs and possibilities for the development of the energy sector in FBiH. The SPP includes the project of 15 sHPPs to be constructed in the basin of River Neretvica, as part of the strategy to use the existing hydropower potential available in FBiH. It is important to emphasise that the SPP is a substitute in the absence of an Energy Strategy in BiH, and it is considered that the SPP will be a base for preparation of the Energy Strategy which will thus include the construction of these 15 sHPP.

The construction of 15 sHPP on the Neretvica River has also been included in the draft Spatial Plan of the Municipality of Konjic developed for the period of 2013-2033. Public hearings were organised to discuss the draft Plan in 2015 and 2016 – the process was lengthy as the Plan needed to be harmonised with the plans of higher order (Cantonal and FBiH) that have not been adopted to date. It is currently in the form of a proposal for the Municipal Council, and is expected to be adopted in March 2017. There were no negative opinions on proposed hydropower projects during the mentioned public hearings. In addition, the Project is included in the draft Cantonal Spatial Plan which is currently in the process of adoption (the Cantonal Assembly adopted the draft document in December 2016 and requested a public hearing which has not been held to date).

4.3.2 EIA Procedure

The process of environmental assessment in FBiH is regulated by the Law on Environmental Protection (Official Gazette of FBiH, No. 33/03 and 38/09), in the Section IX – Environmental Impact Assessment and Environmental Permit (Articles 53 – 64). The EIA process is based on environmental permitting, which is in turn a requirement for other necessary permits, such as Urban Consent (UC). Environmental permitting (EP) is essential in providing actions needed to protect the environment from pollutant emissions from industrial activities.

If an EIA is required, the assessment procedure can be carried out in two phases:

- Preliminary Environmental Impact Assessment (PEIA); and,
- Development of Environmental Impact Study (EIS).

The decision whether an EIA is required or not is based on a case-by-case basis, taking into account other similar projects/activities in the area and the location/environment sensitivity.

The "*Regulation on plants and facilities subject to obligatory environmental impact assessment, and on plants and facilities that can be constructed and commissioned only if granted environmental permit" (*Official Gazette of FBiH, No. 19/04*)* provides a list of activities, plants and facilities subject to mandatory EIA and permitting procedures at the level of FBiH (under jurisdiction of (FMoET). This states that a mandatory EIA and permitting procedures is required for "*Plants for hydroelectric energy production with output > 5 MW for individual plants or > 2 MW for several plants in a row at a distance less than 2 km*".

The assessment procedure for plants/facilities which require a mandatory EIA begins with the submission of the Request for a PEIA. Based on PEIA, the FMoET either issues a Decision on EP, or issues a Conclusion on Environmental Impact Study (EIS). If the FMoET decides that no further EIS is required, the Request for PEIA is automatically considered a Request/application for EP and the Ministry issues a Decision on EP.

If the Operator is required to prepare an EIS, within 30 days from the submission of the PEIA Request and based on the PEIA findings, the FMoET issues the Conclusion on EIS and determines the scope and the content of the EIS. The EIS has to be performed by the institution/company authorised by the FMoET for preparation of EIS.

After the Operator submits the Request for EP with the draft EIS to the FMoET, the Ministry makes the draft of the EIS available to the public, sends a copy to relevant authorities and other interested parties, allowing 30 days for receiving comments, and appoints the expert committee to review the submitted draft EIS. The FMoET is obliged to organize a public discussion as near as possible to the sub-project location, and to invite the public to consultations via printed (or electronic) media/radio/TV. The public needs to be informed about the public consultations at least 15 days in advance. The Operator needs to assist the FMoET during the consultation process.

After the EIS is revised with all the relevant comments received from interested parties, and after positive evaluation of the expert committee, the FMoET issues a Decision on EP (within 30 days following receipt of the evaluation of the EIS). Overall, in the case where an EIS is needed, the FMoET issues the EP within 60 days from EIS receipt. The Law on Environmental Protection prescribes provisions for cases where a Decision on the EP will not be issued and in such cases, the procedure is terminated.

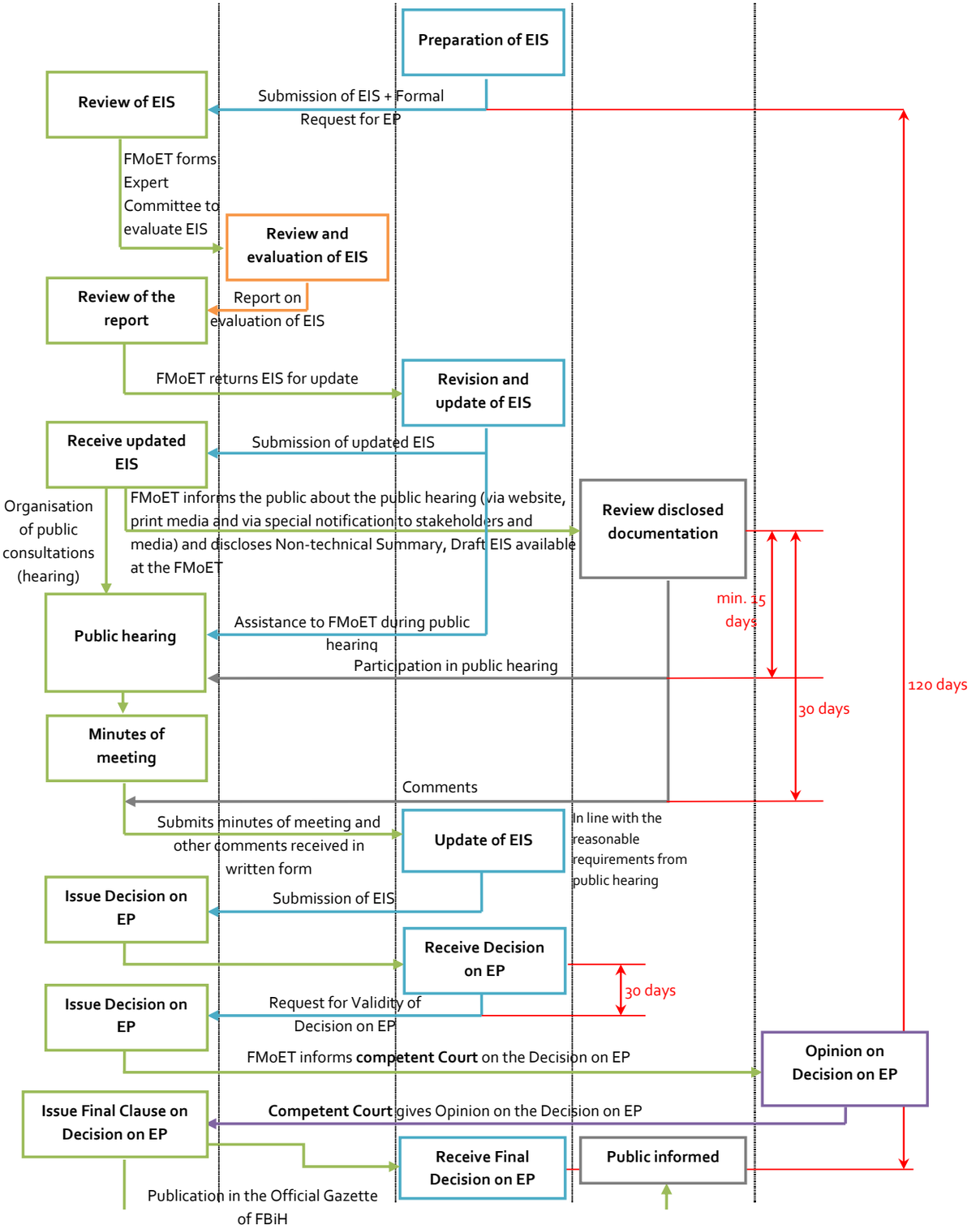
For plants/facilities for which the EIA is carried out based on the evaluation of the FMoET, the assessment procedure begins with preparation and submission of the Request for EP to the FMoET. The FMoET sends the copy of the Request along with the attachments to the competent authorities and stakeholders for the purpose of receiving their opinions and comments. While reviewing the Request for EP, the FMoET takes into account the following criteria:

- Project characteristics (size, accumulation of other structures, use of natural resources, waste generation, pollution emission and interferences, the risk of accidents, etc.);
- Project location and environmental sensitivity of geographical areas likely to be affected by the project (existing land use, availability, quality and regenerative capacity of natural resources, absorption capacity of the natural environment: wetlands, coastal zones, protected areas, etc.); and,
- Characteristics of potential environmental impacts (extent of impact, impact of the transboundary nature, size and complexity of the impact, impact probability, duration, frequency and reversibility).

If it is determined that the EIS is not necessary, FMoET shall issue the EP. Otherwise, the FMoET issues the Decision on the EIS.

A summary of the EIA process in FBiH is presented in Figure 5 below.

Figure 5: Summary of EIA procedures



Source: Enova, 2017

4.3.3 Environmental Permitting and Status of Project Permits

The EIA and environmental permitting procedures in the FBiH are regulated separately at two levels: the FBiH level and Cantonal level (i.e., the Herzegovina-Neretva Canton), depending on the facility type, capacity and annual production.

The environmental permitting procedure for the Project is regulated by:

- The FBiH Law on Environmental Protection[8]
- The FBiH 'Regulation on Facilities Subject to obligatory Environmental Impact Assessment and facilities which may be constructed and operated only with a valid Environmental Permit'[9]
- The Cantonal Regulation on 'Activities and facilities which may be constructed and operated only with a valid environmental permit'[10]

The environmental permits relevant to the Project are outlined in Table 4.

Table 4: Environmental permits at FBiH and Cantonal level

No	Size	Requirements
Environmental permits at FBiH level		
1	HPPs with power > 5 MW for individual plants	Subject to mandatory EIA and submission of EIA Study including a Waste Management Plan Environmental permit issued by Federal Ministry of Environment and Tourism (FMET)
2	HPPs with power > 2 MW for several plants in a row at a distance less than 2 km	
3	HPP with power > 1 MW	EIA carried out on the basis of the decision of FMET for each particular project If FMET assesses that it is not necessary to conduct an EIA, FMET issues the Environmental Permit only on the basis of the Request for Environmental Permit along with a Waste Management Plan; otherwise, it is necessary to submit an EIA Study
Environmental permits at Cantonal level		
4	HPP with power < 1 MW	Subject to obtaining an environmental permit, which is issued by the Cantonal Ministry of Trade, Tourism and Environmental Protection of Herzegovina-Neretva Canton

Source: Enova

The 15 sHPP planned on the Neretvica river have different capabilities, some with greater and some with lower installed power than 2 MW. However, since the Project has been designed as an integral system with a sHPP cascade at a distance of less than 2 km, all sHPP are categorised as facilities for which the EIA is required. Hence, the EIA studies were developed for each sHPP in 2009.

[8] Official Gazette of FBiH, No. 33/03 and 38/09

[9] Official Gazette of FBiH, No. 19/04

[10] Official Gazette of Herzegovina-Neretva Canton, No. 10/12

The environmental permits were issued by FBiH or Cantonal level depending on the installed power, are found in Table 5:

Table 5: Environmental Permits issued for the Project

sHPP	Installed power (MW)	Environmental permit issued by
Phase 1		
Srijanski most	>3	Federal Ministry of Environment and Tourism (FMET)
Gorovnik ušće	>3	FMET
Crna rijeka	>2	FMET
Gorovnik	>1	FMET
Phase 2		
Podhum 1	>2	FMET
Podhum 2	>2	FMET
Donji Obalj	>1	FMET
Poželavka	<1	Cantonal Ministry of Trade, Tourism and Environmental Protection of Herzegovina-Neretva Canton (Cantonal Ministry)
Mala Neretvica - ušće	>1	FMET
Phase 3		
Obašćica	>1	FMET
Duboki potok 2	>3	FMET
Ruste	<1	Cantonal Ministry
Plavuzi	<1	Cantonal Ministry
Prolaz	<1	Cantonal Ministry
Duboki potok 1	<1	Cantonal Ministry

In addition to the above environmental permits, there are a number of water permits the Project would need to apply for, as stated in the Law on Water of FBiH[11]. These water permits are outlined in Table 6 below.

Table 6: Necessary Water Acts for all 15 sHPPs according to the Law on Water of FBiH[12]

Water Acts	Description	Requirements	Validity
Preliminary Water Consent	This consent defines whether the applicant has met the conditions for: • Exercising water rights • The manner of exercising this right • The documentation for the construction of new, reconstruction or removal of existing facilities	Consent to be obtained before applying for an Environmental Permit	3 years
Water Consent	This consent confirms that: • The documentation attached to the request for the Water Consent is in accordance with the Preliminary Water Consent, local legislation	Consent has to be obtained before obtaining the Construction Permit	Expires after 2 years if a Construction Permit has not been issued and construction works initiated.

[11] Official gazette of FBiH, No. 70/06

[12] Official Gazette of FBiH, No. 70/06

Water Acts	Description	Requirements	Validity
	on water and spatial planning documents		
Water Permit	This permit defines: • The purpose, manner and conditions for water use • The operation of facilities • The manner and conditions for discharge of wastewater and disposal of solid and liquid waste	The permit confirms that the conditions defined by the Water Consent have been fulfilled	Up to 15 years

Source: Enova

All of the three water acts described above must be obtained for HPP cascades located at a distance of up to 2 km. The competent body to issue the water acts is the Adriatic Sea Watershed Agency.

The Preliminary Water Consents for the first four sHPP were obtained in 2013, and expired in December 2016, but will not present a risk as the next step is obtaining the Water Consents as described above.

According to the Law on Construction of Herzegovina-Neretva Canton[13], urban permits, construction permits and use permits are also required for HPP projects. These are issued at the municipal level. Hence, the urban permits for the first four planned sHPP on Neretvica River were issued by the Municipality of Konjic (Department for Spatial Planning, Construction and Reconstruction). Urban permits for the first four sHPP were issued in 2015, and expired in January 2017. EPBiH has applied for extension of the urban permits for sHPP Crna Rijeka and Gorovnik. Construction and use permits for the Project have not been applied for to date. EPBiH is currently in the process of preparing the request for applying for construction permits for sHPP Srijanski Most and Gorovnik ušće.

Several other consents are required for the Project for the purpose of applying for the urban permit, including:

- Consent from the Federal Ministry of Culture and Sports – Institute for Protection of Monuments, in line with the *Law on Protection and Use of Cultural, Historical and Natural Heritage*[14] - the consents have been obtained by EPBiH for sHPP Srijanski Most, Gorovnik Ušće and Crna Rijeka
- Consent from the Ministry of Defence of Bosnia and Herzegovina, in line with the *Law on Defence of BiH*[15]- the consents have been obtained by EPBiH for sHPP Srijanski Most and Crna Rijeka
- Approval of the Cantonal Ministry of Transport and Communication – Road Directorate, in line with the *Law on Roads of FBiH*[16]- the approvals have been obtained by EPBiH for sHPP Srijanski Most, Gorovnik ušće and Crna Rijeka

The status of project permits is detailed in Table 7 below.

[13] Official Gazette of Herzegovina-NeretvaCanton, No. 4/13

[14] Official Gazette of SRBiH, No. 20/85

[15] Official Gazette of BiH, No. 88/05

[16] Official Gazette of FBiH, No. 2/98, 48/99

Table 7: Status of project permits

sHPP	Environmental permit		Preliminary water consent		Urban permit		Construction permit	
	Date of issue	Date of expiry	Date of issue	Date of expiry	Date of issue	Date of expiry	Date of issue	Date of expiry
Phase 1								
Srijanski most	12/01/2011 Renewed on 19/10/2016	12/01/2016 Valid until 19/10/2021	17/12/2013	17/12/2016	30/11/2015	08/01/2017	-	-
Gorovnik ušće	12/01/2011 Renewed on 19/10/2016	12/01/2016 Valid until 19/10/2021	17/12/2013	17/12/2016	30/12/2015	08/01/2017	-	-
Crna rijeka	12/01/2011 Renewed on 19/10/2016	12/01/2016 Valid until 19/10/2021	17/12/2013	17/12/2016	30/12/2015	08/01/2017	-	-
Gorovnik	12/01/2011 Renewed on 19/10/2016	12/01/2016 Valid until 19/10/2021	17/12/2013	17/12/2016	17/12/2015	08/01/2017	-	-
Phase 2								
Podhum 1	10/05/2013	10/05/2018	07/04/2014	07/04/2017	-	-	-	-
Podhum 2	10/05/2013	10/05/2018	07/04/2014	07/04/2017	-	-	-	-
Donji Obalj	15/01/2013	15/01/2018	07/04/2014	07/04/2017	-	-	-	-
Poželavka	24/08/2010	24/08/2015	07/04/2014	07/04/2017	-	-	-	-
Mala Neretvica - ušće	10/05/2013	10/05/2018	07/04/2014	07/04/2017	-	-	-	-
Phase 3								
Obašćica	15/01/2013	15/01/2018	07/04/2014	07/04/2017	-	-	-	-
Duboki potok 2	15/01/2013	15/01/2018	07/04/2014	07/04/2017	-	-	-	-
Ruste	25/02/2011	25/02/2016	07/04/2014	07/04/2017	-	-	-	-
Plavuzi	23/02/2011	23/02/2016	07/04/2014	07/04/2017	-	-	-	-
Prolaz	21/02/2011	21/02/2016	07/04/2014	07/04/2017	-	-	-	-
Duboki potok 1	05/07/2010	05/07/2015	07/04/2014	07/04/2017	-	-	-	-

Source: Enova

5 Environmental and social assessment scope

5.1 Overview

The objective of the Supplementary ESIA is to supplement the existing national EIAs undertaken for the Project, addressing gaps to enable the assessment of environmental and social impacts to meet EBRD PRs. The scope of the Supplementary ESIA Addendum has been developed on the basis of:

- Consideration of potential environmental and social impacts associated with the Project
- Review of the assessment of the Project undertaken in national EIAs
- Preliminary E&S analysis, aquatic ecology survey and site visits carried out by Mott MacDonald, Blue Rivers and Enova
- Identification of gaps between national EIAs and EBRD PRs
- Setting scope of Supplementary ESIA to fill gaps
- Completed Supplementary ESIA and national EIAs providing full assessment of environmental and social impacts in-line with EBRD PRs.

5.2 Environmental and social impacts and assessment scoping

For each environmental or social aspect, the potential impacts are identified in Table 8. Where potential significant impacts are likely, the table sets out the proposed assessment approach for each potential significant impact including baseline data collection and impact assessment methodology. Each environmental and social specialist assessment will be undertaken with reference to applicable national legislation, lender requirements and international good practice.

Where gaps between the national EIA reports and EBRD PR requirements are identified, further baseline information will be collected and the assessment will be undertaken in accordance with the methodologies set out in Table 8.

The Supplementary ESIA work plan, which sets out the timeframe for the Supplementary ESIA as a result of the scoping process presented in this report, is presented in Appendix A.

Table 8: Identification of potential environmental and social impacts requiring further assessment in the Supplementary ESIA

Environmental / social aspect	Key issues /potentially significant impacts	Further assessment and methodology	Scoping conclusion
Environmental			
Aquatic ecology	The presence of the IUCN Red list threatened species and migratory species has been identified in the Neretvica river (see section 3.2.2). Potentially significant impacts on the aquatic ecology during construction and operation of the Project are considered likely for the following features of conservation importance: • Sediment discharge into the river during construction affecting habitat for White-clawed Crayfish as well Adriatic Minnow and Neretvian Spined Loach in the lower reaches; • Permanent habitat loss due to in-river structures for fish and invertebrates; • Loss of connectivity between upstream and downstream habitats, including access to migratory (freshwater only) spawning grounds (it is noted that fish passes and screens are included in the current design of the scheme; however, these need to be reviewed to ensure they are appropriate for the species affected such as salmonids); • Changes in flow regime, in particular the change to lentic habitats with impacts to fast flowing water dependent fish species and potential increase in invasive species in reservoirs; • Changes to flows regime downstream of the weirs resulting in flow depleted reaches and consequent habitat changes and loss. Impacts during decommissioning are expected to be temporary and will depend on how much of the infrastructure is removed. Once fully decommissioned and once the habitats have recovered from disturbance, no long term impacts are expected. Currently there is insufficient data on the fish and invertebrate populations and distribution to allow appropriate assessment of the potential impact of the Project. At present the impacts on aquatic ecology, in particular operational, are potentially significant and therefore further survey and assessment is required as part of the Supplementary ESIA in order to then determine the required mitigation.	As the existing surveys were undertaken in a suboptimal period, further aquatic ecology surveys are required to provide a more robust baseline and to inform the magnitude of the effects on features of conservation importance. The surveys will include: **1. Aquatic invertebrates surveys**– in particular White-clawed Crayfish and other rare, endemic or endangered macroinvertebrate species. The optimal survey period is April-May (one week) and August-September (one week). The two periods will capture seasonality and different aquatic stages of life cycle (including larvae, pupa and adult stages of different species). The aquatic invertebrates survey data will be used to: • assess the abundance and distribution, in particular rare and endangered species, and quantify associated habitat; • assess drift dynamics • define food for fish 2. **Fish surveys** – in particular Adriatic Minnow and Neretvian Spined Loach and other rare, endemic or endangered species, as well as migratory species. The survey period is April-May (for spawning migration for cyprinids and some species of salmonids, trout juvenile migration) (one week) and September (feeding time for cyprinids and start of spawning migration of salmonids) (one week). The fish survey data will be used to: • determine abundance and distribution of non-native invasive fish species; • determine size and age of native/endemic fish • determine presence of IUCN listed species and their distribution in the Neretvica River • determine migration patterns • determine White-clawed Crayfish habitat, distribution, and abundance.	Further detailed analysis, including a CHA will need to be carried out in the Supplementary ESIA to assess the impacts of the scheme on the aquatic ecology receptors and whether they could be adequately mitigated. This will include further fish and invertebrate surveys as well as spawning habitat mapping over two seasons in 2017: • April – May 2017 - (invertebrate' surveys, spawning migration for cyprinids and some species of salmonids, trout juvenile migration) (1 week approximately) • September (invertebrate surveys, feeding time for cyprinids and start of spawning migration of salmonids) (1 week approximately). The outcome of the surveys will be used to assess impacts and identify the appropriate mitigation for the fish and invertebrate species present in the river. Where required specific mitigation will be included in the Project's Environmental and Social Management and Monitoring Plan ("ESMMP"). In addition, the results of the surveys will inform the CHA, specifically in relation with Article 16 conditions of PR6. This includes achieving no net loss and delivering net gains if the critical habitat is likely to be impacted by the Project.

Environmental / social aspect	Key issues /potentially significant impacts	Further assessment and methodology	Scoping conclusion
		3. **Habitat mapping surveys** – to develop habitats maps for fish species and White-Clawed Crayfish. Furthermore, due the presence of IUCN Red List threatened species, a **Critical Habitat Assessment** (CHA) will be undertaken in accordance with EBRD PR6 to determine the presence of critical habitat and if so, confirm that requirements of paragraphs 15-17 of EBRD PR6 are met. Further detail on the proposed field surveys, including methods is provided in Appendix B. The impact assessment will take into account the proposed minimum environmental flow, as defined by the latest national requirements, to determine whether it is sufficient to protect habitats and support river processes and species. This is further detailed in the water resources section.	
Terrestrial ecology	Although no threatened species have been identified in the Project area as part of the national EIAs, habitats in the area have the potential to support IUCN/European Red List threatened species and those listed in Annex II and IV of the EU Habitats Directive (see section 3.2.3). If these species are present, the potential impacts could include: • Disturbance of nesting birds as a result of construction such as the Saker Falcon and Greater Spotted Eagle; • Temporary loss of habitat for Endangered invertebrates as a result of ground clearance during construction and from the presence of new structures and infrastructure; • Permanent loss of habitat for threatened species as result of the construction of project infrastructure in particular new access roads as well as quarried construction materials (if not sourced from existing areas of low conservation importance); • Indirect impacts from the creation of new roads (such as increased hunting, disturbance, fragmentation and forest conversion). The impacts on terrestrial ecology are generally expected to be limited and localised within the project area; however appropriate biodiversity management measures will be required during the construction phases. To determine the nature and extent of such measures it will be necessary to confirm whether or not habitats in the area of the Project are suitable for protected or threatened species.	A full review of all IUCN/European Red List and EU Habitats Directive is required to identify potential priority biodiversity features. This list must be agreed with all stakeholders prior to undertaking any further assessments and surveys. Based on the additional species identified on the IUCN Red List the following works are recommended. It should be noted additional actions may be required should additional priority biodiversity features be identified for which these methods are not appropriate. A critical habitat assessment will also be required due to the potential presence of species listed in Annex IV of the Habitats Directive (such as bats) as well those which may fulfil other criteria. Habitat mapping (including the interpretation of satellite imagery) and a suitability assessment of project locations to support important species should be undertaken during spring and early summer (April to May) to determine suitable mitigation during construction. This should coincide with the occurrence of peak vegetation growth and activity of target species of conservation importance and should include proximity of suitable raptor nesting sites and habitat to support specific invertebrates. The surveys would comprise a single visit by a suitable specialist surveyor(s) in order to obtain the required	The overall impact of the project is not expected to be significant at the population level for biodiversity. However, impacts may be localised and require further assessment to identify appropriate biodiversity management and mitigation measures in the ESMMP. Habitat mapping and fauna and flora suitability assessment will be undertaken during the spring (April- May) in 2017.

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	There is the potential for impacts associated with the transmission line, particularly in relation to collision or electrocution risk for birds. The transmission line is an associated facility and will be subject to a separate national EIA process but consideration of these potential impacts will be addressed within the cumulative impacts as this infrastructure is integral to the operation of the Project.	botanical and fauna information. No more than one day is likely to be required for each site and surveys may be combined for efficiency. The findings of the surveys should be supported by academic literature and consultation with species experts where appropriate to determine the likely occurrence of target species in the project area. Further targeted surveys are not considered likely to be necessary as precautionary mitigation measures will be implemented in the construction ESMMP where deemed necessary which are proportional to the likely impacts.	
Water resources	The potential impacts of the scheme on water resources during construction include: • impacts to water quality from spillages and sediment laden run-off; and • potential changes to the hydrology regime if flows are restricted/diverted during construction (minimum flows during construction will need to be implemented). These impacts are not expected to be significant (if appropriate mitigation measures are in place to prevent effects from earthworks carried out during construction) and would be temporary and localised. Impacts during the decommissioning phase are likely to be similar to the construction phase. During the operational phase, a key potential impact from a water resources perspective is the changing of the natural river flow regime created by the short term storage of water behind weirs and diversion of flows through pipelines to powerhouses for power generation purposes. Up to 90% of the length of the Neretvica river could be altered by the project. There are three important aspects that **could** be affected by the operation of the Project, namely: • Physical – impact on the ongoing sediment transport regime and changes to the river channel and bed morphology due to changes in water flow as well as impacts on groundwater Groundwater can be affected depending on the level of dredging and excavation during construction. This could impact water quality and availability and is particularly relevant if nearby settlement use wells for drinking water. • Social – potential reduction of surface and groundwater available for extraction for irrigation, livestock purposes, public supply, etc. • Ecological – maintenance of flows for ecosystem functioning (in particular endangered and endemic species present in the river)	An assessment of the potential impacts from the implementation of the legal environmental flows on ecological receptors in the river will need to be undertaken to determine their likely magnitude and effects. The Supplementary ESIA approach will be to review the proposed environmental flow requirements against the results from the aquatic ecology assessment (as outlined in aquatic ecology section above) to identify whether sufficient water resources will be available to support the natural hydrological regime and therefore the local ecology. Should environmental flows be considered insufficient to meet EBRD PR6 requirements, mitigation measures (including the potential for increase of the minimum environmental flow) will be considered and discussed with EPBiH technical and financial teams in order to determine environmentally and financially sound mitigation measures.	Impacts on social and physical functionality of the river are considered limited and appropriate mitigation, if required, will be included in the ESMMP. Impacts on ecological functionality of the river could potentially be significant and given that there is an identified shortfall in the aquatic baseline information (and therefore a shortfall in the understanding of the extent and nature of aquatic species in the river), an assessment of the potential impacts of the proposed environmental flows will be required as part of the Supplementary ESIA. The assessment will be used to determine the potential environmental impact and appropriate mitigation measures to be included in the ESMMP. Impacts on the physical functionality of the river are not expected to be significant. Nonetheless, they will be addressed in the Supplementary ESIA so that appropriate mitigation measures are identified and included in the ESMMP. This will include considerations of erosion of littoral zones and facilitating sediment transport.

Environmental / social aspect	Key issues /potentially significant impacts	Further assessment and methodology	Scoping conclusion
	Impacts on the social functionality of river are expected **not** to be significant as there are **no** water users identified within or in the vicinity of the Project other than a small fish farm in the section of the river where no Project infrastructure will be built. Therefore, social impacts associated with water resources are not significant. Physical functionality, in terms of groundwater and sediment transfer impacts, is not expected to be significantly affected due to the size of the barrages. However it will be important that appropriate design measures for allowing sediment transport are included in the technical specification. Any further mitigation will be identified in the ESMMP. No river dredging works are envisaged during construction or operation of the Project. Ecological functionally is highly dependent on determination of the necessary environmental flow to be maintained during the operational phase of the Project. The minimum environmental flow has been calculated for the Phase I plants to comply with the Rulebook for Environmental Flow Assessment from 2013 and this approach would be applied to Phase II and III plants. Subsequently Amendments to the Rulebook on Environmental Flow Assessment were adopted in 2016, however these are not expected to have implications on the way the environmental flow is calculated for the Project (see Appendix D for details of the Amendments to the Rulebook for Environmental Flow Assessment and the results from previous Environmental Flow Assessments undertaken). It is understood that the criteria used for calculating the minimum environmental flow are based on hydrological parameters only and the environmental flow does not take into account ecological receptors. Therefore, there is a risk that the legal minimum flows may not be sufficient to protect habitats and support river processes and species, in particular the endangered and endemic species present in the river, so further impact assessment is required.		
Air quality	Construction activities associated with the proposed development could generate dust from site clearing, excavation works, loading/unloading of materials, stockpiling of materials and from increased traffic movements and associated vehicular emissions. These impacts are not expected to be significant as: • a phased approach is being undertaken for the construction of sHPPs and associated infrastructure;	No further assessment is needed.	The impact is not expected to be significant therefore it is not necessary to carry out any further assessment. However, best practice guidance should be adhered to throughout the construction phases of the Project and included within the Environmental and Social Management and Monitoring Plan (ESMMP), such as using dust suppression techniques and avoiding the burning of waste materials.

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	• baseline air quality is good as there is no industry or large combustion plants in the area and there are very few roads as the areas surrounding the project is relatively remote; • there will be a limited number of construction vehicles resulting from the Project activities; • there are limited sensitive receptors located near the proposed construction sites; and, • it is anticipated good practice construction mitigation measures will be implemented. Operational air quality impacts would be limited to operation vehicles. The number of vehicles is expected be low and, considering existing air quality in the area, these impacts would be negligible and not significant..		
Greenhouse gasses (GHG) and climate resilience	GHG emissions arising in the construction phase include indirect emissions from plant and equipment, emissions from construction-related traffic, and embodied emissions within the materials used in the structures. While the reservoirs associated with larger hydropower schemes would usually result in GHG emissions, the nature of this project (a run-of-river hydropower scheme) means that no new areas will be flooded to create reservoirs so no significant emissions of GHGs are expected to arise directly from the reservoir during the operation phase of the project. However, there may be minor sources of GHG emissions from other activities (for example those associated with emissions from maintenance vehicles). Performance Requirement 3 of the EBRD Environmental and Social Policy (2014) states quantification of emissions is required where emissions are expected to be more than 25,000 tCO_2 per year. As no land will be flooded from the installation of the weirs so the only emissions from operation will be from maintenance vehicles, GHG emissions are unlikely to exceed 25,000 tCO_2e per year. In addition, as stated in section 3.6, the project is expected to save 80,000 tCO_2 per year from emissions avoided from fossil fuel electricity generation. Therefore, the impact on GHGs from the proposed development is expected to be not significant. As a result of climate change, there may be a risk of meteorological hazards, such as flooding events or drought in the area that the Project is located. While the impact from such events is not expected to be significant, it is recommended as good practice that the climate resilience of the project is included in the Supplementary ESIA.	No further assessment is needed.	The impact associated with the operation phase is not expected to be significant as operational emissions from the project are expected to be below 25,000 tCO2 per year. Therefore, it is not necessary to carry out any further assessment. Appropriate construction phase mitigation measures to minimise the release of GHG emissions need to be identified and included within the ESMMP.
Transport and traffic	There will be increased traffic flows on the existing road network during the construction phase as a result of two way truck movements to transport building materials, two way movements to dispose of excavated spoil material and delivery of powerhouse components and plant items. This increase in traffic may result in damage to local roads. However,	No further assessment is needed.	Provided that local roads will be repaired after construction and the traffic on the roads at any one time is kept to a minimum by adhering to a phased approach, the impact is not expected to be significant therefore it is not necessary to carry out

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	these traffic impacts are not likely to be significant as a phased approach is being undertaken for the construction of sHPPs and their associated infrastructure so there will be a limited number of construction vehicles using these roads at any one time. Also, local roads are planned to be repaired after construction activities to mitigate any damage which may have occurred during construction. During the operational phase, there are likely to be minor traffic related impacts associated with routine deliveries, staff and personnel responsible for operating the site and equipment and parts during maintenance activities and outages. These traffic movements will be much less than the construction phase so are considered to be not significant. Secondary impacts associated with increased traffic flows have been included within other sections, e.g. air quality, social and noise and vibration.		further assessment. Traffic management and mitigation measures will be included in the ESMMP.
Landscape and visual	During the construction phase, there will be changes to the existing landscape and a variety of visual impacts. Construction of the weirs, powerhouses and access roads and installation of pipelines will primarily result in the following landscape and visual impacts: • removal of the existing vegetation; • temporary construction compounds and presence of plant and associated equipment; • presence of temporary access roads; • presence of above ground pipelines; and • change in tranquillity of the surrounding landscape. These impacts are not expected to be significant as many of the construction sites are located in remote areas with few or no receptors nearby which could be impacted by a change in landscape or visual amenity. Receptors which are located closer to construction sites are unlikely to be significantly affected as the dense forest vegetation of the area should screen the majority of the construction activities and it is anticipated good practice construction mitigation measures will be implemented. During the operational phase, there are likely to be minor landscape and visual impacts due to the small scale nature of the sHPPs and their distance from the closest receptors. Furthermore, the extent of the above ground pipelines will be limited so overall will have limited visual impact. The largest visual impact will be in relation to the associated new 110kV OHL which will be erected and will connect to the existing OHL line Jablanica-Sarajevo. These impacts will be covered in the separate EIA to	No further assessment is needed.	The impact is not expected to be significant therefore it is not necessary carry out any further assessment. However, best practice guidance should be adhered to throughout the construction phases of the project and included within the ESMMP, such as erecting screens around the construction site where appropriate (especially in winter when the natural screening by deciduous trees is less effective), revegetating the area surrounding the sHPPs after construction and restricting the hours of construction site operations to limit light pollution.

Environmental / social aspect	Key issues /potentially significant impacts	Further assessment and methodology	Scoping conclusion
	be developed for the OHL line and any cumulative impacts assessed in the Supplementary ESIA. Overall, the operational landscape and visual impacts of the proposed development are expected to be not significant.		
Cultural heritage and archaeology	No cultural heritage or archaeological findings have been recorded in the Project area. Potential impacts on cultural, historical and archaeological heritage were properly assessed in the National EIAs for each sHPP, and no impacts were identified due to the absence of any such assets in the Project area (i.e. the narrow area of the planned Project infrastructure, river and narrow riverbed belt). This was also confirmed by site walkover surveys at all planned sHPP sites in 2016. In addition, a review of existing permits and consents obtained for the project to date has shown that EPBiH applied for consents from the Federal Ministry of Culture and Sports (Institute for Protection of Monuments), as required by the *Law on Protection and Use of Cultural, Historical and Natural Heritage of FBiH,* and consents have been issued to date for three sHPP (for sHPP Srijanski Most, Gorovnik Ušće and Crna Rijeka). Therefore, no significant the impact on cultural heritage and archaeology is expected. However, it is possible that previously unknown archaeological sites may be found during the construction. Therefore, further surveys have been requested for the Project as part of the national EIA process prior to the construction commencing. Namely, EPBiH is required to conduct preventive archaeological surveys with the aim of protecting possible potential cultural and historical heritage sites, prepare a study of preventive archaeological probe surveys prior to construction works for the first two sHPP, a measure which has been imposed by the Ministry of Culture and Sports. The Ministry will be notified of the results.	Preventive archaeological surveys will be undertaken prior to construction commencing and Ministry of Culture and Sports to be notified of the results.	The impact is not expected to be significant, provided that the further survey undertaken by EPBiH and does not find any previously unidentified archaeological assets. Best practice and any further mitigation identified as part of the further survey will be included in the ESMMP. In addition, a chance finds procedure will be developed and included within the ESMMP.
Waste and materials management	Hazardous and non-hazardous wastes will be generated in the construction and operation phases of the Project. During the construction phase, large quantities of spoil from earthmoving works and green waste from land clearing will be generated. Other wastes will also be generated by the construction workers and through the use of construction materials. Provided that this waste is properly disposed of and the waste management plan is correctly implemented, the impacts from waste associated with the construction phase should not be significant. Waste volumes generated during the operation phase is also not expected to be significant as it would primarily be associated with maintenance activities and waste accumulation debris screens, so would generate relatively small waste streams. The largest waste stream would be from replacing any equipment in the event of equipment failure.	No further assessment is needed.	The impact is not expected to be significant provided that best practice guidance for waste management and disposal is adhered to throughout the construction and operation phases of the project. The measures which were included within the Waste Management Plans for each sHPP in the national EIAs should also be integrated within the ESMMP and any further measures deemed necessary should be added.
Noise and vibration	During the construction phase the main sources of noise and vibration are likely to be from site clearance, ground excavation and earthmoving, construction traffic, ground and foundation works and construction of	No further assessment is needed.	The impact is not expected to be significant therefore it is not necessary carry out any further assessment. However, best practice guidance

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	structures associated with the project, such as the weirs and powerhouses. As many of the construction sites are located in remote areas with few or no receptors nearby, the impact of noise during the construction phase is not expected to be significant. During the operation phase, the main sources of noise and vibration will be from the turbines located within the powerhouses. This source is expected to be not significant as the turbines will be inside a building which should sufficiently insulate the noise – outside the building the noise level is expected to be 60dB. Under the most stringent WHO Guidelines for Community Noise, (regarding the noise outside sleeping areas of dwellings at night) this is deemed acceptable as there should be sufficient attenuation of noise from the source to receptors to not exceed this guideline value. There will also be negligible noise impacts associated with the transmission line and substations but it is expected these will be located away from residential properties so the impact will be not significant.		should be adhered to throughout the construction phase of the project and included within the ESMMP, such as following the scheduled working hours on site.
Cumulative impacts	It is important to consider the potential inter cumulative impacts of hydropower developments with other projects that might be developed in the area, as well as the intra cumulative impacts of the Project as it consists of a large number of sHPPs. The primary effect that multiple hydropower schemes in one area can have is on ecological receptors and water resources, in particular endangered and endemic species present in the river. However, hydropower projects can have a wide range of other cumulative social-economic and environmental effects that can be both positive and negative. The Project is the only planned hydropower scheme in the area, so no inter cumulative impacts are envisaged with other hydro schemes. However, the cumulative impacts associated with the new OHL may arise where the construction of the new OHL overlaps with the construction of phases of this project, and any ongoing cumulative impacts during operation of both schemes. Furthermore, there is a potential for significant intra cumulative impacts from the scheme of 15 sHPPs.	While a cumulative impact assessment for the Project was undertaken in 2009, the impacts were not sufficiently assessed. Therefore, a new cumulative impact assessment will be undertaken in accordance with the EBRD PR and guidance for hydropower projects. Principles set out in the IFC Good Practice Handbook on Cumulative Impact Assessment and Management will also be followed. This would assess whether significant cumulative impacts would occur from all 15 sHPPs in the area that would not be expected in the case of a stand-alone sHPP.	There is the potential for intra cumulative impacts associated with the construction and operation of the 15 sHPPs planned for the project. In addition, cumulative impacts associated with the new OHL may arise and need to be further assessed. Therefore, a cumulative impact assessment will be undertaken and included within the Supplementary ESIA to determine the extent of these impacts and if they can be sufficiently mitigated.
Natural hazards	Based on the geological conditions and vegetation cover significant geo-hazardous processes are unlikely in the vicinity of the Project. However, activation of those processes such as landslides and rock falls may be associated with the construction activities (vehicle movement, construction of weirs, pipelines, access roads). The impact associated with seismic natural hazards may occur during construction and operation of the Project. According to the national EIA the Project is located in moderate earthquake intensity area. This earthquake intensity is equivalent to 5.4-6.1 on the Richter scale.	No further assessment is needed.	No further assessment is needed as part of the Supplementary ESIA. However, a detailed program of geological and geotechnical investigations will be carried out as part of the main design to identify risks of natural hazards and appropriate mitigation during the construction and operation phases of the Project. These mitigation measures will be included in the ESMMP and Project Emergency Preparedness and Response Plan (EPRP). In

Environmental / social aspect	Key issues /potentially significant impacts	Further assessment and methodology	Scoping conclusion
	A detailed program of geological and geotechnical investigations is being carried out as part of the main design to identify risks of natural hazards and appropriate mitigation during the construction and operation phases of the Project.		addition, a section on climate resilience should be included within the Supplementary ESIA.
Social			
Job creation and labour issue	The Project will: • strengthen local business development (under the Concession Agreement with the Konjic Municipality, EPBiH is required to hire a domestic contractor for construction works for at least the amount of 75% of the total investment, and is encouraged to hire a company from the Municipality) • generate employment during the construction and operation phases • develop skills of employed persons • create a multiplier effect of increased incomes in local community The 15 sHPP will be constructed in phases (two sHPP in the first phase, two in the second phase, five in the third phase, and six in the fourth phase). Significant worker influx is not expected (app. 20-30 workers per sHPP). A workers' camp will not be built as all the phases will not be longer than one year, as confirmed by EPBiH. It is expected that local population will be hired. Cultural and other conflicts with local population or exposure to diseases and psychosocial stress of local population are not expected.	No further assessment is needed.	The Project is expected to result in significant positive impact. No further assessment is needed.
Occupational and community health safety, security and wellbeing	Access to construction sites, transportation of materials, workers and waste may generate a risk of traffic accidents, but provided that best practice guidance is adhered to during the construction and operation these impacts are not expected to be significant. While there is a potential risk to local communities from noise and vibration and air quality impacts during the construction phase, many of the construction sites are located in remote areas with few or no receptors nearby and best practice guidance will be followed, so the impact from noise and air quality is expected to be below the levels at which significant health impacts would occur. Other possible risks and negative impacts to public safety can be caused by entrance of unauthorised persons on the construction site. This situation is possible when the construction site is not enclosed by a fence and when there are no panels with relevant information about the construction works and construction works participants.]	No further assessment is needed.	No further assessment is needed but best practice OHS, traffic safety and construction site safety measures will be identified for the Project and included in the ESMMP. The Emergency Preparedness and Response Plan will need to include accident/incident prevention and preparation measures as well as measures to manage emergency situations resulting from community and OHS accidents.

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	Other risks related to community health and safety, security and wellbeing (such as dust emissions during construction works) are not expected, as the Project area is uninhabited, and all settlements are located at higher altitudes than the river canyon. During the construction phase, workers will be exposed to risks directly related to activities performed on construction sites. Potential impacts may include: • Falls from heights from unguarded edges or openings at height, including risks related to scaffolding that may occur during the assembly, alteration and dismantling of the scaffolding or during the use of the scaffolding. • Risks related to working near or on roads with live traffic may include collisions between vehicles operating inside the site, collisions of passing vehicles with site machinery, equipment (e.g. scaffolds) and workers (in case the site is not adequately signed and physically protected). • Working near high voltage power lines can cause serious and fatal injuries due to direct contact with live lines or arcing from those lines to nearby equipment. • Injuries from construction machinery such as injuries due to roll-over of equipment and objects falling onto the equipment, collapse of equipment in use due to overloading, and failures due to poor slinging techniques for lifting equipment. • Explosion risks which may occur from the use of solvents and ignition by sparks, static electricity, explosive atmospheres, damage of pipes containing explosive gases and unexploded ordinance in the ground, and fire risks which may be caused by the use of flammable liquids, welding or abrasive cutting techniques used in places not specially prepared for such works, liquid gases used with an open flame, flammable and combustible materials. During the operation phase, some of the above described impacts can occur, such as the possibility of accidents caused by fire and/or explosion due to poor maintenance of the equipment at the powerhouse which may endanger the workers during maintenance works. During this phase, the main sources of noise and vibration will be from the turbines located within the powerhouses (noise levels are estimated at 85-90 dBA inside the powerhouses) and they may have negative impact on workers authorized to be inside the powerhouses.		

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Livelihoods and economic impacts	The Project is not expected to have any negative impacts on livelihoods of local population. The national EIAs confirmed, based on field visits, that the land plots are not used for any agricultural or other purposes. Since the immediate vicinity of the Project is uninhabited (all settlements are located at higher altitudes than the river canyon), and there is no active use of land needed for the Project, economic displacement is not expected. During the land acquisition process for the first two sHPP, no impacts on livelihoods were identified. The majority of land plots needed for the first two sHPP are forest plots, a small number of plots are categorised as meadows, and only three plots are categorised orchards (of lower class) which have not been used since before the 1992 war. However, there is no active use of land, trees or non-wood forest products for personal or commercial purposes. The trees are low-class (low-quality) forest trees and shrubs, such as oak, acacia, ash. All existing trees were included in the evaluations prepared by official forestry experts, who evaluated the price for timber, increased by compensation for the costs of replanting elsewhere.	No further assessment is needed.	No further assessment is needed. Dissemination of project information and engagement with stakeholders needs to continue throughout the Project's lifetime, as described in the SEP.
Land acquisition and resettlement	The Project does not require any physical or economic resettlement for the first two sHPP, only the acquisition of 58 privately owned land plots for the purposes of placing the pipeline and construction of power houses. There are no structures on the plots to be acquired and none of the plots are used to generate income-based, natural resource-based or other livelihoods. Activities related to land acquisition for the first two sHPP were initiated in April 2016. To date, 91% of land acquisition for the first two sHPP has been completed based on signed agreements on compensation in line with the national expropriation procedure (negotiated settlements are foreseen as the first step in the procedure defined by the Law on Expropriation of FBiH). The national EIAs listed all the land plots to be potentially affected for the purpose of all 15 sHPP, based on data from the cadastre of Municipality of Konjic. Whilst 10% of plots have uses listed in the cadastre, the national EIAs and field visits confirmed that these land plots are not used for any agricultural or other purposes. There are no estimates regarding the scope of land acquisition for the remainder of the Project. However, since the immediate vicinity of the Project is uninhabited (all settlements are located at higher altitudes than the river canyon), and there is no active use of land needed for the Project for	Although involuntary resettlement is not expected to occur in the implementation of the Project, to ensure a fair, transparent and consistent process is applied for the whole Project, it is recommended to: • undertake mapping to document the fact that there are no impacts and identify any situations where a resettlement action plan or a livelihood restoration plan would be required • monitor the process closely and report to EBRD quarterly throughout land acquisition • keep detailed records for all land acquisition transactions, title transfers etc. • provide a grievance mechanism in line with EBRD PR 10 requirements (not required under national law) A Land Acquisition Framework (LAF) should also be developed to guide a transparent and fair land acquisition process. The LAF should summarise the types of impacts expected (or provide conclusive mapping to show that there will be no physical or economic displacement) and identify situations where a resettlement action plan or a livelihood restoration plan would be required	No significant land acquisition and resettlement impacts are not envisaged. However, it is recommended that the LAF is developed and appended to the Supplementary ESIA. The land acquisition process is managed by the Municipality of Konjic and EPBiH in accordance with the provisions of the Law on Expropriation of FBiH, which is broadly in conformance with EBRD PR 5 requirements with the exception of certain specific issues such as the development of land acquisition plans (not expected to be required for the Project) or a grievance mechanism which are not required under the Law. No major issues related to the process have been recorded to date. Detailed record keeping and monitoring recommended.

Environmental / social aspect	Key issues /potentially significant impacts	Further assessment and methodology	Scoping conclusion
	agricultural or other purposes. Physical or economic displacement are therefore not expected in the forthcoming process of land acquisition. No disputes related to land acquisition to date were recorded. Only one person (living in another city) was not satisfied with the price offered (but did not dispute the Decision on Expropriation), and addressed the court to determine the amount (the case is still ongoing). Affected owners were informed of their right to appeal at many stages of the process, as defined by the Law on Expropriation, including administrative and judicial appeals against the decision on public interest, the decision on expropriation and regarding compensation. A Project-specific grievance mechanism has not been established.		
Ecosystem services	The Project could potentially result in losses of ecosystem services (such as supporting and regulating of forest ecosystems) present along the river, but these impacts will be minimal. These ecosystems do not have significant provisioning ecosystem services and therefore significant impacts on users (population) are not expected. There is no active use of land, trees or non-wood forest products for personal or commercial purposes. The trees are low-class (low-quality) forest trees and shrubs, such as oak, acacia, ash.	No further assessment is required	No further assessment is required
Access to villages	The Project is not expected to lead to any major access restrictions with the exception of possible inconveniences in the construction phase. The national EIAs have defined the obligations for development of guidelines which will be an integral part of the Construction Site Organisation Plan. By implementing these guidelines, the contractor will ensure regular communication with the population of the surrounding villages during construction works.	No further assessment is required	No further assessment is required. Development and implementation of the Construction Site Organisation Plan as proposed in national EIAs to be included in the ESMMP.

Source: Mott MacDonald and Enova

5.3 Summary of scope

The output of the scoping stage is that the following environmental and social topics require additional assessment in the Supplementary ESIA:

- Aquatic ecology
- Terrestrial ecology
- Impacts from the implementation of the legal environmental flows
- Cumulative impacts

Furthermore, given the number of the sHPP it is recommended that a Land Acquisition Framework should be developed to guide a transparent and fair land acquisition process for all sites, and appended to the Supplementary ESIA report.

Where mitigation or management measures are required to reduce, manage, monitor or compensate this will be included in an overall consolidated ESMMP. The ESMMP will be produced for the Project as part of the Supplementary ESIA. Where no further assessment is required, the findings of the national EIA reports will be summarised in the Supplementary ESIA and the national EIA reports will be referenced where appropriate.

6 Supplementary ESIA content and structure

6.1 Overview

- Volume I: Non-technical Summary
- Volume II: Supplementary ESIA Report
- Volume III: Supplementary ESIA Technical Appendices
- Volume IV: Framework ESMMP
- Volume V: Land Acquisition Framework

6.2 Content and structure

6.2.1 Volume I: Non-Technical Summary

A non-technical summary (NTS) will be produced for the Project and included as Volume I. This will provide a high level overview for lay readers identifying the scope and nature of the Project and predicted environmental and social impacts. The NTS will be used as a tool to aid consultation and information disclosure.

6.2.2 Volume II: Supplementary ESIA Report

Table 9 sets out the proposed structure of the Supplementary ESIA.

Table 9: Proposed structure of Supplementary ESIA

Chapter	Description of Content
Introduction	Presents a brief overview of the Project, a description of the developer and a brief outline of contents of the report, etc.
Project Description	Describes the Project, including its main elements and activities for construction and operation, as well as a comprehensive description of associated infrastructure.
Project Need and Analysis of Alternatives	Presents the purpose and rationale of the Project and examines alternatives to the proposed project site, unit size, and land requirements for the project including optimisation, break up of land and its availability including the no project alternative.
Policy, Legislative and Institutional Context	This chapter will include a brief overview of legislative and institutional context in Bosnia and Herzegovina and will focus on the applicable EBRD standards and guidelines.
Supplementary ESIA Methodology	Sets out the stages of the ESIA process. Robust criteria for determination of the significance of the anticipated impacts will be developed. Definitions of significance will be clearly defined and make reference as applicable to the magnitude, geographic extent, duration and frequency, irreversibility and ecological, social and economic context.
Information Disclosure, Consultation and Participation	Provides an overview of the consultation processes as defined in the stakeholder engagement process and summarises results including specific reference to comments made during consultation and how they were addressed in the Supplementary ESIA.
Aquatic ecology	

Chapter	Description of Content
Terrestrial Ecology	With reference to the activities required to be undertaken as part of the construction and operation of the Plant, each impact assessment chapter will contain the following sub-headings: • Introduction • Methodology and assessment criteria (specific legislation, summary of relevant consultation comments, criteria for determining significance and associated limitations • Baseline summary • Impact identification and assessment • Mitigation and enhancement measures • Residual impact summary
Environmental flows	
Social impact	
Cumulative impact assessment	This chapter presents the findings of a cumulative impact assessment carried out in line with good practice guidelines and will include identification of valued environmental and social components (VECs), assessment of the predicted impacts to the viability or sustainability of the VECs and design and implementation of mitigation measures to manage the cumulative impacts and risks.
Other specialist chapters (air quality; GHG and climate resilience, transport and traffic. Landscape and visual, cultural heritage and archaeology, waste and material handling; natural hazards)	A reference to the national EIAs will be made and a summary of baseline information and qualitative assessment conclusions presented. Further mitigation will be proposed in ESMMP where required.
References	

6.2.3 Impact assessment criteria

Impact assessment criteria is presented in Appendix C.

6.2.4 Volume III: Technical Appendices

National EIAs and support assessment documentation will be included in Volume III.

6.2.5 Volume IV: Environmental and Social Management and Monitoring Plan

The primary aim of formulating and implementing the ESMMP is to safeguard the environment, site staff and the local population against site activity which may cause harm or nuisance. For the purposes of the ESMMP, “management” will be the control or mitigation measures and procedures required in managing key environmental and social effects and “monitoring” will be defined as monitoring, measurement, site inspection and audit. The ESMMP will contain the following content:

- Project Description – this section provides an overview of the Project description.
- Applicable Regulatory Standards and Guidelines – this section provides the legal and other relevant standards and guidelines for the Project.
- Environmental and Social Management – provides the environmental and social aspects and impacts along with proposed outline mitigation measures for the construction and operations phases.
- Environmental and Social Monitoring – this section will outline the physical environmental and social monitoring and measurement activities and indicators for the construction and operational phases.

It is important to state that, in addition to focusing on mitigation for environmental aspects discussed in the Supplementary ESIA, the ESMMP will also include environmental aspects

which have been scoped out of the ESIA, such as noise, air quality and waste, on the condition that good practice will be followed.

6.2.6 Volume V: Land Acquisition Framework (LAF)

LAF will be produced for the Project to guide a transparent and fair land acquisition process. The LAF will summarise the types of impacts expected (or provide conclusive mapping to show that there will be no physical or economic displacement) and identify situations where a resettlement action plan or a livelihood restoration plan would be required.

7 Stakeholder engagement

7.1 Overview

This section presents the outline programme for engaging stakeholders by describing the activities that will be undertaken throughout the Supplementary ESIA process and on an on-going basis throughout the life of the Project. The stakeholder engagement process is described in the Project's Stakeholder Engagement Plan (SEP).

Several stakeholder engagement activities have been undertaken by EPBiH and the Municipality of Konjic to date. A Friendly Environment Program for the purpose of construction of 15 sHPP in Neretvica was implemented by EPBiH. Program activities were publicized with the aim of informing the public about the plans for construction of sHPP and the effects to be achieved by such construction. A total of 1,200,000 KM (approx. 615,000 EUR) was allocated for various projects within the Program, selected by the Konjic Municipality and the Local Communities in the Project area, including adaptation of four schools, construction of a local water supply network, and reconstruction of a stadium and road infrastructure.

In addition, during the environmental permitting process in 2010, the EIAs prepared for all 15 sHPP were made available to the public in hard copies in the premises of the Federal Ministry of Environment and Tourism, EPBiH, Local Communities, Ecological Society "Zeleni Neretva", Fishermen's Association "Konjic", and online on the web page of Federal Ministry of Environment and Tourism. A public hearing was held in April, 2010. The public was invited to the hearing through the local radio station Konjic, daily newspapers, and via notice boards at Local Communities. In general, the perception of the local population is positive and supportive of the project, particularly after implementation of the Friendly Environment Program. During the public hearing, negative comments were raised by two individuals, who opposed the construction of the sHPP.

Within the Supplementary Analysis, stakeholder meetings were held in October and November, 2016.

A Stakeholder Engagement Plan in line with EBRD PR 10 has been developed for the Project to clearly communicate to all interested and affected parties the stakeholder engagement program which is to be implemented throughout the entire Project cycle.

7.2 Stakeholder Engagement Plan

The SEP has been developed at the outset of the ESIA process to guide stakeholder engagement and public consultation activities throughout the ESIA process and throughout the construction and operation of the Project. The SEP will remain a live document throughout the life of the Project that is to be updated as necessary to reflect Project's progress and to ensure that the public is informed on potential future environmental and social impacts associated with the Project (during the scoping stage) and the evaluated impacts (during the development of the full Environmental and Social Impact Assessment).

The objective of the SEP is to improve and facilitate Project-related decision-making and create opportunities for active involvement of all stakeholders in a timely manner, and to provide possibilities for all stakeholders to express their opinions and concerns that may influence Project decisions. The purpose of the SEP is, therefore, to enhance stakeholder engagement throughout the lifecycle of the Project, and to carry out stakeholder engagement in line with national laws and international best practice such as the requirements of the European Bank of Reconstruction and Development (EBRD).

The SEP provides a consultation strategy for the Project which:

- Identifies people or communities and vulnerable groups that are, or could be, affected by the Project, as well as other interested parties
- Ensures that such stakeholders are appropriately engaged on environmental and social issues that could potentially affect them through a process of information disclosure and meaningful consultation
- Maintains a constructive relationship with stakeholders on an on-going basis through meaningful engagement during Project implementation
- Meets legal requirements related to consultation

Various engagement and disclosure activities are described in more detail in the SEP.

Appendices

A. Supplementary ESIA work plan

A.1 Overview

This section provides a detailed description of the tasks which will be undertaken for the Supplementary ESIA. Table A.1 summarises the work plan and provides key dates for when these tasks will occur.

A.2 Key project tasks

Task 1 – Project inception and data review

- Review the existing Project documentation, including (but not limited to) those related to: scoping assessments, national EIA studies for 15 sHPP, technical design, supporting documentation and permits, community impacts and risks.
- Identify based on the review of the latest technical documents any additional associated facilities that are not yet included in the Project descriptions (e.g. connection to the grid, spoils, quarries, access roads.

Task 2 – Baseline

- Undertake a detailed review of all ecological work undertaken as part of the national EIAs and additional ecological surveys to date as well as a comprehensive desk study of existing national and international literature to inform a relevant aquatic and terrestrial ecology baseline. Review the proposed legal environmental flow requirements against the ecological receptors in the river.
- Undertake aquatic ecology field surveys over two seasons (Spring and Autumn) in 2017 (see Appendix B for more details). This will include water dependant invertebrate and vertebrate surveys, fish surveys, habitat mapping surveys and a Critical Habitat Assessment.
- Undertake terrestrial ecology field surveys. This will include Annex II species, birds and bats species dependent on terrestrial habitats, habitat mapping and suitability assessments of project locations to support important species, and critical habitat assessment if required. Habitat mapping should be undertaken during the spring and early summer to determine suitable mitigation during construction. The surveys would comprise a single visit by suitable specialist surveyor(s) in order to obtain the required botanical and fauna information.

Task 3 - Environmental and social impact assessment

- Assess environmental and social issues and impacts related to the Project and to its associated facilities in a structured way covering all aspects in line with the EU EIA Directive guidelines and including assessment of the risks for the public associated with the construction, and then the operation, of the hydropower schemes.
- Undertake a thorough assessment of the following E&S risks:
    - Impact on aquatic ecology
    - Impact on terrestrial ecology
    - Impacts from the implementation of the legal environmental flows on ecological receptors in the river

    - Socio-economic conditions assessment and livelihood restoration plan
    - Cumulative impacts
- Determine the magnitude and sensitivity of the Project impacts and assess the significance of impacts.

Task 4 – Environmental and Social Management and Monitoring Plan

- Conduct discussions with EPBiH personnel regarding on-site control and management of environmental and social issues.
- State mitigation measures that should be implemented during construction, operation and decommission to limit the environmental and social impacts of the Project. This should include environmental and social measures that will apply best practice guidance across all environmental and social disciplines e.g. air quality, GHGs, transport, landscape and visual, noise, waste, natural hazards and cultural heritage.
- Prepare the Environmental and Social Management and Monitoring Plan (ESMMP) to address identified risks and bring the Project in compliance with the EBRD ESP PRs.

Task 5 – Public Participation

- Assess stakeholder engagement activities, including consultations to date, on the Project and overall capacity of the Client to comply with PR 10.
- Update the Stakeholder Engagement Plan (SEP) as necessary to reflect Project's progress and to ensure that the public is informed on potential future environmental and social impacts associated with the Project (during the scoping stage) and the evaluated impacts (during the development of the full Environmental and Social Impact Assessment).
- Follow the consultation strategy identified in SEP and hold meetings with stakeholders to present the findings of the Scoping Report and the final Supplementary ESIA after the 120 days disclosure period for the ESIA package.

Deliverables

- Supplementary ESIA: meeting the Lenders requirements, and in particular the EBRD performance requirements for Category A projects. The Draft Supplementary ESIA will be submitted following the spring surveys. A Final Supplementary ESIA will be issued following the Autumn survey period.
- Environmental, Social Management and Monitoring Plan (ESMMP): The draft ESMMP will be submitted at the same time as the Supplementary ESIA and will be updated in-line with the Final ESIA.
- Non-Technical Summary (NTS): in consultation with the Client, a concise, over-arching, standalone NTS will be provided in English and Bosnian. The NTS will be written in non-technical style and be used to demonstrate compliance with the EBRD requirements, and provide confirmation that the documents are ready for public disclosure.

A.3 Summary

The indicative Project schedule is as follows:

- Project kick-off: March 2017
- Spring field surveys: April - May 2017
- Draft Supplementary ESIA and ESMMP: July 2017

- Autumn filed surveys: August-September 2017
- Final Supplementary ESIA and ESMMP: October 2017

An indicative Project schedule is illustrated in Table A.1.

Table A.1 Supplementary ESIA work plan

Task number	Key Activities/Deliverables	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17
1	**Project Inception and Data Review**									
1.1	**Project Review** - review existing Project documents and acitivities undertaken for the project to date.									
2	**Environmental and social baseline**									
2.1	**Literature review** - undertake a literature review of background information on the project, with a particular focus on aquatic ecology, terrestrial ecology and water resources to help establish a baseline.									
2.2	**Field surveys** - undertake site surveys during optimal surveying periods to supplement literature review findings and initial scoping field surveys.									
2.2.1	**Aquatic ecology***									
2.2.1.1	Invertebrate surveys, fish surveys, habitat mapping surveys and Critical Habitat Assessment									
2.2.2	**Terrestrial ecology***									
2.2.2.1	Habitat mapping and suitability assessment - to obtain botanical and fauna information, includes mapping the proximity of suitable raptor nesting sites and habitats									
3	**Environmental and social impact assessment**									
3.1	**Undertaking specialist studies** - to assess the potential impacts of the Project on aquatic ecology, terrestrial ecology and water resources and the Projects cumulative impact.									
3.2	**Impact evaluation and determination of significance** - Using the baseline information collected and the potential impacts of the project, evaluate the nature and significance of the Project impacts.									
4	**Environmental, Social Management and Monitoring Plan (ESMMP)**									
4.1	**Identifying management and mitigation measures** - state mitigation measures that should be implemented during construction, operation and decommission to limit the environmental impacts of the Project.									
5	**Public participation**									
5.1	**Present the findings of the Supplementary ESIA to stakeholders** - hold public hearings and meetings with stakeholders to discuss results and findings									
Deliverables										
D.1	**Interim Supplementary ESIA, ESMMP and Non-Technical summary reports** (including Spring surveys) - EBRD and EPBiH to submit comments on these deliverables									
D.2	**Final Supplementary ESIA, ESMMP and Non-Technical summary reports** (including Autumn surveys) - ready for submission									

* The aquatic ecology surveys will last approximately one week per season and terrestrial habitat mapping approximately two weeks - the time periods highlighted in the figure above indicate the window/optimal time period in which these surveys will be undertaken (as they are weather dependent).

B. Aquatic ecology survey specification

B.1 Overview

Additional aquatic ecology surveys to be undertaken as part of the Supplementary ESIA include the following:

- Invertebrates
- Fish
- Mapping of habitats for fish species and White-clawed crayfish.
- Critical Habitat Assessment

B.2 Invertebrates surveys

The objectives of the invertebrates' surveys are:

- To define rare, endemic and endangered macroinvertebrates' species, in particular White-clawed Crayfish;
- To assess drift of invertebrates for cumulative impact assessment of sHPP;
- To define food basis for fish.

Proposed period for field surveys:

- April – May (1 week approximately)
- August – September (1 week approximately).

B.2.1 Study of White-clawed Crayfish and rare, endemic and endangered macroinvertebrates' species

The main focus of the study will be on White-clawed Crayfish *Austropotamobius pallipes* (Lereboullet, 1858). As one of the main threats for this species is alteration of hydrological regime of rivers, it is important to identify its habitats in relation to the sHPP locations. The equipment to be used will include diving equipment, underwater camera, crayfish traps with baits, light traps to be installed in its potential habitats, and tagging. All crayfish after measurements and tagging will be released in the water. Tagging will allow their seasonal migration to be researched. Also other rare, endemic and endangered macroinvertebrates species will be identified, if any.

B.2.2 Assessment of drift of invertebrates

Values of the drift of invertebrates is used as an indicator of impacts on the river system. Understanding of the dynamics of drift at different river stretches is needed to forecast quantitative and qualitative parameters for the sHPPs operation. Sampling of drifting invertebrates will be done using special traps.

B.2.3 Assessment of food basis for fish

Biomass of bottom invertebrates moved by the flow reflects the abundance of bottom communities and serves as the main source of food for fish. Moreover, taking into account food

preferences of fish in mountain rivers, especially salmonids, drifting parts of invertebrates will serve as a preferred food.

B.3 Fish surveys

The objectives of fish surveys are as follows:

- To specify the fish species list for Neretvica river basin;
- To identify main habitats of the listed fish species (spawning, feeding, wintering, migration).

Proposed period for field surveys:

- April - May – for spawning migration for cyprinids and some species of salmonids, trout juvenile migration (1 week approximately)
- September – for feeding time for cyprinids and start of spawning migration of salmonids (1 week approximately).

B.3.1 Determining abundance and species in the river

This will be achieved by continual research of fish in all its forms along the whole Neretvica river, including its impounded stretch and tributaries. The equipment includes diving equipment, underwater camera and non-lethal means of catching (trap with baits, flying net, electrofishing). It should be noted that the assistance of EPBiH will be required in order to obtain a permit for scientific fish catching.

The list of the fish species will be established for the whole river basin as well as for its stretches.

B.3.2 Identification of main habitats of the listed fish species

For each of the identified rare or endangered species, a survey methodology will be developed taking into account its life peculiarities. The main habitats to be identified include spawning, migration, feeding and wintering.

A list of the monitoring locations for invertebrates and fish species is given in Table B.1.

Table B.1. List of the monitoring locations

№	sHPP/river	Invertebrates	Drifting macroinvertebrates	Fish
1	Duboki potok 1 / Neretvica	+	+	+
2	Duboki potok 2 / Neretvica	+		+
3	Donji Obalj / Neretvica	+	+	+
4	Obascica /Obascica	+		+
5	Prolaz / Prolaz	+	+	+
6	Mala Neretvica / Neretvica	+		+
7	Pozelavka /Mala Neretvica	+	+	+
8	Crni Potok powerhouse + water intake Srijanski most	+	+	+
9	Srijanski Most / Neretvica	+		+
10	Gorovnik / Neretvica	+	+	+
11	Podhum 1 / Neretvica	+	+	+
12	Podhum 2 / Neretvica	+		+
13	Mouth	+	+	+

Source: Blue Rivers

B.4 Habitat mapping for fish species and White-clawed crayfish

Habitat mapping will be undertaken for fish species and White-clawed Crayfish.

Period of field surveys:

- April - May - mapping of spawning habitats for cyprinids in parallel to invertebrates and fish studies) (1 week approximately)
- September - mapping of spawning habitats for salmonids in parallel to invertebrates and fish studies) (1 week approximately).

Field surveys will include:

- Measurements of depths in main habitats for fish species and white-clawed crayfish (at cross-sections with longitudinal interval 2 m; lateral – 1 m);
- Measurements of velocities in main habitats for fish species and white-clawed crayfish (at cross-sections with longitudinal interval 2 m; lateral – 1 m);
- Measurement of water discharge. It will be measured in the first and last days of field survey or daily in case of rainy weather (significant water level fluctuations);
- Determination of composition of sediments and baseline morphological parameters (channel types, flow types, in-stream features, bank / riparian zone parameters) for each habitat.

Using the methodology of the Field-Map, the pre-construction maps of fish and White-clawed Crayfish habitats will be developed after the field surveys. Maps will cover different types of habitats where habitats will need to be modified / enhanced to meet desired outcomes: migration, spawning and overwintering, if relevant.

Two types of maps will be developed for each habitat: isotaches (stream velocity) and isobaths (depth). These maps will serve as a basis for the comparison of the pre and post operational changes and as a tool to assess the future effectiveness of the adaptive management plan.

B.5 Critical Habitat Assessment

Following completion of the tasks outlined in Sections B.2 – B.4 above, a Critical Habitat Assessment will be undertaken following EBRD PR6 guidelines to determine whether any habitats or species present within the Project area trigger critical habitat requirements. This process will involve a detailed review of existing biodiversity baseline surveys, a desk study literature review of protected species which have the potential to occur within the Project area as well as consultation with local ecological consultants and other biodiversity experts where appropriate. The findings will be assessed against PR6 compliance criteria and presented within a CHA report.

A biodiversity management plan will also be required to outline measures to achieve no net loss/net gain for biodiversity. This will include details of any design changes which will be implemented, such as fish passes, as part of mitigation measures to minimise impacts on habitats and species of conservation importance.

C. Impact Assessment Criteria

C.1 Introduction

For each specialist chapter, the assessment will identify impacts and report the likely significant environmental or social impacts. The criteria for determining significance are specific for each environmental and social aspect and will be defined in the relevant specialist chapters. In broad terms it can be characterised as the product of the degree of change predicted (the magnitude of impact) and the value of the receptor/resource that is subjected to that change (sensitivity of receptor). For each impact the likely magnitude of the impact and the sensitivity of the receptor are defined, quantitatively to the extent possible. Generic criteria for the definition of magnitude and sensitivity are summarised below.

Typically, the approach for the assessments associated with health and safety, climate resilience and greenhouse gas emissions deviate from the methodology presented in the following sub-sections as significance cannot be uniformly assigned to the risks or impacts identified in these chapters. Specific approaches and methodologies for these assessments are defined within each of these chapters respectively.

C.2 Magnitude criteria

The assessment of impact magnitude is undertaken in two steps. Firstly, the identified impacts of the Project are categorised as beneficial or adverse. Secondly, impacts are categorised as major, moderate, minor or negligible based on consideration of parameters such as:

- Scale of the impact – how intense or severe the extent of the impact is likely to be
- Duration of the impact – ranging from ‘beyond decommissioning’ to’ temporary with no detectable impact’
- Spatial extent of the impact – for instance, within the site boundary, within district, regionally, nationally, and internationally
- Reversibility – ranging from ‘permanent thus requiring significant intervention to return to baseline’ to ‘no change’
- Likelihood – ranging from ‘occurring regularly under typical conditions’ to ‘unlikely to occur’
- Compliance with legal standards and established professional criteria – ranging from ‘substantially exceeds national standards or international guidance’ to ‘meets the standards’ i.e. impacts are predicted to be less than the standard would allow’

Table C.1 presents generic criteria for determining impact magnitude (for adverse impacts). Each detailed assessment will define impact magnitude in relation to its environmental or social aspect.

Table C.1: Criteria for determining impact magnitude

Category	Description (adverse impacts)
Major	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature and requiring significant intervention to return to baseline; would violate national standards or Good International Industry Practice (GIIP) without mitigation.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but small change to the specific conditions assessed.
Negligible	No perceptible change to the specific conditions assessed.

Source: Mott MacDonald

C.3 Sensitivity criteria

Sensitivity is specific to each aspect and the environmental resource or population affected, with criteria developed from baseline information. Generic criteria for determining sensitivity of receptors are outlined in Table C.2. Each detailed assessment will define sensitivity in relation to its environmental or social aspect.

Table C.2: Criteria for determining sensitivity of a receptor

Category	Description
High	Receptor (human, physical or biological) with little or no capacity to absorb proposed changes and/or minimal opportunities for mitigation.
Medium	Receptor with little capacity to absorb proposed changes and/or limited opportunities for mitigation.
Low	Receptor with some capacity to absorb proposed changes and/or reasonable opportunities for mitigation.
Negligible	Receptor with good capacity to absorb proposed changes or and good opportunities for mitigation.

Source: Mott MacDonald

C.4 Impact evaluation

Likely impacts are evaluated taking into account the interaction between the magnitude and sensitivity criteria as presented in the impact evaluation matrix in Table C.3.

Table C.3: Impact evaluation matrix

		Magnitude						
		Adverse				Beneficial		
		Major	Moderate	Minor	Negligible	Minor	Moderate	Major
Sensitivity	High	Major	Major	Moderate	Negligible	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	Low	Moderate	Minor	Negligible	Negligible	Negligible	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Source: Mott MacDonald

C.5 Determining significance

The objective of this ESIA is to identify the likely significant effects on the environment and people of the project. Impacts that have been evaluated as being 'moderate' or 'major' are significant effects and identified as such in the specialist chapters. Consequently, impacts that are 'minor' or 'negligible' are not significant.

C.6 Cumulative impacts

The assessment of cumulative impacts considers the combination of multiple impacts that may result when the Project is considered alongside other existing or proposed projects in the same geographic area or similar development timetable. The assessment of cumulative impacts will identify where particular resources or receptors would experience significant adverse or beneficial impacts as a result of a combination of projects (inter-project cumulative impacts).

It will also identify combined impacts where impacts identified in different environmental and social aspects of this ESIA combine to affect a specific receptor.

C.7 Mitigation and enhancement measures

Where feasible the following hierarchy of mitigation measures will be applied:

- Avoidance and reduce impacts through design (embedded mitigation)
- Abate impacts at source or at receptor
- Repair, restore or reinstate to address temporary construction effects
- Compensation for loss or damage

In addition to the above, community engagement and disclosure activities have played a key role in managing the extent of impacts and consideration has also been given to the identification of enhancement measures. Enhancement measures are actions and processes that:

- Create new positive impacts or benefits
- Increase the reach or amount of positive impacts or benefits
- Distribute positive impacts or benefits more equitably

Each specialist chapter identifies relevant mitigation and enhancement measures. All the mitigation, management and monitoring measures to address likely Project impacts are reported in the ESMMP.

C.8 Residual impacts

Residual impacts are those significant impacts that remain after the application of mitigation and enhancement measures. Impacts considered 'major' or 'moderate' after application of mitigation and enhancement measures, are presented as significant residual impacts.

C.9 Uncertainties

Any uncertainties associated with impact prediction or the sensitivity of receptors due to the absence of data or other limitations are explicitly stated. Where applicable, the ESIA makes recommendations concerning measures that should be put in place with monitoring or environmental or social management plans to deal with the uncertainty so that they may be addressed.

D. Environmental Flow

D.1 Amendments to the Rulebook on the Environmental Flow Assessment in FBiH

Table D.1 below summarises the key changes introduced by the Amendment to the Rulebook on the Determining of Environmental Flow (Official Gazette of FBiH, No. 56/16) adopted in July 2016[17].

Table D.1: Amendments

No.	Content/change introduced	Potential implication for the Project
1	Article 5 of the initial Rulebook is amended to read: "Exceptionally, the provisions of this Rulebook shall not apply to water abstraction for public supply of drinking water, taking into account the prevailing public interest."	Not applicable to this Project – the planned Neretvica sHPPs do not involve water abstraction for public supply of drinking water.
2	Article 6, Item 9 of the initial Rulebook is amended to read: "Good ecological potential" is the status of a heavily modified or artificial water body, classified in accordance with the Law on Water."	Not applicable to this Project – the Neretvica River is not a heavily modified or artificial water body.
3	Article 21 of the initial Rulebook is amended to read: "Water bodies declared to be heavily modified by the water management plan in line with the Law on Water shall not be subject to the method of determining the environmental flow defined in Articles 9 and 14 of the initial Rulebook. The methodology for determining the flow, ensuring the good ecological potential of such water bodies, shall be issued by the Federal Minister of Agriculture, Forestry and Water Management, within 3 years after the adoption of this Rulebook".	Not applicable to this Project – the Neretvica River is not a heavily modified water body.
4	Article 25 of the initial Rulebook is amended to read: "For all existing facilities or facilities for which the urban planning / location permit or construction approval were issued before the adoption of this Rulebook, the procedure for determining the environmental flow for achieving good ecological status (for a natural water body) or flow for achieving good ecological potential (for heavily modified water body) shall be carried out in accordance with this Rulebook within 5 years from the adoption of the water management plan defined by the Law on Water.	Not applicable to this Project – the planned Neretvica sHPPs are not existing facilities. Although the urban planning permits for the first four sHPPs were issued in 2015 (i.e. prior to the adoption of the Amendment to the Rulebook in 2016), the environmental flows for these four sHPPs had already been determined in accordance with the initial Rulebook (2013).
5	Article 26 of the initial Rulebook (referring to water permits issued prior to the initial Rulebook coming into force in 2013) shall be deleted.	Not applicable – the requests for water permits were submitted by EPBiH after January 2013. Specifically, the Preliminary Water Consents for all 15 sHPPs were requested and issued after the initial Rulebook came into force.

Source: Enova and Mott MacDonald

D.2 Assessment of Environmental Flow

The minimum environmental flow for all sHPP was originally assessed as 10% of the annual average flow for the purposes of the preliminary design and national EIA. We have been subsequently informed that the main designs for the Phase 1 plants which are currently under

[17] The Rulebook on the Manner of Determining Environmental Flow was adopted in January 2013 (Official Gazette of FBiH, No. 04/13)

preparation/review considered approach where minimum environmental flow was calculated as 95% of the minimum monthly average flow.

Minimum environmental flow has been further recalculated in 2015 for the Phase I plants to comply with the new Rulebook for Environmental Flow Assessment from 2013[18] (the Rulebook) and this approach would be applied to Phase II and III plants.

For Phase 1a plants the newly calculated minimum environmental flow values have not been included in the respective main designs whereas for Phase 1b, the main designs which are currently under preparation take into account the newly obtained values of the minimum environmental flows as per the Rulebook.

The values of minimum environmental flows (Q_{emf}) as included in the main designs for Phase 1 plants and recalculated values in accordance with the Rulebook are presented in Table D.3 below.

Table D.3: Minimum Flow Calculations

Phase	sHPP	Annual mean flow (m^3/s)	Q as included in the Main Design (m^3/s) [19]	Q_{emf} as per the Rulebook	$Q_{10\%}$
1a	Gorovnik Usce	2,86	0,43	0,634 and 0,951	0,286
1a	Srijanski most	3,29	0,48	0,689 and 1,033	0,329
1b	Crna rijeka	0,69	0,110 and 0,165	0,110 and 0,165	0,0069
1b	Gorovnik	0,29	0,029 and 0,044	0,029 and 0,044	0,0029

Source: EPBiH

D.3 Further assessment required

The assessment of the potential impacts of the environmental flows will be based on a comparison between the natural hydrologic regime (as described by previously collected hydrology data) and the expected hydrology regime once the Project is in operation. This will be done by analysing hydrographs and flow duration curves and assessing the deviation between the natural and impacted scenarios.

The natural flow regime provides for many ecological functions performed by different river flow levels. Given that the weirs will be managed as run-of-river diversions (i.e without storage), particular attention will be given to changes during low flows. The focus will be to assess if/how the proposed environmental flows will be appropriate to provide for ecological function in the dewatered reaches including for example:

- Providing adequate habitat space for aquatic organisms
- Enabling fish to move to feeding and spawning areas
- Supporting hyportheic organisms (living in saturated sediments)

The potential impacts on fish species will be investigated by looking at the habitat requirements published in the literature for the species present in the river. If fish requirements are not known, the suitability of using other fish species (for which requirements are known) as surrogates will be investigated. Likewise, if White-clawed crayfish are recorded in the river, potential impacts of

[18] Official Gazette of BiH No. 4/13

[19] Where two values are provided first value presents minimum environmental flow when mean decade flow is lower than the mean annual flow and the second value presents minimum environmental flow when mean decade flow is greater than or equal to the mean annual flow. All the parameters are calculated for the period from 1961 to 1990

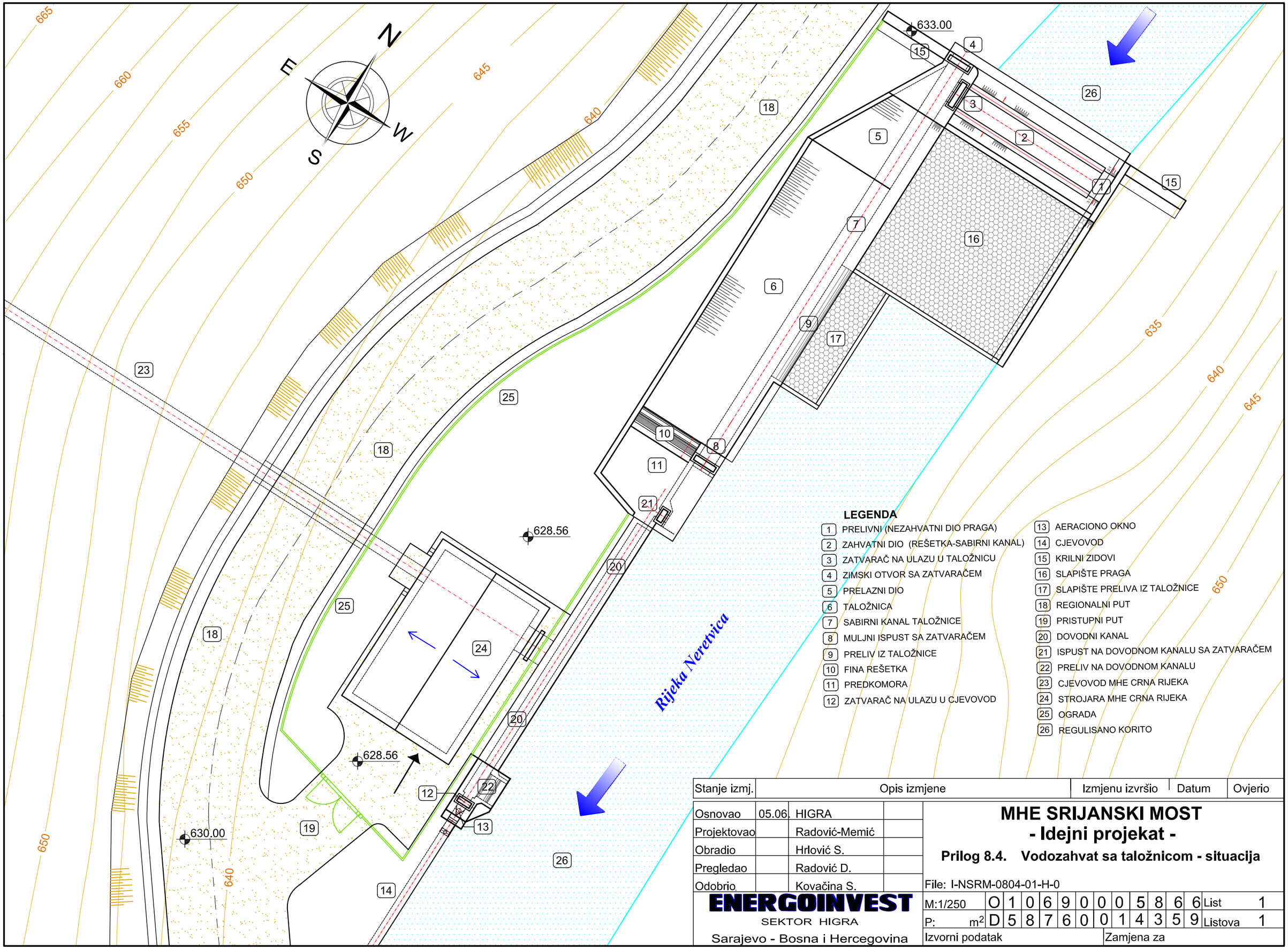
the proposed environmental flows based on the known habitat requirements for this species will be assessed.

The results of the habitat mapping exercise will be used for assessing whether the proposed environmental flows are likely to affect key sensitive habitats (such as fish spawning habitats). The potential proportion of sensitive habitats affected in relation with the presence of the same habitats in the catchment will be considered.

If, as a result of the assessment, the proposed environmental flows are found not to be suitable to support the ecological functions, mitigation measures will be proposed. These will be informed by the results of the aquatic surveys and could include for example:

- the modification of the proposed environmental flows;
- implementation of an adaptive management programme; and/or,
- restoration/creation of habitats in reaches not affected by the Project to compensate for the loss of habitats.

E. Srijanski Most weir and powerhouse designs



LEGENDA

1. PRELIVNI (NEZAHVATNI DIO PRAGA)
2. ZAHVATNI DIO (REŠETKA-SABIRNI KANAL)
3. ZATVARAČ NA ULAZU U TALOŽNICU
4. ZIMSKI OTVOR SA ZATVARAČEM
5. PRELAZNI DIO
6. TALOŽNICA
7. SABIRNI KANAL TALOŽNICE
8. MULJNI ISPUST SA ZATVARAČEM
9. PRELIV IZ TALOŽNICE
10. FINA REŠETKA
11. PREDKOMORA
12. ZATVARAČ NA ULAZU U CJEVOVOD
13. AERACIONO OKNO
14. CJEVOVOD
15. KRILNI ZIDOVI
16. SLAPIŠTE PRAGA
17. SLAPIŠTE PRELIVA IZ TALOŽNICE
18. REGIONALNI PUT
19. PRISTUPNI PUT
20. DOVODNI KANAL
21. ISPUST NA DOVODNOM KANALU SA ZATVARAČEM
22. PRELIV NA DOVODNOM KANALU
23. CJEVOVOD MHE CRNA RIJEKA
24. STROJARA MHE CRNA RIJEKA
25. OGRADA
26. REGULISANO KORITO

Stanje izmj.	Opis izmjene	Izmjenu izvršio	Datum	Ovjerio

Osnovao	05.06.	HIGRA	
Projektovao		Radović-Memić	
Obradio		Hrlović S.	
Pregledao		Radović D.	
Odobrio		Kovačina S.	

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Prilog 8.4. Vodozahvat sa taložnicom - situacija

File: I-NSRM-0804-01-H-0

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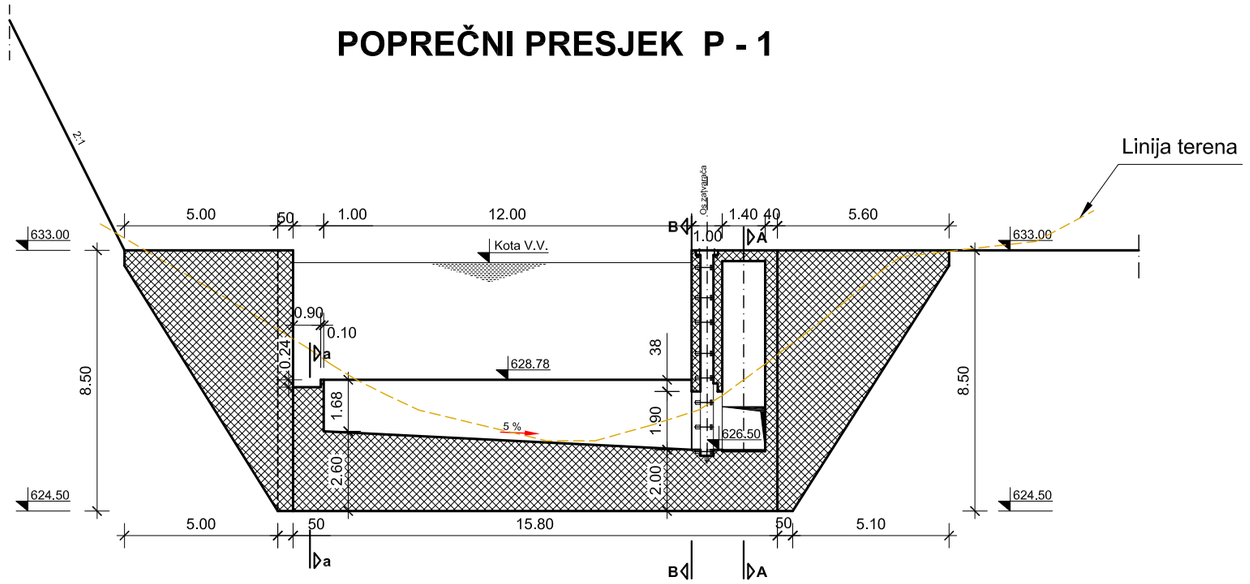
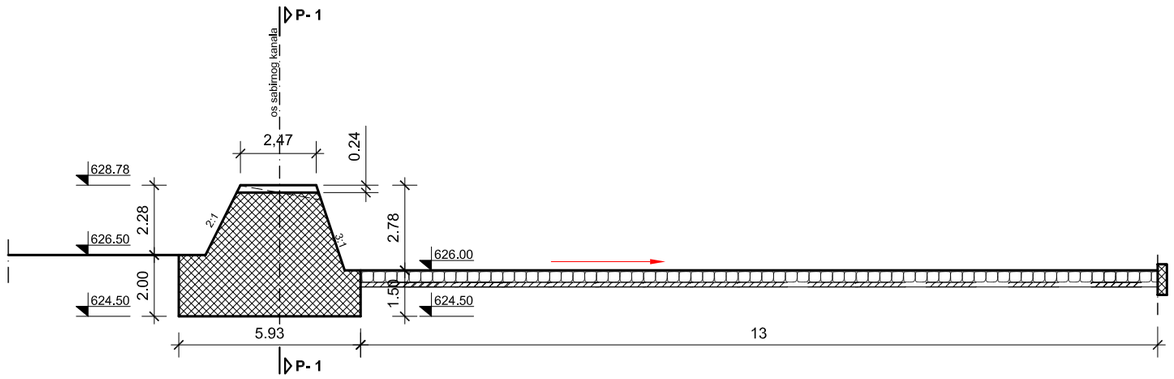
P: m²	D	5	8	7	6	0	0	1	4	3	5	9	Listova	1

Izvorni podatak | Zamjena za

POPREČNI PRESJEK P - 1



PRESJEK a - a



Stanje izmj.	Opis izmjene	Izmjenu izvršio	Datum	Ovjerio

Osnovao	05.06.	HIGRA	
Projektovao		Radović;Memić	
Obradio		Hrlović S.	
Pregledao		Radović D.	
Odobrio		Kovačina S.	

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Prilog 8.5. **Vodozahvat sa taložnicom- preliv za biološki minimum**

File: I-NSRM-0805-02-H-0

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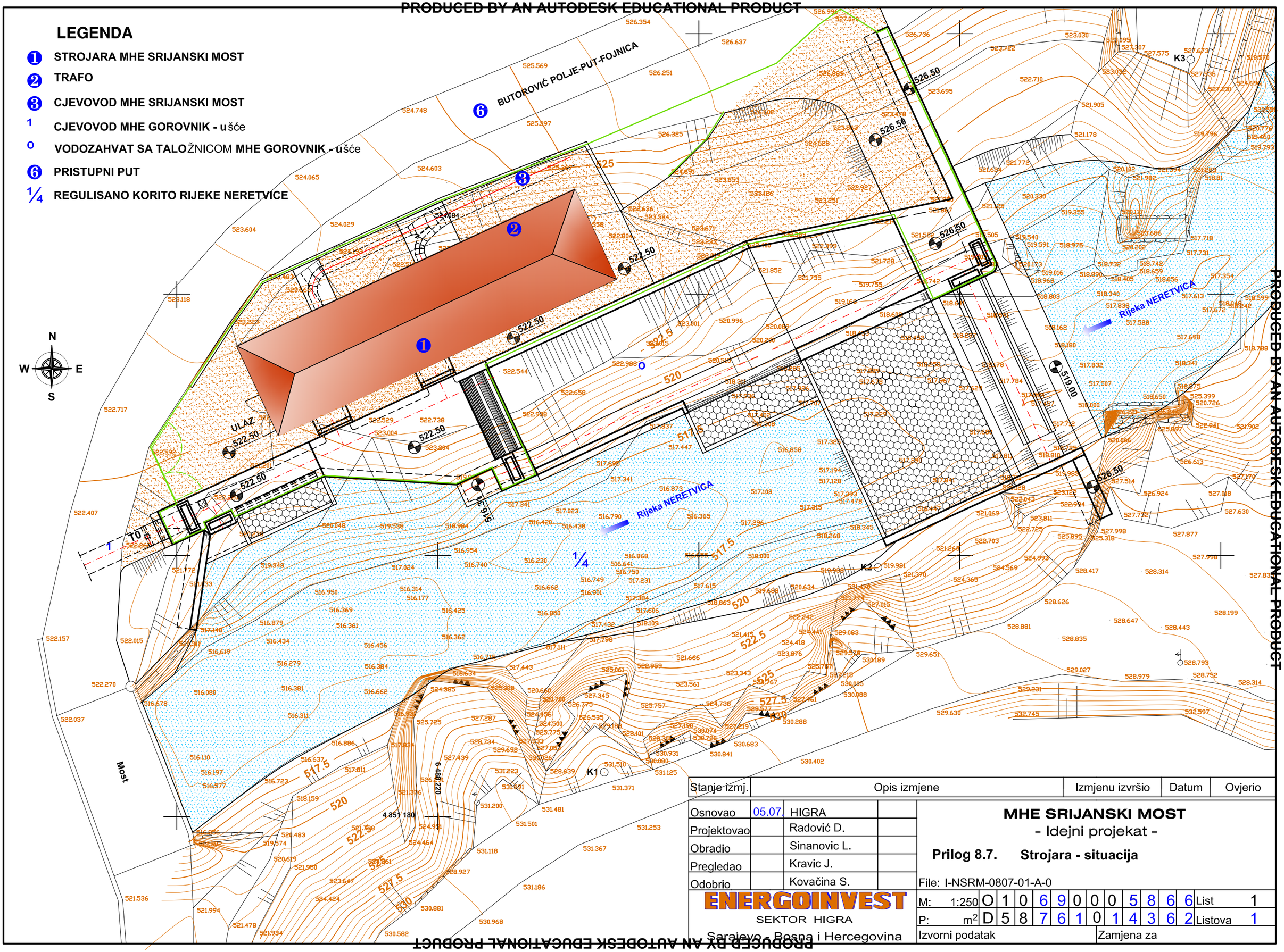
P: m^2	D	5	8	7	6	1	0	1	4	3	6	0	Listova	2

Izvorni podatak | Zamjena za

LEGENDA

- 1 STROJARA MHE SRIJANSKI MOST
- 2 TRAFO
- 3 CJEVOVOD MHE SRIJANSKI MOST
- 1 CJEVOVOD MHE GOROVNIK - ušće
- o VODOZAHVAT SA TALOŽNICOM MHE GOROVNIK - ušće
- 6 PRISTUPNI PUT
- 1/4 REGULISANO KORITO RIJEKE NERETVICE



Stanje izmj.	Opis izmjene	Izmjenu izvršio	Datum	Ovjerio

Osnovao	05.07.	HIGRA	
Projektovao		Radović D.	
Obradio		Sinanovic L.	
Pregledao		Kravic J.	
Odobrio		Kovačina S.	

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Prilog 8.7. Strojara - situacija

File: I-NSRM-0807-01-A-0

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Izvorni podatak | Zamjena za

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F. Blue Rivers aquatic ecology report

Blue Rivers ®

Environmental Consulting

Neretvica River, Konjic Municipality, Bosnia and Herzegovina

Basic aquatic ecology survey

Final Report

Kyiv

November 2016

Document verification

Job title		Neretvica River, Konjic Municipality, Bosnia and Herzegovina Basic aquatic ecology survey
Document title		Report
Version	**Date**	Authors:
Draft 1	07.11.2016	Dr., Prof. Sergey Afanasyev, Dr Alexei Iarochevitch, Dr Olena Lietytska, Ms. Olena Marushevska, Ms. Kateryna Mudra
Final	12.11.2016	Dr., Prof. Sergey Afanasyev, Dr Alexei Iarochevitch, Dr Olena Lietytska, Ms. Olena Marushevska, Ms. Kateryna Mudra

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Contains

Executive summary

This Report presents the results of basic aquatic ecology surveys in Neretvica river basin, conducted in October 2016. The investigated area covered in detail Neretvica River for 22 km of its length from mouth to Duboki potok 1 power house and mouth zones of tributaries Obascica, Prolaz, Mala Neretvica and Govornik. Survey was conducted in the 12 locations on Neretvica and its tributaries where SHPPs power houses are designed.

The results of surveys on fish biodiversity showed the presence of eight fish species, out of which two (brown trout (*Salmo trutta m. fario*) and marble trout (*Salmo marmoratus*)) are migratory and will be directly affected by the SHPPs construction. Two species with IUCN high protection status: Adriatic minnow (*Phoxinellus alepidotu*s, status Endangered B2ab (ii,iii,iv)) and Neretvan spined loach (*Cobitis narentana*, status Vulnerable D2) were identified in the mouth part of the Neretvica River. There are also two invasive species fixed, which could further spread in conditions of the modified riverbed. However, the Consultant considers that more fish species are present in the basin, including two trout species.

In frame of macroinvertebrates' surveys, the reference conditions of the Neretvica River and its tributaries were identified. All survey locations have high values of Trent Biotic Index (TBI) and Belgian Biotic Index (BBI), corresponding to high biological status. This is the starting point for identification of the possible impact of the SHPPs at the aquatic biodiversity.

The results of riverbed and river banks visual survey showed the presence of rich diversity of the habitats, favourable for aquatic organisms. The main riverbed channel type is single type (with fragmented braided). Comparing to the braided one, this type of the channel is less vulnerable in conditions of environmental flow.

The following environmental risks for aquatic diversity were identified:

- Risk of salmonid fish habitats fragmentation, negatively affecting their upstream spawning migration;
- Risk of accumulating of the SHPPs impacts, leading to reduction of the quantity and abundance of invertebrates and correspondingly the food basis for fish;
- Risk of further spreading of the fish invasive species in conditions of heavily modified riverbed channel;
- Risk of loss of habitats for white-clawed crayfish (*Austropotamobius pallipes* (Lereboullet, 1858)) with the IUCN status "endangered", as far as one of the main threats for this specie is alteration of hydrological regime of rivers.

Introduction: description of the field works

The entity "Blue Rivers®" Environmental Consulting (further "Consultant") agreed with the company Mott MacDonald (further "Client") to conduct ***basic aquatic ecology surveys*** in Neretvica river basin.

In this basin, the European Bank for Reconstruction and Development (the "EBRD" or the "Bank") is considering providing financing to JP Elektroprivreda Bosne i Hercegovine d.d. Sarajevo ("EPBiH" or the "Company"), a public utility responsible for generation, distribution and sale of electricity in Bosnia and Herzegovina to potentially fund the construction of 15 small hydropower plants ("SHPPs") located on Neretvica River (the "Project"), Konjic Municipality.

The field surveys were conducted in the period from 26 to 29 October 2016. Surveys covered Neretvica river for 22 km of its length from mouth to Duboki potok 1 power house (located in 5 km from source of river) and mouth zones of tributaries Obascica, Prolaz, Mala Neretvica and Govornik. Survey was conducted in the 12 locations on Neretvica and its tributaries where SHPPs power houses are designed (Figure 1).

Table1. Survey locations

№	Number on the map (Fig.1)	Power houses/river	Elevation, m	Coordinates
1	3	SHPP Duboki potok 1 / Neretvica	1039	43°52'09.3"N 17°52'27.8"E
2	5	SHPP Duboki potok 2 / Neretvica	841	43°51'12.7"N 17°52'24.7"E
3	7	SHPP Donji Obalj / Neretvica	700	43°49'47.5"N 17°52'34.7"E
4	7	SHPP Obascica /Obascica	713	43°49'43.0"N 17°52'34.8"E
5	10	SHPP Prolaz / Prolaz	738	43°49'56.1"N 17°52'57.8"E
6	14	SHPP Mala Neretvica / Neretvica	661	43°49'25.8"N 17°51'14.2"E
7	17	SHPP Pozelavka /Mala Neretvica	666	43°49'38.6"N 17°51'42.0"E
8	27	SHPP Srijanski Most / Neretvica	535	43°48'20.4"N 17°50'57.8"E
9	29	SHPP Gorovnik / Neretvica	422	43°49'17.4"N 17°49'25.3"E
10	32	SHPP Gorovnik / Gorovnik	430	43°47'18.8"N 17°49'24.1"E
11	35	SHPP Podhum 1 / Neretvica	420	43°47'01.9"N 17°49'10.0"E
12	38	SHPP Podhum 2 / Neretvica	251	43°46'45.8"N 17°49'05.1"E

Length of the river surveyed in each location was about 60-80 meters. Lower part of Neretvica up to Jablanicko lake about 1 800 meters was surveyed continuously.

Survey limitations:

During the survey, fishing was allowed at Neretvica river only using flyfishing (relevant license was purchased) from the mouth up to SHPP Prolaz. Upstream this survey location to the source of the river for the length of 11 km any kind of fishing is prohibited for the whole year. There were also seasonal limitations related to fish life cycle. For salmonid fish, October-November is the time of upstream spawning migration and fish catching is prohibited. For the cyprinid fish, this is time when they move from high velocity river habitats to deep habitats of the main rivers, lakes and water reservoirs, which does not allowing assessing cyprinid fish specie composition. For invertebrates surveys, the most favourable seasons include August – September, when imago are big enough to identify them easily, but prior the mass escape.

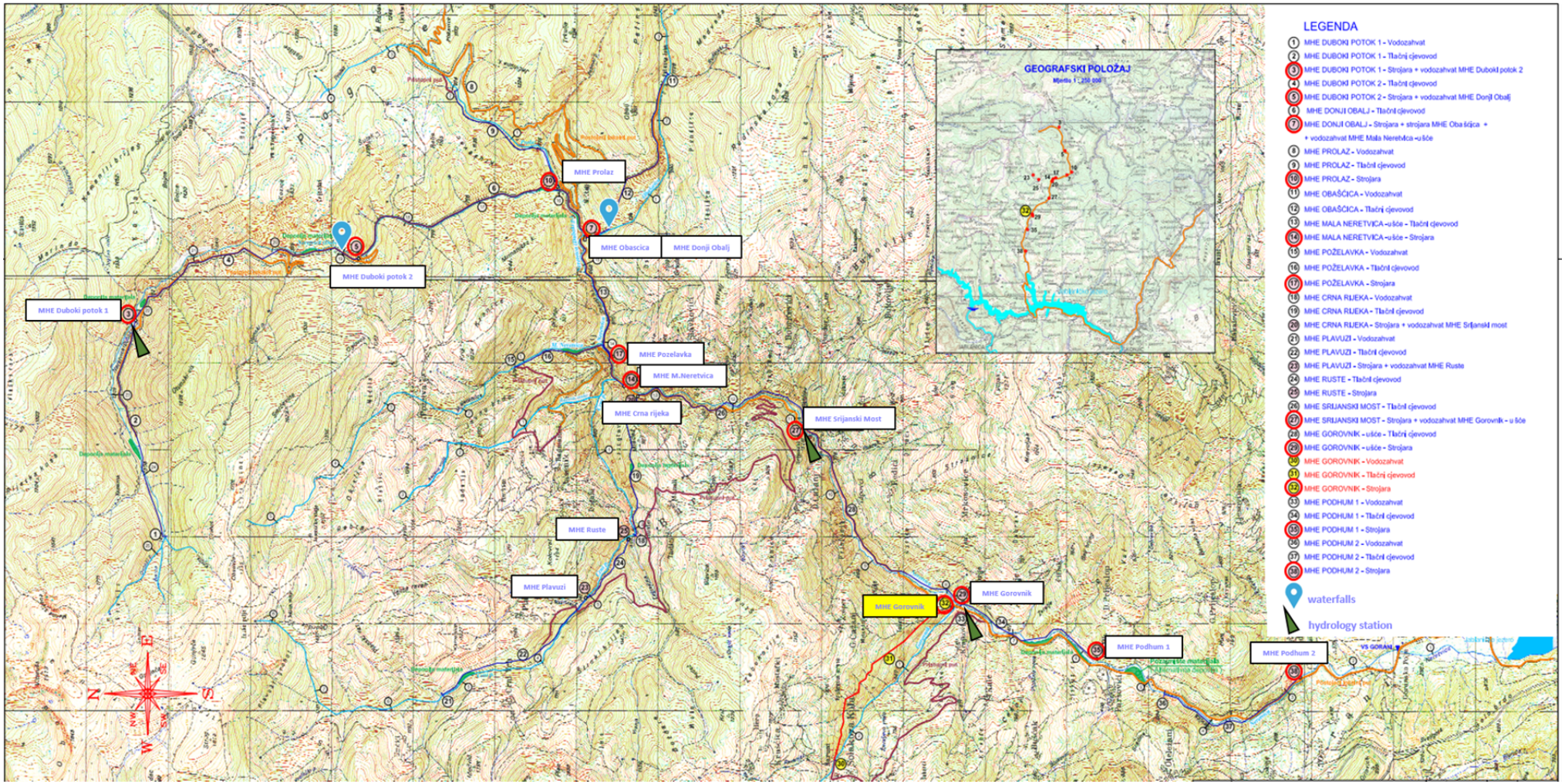


Figure 1. Map of proposed SHPPs and survey locations (marked in red)

1. Hydrology and baseline morphology survey results

1.1 Hydrological overview of baseline conditions

Neretvica is a river in Bosnia and Herzegovina which has a source on the slopes of Zec mountain on altitude of 1792 m. River flows into the Jablanicko lake (a large water reservoir formed at the Neretva river) right downstream town Konjic (Figure 2).

Neretvica is a right tributary of Neretva River.

Figure 2. Neretvica mouth

The length of the river is 27 km; the catchment area is around 136 km^2 (in hydrological station Gorani). The total fall of the river is 1645 m. The channel gradient is 61‰. An average elevation of river catchment is 376 m above sea level.

The river valley has V-shape of the most part its length. U-shape valley is typical for lower course of Neretvica. The river banks are rocky. 60% of the basin is covered by forest and shrub vegetation. Single type of channel is typical for the most part of river. In several places river channel is braided but its total length is insignificant. There are few waterfalls on Neretvica (80 m upstream of power

house SHPP Duboki Potok 2 (Figure 3a) and on tributary - Obascica (100 m upstream of power house SHPP Obascica (Figure 3b) with height up to 3.5m. Waterfalls are natural barriers present in the river.

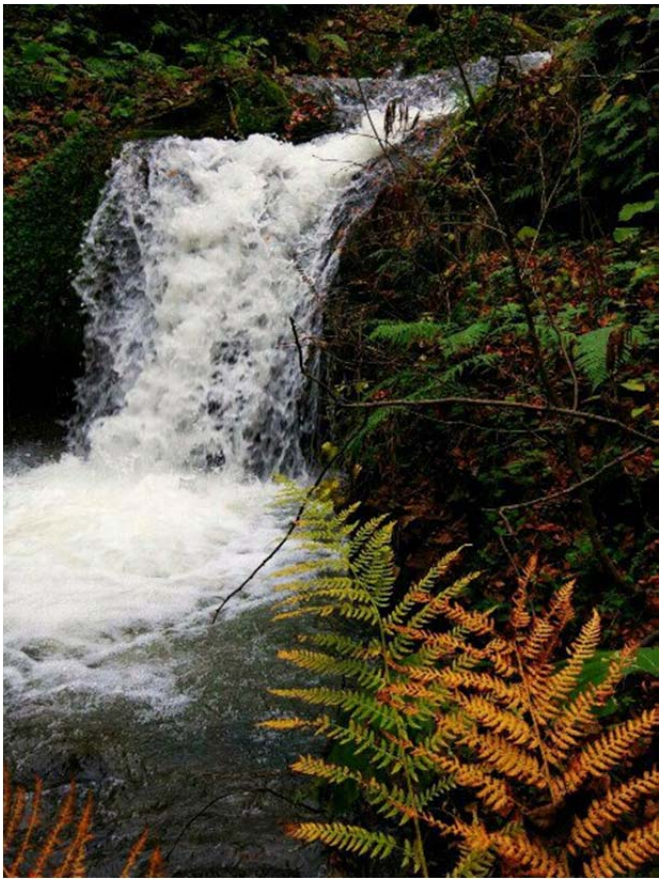


Figure 3a. 80 m upstream of power house SHPP Duboki Potok 2

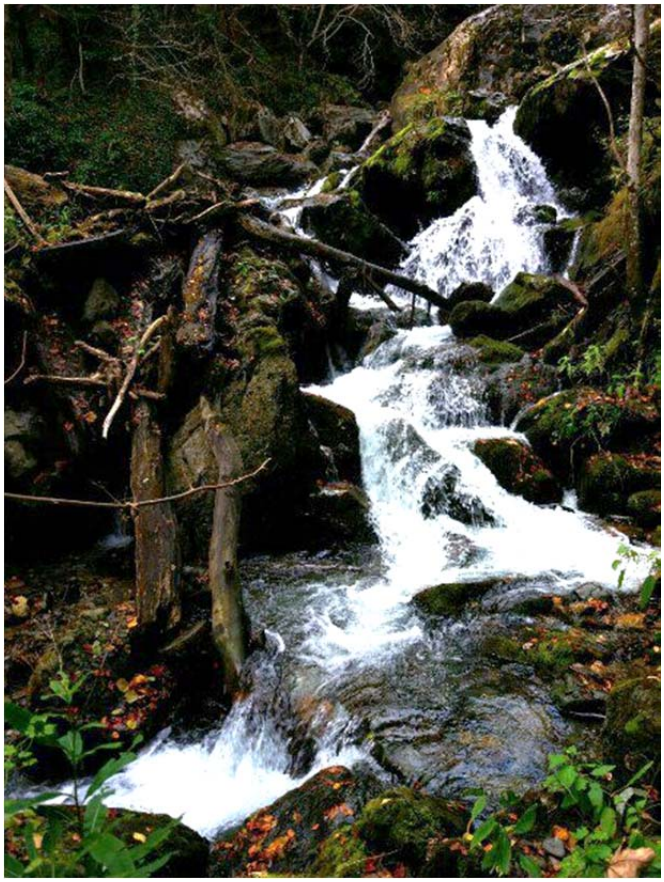


Figure 3b. 100 m upstream of power house SHPP Obascica

There are much wood debris (both trunk and brushwood) in the river channel from very upstream up to mouth.

Neretvica has a humid climate. The average annual temperature is 10.8 °C, the average monthly minimum is – 8.0 °C, the average monthly maximum temperature is 20.1 °C. The absolute maximum temperature is 39.0 °C.

Four largest tributaries – Obascica, Prolaz, Mala Neretvica, Crni potok – enter Neretvica in its middle course and one tributary – Gorovnik enter in lower course.

Table 2. River Neretvica main tributaries

№	Tributary	Left/right	Annual average water discharge Q, m^3/s	Distance from confluence with Neretva to mouth, km
1	Obascica	left	0.293	15.4
2	Prolaz	left	0.095	16.0
3	Mala Neretvica	right	0.093	13.9
4	Crni potok	right	0.205	13.5
5	Gorovnik	right	0.162	7.8

All watercourses within river basin of Neretvica are typical mountainous watercourses according to their characteristics, and during the year they have uneven flow, high water in a short period of time (during the rapid melting of snow in the surrounding mountains or after intense rains) and large amounts of coarse bed load. Precipitation regime is rainy-snowy, which causes the spring and autumn maximums and summer and winter minimums. The spring maximum is much higher than the autumn one and the summer minimum is lower than the winter one.

The average annual water discharge was estimated at Q = 4.62 m^3/s. The preliminary design of the SHPPs in the Neretvica river basin ("Energoinvest", January 2007 Sarajevo), used statistical hydrological data processing for the Neretvica River at the measuring station Gorani.

According to information received from staff of Eletkroprivreda Bosne i Hercegovine, five automatic hydrological and water quality stations were installed in Neretvica river basin: SHPP Podhum 1, SHPP Srijanski Most, SHPP Duboki potok 1, SHPP Obascica, and SHPP Crna Rijeka.

Figure 4a. Automatic hydrological and water quality station at SHPP Podhum 1

Figure 4b. Automatic hydrological and water quality station at SHPP Duboki potok 1

During survey 3 stations were seen: SHPP Podhum 1 (intake, point 33 on the map (Figure 4a), SHPP Srijanski Most (power house, point 27 on the map), SHPP Duboki potok 1 (power house, point 3 on the map (Figure 4b). The Consultant received information on daily water discharge (in graphs). during the 2015 year for all 5 stations.

1.2 Morphological characteristics of selected surveys locations

Survey was conducted in the 12 locations on Neretvica and its tributaries where SHPP power houses are designed (Table 1). Each survey location was characterized by the following parameters:

- Location in relation to the SHPP
- Channel types and morphological parameters (boulders, single, braided)
- Bank / riparian zone parameters (natural riparian vegetation, bank stabilization, bank profile).
- Flow types (freefall, chute, turbulent, broken standing waves, unbroken standing waves, rippled, upwelling, smooth)
- In-stream features (bed elements (bars, riffles/rapids, rocks, step/pool), variation in width and depth, flow types (freefall, chute, chaotic, broken standing waves, unbroken standing wave, rippled, upwelling, smooth, no perceptible flow); large woody debris)
- Average width and depth variation of the river
- Sediments types (boulder (256 mm - 2048 mm); cobble (64 mm - 256 mm); pebble (17 mm - 64 mm); gravel (2 mm - 17 mm); sand (0.06 mm - 2 mm)).

Length of the river surveyed in each location was about 60-80 meters. Lower part of Neretvica up to Jablanicko lake about 1 800 meters was surveyed continuously. The information received during the survey can be considered representative for the whole river.

1. SHPP Podhum 2

Figure 5. SHPP Podhum 2

Power house is to be located at Neretvica River, upstream Neretvica mouth – 2.8 km and 3.0 km downstream of Podhum 1 power house. The catchment area is 121 km^2. The length of the river from the source is 24.2 km. The elevation is 251 m.

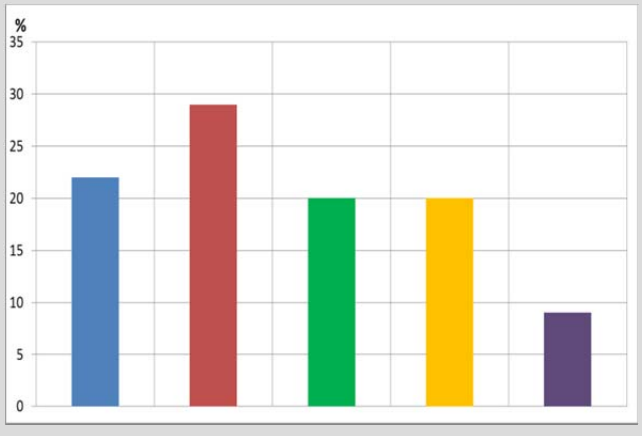
The channel type is classified as a single type. The form of the valley is U-shape. The right bank is flat; left bank is steep. Both banks are forested with bushes and grass-covered. Flow types included rippled, broken standing waves, and unbroken standing waves.

The average width of the river was 10.7 m, and varied from 8.8 to 12.7 m. Bed elements included bars, rapids and riffles.

The average depth was 0.45 m with maximum 0.72 m. Ratio of average width of channel to the average depth was $C_{b/h}$=24.

The riverbed was covered mainly by cobble (29%) and boulders (22%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	22
Cobble (64 mm – 256 mm)	29
Pebble (17 mm – 64 mm)	20
Gravel (2 mm – 17 mm)	20
Sand (0.06 mm – 2 mm)	9



2. SHPP Podhum 1

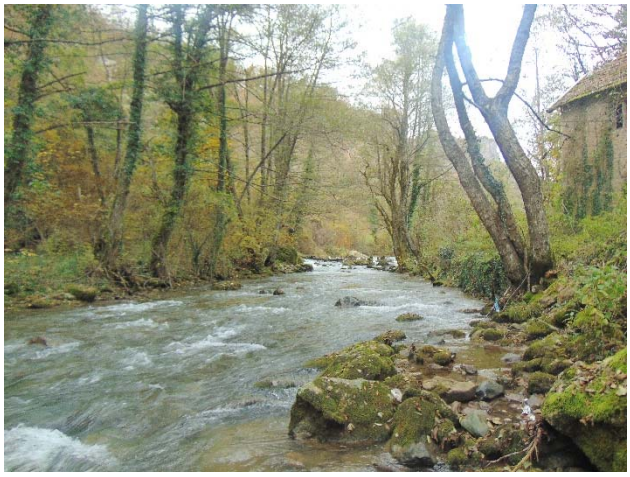



Figure 6. SHPP Podhum 1

Power house is to be located at Neretvica River, upstream Neretvica mouth – 5.7 km and 2.1 km downstream of Gorovnik power house. The catchment area is 114 km^2. The length of the river from the source is 21.3 km. The elevation is 420 m.

The channel type is classified as a single type.

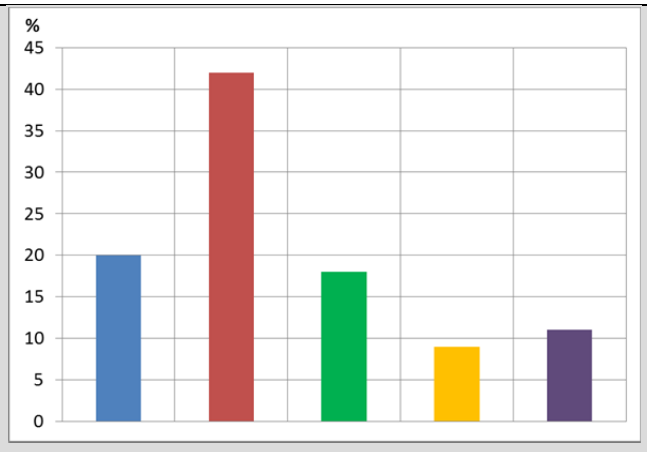
The form of the valley is U-shape. The left bank is flat; right bank is steep. Both banks are forested with bushes and grass-covered.

Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 9.5 m, and varied from 6.9 to 12.1 m. Bed elements included rapids, riffles and step/pools. The average depth was 0.32 m with maximum 0.63 m. Ratio of average width of channel to the average depth was $C_{b/h}$=30.

The riverbed was covered mainly by cobble (42%) and boulders (20%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	20
Cobble (64 mm – 256 mm)	42
Pebble (17 mm – 64 mm)	18
Gravel (2 mm – 17 mm)	9
Sand (0.06 mm – 2 mm)	11



3. SHPP Gorovnik (river Gorovnik)

Figure 7. SHPP Gorovnik

Power house is to be located at Gorovnik river (right tributary), 0.07 km upstream confluence with Neretvica. The catchment area is 3.2 km^2. The length of the river from the source is 4.0 km. The elevation is 430 m.

The channel type is classified as a single type.

The form of the valley is V-shape. The left and the right bank are flat. Both banks are covered by grass, bushes and trees.

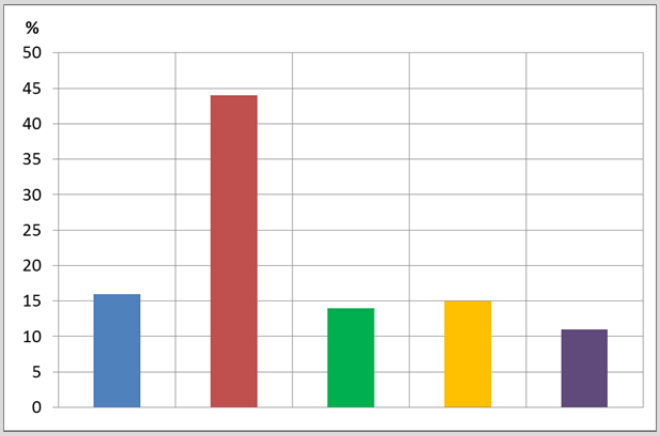
Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 2.5 m, and varied from 1.9 to 4.3 m. Bed elements included bars, rapids, rocks and step/pools.

The average depth was 0.27 m with maximum 0.41 m. Ratio of average width of channel to the average depth was $C_{b/h}$=9.

The riverbed was covered mainly by boulders (44%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	16
Cobble (64 mm – 256 mm)	44
Pebble (17 mm – 64 mm)	14
Gravel (2 mm – 17 mm)	15
Sand (0.06 mm – 2 mm)	11



4. SHPP Gorovnik (river Neretvica)


Figure 8. SHPP Gorovnik (river Neretvica)

Power house is to be located at Neretvica River, upstream Neretvica mouth – 7.7 km and 3.2 km downstream of Srijanski Most power house. The catchment area is 92.4 km^2. The length of the river from the source is 19.3 km. The elevation is 422 m.

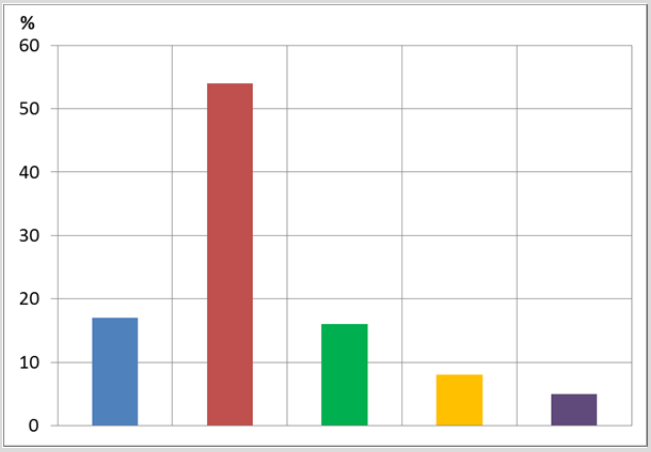
The one tributary Gorovnik enter into Neretvica 0.1 km upstream. The channel type is classified as a single type. The form of the valley is U-shape. The left and the right bank are flat. Both banks are covered by grass, bushes and some trees.

Flow types included turbulent, broken standing waves, and unbroken standing waves. The average width of the river was 7.1 m, and varied from 6.7 to 9.2 m. Bed elements included bars, rapids, rocks and step/pools.

The average depth was 0.4 m with maximum 0.66 m. Ratio of average width of channel to the average depth was $C_{b/h}$=18.

The riverbed was covered mainly by cobble (54%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	17
Cobble (64 mm – 256 mm)	54
Pebble (17 mm – 64 mm)	16
Gravel (2 mm – 17 mm)	8
Sand (0.06 mm – 2 mm)	5



5. SHPP Srijanski Most

Figure 9. SHPP Srijanski Most

Power house is to be located at Neretvica River, upstream Neretvica mouth – 10.9 km and 2.3 km downstream of Crna Rijeka power house. The catchment area is 75.5 km^2. The length of the river from the source is 16.1 km. The elevation is 535 m.

The channel type is classified as a single type.

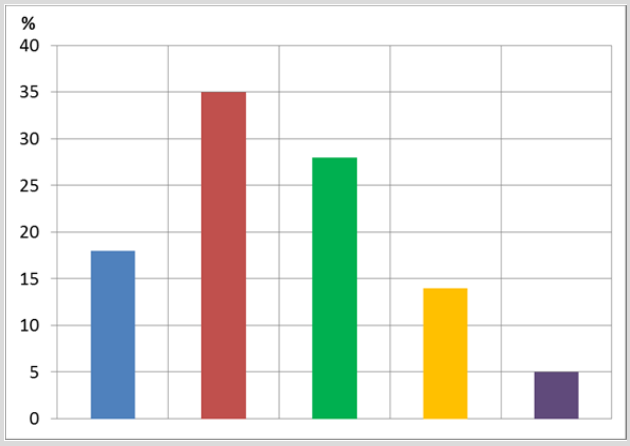
The form of the valley is V-shape. The left and the right bank are steep. Both banks are covered by bushes and trees.

Flow types included chute, turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 6.8 m, and varied from 5.3 to 8.4 m. Bed elements included rapids, rocks and step/pools. The average depth was 0.6 m with maximum 0.85 m. Ratio of average width of channel to the average depth was $C_{b/h}$=11.

The riverbed was covered mainly by cobble (35%), with significant share of pebble (28%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	18
Cobble (64 mm – 256 mm)	35
Pebble (17 mm – 64 mm)	28
Gravel (2 mm – 17 mm)	14
Sand (0.06 mm – 2 mm)	5



6. SHPP Mala Neretvica

Figure 10. Mala Neretvica

Power house is to be located at Neretvica River, upstream Neretvica mouth – 13.8 km and 1.5 km downstream of Prolaz power house. The catchment area is 42.9 km^2. The length of the river from the source is 13.6 km. The elevation is 661 m.

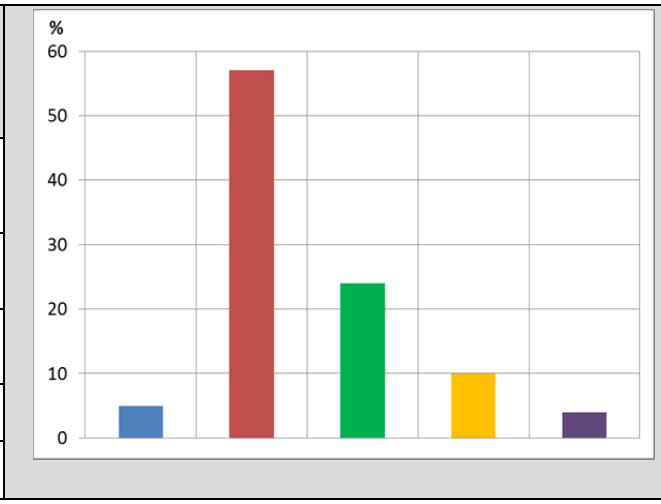
The one tributary Mala Neretvica enters Neretvica 0.02 km upstream. The channel type is classified as a single type.

The form of the valley is V-shape. The left and the right bank are steep. Both banks are covered by bushes and trees.

Flow types included chute, turbulent, broken standing waves, and unbroken standing waves. The average width of the river was 7.6 m, and varied from 5.8 to 9.4 m. Bed elements included rapids, rocks and step/pools. The average depth was 0.58 m with maximum 0.75 m. Ratio of average width of channel to the average depth was $C_{b/h}$=13.

The riverbed was covered mainly by cobble (57%), with significant share of pebble (24%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	5
Cobble (64 mm – 256 mm)	57
Pebble (17 mm – 64 mm)	24
Gravel (2 mm – 17 mm)	10
Sand (0.06 mm – 2 mm)	4



7. SHPP Pozelavka

Figure 11. SHPP Pozelavka

Power house is to be located at Mala Neretvica River, 0.02 km upstream confluence with Neretvica. The catchment area is 3.69 km^2. The length of the river from the source is 5.0 km. The elevation is 666 m.

The channel type is classified as a single type.

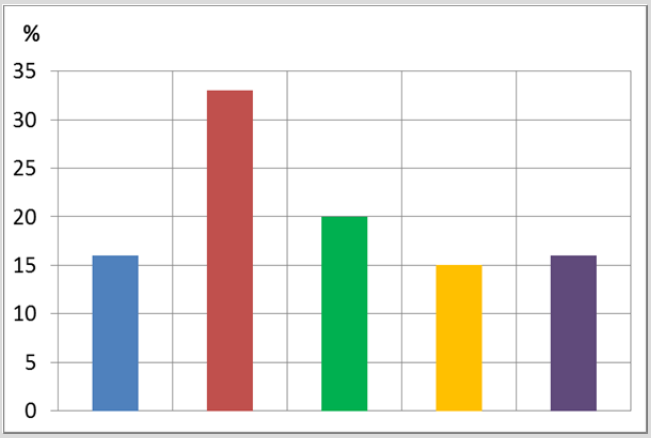
The form of the valley is V-shape. The left and the right bank are steep. Both banks are covered by bushes and trees.

Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 3.5 m, and varied from 2.2 to 4.8 m. Bed elements included rapids and step/pools. The average depth was 0.33 m with maximum 0.57 m. Ratio of average width of channel to the average depth was $C_{b/h}$=11.

The riverbed was covered mainly by cobble (30%), with significant share of pebble (20%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	16
Cobble (64 mm – 256 mm)	33
Pebble (17 mm – 64 mm)	20
Gravel (2 mm – 17 mm)	15
Sand (0.06 mm – 2 mm)	16



8. SHPP Prolaz

Figure 12. SHPP Prolaz

Power house is to be located at Prolaz river, 0.2 km upstream confluence with Neretvica. The catchment area is 4.11 km^2. The length of the river from the source is 4.1 km. The elevation is 738 m.

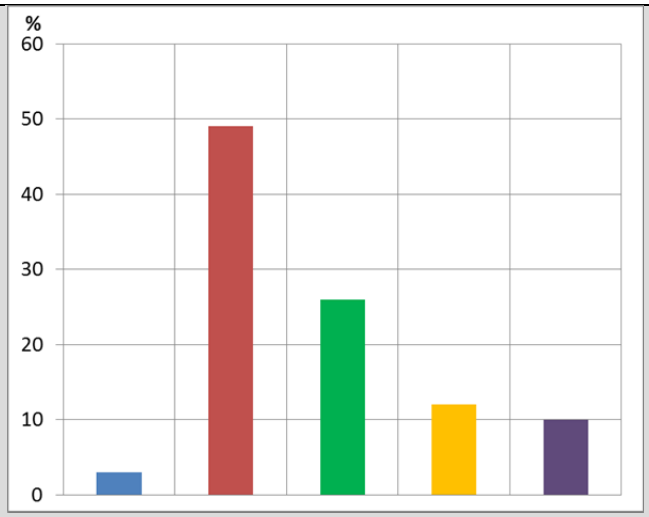
The channel type is classified as a single type.

The form of the valley is V-shape. The left and the right bank are steep. Both banks are covered by grass, bushes and trees.

Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 2.5 m, and varied from 1.7 to 3.9 m. Bed elements included bars, rapids and step/pools. The average depth was 0.22 m with maximum 0.47 m. Ratio of average width of channel to the average depth was $C_{b/h}$=11
The riverbed was covered mainly by cobble (49%), with significant share of pebble (26%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	3
Cobble (64 mm – 256 mm)	49
Pebble (17 mm – 64 mm)	26
Gravel (2 mm – 17 mm)	12
Sand (0.06 mm – 2 mm)	10



9. SHPP Obascica

Figure 13. SHPP Obascica

Power house is to be located at Obascica River, 0.5 km upstream confluence with Neretvica. The catchment area is 4.51 km^2. The length of the river from the source is 3.2 km. The elevation is 713 m.

The channel type is classified as a single type.

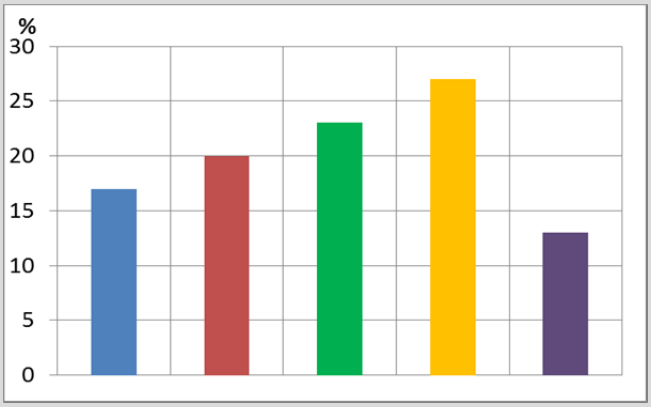
The form of the valley is V-shape. The left and the right bank are steep. Both banks are covered by grass, bushes and trees.

Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 3.1 m, and varied from 2.1 to 4.1 m. Bed elements included rapids and step/pools. The average depth was 0.27 m with maximum 0.43 m. Ratio of average width of channel to the average depth was $C_{b/h}$=11.

The riverbed was covered mainly by cobble (27%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	17
Cobble (64 mm – 256 mm)	27
Pebble (17 mm – 64 mm)	23
Gravel (2 mm – 17 mm)	20
Sand (0.06 mm – 2 mm)	13



10. SHPP Donji Obalj

Figure 14. SHPP Donji Obalj

Power house is to be located at Neretvica River, upstream Neretvica mouth – 15.4 km. The catchment area is 16.32 km^2. The length of the river from the source is 11.6 km. The elevation is 700 m.

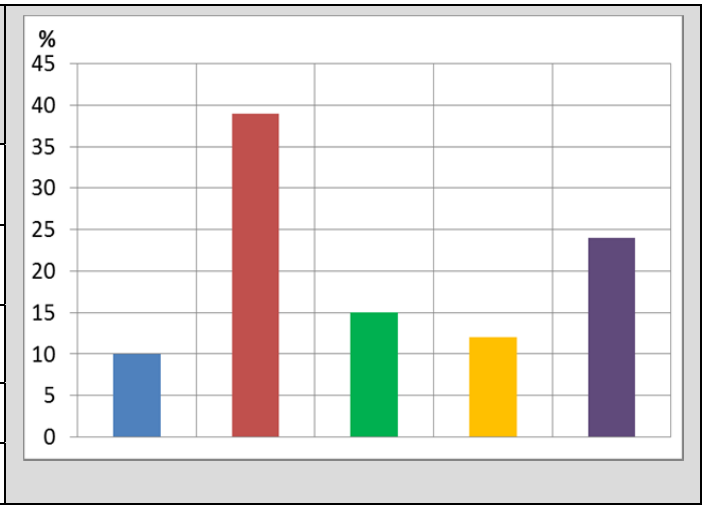
The one tributary Obascica enters Neretvica 0.03 km upstream. The channel type is classified as a single type.

The form of the valley is U-shape. The left bank is flat; right bank is steep. Both banks are covered by grass, bushes and trees. Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 11 m, and varied from 8.9 to 13 m. Bed elements included bars, rapids, rocks and step/pools. The average depth was 0.49 m with maximum 0.9 m. Ratio of average width of channel to the average depth was $C_{b/h}$=22.

The riverbed was covered mainly by cobble (39%), with significant share of sand (24%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	10
Cobble (64 mm – 256 mm)	39
Pebble (17 mm – 64 mm)	15
Gravel (2 mm – 17 mm)	12
Sand (0.06 mm – 2 mm)	24



11. SHPP Duboki potok 2

Figure 15. SHPP Duboki potok 2

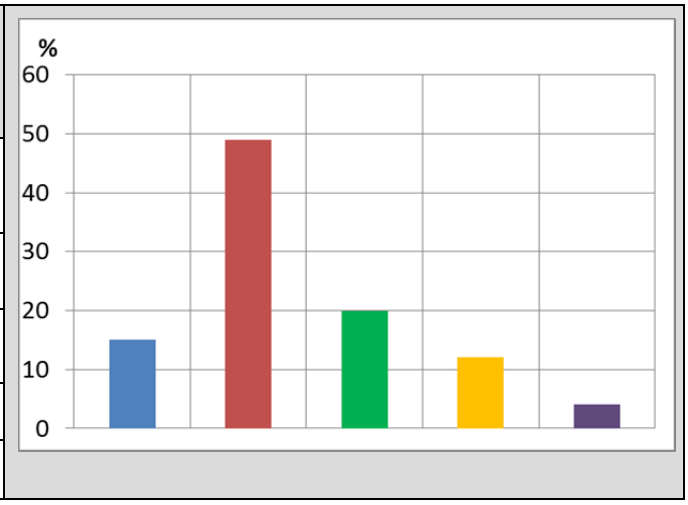
Power house is to be located at Neretvica River, upstream Neretvica mouth – 18.8 km. The catchment area is 9.7 km^2. The length of the river from the source is 8.2 km. The elevation is 841 m.

The channel type is classified as a braided type. Island (parameters: length – 48 m, maximum width – 5.2 m) divided river into two arms. Left arm: average depth – 0.31 m with maximum 0.52 m; average width 1.3 m, and varied from 0.7 to 2 m. Right arm: average depth – 0.41 m with maximum 0.76 m; average width 3.8 m, and varied from 3.1 to 4.5 m.

The form of the valley is V-shape. The left bank is flat; right bank is steep. Both banks are covered by grass, bushes and trees.

Flow types included freefall, turbulent, broken standing waves, and unbroken standing waves. The average width of the river downstream the island was 7.0 m, and varied from 4.0 to 9.2 m. Bed elements included bars, island, rapids, rocks and step/pools. The average depth was 0.5 m with maximum 0.87 m. Ratio of average width of channel to the average depth was $C_{b/h}$=14. The riverbed was covered mainly by cobble (49%), with significant share of pebble (20%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	15
Cobble (64 mm – 256 mm)	49
Pebble (17 mm – 64 mm)	20
Gravel (2 mm – 17 mm)	12
Sand (0.06 mm – 2 mm)	4



12. SHPP Duboki potok 1

Figure 16. SHPP Duboki potok

Power house is to be located at Neretvica River, upstream Neretvica mouth – 22.1 km. The catchment area is 2.66 km^2. The length of the river from the source is 4.9 km. The elevation is 1039 m.

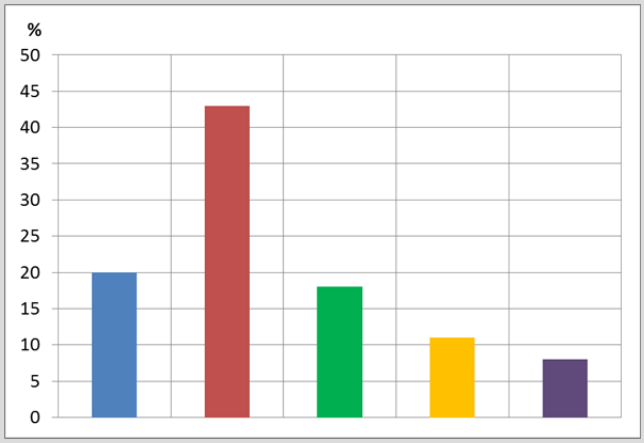
The channel type is classified as a single type. The form of the valley is V-shape. The both banks are steep and covered by grass, bushes and trees.

Flow types included turbulent, broken standing waves, and unbroken standing waves.

The average width of the river was 5.3 m, and varied from 4.3 to 6.3 m. Bed elements included bars, rapids and step/pools. The average depth was 0.39 m with maximum 0.57 m. Ratio of average width of channel to the average depth was $C_{b/h}$=14.

The riverbed was covered mainly by cobble (43%), with significant share of boulders (20%).

Substrate types	% of sediments
Boulder (256 mm –2048 mm)	20
Cobble (64 mm – 256 mm)	43
Pebble (17 mm – 64 mm)	18
Gravel (2 mm – 17 mm)	11
Sand (0.06 mm – 2 mm)	8



Because of the absence of the safe approaches to the river , the river stretch for the power house for SHPP Crna Rijeka was not surveyed.

Conclusions

The riverbed and river banks survey showed the rich diversity of the habitats, favourable for aquatic organisms. The surveys shows that the most wide spread bed elements are riffles, rapids, step/pools. The dominating type of substrate at the majority of the locations is cobble (64 mm – 256 mm). Main flow types on Neretvica River are turbulent, broken standing waves, and unbroken standing waves.

The main riverbed channel type is single type (with fragmented braided). Comparing to the braided one, this type of the channel is less vulnerable in conditions of environmental flow.

2. Aquatic ecology survey results

2.1 Bioindication survey

Methodology

The aquatic ecology survey was conducted in the same surveys locations, corresponding to the potential locations of the SHPPs in Neretvica river basin (Figure 1). It was done by the means of the visual assessment of the distribution of macroforms of hydrocoles and sampling from underwater heard substrates and gravel / pebble, as well as plants and their residues. The sampling was conducted in the typical riverbed habitats taking into account the soil type, character of the flow, depth, type of riverbed processes using standard EU methods developed for the mountaineer rivers. Specifically the Consultant used method “kick and sweep”: its main idea is that a researcher standing against the flow kicks substrate to dislodge macroinvertebrates at the area 0,25 x 0,25 m and collecting dislodged macroinvertebrates by “sweeping” a hand-held net through the water. Later large pieces of wood and pebbles are visually studied and swept in order to take into account the sitting and attached macroinvertebrates.

The sampling and description of the present bottom habitats was done following the scheme of European monitoring "AQEM / STAR" [Schmidt-Kloiber A., 2006] at the reach of the length 100 m.

Identification of macroinvertebrates was done directly at the site up to the level of indicator taxonomic groups using a loop. The survey included preliminary calculation of the specimens of each group as well as the fixation of the presence of one or more species in the groups *Plecoptera, Ephemeroptera* and *Trichoptera*.

Method "AQEM/STAR"

"AQEM /STAR" protocol supports implementation of the Water Framework Directive and is used as a part of ecological status assessment based on water macroinvertebrates. The system described the whole process of the assessment, starting from selection of the sampling point and sampling itself as well as provides some guidelines how to interpret the data obtained. As far as different types of water courses support different types of macroinvertebrates, "AQEM/STAR" uses universal method, applicable for each type of water course. The method is based on the system of biological assessment (Barbour et, 1999) for different bottom microhabitats, where the dominant habitats are selected according to their share within the location (Figure 17).

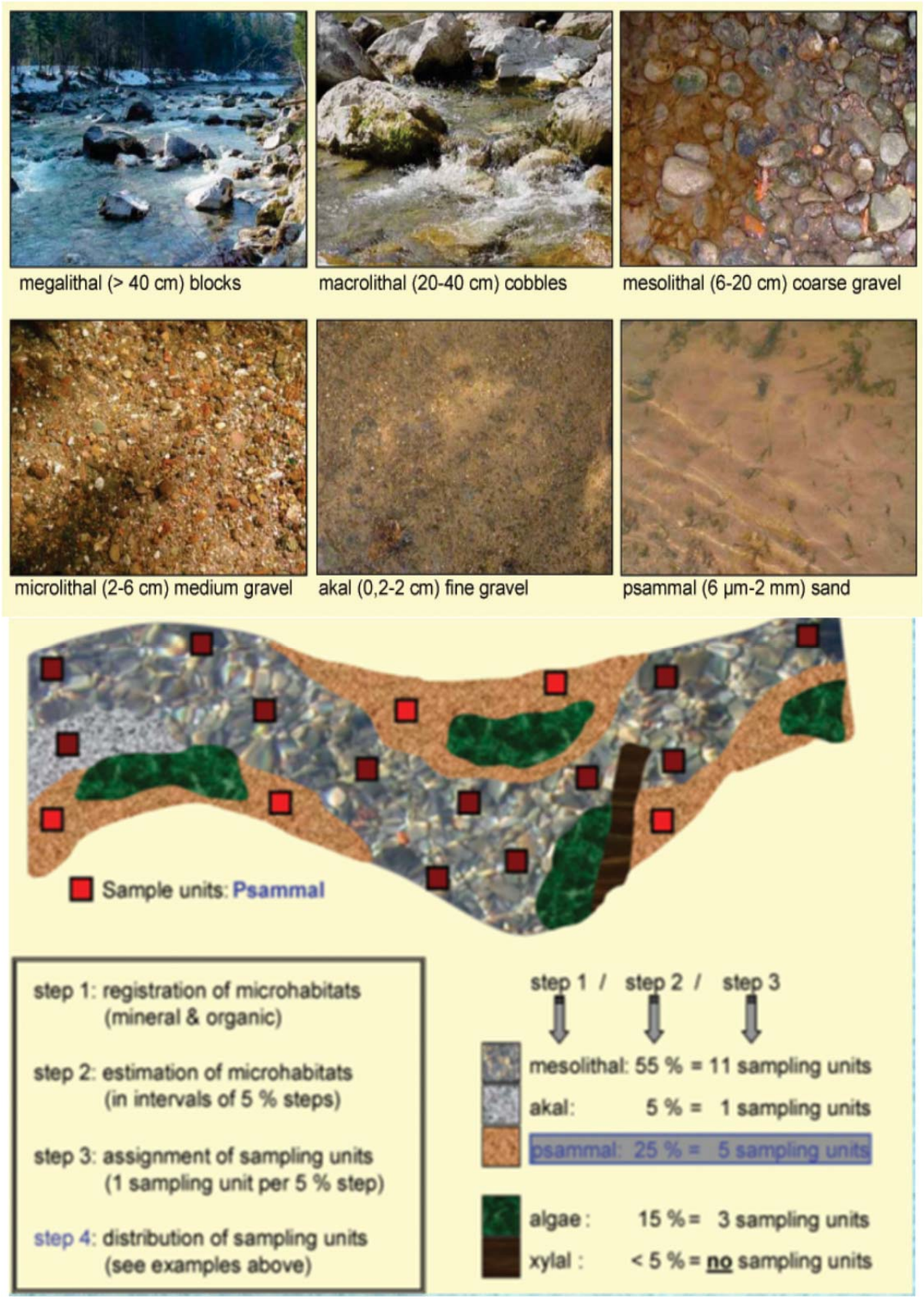


Figure 17. Method "AQEM/STAR"

For general assessment of biological diversity of bottom invertebrates and in order to define the rare species and to obtain integrated assessment of biological status of the river, an integrated

qualitative sample was taken. It is composed out of sums of 1/20 of samples taken at all monitoring locations.

Biological indication of water quality and biological status assessment was done using express methods of assessment using biotic indexes (Afanasyev 2002, 2006). The Consultant selected the following indexes:

- Trent Biotic Index (TBI)[1] as far as it is the basic for most of modern biotic indexes, and
- Belgian Biotic Index (BBI)[2] as far as it is more sensitive, but in the same time it is quite easy in use. It is worth to mention that, BBI is standardized in Belgium and France (French Indice Biotique), and is widely used in current monitoring in other EU countries.

TBI and BBI indexes envisage only fixation of the number of present indicator groups and visual fixation of one or more specie in the groups *Plecoptera, Ephemeroptera* and *Trichoptera*, which allow conducting the preliminary biological quality assessment directly at the river.

Based on the conducted surveys, homogeneous habitats were identified. At each survey location, hydrobiological samples of macroinvertebrates were taken as well as geobotanical and ichthyologic surveys conducted. The riverbed of the main river as well as its tributaries as well as riparian zones with bushes and meadow plants was surveyed.

Results

In the Neretva basin, representatives of the karst spring among the spineless, the so called krenobionti, include some crustaceans (*Fontogammarus dalmatinus, Gammarus balcanicus, Gammarus fossarum, Niphargus castellanus*), insect larva from the groups Diptera (*Atherix spp.),* Ephemeroptera (*Baetis rhodani, Ecdynurus spp., Ephemerella spp*.), Odonata (*Cordulegaster*), Plecoptera (*Leuctra spp., Protonemura spp.)* and Trichoptera (*Drusus synagapetus*), water ambrosia beetles (*Helmis spp.),* turbellaria (*Crenobia alpina*), snails (*Ancylus fluviatilis and Belgrandiella, Bithynia, Dalmatella, etc*)[3]. More detailed characteristic of some groups of water invertebrates for Neretva river basin can be found in a few works devoted to amphipods[4], caddis flies[5], dragon flies[6],

[1] Woodiwiss, F.S. The biological system of stream classification used by the Trent River // Board.Chemy.Indust. – 1964. – 11. – P. 443–447. Metcalfe.J.L. Biological water quality assessment of running waters based on macroinvertebrate communities: history and present status in Europe.// Environmental pollution. – 1989. – 60. – P. 101–139

[2] N.De Pauw, G.Vanhooren. Method for biological assessment of water courses in Belgium// Hydrobiologia 100(1):153-168 · January 1983.

[3] Matoničkin, I., Pavletić, Z., 1972: Život naših rijeka. Školska knjiga – Zagreb

[4] Kresimir Zganec, Petra Lunko, Andrej Stroj, Tomasz Mamos and Michal Grabowski Distribution, ecology and conservation status of two endemic amphipods, Echinogammarus acarinatus and Fontogammarus dalmatinus, from the Dinaric karst rivers, Balkan Peninsula// Ann. Limnol. - Int. J. Lim. 52 (2016) 13–26.

[5] Svjetlana Stanic Koštroman, Ana Previši, Adriana Planini, Mladen Kucinic, Dragan Škobic, Anita Dedic and Paula Durbešic. Environmental determinants of contrasting caddisfly (*Insecta, Trichoptera*) biodiversity in the Neretva and Bosna river basins (Bosnia and Herzegovina) under temperate and Mediterranean climates// International Review of Hydrobiology 2015, 100, 79 –95

midges[7]. For other bottom animals, including mayflies, *Ephemeroptera* and *Chironomidae,* the Consultant did not find any available information.

Separate attention should be paid to the presence in Neretvica of the white-clawed crayfish (*Austropotamobius pallipes* (Lereboullet, 1858)) (Figure 18). It has been assessed by IUCN as "endangered" under criterion A2ce. The studies showed that out of there studied tributaries of Neretva, the biggest number of this crayfish – 31 was caught in Neretvica[8]. This species has been listed under the EU Habitats Directive Annex II and V and therefore requires the designation of special areas of conservation for its protection. It has also been listed under Appendix III of the Bern Convention.

Figure 18. White-clawed crayfish (Austropotamobius pallipes (Lereboullet, 1858))

Based on analysis of an integrated sample, there are more than 20 taxonomic groups of upper rank invertebrates present at the Neretvica River from its upper part to the mouth. *Insecta* (89%) are dominant among them; *Trichoptera* – 35%, *Ephemeroptera* - 21%, *Plecoptera* – 18%, *Diptera* – 15%, other animals - 11%. The Consultant did not find rare invertebrates and white-clawed crayfish.

[6] Dejan Kulijer. Odonata fauna of karst streams and rivers of South Herzegovina (Bosnia and Herzegovina, West Balkan)// "International Dragonfly Fund -Report 72(2014): 1-50

[7] Zivkovic V., Kacanski D. *Diptera, Simulidae* in Neretva and its branches // Glas Srpska akademija nauka i umetnosti. Odeljenje medicinskih nauka.. 1964;17:165-74

[8] Sadbera Trožić-Borovac, Armin Macanović, Rifat Škrijelj. The morphometric characteristics and condition index of *Austropotamobius pallipes* in the Neretva river basin. // Works of the Faculty of Forestry University of Sarajevo No. 2, 2012 (13 -30).

1. **SHPP Duboki potok 1**

Background conditions: water is transparent to the bottom, water was warmed up to + 5.6 ^{0}C, oxygen saturation – up to 175 %.

Distribution of bottom habitats: HS (hygropetric sites (water layer on solid substrates) – 10%, megalital – 50%, macrolital – 20 %, mesolital – 10%, microlital – 5%, psammal – up to 3%, CPOM (deposits of coarse particulate organic matter, e.g. fallen leaves)) - 2%.

Algae were presented by stone biofouling at water edge by *Hydrurus foetidus* (Villars) (Trevisan, 1848) by 10% and at the depth of more than 0.01 m by *Bacillariophyceae.*

Macrophytes cover the floodplain by 3-5%; there were *Inula helenium* and *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are larvae of *Trichoptera* (Figure 19) and nymphs of mayflies, and dayflies (*Ephemeroptera*); there were a lot of larvae of *Chironomidae*, midges, and other *Diptera;* there were a lot of Gammaridae in the fallen leaves. There were also *Oligochaeta* and leeches.

Figure 19. Larvae of Trichoptera at cobbles

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality “very clean” and high biological status.

2. **SHPP Duboki potok 2**

Background conditions: water is transparent to the bottom, water was warmed up to + 6.4 ^{0}C, oxygen saturation – more than 170 %.

Distribution of bottom habitats : HS – 5%, megalital – 50% – 20%, macrolital – 25%, mesolital – 10%, microlital 2-6 cm – 5%, xylal – 3%, psammal – up to 2%.

Algae were presented by stone biofouling at water edge by *Hydrurus foetidus* (Villars) (Trevisan, 1848) by *5*% and by *Bacillariophyceae.*

Macrophytes cover the floodplain by 30%; there were *Inula helenium* and *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are larvae of *Trichoptera* and nymphs of mayflies, and dayflies (*Ephemeroptera*); there were a lot of larvae of *Chironomidae*, midges, and other Diptera; there were a few Gammaridae. There were also very few of *Oligochaeta*, flat warms, *Ostracoda* and *Ancylus fluviatilis*

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality “very clean” and high biological status.

3. **SHPP Donji Obalj**

Background conditions: water is transparent up to 80 cm, due to entrance of turbid waters from Obascica; water was warmed up to + 5.7 ^{0}C, oxygen saturation – more than 160 %.

Distribution of bottom habitats: megalital – 30%, macrolital – 50%, mesolital – 14%, microlital– 5%, psammal – up to 1%.

Algae were presented by stone biofouling by *Bacillariophyceae* and some *Cladophora*.

Macrophytes cover the floodplain by 25%; there were *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are inspects, with domination of *Trichoptera* and *Chironomidae*. There were also in smaller numbers nymphs of mayflies. The number and diversity of dayflies (*Ephemeroptera*); the number of larvae of midges and other *Diptera* increased. There were a few *Gammaridae*. There were also very few of *Oligochaeta*, flat warms, *Ostracoda* and *Ancylus fluviatilis*

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality “very clean” and high biological status.

4. **SHPP Obascica**

Background conditions: water is not transparent (up to 10 cm) because of precipitation in the catchment area; water was warmed up to + 5.1 ^{0}C, oxygen saturation – more than 160 %.

Distribution of bottom habitats: megalital – 35%, macrolital – 45%, mesolital – 10%, microlital– 5%, xylal – 3%, psammal – up to 2%.

Algae were presented by stone biofouling by *Bacillariophyceae.*

Macrophytes cover the floodplain between 40 and 60%; there were *Fontinalis sp.* and *Inula helenium.*

In the structure of the bottom biotic community, the main groups are *Trichoptera.* Nymphs of mayflies and stone flies, *Chironomidae,* midges and other *Diptera.* There were some *Notonecta, Oligochaeta* and flat warms, molluscs *Ancylus fluviatilis*.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality “very clean” and high biological status.

5. SHPP Prolaz

Location a (43°49'56.1"N 17°52'57.8"E)

Background conditions: water is transparent up to bottom; water was warmed up to + 5.4 ^{0}C, oxygen saturation – up to 170 %.

Distribution of bottom habitats: megalital – 10%, macrolital – 60%, mesolital – 20%, microlital – 5%, roots – 3%, psammal – up to 2%.

Algae were presented by stone biofouling by *Hydrurus foetidus (*1%), *Bacillariophyceae* and some *Cladophora*.

Macrophytes cover the floodplain by 15%; there were *Fontinalis sp.* and *Inula helenium.*

In the structure of the bottom biotic community, the main groups are amphibian inspects, with domination of *Trichoptera* and midges. There were also many nymphs of mayflies and dayflies (*Ephemeroptera*); there were a few of the *Chironomidae* and other *Diptera*. There were also very few of *Oligochaeta*, flat warms and *Ancylus fluviatilis.* There were also a few *of Gammaridae* and *Ostrakoda.*

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality “very clean” and high biological status.

Location b (43°49'57.55"N 17°53'06.22"E)

Background conditions: water is transparent up to bottom; water was warmed up to + 5.8 ^{0}C, oxygen saturation – up to 170 %.

Distribution of bottom habitats: megalital – 30%, macrolital – 45%, mesolital 15%, microlital– 8%, psammal – up to 2%.

Algae were presented by stone biofouling by *Diatomeae,* and some *Cladophora*.

Macrophytes cover the floodplain between 30 and 50%; there were *Fontinalis sp.* and *Inula helenium.*

In the structure of the bottom biotic community, the main groups are *Trichoptera* and *Chironomidae* as well as nymphs of mayflies and stone flies. There were some *Notonecta, Oligochaeta* and flat warms, molluscs *Ancylus fluviatilis*. There were few *Gammaridae*.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality "very clean" and high biological status.

6. SHPP Mala Neretvica

Location a (43°49'25.8"N 17°51'14.2"E)

Background conditions: water is transparent up to bottom; water was warmed up to + 5.5 ^{0}C, oxygen saturation – up to 170 %.

Distribution of bottom habitats: megalital – 50%, macrolital– 20%, mesolital – 20%, microlital – 7%, psammal – up to 3%.

Algae were presented by stone biofouling by *Bacillariophyceae* and some *Cladophora*.

Macrophytes cover the floodplain by 5 – 10 %; there were *Inula helenium* and *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera*, *Chironomidae* and nymphs of mayflies. There were a few of midges and other *Diptera*. There were also very few of *Oligochaeta*, flat warms, and leeches.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality "very clean" and high biological status.

Location b (43°49'29.39"N 17°51'20.49"E)

Background conditions: water is transparent; water was warmed up to + 5.4 ^{0}C, oxygen saturation – more than 160 %.

Distribution of bottom habitats: megalital – 30%, macrolital – 50%, mesolital 14%, microlital 2-6 cm – 5%, psammal – up to 1%.

Algae were presented by stone biofouling by *Bacillariophyceae.*

Macrophytes cover the floodplain by 10%; there were *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera* and *Chironomidae.* Nymphs of mayflies and stone flies, midges and other *Diptera* were in smaller

numbers. There were some *Notonecta, Oligochaeta* and flat warms, *Ostrakoda* and molluscs *Ancylus fluviatilis*.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality “very clean” and high biological status.

7. SHPP Pozelavka

Background conditions: water is transparent up to bottom, but there is some turbidity left from Obascica; water was warmed up to + 5.24 ^{0}C, oxygen saturation – more than 165 %.

Distribution of bottom habitats: megalital – 45%, macrolital – 20%, mesolital – 20%, microlital – 12%, psammal – up to 3%.

Algae were presented by stone biofouling by *Bacillariophyceae* and some *Cladophora*.

Macrophytes cover the floodplain by 5 – 10 %; there were *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera.* There were also in smaller numbers nymphs of mayflies, *Chironomidae* and midges. There were a few of stone flies and other *Diptera*. There were a few *Gammaridae*. There were also very few of *Oligochaeta*, flat warms, *Ostracoda* and *Ancylus fluviatilis*

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality “very clean” and high biological status.

8. SHPP Srijanski Most

Background conditions: water is transparent up to bottom; water was warmed up to + 5.8 ^{0}C, oxygen saturation – more than 160 %.

Distribution of bottom invertebrates: megalital – 50%, macrolital – 20%, mesolital – 15%, microlital–10%, psammal – up to 5%.

Algae were presented by stone biofouling by *Bacillariophyceae* and some *Cladophora*.

Macrophytes cover the floodplain by 5 – 10 %; there were *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera* and *Chironomidae.* The number of nymphs of mayflies, midges and other *Diptera* got increased. There were also very few stone flies, *Oligochaeta*, *Ostracoda* and molluscs *Ancylus fluviatilis*.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality “very clean” and high biological status.

9. SHPP Gorovnik (river Neretvica)

Background conditions: water is transparent up to bottom; water was warmed up to + 8.4 ^{0}C, oxygen saturation –more than 160 %.

Distribution of bottom invertebrates: megalital – 15%, macrolital – 50%, mesolital – 20%, microlital– 10%, psammal – up to 5%.

Algae were presented by stone biofouling by *Bacillariophyceae,* some *Cladophora* and *Oscillatoria* (*O.tenuis*).

Macrophytes cover the floodplain by 5 – 10 %; there were *Inula helenium* and *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera*, midges, nymphs of mayflies, and other *Diptera*. There were also very few stone flies, *Oligochaeta* and flat warms, but the number of molluscs *Ancylus fluviatilis* got increased.

Despite the presence of α-mezosaprobic algae *O.tenuis,* express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality “very clean” and high biological status.

10. SHHP Gorovnik (river Gorovnik)

Background conditions: water is transparent; water was warmed up to + 9.2 ^{0}C, oxygen saturation – up to 162 %.

Distribution of bottom invertebrates: megalital – 25%, macrolital – 50%, mesolital – 15%, microlital– 5%, psammal – up to 5%.

Algae were presented by stone biofouling by diatom algae and few *Cladophora*.

Macrophytes cover the floodplain by 5%; there were *Inula helenium* and *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera,* nymphs of mayflies and stone flies. There were many *Chironomidae* midges and other *Diptera.* There were some *Notonecta, Oligochaeta* and flat warms.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 10 points, corresponding to the water quality “very clean” and high biological status.

11. SHPP Podhum 1

Background conditions: water is transparent up to bottom; water was warmed up to + 8.6 ^{0}C, oxygen saturation –more than 160 %.

Distribution of bottom habitats: megalital – 25%, macrolital – 50%, mesolital – 15%, microlital– 5%, psammal – up to 5%.

Algae were presented by stone biofouling by *Bacillariophyceae,* some *Lyngbya*, *Cladophora* and Oscillatoria (*O.tenuis*).

Macrophytes cover the floodplain up to 10 %; there were *Inula helenium* and *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera* and other *Diptera* as well as nymphs of mayflies. The abundance and diversity of stone flies is extremely low. The number of molluscs *Ancylus fluviatilis* got increased. There were some *Oligochaeta* and flat warms.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality "very clean" and high biological status. Although the presence of *Lyngbya* and *Oscillatoria* can prove the organic pollution of the river.

12. SHPP Podhum 2

Location a (43°46'49.89"N 17°49'10.66"E)

Background conditions: water is transparent up to bottom; water was warmed up to + 10.1 ^{0}C, oxygen saturation – up to 155 %.

Distribution of bottom invertebrates: megalital – 30%, macrolital – 47%, mesolital – 15%, microlital – 5%, psammal – up to 3%.

Algae were presented by stone biofouling by *Bacillariophyceae,* some *Lyngbya*, *Cladophora* and Oscillatoria (*O.tenuis*).

Macrophytes cover the floodplain up to 15 %; there were *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera* and other *Diptera* as well as nymphs of mayflies. The abundance and diversity of stone flies, *Notonecta* and larvae of *Psychodidae* is low. Here the number of *Oligochaeta* (Stylaria sp.), flat warms and molluscs.

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality "very clean" and high biological status. Although the presence of *Lyngbya* and *Oscillatoria* as well as increase of the number of *Oligochaeta* signals the organic pollution of the river because of fish farm located upstream.

Location b (43°46'45.8"N 17°49'05.1"E)

Background conditions: water is transparent up to bottom; water was warmed up to + 9.6 ^{0}C, oxygen saturation – up to 155 %.

Distribution of bottom habitats: megalital – 25%, macrolital – 50%, mesolital – 15%, microlital– 5%, psammal – up to 5%.

Algae were presented by stone biofouling by *Bacillariophyceae,* some *Lyngbya*, *Cladophora* and *Oscillatoria (O.tenuis*).

Macrophytes cover the floodplain up to 10 %; there were *Fontinalis sp.*

In the structure of the bottom biotic community, the main groups are *Trichoptera* and other *Diptera* as well as nymphs of mayflies. Here the number of *Oligochaeta* (Stylaria sp.), flat warms and molluscs. The abundance and diversity of stone flies, *Notonecta* and larvae of *Psychodidae* is very low. Near the river, there were dragonflies fixed, most probably *Calopteryx splendens* (Harris, 1782).

Express assessment by hydrobiological parameters showed that the value of TBI and BBI indexes is 9 points, corresponding to the water quality “very clean” and high biological status.

Conclusions

In frame of macroinvertebrates’ surveys, the reference conditions of the Neretvica River and its tributaries were identified. All of them have high values of TBI and BBI indexes, corresponding to the water quality “very clean” and high biological status. This is the starting point for identification of the possible impact of the SHPPs at the aquatic biodiversity.

It was identified that biological resources of the rivers and streams are represented mainly by fish and macroinvertebrates. Zooplankton and phytoplankton are almost not developed in the mountaineer rivers due to a number of negative abiotic conditions: high flow velocity, high water turbulence etc.

It was identified that food resources for fish are presented mainly by macroinvertebrates and at present it is sufficient to support existing natural balance and fish diversity.

Identified macroinvertebrates’ communities can be used for further biological monitoring of the state of the ecosystems as bioindicators of different negative man-caused impacts on the state of river system.

2.2 Fish survey

Ichthyofauna of the Neretva river basin

Ichthyofauna of the Neretva river basin as the biggest river of the Dinaric karst region is in general is well-studied. The total list of the fish species includes 93 fish species; 50 out of which are living only in the fresh waters of upper and middle part of the river and its tributaries[9].

Neretva River plays a special role for European Icthyofauna and together with four other districts in the Mediterranean Sea basin is considered as one of the centres of endemic species. It has the biggest number of endangered freshwater fish species: the share of endemic species here is more than 10 %. Many fish species live under conditions with low variability and limited habitats, considered endangered and included in the IUCN Red list[10].

Salmonides

Neretva River provides main habitats for the salmonids in the Western Adriatic. Among the most valuable ones, there are ***three endemic trout species:***

- Neretvan softmouth trout (*Salmo obtusirostris oxyrhinchus)*, in Bosnian "Neretvanska mekousna pastrmka"[11] - *Salmo obtusirostris* (Adriatic Salmon) has status "endangered" in the IUCN Red List with population trend: decreasing;
- Tooth trout (*Salmo dentex)* , in Bosnian "Zubatak"[12] (no status under IUCN Red list) and
- Marble trout *(Salmo marmoratus*), in Bosnian "Glavatica"[13] , it has status "least concern" in the IUCN Red list with population trend: decreasing.

All three above mentioned trout endemic species are decreasing in numbers because of the reduction of available habitats, dike construction, hybridization or genetic pollution from alien salmonid species, illegal fishing and irrational water resources management[14].

There is also ***brown trout*** (*Salmo trutta m. fario* (Linnaeus)) is present, sharing the same habitats with the above mentioned species. It is an autochthonous trout of the Neretva River. There are two genetically well recognized autochthonous lines of Brown trout found in the river - Mediterranean line and Adriatic line. The Danube line and Atlantic line of brown trout are also

[9] Glamuzina Branko; Pavličević Jerko; Tutman Pero; Glamuzina Luka; Bogut Ivan; Dulčić Jakov **Ribe Neretve.** 2013./ Udruga CEAV – Centar za zaštitu i promicanje endemskih i autohtonih ribljih vrsta, Mostar, Republika Bosna i Hercegovina; Modrozelena – Zadruga branitelja, Metković, Republika Hrvatska. 263 s

[10] Darwall W.; Carrizo S.; Numa C.; Barrios V.; Freyhof J.; Smith K. (2014). "Freshwater Key Biodiversity Areas in the Mediterranean Basin Hotspot" (.pdf). Freshwater Key Biodiversity Areas (KBAs) - Mediterranean - IUCN. Site Collection Documents (in English, Bosnian, French, and Arabic). IUCN. Retrieved 11 April 2016

[11] "Salmo obtusirostris". Balkan Trout Restoration Group. Retrieved 2009-03-10.

[12] *"Salmo dentex". Balkan Trout Restoration Group*. Retrieved 2009-03-10.

[13] *"Salmo marmoratus". Balkan Trout Restoration Group*. Retrieved 2009-03-10.

[14] Freyhof, J.; Kottelat, M. (2008). *"Salmo dentex". 2008 IUCN Red List of Threatened Species. Retrieved 2007-08-05*.

present. There are a number of hybrids between these lines, which are better suited to certain conditions than those of pure autochthonous lines. As a result autochthonous lines are threatened. As well having genetic differences, the different strains of brown trout also display unique characteristics in their morphology. The Mediterranean line and Adriatic line differ from other trout because of the great number of very small, red and black dots which are uniformly distributed all over the body.

The growth of Brown trout depends on environmental conditions. It is mainly dependant on the quantity and quality of food items in its diet. Therefore, brown trout, which live in mountain river streams characterized by small discharges and a limited supply of food, may only reach a maximum weight of 2 kg. In bigger streams, brown trout can weight up to 5 - 6 kg. The brown trout feeds on a variety of organisms such as insects, larvae and even small fish.

In addition to the aforementioned salmonid species in the Neretva River and its tributaries, non-native species can also be found. Out of them only *Thymallus thymallus* has a stable population. Population of the most aggressive rainbow trout (*Oncorhynchus mykiss*) has small size, low survival capacities and therefore low increase in number. Besides, brook trout (*Salvelinus fontinalis*) and lake trout (*Salvelinus namaycush*) were introduced into water reservoirs by fishermen via stocking programmes aimed at improving sport for anglers, but didn't establish yet strong populations. If they do not get caught, these salmonids migrate downstream towards the sea to spawn[15].

Cyprinidae species

As with the Neretva salmonids, the most endangered of Cyprinidae family are endemic species. Especially interesting are four or five Phoxinellus (or Delminichthys and Telestes) (sub)species[16]:

- Adriatic minnow (*Phoxinellus alepidotus*, Bosnian: *Uklja*), endemic to Bosnia and Herzegovina and Croatia.
- South Dalmatian minnow (*Phoxinellus pstrossii*, Bosnian: *Trebinjska gaovica*), which has recently been taxonomically fused with the Dalmatian minnow.
- Dalmatian minnow (*Delminichthys ghetaldii* or *Phoxinellus ghetaldii*, Bosnian: *Popovska gaovica*) is considered "vulnerable".
- Spotted minnow (*Delminichthys adspersus* or *Phoxinellus adspersus*, Bosnian: *Gaovica*) is endemic to Bosnia and Herzegovina and Croatia. It is considered "vulnerable".

[15] S. MUHAMEDAGIĆ , H. M. GJOEN & M. VEGRA Salmonids of the Neretva river basin - present state and suggested sustainable selection programme to protect and strengthen salmonid populations. 2008 EIFAC FAO Fisheries and Aqauculture Report No. 871. 224-274 p

[16] Glamuzina, B., Bartulović, V., 2006. Ribarstvo, 64 (2): 59-64. Glamuzina Branko; Pavličević Jerko; Tutman Pero; Glamuzina Luka; Bogut Ivan; Dulčić Jakov Ribe Neretve. 2013./ Udruga CEAV – Centar za zaštitu i promicanje endemskih i autohtonih ribljih vrsta, Mostar, Republika Bosna i Hercegovina; Modrozelena – Zadruga branitelja, Metković, Republika Hrvatska. 263 s.

- Karst minnow (*Telestes metohiensis* or *Phoxinellus metohiensis*, Bosnian: *Gatačka gaovica*) is considered "vulnerable".
- Turskyi dace (*Telestes turskyi*, Bosnian: *Turski klijen*) inhabits karstic waters. It is considered "critically endangered".
- Minnow-nase (*Chondrostoma phoxinus*, Bosnian: *Podbila*) is considered "critically endangered".
- Neretvan nase, also Dalmatian nase and Dalmatian soiffe (*Chondrostoma knerii*, Bosnian: *Neretvanska podustva*) is endemic to the Neretva River basin. It is considered "vulnerable".
- Adriatic dace or Balkan dace (*Squalius svallize*, Bosnian: *Strugač*; Croatian: *Sval*) is endemic to Bosnia and Herzegovina and Croatia, also to Montenegro and Albania. It is considered "vulnerable".
- Illyrian dace (*Squalius illyricus*, Bosnian: *Ilirski klijen*) inhabits karstic waters of Bosnia and Herzegovina, Croatia and Albania. It is considered "near threatened".
- Dalmatian barbel gudgeon (*Aulopyge hugelii*, Bosnian: *Oštrulja*) inhabits karstic. It is considered "endangered".

Cobitidae species

Cobitidae are presented by Neretvan spined loach (*Cobitis narentana,* Karaman, 1928 Bosnian: Neretvanski vijun). It is an Adriatic watershed endemic fish that inhabits a narrow area of the Neretva watershed in Croatia and Bosnia and Herzegovina[17]. In Bosnia and Herzegovina it inhabits only the downstream of the Neretva River and its smaller tributaries like the Matica River. It is considered "vulnerable". Besides, there was a new Cobitidae specie found - *Cobitis gercegoviensis* in Mostarsky wetland.

Results of ichthyologic surveys at Neretvica river basin

Despite extended information about fish population of Neretva basin, no special description of fish population of Neretvica basin was found. For this the Consultant used the description of the fish species composition of Jablanicko lake. In total there are 13 fish species registered in the lake.

Salmonidae are presented by two species: brown trout (*Salmo trutta m. fario*) and marble trout *(Salmo marmoratus,* Cuv).

Cyprianidae is present with more fish species, namely Neretvan chub (*Leuciscus svallize* Heck. et Kn), white chub (*Leuciscus cephalus albus* Bon.), carp (*Cyprinus carpio* L.) and crucian carp (*Carassius auratus gibelio BI.).* Along these types, in Jablaničko lake in winter season of 1990, the

[17] Mrakovčić, M., Brigić, A., Buj, I., Ćaleta, M., Mustafić, P., Zanella, D. (2006): Red Book of Freshwater Fish of Croatia. Ministry of Culture, State Institute for Nature Protection, Republic of Croatia, 253 pp.

presence of Adriatic minnow *(Phoxinellus alepidotus)* was confirmed. This was the first finding of this endemic fish in this part of Neretva basin after a decade of explorations[18].

Besides, the following species were introduced in the lake: sander (*Sander lucioperca*), rainbow trout (*Oncorhynchus mykiss),* European perch *(Perca fluviatilis),* appearing tench (*Tinca tinca*), chub (*Leuciscus cephalus albus* Bon.), and Pumpkinseed (*Lepomis gibbosus*).

The Consultant considers that the list of the fish species present in Jablanicko lake as a biological fund for fish specie of Neretvica river basin is not complete. The following species probably are present in the basin:

- There are indirect proofs that there are many of sunbleak (*Leucaspius delineates*), which makes a food basis for zander[19];
- There is mentioning about Neretvan bleak (*Alburnus neretvae*), which was used as a food for zander in the first years of its invasion. The statement of authors[20] that this specie disappeared from the lake does not sound grounded because it could hide into the tributaries from zander. This specie was found by the Consultant (Table 3).
- The presence of tooth trout (*Salmo dentex*) was confirmed by the fishermen of Konjic using flyfishing.
- The presence of Neretvan softmouth trout (Salmo obtusirostris) or at least its hybrids with *Salmo trutta*[21] is highly probable.

[18] Nalaz vrste *Phoxinellus Alepidotus* (Heckel 1843) u Jablanickom jezeru // Croatian Journal of Fisheries : Ribarstvo, Vol.45 No.4 September 1990.

[19] J. Pavlecevic, L. Glamuzina, A. Conides, N. Savic, I. Rozic, D. Klaoudatos, A. Kazic and B. Glamuzina. Pikeperch, *Sander Lucioperca* Invasion in the Neretva river watershed (Bosnia and Herzegovina, Croatia) after alteration of the river flow. Research and Applications. River Res. Applic. (2015) Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/rra.2923

[20] J. Pavlecevic, L. Glamuzina, A. Conides, N. Savic, I. Rozic, D. Klaoudatos, A. Kazic and B. Glamuzina. Pikeperch, *Sander Lucioperca* Invasion in the Neretva river watershed (Bosnia and Herzegovina, Croatia) after alteration of the river flow. Research and Applications. River Res. Applic. (2015) Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/rra.2923

[21] Razpet, A., Sušnik, S., Jug, T., Snoj, A.Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina //Journal of Fish Biology, Volume 70, Issue SUPPL. A, March 2007, Pages 94-110.

Table 3. Fish species present in Jablanicko lake versa found in Neretvica during the surveys

#	Name in English	Name in Latin	Registered for Jablanicko lake	Found during surveys in Neretvica	Status (IUCN)
1	Brown trout	*Salmo trutta m. fario*	+	+	Least Concern
2	Marble trout	*Salmo marmoratus*	+	+	Least Concern
3	Neretvian chub	*Leuciscus svallize*	+		
4	White chub	*Leuciscus cephalus albus*	+		
5	Carp	*Cyprinus carpio*	+		
6	Crucian carp	*Carassius auratus gibelio*	+	+	Invasive
7	Adriatic minnow	*Phoxinellus alepidotus*	+	+	Endangered B2ab(ii,iii,iv)
8	Sander	*Sander lucioperca*	+		
9	Rainbow trout	*Oncorhynchus mykiss*	+		
10	European perch	*Perca fluviatilis*	+		
11	Appearing tench	*Tinca tinca*	+	+	
12	Chub	*Squalius cephalus*	+		
13	Pumpkinseed	*Lepomis gibbosus*	+	+	Invasive
14	Neretvan bleak	*Alburnus neretvae*		+	Least Concern
15	Neretvan spined loach	*Cobitis narentana*		+	Vulnerable D2

The field surveys were conducted based on license (Dozvola za sportsko-rekreativni ribolov svih (osim salmonidnih) vrsta riba). Besides, juvenile fish was caught using hydrobiological sweep net. Unfortunately, most of the fish catching means (fish basket, nets) were prohibited seasonally in the period of surveys. In this case, the Consultant used video fixation using underwater camera SJCAM 4000 for extended monopodium allowing to record at the distance up 2,1 m from the operator.

The Consultant found 8 fish species (Table 3).

1. **Marble trout** *(Salmo marmoratus,* Cuvier, 1829*)*

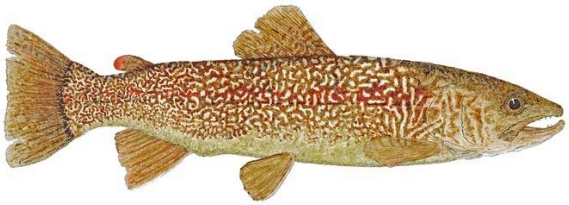


Figure 20. Trout fixed with underwater camera

Most probably it is a marble trout, although it can be also rainbow trout. It was fixed at survey location 35 SHPP Podhum 1 (power house). The habitat includes boulders, the depth - 0.6 m. It is migratory, the Consultant assumes it can reach up to survey location 32 - SHPP Gorovnik at least, but it requires additional study.

2. **Brown trout** *(Salmo trutta m. fario,* L*.)*

Figure 21. Brown trout

It was fixed at survey location 35 - SHPP Podhum 1 (power house), survey location 32 - SHPP Gorovnik (power house), and survey location 33 - SHPP Podhum 1 (intake). Juvenile specimens of the length 10-15 cm were observed mostly near the banks at the depths up to 0.4 m. It is migratory, the Consultant assumes it can reach up to the most upper parts of Neretvica and its tributaries.

3. **Adriatic minnow** *(Phoxinellus alepidotus,* Heckel, 1843*)*

Figure 22. Adriatic minnow

The only juvenile specie was registered in the Neretvica mouth in the habitat with laminar flow at the depth of 0,5 m.

According to the IUCN classification it belongs to category "endangered" (B2a). Very little specific information is available on the biology of *Phoxinellus alepidotus.* It is likely that this species spawns in the shallower parts of streams, where the female probably lays two or three batches of eggs during the breeding season. *Phoxinellus alepidotus* primarily inhabits clear karstic streams, as well as lowland water bodies with little current. During winter or drought, it will enter underground streams. It is not migratory fish.

The Consultant considered, that only the most downstream SHPP can affect the given specie, because in order to escape from zander, this fish can go upstream to lower part of Neretvica from Jablanicko lake. The potential distribution of the specie upstream the river will be limited due to high flow velocity.

4. **Neretvan bleak** *(Alburnus neretvae,* Buj, Šanda & Perea, 2010)

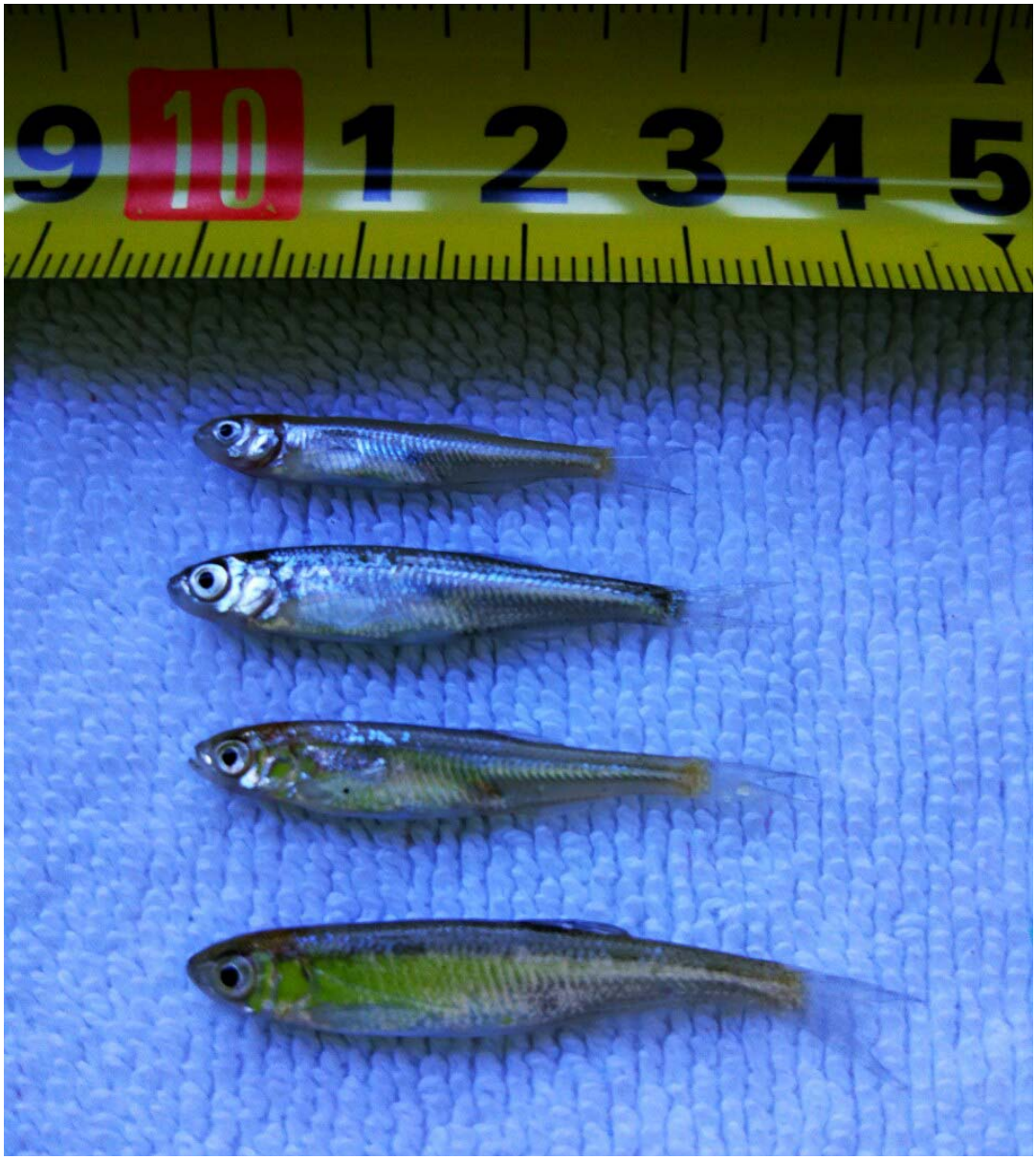


Figure 23. Neretvan bleak

Shoals of the Neretvan bleak were common in the mouth of Neretvica river. Also this specie was fixed in the sweep nets at the survey location 38 Podhum 2. Earlier it was not registered for the region of Jablanicko lake. The species is endemic to Croatia and Bosnia and Herzegovina in the Neretva River drainage including Lakes Kuti and Baćinska, Hutovo blato wetland, waters of karstic fields Rastoke and Jezero near Vrgorac, Mušnica River (Gatačko polje), Trebišnjica River (Popovo polje) and Tihaljina/Trebižat River system. It was fixed in the Neretva upper part of river to the Buna River and in the lower and middle section of the Neretva River from the mouth to about 20 km upstream of Mostar (Buj et al. 2010). It is not a migratory fish.

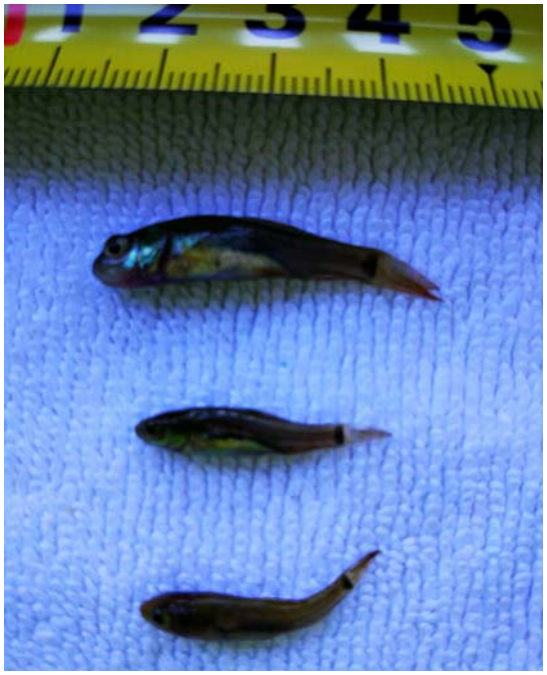
The Consultant considered, that only the most downstream SHPP can affect the given specie, because in order to escape from zander, this fish can go upstream to lower part of Neretvica from Jablanicko lake. The potential distribution of the specie upstream the river will be limited due to high flow velocity.

5. **Crucian carp** *(Carassius auratus gibelio,* Bloch, 1782*)*

Figure 24. Crucian carp

Juvenile species of the crucian carp of the size up to 4,5 cm were fixed only in the mouth part of Neretvica. It is invasive specie, coming from Amur basin; it is widely spread in the European water courses for fishery purposes.

6. **Appearing tench** (*Tinca tinca,* Linnaeus, 1758)*)*



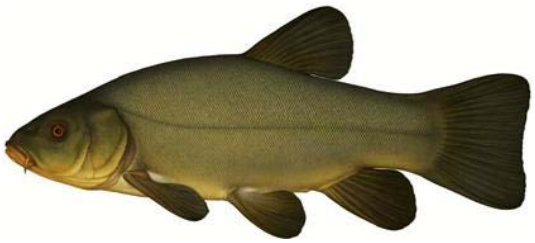


Figure 25. Tinca tinca

Juvenile of the tench were fixed in the mouth part of the Neretvica river only.

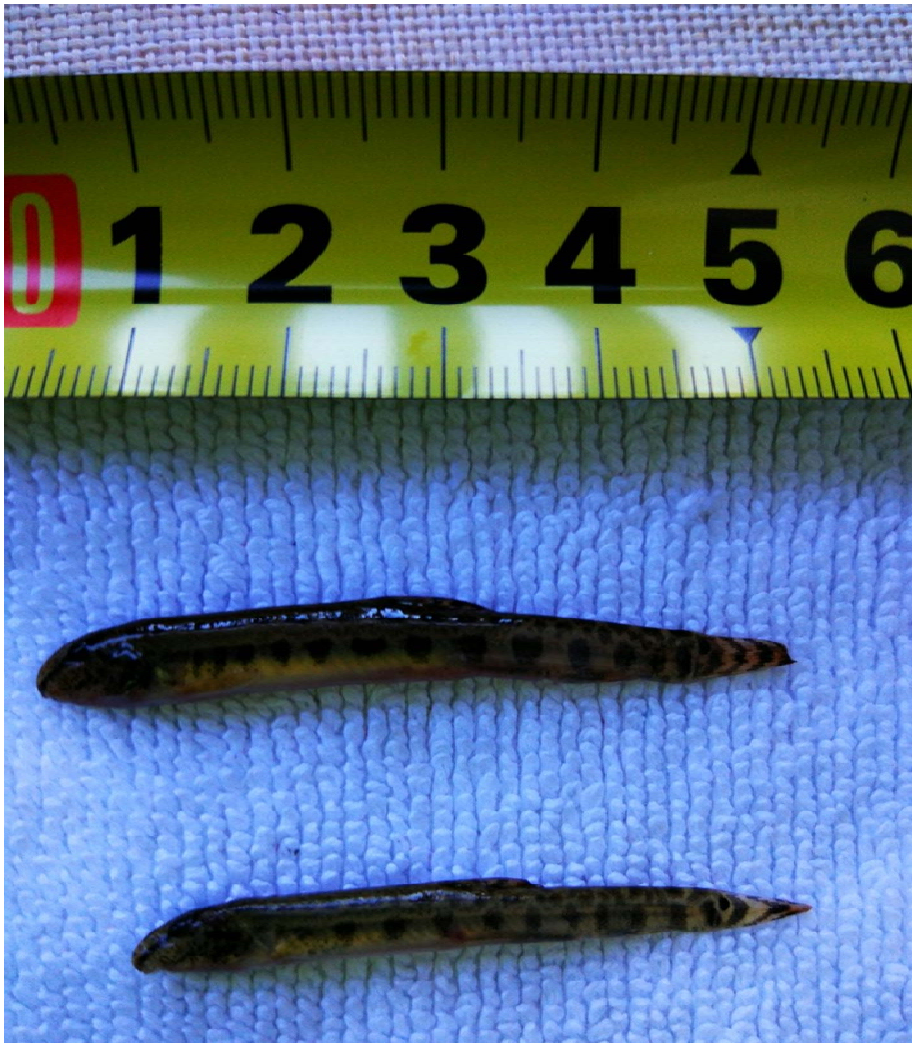
7. **Pumpkinseed** *(Lepomis gibbosus,* Linnaeus, 1758*)*

Figure 26. Pumpkinseed

It is widely spread in the mouth of the Neretvica. Pumpkinseed came from ponds of Northern America (from Dakota to Mexican bay, where it has local industrial importance), lately it came as invasive specie in the waters of Europe and Asia. It was brought in Europe as aquarium fish.

8. **Neretvan spined loach** *(Cobitis narentana,* Karaman, 1928*)*

Figure 27. Neretvan spined loach



It is widely spread in the mouth part of Neretvica river, where it lives hiding in silt deposits. It was also fixed in benthos sample at Podhum 2 (survey location 38).

According to the IUCN classification it belongs to category "vulnerable" (D2). This species is restricted to a single part of a river basin where it is threatened by the introduction of alien species, water pollution, and impacts from agriculture[22]. It was not registered previously for region of Jablanicko lake. *Cobitis narentana* is only found in the Neretva River Basin in Croatia and Bosnia-Herzegovina.

Cobitis narentana is a rare species with a restricted distribution, and very little is known about its biology and behaviour. However, it is thought to spawn between April and August, when up to 2,500 eggs may be released by the female. It is a short-lived species, with most males dying before three years of age, although females usually live to five. *Cobitis narentana* reaches maturity when it is around 5.8 centimetres in length. It is not migratory.

The Consultant considered that SHPPs construction will not affect this specie because it requires silty habitats, which are almost absent in the Neretvica river.

[22] http://www.iucnredlist.org/details/61223/0

Conclusions

In total the field surveys fixed the presence of 8 fish species. Out of them two (marble trout and brown trout) are migratory, so in case of the SHPPs construction the fish passes for the salmonid should be envisaged.

The most of the fish caught were found in the mouth part of the Neretvica river within Buturovic Polje village (Figure 28) outside of the area potentially affected by the SHPPs.

Figure 28. Main fish catching place during the field surveys

3. Findings: key environmental risks for aquatic diversity

The following key environmental risks for aquatic diversity were identified:

1) **Risk of salmonid fish habitats fragmentation:**

- Migration ways for the salmonid fish will be fragmented. Action: SHPPs should be equipped with the fish passes.
- Water derivation will lead to riverbed shallowing and creating of unpassable barriers for fish. Action: additional surveys in order to identify "critical points" and to develop mitigation measures for each of them. Additional surveys of size composition of fish should be also conducted as far as the minimal depth for the fish migration and its capacity to overcome barriers depends directly on its sizes.

2) **Risk of accumulating of the SHPPs impacts:**

- Consequential SHPPs' construction close to each other together with permanent water redirection for derivation reduced the number of the river stretches with natural hydrological regime. Interchange of short natural stretches with long stretches with ecological flow can lead to fish disorientation and change of their migration behaviour. Action: additional studies of the migration behaviour of the fish.
- Interchange of short natural stretches with long stretches with ecological flow can lead to reduction of the areas for development of the reophylic invertebrates and appearance of limnophiles (in case of the riverbed shallowing and change of the character of the flow turbidity). It can lead to reduction of the food basis for fish. Action: additional surveys in summer – autumn period in order to identify the quantitative distribution of invertebrates.
- Interchange of short natural stretches with long stretches with ecological flow changes the natural process of invertebrates' drifting and lead to their reduction in quantity because of the deaths while entering derivation channels. As a result, the food basis for fish will be reduced and self-restoring capacity of the river will be reduced. Action: additional surveys in summer – autumn period in order to identify daily dynamics of invertebrates' drifting. Additional surveys should be devoted to identify rare and endangered invertebrates' species.

3) Risk of spreading of invasive species:

- Consequential SHPPs' construction close to each other together with permanent water redirection for derivation reduced the number of the river stretches with natural hydrological regime. It can reinforce spreading of invasive fish species and invertebrates. The fact that alien fish invasion reinforced in conditions of further riverbed transformation is already confirmed in the researches. Action: additional surveys of invasive fish species and invertebrates.

4) **Risk of loss of habitats for white-clawed crayfish (*Austropotamobius pallipes* (Lereboullet, 1858)) with the IUCN status "endangered**":

- There are convincing scientific data that white-clawed crayfish is present in Neretvica river basin. One of the main threats for this specie is alteration of hydrological regime of rivers. Action: without detailed understanding of the habitats of this specie in relation with the proposed SHPPs any construction is doubtful from the point of view of implementation of the PR6.